

THE BROOKINGS INSTITUTION

TRANSFORMING THE ELECTRICITY PORTFOLIO:  
LESSONS FROM GERMANY AND JAPAN IN  
DEPLOYING RENEWABLE ENERGY

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

MS. WOOD: Good afternoon. Welcome to the Brookings Energy Security Initiative discussion on renewable energy in German and Japan. This event marks the launch of the Brookings Energy Security Initiative's new policy brief which is outside the door which you got on your way in, Transforming the Electricity Portfolio: Lessons from Germany and Japan in Deploying Renewable Energy. Okay. So that's out there; if you didn't get it, you can pick it up on the way back.

I'm Lisa Wood, Executor Director of the Institute for Electric Innovation and a Nonresident Senior Fellow in the Brookings Energy Security Initiative. Joining me on the panel today are two of the report authors. To my left here, John Banks, a Nonresident Senior Fellow in the Brookings ESI, and Charles Ebinger, the Director of the Brookings Energy Security Initiative. In addition to my far right we have Ron Binz, also a Nonresident Senior Fellow in the Energy Security Initiative and a principal at Public Policy Consulting. And Ron will serve as a discussant on the panel today. Welcome panelists.

So the format for the event today is the following: John Banks and Charlie Ebinger who are two of the authors will provide opening remarks on the policy brief and discuss both Germany and Japan. After that Ron will provide his remarks as well as his own point of view on renewable energy in these two countries. After that I'll pose some questions to the panelists and then we'll open the floor to the audience.

So set the stage I just want to say a couple of things, a few statistics about electricity generation sources and how they've changed since basically the year 2000 in Germany, Japan, and the U.S., just to put some kind of numbers around the discussion today. So between 2000 and 2012 according to IEA, which many of you probably know this, electricity produced by renewable energy sources -- this is non hydro

renewables -- in Germany increased from three percent in 2000 to twenty-one percent in 2012. So this is a huge increase. In Japan electricity produced by renewable energy sources increased from two percent to five percent, two percent in 2000 to five percent in 2012. And in the U.S. renewable energy sources grew from two percent to six percent. And in the U.S. even though again six percent is a small number it's quite a bit bigger than two percent which was the number in 2000. So renewable energy is growing significantly. And as you are in some states such as the State of California, electricity produced by renewable sources is well over 20 percent today. So we're seeing a lot of movement in renewable energy across different countries around the world. And then just one statistic on nuclear power, another clean energy source, Germany's nuclear power declined from 29 percent to 16 percent in 2012 as a result of their policy. Japan's nuclear power declined from 30 percent in 2000 to 2 percent as a result of their policies and related to the accident. And in the U.S. nuclear power has been just about constant, around 20 percent. So that's just some background to kind of get your feet wet on a few of the numbers out there. And there's a lot more detail in the report and a lot more information about what's happened with renewable energy over the past decade. And this growth has been driven by both policies and hugely declining technology prices in renewable energy sources.

So with that I'm going to turn it over to the panelists to give some opening remarks. So, John, let's start with you.

MR. BANKS: Great. Thanks, Lisa, and thanks everybody for coming today. I wanted to just set the stage a little bit for you in terms of the origins of this report. Shortly after Fukushima we in ESI were discussing the potential implications going forward and we really started to zero in on the fact that we saw two very large

industrialized OECD countries, Germany and Japan, pursuing a very similar path in transforming their electricity sector. Both countries are moving away from nuclear power, and in the case of Germany completely phasing it out by 2022. And both countries are also targeting the deployment of much higher shares of renewable generation in their electricity mix. So we thought it would be interesting to look at how the countries are doing this, what issues have lessened and themes and challenges are surfacing, as well as perhaps drawing out some lessons. So we undertook this research effort; we spoke with a wide variety of stakeholders in both countries ranging from utilities to renewable generators, civil society academics, et cetera, to try to answer some of these questions and draw out some of these lessons. So what I want to do in my short remarks here to open is two things. First give you a quick summary of some of the similarities, some of the common themes that surfaced in our discussions, and a few unique themes related to each, and then move into highlighting a few of the major lessons specifically related to Germany and then Charlie will jump in with some comments on Japan.

So really there were four common themes that came up in our discussions. First and foremost both Germany and Japan use the feed-in tariff at a national level to promote the deployment of renewable energy. Stakeholders that we talked to in both countries overwhelmingly believe that this is the most effective and efficient mechanism to drive down technology costs and achieve commercial deployment of renewable energy. There was also considerable agreement that this mechanism was far superior to quotas and regulatory and other financial mechanisms. Second, another common theme that came up was that of transmission and other grid related challenges. In both countries there are a number of issues related to deploying transmission to accommodate greater penetration of renewables as well as challenges at the lower

voltage levels. Third, not surprisingly there was considerable discussion revolving around costs and other related impacts, the impacts on household rates, impacts on electricity market and incumbent utilities, as well as potential impacts of this overall transition on the broader economy and industrial competitiveness. This formed a quite significant discussion in both countries. And then finally was the impact of the transition that both countries are implementing on climate policy and the interrelationship between pursuing this transition and how the countries are going about meeting their climate targets, both nationally as well as their international commitments. Those are some of the common themes that came up.

Two unique themes in Germany relative to Japan there is much more discussion and it's much more of an issue for obvious reasons compared to Japan in interconnection and the relationship between what they're doing and the energy transition in neighboring countries and the relationship with the broader EU direction of forming an internal electricity market. With Japan a unique theme that came up as many of you may be aware Japan has instituted a policy to restructure the electricity sector, to unbundle the vertically integrated utilities and create more competition, this in reaction to Fukushima and as a way of introducing more competition and to facilitate the deployment of more renewables post-Fukushima. That is obviously not a theme in Germany. Germany has had a fully liberalized market for a number of years now. So we took these common and unique themes that form the basis of our analysis. And from those we derived a set of lessons that we thought were interesting. I just want to give you a quick summary of some key points there and relate those to Germany specifically and as I mentioned and Lisa mentioned Charlie will jump in on Japan.

First and foremost I think one clear lesson is that it is really critical to

attempt to form as best as possible a minimum baseline consensus on your overall energy objectives, and from there institute a stable, predictable set of policies to help you achieve them. Germany has remarkable consensus on the overall objectives that they want to achieve in terms of moving away from nuclear power and deploying very high shares of renewable energy in the system. This consensus spans the political spectrum and the civil society spectrum. And the overall approach, particularly deploying large shares of renewables has survived numerous changes in government as well. There is remarkable consensus. Now the feed-in tariff -- let me back up one second. You probably noticed in the run up to the elections last year in Germany that there was significant debate and a lot more press on the increasing costs of the transition. That is true and I think what that reflects if you look at the details of that debate is not a debate over the overall direction and objections, but rather a debate about how to get there. There was considerable debate over how to reform the feed-in tariff and the renewable energy law generally, but the consensus on the overall objectives did not change very much. And even some of the more critical institutions, the major national water and electric utility trade association for example put out many analyses arguing about how to tinker and how to change the policies but not the overall direction. I don't think you'd find a single political party for example would ever go back now to promoting nuclear energy or bringing back nuclear energy. So that's not to say there's not debate on how to achieve it but the overall objectives remain pretty consistent. The feed-in tariff itself also has a very strong role in strengthening and continuing to build that consensus. The German supporters of the Energiewende, the transition in Germany, that we spoke with, they don't see the owners of renewable energy as subsidized consumers, they see them as investors. And this feed-in tariff law has helped continue to build this consensus on

the overall objectives of the transition and in fact has really created a very strong renewable constituency, a very politically active renewable constituency that has continued to feed into supporting the consensus that we just talked about. And there are some more details on the feed-in tariff law and the specific lessons and some mistakes that may have been made that we can get into in some detail.

Interestingly, the German government and some representatives that we spoke to -- and this is generally public knowledge I think -- they see the Energiewende as an experiment and a costly one, and they recognize that. They see that they were paying for a reduction in technology costs, but that they were willing to pay for it and that broadly speaking to date, civil society has been willing to pay for that and that that has been part of this consensus. Again the question that there were very strong debates in the last election season and beyond as costs have gone up, that is true, but the Germans recognize that this is an expensive experiment but a necessary one and they believe that they're showing an example that you can achieve high penetration rates of renewables. Having said that, they also recognize that they don't expect other countries to follow the blueprint exactly. Numerous stakeholders, counterparts told us countries have to tailor their own specific approach to the local situation in their own context. We don't expect other countries to follow exactly what we're doing. And this is lesson number two, that really there is a need to tailor your approach for transforming the portfolio to a local and specific situation, and it's necessary to continue to monitor what's going on and perhaps adjust policies to continue the process.

Third, this came up in discussions in Germany but also there's plenty of literature on this, that as you approach much higher penetration levels of renewables, 15, 20, 25 percent and beyond you really hit a new set of challenges that require a whole of

system transformation, right. Instead of thinking of this as interconnecting this renewable, this renewable, and this renewable, you really need to think of it as how to integrate renewables into the system as part of this transformation. And again, NREL and other institutions have written extensively on this, on the need for an adaptation of the approach, a transformative approach. In Germany what we heard as part of this concept, their challenge right now that they've hit 25 percent renewables is how to adapt the market design, how to introduce more flexibility in the market and how to price that flexibility. We had a very senior official, long involved in the Energiewende and the original renewable energy law, tell us this is the major challenge, adapting the market design to continue to accommodate larger shares of variable renewable generation, and point blank told us if we don't do that we'll fail. But recognizing that this transformation is necessary and that it involves introducing more flexibility and pricing that flexibility.

Fourth, as I mentioned the issues related to transmission and other grid related challenges was a very prominent part of our discussions, in particular the need to synchronize the planning and targeting of larger renewable shares with the build out of transmission lines and also handling a whole variety of interconnection issues, and by that I mean neighbor and regional interconnection issues, as well as lower voltage integration issues at the distribution level.

Fifth, managed costs and stranded assets. When you start to see these higher penetration levels as Germany is finding and as I've alluded to a bit here, you have seen challenges of addressing rising costs. In part Germany has been tackling this. They just went through a revision of their renewable energy law; it was called the EEG 2.0 that came in effect August 1st. That was in part an attempt to control costs. But in the last year or two years with rising costs the German government has recognized that



they need to control this and tinker with the policy and find a way to control these costs.

And then lastly it's quite clear that moving to these higher penetration levels of variable renewable generation is going to challenge the existing business model. A lot of talk in the U.S. about the rise in distributive generation challenging the existing business model on distributive generation. Well, it has happened in Germany. You're probably all aware of *The Economist* headline saying the utilities lost a half a trillion dollars in Europe. The big four utilities in Germany are suffering considerably, losing quite a lot of money. In our discussion we heard, you know, just anger and astonishment that -- this from utilities -- anger and astonishment that the government and civil society were seemingly willing to accept the tremendous wealth destruction amongst the utilities. There's a variety of reasons we can get into about why the big four are not involved as extensively in renewables as they are right now that we can discuss. The *New York Times* article in the last week actually alluded to one reaction of -- Peter Terium, the CEO of RWE, admitted we missed the boat on renewables and we may not be able to get on that boat. So for a variety of reasons utilities and other stakeholders need to recognize and get out in front of this renewable wave that's coming if that's the direction a particular country wants to go.

So just one final comment, I think one of the major messages we'd like to convey here is that as you move to these higher levels of variable renewable generation you are going to see a series of issues and challenges, policy related, technical, infrastructure related challenges surface that need to be addressed at the initial stages and in an ongoing fashion if you're going to accommodate these large shares of renewable generation. It is possible there are solutions to addressing these problems. Germany has I think made some tremendous strides in addressing those, but I think the

lesson here is that you can have -- renewables are certainly not the only option for an electricity portfolio, but they certainly can play a vital role in a country's overall energy objectives, and there are solutions to addressing these challenges as you go forward.

MS. WOOD: Thank you, John. Okay, Charlie, let's hear from you. What are some of your takeaways and lessons learned?

MR. EBINGER: Let me begin in the context because I think Japan's approach to nuclear power has been very different than Germany's. You know, in Germany even going back to the late 1960s and early 1970s there was strong opposition to nuclear weapons deployment in Europe, there was strong opposition about the transfer of spent fuel from Germany to France for nuclear reactors, very violent opposition. Then of course we had the terrible tragedy of Chernobyl which further embroiled Germany into the height of the antinuclear debate. So I think this continuity that we've seen as outlined by John is very different than in Japan. Because in Japan if you go back to the first oil shock of '73-'74, Japan was almost 76 percent dependent on fossil fuel imports and the rise in petroleum prices in particular back then devastated the Japanese economy and led to a major effort at fuel supply diversification, looking at importing LNG from places like Indonesia, coal, because the oil situation was simply unsustainable had they not done that. And they had been very successful getting down to about 61 percent fossil fuel import dependence at the time of the great earthquake in fiscal year 2010. But the Japanese have also in addition to fuel diversification have also always been quite concerned about energy security. And the reasons for that is much of the fossil fuels that they import come through vital choke points such as the Straits of Hormuz in the Middle East, the Straits of Malacca, and nowadays through the South China Sea with China increasingly exerting bellicosity and claiming that it owns the entire South China Sea. So

I think you can't dismiss the fuel diversification and the great concern about energy security as you look to how the future of nuclear power has come to evolve in Japan.

With the events following Fukushima Japan has been devastated in their economy, because having switched to LNG at that time they were getting 43 percent of their energy from LNG and that number after the decision to the nuclear power plants occurred of course even more LNG coal than oil have been imported to deal with the loss of power as all 50+ nuclear plants were closed down. Just to give you an idea, in fiscal year 2010 Japan experienced for the first time a massive trade deficit of something in the neighborhood of 19 trillion yen, and think of yen in terms of roughly 108 to the dollar or a 100. So we're talking about very large amounts of money. The costs of fuel and power generation following the closure of the nuclear power plants increased by 3.6 trillion yen, or nearly 30,000 yen per person in Japan. For a country that lives on industrial exports this has been devastating to say the least. As a result of the closure of the nuclear plants, electricity prices for households have gone up roughly 20 percent. And Japan has among, if not the highest, industrial rates for power generation in the OECD, although not is not true in the household sector where Germany has a lot higher utility rates.

But the third triad of Japanese policy in addition to fuel diversification and fuel security is the fact that Japan remains deeply committed to addressing climate change despite the fact that they now are importing large volumes of coal as well to offset the loss of nuclear. And as a result, emissions in Japan have risen quite dramatically since the closure of the nuclear power plants following Fukushima. The response on the policy front after Fukushima has been mixed because initially of course the government in power at the time adopted a policy of closing down all the nuclear power plants. And then when Mr. Abe was elected on a campaign where he said he would like to restart

some of the nuclear reactors Japan has see-sawed back and forth on how many reactors may be able to be brought in and that debate is still very much on the table today, as well as for the utilities themselves that have nuclear plants trying to decide among the deregulation debate which is on top of all this, how many of their reactors will remain competitive in a deregulated market.

Nuclear energy is seen as important by the Japanese industrial sector and by the Japanese government -- as controversial as it may sound -- as important base load low carbon power sources. They believe that nuclear energy, particularly the older plants that they have are energy efficient from a capital standpoint resource and with low and stable operational costs and they particularly emphasize the fact that nuclear power does not have greenhouse gas emissions. In the aftermath of Fukushima Japan has created a major nuclear regulation authority which has imposed standards at least on paper that are probably the most stringent in the world and any reactor wanting to restart has to go through a great deal of hoops to get approval from the new regulation authority. Some people argue the regulation authority doesn't necessarily have the requisite well-trained staff that it really needs to make these determinations but there is a major effort to make a safety culture relevant throughout the Japanese nuclear industry.

Japan has also been very much in the forefront of reducing dependency on nuclear by vigorous development of energy conservation, some of the most highly efficient energy conservation standards in the world. The development, as John highlighted, of renewables and improving the efficiency of existing thermal power plants, most notably their coal fleet generation. The government however I think has a major challenge before it because on the one hand there is an active commitment to deregulation of the power sector and on the other hand there is still an ethos among

METI and other portions of the Japanese government that it should decide what the optimal fuel mix is. When I have been in Japan and said you can't have deregulation with supposedly companies making their own investment decisions and still have a fuels policy dictated by the government. It's kind of acknowledged that that's an interesting concept but it's still the government that at this point in time is going to call the fuel shots I believe.

In September of this year, this month, the new regulatory authority approved the basic design and safety for two existing nuclear power plants to restart and there are others in the pipeline that are likely to do so. But the problem is that again in the absence of being clear on what exactly is going to happen with deregulation, none of the utilities with existing nuclear plants are quite sure whether it's going to be cost effective to bring back, or even to propose that they be allowed to bring some of their plants on. I want to emphasize again that there is a real commitment throughout the Japanese nuclear community to put an emphasis on safety, safety, safety. There is recognition that the culture of being respectful for one's superiors can no longer replace concerns about safety; that if the lowliest worker in the plant sees something that isn't safe they need to call attention to the top management and their calling attention should be paid respect to.

Let me raise a few questions that come along with market liberalization. I don't think the Japanese have adequately addressed what the purpose and goal of the deregulation is. Do they really want to foster competition, perhaps lowering prices through competition? Do they hope that with liberalization there will be more funds for innovation? Do they want the entry of new companies against the historic utility incumbents? I can tell you that there are still a lot of utility incumbents that don't want to

see new market entrance. Do they want diversification of the industry's fiscal and financial structure? Because one of the major cries you hear in Japan is that -- particularly for the large scale transmission investments that need to be made to really have a liberalized market, that none of the utilities have the adequate financial resources to do that and it has to be done by government. And yet the government turns around and says we don't have the money to do it, the utilities have to do it. Does one goal of market liberalization involve the question of less intervention by government? I think if one looks at the continued power of METI, with all due respect to my METI friends in the audience, it's not clear the answer to that question. Do they hope to create electricity choice for consumers, particularly down the road when they move to retail competition? They claim they want to move to retail competition but the very fact that they aren't addressing the core issue of establishing wholesale competition I would suggest, as Mr. Hogan at Harvard has suggested, they have this someone reversed in terms of what should be the most pressing priority. Are they looking for fuel diversification and are they going to continue in a deregulated market to have the same concerns about climate change versus energy security, both of which are concerns of the government, but will they be concerns of a privatized, liberalized sector or will the privatized, liberalized sector be more concerned with profits and things that most commercial companies put into the mix? I think another open question is the transmission system really going to be built out truly allowing open access? I don't think there can be real competition without an open access transmission sector that also has of course non-discriminatory practices so people can use the transmission system and not have it dominated by historic owners of that system.

And there are a host of other questions that in the interest of time I won't

go into. We can get into those in the question and answer period.

MS. WOOD: Thank you, Charlie. Are you finished?

MR. EBINGER: Yeah, that's fine.

MS. WOOD: Okay. I wasn't sure. All right. Thanks. Thanks for those remarks from both John and Charlie as the authors of the report.

Ron, let's hear from you on your perspective on some of the findings.

MR. BINZ: Thanks, Lisa. And thank you to Brookings for inviting me to participate in this panel today. I was not one of the authors of this report. I did give it a read early on and knew from the beginning this was going to be a very important and excellent report. So my congratulations go to Charlie and John and Lisa for their work on this. It's very refreshing to see someone take a sober, honest look at Germany and what they're doing. There's a lot of Germany bashing in this country right now over a supposed understanding of what's happened in Germany. I think this report really will help clear the air.

About a year ago I was before the Senate Energy Natural Resources Committee for my confirmation vote on my appointment to the FERC (Federal Energy Regulatory Commission) and I was accused by one of the Senators of wanting to bring German-style utilities to the U.S. I didn't know what he was talking about but that was okay because he didn't know what he was talking about either. (Laughter)

There's been much talk -- and I'm just going to say a couple of things about prices in Germany because like it or not anytime somebody writes about Germany that question comes up. They are indeed the highest residential prices in Europe, but there's a few things you need to understand. The so-called renewable energy subsidy is at most one fifth of the bill; it's about 20 percent of the bill. In fact it's lower than the

value-added tax is on the German electric bill. So it's in proportion to what the government takes as a tax. It's also the case that the Germans at a residential level use less electricity than Americans do, with the end result that even though the electricity costs more less is used and the German household spends about 2.5 percent of its income on electricity. That's almost exactly the case in the United States. It's higher in the south of the United States because of air conditioning and lower incomes but the German residential customer, although he or she is paying a high price per kilowatt hours, is in fact dedicating no more to a wallet share to electricity.

I have lots of things I can mention here. The first is I think this report adds to a series of reports that make it possible without ridicule to talk about the potential for very large levels of renewable energy and a portfolio in the U.S. A few years ago you didn't mention that in polite company without being laughed at. The NREL report recently which talked about the potential for 80 percent renewables in the U.S. had a cost not higher than other low carbon approaches. So if you buy that we're going to reduce carbon significantly a high penetration renewables case as compared to say carbon capture and storage. A lot of gas, a lot of nuclear renewables in NREL's view comes in kind of in the ballpark. I think we're seeing that with Germany as well. Now you might say yeah, but German prices spiked. Well, the Germans -- without maybe knowing it -- were being altruistic. Their purchase of as much as solar as they did in the short three years basically brought down the world price of solar panels significantly, which brought many Chinese manufacturers into the business. It ended up bankrupting some U.S. firms who didn't have an adequate business plan for prices that low, but Germany basically did us all a favor. The fact that we are all able to install residential -- or more exactly industrial and utility scale solar in this country for \$2.00 a watt thereabouts is due in large



part to what Germany did. So a lot of focus will be on the prices in Germany, the decisions in Japan, but the real importance of this report I think goes to some of those lessons learned and I just want to talk about a couple of those.

The first is the advice that in order to craft a policy -- in order to take a course that actually works, governments need to have a plan, have a strategy to have a vision, to work through all details of it, not just some of them, not just the ones that some lobby is able to get pushed through. You need an integrated system. I'm working in Mexico right now and that's the lesson that we -- the entity I'm working with is taking to the Mexican government as they go through energy reform, and that is to get it right at the front end. That's something we only accidentally do in this country in a few states occasionally. Another lesson I think is that if you go high penetration renewables whether it's distributed or not you're going to have an impact on the market, whatever that market is, and you're going to have an impact on utility business models. Let me just mention a couple of things that's going on in Germany. The large amount of zero marginal cost power that's coming into Germany is depressing the energy markets. That's one of the reasons the utilities are having trouble making money in Germany. They have a single, energy-only market in Germany. They're discussing a capacity market which in part as a response to the fact that they have very low prices in the energy market. Now you can argue whether that's good or bad. Consumers tend to think it's good. The industrial consumers in Germany are benefitted in two ways. They have the low wholesale prices and they also have been exempted from a large fraction of the EEG, the renewables surcharge. So they're actually doing quite well under this whole scheme. Whatever you think of that, it's got to be dealt with. We're seeing some aspects in the U.S. for wind coming into wholesale markets is depressing the price of energy. Depressing is an

interesting word. I mean it's still a market, it's competitive, it's not being fixed by anything, and it's just that we didn't imagine there would be lots of low to zero marginal cost electricity coming into these markets when we designed them. So that's a big lesson out of these reports.

Another one is, and this isn't stated as explicitly as you might, is eliminating nuclear is a big challenge to your climate goals. In case we didn't already know that, there's a helpful U.S. advocacy organization now called Nuclear Matters, and they're going around explaining why the existing nuclear plants in the U.S., which are having trouble making money in organized markets, are important not for the owners of the nuclear plants of course, this is much more patriotic than that, it is because (inaudible) be so much more difficult to meet. Did I just lose power here? I must have said something that Pepco didn't like. (Laughter) But all seriousness aside, we do need to take care about that issue and deal with it.

I have a couple of more points to make. One other lesson that's kind of buried in this or implicit in it is how good a policy tool is the feed-in tariff? As long as you're on the job lowering the price paid through a FIT it works. If you go to sleep at the switch and for three years you pay way too much for solar you end up with a situation like Germany now faces. The question from the front row from a woman who didn't even raise her hand (laughter) is -- but I explained that. I can explain that from having been a regulator in Colorado. We have an RPS in Colorado; we have a quota if you will of how much renewable power the utilities shall build. And they buy that from small customers through a FIT, they have a posted price. But that price goes down regularly and quickly and is not too rich. So we ended up meeting our solar and wind goals in Colorado basically with a very thin margin offered to developers. Enough to bring them in but not

so much that made them rich. And my quick -- and John I'd be real interested -- you seem to be nodding with many of the things I'm saying -- I think the FIT in Spain as well as in Germany was simply too rich for a period of time. The bottom fell out of costs and it was not necessary to pay as much as they did.

MR. WOOD: And, Ron, I think -- and to pay it for 20 years. I mean for quite a long time because once the contract is in place it's in place for a long period of time. So if prices are going down and you have a contract in place where you're way above market prices it may --

MR. BINZ: I have a small quarrel with that. You have to have pretty much a financeable instrument so you've got to give somebody 20 years worth of something. But in any event it just was -- it is too much or was too much. And the best example in my view in the United States was the California Solar Initiative which tracked the price paid for solar, for what are called REX, tracked down over time it's almost near zero now because the cost of solar is roughly equivalent to the cost -- with the Federal Income Tax Credit -- is roughly equal to retail prices, so you don't really even need that.

That's enough out of me. (Laughter) I'm going to mention -- my very last point is I think there are a couple of states to watch in the U.S. If you flip a switch in Denver, Colorado right now one kilowatt hour out of five is renewable; it's 20 percent. Colorado maintains its place as below average nationally in cost for customers, and by our reckoning we spend an additional two percent on renewables in large part because wind is so cheap in the intermountain west. I'm also working in Hawaii. Hawaii is remarkable in many ways. The unofficial goal in Hawaii -- unofficial because it's not in any law or act, is 60 percent renewables by 2030. And they're almost certainly going to make it with the utility being one of the providers of much of that power. It's wreaking

havoc with lots of systems in Hawaii. The commission understands that. They are looking at overhauling not only the regulatory model but also the way that what the utility does how it's compensated. New York also is going through a similar process. It's worth watching I think, although it's not being driven in New York by renewables to the same extent.

Gentlemen, again congratulations. I look forward to the ensuing conversation.

MS. WOOD: Thank you, everyone, for your comments. I'm going to throw out the first question here. And I'm just going to sort of go back to the objectives. I mean all of you I think mentioned the need to be clear on objectives, so we've heard about Germany and Japan in terms of their objectives. Is it really possible given what we know about the policies in the U.S. to build consensus around a similar kind of objective in the U.S.? I just want to hear thoughts on that. Is it possible given what we know today to have consensus in the U.S.

MR. BANKS: Well, I would answer that in part. You know, in addition to this particular research effort we have looked at this question of renewables and distributive generation from a couple of different angles over the past few years. So we've talked to a number of different players across the industry. And one of the common refrains we hear is it would be nice if we had some overarching Federal guidance, i.e., some overarching Federal policy telling us, you know, the rules of the game and the direction that policy should go and what our objectives are. And that comes from, you know, with storage companies, DGEs, utilities, right, you know, some sort of -- the policy stability and durability is probably the best kind of business stimulus you could have. Now is it possible to do that, is it possible to have something like a cap

and trade or a carbon tax or some clean energy standard at the Federal level? Obviously as you all well know it's extremely challenging. But yet from a wide variety of counterparts on all sides of the issue agree that that would help. Having said that, one of the other things we hear, and Ron just mentioned it directly, which is a lot the action is going on at the state level as you all know. Lots of innovation, lots of price declines are happening in these environments at the state level. And many of those same counterparts who wish for an overarching set of policies as a guideline also say well the states are really the kind of laboratories where we can get a lot done. Though maybe there is some sweet spot there where you can achieve some sort of overarching policy in addition to state level initiatives.

MR. EBINGER: I'm concerned and I stand ready to be assailed by my fellow panelists and the audience, but I am concerned that we have given up too much on the whole reliability issue. I think the fuel diversification policy that has guided the industry for a long time is a sound one. And I think the way that wholesale markets are being priced right now, driving them down to very low prices, makes it almost impossible for anyone that is looking at a longer term major capital investment. And I think that poses a real danger. I also think that we run the risk -- again because the way the markets are evolving at relatively low prices in the wholesale market -- I think we run the risk of creating major stranded assets. And that's particularly -- albeit with all their problems, that's particularly I think going to be true for large scale coal and large scale nuclear power plants. In the case of nuclear I think it's particularly misguided to take a major source -- at least our existing plants that, as Ron was saying, do make a major contribution to reducing greenhouse gases and just kind of sit here and watch two go, three go, four go. But that's the track we're on. I think anybody that really believes that

somehow the nuclear renaissance is miraculously going to reappear is smoking weed or something because it's simply -- with the emphasis on these lower costs the capital costs of these plants simply will be invested in if these are the policies we pursue.

MR. BINZ: Charlie, I would not put reliability second to anything. And again it's really an engineering challenge and not a lot more in the sense -- I mean we have to be willing to pay for it. But I watch engineers in lots of places solve problems which five years earlier they said they could never even solve. Specifically in Colorado, there are hours of the day where wind presents 60 percent of the energy generated on the Xcel system. Now those hours are in early morning with relatively low demand but the point is they have learned how to predict the short term performance of wind and during the day the short term performance of solar sufficient that they're completely within all NERC requirements for liability.

Now to your point about diversity, I agree. In fact I wrote a paper about the value of diversifying your fuel mix. The problem is that diversification up until a few years ago meant two percent natural gas in your system which was otherwise ninety-eight percent coal. That was diversification for some utilities. The new worry seems to be too much emphasis on gas. That's the latest version of this and let's suppose that it's right: there's no better fit for gas than wind. In Colorado it's cheaper to build a gas plant plus a wind farm than it is to build the same gas plant alone. I know that sounds counterintuitive, all that extra capital for a wind farm, but the wind steps in, produces fuel, produces energy at a cheaper cost than gas can so they fit together very well. But to your larger point, yes, I absolutely agree we have to be careful and no hour should a utility put its liability at risk simply because of its choices, but my response would be there are engineering solutions which will take us quite deep into renewables. Not

demonstrated that 80 percent is possible. Hawaii is going to be at 40 percent really soon.

MS. WOOD: I want to make one more comment on this point before we go on. But Charlie made the point about nuclear plants. Again back in the U.S. we don't have a policy one way or the other but we have seen nuclear plants close down because of very low wholesale market prices or where they're not making any money. And that's different than saying we should build wind and gas which is what is happening. Should we be letting, you know, that -- I read the same fuel diversity report. Because we don't have a policy, do we just let the nuclear plants close? Because once they close they're not coming back and they're a huge source of clean energy.

MR. BINZ: It's interesting what they're asking for, they're asking for a price on carbon. (Laughter) No, that's their solution. We're not getting credit for the fact that this is carbon free electricity. Senator Evan Bayh is their spokesperson I'm sure many of you know and that's his solution. 111(d) is going to help them in that respect. It may not be soon enough but the EPA rule will help the nuclear industry I think.

MS. WOOD: So let me to turn question to Charlie n Japan. So you talked a lot about Japan's sort of fuel mix, the heavy reliance on nuclear before the accident. Do you think taking all of nuclear off line was the correct response to Fukushima? What do you think they should have done?

MR. EBIGNER: I do not think it was the correct response but I think it as the only politically viable response given the reaction of the Japanese people. And again with all due respect the apparent inability of the utility to handle the nature of the disaster. But I think a more prudent thing would have been to -- I think a lot of people say that for the most part, and without being right across the board, for the most part people think the reactors on the west coast of the country are much safer from the possible tsunami than

on the east coast. So maybe it would have made sense to say let's bring back the west coast reactors and then do a safety review of the east coast reactors. But I think the amount that this has cost the economy, the amount it has set back years of efforts and courageous efforts to diversify their economy I think have been truly tragic. But I think to be fair just as John was saying about the overwhelming consensus in Germany in favor of the renewable policy, I think there are a lot of people in Japan, and public opinion polls bear this out, who do not agree with the government's decision to restart. And so I think there's still a real political question and I think to some extent the Japanese government is waiting until the April elections -- they have a lot of regional elections in April -- to see what the consensus view is before they finalize some of their fuel supply strategies which I think will come back to haunt them too if they really push forward with deregulation.

Just one final quick point: I think the biggest mistake Japan is making is their timetable for deregulation. I mean it's incredibly ambitious, but when you consider that we only started independent generation under PURPA back in 1978 and we're still seeing an evolution of the industry. To think they can do this all in a few years I think is going to be proven to be too much too fast.

MS. WOOD: I'm going to ask one more question and then I'm going to turn it over to the audience so get your questions ready. John, just going to ask a question about Germany and you mentioned this and actually Ron did too, bringing a lot of renewables on line we've heard rumors about grid reliability and stability issues in Germany. You mentioned the fact that there's sort of a threshold level at which point you really need to be thinking about how your market is designed. And you mentioned Xcel bringing a lot of renewables and learning, you know, how to deal with the wind on the system. So has this big deployment of renewables in Germany threatened grid



reliability?

MR. BANKS: I think there's been -- Ron mentioned a lot of German bashing this side of the Atlantic and that is one issue that you do hear a lot about. And usually if you read closely it's worded as the potential for outages, the potential for blackouts, and other system unreliability challenges. But if you look at the statistics, you talk to the TSOs, it paints a slightly different picture. In fact the Federal Network Regulator, Bundesnetzagentur, just came out last month with a publication of their SAIDI Index, right, this is their System Average Interruption Duration Index. It measures the amount of minutes per customer per year that there's an outage. Germany is about 15 and change, 15 minutes and change, the lowest in Europe. And that number is down from 2006. In the United States it's over several hundred minutes. Now it's difficult to compare; this is apples and orange to some degree because Germany has a considerable amount of their system underground, it's underground cables, and SAIDI is not exactly the most perfect Index. But if you were to believe the claims that the system is becoming unreliable you would likely see that Index going north and it's not, it's falling. That's just one Index. When they released that particular Index last month the head of the Agency, Jochan Homann, said point blank the Energiewende and the large amount of distributed generation capacity that's coming on is not threatening system stability. That to me is a pretty point blank statement from the head of the network regulator.

Now you also hear claims about system interventions. The Germans define this as the amount of interventions, the amount of curtailments of renewables, and the amount of times you have to re-dispatch conventional plants. That number is going up. It went up in the winter for 2011-2012 and it came down a little bit but was still high in 2012-2013. It fluctuates depending partly on the weather. But the number of

interventions has been increasing since the Energiewende took off after Fukushima. But when we talk to the TSOs about that they say yeah, interventions are going up but we can handle it. It hasn't posed a problem for us so far. And in fact what they'll say is the interventions aren't the problem; we need more capacity, we need more transition capacity. We can handle the interventions. So our discussions and some of the indices that you look at seem to tell a slightly different story.

MS. WOOD: Open to the audience. Okay, start right here. And we have mics -- I think we have mics -- do we?

SPEAKER: Yes.

MS. WOOD: Okay. Can you bring it up here? Can you stand up and please before you ask your question just give us your name and affiliation. And mic's on its way.

MR. DELADAD: My name is Yad Deladad, former Director of Operations at the World Bank. Coming to Germany, and John Banks this is for you, through the percentages of power generated from renewables non hydro it's not those percentages which contribute to this remarkable consensus, it's really the consensus is on reducing the environmental footprint, again that's one of the major ones, and safety of course. Now having said that there is a technology question which emerges from this. Whatever Germany did, did not reduce the footprint, in fact increased it. And that seems to be driven much more by political motives than a proper assessment of technological development. So in fact it went to the extent of the energy minister, the equivalent of the energy minister saying that we are facing a deindustrialization of Germany. And I quote the New York Times, an article which came out in 2013, late 2013. And because of this Germany in fact imported coal from the U.S. and from Eastern Europe, low quality coal

some of it which in fact further increased the emissions and took them away from their stated directions. Your comment on this and this a very broad ranging thing, how is this prevented in the end, the balance between really what I'm saying economy and economics and politics on the other side? Thanks.

MS. WOOD: Are people hearing the question in the back? I just want to make sure.

SPEAKER: None of them could.

MS. WOOD: Oh, the mic is not on. Okay.

MR. BANKS: I'll see if I can --

MS. WOOD: A quick summary.

MR. BANKS: -- paraphrase your question. Revolves around the fact that CO2 emissions have actually increased in the last few years in Germany largely revolving around the coal fired generation coming on line, and then a sort of related question to industrial competitiveness and the impact that the transition has had on that. First on the CO2, so, yes, it is true. I think the figure if I remember correctly is that CO2 emissions have increased about a percent a year 2011-2012 and forecast 2013. And that is largely due to coal capacity coming on line. If you look at the reasons why that is - and I think implicit in your question, but correct me if I'm wrong -- but certainly in a lot of criticisms of Germany you'll see that related to well, this coal is coming on line because they've taken nukes off line or at least eight plants off line. And renewables are coming on line but it's not enough to fill that gap. So basically this transition, the Energiewende, is causing more coal to come on line. I don't think that's entirely accurate. And the reason is because if you look at the coal plants that have come on line in the last several years they were in the planning pipeline in 2005 to 2008, far previous to Fukushima

happening. And those decisions to bring those plants, put them in pipeline, build them, were made under very different market investment conditions at that time. And some of the reasons why you see coal now -- those plants coming on line also relate to factors not related to the Energiewende. You mentioned coal exports from the U.S. Yes, the shale boom in the U.S. has allowed exports to come out of the U.S., some of them to Germany. That coal coming on the market has depressed coal prices so it's made coal more competitive relative to gas. So right now coal is setting a marginal price that is pushing gas out in Germany. So that's a global market factor. And then you look at Germany's import of gas from the east and that price has been relatively high. So that's sort of an exogenous market factor that's helped make coal a bit attractive relative to coal in these last few years. I would point out that there are a number of these market factors that have nothing to do with the decision to phase out nuclear. Really those decisions were made pre-Fukushima.

What's happening now though is many of those plants that were on the drawing board -- and I think the figure from one study that we quote in there is that about 25 gigawatts of previously on the drawing board plants have been taken off the drawing board. In fact 22 gigawatts have been completely abandoned and 3 have been postponed, right. So the current market conditions with these really low wholesale prices, environmental concerns, some technical problems with those plants have caused those plants to come completely off the drawing board. And right now there isn't any serious plan to add anymore coal. So I think what the German government will tell you is that this is a blip, these last few years; that it's a transition. You're not going to see more coal added and in fact most studies seem to indicate that as a percentage coal is going to come down by 2025 and 2030. So I think there's some nuances in the reason why you're

seeing that increase in coal the last few years.

In terms of the industrial competitiveness question, you know, there again is a -- I don't know if anybody can just show me who has actually relocated to another country. I mean there's talk -- BASF apparently built a plant somewhere in the United States to take advantage of low gas prices, not necessarily low electricity prices. There's lots of talk. Again like the outage question, outages could happen. You could have the deindustrialization. Okay, that's a fear but has it happened? I don't think it really has. There's no question that costs at the residential level are going up but as Ron suggested merit order effect of renewables coming on line have depressed wholesale prices. Industry to date has been largely exempt from paying the surcharge on the feed-in tariff. Industry uses 20 percent of all the electricity but accounts for about 3 percent of the total surcharge. So many a large aluminum smelter has a competitive advantage over its neighbors because of low wholesale prices. You see anecdotal evidence of the French Industry Association complaining about it's not being competitive anymore because they're competing with low wholesale prices of their fellows in Germany.

I also saw -- and I'll just give you one more example of this -- I also saw a recent assessment that said that there is some convergence in German wholesale prices, day-ahead prices, compared to the U.S. In the first half of 2014 German wholesale prices were about 32 euros a megawatt hours. PJM West in that same period was about 64 or 65 euros per megawatt hour. So there are some markets in the U.S. where our wholesale prices are more expensive than in Germany. I think that you need to look at that threat of deindustrialization and the declining competitiveness of Germany carefully, especially what's going on with regard to the wholesale prices, the day-ahead prices.

MR. BINZ: I just want to add two things. I think it's actually the coal

setting the margin in the market which is creating so much more coal being consumed. It's a fuels issue. We have the exact same opposite going on in the U.S. with the price of gas being so low. When the gas is coming from Russia it's not so much low, so. That's a big problem. And as I recall there's actually been complaints to the EU that Germany is subsidizing its industrial electricity rates by the exemption on the EEG. And finally I'm relatively sure that the industrial electric prices in Germany are in the ballpark of the rest of Europe, they're not outsized.

MR. EBINGER: One thing that has happened and we haven't talked about and I don't want to overdraw it, but, you know, there have been some complaints by Germany's neighbors that with the cheap price of power in Germany being forced into their -- Poland in particular, forcing then Poland to close down some of its own plants that can't compete. Now from the climate change perspective those plants are largely coal so that may not be all bad, but you've had problems of this kind with Poland, with Sweden, and to a lesser extent France.

MR. BANKS: So I would put that in the category of a challenge that arises as you move to a higher penetration of renewables. And in this case what Charlie is talking about lots of excess wind generation in Germany and loop flows into Poland and the Czech Republic. So it just gets pushed into a neighboring grid and then they have problems in their market and their grid because of this. But when we talked to the TSOs, this falls in the category of, "We're handling it. There's a cost to it and it's something we should have addressed. There's a lesson learned, right. This is a grid related challenge we should have addressed in particular with our neighbors." But they are working out cooperative arrangements to institute technology phase shifters to reduce this loop flow effect of excess power flowing into another grid.

MS. WOOD: Okay. I'm going to go here next. Wait, can you tell us who you are?

MS. SCHWARTZ: I'm Elinor Schwartz.

SPEAKER: Wait for your -- wait for your --

MS. WOOD: Sorry.

MS. SCHWARTZ: Elinor Schwartz. I formerly represented the California State Lands Commission. And I remember an MIT report of several years ago anticipating some really severe problems with Germany's oversupply of renewables and so it raised the question of various storage proposals and including putting some of the excess into electric vehicles overnight. And so I'm curious to what extent other than exporting they've gotten into some storage possibilities?

MR. BANKS: You know, that's an interesting question. In our discussions with the German -- so the German government does have policies and pilots to look into EVs and try to promote grid level storage. But when we spoke with the TSOs and others in Germany the bottom line answer was that's still too -- storage is still too expensive. And building transmission lines and expanding transmission capacity is cheaper. And that's what we need to focus on. That's not to say that they're not thinking about storage but I think in the near term, before 2020, they're seeing that as a more expensive option than simply building out the transmission capacity to accommodate the renewables.

MR. BINZ: Citigroup did an interesting report on that very issue focused on Germany. And Citi reasoned that when the amount of renewables doubles in Germany from what it is right now -- so today it's 27 1/2 percent I believe, it was 25 when the report was first written; it's gone up -- if that were doubled to say 45 to 50 percent

they would have an over-generation problem midday which calls for storage. And I can't remember the date of the Citi report; it's less than a year old. I recommend it to you because graphically they show what storage could do in terms of taking the excess solar generation in the middle of the day and spreading it out. It would allow a base load plant to continue to run. If you dip down so low in the middle of the day with net low, net of your renewables, you can't justify running a -- you can't run a base load plant at all. So that's where storage comes in and suddenly the economics of storage you're going to love a lot better than shutting down base load plants.

MS. WOOD: Okay. Let me go back here. This -- right there; yup.

MR. RONEY: Hi. Matt Roney with the Earth Policy Institute. I've got two quick questions, one for Ron. You know, in the U.S. we talked about renewables being a still pretty small percentage with non-hydro renewables. We now have nine states with twelve percent or more. Electricity generation from wind in Iowa and South Dakota are both over a quarter. They may be looking at a third in Iowa over the next year or two with a new MidAmerican Energy project. I wonder if you can comment on what Iowa is doing. Is it one of the state's that's doing it right either on accident or on purpose in terms of planning for these higher penetrations?

And other question quickly is for John on Germany. I saw recently that as part of the Energiewende there's three transmission quarters that should be moving from north to south to transmit that abundant wind energy down to the industrial south. I wonder if you could comment on where those transmission projects are in the planning or in the actual construction.

MR. BANKS: Why don't I go first because the answer is pretty quick.

MS. WOOD: Simple.



MR. BANKS: I can't give you sort of an up-to-date, you know, sort of prospectus on the progress of each of those lines. I can certainly try to find that information for you but I don't have the most recent data. But I can tell you that one of the concerns is that the build out of the transmission lines is not happening at a pace that they want. And it's related to a variety of issues. Obviously it's expensive but they're also running into problems that we run into in U.S.: jurisdictional issues. They've attempted and we described in the report how they're attempting to address issues related to this. I mean they have a similar Federal and state jurisdictional issue. They have been trying to iron that out by not surprisingly trying to give the Feds, the Federal government more oversight on siting. They've also been doing some really interesting things too. They're experimenting or thinking about experimenting with how to generate more community buy-in by allowing some of the line that goes through a particular community to be owned by those in the community and setting a threshold in ownership and investment and return. Of course the TSOs want that to put in their cost base but they are addressing this jurisdictional in particular to try to have the line build out keep pace. But I'm sorry I don't have any more specific information on the status of the lines, but it generally is behind schedule with what they want.

MS. WOOD: That's a typical transmission story.

MR. BANKS: Very typical.

MS. WOOD: So, go ahead, Ron.

MR. BINZ: With respect to Iowa, yeah I think there's lots of interesting lessons out of Iowa. I give almost full credit to MidAmerican Energy, the utility there. The same behavior that attracted Warren Buffett to purchase MidAmerican Energy has led to the kinds of very forward-looking thinking about what they're doing with wind. They've

also had a very interesting regulatory regime in Iowa. I wrote a paper highlighting several of the U.S. regulatory regimes and I thought Iowa was one of the best. I tried to give credit to the Iowa Utilities Board and they disclaimed it and said no, it was utility who came up with it. So I now give full credit to MidAmerican. (Laughter)

MS. WOOD: Okay. Right here; Mitzi.

MS. WERTHEIM: Thank you. I'm Mitzi Wertheim; I'm with the Naval-Post Graduate School. I'm working on trying to get the Navy to get really exercised about energy and we have the Secretary of the Navy who is, but we have a lot of people down below who aren't. What I'm so struck by is the importance of telling the story, telling the story in clear, concise, compelling ways. I mean you're talking about -- you want to get the communities involved. I listened to this and I kept thinking if I didn't know a lot about energy, could I really follow this conversation? And I want to urge you to find a way to break it down into issues. I mean I started to see if I could look some of the things up in your report, couldn't find them. And you're doing a lot of good work and good thinking, but you're talking among yourselves and I think this is a story that the nation has to hear. And the hard part of this is if you want the nation to hear it, it has to be written at an eleven year old level. I mean I have been working on this so I know something and I -- the best books that are written at this level are written for junior high school kids. It's really hard.

MS. WOOD: Charlie, is that in 2015 for you? Okay. Thank you.

MS. WERTHEIM: I have to say I think this is true for all the think tanks here in town.

MS. WOOD: Well, yeah, the general education -- I think all of us would agree that especially with energy education in the U.S. there's a huge need to write

things at the right level.

MS. WERTHEIM: Well, it's also incredibly complicated.

MS. WOOD: It's very, yeah; yeah.

MR. BINZ: Go talk to Admiral Denny McGinn. He's now back in the Pentagon.

MS. WERTHEIM: Well, I've spent a lot of time with Denny McGinn.

MS. WOOD: But the military has been very involved in energy.

MS. WERTHEIM: Oh, they are. There's no question.

MS. WOOD: Very involved.

MS. WERTHEIM: Look, I got the line in Bush's (audio skips). So I follow all of this. But what I'm becoming so aware of is how hard it is to get this (audio skips) get the engineers to write it you have to bring other (audio skips) specialists so they extract the meaning without putting it in the code line.

MS. WOOD: Right.

MR. BINZ: We'll work on a YouTube video of this report. (Laughter)

MS. WOOD: Okay. You're next and then I'll get you.

MR. GHOSH: Hi, my name is Prabir Ghosh. I represent Invest that's focusing on SCI with their sustainable initiatives between U.S. and India. The question I'm going to ask is now with the Prime Minister of India coming to D.C. in about a week's time with the energy contingent -- and related to that is Bloomberg new energy finance, new energy outlook that has just been published is now talking about China and India putting together about roughly 1600 gigawatts in China and about 650 gigawatts in India and almost 50 percent of that is going to renewables -- the question is, is Brookings Institute looking at a U.S.-India, U.S.-China initiatives to increase trade and knowledge

that you guys have between these two countries? And what is happening with the distributed energy area with the utilities?

MR. EBINGER: You may be aware but Brookings has permanent centers both in Beijing and in Delhi that certainly over the years have done a lot of energy related work specifically to the new initiative you're talking about. I'm not sure anything is going on. We have a number of people on staff including myself who have worked in India for 30+ years in the energy sector and I would only say that I remain very skeptical that the new government will be any more successful in enacting reforms than previous ones because as you well know the problems in India are subsidies, are theft, are too much bureaucracy, and unless Mr. Modi -- and god bless him if he can -- but unless Mr. Modi takes these issues head-on I don't think he's going to be able to enact the reforms that he at least thank god is articulating that he wants to do. There's certainly tremendous opportunities for renewables in India and China, but as you well know, you also have very entrenched fossil fuel interests in both countries. And in the case of India I always point out to people you can tell the Indians to stop using coal because of climate change, but coal is the biggest single employer in India. And do you want to throw millions of people out of work who literally in many parts of India are doing it with axes. So I think there is a legion of difficulties here, but certainly Brookings within our two regional centers and our headquarters are certainly interested in the kind of issues you're talking about.

SPEAKER: Charlie, I hate it when you mince your words. (Laughter)

MR. EBINGER: Well, I've spent 30 years trying to help India without a lot of success.

MS. WOOD: So let's move -- okay, so back to Germany, Japan, and

U.S., I was going to -- you're next and then I'll go in the back here.

MR. HOLIDAY: Thank you for the report. It's going to be really valuable. My name is Scot Holiday. I work at an East Meets West Solutions and one of my roles right now is I'm an author for the National Academy of Science report on market adoption of clean energy and renewable energy. And I haven't fully read the report yet, I've just glanced over it and heard the introduction, but I'd be really curious to get the panel's opinion on one question that our committee is wrestling with in developing our report that will be coming out in six months. And thinking about the lessons learned, you know, what's the point of the lessons learned? Who's the audience? I think one of the audiences is the U.S. government but also U.S. utilities, but it could be valuable for, you know any country. But a question we spent about three hours talking about with our committee on our report was if U.S. renewable energy or research and development and deployment were funded up to \$1 billion dollars what would you recommend doing with that \$1 billion dollars? (Laughter)

SPEAKER: This is a Brookings level question.

SPEAKER: You're at the Brookings. (Laughter)

MS. WOOD: Do you want to respond? Let's not draw this out.

MR. HOLIDAY: Clearly to help us prioritize, you know, what do we think of the (audio skips).

MS. WOOD: Well, why don't we think about this maybe in terms of -- I mean what's driving renewable energy in the U.S.? I mean and given what's driving renewable energy in the U.S. today which is primarily state policies, you know, maybe we can think about it in that context. I mean I don't know. I mean we do have a -- there is a storage mandate in California which is definitely driving some investment in storage. I

mean this is a --

MR. BINZ: What do you want to spend the billion on? I mean what's the narrowest state under which you want to spend it on?

MS. WOOD: Well, I'm going to make one remark and that is that we've seen prices come down tremendously in wind and in solar. I mean in part thanks to Germany's early investment in solar. I mean from my perspective I think the big issue and (inaudible) working a little bit on this, but is storage. I mean storage is going to make a huge difference for renewable energy. And grid scale storage would be a major game changer for how we run the electric grid. So that's my two cents. My two cents is storage is what needs investments right now. That's where we don't have commercially viable technology.

MR. BINZ: I have a candidate. I'm not sure if it's funded sufficiently now or not. The DOE Sunshot Program is attempting to bring down balance of systems costs for solar. A little factoid is that installation costs in Germany for solar are about 60 percent of what they are in the U.S. A combination of our sun and their installation efficiencies would be an incredible combination. The price of panels are not it because that's a world market and so are inverters. So the differential between their installation and ours is what are lumped together as BOS or balance of systems. And that's local permitting, it's taxation, it's inspections, it's requirements, it's labor, inefficiencies because every system is designed separately and so forth and so on. I don't have the solutions, but the point is that if I were going to spend some money I would spend it on finding out how to get the BOS cost of U.S. solar down.

MS. WOOD: Okay, let's just -- let's --

MR. BINZ: She's the boss. (Laughter)

MS. WOOD: Hang on because we have only a few minutes so I want to just get one more question in. Is there anybody? Okay. All right. So one question. I said I was going to back here.

SPEAKER: Way back.

MS. WOOD: Okay.

MR. SPRINGER: My name is Ben Springer, I'm with the Energy Future Coalition and I just have two quick questions. Charlie, in your conversation on Japan you mostly focused on the nuclear sector and the restructuring that's going on there. Not that they don't have plenty to worry about but I was wondering if you can talk more about sort of the conventional renewables in wind and solar or tidal power and what the potential is there given their land constraints, space constraints, and the rest?

And then the other point I wanted to make is I think Ron brought up the 111 (d) issue and I just wanted to point out that in Illinois there's a situation playing out with Exelon, a large nuclear operator, essentially requesting or threatening to shut down nuclear plants unless they receive what equates to a bail out of several hundred million dollars, and that will be a legislative process that will likely have huge implications for the state's 111 (d) implementation plan. That's just a comment; something to keep your eye on for those who are interested.

MR. EBINGER: On the conventional renewables it's my understanding that right now METI is looking at four scenarios and they're really focusing tremendously on what the cost would be of each scenario. And this is predominantly for wind and solar. They are looking at a 21 percent penetration, 25, 30, and 35. Again one of the big question marks is a lot of the best renewables are of course in the north in Hokkaido. Very expensive requirements to build a transmission link that would allow all those

renewables to come down to the more heavily populated parts of Japan. And who would pay for that transmission link? But that seems to be the scenario they're talking about, up to 35 percent potentially. I believe that's -- I'm not sure but I think that's a 2030 or 2035 target. Might be sooner than that.

MS. WOOD: We are going -- okay, Bob, last question quick.

SPEAKER: Okay. This is for Ron and -- this is basically for Ron. I take it that you're an advocate of wind power and I can't really agree quite with that. First of all there's the production tax credit which allows wind farms to make money when the price is negative. And so they're basically being paid to impose a cost on society. Secondly, generally these wind farms are located where the load is not, which means that you have to build these very expensive transmission lines to bring the energy to the market. The wind farms ought to be paying the full price of those lines because they're dedicated to those wind farms, but they're not. That's one of the big issues in the Midwest, who's going to pay for these lines. Would you care to comment on that?

MR. BINZ: Well, I can't apologize for regulators who did it the wrong way in other states. (Laughter) I know what we did in Colorado and we coordinated our transmission build out with wind development and that's one of the recommendations we're making in Mexico. It's called the renewable energy zones, REZ; you probably know about this. And it's basically to coordinate wind development with transmission. It seems pretty obvious but it hasn't been done before. Minnesota is doing a good job of that as well. We don't have an organized market in Colorado so we don't have negative prices. What we do have is incredible savings from wind as a fuel source displacing gas and to some extent coal. So it works really well. And again the proof of the pudding is in eating. Xcel Energy will tell you they're now buying wind not because it's mandated by



an RPS but because it's the most economical source they can buy. They're doing that actively.

Last question, the PTC. Sure, the PTC at 2.3 cents a kilowatt hour or whatever is obviously "subsidizing wind", but that's more or less exactly the offset that you would get in their cost structure if you put a price on carbon from the coal plants that this wind plant knocks out. So, question, is it also subsidy to let the coal plants and the gas plants use the atmosphere as a dumping ground? I tend to think it is. We haven't done anything about that. So that's my retort on that.

MS. WOOD: Okay. Thank you. Okay, we are going to wrap this up. I think it's been a really fascinating discussion. There's a lot to think about. Obviously the U.S. is moving at a somewhat different pace than Germany and Japan. In part that's due to the fact that the U.S. renewable energy policy is in large part driven by state policies with a few federal subsidies. I mean that's pretty much what we're looking at. But state policy makers like Ron when he was a regulator are basically driving what's happening in the U.S. I think the report is very timely. We will continue to see major increases in renewable energy all around the world and I think we can all learn from these experiences in Germany and Japan.

One takeaway I have is just this need to revisit your policies. I think this was touched on by the different panelists. To really plan to revisit your policies because things will change and things will happen that you don't anticipate. So it's good to have as part of the plan just to revisit your policies once in a while to make sure you're still headed in the right direction. And that's actually happening in Germany, it's happening in Japan, it's happening in the U.S. It's good to have that as part of the plan.

Another thing is just with high penetration of renewables at some point

system issues do come up on the electric power system and the need to rethink that and potentially rethink business models is also a key takeaway. Last thing is we need to start to -- I think your point -- tell our story in simpler terms so that everybody can understand it. So I put that out to everybody in the room to become an educator of energy policy.

All right. Thank you panelists. Please join me. (Applause)

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