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Keynote Remarks:

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Panelists:

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Panelists:

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P R O C E E D I N G S

MR. EBINGER: Good morning, ladies and gentlemen. We're delighted to have you here today. I'm Charlie Ebinger, the director of the Energy Security Initiative. And we're particularly delighted to have this session because this is the first in what we plan to be a number of meetings, for lack of a better term, looking at game-changing energy technologies, which if we can have some additional technological and economic and financial breakthroughs in terms of lowering costs that we believe could be truly transformative for not only the United States, but for the world community. And as we look towards future meetings, we'll be looking at things like algae and other advanced biofuels. We will be looking at advance battery technology and a whole host of other issues.

It's my great pleasure today to have as our keynote speaker Dr. Stephanie Burns, who is the chairman, president, and chief executive officer of Dow Corning. And we are particularly delighted that she could be with us today.

Dr. Burns has been at Dow Corning for 26 years, and her career has spanned scientific research, issues management, science and technology leadership, and business management. She has been a member of the board of Dow Corning since 2001, and was elected president of the corporation in 2003, and chief executive officer in January 2004. She was elected chairman in January 2006.

Dr. Burns joined Dow Corning in Midland, Michigan, in 1983 as

a researcher where she quickly moved in the product development leading advances in electronic materials. In 1994, she became the company's first director of women's health. She relocated to Brussels in 1997, initially as director of science and technology for Europe and then subsequently as the director for two of Dow Corning's industries, electronics and life sciences.

In December, 2000, she returned to the United States to become executive vice president of the company responsible for the company's global operations.

Dr. Burns holds a Ph.D. in organic chemistry, which alone scares me to death, with an organo-silicon specialty from Iowa State University. Her postdoctoral studies were at the University of Montpelier, Sciences & Technique, in Languedoc, France. It's a great pleasure to introduce Dr. Burns. (Applause)

DR. BURNS: Thank you very much for the long introduction. I was reliving my life there. And thanks very much to the Brookings Institute for making this discussion possible this morning.

It's a real pleasure to be here with all of you and to talk about a resource that I think we have all grown to cherish, this inexhaustible resource about which Thomas Edison mused during the Industrial Age, ancient cultures worshiped, and today the world tries to harness for its environmental and economic benefits and for the security of our nations.

We grapple with this in the U.S. where the solar industry started and where we are decidedly behind other nations in harvesting the sun's

power to help satisfy our enormous appetite for energy. We know that we need to get off of the fossil fuel treadmill, and we understand that it is good for the planet to get carbon emissions under control, and I think most of us in this room would agree it is inevitable that one day we will rely on renewable energy, if for no other reason than our energy security.

Let's turn, then, to the incredible economic opportunities of the growth of our solar industry. This industry is creating and will continue to create advanced manufacturing jobs in every part of the value chain. Research and development for the advancement of solar applications is providing and will continue to deliver innovations for generations to come.

What a perfect time in our history, when we need it the most, for the United States to do everything possible to grow this technology and, just as importantly, the market here in this country. I must stand here today and tell you, however, that we are close to letting it slip away. The U.S. has some pretty remarkable federal programs, and there's been some progressive work done in policy and in certain states. However, we are not effectively addressing and acting on the big picture of this economic play, or maybe not acting with sufficient gravity to keep it from seeking other shores, most likely permanently.

I believe it is a matter of timing. We need to accelerate public awareness and the demand for solar by making it affordable, accessible at the residential, commercial, and utility scale level. Manufacturing will not wait. At a time when we have the market in the U.S., the significant manufacturing

R&D and industry growth might have already been firmly ensconced in other countries. Companies are investing in overseas today, and, despite this administration's enlightened advocacy and our domestic investments, we are not developing the adequate manufacturing capacity in the U.S. fast enough to keep up, and global demand will be met with offshore-manufactured PV system.

If significant expansion of solar manufacturing is going to happen in the United States, I cannot emphasize this enough: It is absolutely urgent that we jumpstart America's solar industry now. If we wait 18 months, most of these manufacturing operations will be offshore. At Dow Corning, we're confident that the U.S. will act, and we are moving aggressively on our own.

Dow Corning and our joint venture Hemlock Semiconductor are among the world's leading supplies of key solar materials cheaply: polycrystalline silicon, the base starting material for the majority of solar cells. To meet the world's demand for silicon-based solar materials, we have announced in the past 5 years $5 billion of capacity expansions for our polycrystalline silicon. We are investing in research and development of advanced materials that promote the efficiency of solar cells, and these materials are made in the United States.

It took us a long time, about two years, in searching over a dozen sites around the world where we were looking to make these investments. We chose the U.S. for good reasons, and I believe we made the

right decisions for us. Since then, however, we've seen quite a few companies take their operations overseas to serve existing markets. And nothing makes me sadder than to see our polysilicon get shipped overseas to make the next raw material or the next stages of this value chain.

Let me tell you about our material, and it plays a very critical part. Fortunately, for our world, silicon -- which is the element right below carbon in the periodic table -- has wonderful, unique properties ideal for capturing the sun's protons and converting them to electricity and improving the performance of silver devices. It is in high demand and it is valuable and it is expensive, and we don't keep very much of it in inventory. When we manufacture this material, it sold immediately in its highly pure form, and it needs several highly complex remanufacturing steps to convert it to an ingot, a wafer, a cell, and a module. Sometimes a few companies do this and sometimes many companies are involved in this value chain.

The point is polycrystalline silicon creates manufacturing jobs wherever it is shipped and as soon as it lands. Right now we're shipping out of Hemlock, Michigan. We've been expanding that site constantly for about 6 years, and our expansion has now reached a 500-acre facility in Clarksville, Tennessee. This facility is under construction today. Eventually, we will be generating enough polycrystalline silicon to power a million or more homes every year.

And I am here today spending a lot of time on Capitol Hill and a lot of time talking to our constituents because I would prefer that these

modules get installed in the United States in U.S. homes and in U.S. utility-scaled solar farms. American labor rather than foreign labor should be manufacturing these devices.

You have all seen the movement in the solar sector during the last six months. Some of this are our customers. Companies that purchase our products are investing billions of dollars on non-U.S. facilities. A significant number of PV component makers -- BP Solar, Evergreen Solar, two recent examples -- are closing some operations in America and moving them to countries offshore. In the past two decades, U.S. manufacturing capacity for solar modules has declined from 45 percent to seven percent today.

Despite our anticipated growth in the U.S. renewable sector, the discoveries that created this vibrant world-changing technology are migrating to other lands for manufacturing, and when manufacturing goes, so goes R&D. Frankly, that's why we're talking about the potential for growing solar in the United States. Today it is real; tomorrow that may not be the case. I'm convinced the United States can regain its global leadership.

Our nation, especially in the days of slow-growth economy, desperately needs the hundreds of thousands of jobs that this industry can create in our country. These are highly skilled jobs, these are highly paid jobs, these are jobs that the kids coming out of school seek, and these are jobs that our states are trying to create and attract. And, if I didn't believe that, I wouldn't be in Washington today or last week or the week before that.

To launch this industry at home, we need Congress and

President Obama to expeditiously adopt broad policies that that encourage the rapid growth of renewable energy that's affordable. It would help to tell everyone in Washington who will listen that manufacturers welcome our government as a strong partner to make the industry and the market grow now. Dow Corning has proposed a four-point plan to address the technical, legislative, regulatory, manufacturing, and workforce related factors that influence America's ability to develop this thriving industry.

And let me tell you about some of the basic policy decisions we believe the U.S. Government should move forward on. First, we encourage enactment of tax incentives, renewable electricity standards, feed-in tariffs, federal smart grid and net-metering protocols to promote the growth of this industry. We need these policies to create new jobs, to create new businesses, enhance our global competitiveness, and improve the environment, and increase our energy security.

I get calls almost on a weekly basis from countries like Malaysia, the Philippines, Singapore, China, trying to attract our investments into these countries. These are countries that put forth up to 40 percent tax credits for these investments and for an extended period of time. Let's make the competition for these advanced manufacturing jobs between the states and not between countries offshore.

Last year the U.S. was fourth in the global PV installation. We were behind Germany, Italy, Japan, and, in fact, Germany installed about eight times more PV than we did in the United States. All of these countries

have strong policies in place. Most of them have strong feed-in tariffs in place which really drives the growth and acceptance of photovoltaics.

And let's not forget that many of the decisions about adopting solar as a new technology to power our homes is made by families and small businesses. They're sitting around the kitchen table, and they're trying to decide about the up-front investment and trading that off against the long-term benefit of a sustained investment. These are difficult decisions. Our policies can make them easier.

Second, Dow Corning supports increased federal funding for research and development, speed up solar technology innovation, and deliver efficiency gaps. We are ready to put our own investment in this as well. While we now a lot about energy efficiency and harnessing the power of the sun, we are far from knowing enough. Government, as it does in so many other sectors of our economy, should ramp up support for research on how to make green energy more affordable. From the moment a photon hits a silicon atom to the time the consumer plugs in their car, we can reduce the costs.

Third, it's time to adopt policies that expedite the training of workers in our country. These workers need to quickly scale up our manufacturing, our sales, and our installation of photovoltaics. American institutions of higher education have taken some very important steps in this regard, and we're proud of the programs that we're sponsoring at regional colleges as Michigan converts from an automotive-centric industry, or state, to diverse industry.

Fourth, federal and state governments must make a significant impact on public acceptance of solar power by leading by example. If designers of new federal facilities, incorporated renewable power options, the change in the landscape would remind our citizens that the big cities and small towns that solar has arrived in our lives. A schedule of retrofitting federal buildings to take advantage of green technologies wherever this is reasonable would add to the marketability of solar technology.

Certain visibility of solar panels on or near federal buildings or on or near out post offices would help create the Main Street market so essential for this industry to grow.

And, finally, Congress at some point -- perhaps sooner rather than later -- will want to consider carbon pricing solutions that will fulfill national and international commitments to confront global warming. Whatever plan to reduce greenhouse gas submissions our representatives pass into law should encourage net producers of clean energy.

I'd like to share an example from our neighborhood in Michigan of the impact that these state, federal encouragements can have on manufacturing attraction and job creation. A cluster of solar enterprises is gathering near our facility in Michigan at a time in the history of our region when the loss of automotive manufacturing has created a deep recession, very high unemployment. You probably know that Michigan has the highest unemployment rate in our nation. In recent months this story is changing.

Suniva, Incorporated, encouraged by a loan guarantee from the

U.S. Department of Energy, has announced plans to build a $250 million solar cell manufacturing plant just a few minutes drive from our polycrystalline facility. Michigan economic development leaders expect Suniva will create directly more than 2,000 jobs as it reaches peak production.

This month, Global Watt, a solar panel manufacturer began posting Help Wanted ads for up to 500 jobs as it expects to fill them when it completes $170 million renovation of a vacant factory in a nearby community. State tax credits and proximity to other solar businesses were major factors in their decision to come to Michigan.

Evergreen Solar, they've decided to move their facility from Massachusetts offshore, but they have also chosen to build a $55 million facility to make high-temperature filaments for silicon wafers in our Midland community in Michigan. The company received a $6 million state in local tax incentive and expects to employ about 100 people.

And lastly, Fulcrum Industries, they have supported -- been supported by the state and venture capital to create a facility with tax incentives that would solve solar reflector challenges and new thermal plastic solutions. Add this to our 2,000 jobs that we're creating just in the state of Michigan, not including Tennessee, and our contract workers in building these facilities, and we can really encourage the new job growth that we've been striving to achieve.

Of course, government can't do it all. We know that there are important roles for companies, for academic citizens acting for change through

nongovernmental organizations and think tanks such as today's host. For nearly 70 years my company has been quiet. We're a private company based in rural Michigan. We make our 7,000 products and sell them to our 25,000 customers, and only recently have we gotten into this wonderful solar industry.

We entered the advocacy arena very recently because we have customers, the advanced manufacturing job creators who realize the immense potential and the enormous untapped U.S. market for alternative energy. These customers want to know what we, as a world leading silicon-based company, are doing to influence the growth of this industry in the U.S.

We're diligently working with a number of partners right now to set up an American Solar Power Research Enterprise. Think of it as a center for energy excellence that would concentrate essential research and discovery in one place. This would be more of an open innovation concept.

This collaboration would be unlike anything underway in the United States to date. It would bring together under one roof: plant floor smarts, materials and engineering capability, academic brain power from multiple alternative energy specialties. The Center would strive to seek innovations that U.S. solar companies can integrate into new or existing processes and very quickly move them to production. It would also seek workforce development solutions that, as I mentioned earlier, are an important component of the scaling industry to meet what we believe will become a fast-growing demand.

The state of Michigan and Dow Corning are prepared to make

seven-figure investments to create the Center. We plan soon to apply for U.S. Department of Energy photovoltaics manufacturing initiative and to make this important project a reality in the United States. When industry, public sector, academics, and NGOs pool their talents, we can maneuver around complex interconnections and resolve differences that might stand in the way of achieving our ultimate goal of bringing to the end market cost-efficient solar power.

We have a core of political leaders in Washington who have the insight and courage to make policy changes necessary for this alternative energy adoption. There is unprecedented passion among the group of forward-thinkers in Congress and the administration to move before it is too late. Some states are also taking the lead to set the stage for energy transformation.

The U.S. Department of Energy reports that 33 of them have renewable portfolio standards that require electricity providers to obtain a minimum percentage of power from renewable energy. Together these states account for more than half the electricity in the nation, and some of these mandates are quite aggressive. Maine has a target of 40 percent by 2017; California, 33 percent by 2030. We need the right policies to allow them to achieve these standards.

And, finally, and maybe most importantly, the average American appears more ready than ever for the energy revolution. Various opinion polls are demonstrating this. A recent Gallup poll concluded that 87 percent of

respondents think the United States has a serious energy problem. That same month as Gotham Research Group reported the results of a national survey: some 75 percent surveyed support using public lands for utility scale power installations. A Pew Research Center poll in February found that 78 percent of those asked favored increasing federal funding for wind, solar, and hydrogen technology.

And to build on that, some analysts are saying that the price of oil has settled into what we call the "solar sweet spot." Prices are not so low that their crushing demand for renewable energy are causing fiscal stress in oil exporting nations, yet prices per barrel are not so high that it is threatening our fragile economic recovery here in the U.S. and in Europe.

We have technology that is ready for prime time and beyond. I started my career as a research scientist, and I know the American passion for invention. U.S. laboratories are among the world's best places for discovery, and that will improve the sophistication, the efficiency, and the affordability of sun power.

As I said many times, the components are in place for a rapid ramp in renewable energy production, especially solar. Remember, though, the time for talk is drawing to a close and a time for action is closing in on us. Today's agenda calls for us to speak more clearly on what this country needs and to do a scale-up of domestic solar power so we can create jobs, create profits, and other economic benefits. I urge you to do what you can to make this happen. We need answers, we need action, and we need it in the next

few months.

Thanks again to the Brookings Institute for hosting this day, and I know I'm going to enjoy the panel discussions. Thank you very much. (Applause)

MR. EBINGER: Dr. Burns has agreed to take some questions from the floor, so in the back?

MS. BLISS: Hi. My name's Diane Bliss, and I'm a concerned citizen. I was at a Capitol Hill panel discussion yesterday where a university professor from Wisconsin said that 45 percent of our energy professionals, engineers, are going to be retiring in the next 5 years. What suggestions would you have for the Obama Administration to replace those professionals quickly and, obviously, train them in the new technologies?

DR. BURNS: Yeah, it's a great question and, in fact, I can reinforce that, and our company is a small demographic of America. And if you look at our U.S. workforce, we are going to lose a significant amount of talent in the next 10 years through retirements. And I think, you know, first of all, I highly encourage our universities to get out of the silos that they're often in, in terms of their functional education and think more broadly about educating students across the solar spectrum so kids can learn, you know, what sort of financial systems need to be put in place; what sort of engineering practices do we need to focus on; how are we going to install these things; what sort of business models do we put in place? And so often the students are siloed into either accounting or engineering, or the trades. And we're

encouraging our universities that we work with to think very broadly.

I think we encourage internships a lot in our industry. It gets students hooked on innovation and on the application of what they're learning in companies. And I think the same would be true in certain government labs, and I think we just need to continue the focus on math and science education in much, much younger grades than we are today. And I'm concerned about the loss of that focus.

MR. EBINGER: Yes, I'd forgotten, will you please identify yourself before you ask your questions? We do have a roving mic, too, so if you'll wait for the mic, please.

MR. LIEBERMAN: My name's Dan Lieberman, and I'm a more concerned citizen. You covered the job aspects, which is actually an economic problem, but there is really, I think, a greater problem and that is reduction of global warming and also an alternative to fossil fuels or the fact that we are going to soon be depleting all our energy resources.

So this is an international problem, and although we had an economic problem, can we let that interfere with the fact that being able to manufacture solar cells cheaply throughout the world and have them installed in places like China or India, which are an international benefit to us all. So we have a dilemma right here, but can we let the job problem interfere with this greater problem?

DR. BURNS: No, absolutely not. Absolutely not. China and India and many emerging countries do have a carbon footprint issue, and, you

know, they are far behind western countries in terms of their ability to address that. China is very heavily dependent on coal, as you probably know.

They have a focus and a priority on installing solar in these countries, and they are putting the right incentives in place. You know, very much of it can be driven by the central government in China, and they can make things happen very fast.

So I don't believe my message on jobs is in conflict with that. What I want to see is solar modules that are put in America made in America. I see no reason for these to be manufactured offshore and shipped into America. There's going to be plenty of manufacturing in China for the Chinese market. That's going to grow tremendously, and it will make sense to do that manufacturing there. But it breaks my heart to see over half of our silicon get shipped offshore only to come back as a finished module.

But I think all of this can come together.

MS. JACOBSON: Last week you testified before the House Ways and Means Committee about acceptance --

MR. EBINGER: Will you identify yourself, please?

MS. JACOBSON: Oh, I'm sorry. Debra Jacobson with the George Washington University Solar Institute.

DR. BURNS: Mm-hmm.

MS. JACOBSON: On tax incentives for the solar industry as part of the energy tax incentives package that the Committee is starting to develop, and I wanted to ask what your thoughts are in terms of some of the

key elements that the tax committees need to look at.

DR. BURNS: Yes, I did, and thank you for your question. We are very much in support of investment tax credits or 48C-type manufacturing tax credits to encourage the investment in manufacturing and advanced manufacturing jobs here in America. We benefitted from some of those credits in the investments that I spoke of. Many of our customers benefitted, and it does encourage those investments to be made in the U.S. and to create jobs here.

I would like to see more certainty in the tax credits. Right now 48C is a one-time deal. There's discussion and encouragement to lift the $2.3 billion cap by an additional 5 billion. That would be useful. What would be more useful is a permanent tax credit for the creation of these investments.

I also think many of our customers who are smaller entrepreneurial companies don't actually create the profits to access the tax credit. So these companies need access to financing, they need 1603-type grants so that they can make the investments that are needed on their end.

MR. EBINGER: Yeah.

MR. JOHNSON: Could you say a little bit more about --

MR. EBINGER: Identify yourself, please.

MR. JOHNSON: Oh, yes, Jeff Johnson. I'm a reporter with Chemical Engineering News.

DR. BURNS: That's nice.

MR. JOHNSON: The -- how a feed-in tariff would work in the

United States, we know some of the problems in Spain and the problems in Germany. And if it's going to come -- if people that are -- if it's going to come out of your utility bill for a person that didn't put in solar, it seems like it could be a splitter in terms of those that are installing solar versus those that are paying an extra amount of money. And could you talk about how the mechanism might work?

DR. BURNS: Yeah. I mean, I think there are several mechanisms. I think the most common one is that it's, you know, it's a line item on your utility bill. And I think in Germany it was about a euro or so every month on the utility bills. And to me that's the simplest way to implement a feed-in tariff. And it's -- in a sense, it's the price we need to pay to help make this technology competitive and to help us get to the level of installation and demand that will allow it to grow to grid parity.

We don't need these feed-in tariffs forever. Germany is already starting to dial theirs back a little bit. Japan had similar incentives and most of those incentives are now gone and the solar is more competitive and has reached good parity in many of these countries. California will probably be one of the first states here where we can get to that point.

But feed-in tariffs seem to be one of the most effective ways, along with the tax incentives for investment, to encourage the demand for solar.

MR. EBINGER: All the way in the back?

MR. WEIR: Hello, my name is Chase Weir. I'm the CEO of

Distributed Sun and managing director of SunOne , which is a captive project equity fund. We're building commercial facilities across the Mid-Atlantic right now on hotels and retail and light industrial. So I have a little bit of a different perspective.

If you'd have asked me 12 months ago my opinion about U.S. competitiveness vis-à-vis other countries in solar, I would have talked about it in the context of making solar panels. Now through my lens as a project developer, I think about it in the context of installing solar panels.

DR. BURNS: Yeah.

MR. WEIR: Germany's the highest per capita country in the world for solar, not because they make the most panels, but because they install the most panels. So I'm dealing with them. I'm not going to name the state, but we have a governor that's getting in the middle of one of our installations. They want us to use panels made in that state, which are less efficient and are more expensive.

The question I have is what is Dow doing, and what are you seeing more broadly in the industry to achieve China price? Because if I have to pay more, I'm creating fewer jobs, and I'm installing less, and I have a lower return on investment. And that damages my business and my ability to help downstream, which our analysis says we create more jobs from the project developer forward than upstream in manufacturing.

The second one is, what is Dow doing to help with project finance? Because the Chinese companies backed by the Chinese banks are

getting into long-term finance vehicles and helping me install more solar.

DR. BURNS: Yeah, good. I mean, great questions. I mean, clearly -- clearly -- we need to drive the efficiency improvements in order to be competitive. And when you've got low-cost labor in China and when you've got electricity, which is a component of actually making these cells and modules, being provided by the government at extremely reduced rates, it is hard to compete.

I believe that there may be some steps of this value chain that are done offshore, but I also think there are a lot of steps that can be done on American shore very competitively. The cost of shipping these things around the world is not insignificant, and that we need to keep as many of these jobs on shore as possible. But, ultimately, market dynamics will come into play, and you're going to have to make the decision on what you buy, and you're going to buy the lowest cost-efficient cell that you can.

So you're absolutely right, the U.S. has to be competitive in the creation of these manufacturing jobs and bringing this onshore. And I believe we can. Some of these steps are not as labor-intensive as others, and the labor costs seem to be the big difference.

But I'm also concerned about where our innovation goes, because when manufacturing goes R&D goes. And I know one fairly key player in the solar industry, American-based company who has placed their chief technology officer in China, because that's where they think the action's going to be. And I think that's a shame.

MR. EBINGER: I want to thank Dr. Burns very much for being so generous with her time today. (Applause)

Our format today, after I initially introduce our speakers, is going to be that each speaker will have approximately five minutes primarily to kind of tell you what they're doing at the moment, not really to get into a thorough discussion of the issues we hope to touch on in the panel today. And then we'll move to having the panel address a few questions. It may be addressed to one panelist, but others are more than happy and encouraged to weigh in. And then we'll go for a significant period to the floor, because I know a lot of you will have very interesting questions.

Our panel today, we are delighted to have Richard Kauffman, who is a director of Brookings, and we're always delighted to have our directors participate in our forums. Richard is truly a renaissance man. You have his biography. He is the chief executive officer of Good Energies, one of the largest independent investors in renewable energy. He has held significant positions in finance both at Goldman Sachs and at Morgan Stanley. He is an educator. He is on a number of different boards. He is a supporter for the arts with both the Alvin Ailey Theater and the New York Philharmonic, and we are indeed delighted to have Richard with us today.

Next on the panel is Dr. Lola Infante, who is the director of Generation Fuels and Market Analyses for the Edison Electric Institute, where she has the enviable job of having to follow almost every fuel type in America and all the policy debates going on Capitol Hill, including the now stalled

climate legislation.

She has worked at the Center for the Advancement of Energy Markets, at Washington think tanks, and at GAB Robins in Paris. She holds a master's degree in international economics and finance from the University of Paris, Dauphine; a master's degree in energy environment science and technology from Johns Hopkins, and Ph.D. in political economy from Johns Hopkins where she wrote on the subject of the liberalization of the electricity industry in the European Union.

Mr. Banks, who's chairing our second panel and myself, we're particularly delighted to have her because we both teach in the program in which she holds her Ph.D.

Charles Hemmeline is the team leader for market transformation in the U.S. Department of Energy's Solar Energy Technology Program, and for the past four years he has helped to design and implement the portfolio of non-R&D activities in the solar program focused on reducing the barriers to wide-scale solar adoption. And in that capacity, I'm sure, given the focus of this seminar today, he will have a lot to contribute.

His efforts have included new activities in workforce development, a subject we just talked about; outreach to state and utility decision-makers, and the Solar America's Cities Partnership Program. He holds a master's in public administration, and a bachelor's of science in mechanical engineering from -- both from Texas A&M University.

And our last panelist also offering an interesting perspective is

Hal Connolly, who serves as Senator Menendez of New Jersey's legislative counsel on issues relating to energy, the environment, and transportation. And Mr. Connolly serves as the chief of staff as a member of the Senate Energy and Natural Resources Committee as well as the Finance Committee where Mr. Menendez has been a tireless champion of solar energy. I think there's probably no one on Capitol Hill at the staff level who has a better insight into what is going on in the whole renewable energy debate than Mr. Connolly.

He is a graduate of Oberlin College and the New York School of Law, and previously he was litigator at Cahill, Cordon, and Reindel, LLP, for several years, and he also worked for Mr. Menendez when he served in the House before his 2006 Senate campaign.

So let me start with Richard, and see where we go.

MR. KAUFFMAN: Okay, thank you, Charles. So, Good Energies is a large investor in renewable energy. Most of what we do is actually in solar, so we have 15 investments in the solar industry, everything from feedstock which we're involved in upgrading metallurgical silicon, which is another technique for providing the feedstock for silicon-based PV.

We have investments in machinery, in solar thermal, which is a different kind of solar technology than photovoltaic, which is crystalline based. We have investments in cell and module manufacturers in China and in Germany, and we also are involved in solar development. So we pretty much cover the waterfront across a range of technologies.

Sadly, the vast majority of our investments are outside the United States, and why is that? That's because the markets are outside the United States. And so if we want to accomplish all the things that we want to accomplish in the United States, we need to develop a market.

And so I guess what I would say without -- Charlie, without getting into the substance, I would say just that the solar story is still intact. The industry is a very small industry, but it has grown quite dramatically over the last few years, so it's now big enough so there are a lot of lessons to be drawn.

One lesson is that with scale costs have fallen dramatically, so nobody, I don't think, in this room will tell you that solar is yet at grid parity, but it's certainly gotten a lot closer, and we've seen in the examples of wind that with scale cost come down quite dramatically, and wind is somewhat ahead of solar.

I'm not going to talk about wind, but some, there are lessons about wind that should be applied to solar, and one of this is about scale. And we have a history now of policies that work around the world and those that don't work, and, sadly, I would say that the United States sort of wants to reinvent the wheel, and many of the policies that we have in place in terms of developing the markets are not working.

I would say that in solar we still have the technology, innovation, deployment cart and horse backwards. I think the European example is, let's start deploying good-enough technology, and it will get better in terms of

scale. And we're looking for, you know, the ideal solution, which is very hard in a capital-intensive industry where scale matters; very hard to get cost-competitiveness to conventional sources without developing a market to achieve scale.

And it's also important, by the way, in solar where a lot of the costs are actually after the thing is already manufactured, which relates to installation because almost half the cost of solar is in installation. And that's not high tech, but you need scale in order to get to reduce those costs.

So I guess, just finally, I'd say the problem in the United States really is much more about regulator -- or bad regulations, bad market signals in order to achieve, which prevents us from achieving a market that would result in scale, much more than fundamental problems of technology. I think that technology problems will -- I don't want to say solve themselves, that's not correct, but with that kind of market, we will find that there's much more innovation that will take place.

MR. EBINGER: Thank you. Lola?

DR. INFANTE: Hi. Good morning. For those of you that don't know there is an Electric Institute, it's the trade association -- I'm reading my notes just in case I forget where I work for -- the trade association of the U.S. Shareholder-Owned Electric Utilities -- Companies. I'm sorry, not all of them are utilities. EI's members represent about 70 percent of the power sector and about 90, 95 percent of the shareholder-owned portion, segment of that, which basically means that we do represent the power sector fairly widely.

Within EI, I work in the Energy Supply Division within the Business Operations Group. We do everything that our lobbyists, general counsel don't do. So we do a lot of analysis of energy markets under the utility industry and the regulatory processes and legislative development, and all those things. There I focus on, as Charlie said, pretty much anything that has to do with generation fuels, which means from coal, what is happening to the coal fleet, to natural gas and shale and gas prices, to renewables, including solar, obviously.

I am not a solar expert, but I do think I have a fairly comprehensive view of what the energy picture looks like for members, and I'm excited to be here.

MR. EBINGER: Thank you. Charles?

MR. HEMMELINE: Good morning. Thanks very much, it's great to be here. My name's Charlie Hemmeline. I'm with the U.S. Department of Energy Solar Program. We are kind of the federal solar program that's responsible for the research and development and implementation of solar energy technologies nationwide. So we have a whole portfolio of R&D and market transformation type activities that I lead. Some of them were mentioned here this morning, which is great, some of our new initiatives.

Basically, we have multiple teams, photovoltaics research that looks to improve that technology and reduce cost, a concentrating solar power, the large-scale solar thermal technology research that goes on there, a

fairly new systems integration team that focuses on the grid aspects of solar and how to enable high penetration over time and enable the large-scale ramp up of solar; and then, like I said, the market transformation side which looks at various implementation and other issues that need to be addressed to ensure implementation.

So our market transformation program has been active for a few years now. We started in about 2007-2008 and tried to take kind of a comprehensive look at what are the issues associated with implementation and, in particular, barriers that we can help knock down.

And we have essentially focused on engaging directly with cities and states and utilities to try to understand the issues better and develop programs and resources that try to tackle those issues. Our Solar America Cities Program is one of the largest and, I think, most impactful efforts.

We have direct partnerships with 25 major U.S. cities around the country, have partnered with them giving funds and technical support to help them address particular implementation challenges. And we're in the process now of taking those lessons learned over the past few years and spreading them out nationwide over the next several years to help other cities and counties take that information and understand what the best practices are at the local level.

Our workforce development effort was briefly mentioned. We just made, through the Recovery Act, a significant investment in the infrastructure of training and education on solar in this country, so we will be

investing up to 27 million over 5 years in a series of training institutions nationwide, 9 centers that will be providing professional development and instructor support for the scale up of educational programs. And if you stick around for the second half of the panel today, you'll hear from one of those centers, N.C. State University, and can tell you more about some of those specific efforts.

We look to provide some foundational support for the rapid scale-up of training that will be necessary of instructors and students to actually meet that kind of demand.

Basically, our approach, if you look at our role, in addition to coming up with solutions to particular barriers that the cost issue is a very significant one, and, obviously, reducing module cost and inverter cost/hardware cost is a very important piece of the puzzle, but as some of my other panelists and speakers have mentioned, the installation and non-hardware costs are very significant owning up to half of the total system cost.

And it turns out that there's a lot of different things that go into that, and a lot of our work with the Solar America Cities Program and work with utilities and states is directly trying to figure out, outside of the pure hardware cost, how can we reduce the other costs associated with installation. Because at the end of the day, you as a consumer, either a business or a homeowner, don't really care if it's the module or what, you just know what you end up having to pay. And so we're trying to look at that full system and reduce that.

So very excited to be here. Thanks.

MR. EBINGER: Thank you. Hal?

MR. CONNOLLY: Hi. Hal Connolly. I work for Senator Menendez on his legislative counsel, and he represents the State of New Jersey. New Jersey was where the solar cell was first invented, and New Jersey still maintains its leadership by being second to California in installation. It may be a distant second, but we're trying. A relative lack of sun won't stop us.

Working for Senator Menendez on these issues is quite easy because he has a real vision of what he wants to see the solar market to be like in two decades. And he wants to see everyone, every typical hard-working family to be able to afford solar panels, to be able to install them on their roof without too many hassles from their home state utility or from their gated community or their local historic district. He wants to see, you know, an installation process where you don't need to hire an expert; a local electrician or a roofer or, if you're ambitious, you might be able to do it yourself. And, lastly, he wants to see a robust manufacturing sector here in the United States.

And there's a lot of ways we need to address the policies in order to reach that vision, but, briefly, I mean, I think we need to establish better ground rules nationwide on things like how you connect to the grid and whether you can net meter or whether there's a feed-in tariff. We need national rules of patchwork between all the different states, makes it difficult

for industry and consumers, frankly, to participate in the market.

Secondly, we need to bring down the price of solar, obviously. There's a lot of incentives already in place. We have a 30 percent investment tax credit that's extended out to 2016. That was a great success, but we need to do more. You know, as Dr. Burns pointed out earlier, you know, we need to be willing to compete. It's no longer the case that we can just rest on the fact that we're the largest market and have the best intellectual capital and the most capital. The rest of the world's catching up, and so it's time to examine policies on how we do catch up and stay in the lead.

Lastly, I think that something that isn't a federal government role yet, but is not talked about enough, I don't think, is that we need more standardization in the industry on how we install panels, and there needs to be more industry standards. And if there aren't industry standards, then the government needs to think about stepping and providing more leadership. You know, it shouldn't be the case that a consumer has to choose between a hundred different kinds of installation techniques, and it just -- it makes -- we need more of a plug-and-play system as an industry.

But thanks so much for inviting me. I have to say being up here with such austere experts has me a little intimidated, but I'll try my best.

MR. EBINGER: Thank you, Hal.

Let's start -- Richard, if I may turn to you, and, please, after his remarks, anyone else weigh in. This first question will certainly, I think, be of interest to everyone.

Richard, you seem to suggest that a lot of the policies in place, whether regulatory policies or other policies, seem to be not working. So I wondered if you could give us a quick review of what the current status of policies and incentives at various government levels are for solar power and what is working amidst those policies and what isn't.

MR. KAUFFMAN: Well, that's -- all right. So I'm going to need definitely help from the panel here because I'm not going to try to cover the entire waterfront here.

I think that let's stalk with -- let's start with the tax issue. You know, in the United States we give support to renewables in the form of tax credits, and that is, frankly, quite an uneven form of support. So I think there was somebody in the back -- I don't remember his name -- that's a developer. I suspect that he can't use the tax credits that he gets because most developers, most projects, there's no taxable income. So you have to find somebody to take the tax credits. In the past you went to a financial institution to become a tax equity provider. Well, most financial institutions don't need any -- are paying taxes now for other reasons. So there's been a DOE grant program which has been put in place so a developer can get cash for that, but there's still other tax benefits that are lost.

Similarly, the same thing on the manufacturing side, again in comparison to other countries. Now we're talking about manufacturing, we give tax credits for manufacturing. That may be good for companies that are already established that can use the tax credits because they have taxable

income, but if you're talking about a new company that's starting up, that's not really very valuable because, again, we're talking about start-up companies which are going to take awhile to get to profitability. And so the value of those tax credits are not worth very much today, and other countries provide really cash value for the equivalent of the tax. So the whole tax question is a problem.

We don't give feed-in tariffs. Dr. Burns talked about feed-in tariffs. To feed in the benefit of feed-in tariffs is it's not only in cash, but it is -- makes it much easier to get financing because the -- there's a long-term revenue stream that's of investment grade. And one of the big problems that developers are having is getting financing. And there are certainly efforts now to get guarantees, get a guarantee program, a loan guarantee program, is helping quite a lot, but it's still not enough to get enough debt for projects. Now, I'm taking about, again, projects that -- these are development projects, this is not about manufacturing. These are using technology which works, which is mature. It's very hard to get enough debt for a long enough period of time to make the economics work for a project developer. So again, we're talking about deployment. And so that is also an issue.

I think the last thing I'll say, and then turn it over to somebody else on the panel to help me out, is that I think the focus on the job part, I'm very sympathetic to the point about jobs. But this creates a real distortion in the market because we -- when you think about solar manufacturing, it is a manufacturing process. And the most conventional kind of solar PV

manufacturing is in comparison, say, to the semiconductor industry, is much less -- requires much less capital. It's a much simpler manufacturing process. And when you look at semiconductor manufacturing for electronics, yes, there's some in the United States, but there's much that's offshore.

So I think -- and there's no question if we develop a market in the United States, there will be manufacturing jobs. But there'll be all kinds of other sorts of jobs. But a lot of the government programs now on the state and on the federal level are only providing certain grants or funding if they're manufacturing jobs that are created. And I think that really does create a lot of distortion in markets.

MR. EBINGER: Thank you. Anybody else on the panel want to weigh in on that?

DR. INFANTE: I just wanted to add the renewable energy standards in the states. Many of them have solar carve-outs or carve-outs for distributed generation, which I think has been a main driver for solar in the United States at this point, in addition to the tax incentives and financial incentives overall. I think that's important.

And I also think there's definitely a trend towards consumer --

SPEAKER: (inaudible)

DR. INFANTE: I'm sorry. I think there's also a definite trend towards -- of consumer preferences towards solar or wind renewables in general, and we see that in some states that do not have renewable mandates. They have green pricing programs, which they gather money from

the customers and then they procure renewables without having a mandate. And I also think that has been maybe not a huge incentive, but definitely growing and a piece of the puzzle, I think.

MR. EBINGER: Let's turn to another question. Charles, maybe you can, if you don't feel comfortable, take in the sun -- we'll go elsewhere on the panel. But what lessons should we learn from the policy approaches of China, Spain, Germany, and other earlier adapters of solar power? And we know, for example, that feed-in tariffs have been very successful in Germany and yet they seem to have run in to some difficulties in Spain.

I'd also be interested on the jobs issue. How has it been that Germany has been so successful in keeping its industry in that country since Germany is certainly not usually a low-wage manufacturing country and yet they seem not to be facing the problems that the United States is?

MR. HEMMELINE: That's an excellent question. I think that, you know, an overarching lesson from the state level and the U.S. level and countries overall is that bold action and leadership will get results. I think most of the leadership in the U.S. has come at the state level up until the past couple of years with state renewable portfolio standards with the advent of the new manufacturing tax credits and extension of the investment tax credits that my colleagues have talked about. We've seen some movement at the federal level to make those kind of long-term investments, and other countries have done the same in their own way, and Germany and Japan and Spain that have been talked about have seen very significant activity as a result of those

policies.

The question that, you know, the industry and commentators have looked at is what's the right approach to implement those kind of policies? And I think whereas you've seen a lot of movement, there's also been a lot of shifts in those policies over the past few years as experience has been gained and how the rollout is. I think the feed-in tariffs have been a fairly transparent way to get a lot of installations. They also represent a significant outlay of public resources.

And so as those decision makers have seen that, there's been a concern about that level, and looking to scale back the other overall challenge with feed-in tariffs, as we've seen, is that getting the price right is just an inherent challenge. If you set it too low, you don't get anything; if you set it too high, you sell out of your program immediately. And then the question is have you really created a market or have you just created a program? And so that's a been a concern in whether or not the U.S. with its policy framework feels that that's the way that we'll go is still an open question. A lot of states are looking into it.

I just wanted to echo on the jobs question. As we've talked about, a lot of the value of the installation comes after manufacturing, and, therefore, a lot of the jobs will come as well. And so even in the status of the U.S. manufacturing we added over 10,000 jobs in the solar industry here in the United States, and the industry as a whole grew 37 percent even in one of the worst economic environments we've had in a long time. And so even with

the situation being what it is, there's been significant growth, and because of the distribution of jobs all up and down the value chain, the jobs are growing significantly.

SPEAKER: I guess I'd add a couple of points to that. I think that the German experience in solar has been that scale-up matters. And we've talked about that. And so there was a -- there has been a dramatic cost reduction. Now, you could say that the problem of the feed-in tariffs is it did create very high margins for manufacturers, and that's why the Chinese industry developed, because the margins that German manufacturers were getting were too big, and this goes to the point about if you're going to have feed-in tariffs you'd better be sure that you come up with the right price. And Germany, by the way, the German -- actually, the German employment base is under tremendous pressure now because of the cost of imports, and that's why politically in Germany the feed-in -- or the support structure for the solar industry is under a lot of pressure, because German taxpayers, in addition to having to deal with Greece, are not so sure that they're happy to be creating Chinese jobs.

And we talk about China. I guess I'd make kind of two points. One is that everybody should understand that the Chinese in this very substantial investment that's going on in China is for export. There is a domestic industry, but it is tiny, tiny, tiny. And it's -- I would say that it's probably being used for lower quality product that isn't for the export market. So, it's an outlet to support the manufacturers. But having said that, there's no

question. I agree with Dr. Burns. You get a critical mass of manufacturing, you're going to also get R&D, and so -- but it's because it's -- the manufacturing base has been set up there for export.

And the other point I would make is what Dr. Burns said before, which is really a critical factor, is the point about financing, project financing, because most of the solar industry is non-investment grade, all right? So -- and so what that means is that -- I said before I talked about on the project side it's hard to get financing to install a project from financial institutions, while in other industries the manufacturer can provide the financing. Well, if you're -- since the solar industry is below investment grade, that generally does not happen. It's certainly not happening with U.S. manufacturers. The Chinese manufacturers are beginning to get financing from Chinese banks to help with the project financing, and that is a tremendous asset, and if they really get that right, that will clean -- you know, run the tables in the whole industry.

MR. EBINGER: Is anybody familiar with the Spain experience and why the feed-in tariff seems -- I mean initially been very positive, now creating problems or not? We can move on. Okay.

DR. INFANTE: I am not hugely familiar, so hopefully you can help me out. I think the main problem was excessive premiums. They just -- they had phenomenal prices for PVs, I mean, solar in general. Then what happened, there was this typical boom-bust cycle. A lot of developers came in, a lot of them ordered huge amounts of PVs. The problem in Spain is that retail prices are regulated, but the feed-in tariff is set, so -- and they are --

there's no cap, so they were going to sell whatever they weren't going to produce. If it was 1 megawatt, 1 megawatt; if it was going to be gigawatt, then 1 gigawatt. So with regulator retail prices, what happened is that utilities were not able to recover their feed-in tariff costs from the consumers, so the government -- there was an arrangement. The government has to pay them back whatever they cannot recover, and basically with the addition of the economic crisis, all those things going on, they just could not pay. Or, I mean, I guess they could have, but it created a huge deficit -- budget deficit for the central government in Spain, so they cut them back and they closed the loopholes and they put a cap and everything. The problem is that everything happened in -- within months. I don't think that's a very sustainable way of handling the development of an industry.

I think I can speak like that because I am from Spain, so I can criticize them openly. I think Spain is the perfect example of a policy gone very, very wrong. They depress the whole solar industry in the world just because they didn't get it right, and I think that's one of the main risks of a program like a feed-in tariff. If you get it right, it can work very well, and if you don't it works very poorly. And I think in the U.S. we have other mechanisms in place that are working, and I just checked this morning very quickly before coming here and I think there's about 80,000 megawatts of planned solar projects on. That's a lot of projects. Maybe not all of them will get billed, but that's, again, a lot of projects given that, you know, basically the solar industry in the U.S. is a couple of years old. I mean, one would be seeing the

30 percent growth a year. You know, it's -- you know, I don't think we need to be so impatient as to wanting everything right now. I think things are happening, and we definitely have some incentive structures in place that are making this happen. I'm not saying we don't need to do more. There's definitely a lot more to do. But I do think that things are happening, and, I don't know, I think the Spanish case is just very, very scary to me.

MR. EBINGER: Thank you.

SPEAKER: I'll just echo that we did definitely have lessons from Spain, and it was a good learning experience for the industry and the policy community. It's tough. As someone who is trying to work on the implementation of solar when they were able to install 2700 megawatts in a year in 2008, so it's hard to say that that was a failure, because that's a great thing that that much happened, but then when it dropped to 180 megawatts the next year, I have to agree with the sustainability question and whether or not that's the right approach going forward and the challenge with that.

One other thing I just wanted to add about feed-in tariffs is that often there are other characteristics that go along with that that aren't necessarily inherent to feed-in tariffs and they were alluded to by my colleagues about the transparency and the consistency and predictability over time, as well as the guaranteed interconnection and the process associated with that. So it's not just a matter of the rate being what it is and the price signal; it's that in the countries that have implemented it, it's tended to be kind of a comprehensive approach to the installation process, and by setting it up

that way it tended to knock down a lot of the other barriers that exist in terms of fragmentation and interconnection and whether or not you can do it and looking at the long-term start/stop issues associated with the industry, and so bundled in the feed-in tariff program came some solutions to other problems that, you know, aren't necessarily tied to that as a policy model.

MR. EBINGER: Yeah, just to -- excellent, because I think that -- and others can talk about this, but the equivalent in Germany is to get a building permit, to get connected to the grid anywhere, and anybody can do it. And so I think, you know, you might want to talk about it in the U.S. how difficult it is in some places to hook something like this up.

SPEAKER: Sure. It's just the fragmentation was mentioned earlier. We have 50 states. Thousands of authorities having jurisdiction at the local level in terms of who is responsible for enforcing the national electrical code and conducting permit and inspection procedures, and that has given us a certain robustness, but has also, you know, created a level of fragmentation and approach that we've seen a wide variance in the processes around installation, around permitting and inspection, and a variance in kind of the time and cost associated with that, and so as we scale up we're looking to streamline that to bring some consistency. I agree that as the industry matures we need to get to a more common approach so that if you're a company trying to expand into a new state, you're not dealing with 50 different submarkets within that state. You have a bit of transparency in that.

MR. CONNOLLY: Yeah, I'd like to touch on that briefly, that,

you know, the political reality is that we have a lot of incumbent, monopolistic utilities all across the country that are very willing to pick up the phone and encourage members of Congress to not have national standards on these things, and that's in part because why would you want to compete with solar or any other form of distributed generation if you're an incumbent monopolistic utility.

Now, I had to lean away from Lola so she doesn't punch me when I say this, but, you know, that's something that Senator Menendez has worked on and is working on with Chairman Bingaman of the Energy Committee to try to address, that FERC should have the power to create some sort of national rules; you know, not necessarily a rigid standard for every community or state, but some sort of bottom line that if you have a legitimate clean energy project that you want to install on the grid, you shouldn't have to sign your life away to do it or you shouldn't be right out and flat our barred. And there should be -- we should also be thinking about a national net metering standard, too, so that you can get paid back at a retail level for any excess electricity you generate.

You know, right here in D.C. -- D.C. -- PEPCO is one of the good guys. They have pretty good policies for interconnection, but, you know, being a reformed lawyer looking at the paperwork that they make you sign that you have to -- you're responsible for some line worker down the street getting hurt because of your solar panel, you know. It's even onerous in the good state, so it's something that if we're going to have a legitimate national market

we need to work on.

MR. EBINGER: Let me play the devil's advocate for a moment, Hal. I'm a regulator. I want to deliver the least cost power to my citizens, which is my reliable, least-cost power. Why should I be vigorously supporting, as a regulator, solar projects that are entering my regulated system?

MR. CONNOLLY: Well, I think -- I guess it supposes what kind of regulator you are. You know, I would hope that you're going to support because you have a citizenry that's demanding the right to be able to put solar panels on their roofs and who -- consumers that want to save money on their electric bill by going solar, who, you know, also are probably motivated energy security or global warming reasons. And then, therefore, as a regulator you want your consumers to have that power and to be solar patriots in your footprint.

You know, are there costs associated with it? Absolutely. But I think, you know, the costs aren't that high. And if you put it to people, are you willing to pay a little bit extra on your utility bill to make this country safer and cleaner, I think most people would sign up for that. And I think we can see that in states like New Jersey and California and 31 other states that have RESes that states and communities and willing to do that, to put a small amount of investment now to create a cleaner and more affordable energy future for their states.

SPEAKER: Just to add -- I would add two points. The first relates to the cost of peak power. Now, we're in a recession now, and so

demand for electricity is down. The other thing that's happened is we have gas prices, which are very low and maybe will stay low for a long time because of new technology, and so there's a lot of supply. But before those two factors -- and I know those are two big things -- we had very strong growth in peak power, and what utilities were doing in terms of adding capacity for -- think about the summer and that's what peak is. They were adding gas, gas-fired plants to peak power. And so the thing about solar is you know what it costs when you install it and you know what it costs thereafter, which is pretty much nothing.

A utility knows what the cost of a -- the capital cost of a gas peak or plant, but a utility does know what the feedstock costs are, and so, you know, maybe it'll be true that gas prices will remain low for a long time. You know, a solar panel will last 25 years -- in fact, longer. I think you're going to see warranties for 50 years. I mean, they last a long time. But if for some reason there's concern about water pollution and actually the gas boom turns into be a bust, then we could be in a situation where peak prices for electricity go up an awful lot. So, I would say that it may be useful for a regulator to hedge bets, because we're going to have increasing demand for peak power.

The other point I'd make is really about efficiency, because, to your point, Charlie, about what a regulator ought to be concerned about, which is low-cost power, well, the cheapest form of power is efficiency, and right now of course utilities aren't incented to do very much in terms of efficiency, but the thing that I like most about solar is the very things that would

enable solar -- which would be a smart grid, the ability to do net metering, focusing things on distributed -- on the building level -- all those things that would support solar are the very things that we need to have in place that will support efficiency. And if -- and so I think what's good for the goose is very much good for the gander.

MR. EBINGER: Okay. We'll have two more questions for the panel, then we'll move to the floor.

Lola, from the vantage point of your membership, what do you -- what are your major concerns and what do you think you need to encourage the investor-owned utilities to more vigorously develop solar?

DR. INFANTE: Costs need to go down, period. Let me expand. Out of those 80,000 megawatts that I said were planned, all of them are either direct investment by my membership or PPAs signed by my membership, meaning the electric sector is not only involved in this, it is a crucial actor. We often forget it. When it's not us directly, we interconnect, as was mentioned before.

The queuing process is sometimes out of -- it's just a mess in some areas. It's not really the fault of the incumbent necessarily. The industry does recognize the value of solar for peaking and all those things. That's why we are actually investing in it. It remains very expensive, and it is an industry where regulators -- and then we can go one by one, all 50 of them -- well, I guess 51; D.C. has also a regulator -- they go through prudent reviews, and if they think that the investor is not prudent, they will not allow it.

Our utilities, our members, and the regulators have a statutory obligation to provide power at just and reasonable rates, and they have the obligation to maintain the reliability of the system. All that comes at a huge cost. Integration has a lot of cost to it. The whole allocation of those costs, like who's going to pay for it and when and how and what circumstances, haven't been fully figured out yet, and I think it's normal. We're in the process of learning and seeing how the markets are able to integrate all those. And again, the U.S. is a very complicated system that way because each region has its own mix of resources and its own mix of regulatory rules and its mix of market rules and none two are the same. And to that we add one regulator per state. It makes it even more complicated. That doesn't mean that there's any unsolvable problem, and I will go back to what I was saying before. We're very early in the process of integrating renewables, not just solar. We're learning a lot and regions are doing a lot for that, and I think EA member companies and all the other companies as well -- they're doing a lot, and they're working altogether to solve some of those issues.

Costs, I'm sorry, it remains a huge, huge, huge, hurdle. Solar is the most expensive technology by far. It has huge advantages, and I personally see a huge potential in solar. I think it might be the next big renewable energy, and it has the potential to go even beyond wind, I think, because of the DG applications that it would allow. But it has an enormous amount challenges, not just administrative but economic challenges. And again, the regulators will not allow an investment, whether it's a direct

investment or it's an assignment of a contract if it's going to increase prices to the rate payers. It's just not going to happen.

The cost of solar needs to come down, and I think R&D is a fundamental piece of the puzzle, and of course all the incentives that we were talking about before -- they help, but those were not what is going to make the solar industry come to great parity . It will just not happen with that. I think serious R&D, not just necessarily scale. That's my view.

MR. CONNOLLY: One quick point on that. I completely agree that the cost of solar needs to come down. I think that's part of what we're all talking about, the incentives. But we also need to price electricity fairly, and that means the price on carbon, that, you know, solar shouldn't be penalized because it's a cleaner and greener energy source, and that's basically the system that we have now.

And also solar provides other services that aren't always valued correctly in the market. You know, it does provide peak power. It doesn't get credit for that necessarily. And it also, you know, being a distributed source, can save a lot in terms of transmission cost, and that is not always internalized by those putting up the solar panels, so there's -- you know, solar is expensive, but it's not nearly as expensive as our current market prices that add, and we need to reform those market rules to be fair.

MR. EBINGER: Okay.

DR. INFANTE: Hold on, Charlie, let me just -- hold on, because I think it's very important. The one incentive that can help renewables is the

carbon price. And what we are missing at this point -- and I might get fired in two minutes -- is the comprehensive economic policy, investment policy, energy policy, carbon policy that looks at the whole system altogether, and we were seeing a little bit of, yes, we're doing it; no, we're not doing it; I'm sorry it's not personal. But we're still missing that. We're still not getting to the point, which was -- got some sort of public certainty at all of those levels, so the stakeholders, not just the members of my association, but all of them, the developers, they can have a clear picture of what's coming in the next 5, 10, 20 years and then adjust their investment decisions according to that.

And, again, carbon is -- putting a price on carbon is the best incentive for renewables and other cleaner forms of energy.

MR. EBINGER: The final question, which should relate to everyone's expertise on the panel because it's a federal issue, it's a congressional issue, it's a finance issue, and it certainly relates to the IOUs is really one that I would like for my own edification. We've heard several of you today, and indeed a lot of people, talk about one of the advantages of solar as it can serve as a distributed source of energy. At the same time, we get the chairman of FERC and many others talking about that we will never be able to develop our solar and wind resources to their fullest extent until we fundamentally rebuild our national electricity transmission system.

Mr. Wallinghoff, I believe, has used numbers ranging from $350 billion up as the cost probably of rebuilding a high-quality DC transmission network. I would like to ask you how important is the creation of

a national grid to utilizing solar's full potential throughout the country?

DR. INFANTE: He's looking at me. Transmission for solar is like transmission for wind: it's essential. If we're going to create -- let me back up for a second. I think solar is -- solar's potential for distributed generation applications is phenomenal. However, DG has its limitations. We cannot move away from the central station system that we know today. We can modulate it, we can change it a little bit, but it's not going anywhere in the next foreseeable future, let's say, 40, 50 years at least. So, we need central station and we need central station solar. For that, the most economical way would be to exploit the resources that are most -- the least expensive. For that, we need the transmission system to bring those resources to where they are needed. And just like wind, well, the desert in Arizona is far away from New York where the load is needed. I think transmission is -- we really cannot go anywhere seriously on renewables without a good transmission system now.

There's been a lot of new investments in that, but like in all these things there's a lot of regulatory holes and a lot of regulatory pushback. A company willing to make a decision to invest is not good enough. They need to be getting the permits to start building whether it's transmission generation or anything else, and transmission is something particularly difficult in the United States to build for a number of different reasons and something that has -- again, one of those things that has not been solved, not by Congress, not by FERC, not by state regulators, not by the industry. We're

working on it, and we have to get to a solution at some point. Otherwise, just a development of solar wind or, again, anything. It just will not happen.

MR. EBINGER: Hal?

MR. CONNOLLY: Yeah, this is one of the probably most controversial issues we're dealing with right now. You know, it's -- there's no doubt that transmission's important to concentrating solar and other central solar technologies in order to get them from where the resource is to where the load is, and it's just as important as it is for wind for those kinds of projects. The larger question though is how do we want to frame our transmission policy. Currently we do it state by state and that creates some problems in development, but, at the same time, do we want to federalize this process and have FERC in Washington, D.C., determining whether a transmission line should go through your backyard or through a state park, or is that a local decision? And so balancing those two is very difficult.

The other issue is there's been some movement lately to federalize all transmission issues whether it's attached to a renewable source or not, and in New Jersey for decades there have been attempts to increase the amount of transmission coming to our state, and that would allow our coal generators to our west to have a much more expensive market. So -- and given the fact that those coal generators are part of the reason why our entire state is not compliant with the Clean Air Act, we're not all that excited about adding a new, expensive market for our coal generators to our west. So, there's other -- it's not as simple as transmission's good, let's build it,

especially when we're talking about hundreds of billions of dollars of investment. You know, we need a system where we're weighing local interests and also looking at the entire electrical system as a whole or what kinds of generation do we want to add to the grid or do we want to just build transmission everywhere. So, it's a complicated ongoing debate.

SPEAKER: I just thought I'd add, you know, to your point about reaching solar's full potential. I think that's the operative word to me of that's where, yes, transmission solutions will need to be brought to bear, but I'd like to echo that there is a tremendous amount of innovation on the distributed generation side that will take solar much farther than it currently is. And, you know, I'd propose that we don't need to solve every problem before you take significant action on the opportunities that are in front of you, and I'd -- this doesn't play in a lot of states, but we often say look to what California is doing. Not only are they leading the country at the state level by an order of magnitude, but largely because of some innovative state policy, the utilities are innovating on the way that they are integrating solar.

And so the traditional -- in addition to doing traditional customer-sited, customer-owned generation that is net metered, Southern Cal Edison has created a whole suite of programs to meet some of their renewable portfolio standards with solar looking at utility-owned customer-sited. So then the utility itself owning 1 and 2 megawatts' worth of solar on large industrial rooftops around their territory and owning that utility-facilitated third-party-owned solar where they enable power purchased agreements for third-party

owners to do solar on those same large flat rooftops and combine those, it's a 500-megawatt program: 250 utility owned, 250 third-party owned.

In addition, they're exploring kind of wholesale distributed generation that's similar to a feed-in tariff where they provide standard offer contracts for that. And so when you look at kind of the business model approach, there's really a whole portfolio, and so it's not just a matter of picking the one thing.

PG&E to the north is taking a slightly different approach. They're looking at trying to site between 2 and 20 megawatt systems that are kind of in between customer-sited and utility scale at strategic locations on their grid that will provide specific support to their needs. And so I think the lesson there is there's a lot of different opportunities to take advantage of what solar can do if you have a focus to solve those problems, and I agree that the transmission issues are significant in the long term, but there is progress that can be made quicker.

MR. EBINGER: Thank you.

DR. INFANTE: May I add one thing?

MR. EBINGER: Yes.

DR. INFANTE: Sorry. I just -- I agree completely. I just want to add one point to rich and the full potential. Even in DG, I think eventually we're going to need a functioning smart grid, and I know it's not going to happen overnight, but it's my personal opinion. I don't think we can have a fully developed DG system without a properly functioning smart grid for -- just

the way it is.

MR. EBINGER: Okay. The audience has been very patient. The floor is now yours again. Will you please identify yourself before you ask your question? The lady all the way in the back.

MS. BLISS: My name's Diane Bliss, and, again, I'm a concerned citizen.

Dr. Infante, to take what you started to say and take it a little further -- this is actually not a question, but a statement -- five years ago, I was working as a technical --

MR. EBINGER: Please limit it to a question, please.

MS. BLISS: Well --

MR. EBINGER: We don't really care for a statement. I'm sorry. That's not the purpose of this forum. So, if you don't have a question, we'll move on.

MS. BLISS: Well, I'm just going to go ahead and make this statement anyway. What most people don't realize is that the EPA only measures what are called tailpipe emissions, that there are emissions that are let out into the atmosphere every time any kind of carbon is mined or wells are drilled. And the EPA only measures perhaps 10 percent of carbons emissions into the atmosphere, and that's part of the reason that I'm here. So, Dr. Infante, and actually I'll go ahead and ask the rest of the panel, what do we do to get the carbon industry and the EPA and our government to be a little more honest about the actual emissions and the impact on the environment of

the carbon industry?

DR. INFANTE: I cannot speak for the EPA, but basically what you're saying I think is that we need economy-wide carbon policy whether legislation or regulation that includes life-cycle everything. I would not disagree with that.

Now, how do we go about it? I'm not sure because that, again, would go back to the international competitiveness, all those things to be fully thorough. I guess you would have to go abroad and say, okay, this product I'm importing and what was the carbon footprint there, and just take the whole -- not just the life cycle in the United States, but abroad. I saw recently some study on the footprint of LNG, and natural gas is very clean, but apparently the -- again, life cycle of LNG is not as clean at all. It's -- and I think it was similar to domestic coal production.

So, again, I don't know how to go about it, but I would agree that, you know, the more comprehensive and the more we include the better it would be.

MR. EBINGER: The gentleman on the aisle there, the blue?

MR. FRIBERG: Good morning, and thank you for an interesting panel. My name is Lars Friberg. I'm the climate and energy attaché at the Swedish embassy. My question goes to Richard and to Lola.

Richard, you mentioned that one of the investments you are making is in concentrated solar thermal, and given that concentrated solar thermal is happening is Extremadura in Spain, it would be interesting to hear

what your thoughts are on that. Because as we pretty much only talked about PV -- and PV is nice and I would very much support it -- but if you're talking about serious, you know, chunks of replacing coal, concentrated solar thermal, which can go to, you know, hundreds of megawatts and in installments, what do you see as the prospect for that? I mean, the research cost might not come down as steeply as for PV, but then you can really have it in big chunks where it can make a difference not just in peak load, but also in base load.

DR. INFANTE: I agree. I think there's room for every technology, and each technology has its own advantages. Out of those 80,000 megawatts I talked about before, I think about 50,000 are thermal and only 30,000 PV. And that does not include distributed applications. It's not a utility, a scale. Of course, working where I work we don't like peaking technology anything. Whatever the market develops is whatever the market develops. But I think there's room for everything.

I think thermalized -- you pointed out some sort of thermal has a lot of potential. It also uses a lot of water just like any other combustion technology, which has its drawbacks. And all cost is high, but so is the cost of PV, which has not the water issue; it has a land issue and the capacity issue we were talking about. Again, I think there's room for everything, and I think everything will be developed.

SPEAKER: Yeah, maybe just to add, you know, the point about water, of course. Typically the place where solar thermal works great is in the

desert where you don't have water, so -- or water's an issue.

I also think that -- and while we're an investor in it, I think it goes to this really -- this point about distributed versus centralized solutions. And, you know, I hate to hear, well, what you say about, you know, that we're going to be in this central station world as far as the eye can see, because in the United States -- we think about the problem in the United States. It's really one about efficiency. And as long we continue to define the problem as one of production, we're never going to get anywhere in terms of what's needed to -- if your focus is greenhouse gas reductions -- because when you look at the numbers, it's just impossible to imagine making any meaningful dent without greater efficiency, because we cannot build enough new, clean sources of production to move the needle in a foreseeable period of time.

So -- and maybe the last point, sorry, is that the issue on the solar thermal is, from an investor standpoint, it's really kind of a nightmare to get these projects financed, because they're -- there's not really much technology. It's a giant construction project. And so the problem with it -- the reason why you see more of these projects is that nobody's going to build a project like this unless they have a power purchase agreement from utility. Well, utility is very happy to enter into a power purchase agreement at a low cost, so that means if you're an investor, you know what your revenues are. Fantastic. Now you've got to go build a plant. You don't know what your costs are going to be. So, it's a little bit like the person down the street that finds a great building that they want to put a restaurant in. They're not the one

that makes money; it's the next person that buys the restaurant that buys the kitchen, you know, for cents on the dollar.

MR. EBINGER: Thank you.

Yes, ma'am.

MS. WORTHEIM: Good morning. I've been learning a lot. I'm sorry I got here late. I'm Mitzi Wortheim, and for four years I ran the Energy Conversation, which was the only place in the city where you could learn about energy across the board. It was funded by the Defense Department. We started it in '06.

One of the things that became so clear -- I'm a social anthropologist, so I didn't know anything about energy, but what's clear to me is how do you tell the story so John Q. Public understands it? And I think the complexity of this whole energy story is it has to be visualized, so I was listening to what you were saying and wondering, for example, would the Department of Energy ever be willing to create a map and would each map show what are the rules and regulations in that state that you have to go through in order to build the grid? I mean, I think it would be very helpful for the public to understand the complexity of each one of the issues that we're dealing with. It's all a fog, and one has to spend an enormous amount of time trying to learn about it. And you hear it debated in Congress, but you have no basis upon which to say this sounds like a good idea or a bad idea. So, I'm suggesting, as a citizen, I'd like some of my money at DOE spent on doing this.

SPEAKER: I completely agree. In fact, we've done that. Thanks for teeing that up. So, if you stick around for the afternoon, again you will hear my colleague from NT State probably talk a little bit about the DSIRE database of state incentives for renewable energy, which is a longstanding website resource to provide that transparency. And I don't believe right now it covers kind of transmission and that level of policy, but certainly state and local and now federal-level issues associated with the incentives and regulations around renewable energy and energy efficiency, and so being able to say I am in this particular city, what are the rules for me, and what are the incentives available for me. There's a clickable map. You can go right on it or list the actual text of every -- as well as a summary of every policy that affects you in the available incentive, so it's kind of our No. 1 go-to for inquiries on that.

On the market itself, I'll add that that we have just invested in a new kind of visual mapping resource called the PV open mapping database, which is hosted at the National Renewable Energy Lab. But is it tempting to provide that same kind of transparency on installations, their location, and their cost and their size so that you can see where is the solar in the country, how much did it cost to put it in, and show trends over time and some really interesting visualizations that help capture kind of the status of where we are in the country. So, that's -- if you to go the NREL site, just look for "PV open mapping" and you'll be able to find it.

MS. WORTHEIM: Okay, since we know where to go, because

it's not -- I mean, I hadn't found it before.

SPEAKER: Exactly. We're going to get some more fliers printed up, Steve.

MR. EBINGER: We have a lady here in the middle.

MS. WOODWARD: I'm Jenny Woodward from the World Resources Institute, and I want to get a little bit more detail on the interconnection in that metering issue because I think it's very important.

In a sort of regulatory baseline minimum you don't need, you know, public funding for it, but PV's not going to happen in states where it's not in place. So how -- could you talk a little bit more about the challenges and Senator Bingaman's efforts to let FERC set a national sort of minimum standard? And what -- if the only challenge is these entrenched utilities, what are the arguments that they put up against it? And is there a sort of quantity in terms of megawatts and size of the project where the challenges or the concerns become legitimately different? So, is there is a big difference between 2 megawatts and 15 kilowatts and --

SPEAKER: Yeah, that's actually precisely one of the main arguments that utilities make is that they -- and it's a legitimate argument that they want to have the right to determine -- to have some say on what goes on that grid because it's going to greatly affect how they operate that grid, and that makes perfect sense. And there's no question that interconnecting distributed generation can make their life more difficult and creates a new regulatory environment and has costs, and there are plenty of legitimate

arguments that they make. But I think that most of those of arguments have been passed by, by the experience of other states that have shown great success in incorporating distributed generation in their grids and the amount of economic activity in jobs that that creates. I mean, I think a lot of it is, frankly, just -- it's very difficult to change the way things are, and there's real entrenched interest in keeping things the way they are because that's just easier. So, that's been one of the prime problems.

There's also -- I mean, there's also legitimate concerns about, you know, state and local rights versus federal control over how the grid works, and so there's issues there. But I would have to say that it's not had a full airing yet in the Senate and that the debate hasn't been as robust as I would like it to be. And I think if people honestly spoke about and worked through these issues, we could figure out a way that would make the utilities comfortable and get us to where we need to go. But it's not one of those issues that have really risen to the top yet.

MR. EBINGER: Yes, sir, in the back. We'll try to get to everybody.

MR. SALISBURY: Thanks. Ben Salisbury with FBR. I was wondering -- we're talking about sort of the PPAs and the difference between that and what actually gets billed, and I was wondering if you would talk a little bit more focused on sort of California, but nationwide. Is there any tolerance in the environmental community for reforming NEPA and citing in some of these other barriers to utility scale solar? If utilities are willing to bring large-

scale PV under their balance sheet and sign PPAs, then everybody knows we'll never get billed. Isn't that almost worst for the environmental effort than having a more modest, but more realistic approach, especially as it relates to NEPA and citing?

Thank you.

SPEAKER: All right, I guess I'm taking a crack at that. It's a very important question, a very important issue where engaging with the environmental community and primarily the desert Southwest in regards to the larger scale concentrating solar power plants and others that were talked about where actually the department is in the process of planning a solar demonstration zone that will be a very large demonstration effort to showcase new technologies on public lands to help financing and help mobilize the development of large-scale projects, and working through federal citing issues is a critical component to that. It's kind of right up there with transmission as a structural issue that needs to be sorted out. And I think in a lot of ways it's coming to grips with legitimate policy concerns on both sides and, you know, energy development and environmental protection and wildlife protection. And we're trying to foster the right kind of dialog so that the industry can do what they need to do to minimize their own impact and the environmental community can better understand the full benefit of having clean energy development and what that means in aggregate.

So, it's a -- it's kind of an ongoing conversation, but I think we're shooting to have a lot of those issues kind of dealt with very transparently and

as much as we can resolved in the next few years so that we can get to a set of best practices and approaches that all of the key interests are met.

MR. EBINGER: Gentleman in the white shirt next to the lady in the green?

MR. NIX: Oh, hi. Michael Nix with PJM Interconnection. Question to the whole panel, particularly Dr. Infante.

We've both got a lot of member companies that are telling us, yes, we need a price for carbon to go through on some of these projects. One of our mutual member companies mentioned the other day in a public forum how with clean air and emissions restrictions on them, both federally and in various states -- this particular member company of ours said, okay, other than investing in carbon capture and storage, we're going to through with all our other clean, green technology investments for the foreseeable future. I had thought previously that, yeah, we need the -- we need federal legislation, we need to set a price for CO_2, all right? Can we do this without having a federal piece of legislation passed? And are the states and other federal initiatives -- are these going to make it possible for us to actually move forward with these investments and new technology deployments?

DR. INFANTE: We can do it with a price on carbon. It will just be more expensive. I think we would -- I mean, the options that come to mind just like that -- either regulation or a mandate by technology -- just -- I mean, all that achieves the same, let's say, environmental goal at the end, just at a much, much, much higher price. So is that really what we want to do? I

would think not. But could we eventually do it? Absolutely.

What we're seeing is a lot of shift in investment decisions right now towards clean energy even in the absence of legislation or regulation just because of the anticipation of it. So, there was a lot of delayed investment, but a lot of actual investment in cleaner technologies just because that's what we're expecting or anticipating. And just the fact that there's some looming change of rules is enough to change the risk of some investments and make others more attractive. I think this, in a nutshell, is we could do it. It would just be a lot more expensive.

SPEAKER: (inaudible)

DR. INFANTE: Yes, yes, yes.

MR. EBINGER: Yes, ma'am.

MS. JACOBSON: Debra Jacobson, G.W. Solar Institute. I have a question about federal tax incentives, and two problems. One is that the cash grant program, which had been put in place because the tax appetite was not there to use the investment tax credit for solar; that's expiring at the end of the year.

Number two, basically individuals haven't been able to invest, so there is legislation by Congressman Blumenthal which addresses both the -- extends the cash grant program and also allows a real estate investment tight mechanism. And so I'd like your views on whether those types of approaches are needed to keep the momentum going on solar.

MR. CONNOLLY: Yes. I mean, as I said before, I think when

we're talking about -- what you're talking about really goes to the issue of deployment. And so most -- if you really want to get deployment of solar, both in terms of utility scale developments that are not developed by the utilities themselves, but by independent developers, or if you want to have individuals get involved in -- but I think really the real deployment here that would be most helpful would be utility scale. You need to have tax incentives that really can be easily turned into cash, and that does not happen at the developer level without the grant.

MR. EBINGER: In the back there, two gentlemen. Start with the aisle and then we'll move over one.

MR. HARPER: Hi. John Harper with NPRI. My question is for Charles. What opportunities are there for contractors and other members of the private sector to take advantage of DOE solar initiatives aside from tax incentives?

MR. HEMMELINE: So, the bulk of our effort comes in, in the form of kind of R&D investments as well as grants on the market transformation side, though most of our market transformation work is focused on state and local governments and workforce development investments, kind of the government-to-government infrastructure development. But in our R&D portfolio on the PV side, on the CSP side, and the systems integration, you know, close to half of our total portfolio is to private industry to support new technology development, new system development, new methods of smart grid, interconnection, and grid communication investments there, and CSP

type things. So, I think that's -- if you look across our whole portfolio, we're fairly heavily invested in the private sector. So, we have -- solar.energy.gov is our primary website, and there's a financial opportunities link there that will take you to whatever's currently open and upcoming.

MR. EBINGER: We'll go to the one -- the question behind the gentleman who just asked it. Chase?

MR. WEIR: This is Chase Weir again. I'm going to put on a different hat. I'm also the chairman of the EarthShot Foundation and, like Mitzi, we look to elevate or have a positive impact on the content and the quality of the conversations that we're having like the one this morning. As an entrepreneur, I have a bit of a bias for market-based solutions. And I got caught off-guard last week and ended up being sequestered in a room for a couple of days with a carbon war room, talking about distributive generation in gigaton scale, scaling up, stepping up industries. And the mandate was to focus exclusively on market-based solutions, and we could not do it. And I think it's important to note that I would rather build a solar facility in New Jersey than Arizona.

And the industry is policy driven, and from that perspective, if you're going to blend the two together, what's most important to me is access to capital, cost of capital, pace of deploying that capital, and the return on that capital. So my question specifically to how -- and to Charles, do you foresee the Treasury grant being extended? Do you foresee bonus depreciation being extended? Do you foresee AMT and passive activity restrictions being

removed? And are you focused on credit wrap around long-term cash flows on the projects?

I know it's in the weeds, but this is what's actually going to step up what's currently a microscopically small industry. And if you want to win the regatta, you've got to have wind in the sails. We've got a slight breeze, and it's about to end. I'm wondering if there's a gust coming.

Thanks.

MR. HEMMELINE: The -- well, that's a very good question. The -- I can say that there is a lot of support, including from my boss, to extend both the Treasury grant program, both depreciation, and that there's -- the only real argument given against them is how to pay for it. How do you offset those costs? And for my boss, it's pretty simple. You know, President Obama has laid out a plan whereby we could cut oil subsidies to the tune of tens of billions of dollars and help pay for cleaner energy like solar, and that's a pretty easy call for my boss. But, you know, when you look across Congress, it's a little harder call for some other folks.

But, you know, to be honest, I think that in order for some of these things to happen at this point, we're going to need some momentum on an energy bill and/or climate bill soon because otherwise we're unlikely to get a corollary tax package out of the Finance Committee to join that bill. So, you know, it has less to do with the merits of the actual programs and more to do kind of what's happening on a larger, very partisan, arena right now. And if there's momentum, sensible programs like that can happen. But if there's not

larger momentum, it's going to be very difficult.

MR. EBINGER: We have time maybe for one more question. Yes, sir?

MR. AMA: Thank you. My name is Yoni Ama of Mitsenda Company, a Japanese investment company. My question is the more we rely on renewables, I think we need power storage technology because the renewables are not necessarily stable for supply. Do you think the technology is sufficient to cover the power storage requirement or (inaudible) would solve the issue?

Thank you.

SPEAKER: I'll take a crack at that. It's a good question, and I tend to answer that in the same way that we answered the transmission question. It's something that would benefit the full potential of solar, but not something that's necessarily needed to make significant progress in the next few years. I think that on the DG side, there is a tremendous amount of opportunity to scale up at a level commensurate with, say, PG&E's 50,000 interconnections that they have and that sort of thing before storage truly becomes a limiting factor to the long-term scale-up of solar. I think it's something that would certainly benefit and help you capture the full value of what a Peking-distributed, clean, renewable energy source could provide and the economic value to collaborate with the smart grid, but it's not necessarily something that's immediate.

In the shorter term, I think that that's also one of the advantages

that CSP has, is the thermal storage capability of those large plants is very attractive and, in fact, we're moving very quickly to that to support it both on the R&D side. And we're seeing on the procurement side that utilities are kind of demanding it of eight hours of storage in CSP plant developments, which gives you the kind of ride-through that you would need to smooth out the curve over time, and I think will happen quicker than electrical storage.

SPEAKER: I just wanted to add to that. I completely agree because it's often used -- the question of storage is often used as a reason sort of not to begin. But solar is such a tiny, tiny percentage of power generation in the United States that it's not relevant now.

But the other point I wanted to make is just the interesting experiment that Google has been doing, which I think many people know about, but this whole idea that with plug-in electric hybrids -- and, you know, they're definitely coming -- the idea that solar could be used to charge up the cars during the day when people are at work and solar charging stations. Then when people get home at night, they plug in when they get home and then that's a source of power that can be used at a time for peak. And then later off peak, later in the evening when people are sleeping, the cars get charged up. And so that requires, you know, a lot of things, but that's an example where the smart grid and storage and other things, you know, come together in a kind of neat solution.

MR. EBINGER: Well, I want to thank Dr. Burns again for her excellent keynote presentation and for staying with us through the morning

session. And I want to thank all our panelists very, very much for your participation.

We'll take 5 minutes and have the next panel.

(Recess)

MR. BANKS: My name is John Banks. I'm a nonresident fellow in the Energy Security Initiative here at Brookings. And on my behalf, thank you all again for coming and thank you to our guests for joining us today.

I am going to follow the same format, which is to give each of our panelists about five minutes just to introduce themselves and talk a little bit about what they're working on. And then we'll move to some moderated questions that we'll kick out and follow it up with a Q&A from the floor.

I won't read the full bios; you should have those in the handout. I'll just mention that to my immediate right here is Bob Boehm, a distinguished professor of mechanical engineering at UNLV in Nevada. And I just want to make a mention that Brookings and UNLV do have an ongoing partnership -- Brookings Mountain West -- and we are particularly very happy to have Bob here participating today.

To his right is Steve Kalland, director of the Solar Center at North Carolina State University. And to his right is Kathleen Weiss, vice president of government relations at First Solar, Inc.

So with that I'll just give the panelists their five minutes to sort of introduce themselves and discuss a little bit about some of the things that they're working on. Bob, do you want --

MR. BOEHM: Well, let me just say a couple of words about Nevada. As you may know, there's a lot of solar activity taking place there. We have a 10-megawatt silicon plant in operation, and we're headed for 58 megawatts of thin film PV, and we have a 64-megawatt solar thermal plant. In addition, there are a number of other plants planned in Nevada. One of our issues is, of course, most of Nevada is owned by the federal government, and that complicates life just a little bit.

At UNLV we have something called the Center for Energy Research. This is a totally soft money-funded operation where we work primarily with industry in terms of helping them bring products to market, as well as helping them improve their products in the marketplace. We work on a variety of topics from solar thermal. For example, we have a contract where we're participating with Acciona Solar with their solar thermal trough project in terms of getting some storage, thermal storage, put on that. We work a lot with concentrating PV. We're the primary research institute for Aminex Corporation, a company out of California that does high concentration photovoltaic work. We've been involved in hydrogen installation, particularly hydrogen generation from solar energy and the use of vehicles being converted for hydrogen applications. And we work a lot with home builders and applications to buildings. We have a big DOE project related to decreasing the peak electrical demand for a Southwest new community where we're working with Pulte Homes, the world's biggest homebuilder company, and our local utility, NV Energy, in an attempt to decrease the demand for

those houses by 65 percent over what the demand would be for code-built houses.

So there's a wide variety of things, and most of our work is done by students, typically graduate students, but a number of undergraduate students, too, where it's appropriate. And we have a number of courses and class-types of things at UNLV. We have a minor in solar energy that's open to anyone who takes any degree at the university, undergraduate degree. It has two tracks: a technical one and a non-technical one. And we're in the midst of hoping we're going to be starting a very comprehensive program that will service industry all the way from basic research through financing and various other kinds of things. We'll know in September whether that's a reality.

MR. BANKS: Thank you. Steve?

MR. KALLAND: Well, my name is Steve Kalland. I'm the director of the Solar Center at NC State University. We're part of the college of engineering at NC State, but if you look at my bio, you'll see that I'm not an engineer and actually most of my staff aren't engineers these days either. It's kind of an -- we're an odd duck over at the university.

The university got involved in this through its public service side, something called in a land-grant university the "extension and engagement mission." And we really are not like many of the university research centers around the country in solar. We're not a bunch a guys in lab coats and petri dishes. We're more tech transfer oriented, and so you heard Charlie earlier allude to the DSIRE database which is probably our most visible national

project, the Database of State Incentives for Renewables and Efficiency. It's www.dsireusa.org. Be very careful keying it in. The web was a much kinder, gentler place when we picked that name.

But that said, we do a lot of work in policy, tracking what works and what doesn't work around the country, providing that information to folks and providing technical assistance to legislators and interested stakeholders that are trying to implement those types of policies. We do work on interconnection and net metering nationally through IREC, the Interstate Renewable Energy Council. We're one of their primary partners in a lot of that work as well.

In North Carolina, we are a much broader organization than our name might imply. We actually have programs in the full gamut of renewable technology, solar, wind. We do a lot of work in hog poop and chicken poop because we have a lot of hogs and chickens. We have landfill gas technology work going on. But again, our research tends to be on the applied to demonstration and deployment end of the spectrum.

We also have extensive programs in economic development. We have a couple of MBAs on staff that do nothing but work with companies that we're trying to convince to either come to North Carolina or, frankly -- and several people alluded to it this morning -- the vast majority of their time these days is spent talking to former real estate developers that are trying to diversify into the energy sector. And so we're spending a lot of time helping people work through financial models to try and figure out how to monetize tax

credits, take advantage of renewable energy credits, and all the other pieces of the puzzle that you have to blend together to get a project to go forward.

We have programs in K-12 education and do a lot of work with middle schools in particular and high schools on electric vehicle technology and in solar technology. And we have a fairly extensive workforce development program. Again, Charlie alluded to the fact that we're one of the new DOE regional training centers for trainers in solar focused on both photovoltaic and solar water heating technology. Our focus in our Center is to really work with community colleges, so we actually are the Center that represents this particular area. We cover Maryland, D.C., Virginia, North Carolina, and South Carolina in our regional Center. And we're working closely with the community college systems in those states to help identify instructors that are already doing work in electrical or thermal plumbing or electrical work to get them trained up on how to incorporate solar into their existing curriculums. We don't really want to create a bunch of solar trainers. We want to create a bunch of licensed electrician trainers that will teach people about solar. And so we're trying to do our best in fit into the existing market on that front.

We're also the administrator of the state's green building program, the North Carolina Healthy Built Homes program, which is kind of a residential version of the lead program that many of you are familiar with probably. We do a lot of other work in industrial technology. We're the home of the DOE's regional Application Center for Combined Heat and Power. So

it's a pretty diverse set of activities.

Someone was talking about students earlier. We do have an array of different students at our Center that come from a lot of different backgrounds. We were laughing about it the other day. I actually have more students right now from outside of the college of engineering than I do from inside the college of engineering. My dean is not overly pleased with that, but, you know, we have folks right now from the college of AG and life sciences that are working on biofuels with us. We have folks from the school of design that are working on the building side. Certainly the folks out at the business school, we're always anxious to lay our hands on those folks these days because so much of this game is about trying to put together the financial models. We have them from three different departments in the college of engineering and just an array of other sources. Plus, they're sneaking over to us now from Duke in Chapel Hill because they don't have as many hands-on programs as we do. So, it's a lot of fun these days. I'll leave it at that.

MR. BANKS: Thanks, Steve.

MS. WEISS: Well, I just want to add my thanks to Brookings for putting this panel on today. I think it's really important to keep beating the drum and special thanks to Dr. Burns because she really is out there on a regular basis, making sure that the pressure stays on to move ahead because it is so critical to get action sooner rather than later. And as the panel before this said, even if the action isn't everything we want today, that's no reason to stop moving ahead. So, incremental change is just as valuable in the short

term as the big monumental change that we'd all like to see.

Just want to do a little commercial before I start. Solar Energy Industries Association released their yearend review the other day and it's up on their Web site. And I think it's really important to look at the industry statistics. So, as many people said earlier, it is a small industry, but the growth is phenomenal. And even despite just the horrible, horrible economic conditions that we saw in 2009, the solar industry continued to grow and actually had its best year ever. Solar electric installations grew by 37 percent and cumulative capacity surpassed 2 gigawatts, and revenues grew 36 percent. That's the industry at large. I'm here to talk a little bit about First Solar and we not only mirrored that growth, but we saw, you know, growth trajectories at double those percentage rates.

So let me tell you a little bit about First Solar and then talk a little bit about the policies that helped us reach scale and the speed in which it happened. And really terrific first panel because everything they said was exactly true, even some of the conflicts within. I mean, there are things that just need to be worked out.

So First Solar's the world's largest panel manufacturer, and not coincidentally we're the cost leader. Since the end of 2004 -- so that's just over 5 years -- we've grown fifty-fold, so from a manufacturing capacity of 20 megawatts to over a gigawatt a year at the end of 2009 and adding another almost gigawatt in the next 2 years as well. We've brought our cost of production down two-thirds over that time, so from about $3 a watt to $.80 a

watt with a cost reduction roadmap targeting $.50-$.60 a watt by 2014. And that's on the module side as the other panel said. That's about half of what you need to look at, so you'll also need to look at balance of systems. And you learn by doing and you cut costs by doing, and I think what we've seen since we've entered the utility scale deployment market is the same opportunities to really wring costs out of the overall system cost in a significant way as well. We've built a multiyear pipeline of business extending through 2013. The total's nearly 10 gigawatts as of today.

You know, we've been an engine of growth in the economic development in the areas where we've made these investments. So direct employment -- and that doesn't count all of the indirect and consulting employment that's a result of our activities -- but the direct employment of our company has grown from 200 full-time employees to just under 5,000 in a few years. We've invested over a billion dollars in new production capacity and technology development.

Our focus has been on developing clean, affordable solar electricity. And I'm just going to emphasize "affordable solar electricity" because some of the myths about solar is that it's too expensive. It's more expensive, but costs are coming down, and in some places it is reaching grid parity if you look at peak pricing. There's a little ways to go, but not really the decades timelines that some would have you believe.

And the ultimate goal is to have an energy source and an industry that doesn't rely on government subsidies. We certainly rely on them

today. They're very important because the industry isn't at scale, and we've seen through looking at Germany and some other countries what can happen when the government decides to get behind in a significant and meaningful way this industry to help it scale. But we need that initial couple of years to get off, you know, to get further down the road in terms of our cost. But ultimately, this isn't a very smart business model if it can't stand on its own without excessive government subsidies. And so that's our -- that's a part of our mission as a company.

But we also spend a lot of time thinking about our environmental footprint, and that's really important. To be not only a sustainable economic company, but sustainable in terms of the way we look at our overall energy production. And we're very proud of the fact that we've implemented the industry's first pre-funded collection of recycling program for our modules.

So what are the policies and conditions that have enabled this growth, innovation, and success? Well, the formula's pretty simple. It's basic research, venture capital, and markets, and that equals jobs and innovation. So let me elaborate a little bit.

First, research: One of the keys to our ability to bring costs down is the thin film semiconductor material we use. Much of the basic research of this technology was funded by the U.S. Department of Energy and conducted in U.S. research laboratories. So such basic research funding is a critical area where the government really does need to step up its support. It's okay to shoot for the, you know, shoot for the -- I'm not a sports person, so I

screw up sports analogies, but rafters or whatever it is. And that's important to do, but I think as the panel before me said, there's so much more that we can do with the existing technology that we've got today, and we shouldn't ignore the basic research around some of the existing semiconductor materials that are being used.

Second is venture capital. In our early stages of commercialization and innovation, we were funded by venture capital which got us through our first commercial production, enabled us to ramp production and go public as a public company.

Third is the markets. So the solar market is supported by government programs, particularly in Europe and specifically in Germany, have allowed for solar to reach the scale we have today and reduce costs. So this is an area where I think the U.S. can learn from some of the best practices that have been deployed in other countries. Countries like Germany consider the solar industry strategically desirable due to its high technology content, job creation capability, long-term growth prospects, and environmental benefits. And they've implemented transparent support policies such as feed-in tariffs that are attracting private sector investment, value chain development, creating critical masses of talent, knowledge, and industrial activity. There's a lot of activity in the U.S. We'll wait and see what happens with it, but as mentioned on the earlier panel, there's a couple of things that really do need to get focused on. Transmission is one of those, access to the grid, reasonably priced project financing, and facilitating good, open export and

import markets.

Thank you.

MR. BANKS: Okay, thank you. I think it's encouraging that we're now talking about solar in terms of "giga" with a "g" in front of the watts. A few years ago that was not the case.

I'd like to start -- the way we've crafted this is to have a discussion initially on some of the technologies, and then move into a discussion on R&D and then on the employment side of things. So I'd like to kick this off with a question to Bob.

I was reading recently a few analysts and a little bit of literature suggesting that we're sort of reaching the theoretical efficiency limits of polysilicon-based PV, and that the number of cost inputs along the supply chain for polysilicon is too daunting and that thin film is sort of really the direction to take given its lower materials costs and other factors. Bob, I was wondering if you could take a step back with that as background and sort of give us a view of the state of the current PV technologies, particularly in terms of cost efficiencies and scale, sort of where we are right now?

MR. BOEHM: Okay. Well, PV comes in -- I would classify it in really three categories. There's silicon, which has been the historical one, and typical silicon monocrystal and silicon efficiencies are somewhere in the low 20 percents. An example of this, an American company is Sun Power, who makes cells of this type. That market is, I think, kind of locked in terms of price benefits that are going to be accrued in the years to come. Perhaps we'll see

some drop in prices, but I don't see that happening too much.

Then move on to thin film kinds of systems. The First Solar system is one that's getting a lot of press these days and with good reason. At a recent Renewable Energy Conference in Austin, Texas, there was a paper by a company that monitors the development of PV projects and what the prices are. And they surveyed a lot of the PV projects that have been put in in the last two years. And the cheapest by far was one in Southern Nevada that Sempra Energy put in which was about half the price of other kinds of PV projects that had been put in. So this technology is showing really good pricing movement.

It also is, as was mentioned in an earlier presentation, we're getting to the point where grid parity is becoming a reality. In fact, this particular paper predicted that within two to three years that all but two states in the United States would have grid parity with photovoltaics.

Another area that we've worked quite a bit with is in concentrating PV. This is a little more of a niche product because it involves use of very good beam radiation, which is not present at every location in the country, but certainly in the desert Southwest we have a lot of this. And this uses what we call 3-to-5 cells or multijunction cells that are extremely efficient. And we're going to be seeing some efficiencies of these, I think, that in the near term will be surpassing 30 percent efficiency with this kind of technology. So if you have a low footprint, small footprint, land that you have to develop, then concentrating PV may be the way to go. If land space-wise is not so

crucial, then the thin film kind of an approach is the way to go.

So I think we'll see these various technologies -- there are thin film silicon cells, amorphous-type things, which also have promise as was mentioned earlier today. So there's a number of PV arrangements. There's also the whole area of thermal kinds of applications which I could talk on, too.

MR. BANKS: Okay. Maybe we'll come to that in a second. Does anyone else have -- Steve?

MR. KALLAND: Well, I just wanted to highlight that there's a whole lot of hype about kind of next generation beyond what Bob's talked about, photovoltaic cells out there. Depending on which, you know, investment newsletter you read or which, you know, trade press you read, there's conversation about, you know, printed cells and nano materials and people working on, you know, biochemical photosynthesis emulators and just a whole array of things that are out there. And if I had a nickel for each time that somebody said that we were going to have, you know, unbelievably, you know, orders of magnitude drops in prices of solar because of these new technologies being talked about out there, I could actually fund the Solar Center myself. There've been a lot of those claims made over the years and, you know, it never seems to quite happen. So I'm not sure what the disconnect is there, but there are a number of actually fairly significant and real new technologies that are on the horizon a little bit further out that the Department of Energy's making substantial investments in and a number of private sector companies are as well.

I think that, you know, some of the most exciting work -- but longer term work so I wouldn't be going out and, you know, planning to disconnect from the utility anytime soon -- is looking in this area of solar fuels and trying to work in the direction of, you know, basically ways to emulate photosynthesis that creates a storage methodology for solar technology, you know, as a direct conversion. That technology is still, in my opinion, a good ways out and there's no even real agreement on what the various technology approaches that hold the most promise are at this point. But the U.S. Department of Energy is putting a substantial amount -- and I want to say it's like $40 million over 10 years -- into a solar hubs proposal that's on the street right now I believe. And so there's a group at NC State that's partnering with Chapel Hill and the Duke folks -- it's not basketball season so we can get away with that -- and they're working with RTI International. So that's one of several groups. I'm sure there are probably 10 or 15 groups around the country that are looking at that solicitation as a way of, you know, of kind of jump starting the research on what the next generation of technologies really are going to look like.

That said, I can't strongly say, the way that everyone has, that there's so much to be done with the technology that we've got right now that nobody should be waiting around for that.

MS. WEISS: I would just add sort of a little explanation just to really tie up this connection between costs and technology and what's possible in the near term with the existing technologies. So, you know, once a

company has made the initial capital investment to build the machine, then how do you leverage that capital investment to bring down the costs?

So one of them is just improving the manufacturing processes. So instead of producing one panel every 2-1/2 hours, produce one panel every 2 hours and 20 minutes, 2 hours and 15 minutes, you know, 2 hours. So you are really able to ramp up production and lower the costs that way.

And the other way is just the technology so the efficiencies of thin film are lower than some of the other crystalline technologies, but I think you could use the same way -- you could look at it the same way. Our efficiencies have gone up from, you know, the single digits to I think just under 12 percent energy conversion efficiency. So with each incremental improvement over 12, you're not selling the module, you're selling the energy that the module generates. So if you've got the same fixed costs, but you're able to generate more energy off of that module, again, that's just another way you bring down the costs.

MR. BANKS: Bob, I want to come back to something you mentioned which is the whole area of concentrated solar power and some of the technologies that have been deployed or are being discussed and your experience with some of those and sort of where the state of that technology is in terms of cost efficiencies and scale.

MR. BOEHM: Okay. Well, the historic one that's been up until at least recently and may be still the most installed kilowatts of solar energy in the world has been a "trough" technology. And this has been in existence

particularly through some very large plants that were put in in California in the 1980s and are still working very, very well. It's a very durable technology and has shown itself to be quite longstanding and the efficiency has improved each year. They've learned how to make the plants run better. This is the same kind of technology that was used in terms of the Nevada Solar One, which is south of Las Vegas. It was put in by a company that was originally called -- well, it was part of Duke Energy, called Duke Solar, then it became something called Solargenix when it spun off totally. And then, thanks to the feed-in tariffs that were somewhat badmouthed earlier here, in Spain -- Spain has purchased virtually all of these solar thermal companies that were in the United States, and so that gave them the wherewithal to do that. But "they" being Acciona, also Abengoa Solar is another company that's big in this technology, a German company called Solar Millennium is big in this area. And so when a known technology that's a very long-term kind of reliability is needed, then solar thermal, particularly the trough technology, is desired.

The nice aspect about this and the one other one which is a little bit newer in terms of the horizon is the tower, power tower type, or solar central receiver type of approach. Both of these solar technologies can have thermal storage incorporated in them quite easily. And it's not something that's been emphasized in the past, but certainly is being emphasized as we go forward. So we're going to see, I think, almost all of these solar thermal plants mentioned.

Now it was also mentioned earlier today that they require water.

That's true. They operate much better when they use what we call "wet cooling" on them. But the emphasis is now changing to where all these are going to be "dry cooled." Solar Millennium had the right to go forward with a plant north of Las Vegas, and they had the water rights secured for that. They have since gone away from that because of this concern about water, and so we're going to see dry cooling used in virtually all of these plants. It decreases performance a little bit, decreases the payoffs just a little bit, but it's probably good for the long term.

The other technology in solar thermal is the so-called dish, typically dish Stirling kind of approach. A company called Stirling Energy Systems has been working on this technology since the late 1980s and now has come to a point where they feel they have a commercial product. They are putting in one and a half megawatts -- or they put it in -- outside of Phoenix. These are typically 25 kilowatt systems, each with an engine on them that's a distant cousin of the one you have in your car. So what's the big issue about this? What's the reliability of these? Because you have gazillions of these things in a really big field that are all having these engines in operation and what the reliability of those systems will be is something that will be borne out over the years to come.

So that's kind of a brief run-through on the solar technologies.

SPEAKER: Can you spell "trough?"

MR. BOEHM: Trough is t-r-o-u-g-h because it's built like a half of a pipe.

SPEAKER: Realizing that it's not a power technology, but don't want to leave out the solar water heating and space heating. What we've been talking about are the high-temp solar thermal technologies. It is important to remember that this country actually got its first commercial start in solar in the medium- and low-temp solar thermal areas, for water heating, space heating, pool heating. And those technologies have a sorted and unfortunate history in this country. There was a real strong effort back in the '70s and '80s to try and have a solar renaissance the first time around. The price of oil had been escalating pretty dramatically, and people were concerned about energy use and that led to a lot of federal incentives for solar, a lot of state incentives for solar, all with very good intentions.

Problem was that that industry was not tremendously well developed at that time. And so what we wound up with was a lot of good systems being badly installed and a lot of bad systems being installed. It was a real problem for the solar industry over time. Then Reagan came in: I don't like solar; take the solar panels off the White House. Price of oil drops, federal tax credits go away. All of those things happened, and all the tin men who had kind of come into the industry all evaporated overnight, and then you couldn't find anybody in the Yellow Pages to fix your solar thermal system.

And that one-two punch pretty much decimated the medium- and low-temp markets here in the United States, and they've just really started in the last couple of years to recover as a part of this larger solar renaissance. But we are seeing strong evidence that those technologies are coming back

now, to some extent riding on the coattails of the photovoltaic technology folks, as a complementary technology in some cases. And we're, you know, excited to see that.

The other thing that's been interesting is that we're starting to see a whole lot of European, Middle Eastern, and Far Eastern companies looking to come into the U.S. market because they didn't have this problem in solar thermal. And the solar thermal technologies in those countries have been widely adopted, and now they're looking at new places to diversify their markets and the U.S. is the big, untapped, market that they all see. So we're starting to see a lot more interest in medium- and low-temp from foreign companies looking to invest potentially in manufacturing here because they don't want to ship it as we were talking about earlier. That gets to be kind of expensive.

MR. BOEHM: Let me elaborate just briefly. Actually, the wave started much earlier than that. In California, it was back about the end of the 1800s and in the 1900s, there's --

SPEAKER: I can go back to the ancient Greeks if you want, but --

MR. BOEHM: No, but specifically for water heaters, there was a lot of these put in in L.A. And, in fact, there's a very nice book called The Golden Thread which has a lot of pictures of some of these early kinds of systems, both solar thermal as well as others. But every block had many solar water heaters on it. Then oil was discovered in Southern California and

that became the fashion and all these things went away. The industry then moved to Florida where it's held on a little longer there. But it is -- I totally agree -- coming back. For example, our own state is now going to be rebating solar water heating, and I think this is something that's happening across the country. So we're going to see -- it's a very reasonable kind of technology to get into.

MR. BANKS: Let me move to the subject of R&D and, Kathleen, I'd like to address this question to you. You did mention that there certainly is a very strong role for government in basic research. And I guess my question would be, in your view, are the levels and focus of U.S. Government R&D support appropriate to the needs of the industry and the market? And if not, where and how should it be redirected in your view?

MS. WEISS: Well, I'm encouraged because we actually had a call with folks from DOE the other day where they talked about, as part of their Fiscal Year 2012 budget, having a refocus on basic R&D. So that was really welcome news, so I think that's terrific.

You know, what I've been impressed with at DOE over the last couple of years is that there really is an effort to be responsive to what's happening in the marketplace. So a shift from recognizing that there's this huge gap in terms of what's needed to help deployment happen and they created the solar roadmap and they created these deployment initiatives, which is a real positive, again, a positive to get back to some of the basic R&D. So I'm pretty pleased with where the shift has come and where the shift

continues and the fact that the agency seems to be very responsive to the changing dynamics of the solar industry.

You know, I just want to echo something that was said earlier about the connection between R&D and manufacturing, and it's certainly our experience. It's terribly important, I think, to the U.S. to maintain the technology lead because, you know, if PV does become basically a commodity product -- and we've certainly seen an acceleration to it becoming a commodity product -- then the big question is, well, where's the innovation taking place? The innovation's going to take place where the R&D is, where the universities are, and where the research is taking place.

We have manufacturing where we have expanded our manufacturing outside of the U.S., but continue to have a major manufacturing presence in Ohio. But linked to that manufacturing presence is where we're doing our R&D. So all of our R&D takes place in Ohio at our Perrysburg plant. And, you know, are investing to the tune of about $100 million a year in R&D and attracting some really terrific, bright, Ph.D. students, you know, to move from sunny California -- a lot of them -- to Perrysburg, Ohio, which is just terrific.

SPEAKER: Just as a quick follow-up, in your discussions -- in these kinds of discussions with DOE, are you getting sense of where they are looking to move in basic R&D, in any particular area of technology, whether it's PV, thin film, CSP?

MS. WEISS: No, and I think it's appropriate. I mean, you can

just go back to the building blocks of what's out there and what's in existence. So whether it's polysilicon, whether it's amorphous silicon, whether it's CIGs, or whether it's Cattell, you know, the basic building blocks is really in all of those technologies -- can use some additional research, and we're encouraged by that.

MR. BOEHM: As a potential furnisher of Ph.D.s through our program, there are a couple of problems that I think are very much present. One of them is this administration has tended to focus more on the national labs in terms of having that be the center for where research is done. I'm not saying they've ruled out universities, but it's become additionally more competitive it seems like for the universities to take part. The natural trend is to give the money to the national labs that exist of which we have a very high number of these things.

The other thing that is typical of EERE, the Energy Efficiency and Renewable Energy Division of DOE, is they require cost share on all of their proposals. They feel that this broadens their reach because they can get more bang for the buck. The problem is that really harms an operation like ours where we're totally soft money-funded. We don't have any big stash of money that we're sitting on that we can share in the cost of a project. As a result, there are a lot of projects we can't even respond to because we don't have the cost share available to us. I think both of these are problems that from the standpoint of a university and the university being a vital source of manpower for the future, I think these need to be addressed.

SPEAKER: Only piece I would add is that, you know, if there's anything to say about R&D spending on solar and other renewable energy technologies, it's please stop the rollercoaster, I want to get off. If you look at the history of funding of R&D in this field dating back to the '70s when we didn't have a Department of Energy, we had ERDA and some of its precursors, you know, the funding cycles have run like this for years.

And probably the single biggest problem that we've faced nationally in trying to move these technologies forward over the long term is that we hire a bunch of people and do a bunch of research, and then we lay them all off. And then when it's time to do the research again because we've got money again and all those people are gone and we have to learn it all over again. Thank God for the digital age, but I still have people that periodically come to our library to find old Sandia reports from like the 1970s that exist in hardcopy there because they can't find them anywhere else. It's like going to the moon all over again in some sense.

So, you know, there's a real problem I guess in the consistency of approach of this country on this front that I, you know, would like to think we're coming to an end of that period at this point. And I've seen some evidence of that.

The other thing is that I've seen good evidence that at least as long as the fat lasts, the venture capital community has filled in that gap in the last couple of cycles. And so we've continued to have private sector investment in R&D that has helped to fill some of those gaps in the cycle of

funding from the feds. But, you know, of all of the various priorities that can be picked, you know, pick them, but please, God, just do it consistently and let the money flow for a while.

MS. WEISS: Just one comment on the cyclical nature of solar. And I think what's different this time around is even if something happened and the U.S. Government did a, you know, a complete turnaround again and it stopped, the rest of the world isn't stopping. So you're going to see that continued investment and the funding and the structural regulatory reform happening in other places. So the good thing for the industry is it's not a question that the industry's going to go away. The question for the U.S. is, is does it happen here or does it happen elsewhere?

MR. BANKS: I'd like to ask a question within the realm of R&D regarding the opportunity costs of R&D and what I mean by that. The Electric Power Research Institute, EPRI, has developed a model in which they look at a full portfolio and a more limited portfolio basically trying to look at what the generation mix would look like in the future based on a set of policy assumptions. And in the full portfolio, they show with a full range of policies and incentives for expanding nuclear power, carbon capture and storage, et cetera. In that full portfolio, it looks like solar gets sort of bumped to the side, whereas in the more limited portfolio, there's a wider range for solar deployment.

So my question is, in an era of sort of limited resources, how do you prioritize where the R&D and other money and support goes when you

might get a bigger bang for your buck in terms of CCS and nuclear and reducing your carbon emissions, assuming that's your overall goal? So this broader question on the opportunity cost of R&D in a particular industry like this.

MR. KALLAND: I'm familiar with that model and I guess the old axiom from when I was in grad school still holds to some extent which is, garage in, garbage out. If you look at the basis of that model and you look at the cost numbers that are used for the analysis in that model, the electric power industry tends to have a much more pessimistic view of where costs are going on the various renewable energy technologies than most of the rest of the free world seems to. You know, that comes from a number of different sources, one, you know, if you're in charge of reliability and supply for the entire U.S. population, no matter how far off the main grid and how far away from a central station power plant they live, it tends to make you fairly conservative which is a reasonable position to have. But that said, conservatism, you know, in estimates, is not necessarily always the best way to get at where the markets are really going.

This issue of cost, you know, that was discussed fairly extensively in the beginning, I did want to kind of get on my soapbox for a brief instant on that topic which is, you know, if you look at the energy markets, there's two things that are certainly true, one is that if we do nothing, electricity is going to be more expensive. If we do nothing in renewable energy, prices are going to continue to go up. We're going to be having increased demand

which is going to lead to increased installation of something, probably central station nuclear power plants which are not inexpensive, and so electricity prices are going up. And when you look at the price of electricity from constructing new central station plants of any kind and compare that to the price of electricity from new renewable energy of any kind, renewable energy wins that cost fight. You know, renewable energy is currently more expensive than currently constructed and already paid for plants, but when you start building new plants, it's a very different discussion.

Another piece of that puzzle is that there are a whole array of subsidies that are in the system already for conventional resources that have been put in place over the last 150 years that, you know, perhaps are not well thought of as incentives anymore. But if you look at the Price-Anderson Act and the fact that it extracts the cost of a risk from the nuclear power sector, or if you look at, you know, just the power of eminent domain that was used to lay railroads around the United States and what's that done to make coal cheap and inexpensive, you know, there's a lot of incentives in the structure of the system that are not really accounted for, and that's even before you get to the discussion of human health and the impacts of emissions from coal-fired power plants, which is a big issue in our region of the country.

So, from a cost perspective, you know, you have to understand that this is energy. Every single source that's out there is subsidized and almost all of the other sources are getting more expensive, not less expensive. The nice thing about renewables is the more of it we build -- it's

just like building cars -- the more of them that you build, the price goes down. There are going to eventually be limitations on that equation as well, but I don't see them coming up anytime soon.

So, I'll leave it at that.

MR. BANKS: Okay. Anyone else want to comment on that?

MR. BOEHM: I agree totally on the nuclear part of the thing. We don't have an ability to build nuclear plants in this country anymore. We're going to have to crank that up again if we want to do that. Plus, I think the proponents of nuclear power are greatly underestimating the cost of doing this and so I think it's a fairly high-cost option that we'll have to go to foreign shores in order to satisfy the desire for it.

MR. KALLAND: And since I do have a college that has a nuclear engineering department, let me qualify. I am actually a big fan of nuclear power and think that we will probably need to build more nuclear power plants in this country, especially if we want to shut down coal-fired power plants that are causing all these problems on the climate change front. So, I don't want to discount that by any stretch.

I guess the big concern I've got is that if you build them first, then you've got to sell electricity from them in order to pay for them, which makes it a lot harder to justify reducing the electricity that's needed through energy efficiency, which is the lowest cost option, and it also makes it much harder to use distributed generation. So, to the extent that we can use energy efficiency and distribute generation first, and get those out into the system and

get them, you know, to capture the appropriate portion of the sector and then come in and back fill with nuclear power, that would be the optimal solution.

The problem is, of course, timescales for building nuclear power plants tend to run in the 10- to 20-year span and so it's very hard to match those pieces of the equation up. Fortunately, I'm not a policymaker, I'm just a university guy, so I don't have to figure out the ultimate answer to those questions, but I hope somebody's working on it.

MR. BANKS: Steve, I wanted to move to you with a question on employment with regard to the solar industry and specifically it is -- with this growth that we've seen in the last few years and potential for further growth, is the training and education infrastructure keeping pace? And how so?

And as a follow-up, what in your view would be the most effective policies to continue to create jobs?

MR. KALLAND: Well, it's interesting. The most effective policies that we could do to get more workforce trained would be to put in a feed-in tariff. The real concern right now about the workforce side of things is that we may be putting a little bit of the cart in front of the horse, at least in the short run. We've got massive investment through the Stimulus Act to start ramping up training programs of all different kinds in the energy sector all over the country, which is a wonderful thing, right up until you graduate from the program and there's not enough market there to support you getting a job in the field. And so we've got a little bit of an issue on that front in the short run.

My hope is that folks like First Solar and others, as the market

starts to recover and we start to see increased demand for these types of systems, that that's going to catch up very quickly. But certainly, you know, there's a lot of activity right now from weatherization training for, you know, fairly low-skilled folks in the construction industry that have been idled recently that are trying to diversify their skill sets. And once those people -- once the construction sector comes back, it's not like those people will forget that information, they'll go and use it in their day-to-day work in the construction field.

So, we'll see more energy efficiency and I think a lot more solar training is going to lead to a lot more opportunity to include solar in common construction around the United States.

We were looking at it the other day, the Solar Center has something called a Renewable Energy Technology Diploma Series. This is a continuing education program that we run in renewables. It has week-long courses in photovoltaics installation, solar water heating installation, small wind installation, biofuels production, different pieces of the puzzle. A couple of years ago, we would do 1 or 2 week-long courses in each of those areas a year and, you know, have 25 to 30 students. We'd try to cap the classes at 25 when we can because we feel real strongly that there needs to be a hands-on component to the training and if you get much bigger than that it's hard to do hands-on work very effectively. This year we're going to do 26 PV classes alone. The whole program has gotten completely out of hand. I can't even keep staff in place to run it because as soon as I get a good instructor trained

up, somebody from the private sector hires him off and uses him for training their own dealers. So that's always the problem in working in these universities is you're supposed to be training the next generational workforce, but, damn it, it would be nice to hold on to your own people for a little bit so you could get something done.

All of that said, you know, that's probably the limiting factor right now for us in our up growth is finding good, qualified instructors and getting them trained out there. I'm real anxious to be launching this, you know, our regional center as part of this national effort to get regional training centers up and going around the country because I think that getting more people that are used to the electrical trades and the plumbing trades better equipped to handle the solar piece of the puzzle is going to be a good thing for us in the long run.

MR. BANKS: Kathleen?

MS. WEISS: Yeah. I mean, so some of this is happening real time. One of our projects is a 550 megawatt PV farm in Desert Center, in California, Riverside County, and so yesterday we actually kicked off -- there was a press release -- a training center. And so it's a joint effort between First Solar and the College of the Desert Sun to do worker training in anticipation of the jobs that we'll need once we start construction of the solar farm.

You know, there's a lot of focus on manufacturing jobs and I think that's appropriate, but as a gentleman in the audience noted earlier, there's a lot of jobs associated with the actual deployment of it. So, if you just

look at our pipeline and we're -- you know, we're just a piece of the pie, and all of this is utility scale, so if you're looking at just under a gigawatt of sort of what we expect to in the next 3 to 5 years, we associate about 1,800 direct jobs. So, those are contractor's jobs, and you can extrapolate other jobs associated, but just in terms of our subcontractors, that's about 1,800 jobs.

So, then folks will ask the question -- or make the statement, I should say, yeah, but those are temporary jobs. Those aren't as valuable as the manufacturing jobs because the manufacturing jobs are permanent. And my answer to that is, you know, if we have a vibrant industry they will be permanent jobs because I think about it the same way I think about a homebuilding job. You know, if you build a home, it's a construction job and once it's done, that person's out of work. Well, not if there's another home to build. So, I think that that's just a different way to look at it that's appropriate.

MR. KALLAND: Just one other thing to add on this, you'll notice I didn't even use the word "manufacturing" in a sentence, didn't even talk about training employees for manufacturing facilities. Right now, at least, that's not the game in this country. Dr. Burns and others alluded to the fact that a lot of the manufacturing is either already overseas or moving that way. What's interesting about it is that it's a tale of two departments. You know, I go over to the State Department of Commerce and all the economic development guys, that's all they want to talk about is manufacturing plants. If it's not a manufacturing plant, if it's not at least 50 jobs or 100 jobs, it doesn't hit some trigger in state legislation, no incentives are available, and, you know,

they're just not interested in that kind of work. You know, I go over to the Department of Labor and all of the sudden it's all about, you know, retraining unemployed people that are, you know, perhaps lower skilled or mid-skilled, you know, setting up community college programs to train the people, all of these pieces of the puzzle.

What's kind of in my mind, the piece that the states are somewhat missing the boat on on this, is that if you build the market, what you're going to get is the deployment jobs. And if there's any job in this sector that you can't export, it's the deployment job. And so why we don't focus more on that, I guess, is as much a historical precedent issue in the way economic development is done in this country as anything. You know, we were a manufacturing country and we think like a manufacturing country even though we're really not much of a manufacturing country overall anymore, although I'm sure there's five or six unions that are going to come and beat me for saying that.

But, you know, as we've made this transition to a service economy and we've brought in more folks that are much more focused on, you know, the building trades -- I mean, when we had these two classes a year a few years back, they were filled with guys in, you know, tie-dyed t-shirts and Birkenstocks dancing around singing "Kumbaya." You know, these days my classes are filled with roofers, plumbers, electricians, all of these kind of core trade people that are doing this. The HVAC industry is doing a huge amount of diversification exploration right now and so we've got, you know,

this real collection of, you know, kind of real jobs people that are trying to figure out how their industry fits in solar, and not where we were a few years ago when we were trying to figure out how to fit solar into their industry.

So, it's a big difference.

MR. BANKS: I think Dr. Burns mentioned in her speech another issue regarding a sort of silo effect within the education community about, sort of, finance engineers, different blocks of knowledge. Is that, to anyone's knowledge, is that something that is being addressed? And if so, how? And kind of within those, where are the knowledge gaps as well? Where would additional efforts need to be made not only to address the silo effect, but also strengthening each of those disciplines that are required?

MR. BOEHM: Well, it's a need that we see that we're definitely working on. We've got some across-majors kinds of interactions. Our center, for example, involves people from the business school, environmental studies, architecture, engineering, so there's a lot of interaction there. And this new program, this comprehensive program that we're initiating, hopefully will be initiating, has that as a key ingredient to the operation of it. It's very much cross-disciplinary and covering virtually all of the industry kinds of potential needs.

MR. KALLAND: Yeah. NC State just recently reorganized its whole environmental studies department and pulled it out of all of the colleges, much to the dismay of many deans and department heads, but they're now setting that up as kind of an interdisciplinary program that cross-cuts colleges.

And they're looking right now at minors and majors and, you know, eventually headed towards certificate programs and master's degrees.

You know, I alluded to it earlier in the scope of graduate students and undergraduates that we have at our center, you know, energy is not a technology question, by itself at least. You know, it starts with technology, but to a large extent, we've got enough of the technology questions answered to move forward in this industry right now. There's always the next generation of technology and the efficiencies that we can accrue from that and the barriers that we can reduce with better technology, but, you know, to a large extent, you know, the game right now is in finance because of the complexity of the various mechanisms that you have to work with to get a project done in the United States. You know, in my region, where we're dealing with regulated markets, you can't have third-party power purchase agreements and so you've got to deal with the electric utilities on, you know, the buying of RECs and then you've got to deal with state tax credits and federal tax credits, and does the federal tax credit reduce the basis for the state tax credit? And what does accelerated depreciation do? I mean, I've got more financial guys in my office trying to figure out how to put these things together than anything right now, and so the business school and the policy school, you know, those are big pieces of the puzzle for us right now.

MR. BANKS: Okay. I think with that I'd like to open the floor for questions. There are microphones that will be circulating and I think the same rules apply. Please identify yourself. There are microphones coming.

Sir?

MR. HASKELL: Hugh Haskell from the Institute for Energy and Environmental Research. I've been reading recently about a hybrid system now that involves a photovoltaic backed by a thermal water heating system using the waste heat from the photovoltaic system. Is that an idea that might be of some value for residential customers? Is that going to take off?

MR. BOEHM: Well, there is quite a bit of interest in that. One of the issues is, is if your cells are silicon, they like to operate as cold as possible, and when you're trying to heat water at the same time, that gives you a little bit of a cross purpose at what you're trying to do. But there's certainly a lot of work going on on that particular topic and we'll see -- I think there are several systems of that type going in, but I don't know that it's mainstream commercial at the present time.

MR. KALLAND: Yeah. We at the Solar Center actually field tested a system like that for -- I think it actually might have been Duke Solar at the time, as early as the -- I think it was the early '90s. It was on an Applebee's restaurant and a BB&T Bank, and it did exactly that. It was a water heating/PV combination system.

Lots of people have kicked that idea around over the years. I don't think anybody's cracked the technology piece. I think a piece of it is that there's not too many companies at the manufacturing level that are interested in both sets of technologies and so this tends to be people further down the chain trying to take a product off of one shelf and another product off another

shelf and figure out how to put them together. So, you know, it just hasn't, perhaps, gotten as much attention yet as it needed.

MS. WORTHEIM: I'm Mitzi Wortheim with the Naval Postgraduate School. I'm a social anthropologist, so this is a technical question I'm asking. I want to know how strong thin film is. I mean, if it gets hit by a tree, does it get damaged? I mean, are these only technologies we can use in the desert?

MR. BOEHM: If it gets hit by a tree?

MS. WORTHEIM: Well, you know, if trees --

MR. BOEHM: If anything gets hit by a tree it's not going to work.

MS. WORTHEIM: No, but my -- no, no, but if a branch hits my roof right now, it doesn't matter. But if a branch were to fall on thin film or one of these silicon things -- I mean, I'm just trying to understand. I mean, in the military we used to talk about the technology had to be temporized so that it was really tough. And so my question is, how tough is this stuff?

MS. WEISS: At least in our manufacturing process, because you can use the thin film in different applications, but our application looks pretty much like any other solar panel. So, it's two pieces of glass. So the semiconductor material is a thin, thin, thin film that's just deposited in between two pieces of glass and the glass has to go through all kinds of testing, you know, they launch things at it and they freeze it and they drop things on it, and so it's sturdy and it can be used, you know, anywhere.

MR. VAN AGTMAEL: Antoine van Agtmael of the Emerging

Markets Management and a Brookings trustee. I wanted to ask you kind of a very simple question that may have a difficult answer, but let's say that you live not in California or Florida, but in a kind of a medium sun state. And let's say that you want to make maximum use of solar through both the low-hanging fruit -- the panel and photovoltaics -- and you want to use it for maximum electricity generation and also for heating pool, whatever. Could you give us a sense as to what percentage in a suburban home that has a southern exposure, roughly, that you could count on generating over the year? What percentage of your electricity and your heating needs, just a rough sense?

And then the second question I have is, to what extent can you, as they seem to be doing in Europe, combine solar with geothermal?

MR. BOEHM: Well, the answer to the first question is a little bit difficult because you can go with any size system and it depends so much on your load that you've got. You know, in other words, some people live very extravagantly with energy and other people are quite careful with what they use. So, I would say that it's possible to furnish virtually 90 percent of your needs with the right kind of balance between those things. For the typical place, though, it's probably going to be much less than that.

You certainly wouldn't -- if it's not in a high solar flux area, you don't want to use anything that concentrates because that's not in the cards when you've got sort of mediocre kind of sunlight. But you can do pretty well anywhere depending on how big a system you want to put in compared to

what your load is.

The geothermal thing, I assume what you're talking about is maybe a ground coupled heat pump? Is that what you're talking about? Yeah, and that has -- that's becoming more and more popular. It's been around for a long time, but it's becoming more and more popular. It's even penetrated the Las Vegas market, which is a relatively new one for them partially because we have something there called caliche, which is solid rock some places not too far under the surface. But that's something that has a lot of application in certain areas, particularly if it's easy to install the pipes that need to be installed in the ground.

MR. PEARLMAN: I'm Lou Pearlman with the Institute for Regulatory Science. I had also a couple of questions, one technical and one strategic. And since I missed the earlier session today, my apologies if I'm repeating something that was heard before.

The technical question is simple. Which storage technologies do you find most promising or interesting?

The strategic question may be a little bit more complicated. To what extent do you see environmental activist opposition delaying or obstructing the deployment of solar systems?

MR. BOEHM: Okay. For storage, thermal storage is obviously fairly simple, conceptually at least, for large-scale central plants that use thermal kinds of approaches, particularly trough plants or tower type plants. What the particular mode of how that's done varies a little bit. Molten salt is

one of the things that is being considered a lot. This salt is not the same as your table salt, but again it's a distant relative of table salt and it stores energy at high temperatures without very much pressure, which is a desirable sort of thing.

It was also mentioned earlier -- in the earlier session where you weren't in attendance about the possibility of using electric cars with PV kinds of systems and saving energy in the batteries of the car for use at night, and then possibly if you need to bolster how much is in there by recharging them off of the nighttime kinds of charges. So, those are the storage things.

In terms of the desert kinds of implications, I'm familiar with that. It seems like it's becoming more intense. There's all kinds of concerns being expressed on the part of environmentalists now about virtually every kind of thing. It's kind of interesting how the environmentalists have kind of turned against some of the solar and wind kinds of projects because of the great amount of land that they use.

MS. WEISS: You know, my response to the question about environmental obstructionism, I think if we all just listen to one another, a lot of those problems are going to go away and I think a lot of that's starting to happen. Some things happened early on and people just weren't listening to one another. So, there are different technologies that would probably work better in different areas, but the good news is, there's a lot of areas where all the technologies can work. And I think when industry is listening to the environmental community with an open mind, some decisions can be made

that respond to their concerns that are legitimate, and when the environmental community listens to industry and we're being responsive, a lot of that will go away as well.

So, I think the mainstream environmental community -- sorry, thought I turned that off -- I think there's a good dialogue going between industry and the environmental community. And there's always going to be a fringe element with a more narrow agenda and that's just part of life.

MR. BANKS: There was a question in back. Yes?

MR. HAUBENSTOCK: Hi. Yes, Arthur Haubenstock with BrightSource Energy. And Kathy, you just missed an opportunity to plug a pretty big success that First Solar had in working with some of the mainstream environmental organizations and trying to reconfigure one of your sites to satisfy a lot of those concerns. And I think that that's a tremendous success that should be talked about a lot in these different forums.

I wanted to ask a question that I don't think was addressed in terms of the challenges and that is regarding renewable integration. We're still at a penetration level that's relatively low and so it isn't quite so much of an issue, but we're starting to see some panic among balancing area authorities and other entities that are responsible for reliable operation of the grid. There are a lot of things that we can do to make sure that as environmentally sensitive solar technologies and other renewable energy technologies do reach higher levels of penetration, that we don't have a dampening in the Co2 reductions and we don't have a dampening in the emissions -- other criteria

emissions that we're expecting. The worst-case scenarios, you know, still show 80 percent of what we think we're going to get or 50 percent of what we think we're going to get, still substantial reductions when you add in these new technologies.

But if you do it right, if you do try to balance renewable energy technologies against each other, if you use renewable energy, different sorts of technologies and the diversity of locations, you can achieve the full suite of reductions that you're looking for. Storage is going to be helpful, hybrids would also be really helpful. And I think it would be interesting to hear what the panelists have to say about how we can move forward to make sure that we have a robust, reliable grid as we're reaching higher levels of renewable energy penetration.

MR. BANKS: Well, to some degree that was handled in the first panel, but I'll allow our panelists to address that if they have some thoughts.

MR. KALLAND: I guess just real quick. I think you already addressed it, you know, the two big -- there's three things that are going to fix that problem long term: storage, smart grid/grid management of these intermittent resources and how you match them, and then direct hybridization of systems where you're actually co-installing them to match each other. Those are all big issues somewhere down the road. I think Charlie this morning kind of stated it pretty effectively, though. From a solar perspective, at least, it's an issue that's still pretty far down the road. We've got a lot of room right now from where we are to where that starts to become a technical

issue for grid management.

I will say that we're getting a little bit painted with the wind energy brush because I think wind energy systems are a little larger. And they're running into that problem in certain parts of the country a little more quickly and that may have some impact on our ability to fit in against the margin.

And there's also a little bit of controversy still remaining in this. I know when we were over at FERC a number of years ago, working at federal interconnection standards, and there was those of us in the renewables community at one table and there was the folks from the utility sector at another table and then the folks from the regulatory community at a third table, and we were walking through this. Everybody had pretty much a different idea of exactly what percentage penetration was going to be a problem. You know, we were pointing at a GE study that said you could do DG up to maybe 20 percent on most feeders and not run into problems. And the electric utility industry was saying, well, .2 percent sounds a little scary to us. And the regulators were somewhere in the middle.

So, if you look around the country at interconnection standards as they have emerged and at the federal level, there's a whole series of screens that new project installations have to go through. And one of the elements of those screens is, how much other stuff is in that vicinity and how does it impact that local grid management?

So, we have some methodologies in place to kind of look at that

issue. I don't know that we have agreement on what's a problem and what's not a problem yet.

MS. WEISS: I would just add one quick comment because on the earlier panel, you know, Lola was given a little bit of a hard time. But, you know, what we need to do, we really need to recognize the role and the utilities that are stepping up. We work very closely with the utility executives in implementing and planning for some of these very large power plants that are coming online and I think there are some really enlightened utilities out there where they've got really terrific resources and there's a real -- approaching dealing with some of these issues with the solar companies in a very collaborative partnership frame of mind. So, I think that needs to be recognized.

MR. BANKS: I think there was a few other questions. The gentleman in the back, you had your hand up. Seated there.

MR. AKIMBE: Femi Akimbe with the African Development Center. My question is, I'm from the continent of Africa, we have abundant sun. We have severe energy crisis. We have two major options left to us if we want to keep an ecosystem, that's the wind and solar. On the solar end is the issue of cost. My question to you then, the panelists, which of the films are the least expensive that could be used on the continent of Africa?

And secondly, what is the position of the U.S. Government or trade office on the issue of technological transfer to Africa to manufacture it on the ground of the continent so we don't have to pay the costs of shipping?

And thirdly, I guess, what is the position of the U.S. in the solar global position? In other words, is the U.S. number one, number two? And what could the U.S. do to help enhance the China -- just all over the continent of Africa so that there could be some form of competition?

Thank you.

MS. WEISS: I'm not intimately involved in all the different programs that the federal government has going, but I do know at a high level there's quite a bit of activity and interest in seeing that these renewable technologies get deployed to areas around the world where it's really going to help meet peoples' basic needs and help lift folks out of poverty and provide energy for, you know, for health reasons and so that kids can have a school and they can read at home at night and things. And so I think from a private sector view, you know, we're really focused on bringing the cost down and until you bring the cost down, you're really not going to see that kind of wide-scale deployment.

That said, while the cost is coming down, I'm really encouraged that you're seeing a lot of international focus and certainly focus being driven out of the State Department in the U.S., as well as the Secretary of Energy's office, to find programs and fund programs and work with the international community to make sure that there is -- that there are loan guarantees and there's funding available so that you can start to deploy some of these renewables into less developed economies.

MR. KALLAND: I guess the only thing that I would add to that is

that Africa does have one big advantage over the United States and Europe on this front, which is that you don't already have, you know, a hundred and some years of invested infrastructure to overcome. You're at least in a position where investments are being evaluated for the first time and people will make the decisions as to whether to build central station power plants and lay transmission lines or whether distributed generation approaches off the bat make more sense. And so in that sense, you're ahead of the game.

I think investment in general with Africa is a challenge that many people are trying to figure out how to improve it and I think renewable energy technology will probably be a piece of that larger picture.

MR. BANKS: Yes?

MS. ALEJANDRO: Hi. I'm Lisa Alejandro with the U.S. International Trade Commission. I've been spending quite a bit of time recently looking at the services component of renewables. And I've found in the wind industry that major equipment manufacturers are increasingly trending toward providing services in conjunction with the equipment and finding that the provision of services from project development, design, engineering construction -- not so much the construction -- and then the long-term operations and maintenance services are, in many cases, more valuable and give them a more competitive edge than just the equipment.

So, I'm wondering, for solar manufacturers, how do you view or how do they view the provision of services as maybe part of their long-term strategy for competitiveness and profitability?

MS. WEISS: Well, for some of the PPAs and some of the utility-owned construction that we're doing we have signed monitoring and maintenance agreements. And interestingly enough, in a company meeting the other day, the fellows who work in the area where they do the monitoring and maintenance said, hey, can't we be a standalone profit center? I'm like, down boy, down boy.

So, they do -- I think it is -- there's great potential for it. It's a service that comes. It's just another, I think, really great example of once you start peeling the onion back of what the economic opportunities are for this industry once the industry grows, that there are pieces of it that will end up emerging as their own profit centers and their own industries and their own opportunities for employment. So, I think that's a great example and it's just another indication that long term there are things that will add value and create jobs that aren't really even being talked about in a focused way today.

MR. BANKS: Sir, in the back?

MR. CASE: Hello. My name is Ethan Case. I've had some experience working with solar energy companies in New Delhi, India. My question is more for Kathleen.

About a year ago, I was having lunch with a good friend who is a solar engineer in New Delhi, who worked with the Energy and Resource Institute. And we were sort of oohing and aahing about everything that First Solar has been doing around the world, but he brought up the concern that as we send these thin films all over the world, especially to less developed areas,

that in some of these areas there aren't the regulatory bodies that will look out for these panels in 30, 40, 50 years when they start breaking down, they start perhaps poisoning the water supply. So, I'm wondering if First Solar has developed any plans like that.

And I'm also curious about the technical aspect of the breakdown of, you know, these cad-tell panels, these panels with gallium and arsenic and things like that.

MS. WEISS: Well, thanks for the question and since I'm not the technical guru for more -- for deep information on the safety of the product, I would just ask you to go to our website, firstsolar.com. But the issue around what happens when the modules reach the end of its useful life is really an industry-wide issue. And as I mentioned earlier, you know, we've put together a prefunded program so that we're paying for the take-back and recycling of the modules. And there's a great cooperative agreement industry-wide in Europe, which there's just much more deployment in Europe, to put together a group called PV Exists, to put together a voluntary program.

In terms of the semiconductor material itself, we've done lots of testing and, you know, won great support in all the countries where we deploy, so we're deploying the same product whether it's in the U.S. or Germany or a place like China or India, so there's no difference in that. And the safety standards wouldn't changed because we've got one manufacturing process and, you know, whether it's the fire test or the breakage test or the leakage test, we've done all those testings and have great confidence in the safety of

our product.

MR. BANKS: Okay. Any other questions? I think we can look to wrap up if there are no more questions.

And I'd like to, on behalf of Brookings, thank Bob, Steven, and Kathleen for joining us today for an excellent discussion, and thank you all also for coming and joining us today. Thank you very much.

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I, Carleton J. Anderson, III do hereby certify that the forgoing electronic file when originally transmitted was reduced to text at my direction; that said transcript is a true record of the proceedings therein referenced; that I am neither counsel for, related to, nor employed by any of the parties to the action in which these proceedings were taken; and, furthermore, that I am neither a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

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