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ELECTRICITY ADVISORY COMMITTEE MEETING

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P R O C E E D I N G S

(8:01 a.m.)

CHAIRMAN COWART: Good morning everyone. As we always state at the beginning of these sessions I will remind people that a transcript is being prepared so your remarks are being recorded for posterity and if there's no other business before the committee we can turn this over to Wanda Reder the Microgrids panel. Thanks Wanda.

MS. REDER: All right between now 8:30 and 10:00 we'll have the opportunity to hear from four guests on our Microgrid panel this morning and this anticipation for coming up for a work product in 2016 on where we need to take Microgrids and understand what the recommendations are to remove barriers et cetera. The focus of this panel is really on financing, the commercial aspects but I thought before diving into that is probably worth it to get grounded a bit on what is Microgrid just to make sure we'll all on the same page before we move into that space. Microgrid is a localized grouping of distributed electricity

sources, loads and storage mechanisms that can either operate in conjunction with the central grid or can isolate and operate independently as an island. I think that part is really, really key. Sometimes we get kind of confused in the discussion but that island aspect is really, really important. There are a lot of different types of Microgrids; an individual sports stadium for example can be a Microgrid. It can get a larger and include multiple consumers at a particular geographic area that's always electrically bounded like a military base, a university that type of thing and those tend to be more community oriented where they're taking on the owness themselves for various reasons which I'll talk about. The other respect is utility Microgrids. So the utility might decide I might want to get into the Microgrid space, provide some supplier resources on the consumer side, manage that control activity and so right now the jury is still out on which direction the Microgrids are going to go, how the markets are going to evolve.

Having these three approaches in mind is probably useful as we get into the conversation on how the market advances. Typically three major buckets of why Microgrids start evolving. Once is looking at the resourcing in energy security aspects so the extent that consumers need more reliability in the grid, there's more increased dependency on it. That can be a driver to provide local power during outages, increase the reliability, serve really critically loads, address cyber security aspects and just be more independent relative to being energy aspect. Another driver is efficiency and optimization which is inscribed on the next slide and here talking about peak reduction, offsetting energy, often solar is a part of this as are many other local generation sources to the extent that you're generating locally there's less losses because you don't have to go through the delivery aspect into the extent that markets are evolving there's an opportunity to provide ancillary services back to the grid. Often times some interaction with combine storage to get that

increased sufficiency and optimization. I think one of things that's important to think about which is described on the next slide is that storage often is coupled with these Microgrids. This talks a bit about how solar prices have come down over time and actually crossed on a per kilo watt hour with diesel so we are seeing solar as one of the sources that are often incorporated in the Microgrid space and with that often time batteries can then smooth the intermittency and manage the reverse power flow aspect, keep voltage within limits, control ramp rate, that type of thing. So these technologies are converging and actually part of the scope typically. And of course the last slide here in terms of drivers is the green integration aspect so just being able to manage the variability that comes out of renewable and making sure that easily integrates back into the grid. So three big chunks of why folks are moving forward but again as described on the next slide is how are these things getting paid for and that's really what we want these folks to talk

about is the commercial aspects. What are the barriers to kind of move Microgrids forward? In many respects the technology is there, I think we are learning but it often times is more of a market aspect than it is a technology aspect so that's what we're here to learn more about. So the objective of the panel is to discuss quantifying intangibles such as the resiliency and the reliability aspects. What types of market designs are really most demeanable to facilitate Microgrids and create an environment that's receptive to them to the extent that there are barriers or challenges and what we can do to overcome and understand them so ultimately we can have higher deployments and then lastly what is the utilities role in this face? To the extent that there's consumer community type Microgrids that want to interconnect, how do you facilitate that change and the flip is also true to the extent that utilities want to become more involved in this area; what's required in order to allow them to do that and strategically what the

advantages are. So that is really the background of why we are having this discussion today with our four esteemed panelists. We will have comments in order of James Gallagher will start, Ed Krapels, Nancy and then David Treichler and then after that we'll open it up with some questions. But before they get started I'll just provide some introductory comments for each of them and then we'll have some slides and go into discussion. Jim Gallagher will be our first speaker. He is currently the executive director of the New York State Grid Consortium. Jim was named executive director of the organization in April 2013, has many years of experience in energy policy and industry as well. He oversees the consortium and as members as they work towards a broad statewide implementation of a safe, secure and reliable smart grid to modernize New York's energy infrastructure. He has a lot of experience beyond that; he was involved in strategic planning at the New York ISO, director of energy policy for the city of New York. He was the director of the

office of electricity environment for the New York public service commission and prior to that was even involved in TVA so he has a broad range of experience. He's currently on the advisory board for the grid for EU which is the largest smart grid project funded by the European commission and serves on the EPRI grid modernization advisory group. That is Jim's background.

MR. GALLAGHER: Good morning. It's good to be here and see a lot of familiar faces of people I've worked with over the years and still work with. My name is Jim Gallagher of course and what I would like to do, I going to be focusing on today on Microgrids but I'll begin with the first slide. Just very briefly the Smart Grid Consortium was founded in 2009. It's a non profit public private partnership of organizations and primarily based in New York. It's made up of the leading utilities in the state, many of the states universities, Brookhaven International Lab is a member, NYSERDA is a member as well as leading edge technology companies, IBM, Solar City, and

Smart Grid Solutions. We're trying to get more of the merging game changing companies on our board. And importantly the governments been involved as well in the consortium with Audrey Zibelman but she's a member of the Board of Directors for the Smart Grid consortium. The idea of our organization is to get the key players, the key organizations at the table, try to identify barriers and making progress in implementing energy policy into identified solutions as we can. Our mission is to stay focused on the future grid and to make sure across all these players in the energy value chain in New York that we're working together and we're not at odds with one another. The key priorities for 2015 for our organization is number 1 get real world projects up and running and Microgrid demonstration projects are probably number one our agenda in terms of real world projects and I'm going to focus on that today. We are spending a lot of time on strengthening our research and international collaboration. I'm going to talk about our research especially today

in the area of Microgrids. We have two papers coming out next week that I think would be relevant to your thinking about the Microgrids. And lastly the utility of the future and we are very involved in the rev proceeding that I'm sure you've heard about up to this point and I am co-facilitating the rev efforts on market designs and platform technology and actually our report is due tomorrow as well which I didn't realize when I agreed to come down and give this presentation. I want to talk about two projects that we're concluding and we've spent the last year on them working with Navigant. The consortium retained Navigant and we wanted to do two things. First of all we wanted to do an inventory of Microgrids within New York State. One of the first things I've found in talking to people around the state is so many people would say oh yeah we have a Microgrid and you would find out they really don't. What we tried to do was put together an inventory of all the Microgrids in New York State. The key characteristics, ownership models, who the

customers are, any impediments they may have had in implementation so we have a strong foundation when we're talking about Microgrids as to what it's existing, what's there in the state. And we also wanted to put together a good data base on new projects and emerging projects. I'm going to show you a little bit of that but the more interesting project I believe in building upon just the inventory is case study projects. And one of the things we tried to do working with Navigant, Navigant has a data base called Microgrid tracker that they believe they have most Microgrid projects around the world within that tracker. I work very closely with Navigant to try to identify in this worldwide data base of Microgrids what are the most interesting projects in terms of business models, which Microgrids appear to have the highest potential of being economic, which ones engage the community to the greatest extent and really those that we can learn from as we here in the U.S. begin to try to accelerate our own involvement in Microgrids. I'm

going to talk a little bit about some of the key findings from that report and lastly I'm just going to touch on New York Prize which is a Microgrid incentive project underway in New York right now. It's a $40 million reward program to encourage Microgrids in this state. So far the response has been incredibly surprising. We've done preliminary provided contracts for feasibility studies for community Microgrids around the state so it's a very good response. In terms of the inventory report I'm not going to spend a whole lot of time on this. We started with a large inventory or projects in the state. We narrowed that down extensively when we found that many of the projects did not have the islanding capability. We also eliminated a lot of what I would refer to as Narrow grids which is a single building with a dedicated generator. We took them out of our inventory of projects and we have come up with an inventory and this is just the names of those organizations. But it's a mix of what we typically see around the country right

now is campus style projects, a lot of single customer Microgrids. Only one of them in fact in New York State crossed a public right of way but for the most part they were single customer campus style Microgrids. What we're interested in doing as I lay this out is to broaden the types of Microgrids in this state especially post Sandy to try to get more community engagement in the Microgrids to try to get a more diverse participation in the projects and what we're seeing so far. And that moved us to the case study projects. We looked at a broad range of projects and there are hundreds around the world and it was very difficult to find projects that are operating economically or you find they reported they were operating economically when you really got into the details there were some very heavy subsidies. They are a lot of promising elements and components of a number of different projects and things we can learn from but a lot of lessons learned in terms of things we need to do better. We did a deep dive on what we considered

six of the most promising and encouraging Microgrid projects around the U.S. Several are in New York, I'll touch on them and we narrowed the world wide projects down to one Bornholm Island, off of Denmark and I'll give you a little bit of details to that. But again the emphasis with which of these projects are best at community engagement and are interesting business models. The six projects that we focused on are Borrego Springs, California, Stafford Hill which is a new project up in Rutland, Vermont, Co-Op city in New York City, the Hamden project in Hamden, Connecticut, Bornholm and then Hudson Yards. And Hudson Yards we put in there more as an interesting project. The Hudson Yards project is right now the largest real estate project in the world it's a $16 billion dollar project in western Manhattan. It includes a Microgrid and we did a case study and a deep dive on that project just to get a better feel for some of the challenges and impediments they are facing. Several of these projects got their launch using some DOE funds,

various types and various amounts of DOE money for feasibility studies. Connecticut put feasibility study money into the Hamden project. Bornholm Island was a utility project and some of these also have heavy utility involvement. The Co-Op City project in particular is noteworthy because it has been in existent for about 10 years but Co-Op City was one of those few areas in New York City that post hurricane Sandy was able to stay up and continue running. There are 50,000 residents in Co-Op city and a mix of public/private retail establishments. The things that we looked at across these projects; the diversity of customer involvement, the extent that they considered energy efficiency and active load management, the diversity of participation and also how they engaged the community. We did a very thorough review of the business models that were in place and some of the challenges and the report is going to be released probably early next week both of these reports and I think they'll have lot information you'll find useful. Some of the

specific things that we did a very thorough analysis of are the ownership models, how they were financed and regulatory impediment. And we ultimately came up with lessons learned and these are just some of the preliminary lessons learned that Navigant identified. I'll start with asset ownerships. One of the things I think a real eye opener in looking at these projects is heavy utility involvement was a big factor in whether or not these projects were successful and for the most part asset ownership by utilities is fairly hazy and muddled across the country and across the world in terms of what's allowed and what's not allowed, how the utilities recover their cost and they establish fees for special services so there's a lot of clarity needed in that particular area. Diversification of monetization strategies is critical and by that we mean the more successful Microgrid projects they attempt to monetize almost every benefit that they can provide. Whether it's heating, it's cooling, its hot water, its providing peak load reductions, its

ancillary services; you really don't want to leave anything on the table. Optimal system design, one of the things that we found is the more complex the project, the greater value there is to the customer and also the more important it is to have competent operation, someone competent running the projects. So again the more complex, the more value and also the increased need for expertise in running the project and we also found focusing on key steak holder was critical. Getting key steak holders involved early, getting them engaged. One of the things that's not up here and in fact it will be in the file report that I'm still working with Navigant on is we did find one of the biggest impediments was the inner connection arrangements for DG and Microgrids with utilities is just a real black box. It increases the uncertainty of these projects to an incredible level and there's a real need for clarity around those types of things. Business model optimization, we really need to do a better job of reducing legal and regulatory barriers and in the report we'll be

identifying some of those key barriers. We need to encourage comprehensive benefit monetization to really allow these projects to participate in ancillary service markets to either fully participate and demand response type markets and also to make sure that the benefits that they are providing to the utility and to the grid are properly reflected in the benefits that they're receiving and the monetization. There needs to be a better job done in terms of determining the cost recovery for these projects. Right now most of the utility projects around the country and also around the world, they are not allocating costs directly to those who are benefiting, to those who are being islanded. The cost is being spread across all customers and there needs to be more thinking in terms of targeted fees to those who are receiving the benefits. One other point in terms of the utility interconnection arrangements, we found that utilities need to do a better job in terms of not just coming up with the cost if they have to provide backup power if a system is not

going to be there but they need to recognize the risk of that happening and also the diversity of many Microgrids providing these services. I'm not going to go into a lot of detail on some of these other projects because I'm concerned about time but again the key was to standardize as much as we can about processes, requirements and technologies. We found the easiest projects to get up and running and easiest are probably not the word is projects with heavy utility involvement. Third party projects and the Hampden project are privately owned and it does appear to be that it's going to be an economic project depending on the interconnection arrangements with the utilities. The difficulty that a lot of these private projects are facing is the challenge in negotiating long term contracts with prospective customers. New York Prize is very quickly and so far is very encouraging and it's a $40 million dollar project. So far 80 awards have been provided for up to $100,000 for feasibility studies and the key to these projects is that

they're community driven and community led. The state did a very good job of going around to all the communities and helping to educate them as to what are Microgrids. My organization, I work closely with the state and we did a webinar for communities and we had 102 communities that participated in the webinar. We're able to ask questions, we brought them up to speed; we developed a community Microgrid cookbook to help them understand what we were talking about. So there was a lot of work ahead of time to try to educate communities as to what we were talking about. I was incredibly impressed when you go out and you talk to these communities. Once they're educated with the basics, the ideas they have were just so creative in terms of what might be done way beyond what I found just when you get in a room only with the utility. Getting the stake holders engaged just really opened things up in terms of creativity. The next phase of this project is going to be taking the best of those 80 and providing additional engineering award money

up to $1,000,000. And then ultimately to build up at least four to five of these projects in the state. We expect a lot more to be built. One of the most important things we're looking at is for the New York Prize program we really want to move beyond the campus style projects, we want to have the communities actively engaged and we really want to look at projects where we have the potential for an economic project in the end and also one that does not require state or federal subsidies. We're not sure we're going to be able to get there yet but we're hoping to find projects that can be replicated without heavy government involvement. Some of the keys that we want to test are active network control, getting efficiency involved and engaged as much as possible, make sure customers are engaged with the grid using clean energy and storage to the extent that we can and then lastly to maximize the amount of outside capital that we have engaged in these projects. Because ultimately the idea is we want to reduce utility cost of maintaining and building

out their grid. The webpage nyssmartgrid.com as well as my email and again I hope to have these reports up on our website and I'll make sure that they get provided to the committee. They should be finished within a week. With that I'll conclude and I don't know how we're going to handle questions. Thank you.

MS. REDER: Okay thanks Jim. Our next speaker is Ed Krapels. Ed is the founder of Anbaric the company that develops most transmission and Microgrid projects from the transmission perspective he's been focused on HVDC lines. There are a couple operational with PJM and New York ISO, three in development and the funds set aside to really on Nextgen HVDC technology development. And then on the Microgrid side it's a portfolio of large 10 to 200 megawatt type Microgrids in partnership with Exelon that he has really focused on in the New York area. So with that Ed Krapels, thanks for being here.

MR. KRAPELS: First of all it's nice to be back. Mr. Chairman good to see you again. I

should say the person who should be here is someone that many of you know Dirk van Ouwerkerk who is actually my partner in charge of this business and a brilliant guy and has led to most of the progress that we've made in this area. You may say this is odd when I was talking to Gordon earlier he said I thought you were a transmission guy and I am but we no transmissions is hard to build and I thought for years people talk about transmission alternatives, non transmission alternatives. So I felt like we had to get involved in the Microgrid business to understand how the world was evolving and since transmission lines take on an average of 10 years to build Microgrids can fill in the gaps between the transmission projects. Based on what we've seen it's an incredibly exciting area. I'm going to see if this technology works now in terms of advancing my slide. I'll skip the introductory slide but to say one thing and that is I was able to persuade after a long dialog our friends in Chicago at Exelon to go into this venture with us

to explore the world of New York Microgrids. I've got to give credit to Jeff Youkilis at Exelon who had the vision to see that Exelon is still a power company it does it all. It does transmission, it does generation, it does distribution and I think the business model for them might be, I can't speak for them but it might be well gosh if there's going to be 1000 Microgrids and they need investors and they need operators maybe this is a business we should be in. And when we think about that we thought it would really make the most sense to look at larger Microgrids. We're very aware of and respectful of what Connecticut did a couple of years ago with the smaller systems. But with third party ownerships which is what we're looking for, something that creates a model that's repeatable in hundreds and thousands of cases I think a larger Microgrid makes more sense than a smaller one. So Maureen sent me a bunch of questions but I'm not going to go through those for those of you who care are answers to your questions are in the first couple of pages. What

I really wanted to do is I wanted to lay out a typology that follows on Jim's really excellent presentation. The typology of types of projects that are Microgrids and in New York and some cases we can say the name of the project and other cases we should say more generic but I've got six projects that we have looked at in detail that have really run the gamut of different categories of Microgrids. So the Rockaway peninsula was devastated by super storm Sandy. One hundred thousand people and peak load has 150 and has the element of a bunch of people coming in, in the summer but also has a really large population of residents who are not wealthy for the most part. So it's a really fascinating area. In the wake of super storm Sandy the question is what should the utility do and PFCG is now running the system for LIPA. It's not an easy answer because you could rebuild what was there before but you could also look at it as a potential Microgrid. So we've been looking at it through fresh eyes looking at it as a Microgrid and I'll show you a couple of

thoughts about that in a second but that could be a very large one. One hundred mega watts obviously are a couple hundred million dollars of investment. The Empire State Plaza for those of you who go to Albany is one of your favorite pieces of architecture I know, there is an interest there in transforming that. There's an RFP out transforming that into a big Microgrid so that's an existing building and I think it's really almost a refinancing of the energy system there. Mega factories, this really to me are really one of the most exciting areas. New York is the home, not New England I'm sorry to say Gordon but New York is the home for some really exciting, large, super factory future developments. So imagine you're a utility and you get a call from a guy who says I need 300 mega watts of new power by four years from now. What are you going to do? If you're the local utility you say well let me connect you with the New York ISO and lets go through an interconnection process, I'm not sure how much it's going to cost

you and I'm not sure when I'm going to be done but I'll get you your 300 megawatts sometime between 2019 and 2025. Well you cannot build a world class factory with that kind of electric service. So I think this is the kind of opportunity that begs for a Microgrid. University hospitals, Jim covered that very well. New York City Commercial this is the Hudson yards model which is incredibly exciting. They are doing a Microgrid development as I understand it more or less or their own and I think this is a case of a really smart bunch of real estate guys saying I want to get or maybe I don't want to get into the electric business but I'm going to get into it and see what happens. And then finally we have Freeport Electric as a model of immunity that is getting into this business. Let me talk a little bit about the mega factory. If you need say 300 megawatts of incremental power in a place like upstate New York or western New York what do you do? How can you get that in a way that is predictable? And I think when the New York ISO rules were developed

they were developed in the context of gradually diminishing a load and a load that was diminishing in kind of a careful step by step process by a few per cent each year. What the reindustrialization of America creates are these sorts of surprising developments. The Tesla factory in Nevada. The Global Foundries factory in Saratoga. The Solar City Factory in Buffalo. These are rally big developments and I think they cry out for innovative electrical development. Municipal utility Freeport is one of the utilities that has won a New York Prize and Jim probably knows more about this than I do but Freeport is an existing unique that has longstanding relationships with the New York Power Authority. And Freeport is a municipal utility that has decided to take advantage of the Prize process in order to redesign and refresh its urban card. So its Microgrid will be within a municipal utility and I think it's fair to say that the purpose of the Freeport Microgrid is to create a more resilient core then perhaps to impose some standards of

clean energy that they're not getting from the larger grid. Universities are to me along with DOD base it's sort of the leading edge of all this development and I wanted to put this slide up because I wanted to shout out to three universities that have really led Microgrid effort. University of California, San Diego, Princeton University and Cornell. And at Cornell there is a proposal that has been sent to the department and also to NYSERDA to do a different thing in Microgrid development which is to take a carbon target a carbon goal that the president of the university announced which presidents tend to do and say we are going to be carbon neutral at 2030 or maybe 2035. And then calling his engineering department and his energy guys and saying figure it out right? And so at Cornell is a university obviously in a very cold place, when you look at their energy use much of it is for heating, they have a district heating system. And they use a gas powered plant to heat the water and the steam to heat the university and roughly

speaking that's about a $100,000,000 piece of equipment and maybe a 20 to 30 million dollars a year operating expense for the college. Being engineers and pretty good engineers they have developed an idea of earth source heat which is roughly reflected on this where they would drill five kilometers down and they would anchor the heating of their campus. I'm not a scientist as people in Washington like to say and I don't know about climate change but I think this is a pretty neat idea. And the question then is how the electric system that Cornell lives in can allow it to do this kind of experiment and if it works can the electric system and the development of Microgrids provide not a subsidy but an economic platform within which it can engage in this sort of experiment. It's very exciting so the status of that right now is Cornell was to do a demonstration project it has asked NYSERDA for a grant, it has asked DOE for a grant and it has asked Exelon through my company to support that and we'd love to support that. And we think this

kind of public private initiative makes the most sense when it is part of a Microgrid construct that's as if this works. There are many places in New York where it could be applied and it could be sort of a breakthrough technology. Honestly I don't think this would have come up but for the economic opportunities that Microgrid development creates for major campuses like Cornell. So let me stop there in the interest of time and say there are a couple more examples in my presentation. But we are the leading edge or the canary in the coal mine for Microgrid development. We have a willing investor. If we succeed and we will succeed on the basis of economic and not of subsidized development so we have to figure out in New York how to make these Microgrids work under the rules that exist today. We're not counting on any sort of benefits or changes in regulations. So thank you very much.

MS. REDER: Okay thanks Ed. The next presenter is Nancy Pfund. Nancy is the founder and managing partner of DBL partners Adventure

Capital Firm whose goal is to combine top tier financial returns with meaningful social, economic and environmental returns in the regions and sectors in which it invests. Nancy sponsors sits on the board of directors of several companies to name a few Solar City, Right Source Energy, Primus Power, Ecologic brands and Farmer Business Network. Prior to their public offerings Tesla motors and Pandora media. So prior to founding DBL Nancy was a managing director in venture capital at JP Morgan having started her investment career at Hamburg and Christ in 1984.

MS. PFUND: Thank you very much and it's a pleasure to be here today. My bio goes a little further back. I have worked in the public sector, I worked for Governor Brown the first time around on issues like these that were not quite as well articulated but have been following energy most of my career and it's really a pleasure to be here today and talk about one of my favorite subjects Microgrids. DBL is as just described we pursue both top tier financial return with our investment

strategy and social impact. We have metrics relating to both and we are a top fund and really have been able to pioneer this field, social, environmental and regional economic benefits. In some ways we're like a utility in that we have a job to do in terms of making money but we also have a huge community and kind of planetary impact. We raised just under $800 million across four funds and last week we just announced our latest fund $400 million focused on impact venture capital most of that going to sustainability and that is the largest impact venture capital really in the world so we're extremely proud and excited about that. We have already have a Microgrid investment which I'll tell you about. We've been doing this for a long time. In 2005 we invested in Power Light which was the first solar integrator to really achieve scale and we sold that some power as we just heard, Solar City, Tesla, Nexttracker, which is a great company on making tracking systems. So we are all in for making a lot of money out of this as well as

driving 21st century improvements in our energy infrastructure. We sometimes joke that if our portfolio were a state we'd behind California in terms of climate enhancement and carbon reduction and job creation, we're all about job creation and we feel that this approach to distributed energy with and now the next phase with Microgrids are enormous opportunities for quality job creation. And you see that in companies like Solar City that are 12,000 employees only seven or eight years old. Tesla is about the same. These have come out of nowhere and already have huge employments aspects to them. We write a lot of reports which are on our website if you'd like to read and just on subsidies it's kind of important to remember that all energy has been subsidized since our country's founding and we have a report on that that we wrote a long time ago called what would Jefferson do. I highly recommend you read because it takes away the stigma of subsidies, we've always done it, its works, we became an international power by subsidizing oil and gas

back in the last century and we continue to subsidize those. Maybe that's not such a great idea 100 years later but it's really not true that energy is subsidized every inch of it is and so this notion that you can do something unsubsidized is really not accurate. So who is financing Microgrids and energy storage projects and why? I want make it clear that while we're all talking about this now and Susan Kennedy whose leading advanced Microgrid solutions she's got this great line Microgrid is the new kale. But in truth it's interesting we started working on this, we got a grant from the California Public Utilities Commission and when I say we it was Tesla and Solar City in 2010 and we had been working on that for a few years before, we had zero money in those days and so the CPUC really helped us get going on solar and storage. And so the notion that this is a new thing, it's not new we've been doing this forever and the good news is we've solved a lot of the problems and now we're commercial. And so I think it's very important to say this is not

rocket science and I do have space x in my portfolio and that is super hard as you just saw this weekend. This is not super hard. We've gotten some great technologies out there and we're already doing it and so while I love the studies, love the models we don't need to study anymore we just need to do and we need to do at scale and that's what we are funding and that's what I want to talk to you about in terms of just don't let the perfect be the enemy of the good. We could study this all day and think we're not getting subsidized when we really are but it's important just to get out and do it. And so what you're seeing is that there are a lot of different funders of this. They're very picky, it's very reminiscent of the early days of tax equity in distributed solar or the early days of utility scale solar where the banks or the PE funds or the IPP's they really don't understand this and so the terms are not as great as they will be but there are funders out there. Unlike the last generation of renewables now the solar and the battery

company themselves like Tesla and Solar City and Sun Edison are part of the funding base. And so we're going far beyond the very strained treasuries of our states. We've got multi billion dollar evaluation companies jumping into this which makes like a lot easier. And what is driving this investment the lowering of cost of solar and storage which are at the base of a lot of Microgrids along with improvements in data management and software. And this notion that things start expensive, yeah they do there's no getting around that. Anyone that has a phone like this understands that 10 years ago it was this big and it cost thousands and thousands of dollars, that's just where technology starts and so you're not going to get the cheapest Microgrids today. You're going to get them tomorrow but you've got to start somewhere and that's where policy can come in and these mega companies that can afford to invest for the long term. And certainly the huge reception of the power wall, the Tesla announcement that Solar City and others are also

involved in, shows you. I mean that struck a nerve in an incredible way and already there's hundreds of millions kind of a back log that's being built there. So this far transcends government budgets in terms of where the funding comes from. And frankly there's a fear of missing out. A lot of companies come to me and say I wish I would have invested in Solar City or Tesla in those early days and so now they're trying not to make that mistake a second time. So that bodes very well for the ability to really get out there and make an impact. For utilities there's a huge opportunity which we love because it's part of our mission to work with low income neighborhoods, work in diverse neighborhoods to put some of these Microgrids and so we're working with our companies to make sure we address the environmental justice issues relating to particulates in air that Microgrids can help to alleviate so that's another driver. So remember I'm a venture capitalist so what I like and don't like isn't necessarily, it's just one part of the market but since we have

created these iconic companies already, energy companies of the 21st century and we're going to do it some more, I think it's important for people to understand what we like and what we don't like and we don't like standalone Microgrids. They're fine I mean we need them, islanding is super important but it's yesterday's news. Those have been around for a long time, you can tweak them you can make them better but that's not going to build a multibillion dollar industry. What we like are Microgrids that interact and work with the grid itself and these are interdependent Microgrids but we're not talking about yesterday's technology. We're talking about being able to use that grid, that wonderful machine that we're only using a fraction of its capability today to figure out real time which source you should pull your power from. Should it be from your grid, from your battery, from your roof top solar and arbitrize that with pricing, all of this is going to happen very quickly and is in its early days. And it's kind of like again the phone, what if

your phone you could only use it for making calls? That used to be the model but you've got music you've got directions, you've got your camera, I mean you've got everything on this device. Well that's where the grid is going. The grid is going to be a powerful interconnector and enabler of services that some of which we don't even know today and that's great news, it's a happy revolution I call it because it's great for utilities, it's great for the public and it's great for these new entrance that can scale and can make things interesting for customers. Utilities aren't that good at that in terms of getting back sizzle. But they can work with the companies that are to everyone's advantage. So in terms of some of the do's and don'ts just having done this for over 10 years we've seen every kind of policy out there and we're excited about a lot of the distributed energy policies that are cropping up all over the country. Some are further along then others obviously and so we like to as venture capitalists we're really skating to

where the puck is going to be so really look at states like California, like Hawaii. We're hopeful about New York but that policy is still a work in progress. But we're super interested in the principals that are being developed there. Where you really see large amounts of renewables you know Solar City on a good day it generates 6 giga watts of solar. I don't think people understand that. A lot of people still think these companies aren't generating massive quantities but they are. So it's super important to make policies that help integrate these new entrance and allow these utilities thrive. So a few things, mandates are actually quite helpful. They shouldn't be quantitative mandates that is. They shouldn't be too prescriptive because they can in that case be counterproductive. I'm a numbers person. There's nothing like a quantitative metric to show you are you doing well or are you falling behind. Not anything qualitative, we envision the future or things like that. Did we make our goal or didn't we. And that's when you

see things like in California the storage mandate 1300 megawatts of energy storage, there's a reason that there are Microgrids being built in California today that are 20, 30, 50 megawatts in size and it's because of that mandate along with technology and innovation. And we're not studying it, it's not going to be perfect but its attracting investment and that's what's key. We don't need to study, we don't need to think small, and we need to be big. And funding pilots really can be counterproductive. It's like me, it's just as easy to make a $20 million investment as it is a $2 million investment. You have to do the same amount of work but when you're doing a pilot you're basically giving still the dominant approach in terms of natural gas plants. All of that is still going to be the dominant modality because your pilots really don't make a difference. They're interesting, like for me as a board member and I have my CEO say to me okay well we have a 50 megawatt contract that I think we can get from So Cal Edison or we have a 5 mega

watt from some place USA. It's kind of like you take that 50 megawatt, that's how you scale, that's how you're going to build value, that's how you're going to dominate. And so it's very, very, important to think big and not to get stuck in sort of demos and pilots. And it's also important to realize that the investment community is really wanting this to happen but if it doesn't happen there are other opportunities and for example direct access internationally bringing clean electricity, distributed electricity to places in the globe that don't have them today like Africa and parts of India. That wasn't a great market a few years ago; it's a fantastic market now. And so if we see to many have nots in the United States in terms of states that aren't going big and getting this done, we're going to say lets invest in Tanzania. We should be doing both but there is a choice and capital flows to where scale and returns can be made. And so the last thing you want to do is have the have's and the have not's and have villages in Tanzania have solar

storage before many cities in our country. I mean that would just be crazy. There was great statistic that came out this morning which no one predicted which foreshadows some of our world is after six years there are almost 50 per cent of US homes don't have a land line telephone. No one predicted it would happen that quickly and that's very instructive to what we're talking about here in terms of how our grid will be changed. So in terms of the policies you do need to create finite incentives. These things aren't going to get built on their own; this was not cheap from day one. Microgrids will not be your cheaper solution, just get over it. If you want to lead with this and look at the valuations of the companies in electric vehicles and in solar compared to what they were seven years ago it's a good investment, it's one of the best investments you could make. And so you do need things like mandates or S chip in California, the behind the meter rebate. What is it about $1.80 now, the rewards behind the meter storage. These are tried

and true policies that are enabling scale. We're getting these 50 megawatt, these huge companies to wake up and pay attention to this. Not pilots, not demonstrations but real life projects. And so you don't want these to last forever and they don't, they're finite but these are very, very important. We're also looking at creating infrastructure as a service so that utilities can benefit from some of these investments in a way that they can't today and work with new entrance. All of this kind of tension between the new entrance and the utilities, I think we're finally moving beyond that and Microgrids and EV's are a part of the path toward working together and so we're seeing a huge shift in that mindset. And so just one example of a company from our portfolio that I want to show you why scale matters, Advanced Micro Solutions. Susan Kennedy who was Governor Schwarzenegger chief of staff, she was also a CPUC member, she knows everything about electricity. She kind of got the entrepreneurial bug, she's creating this company and right off the

bat she won a 50 megawatt award from So Cal Edison against huge competitors because she knows how to link policy with utilities and kind of came up with the hybrid building concept which is to go into areas of weak grid performance in the So Cal Ed territory, work with some big office parks and land owners, put in hybrid buildings with storage and solar and then control just as I described a few minutes ago, control where you're pulling power, this is our future. It's not islanding, it's not yesterday's the university Microgrids. Those are fine, we need those but we're not going to build iconic companies in doing yesterday's approach. We need this interdependent grid. So she in addition to getting this 50 mega watt contract she also was able to convince Tesla to give her a 500 megawatt purchase order relationship where they've agreed to supply her huge amounts of batteries for her customers. So do you think Tesla would have signed a deal with her had she said I have a 5 megawatt pilot here and a 10 megawatt demo there. She wouldn't have

gotten in the door. The scale she had the ability to work with some of the largest IOU's out there, that's what gets the attention of the Tesla's of the world. And so I really urge you to make a little bit bolder mark because otherwise you're going to be in the queue and you won't get the attention of the leading players. Conversarily I've looked at some of the various state programs and who they're signing up with and such and I think some of them are okay but as an investor I can of ask different questions then regulators do when they give small companies money and I'm not sure you're going to see the future Tesla's in those companies. Some of these companies are just not going to scale and so that leads to my question of well how do you adequately capitalize these companies once their grant is over because a lot of people come to me for that. They say see we got this grant and we did this pilot but I'm not going to fund those, we've got bigger fish to fry, I want to make a bigger impact more quickly. So I am somewhat troubled by that. I do think

that one of the things we could do is have more convening's where the regulators, I never got a call from anyone when some of these choices are being made in terms of what to fund and no one has to take my advice but people like us in our field know a lot about what's going on and who's doing what to whom and we could be very helpful to kind of give you an assessment of the health of some of these companies that you're pouring tax payer dollars into. So that would be one of my suggestions. Another suggestion and Susan who you'd really love having her at a future meeting, Susan Kennedy from Advanced Microgrids, this was something that having done a lot of natural resource management work in the state of California for two governors this is an idea we've been noodling over. Why don't we bring the concept of adaptive management into energy? Adaptive management is a natural resources policy where you are able to tweak and revise regulations based on the evidence that comes in from your early entrance like what is happening to salmon

populations with a certain natural resource policy. And if it's not actually working and the salmon are not arriving up river to spawn things change in that policy and there is a mechanism to do that. We feel that building policies that have this flexibility of adaptive management in energy and Microgrid procurement will help reduce the key risk for investors. And there are people standing on the sidelines that do think this is to long term of a commitment, unknown outcomes, and ossified policies. So if you could make it look more responsive you'd open up more financing for these 21st century approaches. So finally I just want to leave you with, these are just a few scenes from our portfolio. Again Primus Power has a flow battery that's being used in military bases and up in Puget Sound to avoid another substation from being built on Bainbridge Island near Seattle and Solar City of course we've talked about it's pioneering of energy storage and renewables together and this concept of infrastructure as a service linking in to the utility grid and making

it that dynamic provider that I've talked about. Advance Microgrid is the company that is working with So Cal Ed and of course Tesla needs no description. But this is where our future is, this is not a mom and pop opportunity. These are going to be the 21st century names for energy and electricity and if we follow some of these approaches the capital will flow and we foresee both a huge return and kind of access to public markets but also solutions to the pressing climate issues that we face. Thank you.

MS. REDER: Thanks, Nancy. Our next presenter actually brings to us the utility perspective. David Treichler is the Director of Business Development and Financial Modeling at Oncor Electric Delivery. He joined Oncor in 2013; he came to Oncor with 15 years of management experience and classified intelligence, defense and aerospace.

So, anyway, with that he has been focused on leading business development efforts outside ERCOT, and doing financial modeling for

strategy and technology adoption. So, looking forward to hearing the utility perspective. David?

MR. TREICHLER: Thank you very much, and I appreciate the opportunity to address you this morning for just a few minutes, I know we are running late so I'll try to be brief. I'm going to talk about a lot of the same words you've already heard this morning, and I'm not going to show you any more slides, so that's the only one you are going to look at.

At my previous employer my job description was, I was a Vaporware Engineer who rearranged electrons for the entertainment of leadership, which means I put together a lot of the slides, and just presented them to my boss, and said, this is what we are doing.

I'm done with slides. You can look at them if you'd like to afterwards, but we are just going to have a little conversation this morning about what's going on in the utilities space, as far as microgrids and energy storage are

concerned, and that's the next topic we are going to talk about. And I was very interested in learning about your distributed energy storage plants, because you may be aware of the fact that Oncor engaged a company called the Brattle Group in Boston to be the study for us about distributed energy storage on our grid in West Texas.

We have 3.2 million meters -- about 3.2 million meters. We have about 100,000 miles of distribution lines, and we have about 16,000 miles of transmission lines. And the reason why this is important for you to understand is that the Texas State Demographer has told us that by 2050 there will be two Texans for every one that lives there today.

So, we have 35 years to figure out how build another 100,000 miles of distribution lines, and build another 16,000 miles of transmission lines, but we also had to figure out how to convince everybody to take one shower every other day, and we also had to figure how to double- deck every road, in the State of Texas. Now that's if

we do things the way we've been doing them for the last 135 years in the electric industry.

And everybody knows that utilities are slow-moving people, we don't change a lot, but we've just been listening to the discussions about change, and change has been with us forever. There was a Professor at Stanford University by the name of Tony Seba, and if you had a chance to watch any of his videos, he has YouTube videos, he talks about the fact that on Easter Sunday, 1900, a picture was taken at Broadway, and he asked the question: Find the car? Look at the picture and see horse-drawn carriages, and there's one automobile on that street.

On the same day, Easter Sunday 1913, just 13 years later, Tony asked the question: Find the horse? So, over 100 years ago, we had an almost a complete transition in transportation, at least in New York City, in 13 years. So, the rate of change that we expect to incur and see in our utility and in the State of Texas, and with the doubling of the population, and all of sudden we

are going to find out that there are going to be more people who don't speak Texan than do speak Texan living right next door.

That's an issue that we figure we have to figure out how to address and how to address it quickly. So, microgrids are one of the things that we think will become important in Texas, and throughout the nation. We also think that energy storage will become very important, and that's the reason why we commissioned the Brattle Report.

The Brattle Report basically said that the State of Texas could economically deploy 5,000 megawatts of energy storage, when we reach the price point of $350 per kilowatt hour installed. The important thing for you all to understand is that we are not at that price point today. We've seen some price points of, you know, $300 range for the battery itself, not installed, not power electronic, not the interconnections and the communications that's going to be required.

To give you an idea of the scale of what we are talking about, 5,000 megawatts of energy

storage in Texas in the kind of distributed format that we are talking about, and that you are apparently looking at, could require as many as 25,000 endpoint batteries.

The problem is not the batteries, it's not the chemistry, it's not the power of electronics, it's how do you manage 25,000 different endpoints, some of which are responding to an outage, some of which are responding to a normal arbitrage situation where you are charging at night, discharging it during peak periods, and other times you are using the batteries for voltage regulations, and VARs and things like what we were talking about yesterday. And my twin brother, Ken Donohoo, who is sitting over there, and Ken and I talk a lot about these issues.

And just so you know, I've never met a VAR I didn't like. But in any event, the issue comes back to; we have a number of challenges ahead of us, if we are going to try to make the kind of changes that are going to be important for us in Texas, to be able to serve twice as many of

us as we are serving today. And Tony Seba, in his video, will about the fact that we are not going to have to double- deck every road because we are going to have self-driving cars, and you'll be able to drive them closer together and you won't need as many roads.

You know, talk about the fact that he believes that by 2050 they'll be generating all the power we need from the sun. So, all the problems in Texas will go away by 2050 because technology will solve all of them for us. But we have some issues we have to deal with, such as these control systems. Such as, how does the price point get down? And one of the things that people tend to be talking about a lot is Mr. Musk in Tesla, and the fact that he's building a Gigafactory in Nevada.

But in the midst of all of these discussions, one of the things that's been little noticed, is the fact that L & G Chem, which is one of Musk's competitors, announced a few weeks ago that by the end of next year, they will have the

equivalent of three Gigafactories operating and delivering batteries for automobiles, for Nissan and other manufacturers around the world, because they happen to be building batteries for 40 percent of all the electric cars in the world. The other 60 percent are being built in China.

So, we tend to focus in on some of the things that are important to us to understand, how to address some of these issues but we are not watching the fact that, as Nancy was pretty much indicating, the market has moved beyond us. The people who are going to make money from energy storage or from micro grids are already doing it. Us, at Oncor built a microgrid just last year, the first hallway conversation about, shall we do this, took place on or about August 1st -- excuse me -- April 1st, 2014.

On April 7, 2015, we commissioned that microgrid. It was already operational. We did not look for any grants, we were not writing any reports to any Federal agencies about what we were doing, we just did it, and you are going to find

that the entrepreneurs, who are out there, are going to just do it. And one of the things that we are doing with our micro grid, is we are trying to learn the lessons that we, as utility, will need to note how to deal with this going into the future.

So, for example, we did not use the single integrator to go build this thing for us, we went out and we found as many different technologies as we could from as many different suppliers as possible, so we could learn the lessons of how do you integrate a whole bunch of different pieces from different people, rather than just going to a manufacturer, who builds everything themselves, because that's the way the grids are going to evolve. Those are the problems that, we, as a utility are going to have to have to face, and as we go build out these kinds of grids.

We also decided that we needed to learn how to have nanogrids within microgrids operating, for references to that to different buildings, and

so on. So, we actually have four different nanogrids within our microgrid, so we can operate individually, separately, or any combination. We've integrated solar, we've integrated gas turbines, we have a Tesla battery on site, we have power electronics from Princeton Power, and we are bringing pieces and parts together.

We have five different types of generators on site in addition to our renewables. So, we have a lot of pieces and parts that we are trying to figure out, what are the lessons learned from doing this, and one of the things that you'll see coming out of Oncor over the next couple of years, is a bunch of publications, because everything that we learn over the next two years, we are going to publish and share with everybody, because one of the most important things at this organization, at the Department of Energy, you should be focusing in on, are the standards around microgrids.

We have to make sure that they are repeatable. When you build something, they should

be operating to the same set of standards. The second thing we need to focus in on is scalability, against another thing that Nancy referred to, building a $2 million microgrid, or a $20 million microgrid, they are all the same, but the problem that we've already identified in our microgrid, after only three months of operation, is that the microgrid controller we have is not a scalable item.

So, we are learning the lessons, what are the problems with these things. Another thing is the integration and the interoperability with a larger grid, so if you are not focusing in on those components, we are going to have all these standalone, one-of-a-kind solutions that won't play well together. And the main thing that, you know, the Department of Energy and this organization need to be focusing on, is not creating interoperability difficulties for the major grid, which is to create reliability issues.

Now, coming back to the last thing that you asked about, in terms of financing, one of the

things that we've determined from our position is that, the first microgrids that you are going to see as scaled are going to be public- purposed microgrids. We've already heard that the references, a fact, these things are not economic.

In fact, the microgrid we have on our facility in Texas, is not an economic entity right now, it runs on grid power most of the time, but we are learning the lessons about how to make it more efficient, more effective, we are tracing the arbitrage value of the generation that we could generate there, where we are selling it back into the grid over the next two years.

And the reason why we are focusing on the next two years is that some of you may be aware of the fact that the Texas Legislature meets once every two years for 140 days. It's a practice I would recommend to everybody. We actually would be able to watch news for 18 months, and not be talking about the same things. But, you know, in 2017 we will be going to the Legislature in Texas, and asking them permission

for a wires-only utility, which we do only transmission and distribution, to actually own the asset.

There was another thing that maybe a policy that could come out, is that storage should be a dual-use asset, because it does not generate any power. But in the State of Texas, this is considered a generation asset, so we are not permitted to own it. That's the law we have to change. The description we use with our Legislators in Texas is, a battery is just something that receives power, holds it for a little while, and then releases it.

It's like a transmission line, only it stays there a whole lot longer. So we are trying to -- we were trying to make the case and they said; no, that's not a good case, you've got to get the law changed anyway. So, you know, we are practical people, we'll wait, we are patient. You know, we've been around for 135 years, we'll be around 135 years from now, despite what Elon Musk and others say about the utilities.

But we'll have a lot more batteries on our lines, we'll have microgrids throughout, we'll be an enabler of energy choice for anybody who wants to do whatever they need to do with anything that requires power, we will find a way to deliver it to you. So, with that, I'll give you back some more of your minutes, and thank you for the opportunity to address you.

MS. REDER: Okay. We appreciate the comments here. We are scheduled to go until 10:00 o'clock. I have some prepared questions, but you know what, I know that many of you are dying to ask yours. So, with that, you know, once you put up your tents. Granger, you've got one going, Merwin, we'll just kind of start hearing from you right away.

MR. MORGAN: The one phrase I didn't hear in any of that was the phrase exclusive service territory, or can you can you talk about where across the 50 states; there are efforts afoot to modify state laws that grant conventional utilities, exclusive service territories, because

it strikes me that that's a significant obstacle to the development of entrepreneurial activity in this space?

MR. TREICHLER: If I could respond to that. This is Dave Treichler from Oncor. I would disagree; I think that exclusive franchise territories are essential when you have a wires-based electrical delivery. If we get to the point where we can deliver electricity wirelessly then I would agree with you that that would be a barrier, but as long as you have the requirement to deliver electricity through wires, if you eliminate exclusive franchise, you are going to have people who are -- entrepreneurs who are going to be at huge disadvantage in terms of cost, which is too --

MR. MORGAN: So, I'm not asking the pros or cons of doing that, I'm asking where across the states, or is there an initiative to modify these rules; Yes, of course, we need to figure out how to keep the grid and distribution system for working, but, you know?

MR. GALLAGHER: In New York right now, if you cannot sell electricity to your neighbor, you cannot cross a public thoroughfare, you can come in and request and exemption, but it's usually a very lengthy process, and there's only one company, one microgrid that has ever done that. It's in Utica, the Burrstone Energy Project and -- however, that is an issue that is on the table right now, and in the Commission's read proceeding, so it's teed up, and it's going to have to be addressed for these 80 feasibility studies that are being done.

MR. MORGAN: Can the Commission deal with the Director, or does it require state law change?

MR. GALLAGHER: That's a very good question.

MR. MORGAN: I try to ask (inaudible).

MR. CURRY: Let me see if I can answer that. In New York, as you may recall, we separated generation from transmission distribution of -- with the action of the Public

Service Commission was a reference to the legislature. The contrast with California where the legislature is terribly involved in what's going on in New York where it is occasionally involved in what's going on, depending on the political season that happens arise. So, perhaps in New York there can some sidestepping in moving things along. At least that's, I think, the Commission's perspective.

MS. REDER: Very good. Merwin?

MR. BROWN: Merwin Brown, University of California. Of the Panel Members, the utility persons, the gentleman that raised the question of operations of these microgrids, the others of you didn't really bring that up as a subject matter, it was, we've got to get this stuff built and put out there, but I didn't hear anyone thinking about, can you really make them work?

I'm coming from a premise, I guess, from my utility background, that this is actually a pretty complicated thing, if you want to milk the microgrid for the benefit it's needed. And I

would argue, at the moment, in places like California where they are putting in large amounts of distributed photovoltaics. For example, a microgrid solution may be the only way out of the problem that it's creating.

So, I guess what I'm asking with this is, if this is the three parties, have in your domains, from your perspective thought about this issue of, will they work, or is the progress going to get stopped along the way, because we don't have the ability to really operate a sophisticated microgrid?

MS. PFUND: Well, the examples that we are building, the large, say, 50 megawatt, so-called, (inaudible),I mean the utilities are in it very extensively, but so is the customer, so it's a partnership between the integrator, the customer and the utility, and it's all a lot of these deals are being inked right now, in terms of who has responsibility for operations. But it's very solvable, but it is very -- case-by-case depending on which customer they are working with.

But, while they are complicated, these are not going to be systems where, you know, everyone is starting from scratch.

MR. GALLAGHER: One of the points I made was that, to really wring the value out of a microgrid, they are going to be complicated, the operation is going to be incredibly complicated. But, technologies are advancing, you know, very rapidly worldwide, in terms of that active network management within a microgrid, you know, we've had a couple companies that come to New York in fact, that have been very -- that have implemented some successful projects in the U.K. and Europe, and now working with Con Edison.

So I think the technology is advancing but the ability to control the microgrid -- I mean, what I'm seeing it's going to call for a significant utility environment in all these stages.

MR. van WEILIE: There's a wonderful opportunity for existing utilities to become microgrid operators outside their service

territory. So if you look at the spirit of FERC Order 1000 in the transmission space, I think if you apply that to distribution, and I think you can see it in my partner in New York, why shouldn't a utility-based in Chicago, operate microgrids in New York, or Texas.

And I think it is a discipline for sure, it's going to be a tough business to be in, but I think it will be a great business to be in, to be the microgrid operator. We have today a lot of power plants that are owned by the Danish Pension Fund that's being operated by a company that is a specialist in power plant operations.

MS. PFUND: Just to underscore, this is a great deal for utilities and the new entrants, some of the solar suppliers, the Teslas of the world, the AMSs, to work together and to scale, and I think, sure, have we done record, no, did we have electric vehicles before? No. Did we have 6 gigawatts of solar? No. I mean, we've come a long way in a short amount of years, and this is -- you know, this is very doable, we don't need to

wring our hands and worry that this is something beyond our reach. This is something that we've got, really smart people, a lot of experience, pulling us forward.

MR. BROWN: I think you made an interesting agreement up there, that utility will very likely would want to be involved, and may not necessarily be involved, there's someone with that kind of experience and background, kind of in their genes, which is an interesting observation, because there were other people who would argue the microgrids are putting utility out of business; and so if it interesting.

MS. PFUND: Our view is that the grid is too useful to defect from, and that we are only -- just as, you know, you never thought you'd use your phone for taking pictures, and listening to music, the grid has a lot more capability in it than we've been using it for, by directional, more EVs, more renewables on the load, and so that -- you know, certainly, there are those that do want to defect, and that's -- but I don't think that's

a huge part of the population, especially when we show people what can be done, when these groups work together, and make a grid that really answers a lot more needs than it has in the past.

MR. GALLAGHER: Also, the utility is going to play an important role down the road, in being, in effect, the air traffic controller for multiple micro grids. You know, if a generator fails in one microgrid, you know, they are best suited to be observing from above and directing power. So I think they are still going to have a critical role.

MS. REDER: Okay. I have, in sequence, Bob, Anjan, Sonny, Tim, Carols and Rich, and I think in the interest of time, that's probably as many questions as we can take. So, Bob?

MR. CURRY: In looking at the current utility model, which focuses on raising capital in the debt and equity markets, more widows and orphans looking for dividends, more certainty of return from a bond coupon, microgrids present a threat. They are disruptive; it could be argued

they are cannibalizing the existing structure. What's the best story to tell to those folks on Wall Street, whose jobs it is to analyze for the benefit of prospective purchasers, the current offerings of incoming utilities?

How do you get the bridge from these very, very good constructive ideas, and fund them at a greater cost than currently is being incurred, that's my ex-regulator speaking, and then get to the delivery of what you guys are looking for.

MR. TREICHLER: This is Dave Treichler of Oncore again. I think that part, the answer to your question is that the utilities cost the power for at least the foreseeable future being lower than the cost of the power that will be generated within a microgrid, so for the most part, the microgrid is going to be more of a backup and safety valve kind of thing, just because the operating cost is going to be so much higher, that the people aren't going to want to operate the system all the time.

I think that the operators and the people they are going to put in these microgrids, for the most part, aren't going to use them for daily operations; they are just too expensive to operate for the foreseeable future. You know, my comment about the Brattle Report, until the cost of it, a kilowatt hour of storage gets down to $350,000 it's not economic in the State of Texas for us to do that, and we won't do it.

So I think you are going to see the same thing for Wall Street, that still will be connected to the grid, the grid is still going to be the primary focus of power, and I think you are going to find the utilities for the most part, are going to be looking at, how do we develop higher reliability solutions that we can offer to people, so they don't feel the need to, necessarily, go with microgrids.

We've been studying that at Oncor for a number of years now, we have some solutions we are coming out with, but we are actually going to be able to offer people a microgrid-like reliability

offering, that does not necessarily include onsite generation. So, what we are looking at -- the utilities just like everybody else, are going to react to what's going on with the microgrid momentum, and we'll come up with solutions that will either be cheaper or will be more reliable for the end user, as a way of trying to slow grid defection, which we know will occur at, you know, by the end of the century, but potentially not before.

MR. KRAPELS: May I add something to that, Bob. Because you and I have talked about this, before, that there's a drama taking place in the access to capital in the power business as well, and you see it play out in the yieldco that utilities are developing. And so in my company's own experience, our first transmission lines had to be funded by private equity, because they had the vision, and the idea, and the guts to do it.

But then, as time went by, our next generation is funded by utilities, and as time goes by, I'm pretty sure the next generation of

transmission lines will be funded by institutional investors who have, like, 5 percent hurdle rates, instead of 20 percent hurdle rates of venture capital. And that's the normal progression, I think, in a competitive market. And that's the way it ought to be, but it takes a long time for that to happen, and if you get ahead of that, you can suffer some terrible things.

But I think microgrids will be the same, that initially, Nancy, and her funds will create incredible models or us, but then the utilities are already moving into that space, and they have a lower cost of capital, and I can already -- I'm already having conversations, with institutional, investors who say, I like the sizzle of that business, I want to be in it.

And it's up to us to figure out, how can we structure funding so that this rate payer doesn't have to pay 20 percent for the money? And to me that's the challenge for the next five years.

MS. REDER: Good. Anjan?

MR. BOSE: My question actually just follows up on that. It seems to me that we've got two sort of opposing scenarios going here. One is the need for microgrids for various reasons. One of the biggest ones is resiliency, and obviously New York, and so on are working that, and the other is this formation of an entrepreneurial or a business model of some kind that needs to attract capital in the open market which acquires a business.

And it seems to me that what that depends on is whether -- what the price of electricity is in that area. I think we just heard that in Texas, obviously, microgrids generating the power by microgrids is not very useful in the marketplace, and I come from the Northwest where my university is a microgrid and, you know, we never turned on any of our backup generation or anything, because we pay $0.05 a kilowatt hour for our electricity.

So, the only time we think of turning those things on, is when our animals will die in

the experiments, or otherwise we never turn them on. So, I think we need to have -- on the one hand, you know, places like Chicago and New York City, and L.A., will probably have entrepreneurs who will come in and compete in the market, whereas other places, like the Gulf Coast, you know, if you are going to stay up with the heart pains and so on, will have to have policies that will help build microgrids for resiliency purposes. Am I right there? Is that a clean-cut case, or is it still very fuzzy?

MR. KRAPELS: Yeah. I think what motivated us to get into the microgrid business, is the realization that utilities in the past have typically sold one class of service. You didn't have, you know, brown, silver, and gold and platinum, and then with the development of certain types of industry like datacenters, we suddenly have learned that there are people that need platinum.

And then when a Super Storm Sandy comes along, we say, gosh, you know, the normal service

doesn't really work for communities that are on the coast, and so you have the Rockaways just devastated, when other areas were not. And there's a matter of social justice there that should society spend more to protect the vulnerable places, you know, and you can't do it if you could only charge $0.05.

And so that whole issue I think has come bubbling to the surface and I believe in the next 10 years, we are going to have different forms of electric service. They are going to be green and more alive, and more resilient. When the President of Cornell says, I want my campus to carbon neutral, he's not saying he's going to do it at $0.05, right? He is internalizing a goal that a lot of universities are willing to internalize, and it might be $0.07 or $0.08, but in a competitive microgrid environment, I think we have a better shot at doing that economically, than in the old paradigm.

MS. PFUND: And I would just add that there are some other sources of capital for these

areas that aren't just natural, in terms of attracting capital, and this, again, it's something we did a long time ago, out of, it was more of philanthropic effort on the part of Solar City and Elon Musk, but we put one of the first solar and storage installations at scale in a community center in Codan, Alabama, which was hard-hit by both the Gulf -- by Katrina and the Gulf oil spill, just a shrimp, fishery area, that had just lost a huge part of its economic base.

I think we did it, I don't know, 2009, or 2010, and it was hugely expensive back then. Can you imagine? I mean it's a big community center, but now they have power for several days, should they experience another weather- related problem. So, the fact that it was done through philanthropy, you know, there's a huge interest. I mean, a lot of the reason we raised 400 million, which was a surprise to even us, and we could have raised more, frankly, is because family offices and foundations are very interested in funding some of these earlier-stage efforts together with

public sector, and other partners.

And so, we see that and maybe perhaps some of the green banks that exist, or if there's ever a national green bank, these are ways to get at areas if the market doesn't often forget -- or the market forgets sometimes. But it's real, and those are the kinds of efforts that will eventually lead to driving down the cost as we scale them.

SPEAKER: Can I add to that briefly. One of the things that we are seeing, is the resiliency market, you know, and the ability Island, is going to be very important, but also probably limited, and the real driver on for microgrids, at least what I'm beginning to see is, you know, maximizing the -- optimizing the economics of multiple facilities being involved, you know, working with one another.

And a good example in New York is, there is the Buffalo and Niagara Medical Campus, which has about 15 different hospitals, research facilities. They wanted to put the ability to

Island, and my conversation with them, I asked them, when was the last time you had an outage? And they said, 1964. But as they did their analysis they found that really optimizing the loads and the generation within their multiple facilities is really where the biggest bang was for the buck?

MS. PFUND: There are also in some states, I think California, there's a Bill out there requiring all new construction to be net zero energy, is that right, Carl?

MR. ZICHELLA: Yes.

MS. PFUND: So, I mean, that's not exactly microgrids, but it often embodies microgrids, and you can see that in the West Village Campus that U.C. Davis, for example, which is a net-zero energy campus that was done, you know, several years ago. So, I think that they are going to be different pools of money, and different policy priorities that point towards these microgrids in areas that are more cost sensitive.

MS. REDER: Good. Sonny?

MR. POPOWSKY: Thanks, Wanda. And it's just a terrific Panel. My question was for Jim Gallagher, at least to start. I think you said during your presentation that it was difficult to find economic examples, examples of economic microgrids. And my question is, economic to who? Economic to the individual microgrid participants, or as in the case of the hospital it hasn't had an outage since 1964, or economic to the grid as a whole, and to society as a whole.

Because I think you get two different answers to where we are going depending on which test and particularly if you start talking about utilities putting these microgrids in the right base with cost-shared by all customers rather than just having the cost borne by the customers who participate.

MR. GALLAGHER: My point is that in the microgrids that we looked at, around the world, we did not find projects from a societal perspective, that they tabulated the total dollars that went

into it, and the total benefits coming out. There are a lot of demonstration projects around the world, but it was very hard to find one that -- you know, especially, you know, one that you could find where the benefits were monetized well, in terms of resiliency, benefits and the like, and that someone was making money.

You know, we looked hard, and we were not able to find those projects, and if there are those projects, we really want to look at them, and better understand the business model.

MS. PFUND: Well, those projects are being developed, but they are using incentives, and they are also much, much bigger than what you are -- the chart that you threw up on the slide there. And they won't attract capital if they are just 5 to 10 to 15 megawatts. You need to get bigger, and for that you have a main date, like the 1,300 megawatt mandate from California.

You have S-chips. I mean, just like you saw the role of rebates and all states -- many states are using rebates now to get their solar

program started. Different states are on different levels of maturity of that, you know, that helps to capitalize the market, and they don't need to last forever. The California Solar Initiative Rebate was very well designed. It's basically nothing anymore, but it played a role. And so, you know, you can't have your cake and eat it too, and you can't get the large quality vendors if you are not offering them anything.

MS. REDER: Okay. Tim?

MR. MOUNT: So, these were very interesting presentations. One of the examples that was given from the Pacific Northwest was putting in battery as an alternative to building peaking capacity. This sort tradeoff between install capacity and storage does not seem to be well reflected in the rates that people pay, and so we also hear how batteries don't pay for themselves because price arbitrage is inadequate, which I think is generally correct.

So my question to the Panel is, who is, or should be trying to get rates changed to

reflect the value that storage does a lot more than provide resiliency and price arbitrage? It also reduces the amount of stuff that you need in the ground, and that in a way, is one of its most valuable contributions.

MR. TREICHLER: This is Dave Treichler again, from Oncor. I think one of the things that you'll be interested in reading is the Brattle Report, because the purpose of the Brattle Report was really to identify what were all of the value streams that are available in society to pay for a battery and make it, essentially, you know, within the societal returns, beneficial.

And I think that the answer to your question, is I don't know if we have to do a lot with the rates right now, because the advancements in the cross-curve for energy storage will continue to accelerate for a period of time here, and we believe that by 2019, 2020, we are going to be able to offer this without any increase to rate payers in the state of Texas. So I think that the technology advancements that were occurring in

storage will make this a much more economical offering than it is today, within three to five years.

MR. MOUNT: So you are arguing that basically, current demand charges are adequate?

MR. TREICHLER: Mm-hmm. They will be.

MR. KRAPELS: Tim, one of the things, that I think, your neighbor to your left can tell you about, is the changes in the capacity regimes, Gordon, and a lot of ISOs, will reward more capacity that can respond timely to the needs of the grid, compared with the old stuff that couldn't respond timely, and I think that's a very constructive and productive development, right?

MR. van WEILIE: You know, I'm glad raised it. I think there's an elephant in the room that we don't talk about, which is, I think where you have nothing -- one of the questions to the Panel, to David from Oncor is, once the PUC approved the rate-based recovery of batteries, for Texas, what are the implications for the wholesale -- the electricity design in Texas? Because I

think the problem is, if you have as an objective that the wholesale market should ensure resource and adequacy through private investment, there's two ways of doing that.

One is through an energy-only market like they have in Texas, or the other is to do it like in New York and PJM, where you have an energy market, and the capacity market. But it think to Ed's point, you can get the right incentives in place, if storage and microgrids can actually participate and are economic.

But once you take the step of essentially, paying for this resource on the side, you have another policy question to answer, which is what do you do about all the other resources connected to the system? How do you ensure revenue adequacy? How do you ensure resource adequacy? It would be interested to sort of hear the thoughts on that.

MR. TREICHLER: Yes. In the Brattle Report, they specifically talk about the fact that the amount of time it would take to deploy 5,000

megawatts of energy storage, would parallel the amount of time it would take before you would be able to, at the growth and the stage essentially would require additional capacity to be added to the system.

So, in the State of Texas, what the Brattle people came back and said was, that the growth would essentially obviate the need for any increase in generation for a period of time, but that when you finish the build out the growth would go beyond that, so essentially you don't have any effect on the wholesale price in the State of Texas.

MR. van WEILIE: But what about the merchants that have already made the investments on the strength of future energy revenues?

MR. TREICHLER: Those revenues will stay the same throughout this period of time, because while we are putting out our storage that's essentially equivalent to the amount of normal peak or plants or additional capacity that would have been added during that period of time. It's

just that the merchants aren't adding additional during that three to five-year build out, but we'll continue building beyond that timeframe. People who are already in place will maintain their existing rate.

MS. PFUND: It's important, just in that example, Bainbridge Island, there's a whole -- the consumer choice is driving it. They didn't want another substation on that island. If you've been to that area, it's very bucolic, you know, they have a certain way of life, and they didn't want to pay for it, and they didn't want it there, and so the Bonneville Power Authority had some -- you know, it was funded, in part, through some grants, because of course it's not market-priced today, but when you make one flow batter system, it's going to be expensive.

But once you get to 10, 11, 12 the costs come down, and the point is that if you want to be responsive to your customers, which I think any successful business does, you are not going to have a choice but to implement these, and so the

good news is that the cost will come down, and you are going to have to adapt your regulatory framework to do it. Or else, then, you will have the defection problem, which will be kind of the unintended consequence of inaction.

MR. GALLAGHER: One of the most important things that I believe need to be done, and we are trying to do it New York, and we are trying to do it in California, is more to location-based pricing on the distribution system. And I believe that, you know, the subsidies Nancy is talking about that she's looking for, we really need to move more towards pricing, distribution, based on, you know, the real costs that are being placed on the system.

And I mean, one of the things you are going to see coming out of the Reg proceeding in the next few weeks, are recommendations to being moving us towards that locational- based pricing, and we'll --

MS. PFUND: With all due respect though, I mean, California is actually doing it, as

opposed to planning for it, and --

MR. GALLAGHER: Not really. Their plan --

MS. PFUND: Yes. I mean, they are doing -- they are doing 50 megawatt and above implementations that are going to be coming on line before, you know, some of these regulations even get out of the agencies they come from. So, you know, there's actually doing, and there's having orders of magnitude, higher penetration of renewables that those states have compared to laggard states.

So, you know, I think we can learn from both, but as a mission investor, we don't think there's time to kind of regulate, regulate, regulate, and five years from now get to 50 megawatts, we need to be there today.

MS. REDER: Good. Rich, in the interest of time, we have two more questions. Is that all right, or?

CHAIRMAN COWART: I think we are going to be fine.

MS. REDER: Okay. Good. I know you are doing some juggling on the agenda. So, all right, with that, Carlos?

MR. COE: David mentioned one regulatory hurdle that you guys were facing, I was curious in other states, what were the regulatory hurdles, you know, that microgrids face?

MR. KRAPELS: We don't have enough time to talk about that (laughter). There are 50 states, I mean, generically, it is. I mean, when we look where would we be willing to commit private capital? We picked New York because we live in the Northeast, and we like New York because we understand it to some extent, or it's a magical place. We are not in California, but that's the other place, and as far as I'm concerned, New England is behind. Other states, Texas I think is the leader in this, but they are all different.

MS. PFUND: Hawaii.

MR. KRAPELS: You know, they are all different, and so I really can't answer that.

It's a great question; I can't answer it, because I think we've got 50 different laboratories in this country.

MS. PFUND: Well, at least laboratories, you often have informed consent, that there's not a lot of informed consent going on here. I think that's a law that was passed in the '70s, or so. The point I wanted to make is that, a company like Solar City, and now Sun Run is going public, you've got Vivint. Do you know how many Government Affairs people they have? They have, like, 37, which is unheard of in a startup company in Silicon Valley.

I mean, it's kind of like every day, it's what's Massachusetts doing? What's Hawaii done? It's like you wake up and it's, kind of, like this assault of, which hole do you plug first.

MR. TREICHLER: And I think you raise a very interesting question, and I think one of the important things that this organization could do, would be to essentially put together a table of

what are the right regulations across the 50 states, that create barriers to expansion of microgrids and energy storage. And then look at that, and try to make some determinations about where are the commonalities, what are those issues that they are trying to address, and then what can the Department of Energy do to try to address the concerns that those states have.

MR. GALLAGHER: The Navigant Study Report that we are releasing in a week, also has, you know, a fairly thorough view for those key projects. What were the regulatory issues that were stumbling blocks?

MR. CURRY: Quickly, another approach would be to set up best practices and let the states bounce off the best practices. That's a more efficient, I think, use of DOE efforts.

MS. PFUND: One problem with the S-chip, which is been phenomenal, in terms of driving behind the meter storage, is that there's a finite amount of them, kind of available at certain times, and like a Tesla (inaudible), or a Bloom

Energy, or Solar City, I mean, it's just -- there's only so many, and it's like a -- and so everyone pounces on them, and so that's something that I was talking about.

You need to kind of figure out how to prevent that, so that there is a distribution that encourages innovation, and there are ways to fix that, but that's just one example of something that we deal with. And while it is perplexing and challenging to do this, you know, times 50, I've never seen a more motivated and inspiring group of people, the utilities and new entrants, combined, to make this happen. I mean, people just jump out of bed in the morning and, you know, say; we are going to do this. So it's fun even though it's frustrating.

MS. REDER: Rich, final question?

CHAIRMAN COWART: Maybe you can, in the interest of time, you can give your answers really quickly. I heard two different models for the future of microgrids, and one is this notion that I think, and Nancy, you use the phrase, getting

permission for utilities to offer infrastructure as a service. And so the utility model of delivering microgrids is part of a package, and I think the Oncor approach is that way too.

You also hear a lot of people saying, no, get the dinosaurs out of the way, and let the third party entrepreneurs come in and build microgrids, including offering service to multiple customers, and don't let the utilities, exclusive territories, get in the way. So, my question for you all is, which model do you see for rapid rollout of advanced technologies? Utilities have to lead, or third parties have to be led in, or both?

MR. KRAPELS: You know, what I'm going to say, I mean, utilities are the inevitable and essential platform for the development of microgrids and we need them, we need them healthy, we don't need death spirals and utility with land, we want them healthy and hail, and hearty. That said, you will only get the destructive creation that Schumpeter talks about if you let crazy guys

like us come in and try to sell with other competitors, the construct of microgrids to different communities.

We are not afraid to fail. And when you get into the utility world, you can't fail and the mix of those two cultures is I think what will create progress here.

MS. PFUND: Yeah. I couldn't agree more. And there's a wonderful blog that one of the founders of Solar City wrote, Pete Rive, on recommending this infrastructure as a service, which is on their website if you care to take a look. But it's just, we can do so much more, working together, and using this immense asset that we have, that has been underutilized, frankly.

I think what we go into was sort of a -- which you do in any early stage of innovation, where you got the new entrants, and the incumbents going at it, and that always happens. It's messy, it kind of dominates the conversation for a few years, and then you kind of -- if everyone

realizes there is no going backwards, and so we are going to have to figure out how to get along.

And so I think, happily, we are entering that stage, and I would say that the companies like Solar City and Sun Run, they want that connection to the utility and to the grid, because there is going to be so much more loaded onto that grid. I mean, in California, we see a day where we'll have a solar power D-cell plants.

I mean, those are huge energy consumers, we need to be able to control flows and to solve, you know, another climate challenge that we had. So I mean, we just feel that there's so much that's going to be required, that the only way they will effectively address it is together.

MR. GALLAGHER: Rich, in my view, I think that probably the most effective model will be utilities subsidiaries. You know, along the lines of what Ed had described earlier. Going into other service territories, and potentially, and then competing to build microgrids.

The real challenge however, of that as

well as just leaving it to other companies, there's going to be a big portion of the customers, lower-income customers, for example, that's so (inaudible), looking at everyone else with their lights on, and they don't have their lights on. So I think the utility is still going to have a role, a provider of last resort, in even areas such as microgrids.

MR. TREICHLER: You know, Nancy talked about the requirement for some kind of subsidies, or participations, one of the points I think I made earlier was that, we see it as the earlier microgrids in Texas anyway, are probably going to be public purpose microgrids for the most part, so they think that where there is a public-private partnership on developing these things, is how you are going to accelerate their adoption quickest, at least in Texas.

And I think you'll see that in other states as well, where you have a public sponsor because of the fact that they are not economic on their own, but that they have a public purpose

that requires to have this highly reliant, reliable, uninterruptible type of power that those kinds of partnerships will accelerate this, and we are already working on those in Texas where we are talking public entities about how we can work with them to accelerate the adoption of a higher resilient grid in Texas.

Even though we don't worry about hurricanes much, we do worry about tornadoes and other things that take out large pieces of infrastructure, and we have a much more difficult requirement in terms of the resiliency required from a tornado than you do from a hurricane.

MS. PFUND: I'm not at liberty to describe the projects in detail, but the ones that are seeing they are pilots, they are not demonstration, some of the earliest microgrid programs, the IOUs, and new entrants are planning for, are in disadvantaged communities addressing environmental justice issues. I think that will do huge amounts to get everyone on the same page and see how profoundly positive that this new

approach can be. So, it's almost the opposite of what you might expect. That they are not getting left behind, they are actually, some of those first installations are going to be addressing those populations, which is a fantastic thing.

MS. REDER: Okay. Jim, Ed, Nancy, Dave, I really appreciate your time. Great Panel. Thanks, Scott.

(Applause)

CHAIRMAN COWART: All right. Our next topic is a report from the Energy Storage Subcommittee. Wanda, thanks very much.

MR. BROWN: Well, when I was putting this presentation together I was asked to make it brief, and I though they said grief so I made I long. And if we don't have time for all this we'll just quit, and you'll see why in a moment, but I think what I have to say is of use to this group here because you might have some reaction to how we're approaching a product that we're developing for Energy Storage Subcommittee.

This report is an update on our

activities and plan in this particular Subcommittee and if this works, it works. Our plans for the next couple of years are, one, and we've already talked about this and you've already had a presentation on it by Carlos Coe, on the distributed energy storage white paper, so I won't go into that. That's been covered already. The reason I list it here though is a significant number of the Energy Storage Subcommittee members are working on this and contributing to it so that's where some of our resources are going.

The second thing was though the new product that we're working on now, it would be a white paper on the Implications of High Penetrations of Energy Storage in the Electric Transmission and Distribution Systems. I think maybe sometime around 2016 we might be able to finish it, but there is a competing product in between that we're going to be having to do which is the Biannual Energy Storage Program Assessment for DOE, and that needs to be done in 2016. So depending on resources and how many new members we

attract to the Energy Storage Subcommittee to produce product may affect some of these anticipated dates.

I'm going to spend the rest of the presentation talking about and giving you some perspective on what our Subcommittee wants to do on the Implications of High Penetrations of Energy Storage in the Electric Transmission and Distribution Systems white paper. This graph here is one at least projection of where energy storage is going, and it is a projection because if you look at the historical data it really doesn't justify the projection, but there is a lot of sentiment and logic that does drive a belief that there probably will be a fairly significant growth in the use of energy storage in the electric grid. So the implication of that is that penetrations could become high and become fairly ubiquitous on the electric grid. And then the other kind of sea change that's taking place that Carlos has been talking about in the white paper he's leading is that there has been somewhat of I believe to many

people a surprise growth in the area of distributed energy storage. So the implication there is if there is high penetration of energy storage it could become ubiquitous through the electric service value chain, including at the customer level. So these are kind of two givens that we're going with in this study that we're doing, or if you will two major assumptions that we're going to go with. So if high penetration of energy storage deployments occur as expected what would be the electric grade consequences is one way to put the question. It was suggested that perhaps what this really should be titled or sub titled is what happens if the dog catches the bus. And so let me elaborate on that. High penetrations of energy storage are expected to bring substantial benefits to the production, the delivery, and the use of electricity. This is what most people talk about when we talk about the future of energy storage, and it's the thing that drives us forward to make it happen. Energy storage might be -- in one case it might show up

as just another competing technology providing traditional grid service, competing with combustion turbines, demand response, and things like that.

On the other hand, it has the potential we believe to be a disruptive technology for the grid. That is it's really an electric delivery temporal power flow control capability, which is really a first for the electric grid of any great significance. I mean we've got fax devices and other kinds of your VAR devices just that really are energy storage devices, but they operate on extremely short times. Here we're talking about having the ability to delay power flow control to the point of serving as a product warehousing and this has implications not only for operations, but the functioning of the grid and frankly the business models.

So there are those two kind of extreme ways of looking how energy storage may play in the future of the electric grid. The part we don't talk about very much I think is that high

penetration energy storage also could result in dislocations and difficulties for the function and the operation, the form and (inaudible) success factors of the electric grid, at least as it's configured today, and probably will be given its legacy influence for some time to come. And so this is another part of this question we need to look at and what I think leads to the general question what happens if the dog catches the bus. So we think the grid needs a better understanding of the potential benefits versus dislocations of high penetrations of energy storage.

Therefore the purpose of this white paper, which I've already stated the title before, one, is to examine qualitatively at a very high level, because of the complexity and the great uncertainty in what's going on in this area, of the implications of high penetrations of energy storage into electric transmission and distribution systems. The other purpose we hope it can provide is as a framework for one, identifying quantitative measures to more

thoroughly characterize the vision of energy storage as an agent in the grid, both physically and institutionally. This is really in shorthand terminology, it's getting the metrics. Pat was talking about yesterday this meter so that we could make better decisions about how do deploy energy storage and how it might unfold as a component in the electric grid. And then sort of a second purpose is if we can qualify to some degree the implications it might lead to defining a grid technology R & D program that would enhance the benefits and mitigate the dislocations of high penetrations of energy storage. And given this purpose we really see the purpose and the function of the white paper is that -- with the assumption that DOE is assumed to be the focal audience for this white paper.

Now the challenge for the Committee or anyone frankly who takes on this task is how do you analyze future implications of high penetration of energy storage given the complexity and the uncertainties facing the electric grid. A

traditional linear thinking approach to this thing turns out to be very complicated and frankly very risky. For example, what policy planning and investment decisions shaping the future electric grid will be made in the next few years or decade that will influence how this high penetration takes place, what electric grid business models and goals and strategies will dominate the future. And there has been a lot of talk about that in the various panels we've had over the last couple of days. And how do you characterize the future so that decision makers can identify future opportunities and not foreclose options and then handle surprises gracefully. In other words, how do you put together frankly a robust, in this case R & D program to work with in assisting the penetration of energy storage into the electric system?

And one possible approach to this, and the one that the Subcommittee is using, is scenario planning rather than sort of traditional strategic planning. I'm going to talk a little

bit about the scenario process we're going to be using, and I hope this is not seen as a waste of time, I think it's kind of important to know how sausage is going to be made here to know how good the product might be or not be. Scenarios are not about predicting the future, they're about perceiving futures in the present time. For example, scenarios first of all are plausible narratives of alternative environments. In other words they are stories about the future that make sense, that are not necessarily probably, that are not a prediction, but they could happen because they make sense, their hypotheses of different futures which can be used then to test what those hypotheses mean. And hopefully that they highlight the risk and the opportunities of strategic issues, which goes right to the heart of what we're talking about here with high penetrations of energy storage, what are the opportunities and what are the risks?

The scenarios are not -- this is getting to be repetitive -- they're not predictions of the

future and they're really not strategies, although they can be used to test the strategies. They provide you a context in which you can test your strategies with. If this future unfolds does my strategy hold water or not. So really what we're developing here are tools for hopefully DOE or anyone else who wants to use them for ordering one's perceptions of what alternative future environments in which one's decisions might be played out. And that's a quote from Peter Schwartz; he was a major factor in developing this form of scenario planning at Shell Oil back when he was head of the Shell Oil planning London. So the Energy Storage Subcommittee is using a simplified scenario planning process and this is where it may get a little complicated in explaining all to you in various shorthand time for those who do not know this process, which is one of the processes that has been used by the Shell Oil planning. But what it is is that up here on the screen you see a four quadrant vector diagram, and the four quadrants are made up of the

fact that you've got two somewhat independent variables that we're going to look at that influence the electric grid in the context of very high penetrations of energy storage, and therefore create if you will different stories of how the future might unfold. And so in -- and I'm hoping to explain this also with an example, because this is a bit esoteric here, but you get each of these four scenarios by -- or therefore different plausible futures, by the logical implications of the cause and effect interactions in each of the quadrants with these two highly uncertain variables. Now if that isn't crystal clear maybe this will help. Here's an example of a simplified scenario planning process that my team did and that got published in Utilities Fortnightly on the question of what will the electric grid infrastructure look like in 2050, roughly the date. And we picked -- and there's a process for going through to do this -- the two highly uncertain and very variable variables. On the horizontal we picked the future of technology, and

you'll see that it spans on the far left from technology only develops incrementally and only gets deployed implementally, because those go hand in hand, you've got development and then you have to use it. To the other extreme which is technology gets developed and adopted into matter in the electric grid in which it causes paradigm shifts. It's a radical transforming effort. And that's a continuum, a spectrum, all the way along there. Then if you look at the vertical access there the variable we picked was societal reactions to building traditional technology and distribution poles, wires, and towers. And at the bottom the one extreme shown is that society resists building more of these things. On the other hand at the other extreme is society actually wants to build more transmission and distribution. And I don't have time to go into why we picked those and give you the logic for them, but I just wanted to show you these were two we picked.

And here are the stories we got. If you

look at the interaction of -- let's call it a poor technology environment, but a very rich one for building something, guess what you're going to do? Your story is what we call the beefy electric grid, and it's really more of the same. We build a lot more transmission towers and lines and stuff like that. And the success factor in that story for the electric grid is you can build infrastructure. That's an over simplification, but that's one story that we created of the future. Going over to the right now we still have a society that welcomes the building of infrastructure, but new technology gets developed and gets adopted in such a way that it does create paradigm shifts. And what it does is opens up opportunities that weren't in the beefy scenario. And we label therefore this one the nibble scenario, and we also called it delivery a kilowatt hour from anywhere to anyone at any time. And so it's a very, very nice, rich, satisfactory story for the electric grid and the key success factor here becomes flexible service. You can

offer products and services that weren't possible without the new technologies.

And then moving down to the third quadrant, we now are still in the quadrant where there is a lot of technology available to use and is used, but society doesn't want to see more build out. And so we're constrained by taking the more traditional approach to expanding the grid's service. And we call the one the techie because the future of delivery of electricity depends highly on technology. Also we sometimes call this the MacGyver scenario. And basically, due to demand you have to use new technology, and so the success factor that we came up with was you need intelligent Microgrids and/or the invisible transmission. In other words technology allows you to overcome the resistance to it, such as undergrounding, what might be one example of the.

And then the fourth scenario to look at, this is now from a transmission or even from a grid point of view the most dismal one. This one is you don't adopt new technologies or you don't

have them and you don't adopt them, and also you're not allowed to build anything. And we call this the T.rex. And the reason why is in our story anyway transmission struggles to survive because it really doesn't have any options for going forward that are very desirable. And distribution struggles to thrive. In other words it's really the only game in town, but even without new technologies it struggles to be able to provide service. And so the real success factor here is a focus on distribution networks going forward; this is the only way out of the story.

Now my purpose to show you all this was to give you some idea of how we are planning to proceed in the Energy Storage Subcommittee on looking at what happens if there is high penetrations of energy storage. And so we need to put together this particular matrix here and create the stories and then use those stories to learn something about what the future of a high penetration of energy storage might look like

under those conditions. By the way, if you have the time and the energy you can -- and if it warrants it, you can select other variables and do that game too to give you more scenarios, but it's usually not done because it's overwhelming, but you could do that, particularly if you aren't -- if it isn't easy to select the two variables that appear to be the most influential.

So worst scenario, future scenarios for T & D, resolved it with various use of the three additional build and technology innovations, what came out of this example. So we just started this in the Subcommittee and so there is some work in progress. I didn't go through the eight steps of this process partly because of time and also partly because of complexity, but one of the first steps is you've got to identify what is the question you're trying to answer, what is the focal issue or decision. And it's pretty critical because if you focus on the wrong question you come up with a lot of wrong answers. And so the Committee has just now begun to look at what is

the focal question and in a recent meeting -- this is a summary of what happened -- we kind of looked at these possible questions: One of them was how would the function and the operation, the form, and the critical success factors of the T & D system be impacted by high penetration of energy storage? Another one we looked at is a little more directly to the point, what technology R & D should DOE do to help prepare the electric grid from high penetrations of energy storage? And then a third one was what electric grid technology developments are needed for high penetration of energy storage? This is sort of a Goldilocks story here. The first -- well, let me finish the statement, and the (inaudible) statement is it needed to maximize the benefits and mitigate the difficulties for the electric grid of high penetrations of energy storage. The first one would be very, very rich in information, but it would also be very complex, probably could not be done by our Subcommittee given the constraints we have on meeting and provides stuff that goes way

beyond the basic thing of what we're really shooting for, helping DOE have a context in which to do planning. It can be very useful to them I suppose, but it also has a lot of extra stuff with it. So we looked at the second one, and this one we felt had a drawback in that we would have to be pretending to be DOE, and we could do that but we can't do it all that well. And so we said well maybe we'd get it wrong because we don't have the right perspective. So the third one was the one we settled on. It was the bed that was just right for Goldilocks, which is what electric grid technology developments are needed. And so we felt this one would give quite a bit of guidance we hope to DOE, but also could be used by others to look at too, other providers of technology and technology development. So for the moment, at least until we have second thoughts, it's the third statement or question that we're going to work on. So tentatively, alternative three is the candidate focal question that we've chosen.

Now in this last -- you'll be glad to

hear -- last slide, the next step is you need to pick those factors that you're going to use, and this has got to be done carefully too or you come up with scenarios that don't mean very much and don't have very much value. So some key factors influencing the success or failure in addressing our issue, our question, and the Committee has not had time to go through these, so these are my suggestions of example candidate areas to start to look into to find the variable and choose them. And those people in the Subcommittee working on this, this will be sort of your first exposure to this, although I have sent it out in an earlier document but it didn't really point it out to you; you may have caught it. But either you'll accept, reject, amend, and add to these in a future meeting. So please don't take these too seriously, they are one person's interpretation. But here are some of them: One, what's the transitive mechanism for pricing electricity in the future? And the two extremes are markets and regulations. But that's going to be I think

important to determining how the high penetration of energy storage influences the grid. And I think it came out in, for example, the Microgrid discussions. Another one that came out in the Microgrid discussion is who owns the energy storage asset could influence the way high penetration influences the electric grid, and the ownership could be utility, the ownership could be the end user of the electricity, or it could be a third party. So again a variable with uncertainty involved. Then there is the technical sophistication in the grid and energy storage. We heard from the Microgrid community frankly that they're relying on technology to make the Microgrid happen. What if technology doesn't happen, what if it isn't sophisticated enough, or it isn't deployed? That's one extreme, and you saw that in the example of the other scenario planning process I just used as an example. Or on the other hand it would make them ubiquitous. It may be fast coming. That could have again influence on how energy storage influences the

electric grid. And there are a number of other factors that have to be looked at I think, such as integration of renewables, how does that go? How about the future generation mix and its location in T & D? This is a broader question frankly of the integration renewables. Is it going to be heavy in (inaudible) generation of heavy in central station or what? And then what about demand response, will it be a tool or not a tool that the utility can use in a condition of high energy storage? So we need to look at all of these and more of these variables and consider how we would maybe choose those as a variable to look at as they drive the function, the operation, the form, and the critical success factors of the electric grid in the future, because that will all have an interactive relationship with high penetrations of energy storage.

Then how was high penetration of energy storage was it achieved? We're assuming high penetrations, but we haven't assumed how they come about, and there could be again two extremes. One

of them is a market pool, and that was talked again on the Microgrid about market pool in this area, or it could be policy driven, and that was brought up too on the Microgrid Committee. So it's another uncertainty to look at. And then another one which I threw in there because it was -- I had talked about it in the earlier example, is the ability and the cost to build traditional wires, poles, and the towers for the electric grid could again affect high penetrations of energy storage affect the electric grid in the future. And what business models dominate for T & D owners. So out of these and others, some might want to note that because the Subcommittee has not had time to go into these and put their stamp on it yet, which one had the greatest uncertainty and which one had the very high importance, because if it's not important then there's no point in looking at it, and if it's not of high uncertainty then you don't create the scenario you just have an assumption of the future. Demographics is usually one example of that. Usually population

growth is pretty predictable and so you put that into your story as a given if that happens to play a role. And we'll be getting into that also on the Subcommittee, what are the things that are givens pretty much.

So this where we are, this is where we're heading and I thought you ought to know about it. If there is any discussion or discussions, I stand here ready to receive your wisdom.

CHAIRMAN COWART: Questions or comments for Merwin? Carl?

MR. ZICHELLA: Just a quick comment. I think this approach is very helpful. We've used it at WECC to help guide transmission planning and I think we've learned a lot from it. Some of the assumptions had to do with the economics, how fast the economy might grow, and also how fast we might anticipate technological development to occur. I think one of the key things is getting a good mix of futures that actually can be separate from each other, that actually demarcate the boundaries of

the conversation. And this can certainly help do that. So it's a lot of work. It's very ambitious, Merwin, but it also I think gives you a really useful result.

MR. BROWN: Thank you. I have the same feeling about this that I had about some of the comments of to introduce microgrids in the system you've got to put a lot of money into it. I sort of quaked and thought that's a pretty good risk there if you're not making something up, but we've got the same issue here. And one of the problems we're going to have is not being able to meet face to face. I'm trying to figure out a way around that barrier, to handle these things by phone calls. I'm thinking maybe we could convene east and west coasts kinds of things by dividing up the different quadrants and one coast take one quadrant.

MR. ZICHELLA: Yes, I think that's right. I mean it does take some time thinking together, reacting together to what people are saying. That's really hard to do on telephone

conferences that last an hour or so. When we got started on WECC we actually spent days together doing this.

MR. BROWN: Yes, this is going to be a challenge and it will probably be a -- I can't think of the right word -- superficial isn't a good word to use here, but anyway it will be a light look at this, but I hope it's a start and it's going to be usable.

CHAIRMAN COWART: Clark?

MR. GELLINGS: I want to echo, Carl, what you were saying. Part of my ability to eat comes from (inaudible) paying me to do stuff like this, and I also do it for utilities, although we don't advertise the fact that I do it, okay, because most of it can't be published. Utilities don't want it published. I'm skeptical for very much what Carl said. This is at least a four day process to even get started with the group together, not on the phone. I kind of have a negative reaction to your putting the key issues. I think the group has to do the key issues. If I

started out by allowing you to tell me what they are you don't have my buy-in in the process. And I'm reluctant to think that in the end this will all be your work, you know, and you're an extremely bright guy who has done some of these professionally as well, but I just don't that it's really going to be that robust an answer.

MR. BROWN: I apparently didn't make it clear, but it was risky. I didn't put these up as givens. I said these were examples to get started on, for the group to massage, destroy, get rid of, et cetera. But as facilitating these things in the past, it is dangerous for the facilitator to put these examples up because it does lead the witness so to speak. So your point is well taken, but it was not an intent to say these are the ones, they're not. The group has got to go through them and pick them out. So this is a bit of an experiment in process, that's why I brought it up to you, to know this is what we're going to try and do. And we may abort the ship along the way as it starts to take on water.

CHAIRMAN COWART: Well, we might need to speak to the department to see whether or not there's a way we could actually facilitate an in person meeting of the team that's working on this paper. That's a conversation which I'll try and have or you and I together should try to have with the department.

MR. BROWN: That would be very nice; it would help a lot.

MS. BROWN: I just wanted to chime in that my general level of enthusiasm for scenario analysis as an alternative to extrapolating trends in particular technology or economic fields, when you look at how technology breakthroughs or economic opportunities pull together in unusual combinations, which it can do in scenario analysis, you may get unanticipated insights. And so I fully support this kind of an approach to compliment the usual, you know, drilling down in some one single technology field.

MR. BROWN: Thank you.

MS. BROWN: Yes.

MR. BROWN: I don't know whether you know this or not, but the success factors in the study that my team did, every success factor was quite different in each of the four quadrants. And so to me, if nothing else, that's a message for the electric grid going forward, you've got to watch what it is you're focusing on as your success factors because as the future unfolds picking the wrong one could be disastrous. So that was probably one of the surprises that came out of our study was how different success was in each one of them. And anyway I wouldn't put a lot of weight in the study, it's just a study, so.

Are we done?

CHAIRMAN COWART: Anything further? Mark?

MR. LAUBY:: You know, NURC has done some work along these lines as well looking at scenarios. And, in fact, we had a report where -- and I think you probably have already looked at this, what's the status of all these technologies, because they're all of kind of together. And for

example storage is within itself a family of different types of storage, everywhere from long-term to real fast bursts, so a lot of different types of applications there. And then, you know, looking at the different types of technologies, variable, generation, solar, et cetera, these are all going to be coming up together, and so you kind of look at the overall field and say well what's the status of each one of these technologies, and that helps you narrow that scenario or scenarios a little bit more, what seems to be more pragmatic than others. We looked at it going out to 2050. Of course there's a look that we did back in -- before five years ago and perhaps needs some updating as well, but it might be also helpful. But overall our view was that storage is nothing but beneficial if it become economic. And it's, you know, it's kind of like the silver bullet for reliability anyway from our perspective.

MR. BROWN: Thank you.

CHAIRMAN COWART: All right. Merwin,

thanks very much. This concludes our agenda for this meeting. Before Bob Curry left I was going to take a moment to thank him for his long service on the Committee. He was on for five years and this was his last meeting, and unfortunately he's not here to hear me thank him, but maybe he'll get the word.

I'm told there are no members of the public who have signed up to address the Committee and therefore our business is concluded. All right. Anything from you, Pat?

MS. HOFFMAN: Just a couple of closing thoughts. I spent a lot of time thinking about how we want to move forward and some of the things I'm looking for in future meetings of the EAC Committee. One of the comments on the microgrid discussion, you know, was the role of DOE and looking at the development of standards, advanced controllers, public purpose, microgrids. And I know that we've had a call looking at advanced controllers and control technologies for microgrids. In the future I think what I'd like

to do, push with the staff here, is if there is a part of the topic that we're talking that relates to some R & D efforts that we're working on is to make sure that that gets out as part of the Committee's discussion so we can look at the relevance to where DOE is heading in DOE's work.

Some of the other things that I thought were really interesting for future discussions, looking at value analysis, whether we're talking the value of solar, the value of the electric grid, the value of energy storage; you know, that seems to be a reoccurring them across the industry as well as -- let's see, there was a discussion about where is the inertia in the system going, different forms of electric service, whether we're talking pricing or reliability or transitive, automation, the development of automation cross the system, whether you're talking dynamic protection schemes or automation at the distribution level, going back from, you know, central control versus distributed control.

So hopefully we can take a hard look at

some of what is the most pressing topics coming up and moving the grid forward, take a hard look at some of those and tie that to also some of the work that the department is doing so we can continue to push are we meeting the highest priorities with respect to what we're asking the national labs to do, but what we are doing in running our solicitations and our industry solicitations in addition to our laboratory calls.

So those were some of the thoughts that I picked up from the meeting today. I thank everybody very much for the discussion and I appreciate your time.

CHAIRMAN COWART: Thank you very much. We are adjourned.

(Whereupon, the PROCEEDINGS were adjourned.)

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CERTIFICATE OF NOTARY PUBLIC

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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.

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