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RE-EXAMINING SMART POWER:  
HOW ELECTRIC UTILITIES CAN RESPOND TO CLIMATE CHANGE CHALLENGES

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

MR. EBINGER: Good afternoon ladies and gentlemen. I'm Charlie Ebinger, the Director of the Energy Security Initiative. We are absolutely thrilled and delighted for the second time to have Peter here to discuss his newest anniversary incarnation of his book, Smart Power. I think those of you who have had a chance to look at it, either the first edition or the newest one, will find, in the newest one particularly, there are some very fascinating essays by leading people in the field, kind of commenting on the same trends that Peter sees, but adding to them. So without further ado, the way we will do this, let me introduce the panelists. You have their full biographies, so I won't take time to read those, but we have my colleague Adele Morris, who is a Fellow and Policy Director of our Climate Change and Energy Program in our Economics Division here. And we have Rudy Stegemoeller, who we're particularly thankful for his efforts to get down here today. He is the Special Assistant for Energy Policy in the New York State Department of Public Service which of course, New York being one of the states that's kind of in the forefront of major change that's going on in the market place. I think we'll first have Peter make some opening remarks and then we'll go. Oh, excuse me. And I wanted to remind you all that Peter's book is available for sale in the back of the room after, and he'll be glad to sign any copies following the seminar.

MR. FOX-PENNER: Thank you. Thank you Charlie. Thank you, all of you for coming out today. I hope you all noticed that Charlie used the term new incarnation for this book. That's because he just came from a meeting with Prime Minister Modi, and I have heard this new edition referred to as many things but never a new incarnation. And I will long remember that term. And I appreciate it. But honestly I want to thank you and John Banks and your whole team here at Brookings for doing this, yes for a second time. They didn't learn the first time.

I also want to thank my colleagues at Brattle. We've got Frank Graves and heads our utility practice. Alexi Mananas, our president, and Heidi Bishop who heads the all things Smart Power here today, and I want to thank them. And I want to thank Island Press' whole team, led by David Miller, and the panelists who will give us their insight and are generous with their time. And finally, I want to give a shout out to another Smart Power. There is a group, a non-profit group that promotes community based energy efficiency. I share the name Smart Power with them. You can look them up. They're smartpower.org -- great people doing great work, so I want to make mention of them on this august occasion.

So five years ago, the term "utility transformation" was largely unheard of. Similarly, the term "utility of the future," and today, it's almost commonplace. And it's personally gratifying -- there's lots and lots of publicity about the term, lots of work going on. The purpose of the book was really to raise the issue and talk about where it was going and the book has two parts. The first part is to talk about the drivers -- what's causing this really once-in-a-century transformation of the industry and then I went on to talk about the new business models that will evolve from it. So let me make my remarks in that same order.

In the last five years, the drivers have progressed enormously. The imperative to take care of global climate change, to decarbonize our power sector and really all other sectors is larger than ever. Many of you saw the publicity around Climate Week and the announcement that week that global CO2 has gone up by 2.3 percent even more, 2.9 percent here in the U.S. Scientist Glen Peter saying this is an all hands on deck moment. Adele's going to talk more about this which is great. I just want to note that, as important as this driver is, in the last five years, it has become, I think, more and more clear, just to me personally, that it is technically doable and affordable to de-

carbonize the U.S. electric power sector by 2050. All of the signs are that that's a very very achievable goal if we just get about doing it. And I think we are getting about doing it, just not fast enough.

One of the reasons we're doing it, is that another of the big drivers have changed in the industry. All of you who haven't been living in a cave in the last five years know, is that renewables and particularly PV power have gotten much much cheaper, 70 to 80 percent cheaper since 2008. That's true of both utility scale and rooftop power. Many of you may not know it but utility-scale solar installations are about 60 percent of all the PV that's going in. You don't see it but it's larger than what you see going on the rooftops. And it's significantly cheaper. There have also been great strides on other renewables and in particular, storage, with all of them becoming cheaper, not as cheap as fast as PV. Wind's very competitive in many parts of the country. So that driver has rolled on.

Another of the drivers that has continued, even stronger than I expected, was the kind of flattening of load growth in the United States. We're still below our 2007 retail sales levels by, as of 2013. And what we -- we do a lot of load forecasting and have for many many years and we see a real shift in the coupling between GNP and electric use. That is a once in a century phenomenon. AEP CEO Nick Akins calls it "a new world that we live in." Another of the drivers was broadly characterized as Smart Grid. That's the addition of communications and sensing control technologies to what was largely a one-way analog grid. It's a very very broad topic, a very very broad suite of technologies, and with equal broadness, it has rolled forward making significant progress and it will continue, nothing particularly exponential because it's a giant shift in the grid, but steady progress. We're at about 40 percent penetration of smart meters. We're up to two percent of all electric customers on rates that vary by time. That may not sound like

a lot but five years ago it was almost zero. I think it was a tenth of one percent. So that's quite a significant shift for us folks in the industry, in part because the first few percent are definitely the hardest on this topic and we are moving through that point. Finally, there is a driver that I didn't appreciate. There's a new one that's entered the scene. I don't talk about it at all in the original book, and it goes under the general heading of resilience. All of us lived through super storm Sandy and quite a lot of events. U.S. had 11 events in 2012 with greater than billion dollar damage affecting counties with 76 million people. That's about one in five Americans. In 2013 there were only nine billion dollar events. It's becoming a big federal budget item. And these climate events, which I think scientists tell us are getting more severe due to climate change, are having impacts, outage event impacts on the grid that, at an unprecedented scale, and super storm Sandy is really the poster child for this. Eight million customers out, many for three weeks -- I have never seen anything like it and most of us in the industry have never seen anything like it and quite legitimately that has prompted everyone to ask whether a different architecture of the grid, and whether greater use of distributed energy resources would help in the response to those sorts of events, and whether the smart grid will help. And those -- all of those technologies and resources and changes will help but I would caution against being too simplistic about it. Some solar cells on your roof may be a good thing, but they won't necessarily prevent some very severe impacts. So it's not a simple topic but it's an important new driver for industry change.

Now one thing that has happened in the last five years is a resurgence of talk about the utility death spiral. The very first article I ever published in Public Utilities Fortnightly, which I meant to look up on the way, before I came over here, was in about 1983 or so, and it was about the utility death spiral. I was a researcher at the Illinois Governor's office, researching utilities and there was a lot of talk about it because of

nuclear cost overruns and the Arab oil embargo which was still working its way through the system. The talk subsided and I didn't see the term for 25 years probably and neither did you. There's been a resurgence -- it's almost like an urban myth. But the interesting -- one interesting part of the resurgence is that a number of utility Wall Street analysts, very respected ones have taken a pretty hard look at it and almost uniformly concluded that it is neither imminent nor likely. And I must say that we do a lot of financial modeling at Brown Group and we would agree that it is, almost, generally speaking, broadly speaking, neither imminent nor extremely likely. But I do want to caution everyone that again, just my personal view that conclusions like that are -- we shouldn't be too sanguine about this because long before you have anything approaching a death spiral, you have progressively weaker earnings and progressively higher rates at a utility. And in my, just my opinion, the real thing to be concerned about there is not the likelihood of anything that you and I would call death, although you worry about that, but long before that, you worry about the collateral damage, the damage to innovation, the damage to public purpose programs, the damage to access to power for low income customers and there is a tremendous amount of important transformational activity being anchored by the very utilities whose credit worthiness may be impaired. So the first thing to worry about is collateral damage. The other to note in all of our work is that, in case you hadn't noticed in the last five years, predicting black swan events is very hard, and what will happen. And black swan events would really change the political and economic dynamics, wherever they occurred.

Let me turn though to the, I think most enjoyable part, clearly of the inquiry into the utility transformation and that is to look at the new business and regulatory models that are emerging now. In the original Smart Power, I introduced two business models. Hopefully all of you have memorized them by now -- the Smart

Integrator, which is basically a -- well, the Smart Integrator is one and the Energy Service Utility is the other one. The Smart Integrator is a kind of an open access platform for distribution services. And that particular business model I thought was extremely likely and fit well in the parts of the United States and the rest of the world that have retail competition, retail choice, where you already have open access in the sale of commodity electrons and wholesale markets coupled to them. The second business model is the Energy Service Utility. And that's a vertically integrated utility as we have in the traditionally regulated parts of the United States, but that utility would expand to its mission away from just selling electric power, commodity electrons, into selling the full suite of distributed energy services, energy efficiency and demand response distributed generation and so on.

So those were the two models that I posited and there has been a fascinating evolution in both of those directions. The original efforts were almost all directed at the Smart Integrator model, mainly because the interest kind of came out of the parts of the country where retail choice was established and that's just generally a model that seems to fit kind of the application of markets to the electric power space. But the original efforts to look into the Smart Integrator were pioneering but they were more pilots and think pieces. One of them happened just a few blocks from here with the Energy Future Coalition helping the state of Maryland do a "Utility of the Future" study and a number of pilots that went along with it. I don't know if anybody's heard of it. John Jameson was involved in it, and maybe you know him. Ron Bins, who has shared this stage I think, with me and others, did a project called Utility 2020, and that really helped to get the idea out and start the conversation going.

But what has happened in the last year and a half or so is that certain states, New York being the poster child, have progressed to really a full commitment to a

full scale implementation of the new business model on a state wide basis, so we have proceeding underway in New York as well as now in California and Hawaii, to look at new utility business models. That's the mission of the proceeding. The intent is to move utilities to those new business models and that's quite amazing. I hope Heidi has it up, yep; this is a slide that comes directly from August, 2014, New York Proceeding. It's called the REV Docket and Rudy's going to talk about it and what is -- what was really great, I thought, not only about the mission of the docket but to see emerging from the discussion in the docket, was, what you see here is a decomposition or unbundling of all of the services that distribution utilities provide in order that you could take a hard look at those and figure out, in the utility of the future, that isn't going to be a single service and a single price because there's -- that's really not going to be efficient or workable with all of the tensions on the grid. So there needs to be an unbundling of the distribution services, much as we unbundled wholesale service and wholesale transmission service in particular, and the New York REV Docket has really begun that essential work.

So as I watch these proceedings, I'm struck by a couple of other things. First of all, there are sort of two different versions of the smart integrator model emerging, and here's how I think about them. The first model, and remember to me a model is a business model for the utility and a regulatory model and an ability to finance those -- that synergistic combination altogether in one kind of workable hull. So the first version of this is what I just call for lack of a better term, a performance based rate or a PBR contract model, where the regulator goes to the distribution utility and says, here's a whole bunch of services that I want you to perform, let's set some targets and some goals and make clear that that's your mission to do that, and if you do that well, you'll earn your rate of return and your revenues will be adequate and we're going to monitor each of those targets, those performance requirements or targets, and if you do better, we'll give you a

little bit more earnings, and if you do worse, we'll penalize you a little bit but that's what performance based regulation is all about. So it's a big PBR contract embracing all of these services. That's the RIIO model, which many of you may have heard is also being used now in the United Kingdom for all of their distribution utilities although it's directed less at the utility of the future and more at rebuilding their aging infrastructure. But it's the same idea.

To be honest, I had a different version of the smart integrator in mind, just a different variant on this kind of regulatory business model, financibility complex. Mine was based really, what I call it, a pricing model, a pricing based model and it's a little bit more like what we do here in the U.S. on the wholesale level and that is that distribution utilities would look at the services they're providing, unbundle them and figure out how much it costs them to provide those services and price them that way. And then the market would use as much of those services or as little of those services as they wanted. It's a tremendously complex undertaking. Frank and I have had hours of discussion about how to do this because you want to preserve the ability to make sure that the distribution utility is earning enough money but not too much money, so you need to figure out how much it's earning off all these services and many of these services are brand new or just starting to unbundle them and figure out how to even cost them out before you can even price them out. So it's a very complex model. It's the kind that probably only an economist would grow to love, but you know, it does seem to follow in the tradition of how we have unbundled our industry here. There's a little bit less of that going on than the PBR model, but we'll see what happens. We've made a lot of progress but we're really really early stages.

There is also a third variant of this that I also didn't envision. And it goes by the name of the independent DSO model. DSO stands for a distribution system

operator. It's the precise analog of the independent system operator or RTO at the wholesale level. In other words, it is an independent, not-for-profit entity that operates the distribution wires but doesn't own them. That's what we have in some of the United States, well, about half depending on how you count it. We have them at the wholesale level and a couple of folks have raised the idea of doing this at the distribution level, one of whom I respect very much, John Wellinghoff, the immediate past chairman of the FERC, raised this idea. I am worried about the complexity of doing that, but I think it's an idea that's surfaced. It needs to be thought about and examined and it is a different approach to this or a different variant all within the notion of Smart Integrator.

Now on the Energy Service Utility side, there is less of this high profile, high visibility activity as we see in New York and California and Hawaii but there is activity and more than I expected. There is particular interest in this as you might understand in the utilities that still serve traditionally and particularly interestingly among the electric cooperatives who don't generally have retail choice models and municipally owned utilities. Where they see utility transformation happening, but they don't have retail choice and they want to serve their customers and in general, they're not-for-profit entities so they have a little less pressure on bringing shareholder returns and you might say they don't face any disincentives with respect to lower or much fewer disincentives with respect to lowering sales. If their sales go down, as long as they're not stuck with stranded costs, if I could just use that term, they don't mind. They don't have to go to their city council just to take an example and say, "I'm doing a better job for you, City Council, because electricity sales went up in our town." If they have happy customers with low bills and warm homes and cold beers, as Amory Lovins would say, they're doing their job. So there's a lot of experimentation starting and a lot of it's not that visible.

I'll just give you two quick examples of that, just across my radar screen

and Heidi's. When I went out to talk to the Minnesota Electric Rural Cooperative Association in Red Bluff, Minnesota one year, two years ago, they told me that they were trying all sorts of new services with their customers and the customers liked them. They were offering their customers shares of a solar garden. You could own a piece of a solar garden and you got all of the power from your share of the PV installation. They were selling energy monitoring services. And there are four co-ops in Kentucky that have something called How Smart Kentucky, which is basically on bill financing of energy efficiency improvements in your home and this is really full service by the co-op. The co-op will come out to your home, help you figure out what's cost effective for you to put into your home. It will -- it has an approved list of contractors. It will help supervise the contractors, finance it and puts the financing on your bill and it will only finance improvements that lower your total bill. The average bill for customers who are doing this is eleven bucks a month lower than had they not done this. And interestingly, if you look at the web site, there's a quote on it that really struck me, and let me just read it to you. They say this service, quote, "is not a loan or subsidy, but an extension of utility services that households are already receiving." They're saying this is part of what we do for you. This is part of our service offering. So that to me is really a movement in the energy services direction.

Let me just touch on one more thing and then close, because I know I'm going on too long and I'm sorry about that Charlie.

MR. EBINGER: No problem.

MR. FOX-PENNER: There's another topic that has really received much more attention since I wrote the book and that I regret not talking about more in it and the name that I have seen and that I like for it is the Grid Edge. And that is this explosion of new technologies and applications for saving electricity using computing power, demand

response to distributed energy resources -- all kinds of new technologies that really couple up with the Smart Grid broadly speaking at the edge of the Smart Grid to give customers better service or to help utilities manage the grid better. And the proliferation of innovation here is fantastic to see. Some of my favorite companies are one that's using technology from nuclear submarines that's the way they communicate back to the base to sense what's going on on transmission lines, over hundreds of miles. There's another company that's basically crunching big data from all the smart meters to try and figure out all of the algorithmic ways to turn homes into virtual peaking plants. There's a lot going in thermal storage. It's really -- it's great to see.

But what I didn't say in the book and what I now appreciate is that these two different business models, Smart Integrator and the Energy Service Utilities, they're about the utility and what it needs to do to provide services to the Grid Edge, and to survive and thrive and make adequate investment and give good service. But the implications of these two models for the Grid Edge in their business models are really interesting and profound and important. In the Smart Integrator, the interaction with all these Grid Edge companies is pretty much arm's length and price mediated. And you really don't have a stake in who wins and who loses and who succeeds and you just let -- you're almost neutral, you stay out of the way and you let that Grid Edge battle it out with customers one at a time, one customer at a time.

The Energy Service Utility, you have a very different relationship with all the same companies. You have what is often referred to by variously as a trusted partner, single buyer or gatekeeper model, where in order for you to work with, if you're a Grid Edge company, you need to partner up with that Energy Service Utility because it's going to want to deliver all of your services and products to its customer but it's really the conduit. That's the services it's providing. And the issues there are of course, access

fairness, efficiency and agility.

There is a really interesting analog to this that's happening now in the commodity retail electric space, where those of you who follow this, there are a lot of parts of the country where individual electric retailers compete to sell one household at a time to sell retail electric service and I know I get mailers, well actually, I live in Virginia, I don't get them but my mother who lives in Illinois gets mailers and she saves them all for me, and frequent flyer miles to sign up with this electric retailer and so on and so forth. That's a Smart Integrator sort of relationship. There is a growth of something called customer choice aggregation -- community choice aggregation, CCA, and that's where a community like the City of Chicago aggregates all of its customers and bids them out amongst these same competitive retailers. But it sort of goes to them and says, I'm using my buying power by bundling all of my guys and I'm, you know, whoever of you gives me the best deal, I'll pass that on to my 600,000 Chicago customers. You wouldn't see that model be popular if there wasn't something to the idea of bundling, aggregating services and creating an intermediary who deals with the Grid Edge services and provides some value. So I think it is early days but we are starting to see some interesting changes in evolution in the Grid Edge.

Another phenomenon we're starting to see is an interesting, what I would say, convergence into, I call them, energy service conglomerates. Five years ago, every electric retailer in the deregulated retail choice states only sold electricity and they really eschewed getting involved in any other kinds of business. And now you see deal after deal after deal where electric retailers, solar rooftop providers, demand response curtailment services providers and all those sorts of folks are buying each other. Just to cite a couple of examples, Direct Energy, largest electric retailer I think in the U.S., or one of them, just bought Astrum Solar, the tenth largest rooftop installer. Exelon, generally

thought of as a generation company, is providing curtailment services and marketing bloom energy field cells. So there's very interesting changes there.

So just to wrap up, we obviously live in a fascinating and important time of change. I continue to believe that the sort of Smart Integrator direction is likely to be sort of somewhat dominant but I also think both models, as far as I can see, are going to survive for a while. I also want to emphasize something I said a lot five years ago when the book came out, which is, we're going to want to and need the power grid for many decades to come, maybe it's 30 years from now, at the 35th anniversary of Smart Power that we commemorate the dismantlement of the Grid but I don't think it's any sooner than that. I'd like to be the first to invite you to that event. But until then we need to preserve the best of the industry that we have while we enable the industry of the future, and that means balancing a paramount need for decarbonizing quickly, balancing the need for affordable low cost electricity and low cost energy services, let me correct that, allowing this tremendous innovation in new customer services to emerge and of course, universal and affordable access is one of our proudest achievements I think here in the U.S. So I look forward to seeking this balance with all of you and thank you very very much.

MR. EBINGER: Well Peter that was certainly provocative enough that I'm sure when we get to the question and answer period you will be besieged and I have a number myself. But we'll go to Adele next.

MS. MORRIS: Well thank you Charlie and thank you Peter for your deep thought on this topic and you've really done a great job walking us through these myriad drivers of transformation in the utility sector and you know, you've covered a lot of ground. We talked about technology and the incredible commercial innovation that the technology enables. You talked about demand trends and how those didn't necessarily turn out like we would have expected. I think the IA has revised this forecast many many

times and I think that's going to continue. You talked about prices and we can't not mention the change in the relative prices of different fuels. You mentioned the cost and broader economics of renewables and then all the policies that are underway to affect all these transformations.

So I just want to pick up on a couple of your themes and talk about something you didn't talk about, to kind of complement the discussion. You talked about prices, and I think we're all really cognizant of the important role of prices and incentivizing all that commercial innovation you were talking about and getting, and you were talking about, and you go into some detail in the book about how the new technology, the Smart Metering allows dynamic pricing and that could really change the economics of dispatch and all sorts of other things. And so I'm going to pick up on the theme of prices and you note that depending on the demand levels and the dispatch, you can -- the cost of producing and delivering the kilowatt hour can vary by a factor of ten around that. So that's important in the economics.

And then you talked about the exigency of reducing carbon emissions and going so far as decarbonizing. So this -- prices and carbon, hm, what might I talk about? And obviously I'm going in the direction of pricing carbon, right? So if you want to price in the true costs of producing and delivering electricity and energy services more broadly, obviously you want to think about incorporating the environmental, the external environmental costs associated with the generation of that electricity. And so before I talk about carbon pricing and all the ways we might do it and how it poses challenges and opportunities for the electricity sector, let's just very quickly review what's going on.

We have a proposed rule by the EPA that could have very significant consequences for electricity generators in some states, maybe not in others. But there are several important features in these new proposed rules and one of them is that it's a

state by state approach. So every state has its own rate of emissions of tons of CO2 per kilowatt hour generated that has to be reached by a certain date, and the target for each state is based on EPA's calculation of what's feasible according to four categories of action, including improving heat rate at coal generating power plants, increasing the utilization of natural gas fired power plants, increasing the amount of renewable generation and then of course, energy efficiency and other activities on the demand side. So EPA's put that proposed rule out and the administration is very determined to finalize that rule and of course there's going to be state implementation plans of that rule.

So we're looking at a multi-year process that is going to be potentially an important driver of transformation in the utility sector and then, so the question arises, how is that going to play out? And how do you reconcile that state by state rate based approach and then states are allowed under that proposed rule to convert their rate into a mass-based standard, although we're not entirely sure exactly how that's going to work. But so how do we reconcile the state by state rate-based standard with some flexibilities into something that an economist might admire is providing efficient prices and economic incentives to do all the technological evolution that we'd like to see in the sector.

So there are a couple ways to do it. One, we've already seen in the regional greenhouse gas initiative and California's AB 32 to have a kind of cap and trade approach. Within RGGI you obviously have multi-state approach where you've got a cap associated with each state but then they can allow trading and emissions across state lines. I think that has potential to be expanded under the EPA rules and EPA has acknowledged the potential of these regional or multi-state arrangements.

I think there are a few challenges though that we should recognize. One is that it's one thing to have this cap and trade program at three dollars a ton. It's another thing if you're really trying to use that to ratchet emissions down and you're talking about

ten dollars a ton or potentially even more depending on the stringency of the rates. And why does that matter? Well, one reason it matters is that at that higher price level per ton of CO<sub>2</sub>, you're really amplifying up the amount of revenue that comes from the auction of these allowances. And then economically, it becomes a lot more important what you do with that revenue. So typically RGGI related auction revenues have been earmarked for spending that has some kind of energy efficiency quality or some other clean air or environmental purpose. I think that state fiscal authorities would rightfully take more of a serious look at the kind of revenues we might expect under a really beefed up cap and trade program that's trading at higher prices and maybe try to find other economically efficient ways to use that revenue such as reducing other state level taxes or funding other priorities. States have all sorts of fiscal exigencies that they could address.

Another thing that happens when you start really beefing up this multi-state program is, you run the potential for significant trading and emissions allowances depending on the relative costs of abatement across states and then you're looking at transfers -- transfers of income and revenue from one state to another, which may or may not be a big thing but I think people are going to notice, hey, what are the dollars of my state doing going to this other state, so that they can reduce emission? I think there will be a little more political sensitivity as the states grow.

The other challenge I think using something like RGGI rules is that the EPA power plant rule is presumably, without new authority, the first in a series. They're starting with power plants but there are other important stationary source categories in greenhouse gas emissions, right? So in each of those source categories has to meet its own rate standard when the time comes, independent. So these are not fungible emission sources, at least as I understand the Clean Air Act. So if you've got an elaborate structure to comply with the power plant rules, you're going to have to reinvent

something else to do with oil refineries or chemical plants or cement plants or whatever else what might be regulated under the Clean Air Act under future rules. So states might want to think ahead when they chose the regulatory approach for power plants, what it means for those other source categories.

Now another approach was proposed by Great River Energy and the Brattle Group which posited a rule for the integrated system operators, where they would attach a carbon fee into the dispatch in order to prioritize the lower carbon approaches. And so that makes some sense because again, you're giving that efficient price signal, at least at the dispatch level, but again there's a few challenges that are worth noting. One is that at least as they describe this proposal, it's not clear that the approach they envisioned would result in retail electricity prices that fully internalized the cost of carbon. Now that might be a good thing if you're just really worried about retail prices. But if what you want is an efficient outcome and efficient incentives, including on the demand side, you want to pay attention to whether the retail price has fully internalized the external cost.

Another challenge with the ISO approach is that the state is the unit of compliance with the EPA rule. Well with any given state, it might be -- it might have one ISO that covers the whole state, but there are a number of states that only part of the state is covered by the ISO or parts -- two different parts of the state are covered by two different ISO's and then there's part of the state that's not covered by any ISO. So technically speaking, if you're doing this ISO approach, you might need three different compliance plans that incorporate whatever the policies of the individual ISO's are, plus have another plan for everything that's not in the ISO. So it adds some complexity and it also has the same challenge of potential interstate transfers.

So why would I list all these problems if I didn't have a better idea? So I

think the idea that I really want to throw out there is the idea for state-level carbon excise taxes, as a primary means of compliance. And so it would work very much like we've discussed. The Federal level excise tax, very simple, imposed on the fossil-based fuels going into the regulated plants. And you can price this according to what the models predict would be necessary to achieve the gradual trajectory down that EPA envisions in the rule. Now why would you do this? You'd do this because number one, there's no interstate transfers. The revenue stays in your state. It creates, assuming the pass through of the carbon price; it creates efficient retail energy prices.

Number two, it's the perfect vehicle for expansion later when additional source categories come on, because if you're already taxing coal for power plant, it's very simple to expand that to a tax on coal for -- your still coking or yeah, yeah -- primary metal production, right? You might have to have a slightly different rate but all your state regulatory infrastructure is all set up. No problem.

Third, you can use that revenue to do at least two important things. One is, to offset any distributional concerns you have about the policy. Remember, if you just regulate and you don't raise revenue, you don't have any direct way to mitigate impacts on poor households, and I would advocate doing that in a way that doesn't blunt the incentive to conserve but preserves that social safety net that we all feel is very important for low income households. There's a lot of ways to do that. And two, states can use that revenue in lieu of raising other taxes that they might have to do, given their fiscal problems, or reduce distortionary taxes. We know there are some very distortionary revenue instruments at the state level. And you could imagine at the state level, a pro-growth tax reform that allows you to comply with the EPA rule. And so I really like to throw that idea out there. Now the states who are already involved in RGGI, this might make me attractive to them but if they're looking for a long term compliance strategy with

other stationary source categories, or maybe you're in New Jersey and RGGI's not part of your life anymore, you're looking for an alternative, I think there's a really efficient market-based way to go.

MR. EBINGER: Thank you very much. Rudy?

MR. STEGEMOELLER: Well okay, it's hard to be third in this group, so -- a lot to follow there. I have talked about REV to a lot of groups and usually I talk about what we're doing and why, but Peter really covered a whole lot of that. Just to sum it up, we want distributed resources to be a primary tool in the planning and operation of the grid. We want a Smart Integrator to be the vehicle to do that through markets and we see that as being the utility and we need to fix the way we set utility rates to align their financial incentives with our policy goals.

I would point out there's not a one-to-one correlation between our staff proposal and the vision in Peter's book. We don't have to go into all that right now, but if there was one major conversation piece, I would say it would be around the role of dynamic pricing and advanced metering. We could maybe talk about that later.

As far as the carbon rule, it's going to have a gigantic impact on what we do. Again, if carbon were somehow dealt with via the carbon rule, we wouldn't have to deal with it by figuring out how to integrate externalities into the pricing in these markets and as we all know, trying to integrate externalities into markets is a very difficult thing to do, so we are committed to that policy but boy, it wouldn't be bad if it got taken out of our hands.

Otherwise, the metrics, whatever the 111D compliance winds up being, the metrics the EPA accepts for that will probably have a big impact on what we can do, because again, what is the products and services that are valued in our markets if they're also going to be delivering carbon reduction, are going to have to conform with metrics

that EPA will accept. So it's among the hundred other issues that we're pondering, that's one of them.

So again the what and the why we really talked about so I'm just going to talk very briefly about how we're doing it. And I don't know how many of you are regulatory geeks like I am and if you're not, I apologize, I'll try to be quick. If you are, then you probably have a sense of how really difficult it will be to get from where we are to where we're trying to get. Peter's book described it as a herculean effort for regulators and I'm hoping that turns out to be an overstatement. He also says that our budgets need to be increased substantially and I appreciate that very much. I just hope that the rest of the book is more realistic than that.

Like any other impossible or difficult job, basically you have to break it into manageable pieces and take it one step at a time and that's what we're trying to do. We spent about a year before issuing our staff proposal which came out last month. We have a formal proceeding going on there, 200 and -- last count, over 260 parties which, for a state proceeding is a lot and it really strains our ability to manage a case efficiently. We tend to establish -- we tend to make policy through collaborative effort and it's hard to do a collaborative with that many parties, but we're staying on that track and really for a reason that's becoming more and more apparent to me, that we -- by we I mean the department staff and the commission, we are not going to build this Smart Grid. We are not going to design the architecture. We're not going to conjure it up out of thin air by regulatory fiat. It really has to be built by the market participants, the distributed resource providers, the utilities. What we need to do, we need to allow it to happen at the most basic level, we need to enable it to happen. So we're distinguishing between the commission's role which is really to make some basic policy decisions, identify the outcomes and supervise the markets as opposed to the market's role. By market I

include the utilities of actually designing the system architecture and designing the market rules and engaging the customers, which is crucial, and if they're not able to do that, then we're not ready. We just can't do this by edict. If the industry isn't ready to do it, it's not going to happen well. So far, I think they are. Again, we have 260 parties of I don't know how many -- easily over a 100 of them are companies that are engaged in these markets or want to be engaged in these markets. Utilities have been very supportive. As far as the policy issues that the commission is going to have to decide, probably the most contentious ones right now involve the utility's role. Not so much the utility's role as the Smart Integrator, because there's been some noise about that but really more whether the extent to which the utilities can actually play an active role in the markets, by providing services. The second one is access to data, access to customer data -- you have a lot of privacy concerns, access to system data -- you have security concerns. A third set of issues involves the extent to which we will be involved in regulating the participants in these markets. We have utilities that are obviously heavily regulated. We have ESCO's, competitive commodity providers who are lightly regulated and right now we have distributed resource providers like, I know, some of them might put solar on your roof and they are entirely unregulated. If we are creating markets, we are creating essentially a disaggregated power grid that will be relying actively on the real time participation of these providers, then we have a reliability concern there that isn't there right now, and we also may be incumbent on us to engage in more consumer protection with those sorts of industry participants, so this is not, it's not an easy issue to deal with, so you know, we'll be getting a lot of comment about that.

And then finally, the whole issue of benefit costs, which just kind of floats over this whole proceeding and I guess my mantra here is that it's not an issue; it's a whole family of issues. And it's really -- the question really is, how will decisions be

made, by what criteria will decisions be made at various points in this process and in these markets, so the benefit cost analysis that the public service commission might need to have in front of it in order to make a big policy decision about the future of the industry is very different from the benefit cost analysis that might accompany a proposal to build a certain piece of infrastructure, which is in turn, different from the benefit cost analysis that would go into pricing products in the market.

So back to the how -- we're just -- there are so many issues and they're so interrelated that it is a little bewildering. We're just trying to phase them as carefully as we can. And we have some near term priorities. One is to expand the asset base in the state of distributed DG or storage. Another is to get demand response tariffs implemented for all our utilities. Con Edison has its own now. The ISO has demand response tariffs but they're really only accessible to very large customers so we want utility level demand response tariffs and eventually, those might be superseded by a different sort of market vehicle but in the near term, they will build the asset base, the asset base taken broadly as a demand response industry.

And then third, we want to identify distribution projects that can be potentially displaced or deferred by non-wired alternatives. There is some of that going on downstate and we'd like to expand that. So again, that's a near term -- that's not a final market sort of solution in the Smart Grid vision, but it's a way of getting projects in the ground and developing the industry.

For the longer term, and all this has to happen simultaneously which is hard. We are starting an effort to develop the technology platform for the Smart Integrator, your term -- Distributed System Platform, our term, very similar. That needs to be standardized, although we envision each utility being its own sort of the maker of its market in its territory. The market rules and the technology protocols really need to be

standardized so those discussions are going to start soon, and again, we'll be there, staff will be there, but it's got to be the industry building this.

Now at the same time we're doing all this, we have our rate making track and I could go on for hours about it but it goes deeply into regulatory geek-dom there, so I won't. But essentially we need to reform the way we -- you know, people like to dump on utilities. They say, why haven't you done this, why haven't you monitored ISIS. We as regulators really have not given them the financial incentives to do that, in fact we've created a lot of risk and given them disincentives to doing it. The other part of the rate making is really important and it gets back to Peter's observations about the death -- there's not death spiral but there could be a very painful contraction and that pain would mostly be felt by low, moderate income customers and so, designing the rates so that the allocation of costs and benefits from these new market activities winds up being fair is a high priority for us.

Now at the same time all that is happening, we have actually rate cases coming in, and each utility's going to have its own, now that this has been underway for a while and our chair has made it very clear, she doesn't want to waste a lot of time and so each utility's going to be having REV-like proposals in its rate cases and I wish I could tell you that I've got a real clear plan on how to integrate the rate cases with the REV case but we are doing the best we can. So it's a lot. It's a lot. And it's not all going to happen in the next one to two years. It's going to take a number of years and again, the way I stay sane is by reminding myself that we are not building this. We the commission are not going to build this smart grid. We are going to allow it to be built.

MR. EBINGER: Okay, thank you. In the interest of time, I'm not -- I'm going to raise a few points that I don't necessarily want them to discuss, because we want to get to the floor, but I do think maybe they'll come up in the discussion. The first

question I have is what about the regulatory compact. When utilities have built facilities under certain criteria and perceptions that they would be long-in-life assets getting a fair rate of return, what -- is this really a fair legal structure to go after them, saying the rules of the game have changed one more time? And what do you think -- what is the real cost of the potential for massive stranded assets of existing facilities to all of a sudden hit society? I also, with all due respect to Rudy, some work we've done on the Arctic, looking at the whole debate between prescriptive and performance based regulation. I mean, clearly performance based regulation which I think we're looking at, requires a lot more sophistication and a lot more training by the regulators. You can't, in states where regulators are still elected, you can't just have some yahoo elected who has absolutely no understanding of how the utility industry, needlessly, industry you're talking about, works. And the whole basic factor of a lot greater assets need to go into the regulatory process. I don't know how many of you have seen the IHS CERA recent study on the whole question of reliability but it is a very thoughtful, whether correct or not, it is a very thoughtful argument that they have serious concerns about reliability as we move to the types of markets the panel has been discussing today, and argues that we are linking ourselves up into a less diversified fuel resources for the power sector.

I also want -- we haven't heard much about net metering and who you think, how we resolve that question as traditional utilities, at least in many parts of the country do not receive any financial input by people that they have to be standby power for, has those people usually leave the grid, but in an emergency, how do you get compensation?

Adele, I haven't thought this through but your point on state level carbon excise taxes -- I'm wondering, is this an attack? Will this be politically seen as an attack on the fossil fuel industry and the states that largely produce fossil fuels? And is there

any chance in our current era of now debating that the U.S. is emerging as a major potential oil and gas exporter, how do those taxes necessarily affect our export competitiveness if we're actually going to go that way?

I am worried about when we hear there's not much regulation of rooftop solar. Well what happens if the rooftop solar panels wear out? Are there legal warranties that protect the homeowner or can be assured that there will be people available at a reasonable cost and on a timely basis to fix the rooftop solar system if it's not really under any kind of regulation?

So let me just cut off there and maybe some of those issues will come up. We'll go to the floor now and please if you would identify yourself, actually ask a question, and if possible address it to whatever member of the panel you would like. Floor is open; we've got roving mikes coming around.

SPEAKER: Hi, I'm Eugene from Carnegie Endowment for International Peace. I'm hoping that Peter could expand more on the innovations in storage. You said that renewable energy and storage have developed tremendously and that has been one of the few drivers in developing smart goods. So I'm wondering whether he could talk more about how the storage of energy has -- electricity has been improved, how it will be developed and what implications it has for policy, especially the role of electric vehicles, as mobile batteries, and which that can help to save in the storage of electricity.

MR. FOX-PENNER: Well, there's a lot in there so let me try to talk about a few things and begin by saying, I don't consider myself to be a particular expert in storage. It's obviously an extremely important technology in the future utility eco-system and in particular it is an essential complement to variable renewable sources and helps turn them into the kind of controllable electricity sources that we've used traditionally and we manage the grid with. So it is an absolutely foundational enabling technology. It's

clearly getting cheaper and cheaper and cheaper to the point where there are storage deals now, behind the meter storage deals now happening in Rudy's capitol city and his largest city. So and it very deeply affects the economics of distributed energy resources because as Adele noted and we do a ton of work on this in Brattle Group these days, many of you know our partner Ahmad Faruqui, who has spent his whole career talking about time varying rates and the economic efficiency that they bring. With storage, your distributed energy resource can be controlled to provide power to you and to the grid when it's most valuable so it profoundly changes the economics of variable renewable sources if you can combine cost effectively storage and the renewable sources and you can do that in theory someday at your home with batteries of some form in your garage and you can do it at large wind power facilities in the 100 megawatt level and both of those are starting to occur. You have very large scale, megawatt scale batteries in Texas, attached to wind farms and you have batteries, although they're not really terribly cost effective for you and I at home; that can change the profile of when you put power to the grid. So that's coming on and it will greatly enhance the value of distributed resources and it will make them controllable, change the whole architecture and control of the grid, including addressing what you raise, Charley, which is reliability issues. Because if you have a lot of stored power, you will ride through. Your panels go out and you just rely on your battery until the truck rolls up tomorrow, although solar panels are quite reliable. It's more likely your inverter that goes out or something like that.

MR. STEGEMOELLER: I would just add to that that we view, we want to be as technology neutral as we can be and we're trying to make a move towards outcomes and objectives as opposed to technology, so to the extent it's a technology that works and is cost effective and it meets our objectives, then it will be highly valued. This is a move away from a generation of state-sponsored clean energy programs which are

very technology centric and our hard targets are okay, we want this many megawatts of solar, we want this many megawatts of storage, we're going to allocate this many dollars to accomplishing each one. We're trying to get past that towards a more market based approach, again, driven by policy objectives which will influence the valuation in the markets. So from that standpoint, and storage, again, storage has -- a lot depends on what is generating the power that's being stored. If storage per se -- there is an efficiency penalty in the round trip efficiency of storage, whether -- it's a lot better than it used to be, but if it's storage that enables clean intermittent generation like wind or solar, then that's an environment benefit. If it's storage that enables a dirtier power source to be used more frequently, then it's less attractive. So again, we're not going to look at a technology per se if we can help it. We're going to look at the outcomes it produces.

MR. EBINGER: Over on the wall.

MR. BETON: Thank you. Paul Beton, National Academy of Sciences. My question, I guess aimed primarily for Peter, but really for any of you that would want to jump in, curious to know if you have a thought on the possibility of the mounting pressures that you discussed now, pushing for maybe restarting the restructuring in various markets, if that might get taken up again. And in particular, maybe if not, what are the implications for that and maybe going forward, are we going to see sort of entrenchment really baking in two different kinds of markets for what's possible or not in the face of changing technology and other pressures and sort of like maybe also what implications that might have for firms that try to operate in both types of markets?

MR. FOX-PENNER: Well I do think that as this progresses, retail choice will be looked at in the states that don't have it. I think that because as people see what happens in New York, they'll sort of say well, do I want that in my state or not. And it's beyond looking at, I think people have seen what happens with just pure retail choice and

the states have made their selections and I think they're all comfortable with it. But what's happening in New York is a totally different animal, you know, N dimensional compared to one dimensional commodity electric sales. So I think it will prompt people to look at things, relook at this, but I don't think it will -- it will be a long time before I think -- you can see enough about what's coming up in New York, as Rudy mentioned, it's a multi-year process to really reach any conclusions about whether -- if you're doing an energy service model, whether you're doing worse than New York's doing, for example.

MR. EBINGER: The very back -- standing.

MR. DELUREY: Hi, Dan Delurey with the Association for Demand Response and Smart Grid. Question, actually two questions for Peter, and I got here late, so I apologize if these were already addressed, but the first is, your thoughts on the potential role for Smart Grid in the compliance plans that states will be putting together for the EPA 111D regulations. The second question -- have you had a chance to mention that project that you and I are working on?

MR. FOX-PENNER: Why don't you do the second one? Dan is referring to a conference on Smart Grid and Climate Change that is coming in December, is that right? Thank you. December 2nd, 3rd at the Reagan Center. I think the Smart Grid will enable new kinds of carbon saving technologies. To find out more about that, I think you should come to the Reagan Center on December 2nd and 3rd. We're still busy inventing them and there's going to be a lot of invention in that area. I don't want to overstate the magnitude of it because shifting from a coal-fired power plant to renewable sources is a giant carbon shift, and the Smart Grid is not going to bring carbon shift that big, but it's going to enable some, it's going to enable that change and it's going to bring some on its own.

MR. EBINGER: Purple shirt.

SPEAKER: Directed at Peter but again anybody on the panel can pipe in. You had mentioned you don't think that the grid as we know it is going to dismantle in at least the next 30 years, maybe 50, something like that. Barring some sort of black swan or multiple black swan events, have you given any thought to what might be one of those, and this could go to the other panel members as well.

MR. FOX-PENNER: Since I haven't, why don't you guys.

MR. STEGEMOELLER: I'll pass on that.

MR. FOX-PENNER: You know, Hurricane Sandy was to me, something of a black swan event although I shouldn't be thinking about it because we'll have more of those. Honestly, I don't know, but if you look back at the history of the industry in the Arab oil -- if you look at the history of the industry with the Arab oil embargo and some of the bankruptcies that followed, that and utilities, you see unique circumstances. Those were the black swan events I think of in this industry, one of which happened in Rudy's neck of the woods with the Long Island Lighting Company. Who would have thought that a nuclear plant that started up for 15 minutes, Carl remembers this, would then be taken over by, just long enough to get it radiated, would have then been taken over and dismantled by the state? I would have never thought that.

MR. EBINGER: As an ancillary point on that, we often hear people talk about, that we can't fully utilize our great renewable potential because of the location of most of our wind and solar resources without building long distance transmission and there are other people still talking about replacing the existing grid you know, with DC current. How do you see -- is that a viable argument or is that argument really out the door and what we're really talking about is a massive switch to purely or overwhelmingly distributed generation rather than long distance transmission?

MR. FOX-PENNER: Well I don't know that it's either or, but my point

about, it's a long time before we dismantle the grid is my way of saying that central, relatively large scale resources, not necessarily giant gigawatt scale plants, but plants big enough to require transmission still remain much cheaper today. I was mentioning PV; large PV plants are cheaper than putting it on your rooftop. So de-carbonization and moving entirely to small scale sources are not the same thing and I think we need to do large scale low carbon power in order to meet a climate timetable, so I do not see us going 100 percent distributed for over the period that we continue to have a grid.

MR. STEGEMOELLER: Yeah, I would agree and we've emphasized that, that we are looking to complement the centralized system, not by any means replace it and that one of the great values of what we're trying to do is that any foreseeable very low carbon generating mix would be a combination of central and distributed is going to require a much more responsive demand, whether it's intermittent generation or some sort of ultra-clean base load generation, you know, either way, it needs a responsive demand and that's one of our drivers.

MR. EBINGER: (off mic).

MR. HAIER: Corbin Haier, S&O Energy. I was just hoping you could expand on the why the concept of a death spiral is not something that utilities need to be concerned about as much, so you know, I guess you could say that they're politically powerful and for those reasons, death would be out of the picture, but a lot of the trends that you identified are still there, progressing. So I mean, what can utilities do to avoid a bad health spiral and you know, what can federal policy makers and federal regulators and state policy makers and regulators do to also help them avoid that bad health?

MR. FOX-PENNER: Can I just say that I love the phrase, let's call it an ill health spiral. There are a lot of things that utilities, I think, can do and are doing to try to avoid that and regulators with them. You could say that the whole New York REV

proceeding is to head off an ill health spiral.

MR. STEGEMOELLER: I would say that.

MR. FOX-PENNER: You would say that and I would agree with you.

Now, and we hope they can do that. So this -- the -- really and truly, I wrote the book in order to try and head off ill health spirals and certainly death spirals and everything utilities can do to choose one of these new business models incrementally and work with their regulators and all the other stakeholders to pick one of them and change their revenue model around to something that's more sustainable with flat sales, flat commodity sales, will help them avoid that.

MR. EBINGER: Do you think these new technologies are going to further drive down wholesale electricity prices?

MR. FOX-PENNER: I think they are already.

MR. EBINGER: Because I think, you know, we've seen the closure of Vermont Yankee nuclear plant, I don't know, just in the last several days, because there have been horror stories about what the closure of that plant's going to mean for utility rates in Vermont and Western Massachusetts, you know, some increases being predicted upwards of 50 percent for consumers, but that's --

MR. FOX-PENNER: Well in wholesale spot markets, when you have solar and wind resources with zero variable cost, that tends to bring prices in those spot markets down. Now beyond that simple observation, this is a really complicated question that we'll be happy to spend the next six months studying for you, Charley. But there are impacts.

MR. EBINGER: In the back? I guess we have two in the back. We'll do one and then the other.

MR. BEHR: Pete Behr with EnergyWire for Peter. Is this a transition

that can be handled primarily by the states, recognizing the difficulty in getting federal legislation or are there changes in federal law that are really necessary for example, to address transmission or pipeline issues or cyber or natural disaster threats? If the Feds sit this out, does this work in your view?

MR. FOX-PENNER: It's an excellent question Peter, and I must say I don't know. Primarily of course, this is a state centric issue since the distribution utilities are regulated at the state. And so a huge amount can be accomplished without federal changes, as Rudy and Audrey and their colleagues are demonstrated in New York. There is much much work that can and should be done at the state level with relatively little federal changes necessary. He's not waiting for federal changes.

MR. STEGEMOELLER: I would say we're certainly not premising any of our plans on a change in federal law. We are premising it on cooperation with federal jurisdictional entities like the ISO. We're going to have to closely coordinate with the ISO's programs. Another national, whether it's federal or not, is in the area of technology protocols. NIST has a very important role to play as we create the standards for interoperability in these markets.

MR. FOX-PENNER: Right, now having said that Peter, there is one dimension of this that does, I think, have to be dealt with and that is, what I will call for lack of a better term, the jurisdictional boundary between federal and state authority over the power grid. I think Bob Nordhaus, I see him right here. He and I have been talking with others in the industry about the fact that the traditional divide between federal and state authority which was established around the technology of the industry in the 1930's and 1940's and made sense then, simply is just flat out unworkable in the oncoming utility industry and we saw that with the vacation of order 745 at the FERC. The technologies are destroying the boundaries between what we traditionally thought of as the bulk power

market and what is, and the individual household. And so therefore, that issue sooner or later has to be dealt with, Peter, and I think that can only be dealt with at the federal level somehow.

MR. EBINGER: We had another question in the back row?

MR. WAGNER: Hi, I'm Danny Wagner at Advanced Energy Economy and my question is on the utility service model. Have you thought about what happens to innovation and energy services if you allowed the utility to go beyond the meter or perhaps even leverage its franchise beyond the meter? Utilities haven't traditionally been great innovators in that sense because they haven't been incentivized to do so or their equity holders invest in them because they are safe investments but they traditionally don't drive a lot of innovation, where these third party providers are the ones who are driving that innovation. So if you allow the utility to get involved in what they're involved in now, I see, I think it could hurt innovation. The flip side is: you can get more participation in the market with utility, offering those services. What do you see on this?

MR. FOX-PENNER: I agree there is some trade off there and I think the energy service utility model won't survive if the utilities aren't able to be -- I use the term in my remarks -- agile enough, to pass that innovation through to their customers, if people living in states without Smart Integrator models look at those states with Smart Integrator models and see so much better and faster customer service and innovation in that market, they won't stand for it. They will demand that business and regulatory model, because it's delivering innovation better to the customer. So we will have to run that experiment. I'm not so sure that utilities will quote, unquote, "block" the innovation of the market. I don't think they will have any incentive to do that. I think they're smarter than that. There were old incentives having to do with them trying to get their sales up but I think that era is over. So they may not have the same incentives to behave the way

they were behaving in the past and they may want to bring all that innovation from the market to their customers. But we will see about their incentive to do that and their ability to do that.

MR. EBINGER: I think we're out of time, so I would like you to join me in thanking Peter, Adele and Rudy for a very interesting day.

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