

**INTERNATIONAL PERSPECTIVES ON ALTERNATIVE
ENERGY POLICY: INCENTIVES AND
MANDATES AND THEIR IMPACTS**

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY, NATURAL RESOURCES,
AND INFRASTRUCTURE

OF THE

COMMITTEE ON FINANCE

UNITED STATES SENATE

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**INTERNATIONAL PERSPECTIVES ON
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THURSDAY, APRIL 12, 2007

U.S. SENATE,
SUBCOMMITTEE ON ENERGY,
NATURAL RESOURCES, AND INFRASTRUCTURE,
COMMITTEE ON FINANCE,
Washington, DC.

The hearing was convened, pursuant to notice, at 2:15 p.m., in room SD-215, Dirksen Senate Office Building, Hon. Jeff Bingaman (chairman of the subcommittee) presiding.

Present: Senators Kerry, Cantwell, Salazar, Crapo, and Thomas.

OPENING STATEMENT OF HON. JEFF BINGAMAN, A U.S. SENATOR FROM NEW MEXICO, CHAIRMAN, SUBCOMMITTEE ON ENERGY, NATURAL RESOURCES, AND INFRASTRUCTURE, COMMITTEE ON FINANCE

Senator BINGAMAN. This is a first hearing of a new subcommittee that Senator Baucus has established here in the Finance Committee. This is the Subcommittee on Energy, Natural Resources, and Infrastructure. Senator Thomas is the ranking Republican on the subcommittee and I am the chair of the subcommittee. We welcome everybody and hope we can make it a useful initiative on the part of the Finance Committee.

This hearing today is trying to give us a global perspective to see what the policies are that other countries have adopted to encourage more development and use of alternative energy.

In 2005, when we passed EPAct, we began the process of trying to put in place a national energy policy for the United States. I think we included in that bill several provisions that I think are important in moving our country toward more use of renewable energy and alternative energy.

The long-term policy that we have in this area has to obviously contain three, or be consistent with, three primary goals. First, to ensure adequate and affordable supplies of energy—I think everyone agrees with that. That goes without saying. Second, improve the efficiency and productivity of our energy use. And, third, be mindful of the environmental effects of different choices that we are making in our energy.

In current law, we have a production tax credit for alternative energy. We have investment tax credits, we have accelerated depre-

ciation schedules, we have deductions for manufacturers, buyers, residents, and builders, as well as financing provisions and other measures. Each of these provisions that we put into the law was designed to stimulate supply, to increase demand, and to motivate development of new technology.

I think we all intend to try to build on what has been done. Build a market in which there are cost-effective, reliable, and environmentally responsible alternatives to traditional energy supplies. So that is sort of the goal as I would see it. We want to identify those energy tax provisions that have been helpful to us in achieving policy goals we have set so far, and apply these concepts to new markets and, of course, learn what we can from mature global markets for alternative energy as to what has worked elsewhere in the world.

I think it is important testimony that we are going to hear today, and the incentives which we are able to put in place with some of these provisions, I think are very important to moving us in the direction we want the country to move in.

So whether it is alternative energy price supports, or production incentives, or investment incentives, or mandates, we need to know what the right mix is, and I very much welcome the witnesses today.

Let me call on Senator Thomas for any comments he has, and then after that I will introduce the panel of witnesses that we have today.

Senator Thomas?

**OPENING STATEMENT OF HON. CRAIG THOMAS,
A U.S. SENATOR FROM WYOMING**

Senator THOMAS. Thank you, Mr. Chairman. Thank you all for being here. We had a hearing this morning on bio-fuels and that sort of thing, so it is good that we are continuing to look at this. I look forward to your comments.

We are concerned about the environment, of course, and the emissions and the finite nature of fossil fuels which I feel a little different than some about.

Interestingly enough, the technology for a lot of these alternatives has been developed here, but has not been used as much here as perhaps in some of the foreign jurisdictions. So I think we are here to explore how these investment decisions can develop policy for ourselves.

Tax incentives have been around in the United States, of course, for a long time. None of these has enjoyed widespread mass deployment. I believe that we need to further examine our goals in this arena. Our primary goal is to control emissions, to improve efficiency, or to find the intersection of both. We need to examine the incentives that are currently in place and determine to what extent they have been working.

My view is, the goal of these incentives needs to be temporary assistance so that we do not develop technologies that have to sustain themselves by government funding, and certainly a results-oriented approach is what we need to do.

I do want to make the point that there are some alternative uses and activities related to fossil fuels—coal being one of our largest

resources. Clean coal becomes similar to most other alternative fuels, and I think in terms of the interim period, between where we are now and when these other things really get into place, we need to take a look at some of the fuels that we have available and we know how to take care of as we move towards the others.

We look forward to your comments today, and I thank you again for being here.

Thank you, Mr. Chairman.

Senator BINGAMAN. Thank you very much. Let me just introduce our witnesses. Mr. Charles Boortz is vice president of business development with Advent Solar, which is an Albuquerque-based manufacturer of new solar technology that serves markets both in Europe and in Asia. One reason that Mr. Boortz is here is I was able to attend their open house when they opened their manufacturing facility, and I noticed that most of the people in the room seemed to be foreigners. That caught my attention. Mr. Jonathan Johns is here. He is a partner in charge of the Renewable Energy, Waste, and Clean Energy Group for Ernst & Young in the United Kingdom. Thank you very much for being here. And, a familiar face for this committee is Mr. John Krenicki, who is the president and CEO of GE Energy in Atlanta. He was here testifying—how long ago was that? Two weeks ago. So, we very much welcome him back. We look forward to hearing from all of you on your insights.

Since we have the time, I suggest you take 6 or 8—10 minutes—whatever you think is needed to summarize your main points. Obviously, your full statements will be included in the record, as they have been submitted. If you could make the main points so that Senator Thomas and I and any other members who arrive could understand those, that would be most useful. Then we will have some questions.

Why don't we go first with you, Mr. Boortz? Why don't you give us your perspective on this set of issues?

Would you be sure to push the button there, so that you are able to be heard?

Mr. BOORTZ. Okay, I think I'm in business now.

Senator BINGAMAN. Thank you.

STATEMENT OF CHARLES BOORTZ, VICE PRESIDENT OF BUSINESS DEVELOPMENT, ADVENT SOLAR, ALBUQUERQUE, NM

Mr. BOORTZ. Mr. Chairman and distinguished members of this subcommittee, thank you very much for giving me the opportunity to address you this afternoon. My name is Charles Boortz. I am vice president of business development for Advent Solar. We are located in Albuquerque, NM. Advent was founded in 2002. We currently have 165 rather well-paid employees. We have just commenced operation on our first commercial line—a 25-megawatt line—in our facility in Albuquerque.

Advent manufactures photovoltaic cells. We use a technology that we licensed from the Sandia National Laboratories, in Albuquerque. Our cell is rather unique. It is an emitter wrap-through photovoltaic cell. This is a 156-millimeter square cell. It is a back-contact cell with negative and positive gridlines on the back side. It contains approximately 25,000 laser-drilled holes in this one cell.

I am going to pass it up to you to look at, if you like.

Presently, Advent ships its cells to an OEM module manufacturer or fabricator in Dresden, Germany. We sell our product into the European markets. Eighty percent of our production is sold into Europe at this present time.

In addition to that, I would like to point out, in our new manufacturing facility, nearly all of our cell manufacturing equipment comes from the leading equipment vendors in Europe and in Japan. So at this point in time, although we are Albuquerque-based, a good bit of our business in equipment buying is done in European and Japanese markets.

I would like to take just a moment, very briefly—I think you are familiar with some of this data—but just look at the size of the photovoltaic market and the growth that we've been experiencing in the last number of years.

As you can see from this chart, the industry has grown from approximately 200 megawatts in 1999 to 2.6 gigawatts in 2006. These numbers are getting to be very large. This represents a 40-percent compounded rate of growth, and really an exponential rate of growth over this period of time.

Senator BINGAMAN. Let me just interrupt. This is worldwide?

Mr. BOORTZ. Yes sir. This is a global consideration here.

Senator BINGAMAN. Global production of solar cells?

Mr. BOORTZ. That is correct. And leading industry analysts are predicting that by 2010 this number will be 15 gigawatts, so we will need a log scale really to present this to the hearing. By 2015 we are predicting multiples of the 2010 number.

The point I would like to make here is that this industry is scaling, and it has grown very, very rapidly. For companies like Advent Solar, there is a need to scale as well, and to get on board with the growth of the industry.

Time is running out really for the United States in this context. The world is moving forward in this technology, and we have some room to make up.

Let me go on to the next chart, if I may, and consider what is driving this growth in the industry. The markets that have done the best are the markets that have benefitted from demand-side incentive initiatives, public policy incentives to motivate demand in their respective markets.

This is a chart showing cells by countries. As you can see, the primary markets in this industry—you probably realize this already—are Japan and Germany. Between Japan and Germany, the two account for over 70 percent of the market share in the photovoltaic industry.

Senator BINGAMAN. Excuse me for interrupting again, but which is the very tall?

Mr. BOORTZ. The very tall is Germany, which presently has approximately 55 percent of the global market. And, right in the middle is Japan. And the first one, which is quite small, is the United States. I am just contrasting these three markets. The U.S. market in 2006, about 80 percent of that is California. That is the market that also benefits from demand-side incentives. So this gives you some measure of the growth in these markets.

One of our purposes was to consider the benefits that are in these respective countries. In Japan, they have had a rebate pro-

gram that began in the mid-90s. It is a rebate program for a 10-year period. The way that worked is that consumers would get rebates on photovoltaic equipment purchases based on capacity. That is referred to as a capacity-based incentive system.

In Germany, the incentives were performance-based. The country used a feed-in tariff in which consumers would be actually paid for the renewable, or in this case, photovoltaic energy they produced. It would be based on performance. So it is performance-based with a feed-in tariff, or capacity-based with a rebate.

Senator BINGAMAN. Who provides the rebate?

Mr. BOORTZ. The rebate, if I may speak to the capacity, Senator, I am not exactly sure about who provided the rebate in Japan. In Germany, the feed-in tariff, or the financial incentive, is provided by the incumbent utilities or government. Then the cost of that is spread over the entire rate base. I wouldn't be surprised if that is not a similar way that it is done in other countries.

So, in other words, in Germany, the people who put the photovoltaic on their rooftop have a direct benefit of the feed-in tariff, but the cost of the program is spread across all rate payers in the system.

Senator BINGAMAN. You think that is what happens with the rebate as well? You think the utility is the one that provides the rebate, and then everyone winds up paying for it?

Mr. BOORTZ. Yes sir, that would be my assumption. It is a way to spread the cost of the incentive programs across the entire base.

My last graphic speaks to photovoltaic cell production. What we can see by looking at this graphic—and again, here I have included four markets. I have included the United States first.

Senator BINGAMAN. Could you move that a little further? The light is fouled-up. That's better. Thank you.

Mr. BOORTZ. Gentlemen, what I am trying to demonstrate here is the impact of demand incentives on supply as well. We can see that in the markets that dominate the photovoltaic cell production, these are the markets that also have benefitted from the demand incentives. Demand drives supply, demand drives the scale-up. More supply causes the cost to be lowered, creates more demand in the system, and the system moves in the right direction. That is certainly what we have seen in these markets.

You can see from looking, just visually, at this graph, that Germany and Japan have benefitted from their early leadership positions, particularly Japan. Four of the six largest photovoltaic cell producers in the world in 2006 were from Japan.

Japan instigated their rebate program in the mid-90s. It was a 10-year program, and it has since run its course. The German feed-in tariff program commenced in the year 2000. And it is early on in their program, but you can see the impact that it has had on production.

Also on this chart I have China. China is a little bit of an outlier. They do not have much of a domestic market for photovoltaics. Their consumption is very low, but their production is accelerating very, very rapidly. Many analysts feel that they will command over 50 percent of the market very quickly. They export 95 percent of the photovoltaic goods that they make.

So, my point really is that the leading countries in this industry are countries that have put demand incentives in place. Those demand incentives have spurred demand which has had an offsetting effect of spurring supply, creating scale, lowering costs, and the industries have done quite well. Also, developing a lot of jobs.

At Advent, we are a very optimistic about the U.S. domestic market. We think there is a lot of potential. We are questioned often by our colleagues in Europe and overseas about the U.S. market, wondering when is it going to take off and achieve the kind of scale that we have had elsewhere.

Certainly we have a lot of drivers, from energy security to energy costs to environmental issues, and I cannot emphasize enough, economic development. No industry creates as many jobs, per watt, as photovoltaics. Its distributed clean and scalable attributes make it a perfect complementary energy source to a portfolio of fuel sources in creating electricity in this country.

But it all begins with creating demand. We need demand in the United States for Advent Solar and for us to grow the scale of our industry to meet the demand in our own country. We can continue to ship product overseas, but we will have a larger standing and a better footing if we can say to our world competitors that we are part of the world's largest energy-consuming market and part of the largest photovoltaic industry in the world.

So, that is certainly our desire and hope, and we ask you for your leadership in creating the kind of demand incentives we need to stimulate growth in our industry and allow us to participate on a global basis in a manner that we are allowed to. This industry requires a lot of scale. The largest players are getting bigger by multiples. We are 25 megawatts, the largest players are approaching one gigawatt.

And, years from now they are going to be approaching two or three. The industry is scaling rapidly. The United States has an opportunity to participate in a big way, but we need to stimulate our domestic demand to spur growth.

Thank you.

[The prepared statement of Mr. Boertz appears in the appendix.]

Senator BINGAMAN. Well, thank you very much. Mr. Johns, go right ahead.

STATEMENT OF JONATHAN JOHNS, PARTNER, RENEWABLE ENERGY, WASTE, AND CLEAN ENERGY GROUP, ERNST & YOUNG, UK

Mr. JOHNS. Thank you, Mr. Chairman and members of the committee. I am Jonathan Johns. I am partner and head of Ernst & Young's global renewable energy unit based in the United Kingdom. We have 45 staff servicing a number of global corporates, entrepreneurs, and we also provide advice to government.

I appreciate your invitation and the opportunity to testify today on International Perspectives on Alternative Energy Policy. In my testimony are extracts from our global country attractiveness indices where we score over 20, soon 25 countries, on the attractiveness for future investment. It is important to say that it is for future investment.

Senator BINGAMAN. This is the chart on page 19 of your written statement?

Mr. JOHNS. Yes.

Senator BINGAMAN. Thank you.

Mr. JOHNS. We have a number of underlying indices as well. A lot of research goes into that. We look at a number of factors including tax planning, incentives, the finance climate, and the state of the actual market in the country concerned.

Climate change is a global issue, and big business is dealing with it on a global basis. The scale of the challenge means that, at present, there are, in all probability, insufficient resources in the supply chain to satisfy demand.

Consequently, countries are effectively competing with each other for renewable energy resources, and, most importantly, financial and corporate capital, which is moving rapidly to the most favorable investment climate.

I would like to make the following five points.

First, renewable energy infrastructure represents a long-term investment, and thus requires a long-term consistent—10 to 15 years—policy framework to ensure sustained development. Stop/start mechanisms, or frequent changes in policy direction, produce uncertainty in the investment community and have an adverse effect on corporate and individual behaviors. There is strong evidence to suggest that longer incentive periods lead to greater capacity at lower cost and foster domestic manufacturing industries.

Second, there has been much debate over the effectiveness of feed-in tariffs compared with other mechanisms. Feed-in tariffs or guaranteed fixed price payment mechanisms tend to leave more risks to the State and usually have a direct effect on the taxpayer or consumer.

They have been effective in introducing large volumes of capacity, particularly in Germany. In liberalized markets, the market-based green certificate mechanism tends to be preferred. However, if supply is constrained, then price distortions can occur.

Third, it is important to complement a regulatory incentive with appropriate infrastructure. Ease of planning, appropriate grid investment to deal with distributed, as opposed to centralized energy production and supply chain, can have a very significant effect on the rate of deployment and undermine otherwise effective mechanisms.

Fourth, the U.S. Federal tax incentives, when combined with individual State renewable portfolio standards, could be effective if applied more consistently over a longer term.

In a way, they all fit together as a hybrid system, with long-term price certainty being provided by the production tax credit, and a market mechanism by way of the portfolio standard.

This begs the question as to whether each State should have an RPS to capitalize on its own resources. Many argue that carbon trading can provide adequate incentives; however, individual projects need visibility of forward prices for an investment to flow in a cost-effective manner. Cap and trade carbon schemes are best used as a means to curtail the activities of high carbon intensity industries, not removing the State incentives for new renewable capacity.

It is a matter of choice whether a uniform incentive is applied irrespective over the maturity of a technology or whether more favorable incentives are used to encourage emerging technologies. If climate change is to be a policy driver, technologies will need to be deployed in volume.

Five. Any renewable energy policy needs to be coherent with a whole, with complementary measures focused on power production, transport, fuel, heat, and energy efficiency. The democratization of power whereby consumers, government, corporate, and the public become suppliers of renewable energy in their own right, as well as consumers, is likely to become an increasingly potent force. I would advise the committee to continue the excellent work it has begun to encourage the production of renewable energy in the U.S.

You will note that, in the table on page 19, the U.S. is number one in our indices, and is currently the best place to invest future capital. This is shown by the flows in investments that have taken place in the past year.

However, this is predicated on the renewal of the production tax credit and investment tax credit or their replacement by another suitable long-term investment mechanism.

Thank you for the opportunity to share my views with you. I will be pleased to answer any questions you might have.

[The prepared statement of Mr. Johns appears in the appendix.]

Senator BINGAMAN. Well, thank you very much. Mr. Krenicki, we welcome you back to the Finance Committee and thank you for coming.

**STATEMENT OF JOHN KRENICKI, JR., PRESIDENT AND CEO,
GE ENERGY, ATLANTA, GA**

Mr. KRENICKI. Mr. Chairman and members of the committee, I am John Krenicki, president and CEO of GE Energy. In response to the committee's interest in renewable energy policies in place overseas, I appreciate the opportunity today to offer an overview of European and Asian programs currently driving the deployment of renewable energy technologies.

The renewable energy industry is a truly global industry. There are varying programs in place around the world to require or encourage greater use of renewables. Because GE's business is global, we have reviewed programs in the EU and several of its member states and in the leading Asian markets, specifically, China, India, and Japan.

Our objective was to share with the committee information that may help you identify what, if any, of the approaches adopted overseas might be applied in this country.

Our conclusion is this: the increase in renewable generation in Europe and Asia demonstrates that government incentive programs do work. However, there is no "silver bullet" to be found in these programs that could be easily replicated in the United States. We believe that Congress has already identified an efficient and effective incentive for the growth of renewable generation: the renewable energy production tax credit.

There are, however, certain aspects of other systems that can help to improve the U.S. PTC approach. One very important lesson that we can take from the European experience is the importance

of predictable and consistent incentives. This is one area in which U.S. policy has not been optimal, as the “on again, off again” nature of the PTC demonstrates.

Earlier this year, the EU heads of state adopted a binding target of obtaining 20 percent of primary energy from renewables by 2020. With the EU agreement on extension of the renewable mandate to 2020, suppliers have the additional certainty they need to be able to make investments in production capacity.

While this target for renewable energy is EU-wide, it is implemented by a differentiated national target for each of the EU member nations. Each member state adopts its own system for achieving its target.

Frameworks currently being used by the EU member states include the feed-in tariff system. The FIT is a relatively simple system, which has clearly been successful in promoting technologies that range from those that are far from being competitive with fossil fuel, such as solar, to those that are approaching mainstream status.

One of the real benefits of the FIT has been its predictable and long-term duration. This stable market at home has enabled European companies to become major players, for example, in the global wind energy market.

Another lesson to be learned is that an incentive must be set high enough to be effective. While the feed-in tariff mechanism has been successful in spurring new renewable generation in Europe, it has been less effective in China. We believe it is, in part, a factor of the levels at which the tariffs are set.

Here again, the U.S. has gotten it just about right with the production tax credit. The credit has been high enough to stimulate substantial investment while not putting an undue burden on electricity users.

For financial incentives to work, they must be also paired with sufficiently mature technology. One specific experience we have with successful incentive programs relates to wind technology.

For solar power generation to be priced competitively with traditional power generation technology, technology innovations and even breakthroughs must continue. Therefore, we believe that, for solar incentives programs to be successful at this point in the technology development cycle, they should be investment-based, rather than production-based. Also, these tax incentives must be coupled with government-sponsored research and development programs until this technology reaches sufficient maturity to be near-term price-competitive with traditional technologies.

Finally, because this is a global market, we believe that it is appropriate for the committee to consider the effect of tariff barriers on the growth of the renewable energy industry. Tariff barriers as well as preferences for a particular technology that are built in to some incentive programs can have the effect of limiting the growth in renewable energy generation.

We support U.S. efforts to eliminate tariffs worldwide for cleaner energy equipment. In summary, there is strong demand, global demand for renewable energy technology. Approximately 38 countries have renewable energy targets and various programs in place to foster further investments in renewable energy. We believe the

U.S. renewable energy production tax credit is a cost-effective approach that should be maintained and extended to stimulate the use of renewable energy in our country.

An extension of the PTC combined with State and potential Federal renewable portfolio standards are appropriate tools to foster a sustainable business environment for renewables.

Thank you again for the opportunity to testify. I would be pleased to answer any questions.

[The prepared statement of Mr. Krenicki appears in the appendix.]

Senator BINGAMAN. Well, thank you very much. Thank you all for your good testimony.

We will do 5-minute rounds of questions, and let me start. I will ask you, Mr. Boortz, to just give me your thoughts about—I know that your main point, as I understood it, was that we need to stimulate demand for photovoltaic cells for solar power in this country. And that, that will cause production of that technology and production of those items to be centered here to a fairly substantial extent. I think that was your main point.

Mr. BOORTZ. Yes, sir. That is a point I would like to make. That I think demand incentives, particularly in this area, will create a very large demand and response. Very, very large markets that will need to be satisfied. Initially, a lot of the production will come from overseas. We simply do not have enough in the United States to meet that demand. But the domestic demand will spur domestic supply. And the larger the supply base becomes, the larger the economies of scale, the lower the cost, the higher the demand, the greater the supply, and the system works as we know it will.

The United States is not a leader in terms of consumption or production of photovoltaic power. It is far and away the largest electric consumer in the world, and all of the drivers that are driving the rest of the world are pertinent to the United States. I think the empirical evidence is clear, and I think we would benefit by following some sort of demand-side program as we have seen in Germany and Japan with great success. I think we could look forward to the same success here.

Very quickly, Japan and Germany have become the leaders in this industry. Far and away, the leaders in terms of production, in terms of equipment—I don't want to say in terms of laboratories and research, but certainly they have distinguished themselves in that category as well.

We need to catch up. The industry is scaling so rapidly. I am concerned that we may look at it 5 or 10 years from now and it will not be as easy to get onboard, with most of our products coming from overseas. I do believe the first step is building that demand base. I think we are very, very close. We have seen success in the markets.

Senator BINGAMAN. Let me just make a comment and then get your reaction to it. I don't disagree with you that maybe the first step should be to increase demand. But, a parallel step, it seems to me, should be to do something to stimulate production in this country, other than just increasing demand.

I look at your chart that you have up there and see the increase in production of photovoltaics in China. I am not persuaded, in my

own mind, that because demand increases substantially in this country for photovoltaic cells, we are necessarily going to wind up producing them here. We may well wind up buying more and more from China. We have done that, virtually, in every field of electronics. They have been very much quicker to pursue some of these new technologies from a manufacturing and production perspective than we have. I feel that, without some kind of stimulus by tax code or elsewhere, we are likely to see the same thing in this area.

Mr. BOORTZ. Right, Mr. Chairman. I absolutely agree with you on focusing on demand, based on the empirical evidence we have seen in these other markets. But, if you look at the top 15, 10 or 15 or 20 photovoltaic cell producers in the world, you will be hard pressed to find anybody from the United States. That is not exactly true. BP solar is based here, but they have production all over the world. If you look at the companies that are leaders in this industry, you will see that they are from Eastern Europe, they are from China, and they are from Japan. All of those regions or all of these companies have benefitted significantly from economic development grants and government programs. And, I am speaking to production now and not supply.

Conergy, a very, very fine company in Germany, a subsystems integrator for all sorts of renewable energies, including wind and solar, just announced a 250-million Euro plant to be built in Germany. And 2 or 3 days later, there was a press release talking about a 76-million Euro grant from the EU. Not a loan guarantee, not a tax credit, but a grant.

In China—I have been over there and visited some of these companies, and they introduce themselves as being public/private enterprises. And in huge industrial parks, with 8-lane corridors with employee housing under construction on the same campus, they are given significant government aid, as we know. And they are getting to approach the 50-percent mark in this industry.

On a production basis, our competitors are getting a huge amount of government support. The quid pro quo is jobs; they are producing jobs. And that is what they need in Eastern Europe; that's what they need in China. In the United States, I think some sort of investment tax credit for producing photovoltaic cells domestically, or any kind of equipment, however broad we wanted to make this relating to renewable or alternative energies, would be good.

Also, government loan guarantees would be something else, underwritten on a conventional stringent manner, but just a way to attract capital to this industry. We do not want to be here asking for so much, but I think we need to make a decision whether the United States wants to participate in the production of equipment and cells and modules in this industry or not.

When I was in China last fall, we had an opportunity to visit Suntech, which is a remarkably successful public company. They said their number-one target was the United States when they saw this market opening up. So your points are very well taken.

Senator BINGAMAN. Thank you very much. Senator Thomas?

Senator THOMAS. Thank you. Mr. Boortz, we have had incentives in place for solar for a number of years. Why do you think the existing tax credit has not worked as intended in the market?

Mr. BOORTZ. Well, I will just go back to the Energy Policy Act, I think of 2005, and the incentive there that was created on a 2-year basis. At least for the residential market it was a 30-percent investment tax credit, but limited to \$2,000. I would say that there are probably a couple of things wrong.

One, the time frame is much too small. Industry cannot respond in 2 years to that, in terms of providing supply. And I think that, even from a consumer's point of view, if it is a program that is put in place for 2 years, there is a little uncertainty about, do I want to be the first to step out, is this really valid technology, why would it only be for 2 years?

Honestly, solar for a period, I think, of decades has been an industry that has not enjoyed any government benefits that I am aware of in terms of stimulating demand. Other than what happened in 2005.

Senator THOMAS. You have been given tax credits, but as far as stimulating demand, you have not.

Mr. BOORTZ. Well, the tax credits came with the bill of 2005?

Senator THOMAS. Yes.

Mr. BOORTZ. Prior to that, I think you would have to go back decades to find any kind of government stimulus for consumer consumption in the photovoltaic industry.

Senator THOMAS. Okay. Mr. Johns, are these solar things basically for each house, or each building? They are not an electric generation system, are they?

Mr. JOHNS. There are two or three types of technology. First of all there is solar thermal, second solar PV. I talked about the democratization of power, where individuals wish to participate in the climate change debate. People and corporates can install their own facilities.

Senator THOMAS. That's basically where we are here.

Mr. JOHNS. And really, California is being very effective in encouraging that. And that is one of the reasons why the U.S. scores highly in our ranking for the U.S. because of the California program.

Japan and Germany have multiple, thousands and thousands of home programs to actually put solar panels, you might almost say, everywhere in Germany. As a consequence, this has stimulated their own domestic industry.

Senator THOMAS. Centralized with transmission to the user or not?

Mr. JOHNS. There are then collecting solar devices and concentrating devices which can actually trade as power stations in their own right. Power stations have been erected, as I understand, in the U.S. as well. So you can transmit power from solar, from solar facilities. They have usually been subsidized by the types of infrastructure grants the previous speaker was referring to.

Senator THOMAS. You both mentioned California. California is going to have to do something rather quickly if they don't like energy developed by coal, or they are going to have the lights out.

Mr. BOORTZ. Yes.

Senator THOMAS. There is a great demand there. So what percent of the market is in solar use?

Mr. BOORTZ. The percent of the consumption market?

Senator THOMAS. The consumption market, the electric market. Not your sales, but the electric market.

Mr. BOORTZ. It is inconceivably small, the present market for photovoltaic electricity. Again, there are a number of analysts and futurists, if I may say, who see solar playing a larger and larger role.

Senator THOMAS. What is it now?

Mr. BOORTZ. In the electric grid, it would be well, well under 1 percent, probably $\frac{1}{2}$ of 1 percent.

Senator THOMAS. Right. Mr. Krenicki, GE sells enhancers for Integrated Gasification Combined Cycle (IGCC) plants, I think.

Mr. KRENICKI. Yes, sir.

Senator THOMAS. I am curious to know whether markets provided the demand or do you attribute that to incentives or mandates?

Mr. KRENICKI. Okay. We are in the solar business as well. I think in some respects, the gasification challenge is similar to solar in that we need some investment support to lower the initial capital outlays to build some scale. And, if I could just illustrate the solar challenge and then relate it to wind and coal.

You know what? To build a coal plant today would have a cost of electricity of roughly 6 cents per kilowatt hour. Wind would be 8 cents. And that has dropped about 80 percent in the last 15 to 20 years. And solar would be a multiple of wind—4 or 5 times.

What solar requires is material science breakthrough to lower the cost. So that is why we support investment credits and research. But, how do you go from 40 cents to 8 cents? It requires technological breakthroughs. And, they are absolutely the right thing to do.

On clean coal, and wind power, it is largely scaling to get lower costs. So if we have some wind at 8 cents, if we could grow even faster, the cost would drop even more. So how do we deploy faster? And, in the case of wind, there is a zero CO₂ option. But that is how we see it, Senator.

Senator THOMAS. Well, I appreciate that. In fact, I think I said, and I will say it again, I think we need to look at where we are going to be as these things become more effective, and we know how to do something with coal now in terms of the volume.

The volume of solar is relatively small. We heard about California. And you have all mentioned California, and they are going to turn the lights off if they intend on going in solar. They have to do something in the interim. So, anyway, thank you sir.

Senator BINGAMAN. Going by this early bird rule that we supposedly use in this committee, Senator Crapo is next and Senator Cantwell, then Senator Kerry, then Senator Salazar.

Senator CRAPO. Thank you, Mr. Chairman. Mr. Boortz, in your testimony you talked about Japan's rebate program, and all the witnesses have talked about the United States' approach using tax incentives for homeowners who purchase solar panels. How do you feel about the use of rebates and how it compares to our system in the United States of tax incentives? Would one approach be more or less effective than the other?

Mr. BOORTZ. What they have in common is providing cash up front to the purchaser with solar. And, as you know, you are mak-

ing your entire capital investment on the front end. So any help you can get in lowering that capital cost is very effective.

If I were to get a \$3 per watt, say rebate, by putting solar on my rooftop in California, that would be very, very similar to a \$3 investment tax credit that I might have through the Federal investment tax credit.

Senator CRAPO. So they both work in about the same—

Mr. BOORTZ. I would say they would both have pretty much the same effect. And, for solar, where you have individuals, homeowners, consumers making this investment, that kind of savings on the front end is very effective, I believe.

Senator CRAPO. Mr. Krenicki, did you want to comment?

Mr. KRENICKI. Our view is, mostly, feed-in tariffs outside the United States tend to be more expensive than production tax credits. So those costs are born directly by the users, by the consumers. So, based on our analysis, we think that PTCs are a pretty economic option for rapid deployment of wind technology. In the case of solar, we encourage more investment tax credits to really address the engineering challenges.

Senator CRAPO. That was going to be my next question. How important is the investment tax credit to the commercialization of solar?

Mr. KRENICKI. My view is, it is absolutely critical. You know, the demand for solar is out there. One of the advantages of solar is that it generates power when you need it. You know, peak consumption is during the day. So, there would be a lot more rapid deployment of solar if it was just lower cost.

Senator CRAPO. And to any of the panelists, what about the accelerated depreciation of solar properties and investment? Is that the same answer, Mr. Krenicki, you would give on that?

Mr. KRENICKI. What would—I would say the answer would be different. I would say the direct investment tax credit—

Senator CRAPO. Is much better?

Mr. KRENICKI. Is much better in the case of solar than accelerated depreciation.

Senator CRAPO. Anybody else want to jump in on this general issue? Mr. Johns?

Mr. JOHNS. I just want to join the debate a little bit and remind about solar thermal, because solar thermal is much more cost-effective, and I mentioned the issue of heat. If you are out for saving emissions, that is an area where you can get a lot of value for the money for your incentives.

Senator CRAPO. Thank you. Would all of you agree that the production tax credit is working as well as the FITs are in the other parts of the world?

Mr. KRENICKI. I would agree that it is working better.

Senator CRAPO. Working better?

Mr. KRENICKI. At the moment. In terms of cost-effectiveness, and if you look at where manufacturers are allocating units today, the U.S. is probably the fastest-growing market in the world.

Senator CRAPO. Mr. Boortz?

Mr. BOORTZ. I would just make the point, with solar a production tax credit is a little more cumbersome. If I am a homeowner who has invested \$12,000 to put 2,000 watts on my rooftop—or 1,500—

what I want and what I need is assistance with that initial capital outlay. And to be able to measure the number of kilowatt hours that I am producing and try to get some sort of rebate from some source is cumbersome.

We have 50 State jurisdictions and, I think, over 3,000 utilities in this country, and the nice thing about the investment tax credit in the Federal tax code is it is treated the same by everybody and the benefits are predictable and they are immediate. Just the administration of the program for small-scale solar is not nearly as cumbersome, and I think it would work very well. For wind, I can see, with a large CapEx investment, and large corporate owners, many already in the utility business, how effective the production tax credit is. So I think there are two different incentives for two different markets.

Senator CRAPO. Mr. Johns, did you want to elaborate?

Mr. JOHNS. Yes. I made the point that you need to decide whether it is a matter of policy and choice, whether you have different mechanisms for emerging technologies compared to conventional technologies. The truth is that mechanisms which focus on the path of grant aid tend to be better for actually emerging technologies. Whereas, mechanisms that focus on production tend to be better for mature technologies.

Senator CRAPO. Thank you. I assume my time is up.

Senator BINGAMAN. Just to clarify that, you would suggest, Mr. Johns, that if, and I guess the rest of you would agree that, in the case of solar thermal, since that is a developed technology, we would be better off there with a production tax credit even though an investment tax credit makes more sense with photovoltaics?

Mr. JOHNS. I think I would distinguish one point, which is the bigger user community of domestic users for solar thermal, and actually the main point is the ease of administration for them. They don't really want to be collecting credits every year. They would rather collect money for investment up front. So maybe there is a tactical reason to keep the investment tax credit to encourage rapid deployment.

Senator BINGAMAN. Thank you very much. Senator Cantwell?

Senator CANTWELL. Thank you, Mr. Chairman, and thanks for your leadership on this committee and on the Energy Committee overall. I am pleased that the Finance Committee has created this subcommittee. I think it can play a very important role in our Nation's energy policy by getting the predictability on tax incentives right for a clean energy technology. So, I want to thank our panelists for shedding light on that today as well.

If I could, Mr. Chairman, I'd like to enter a longer statement in the record about my thoughts on what some of those priorities should be and how I think we ought to be aggressive in not only making sure we capture this market opportunity for the United States, but that the United States also be an energy leader in exporting our technology into developing markets as well.

If I could, with the panelists, talk in a general sense about the lengths of tax credits in general. I know it is not a science—it is more of an art. But, what do you think, from the perspective of stimulating investment and leveling the playing field against fossil fuels, that we ought to be looking at from a time horizon?

Our challenge here is, obviously, we are in tight fiscal times. We would all like to say we are going to have a 10-year horizon on something. But let us be realistic. What do we get for looking at longer horizons, and do you think that there is a sweet spot on this particular issue? You know, 5 versus 7, versus 10, and what we ought to be looking at. And, when I say that as a tax point, I am talking about a broad clean energy incentive that is agnostic to a particular technology but a broad policy.

Mr. JOHNS. I think if I could comment on that. In the UK, we did some work for the UK government when the non-fossil fuel obligation—a different mechanism—was in place. It was initially launched for 7 years and did not have much of a take-up for individual projects. We did a study, we did some careful analysis, which shows for capital investments of this nature, the investment benefit needs to last for the particular project for its capital life, which it turns out is often 15 years.

So from the project perspective, the benefit needs to be there for that period of time. In relation to the actual framework itself, there is a lot of evidence to say that a consistent policy framework should be adopted for a long period of time—and I use the word “framework” deliberately—it does not mean to say you are tying yourself into huge amounts of spending for that period of time.

But a consistent policy framework for a long period of time, I am afraid, again, is, you know, 10 years, I would say 5 to 10 years is the minimum period for that. This has a very significant effect on inward inflows. It has a particularly significant effect on the siting of manufacturing plants. When the PTC was not renewed, a number of plant openings in the wind turbine industry were cancelled in the U.S., and now you are importing those turbines from Europe.

Mr. KRENICKI. I would just add kind of an overlying statement, which is the overall subject of climate change. Legislation and where the country is going to go will impact this policy in many ways. So that is an open question, but I think the country needs to have a diversified approach. Renewables are certainly key, nuclear, clean coal, and different medicine in different cases. But, I think in the case of renewables, specific for today—

Senator CANTWELL. Let me make sure I am clarifying that. No one thinks you are getting predictability with 2 years?

Mr. KRENICKI. No.

Senator CANTWELL. Okay. Everybody thinks that 5 years is the starting point.

Mr. KRENICKI. I think it is longer. I agree with my fellow panelists here that, if you just look at Europe as an example, how long did it take to get wind off the ground? It took 10–15 years. I think we are at a point now where we have moved the cost curve on some of these technologies where we could extend maybe up to 5 years and then look at some sort of transition to RPS standards at the State and perhaps Federal level. So I think at different points in the maturation cycle, the medicine will be different. But, I would also add a key thing on climate change. You know, what is our approach going to be on nuclear?

Mr. BOORTZ. If I may just add very, very quickly, if I am thinking in terms of the sweet spot, I would probably be thinking 10 to 12 years. But I think about, for the photovoltaics and the solar—

Senator CANTWELL. Obviously you are not thinking about our budget. [Laughter.]

Mr. BOORTZ. Well—

Senator CANTWELL. So you are thinking about the energy for the private sector—

Mr. BOORTZ. Right. I am thinking energy security and a lot a things that do pertain to the budget in an indirect way. But I would like to make a point for a potential market that is as deep as this one. There are supplier issues. In our industry right now, we have issues with polysilicon and silicon wafers. We have issues with installers. We have issues with machine makers. If we want to order a piece of equipment, it will take 12 months for it to come. We have capital issues. So the shorter that time frame is, and particularly when you are accelerating the very, very deep market, you have to have some time. We don't want to make a push, be ready to go in 6 years and have the incentive go away 2 years later. So there are some start-up issues to consider as well.

Senator CANTWELL. Thank you.

[The prepared statement of Senator Cantwell appears in the appendix.]

Senator BINGAMAN. Senator Kerry?

Senator KERRY. Thank you very much, Mr. Chairman, and I enjoyed listening to the testimony, and I thank you for moving the committee in this direction and engaging us.

Mr. Krenicki, thank you for mentioning global climate change. The thing that bothered me in this whole discussion up until then—I know one of you mentioned it in your testimony—is that we are talking about incentives for the marketplace, but the marketplace is behaving, the marketplace role is a reflection of an attitude about demand, about behavior.

And right now we are operating in a marketplace that is frankly way behind the curve in the United States with respect to climate change. It is not the marketplace we would like to see. So as we think about these questions of incentives, to put an incentive in place that does not address the larger policy issue does not make sense.

So if we are talking about incentives based on the market now, and you say, well, we are going to try to get solar down from 35 or 40 cents a kilowatt hour and make it competitive, etc., etc., that is on a different demand curve of what many of us hope we are going to have and ought to have.

So let me just ask you a couple of questions. I know Jeff Immelt and GE have done a terrific job in the “ecomagination” products, we are well aware of that. We are aware of your investment and what you are doing. I gather you have about \$17 billion of additional revenue booked based on these green products you are now producing or something to that effect.

Mr. KRENICKI. Not quite. But I think that is a longer-term goal.

Senator KERRY. Longer-term?

Mr. KRENICKI. Our revenues in wind this year will be in the \$4-billion range.

Senator KERRY. I'm not just talking about wind. But, you have also produced other lines, I mean the whole energy lines, including light bulbs and other things.

Mr. KRENICKI. Right, right.

Senator KERRY. I think you have had, if I recall, I think you had about \$10 billion of additional revenue in the first few years.

Mr. KRENICKI. I think that is accurate.

Senator KERRY. So the point I am making is that, it is big business here. That is the bottom line. There is a lot of money to be made if we change attitude. Is there anybody here who disagrees with the science of global climate change? Do all of you accept that we have Jim Hansen's frame of about a 10-year window to get it right? To sort of begin to move with the right choices we have to make. Anybody argue with that? You all agree?

Mr. JOHNS. I am 10 years or less.

Senator KERRY. Ten years or less?

Mr. JOHNS. I agree with all of that.

Mr. KRENICKI. I agree too.

Senator KERRY. I think it is 10 years or less based on the data coming in today. So, if that is true, let us sort of get to the issue of the choices that we get to make. You have a 10-year window, and you have to get carbon-neutral. The scientists are telling us today, we have to reduce our carbon level per million parts, from where it is today, down to—the most we can allow it to go up to is about 450 parts per million and have an equilibrium and not raise the temperature more than 2 degrees centigrade. If that is true, then whatever incentives we are going to consider here have to be enormous. My question leading up to it is, do you not need to price carbon and have a cap that is economy-wide in order to change the fundamental behavior and then gear your other tax incentives, grants, subsidies, to what that new marketplace is going to be with that pricing? Because anything less than that, we are not going to meet the scientifically arrived-at goal. Is that correct, Mr. Krenicki?

Mr. KRENICKI. As you know, we are part of this U.S. cap initiative, and we believe that there should be value associated with carbon. The only thing that I would add is—I think that many of the things that—

Senator KERRY. Let me just, for the record, so the record is clear—the U.S. cap represents some of the largest corporations in the country including Dupont, GM, Dow Chemical, GE, others, all of whom say we have to get a pricing on carbon.

Mr. KRENICKI. Not a pricing on carbon. I think we need a price signal in terms of driving investments.

Senator KERRY. Once that has happened, the marketplace—and leave our incentives aside—the marketplace is going to begin, because you have, automatically, the capital issues that you have, Mr. Boortz, and these others are going to be affected. Are they not?

Mr. BOORTZ. Right.

Senator KERRY. So don't we have to think about incentives in that context and not just the marketplace we have today?

Mr. KRENICKI. I absolutely agree that it has to be taken into account, because these are long-term decisions. But many of these

things that have already been done—the production tax credit for wind is zero CO₂, so it is supportive of the climate change.

So I would say what has already been put in the ground has been good work and consistent with that objective.

Senator KERRY. Could you foresee that, if we had an economy-wide cap pricing of carbon that that solar ratio is going to begin to change?

Mr. KRENICKI. From 40 cents to 8 cents is a lot. A long way to cover.

Senator KERRY. But there is about \$1.5 billion, I think it is, that has moved in venture capital into those investments.

Mr. KRENICKI. Yes, I, I—

Senator KERRY. Wouldn't a lot more be drawn in to it by that, and then you have that infrastructure breakthrough you talk about?

Mr. KRENICKI. We would certainly push it forward. My prediction is, if there was an economy-wide value associated with carbon, nuclear would be on the table in a much bigger way.

Senator KERRY. I think it would be. I agree with that. It is going to be part of, no matter how you like it, or don't like it—I don't think it is a long-term vision, but in the short term it is going to be part of that mix. Yes, Mr. Boortz.

Mr. BOORTZ. I would just say I believe a carbon pricing mechanism would also draw the utilities in to the small-scale photovoltaic industry. They would become more of a player, more of a participant. Again with PV we are often times talking about homeowners, we are talking about small consumers, and I would make the case that, if I am paying higher rates and I am paying 29 or 30 cents a kilowatt hour, that I am getting very, very close to PV being economic.

I don't agree that it is 5 or 10 or 15 years out. I think we need a market, we need a market response, we need scale, and I think we are very close.

The American Appraisal Institute says that, if you put PV on your house, you will add to the value of your house 20 times the first-year savings in electricity. That does not show up anywhere in 40 cents. We are not talking about throwing money away. We are talking making an investment in an income-generating asset and putting it on your property. We are much closer with PV being economic than people realize. We need a bully pulpit, we need people talking about it, we need incentives, and this industry will take off. It is not that far away.

Senator KERRY. My time is up. Could I just summarize one thought? In 1979, after the first oil crisis, President Carter committed us and the country to this effort, and we started a lab out in Colorado. We had a lot of tenured professors who left their jobs around the country to go out there to do research.

The Reagan administration came in, pulled the guts out from under the subsidy structure and the incentives you are talking about today. We were doing this in 1980. It went away, and the technology we had developed in the United States, in our laboratories—it never went to an American shelf—it went to Japan and Germany—and they now, as one of you in your testimony said, they have the lead today.

When the former Soviet Union folded in the 1990s and they suddenly looked at the devastation of those Communist power plants and so forth and said, what are we going to do about this, they went to those companies in Japan and Germany to look for the remediation and clean-up of the Danube and so on and so on. We lost, on estimate, over 200,000 jobs as a consequence of our lack of that sustained commitment. So I hope we are going to do this one right and make that kind of commitment. I think on the long-term basis—every venture capitalist I have talked to, every major businessman, says you can't make a business plan. You cannot deal with capital without seeing it go out into the out years. We need to get it right.

Senator BINGAMAN. Thank you very much. Senator Salazar?

Senator SALAZAR. Thank you very much, Senator Bingaman and Ranking Member Thomas. Senator Kerry, I appreciate the comments you made about the National Renewable Energy Lab and its founding back in the 1970s and what happened in that robust area of investment in research and development and how, in fact, we have been disadvantaged because we have not paid enough attention to this issue in the last 25 years.

I do think that when you look at some of the charts that you produced, Mr. Boertz, that show what is happening in Japan and Germany and China, that much of what we developed here, through our investments in the 1970s, really has been taken by other countries. So I very much agree with the points that Senator Kerry made.

Senator Bingaman, I have a longer statement for the record that I will just submit for the record. I want to just make a comment.

I think that what you will find probably, at least among most of us who sit on this committee, is an agreement with the point that you made in your written testimony, that what we need to do is to have a longer-term horizon with respect to the production tax credit in order for us to be able to stimulate the same kind a revolution we have seen in Europe and other places with respect to solar and renewable energies.

Senator Smith, myself, and others have introduced legislation that would take us at least to an 8-year window, and I hear you talking about the sweet spot perhaps being around 10 to 12. Those are issues that obviously have budgetary implications. But I do think that we have to make the commitment for a sustained effort here. That it does have to be something that we do for much longer than just 1 or 2 years. In that regard, I hope that we in the Finance Committee and working in the Congress can find that longer-term horizon. Let me ask you this question, with respect to some of the policies that some of you talked about in your testimony regarding a renewable portfolio standard, which has driven much of this and many of the European countries. In my State of Colorado just a few years ago, we passed a renewable portfolio standard that said we were going to get to 10 percent by the year 2015 of our electrical generation coming from renewables. We have done so well because of the investments in wind and other things that we have actually now doubled the amount. The industry, in fact, Xcel has been one of the leaders in promoting the doubling of the RPS.

Senator Bingaman, last year, I joined him in an effort to try to get an RPS established for our country in the National Energy Policy Act of '05. We were not successful in doing that. My question to you is, if we were able to come up with a national RPS, be that 10, be that 20, whatever that might be—what would that do in terms of spurring forward the kind of investment with respect to renewable energies? So why do we just take that, take a minute of the time and we will go across the table.

Mr. BOORTZ. Thank you. I will be brief. I think the RPS would be a very valuable thing. Again, the prospect of photovoltaics and relatively small consumers, I think it would have the impact of getting the utilities involved, as they should be, in our industry, and playing a larger role.

PV works because of the grid. The utilities own the grid. If the renewable energy portfolio standards are out there, they will pay attention to that. The other thing I would like to say—one of the things I have noticed about the portfolio standards is that, if you do not say that a certain percentage of it needs to be distributive, then the standards are met the day they are enacted by the wind industry.

I like wind. I am for portfolio solutions. I do not think solar can go it alone. But with the RPSes, I would really like to see the States and the governing jurisdictions say, we want at least 10 percent of this to be distributive. In other words, fuel cells, solar, things of that nature. It should not all be met by the same technology.

Senator SALAZAR. Mr. Johns?

Mr. JOHNS. My observation is that resources vary by location and that, if you have a national policy, that would help a lot of people on the investment front, because it would make life easier in terms of understanding the regulations. It is very important that it is tailored at a State level or at least at a regional level based on the resources. My comment would be that I think that you are under-exploiting the valuable resources that you have in the U.S. which would help you in the carbon area. The area of biomass is one area, and in relation to certain waste materials as well, you could actually get a little more bang for your buck, as it were. So I think it is very important that it is calibrated if you have a national standard for the resources in each territory. Because you want to use the appropriate resources in those territories and for those territories to contribute on an approximately similar basis to the solution.

Senator SALAZAR. Thank you. Mr. Krenicki?

Mr. KRENICKI. I agree with Mr. Johns. State-by-State resources do differ—that needs to be taken into account—but I also think there is an opportunity using transmission and distribution to move renewable power from the energy-rich States in the Midwest, Texas, around the Nation, and something that needs to be taken into account is T&D—transmission and distribution. How do you effectively move this resource?

Senator SALAZAR. I appreciate that. Mr. Chairman, the only comment that I would make is that I think that, perhaps, it will be in our other committee, the Energy Committee, that as we look at the energy future, we look at the RPS. I think it has worked for many States that have adopted it. It certainly is working very well

in my State of Colorado. I think half the States in the country have an RPS. It might be a useful thing for us to look at an RPS in a manner that is a national standard that has some flexibility in terms of State implementation. Much in the same way as we do with respect to our environmental laws where we allow the States to take the lead, but have a national standard. Thank all of you. I did read your testimony, and it was very enlightening. Thank you very much.

[The prepared statement of Senator Salazar appears in the appendix.]

Senator BINGAMAN. Let me just ask on one other issue here. When you were here before, Mr. Krenicki, we talked a little about it. In the case of the investment tax credit that we have in place for solar, it is easy enough to figure out, okay, should that be 5, should we extend that for 5 years or for 10 years, or 15. In the case of the production tax credit for wind, for example, we do have a little bit of a box we have gotten ourselves into, because the way that works is, we have said—we have extended it for 2 years, we enacted it for 2 years, and then we said, if you get your wind farm in operation by a certain date, you then have the production tax credit for a 10-year period.

Now, how do we structure the extension of the production tax credit? I think one of the concerns, Mr. Krenicki, as I understood your comments when you testified before, was that if you say, okay, you have 5 years in which to get something in place and then you have a 10-year period, you might, in fact, cause a reduction in investment for a couple of years—2 or 3 years—because people would figure there is no reason to rush. We've got plenty of time here.

How do we fix that structural problem in the design of the production tax credit? I sort of asked you that when you were here before, and I am still a little at sea as to how we solve that problem.

Mr. KRENICKI. I will take one more shot at it.

Senator BINGAMAN. You can take another shot, and then if either of the other witnesses would like to give their views.

Mr. KRENICKI. It is still something that we are thinking through, but one point I would make is, the back end of the tax credit—the 10 years—I would not disturb.

Senator BINGAMAN. So once you've got it, you've got it for 10 years? I think we should ensure that. Then the question is, how long can—

Mr. KRENICKI. What is too long?

Senator BINGAMAN [continuing]. Can you take advantage of this 10-year window?

Mr. KRENICKI. And that is something that—how do you incur a level-loaded production ramp-up in deployment, because that is what the country needs is to get the capacity out. So I've asked my team to work on appropriate language and talk to other customers of ours about what would be most effective. It really comes down to what is too long. How could we describe the ideal implementation scenario that is good for the country? Again, I think it is something we could submit to the committee.

Senator BINGAMAN. Any other thoughts you have on it, I would be anxious to hear. Mr. Johns, did you have any thoughts?

Mr. JOHNS. Well, the type of regulatory frameworks, I think I used the word framework. What the industry needs is a framework so it knows rules will be in place for a long period of time. In relation to budgetary control, I think it is the right of government to take the gas pedal up and down in relation to the amount of spending it is going to incur.

The suggestion that I would have is that you would actually set a budget for how many credits you want to issue over a 5- or 10-year period that you would actually annually announce the amount that is the target, but that you would basically be able to borrow from 1 year to another and transfer from 1 year to another. That would encourage rapid deployment, because people would try to get as much in as possible in the early years.

You could set a limit to how much you are going to borrow from the next year, if you will. But at least you would have set a slug of money that you are going to use over a period of time and not be subject to having—I think the concern is—an unlimited expenditure requirement 7 or 8 years out because lots of people have put on wind farms in that initial 5-year period.

That, I think, would actually provide the framework. It would allow you to adjust the pace of development according to your policy frameworks. I have to say the conversations are always predicated on wind and solar, and there are these other technologies that can help.

I think you really should look at energy efficiency. I think you should look at, as I said, biomass. You also have co-firing incentive which needs thinking about. And if you are going to solve the problem, then you do need to calibrate, unfortunately, by technology because they have different investment paradigms.

Senator BINGAMAN. Mr. Boortz, did you have any thoughts on this?

Mr. BOORTZ. The only thing I would mention, I think a number of the feed-in tariff programs in Europe do, in fact, provide a higher incentive for people who access the programs early on. They may have 20 years of a tariff, but if they do it in year one, that tariff is greater than if they do it in year two or three. So it does create an incentive not to stand on the sideline and wait, but to access the program early on to get the maximum benefit.

Senator BINGAMAN. I also just wanted to see if either Mr. Johns or Mr. Krenicki had any thoughts as to the suggestion Mr. Boortz had that we specify in a renewable portfolio standard that at least 10 percent of the renewable energy that they are getting credit for be produced from distributive sources. That is the way I understood is your suggestion.

Mr. BOORTZ. That's correct.

Senator BINGAMAN. Do either of you have thoughts as to whether that is a problem, or it does not make sense, or what?

Mr. KRENICKI. What we argue is, we should not be specific. Because, based on where we are in terms of the cost of that technology, being specific on the amount is going to drive costs to the consumer.

Senator BINGAMAN. But you would also agree, I think, Mr. Boortz's point is that a renewable portfolio standard that doesn't do that, does not wind up doing anything for solar—

Mr. KRENICKI. That is why we are championing a higher investment tax credit for solar, because we feel that it just needs different medicine at this point in the technology cycle.

Senator BINGAMAN. Mr. Johns, did you have any thoughts on this?

Mr. JOHNS. I think I agree with Mr. Krenicki in relation to the solar issue. The issue that I would raise is high intensity carbon users who have energy requirements. A good policy measure would be to encourage combined heat and power at their manufacturing locations. That is the initiative that is taking place throughout Europe, and it is having quite a big effect. It would have the advantage, in some cases, of preserving jobs. We have been doing work for a very substantial energy user in the UK where their business is threatened by rising energy prices. We have helped them come up with a solution where they are putting up a combined heat and power plant on their plant location. It was a consequence of that, that they are keeping the jobs in the UK.

Senator BINGAMAN. Well, thank you very much. I think it has been useful testimony, and we will probably continue to be in touch with you as we try to develop legislation in this area.

Thank you.

[Whereupon, at 3:33 p.m., the hearing was concluded.]

A P P E N D I X

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

Testimony to the Finance Subcommittee on Energy

April 12, 2007

Charles Boortz, Vice President, Advent Solar, Inc.

Mr. Chairman, distinguished members of the subcommittee, I would like to sincerely thank you for the opportunity to testify before you today on alternative energy policy with a focus on strategies employed by the leading countries in the solar energy industry. Our CEO, Rusty Schmit apologizes for not being able to make it this afternoon as his plans changed due to pressing business matters; however his thoughts and comments are included in my written statement.

I am the Vice President of Business Development at Advent Solar, a solar cell manufacturing company located in Albuquerque, New Mexico that is commercializing an advanced solar cell technology developed under Department of Energy funding in the 1990's at Sandia National Laboratories. The company has been in operation for nearly four years and recently began high-volume production in its new 25MW manufacturing facility. Advent currently employs 165 people in manufacturing, engineering, R&D, finance, and sales and marketing, and we expect to grow rapidly as we expand production over the next few years.

Even though Advent Solar is a U.S.-based company utilizing U.S.-based technology, most of its sales are in Europe and virtually all of its manufacturing equipment was purchased from European vendors. Advent believes that the U.S. has the potential to be the largest and most prosperous solar market in the world, but for the immediate future, the company has found better opportunities working with customers in the Europe. In addition, most of Advent's formidable competition resides in Eastern Europe, Japan, and China, areas of the world where incumbent manufacturing firms benefit from significant economic incentives and monetary grants.

With a 6.8% market share of solar cell production in 2006, the United States is continuing to fall behind the leading solar energy producing and consuming countries of the world in terms of technology development and job creation when it comes to the utilization of renewable energy sources. The main reason for this comparative decline is that the United States has not provided adequate stimuli for market demand, R&D, and manufacturing incentives. At the same time that our country is lagging in providing policy incentives, the rest of the world, particularly the EU and Japan have been asserting their policy leadership and taken a commanding lead in alternative energy development.

Twenty-five years ago the United States was the clear leader in technology development for solar power generation as well as general manufacturing. The Department of Energy and other government agencies funded critical early work

to develop reliable products, and the results of that early work can still be seen today around the world.

Today, sadly, that is no longer the case. Only BP Solar is among the top ten producers in the world that is located in the United States. Today's leading companies are located in Japan, Europe, and increasingly China. This loss in technological leadership translates into job losses and missed opportunities to create hundreds of thousands of new jobs.

INTERNATIONAL EXPERIENCE

The alternative energy policies initiatives implemented in other countries have done three things to advance market leadership in these respective countries:

1. Advanced the technologies more rapidly than the U.S.
2. Accelerated market demand and reduced dependency on conventional energy sources.
3. Stimulated the building of indigenous manufacturing, thus creating high-wage jobs and related benefits.

I would like to present three examples of countries that have implemented policies that have had significant, identifiable benefits: Japan, Germany, and China.

Japan was the first country to have a meaningful, long-term market stimulus program as a result of robust R&D funding. A rebate program was implemented in the 1990's in order to stimulate demand. In this program the purchaser (typically a homeowner) received a rebate for a certain portion of the price of a solar installation. Although this rebate declined annually, the market demand stimulus was sufficient to create significant demand and fuel growth for what would become the largest manufacturing firms in the industry. In 2006, the rebated was phased out totally, but market demand in Japan continues to grow. This steady, long-term creation of demand enabled Japanese manufacturers to build strength in their market. It is not a coincidence that today there are four Japanese companies among the top ten manufacturers in the solar industry: Sharp, Mitsubishi, Kyocera, and Sanyo. As recently as fifteen years ago, none of these companies were in the top ranks. In 2006, Japan was the second largest solar energy consumer with 17% of the global market, but the country is the largest solar cell producer with a 36% market share.

Germany was motivated to drive more wide-spread use of solar power by several factors: the country needed additional electric generation, the public was not interested in adding nuclear power, and there was broad concern over climate change and other related environmental risks. Based on these criteria, the government decided to test several programs intended to drive market demand for solar power. After initially trying a rebate program similar to the Japanese,

the Germans settled on what is referred to as a "feed-in tariff" – a program under which the electric utilities buy solar-generated electricity at a higher rate than the rate payers pay for the power. For example, in 2006, solar-generated electricity was purchased at 49-52 Euro cents per kilowatt-hour (depending on system size), whereas the typical homeowner was only paying about 15-18 Euro cents per kilowatt-hour. This rate differential declines 5% per year, but the premium rate is guaranteed for a 20 year period. It is important to note that this program is not government-funded, but rather the additional costs are funded by all rate payers. Each pays a small additional amount on their monthly bill to fund the solar feed-in tariff.

This incentive program has made Germany the largest solar energy consuming country in the world with a 55% market share in 2006. The broad market penetration of solar has also enabled related and necessary infrastructure to develop. For example, banks now readily provide the financing for the purchase price of solar panels because the market flow from selling the power is well established and predictable. This helps overcome the up-front cost barrier that had prevented many homeowners and businesses from installing a solar power system.

As was the case in Japan, the strong market demand in Germany has also driven incredible industrial development and employment. An estimated 100,000 jobs have been created in the renewable energy field over the past number of years in Germany. In 2006, over 35,000 jobs were reported in the solar sector alone. Germany trade associations predict a total of 200,000 jobs in the renewable energy sector over the next fifteen years.

This build-up of manufacturing of solar power components has been further accelerated by the government's policy of aiding companies who create high-wage jobs in regions of Germany that need economic development. Generally, the German and E.U. governments will pay a company for about 25-45% of a total project investment in these challenged areas. One recent example is Conergy AG, a company based in Hamburg, Germany, which has embarked on a 250 million Euro factory in one of these German economic development zones. The combined investment grant of the various governments towards this project is 76 million Euros. While I cannot speak for Conergy, it is clear to see that this is a tremendous incentive to locate manufacturing facilities in those regions and not in areas that do not provide a comparable incentive.

The newest country to begin realizing the potential of the solar power industry to create jobs is China. Five years ago there was not a single Chinese company of any significance manufacturing solar power components. Today there are numerous Chinese companies publicly traded on U.S. stock exchanges and many more benefiting from public/private incentive programs. One of these companies, Suntech, became the fourth largest solar cell producer in the world in 2006. The reason for this recent growth has been the Chinese government's

policies promoting manufacturing in the renewable energy sector. Many analysts predict that China will soon control over 50% of the solar manufacturing market. Presently, China exports 95% of its production and is not expected to be a significant consumer of solar products for a number of years.

Advent Solar

Now I would like to bring this back to the specific case of the company I work for, Advent Solar. We are a typical American company competing in a very rapidly growing global marketplace. Advent has a unique technology, developed with Department of Energy R&D funding and is in a strong position for growth. However, there are two significant barriers for us to continue to keep our growth and jobs in the United States.

First, there is insufficient demand in this country for our products. In 2007, nearly 90% of our sales will be in Europe. As our volume increases, the economics of shipping large quantities of products around the world becomes prohibitive, making overseas manufacturing attractive. In order to continue to manufacture here, we will need a robust and growing domestic market to support in the United States.

Second, we will need large amounts of capital to expand our manufacturing capacity to achieve an economic scale. It is increasingly difficult to attract this kind of capital when our overseas competitors can add the same capacity for two-thirds of the investment in lower cost markets. At some point, Advent will be forced to consider the benefits of expanding in lower cost countries in order to remain competitive. Outsourcing is a term that is often used these days to refer to the shifting of jobs to low labor cost countries, such as the movement of jobs in the Information Technology industry to India. In this industry, however, labor is not the major cost component - it is the cost of capital and that cost is lower in many other countries. Whether in Germany, driven by the need for economic development, or China, where the cost of capital is inherently low, it is very difficult to compete from a U.S. manufacturing base. It is not our intent or desire to invest overseas, but unfortunately, it may be a competitive reality.

Recommendations

Based on my company's experiences, I recommend the following actions by this subcommittee in order to begin to address the energy and environmental issues. I have only included recommendations that fall under the Finance Committee's jurisdiction. Obviously, many of the EU models to create demand are not tax-based incentives and are therefore not included even though I think they have significant merit. I would be happy to provide more information if you are interested.

- Expand the existing investment tax credit for the purchase of renewable alternative fuel power systems, such as solar along the lines of S.590 – a bill introduced by Senator Smith and Senator Salazar with broad support on this Committee. Like Japan and Germany before, this demand incentive will provide the stimulus to awaken the largest potential solar market in the world.
- Create some type of manufacturing investment tax credit to assist domestic manufacturers in technologies such as solar products and equipment. This new manufacturing tax credit should be available to U.S. based manufacturers who are located in the United States and pay U.S. income taxes. The demand created above described incentives should be satisfied by U.S.-based companies, and this investment tax credit would help make U.S. manufacturers competitive in a global industry.

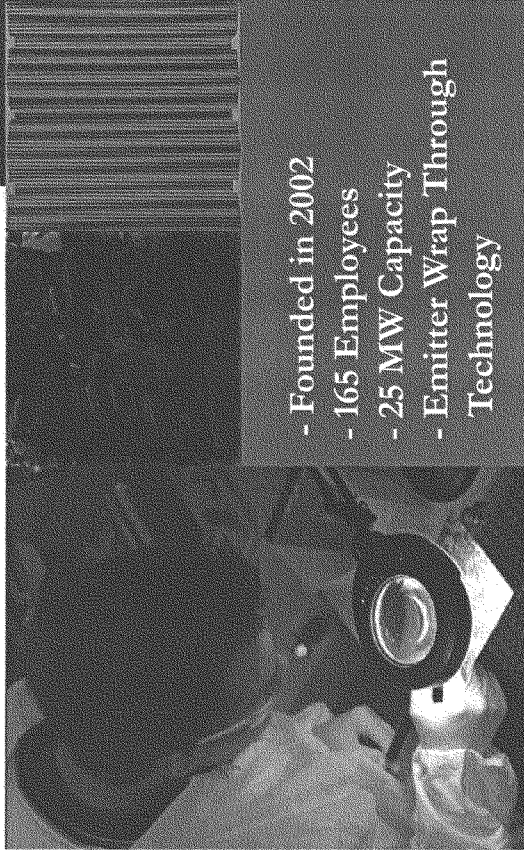
The program should have a graduated tax credit to encourage investments. For example:

Qualified Manufacturing Investment	Investment Tax Credit
Less than \$5,000,000	10%
\$5,000,000 to \$10,000,000	20%
\$10,000,000 to \$50,000,000	30%
Greater than \$50,000,000	40%

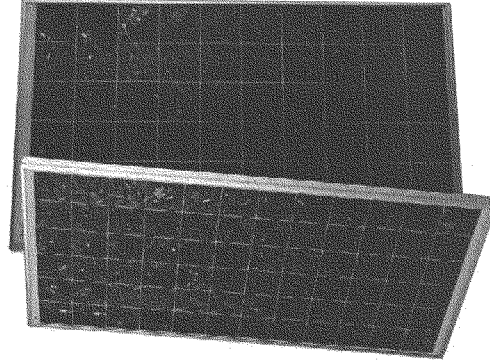
Mr. Chairman, I look forward to working with you and your staff on these ideas and others you may have. Thank you.

ADVENT[®]

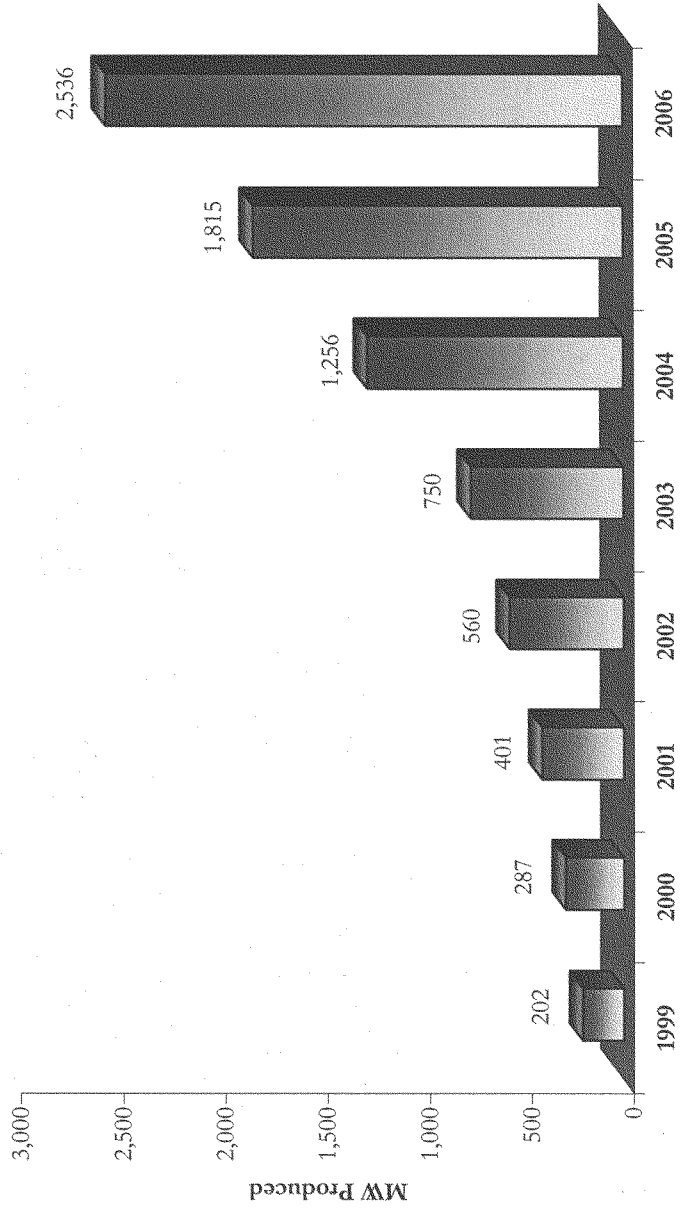
S O L A R



- Founded in 2002
- 165 Employees
- 25 MW Capacity
- Emmitter Wrap Through Technology

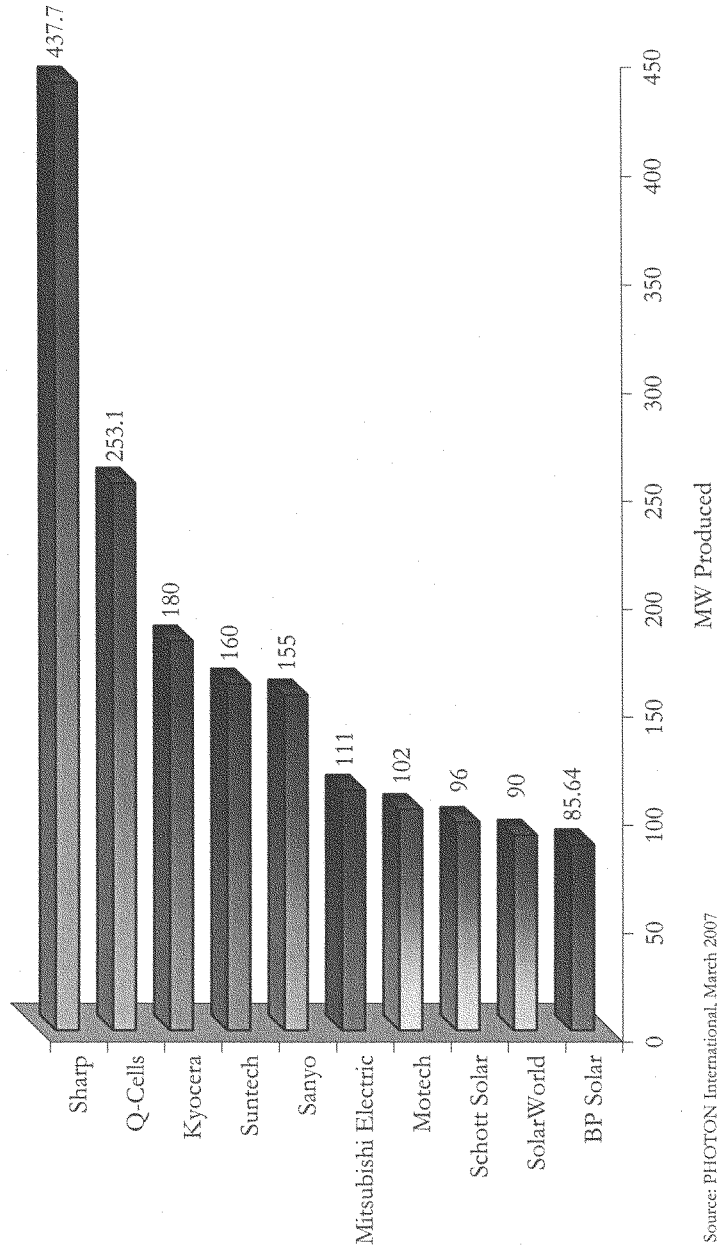


Solar Cell Production (1999 to 2006)



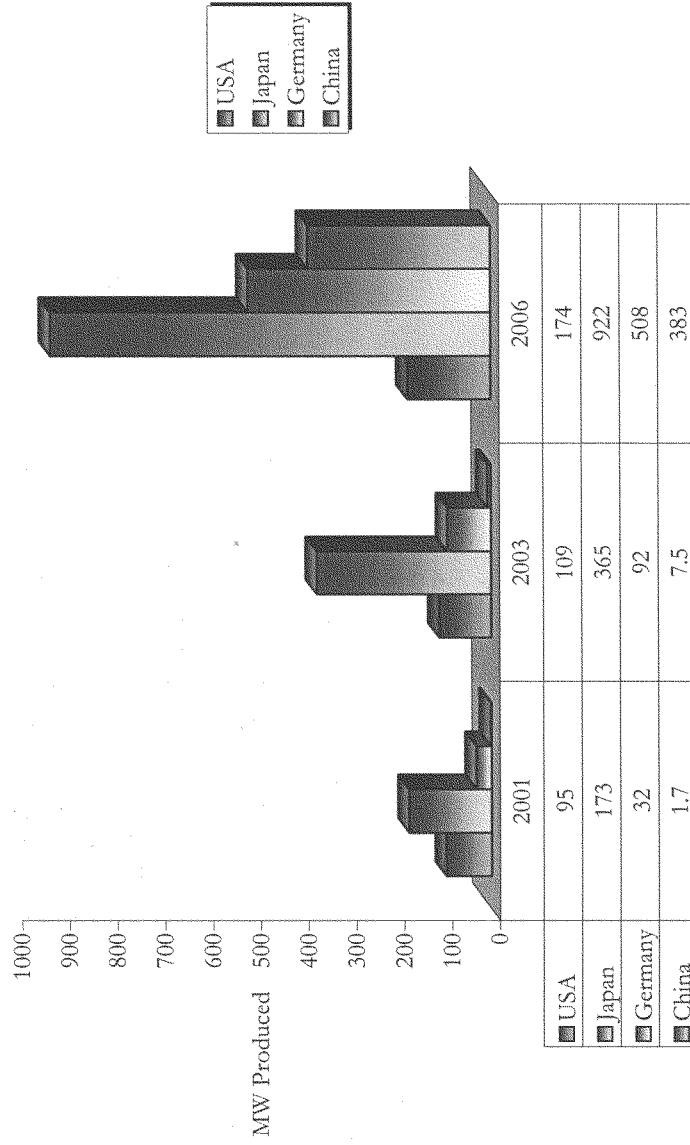
Source: PHOTON International, March 2007

Top 10 Global PV Cell Producers (2006)



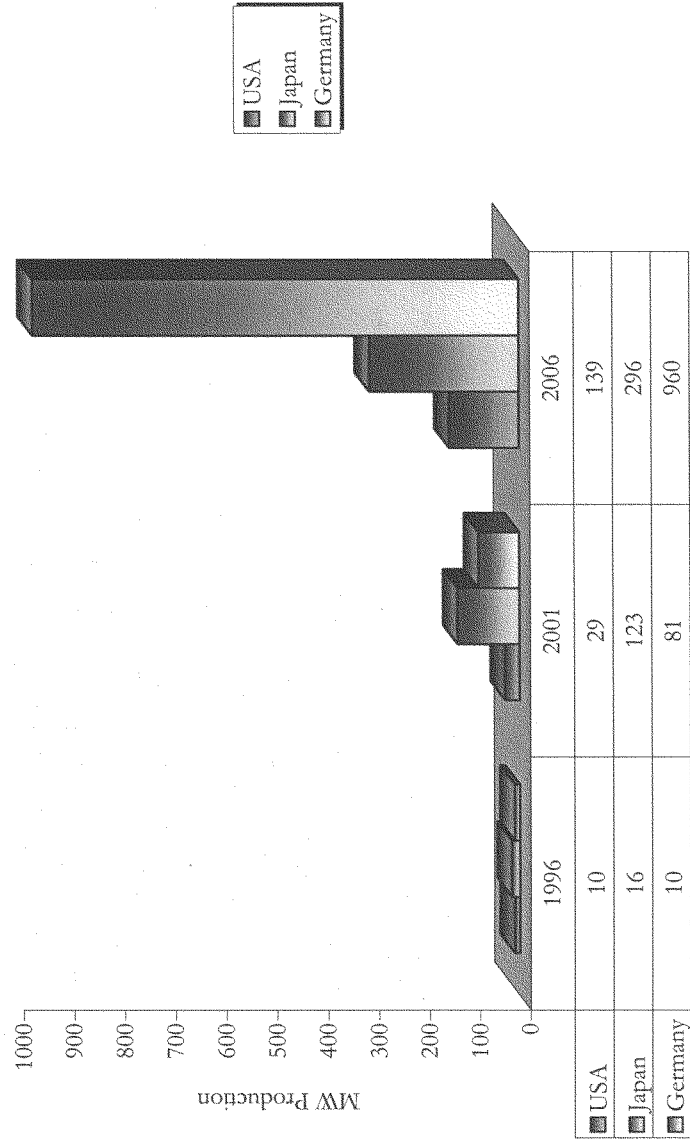
Source: PHOTON International, March 2007

Photovoltaic Cell Production (2001-2006)



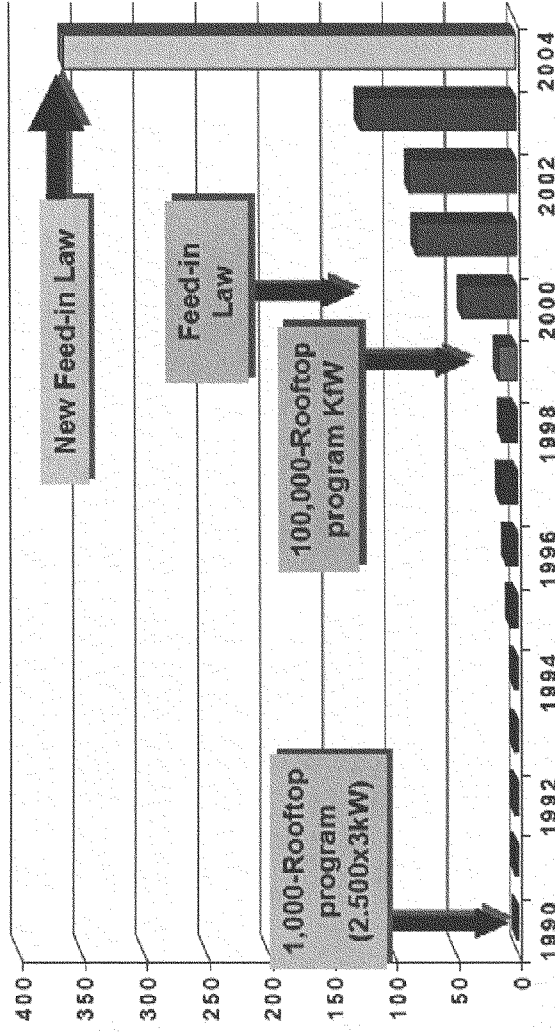
Sources: PHOTON International, April 2002, March 2004, March 2007

Photovoltaic Sales by country (1996-2006)



Sources: <http://www.iea-pvps.org>,
http://www.solarbuzz.com/Marketbuzz2007_intro.htm

Influence of Feed-in Tariff on German PV Installation (EPIA)



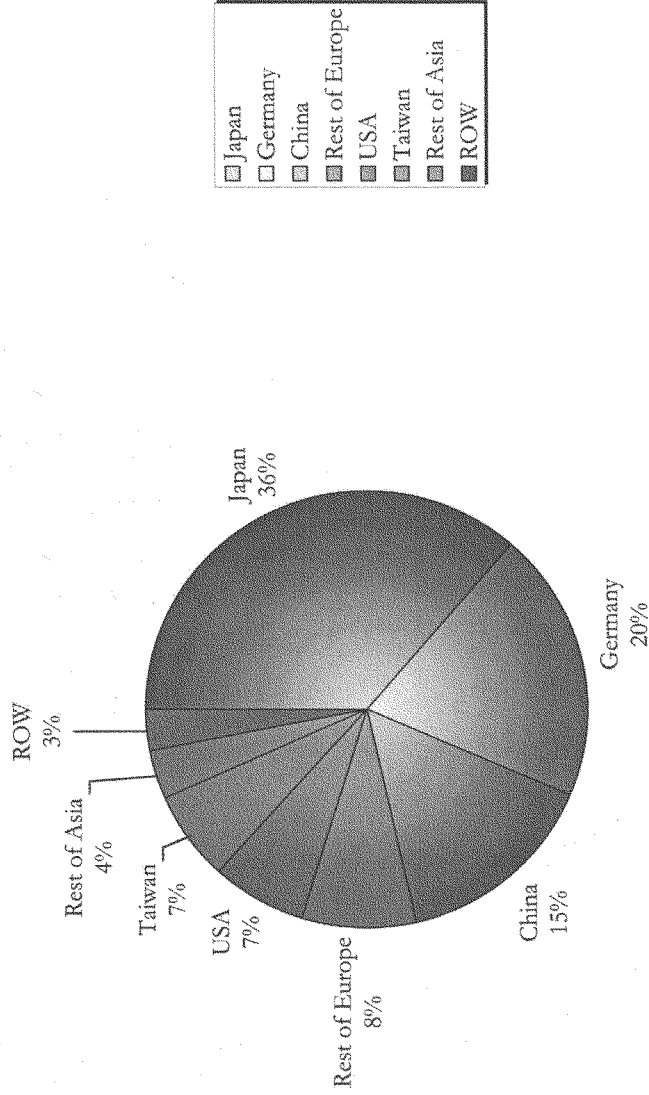
Source: EPIA

European Feed-in Tariff Programs

2006-2007	Tariff Euro cents/KWh	Term (years)	Program Cap	Comments
France ¹	22.5-30	20	Not yet fixed	Lower rate for residential, higher rate for industrial customers and overseas territories. 50% tax credit (residential)
Germany ²	37.4-54	20	None	Varying rates for ground-mount, rooftop and façade installations. 5% annual tariff decline (6.5% for ground mount)
Italy ³	36-49	29	500 MW	5% annual tariff decline. Annual cap of 85 MW of installations.
Luxembourg ⁴	28-56	N/A	3 MW	Private individuals can access the higher rate. Public bodies can access the lower rate.
Portugal ⁵	28-51	15	N/A	Payable to Independent Power Producers, widespread confusion about the scheme
Spain ⁶	22-42	25	400 MW	Higher tariff payable for systems up to 100 kW
Greece ⁷	40-45	20	700 MW	No special tariffs for ground mounted or BIPV systems.
Austria ⁸	47-60	20	15 MW	Very low annual cap, amendments to law are in process

Sources: 1. Energies Renouvelables Et Efficace Energetique, Solar Buzz 2. BSW- German Solar Industry Association 3. Photon International (March 2007), Renewable Energy World (July 2006) 4. Solar Buzz Photon International (Jan. 2007) 5. Spanish Renewable Energy Association, Solar Buzz 7. Renewable Energy World (July 2007), HELAPCO (Hellenic Association of PV Companies) 8. HELAPCO (Hellenic Association of PV Companies)

Photovoltaic Cell Production per region (2006)



Source: PHOTON International, March 2007

Senator Maria Cantwell
Finance Energy Subcommittee Hearing – International Perspectives on Alternative Energy
Policy: Incentives and Mandates and Their Impacts
April 12, 2007

Mr. Chairman, thank you for holding this important hearing today, and thank you for your continued leadership both on this Committee and on the Energy Committee.

I am particularly pleased the Finance Committee created a subcommittee dedicated to energy issues. As Congress considers policies that will enable us to shift our nation's and the world's energy system to clean energy alternatives, we must be mindful that such a shift will take significant and sustained private-sector investment and require a reallocation of federal resources.

It is critical that the Finance Committee play a key role in pursuing tax, trade, and economic policies that put the right tools and incentives in place so that we can create the best possible U.S. and global market conditions for those crucial private-sector investments.

I hope this subcommittee will serve as a forum for real dialogue on the economics of energy. Because we must dedicate resources to achieve our goals we must have a full, open debate on the incentives we believe will help our economy transition away from an over reliance on fossil fuels and will encourage investments in—and broad deployment of—clean, renewable energy resources.

I think every member of this Subcommittee recognizes that while there is no single technological silver bullet for our energy problems, there are many emerging technologies that if adopted and deployed could go a long way in meeting our vexing energy security and climate challenges.

Federal tax incentives can be a powerful economic tool if those incentives are put in place for sufficient duration to provide certainty to developers, investors, and consumers. We know we can not make a long-term difference with start-and-stop tax policy, but we should also recognize

that after a reasonable period the federal government should get out of the way and the marketplace should be allowed to function on its own.

I am considering legislation that will provide for some reliability in the tax code incentives for renewable energy technologies and the tax incentives to become more energy efficient. This is an issue I know is important to you, Mr. Chairman, and I look forward to working with you on meaningful legislation.

As the topic of today's hearing clearly indicates, the problems we face are global; we should strive to seek global solutions. I welcome our witnesses and appreciate their insights into what is working and not working abroad, particularly in the European Union.

I would stress, however that we must also take a more proactive role in the development of comprehensive bi-lateral energy policy with China. Just yesterday, I, along with 12 of our colleagues sent a bipartisan letter to President Bush urging that he implement a comprehensive, mutually-beneficial U.S.-China energy policy.

As we noted in the letter, the way we approach global energy issues will affect the international economy and the world's environment for decades to come. The U.S. and China are the world's two largest energy importing nations, so both have a common interest in avoiding global supply shocks and lessening reliance on supplies from unstable regions of the world.

With China slated to become the world's largest greenhouse gas emitter by 2009, it is imperative that begin a productive dialogue with China now. I hope that President will consider our proposal for a bilateral U.S.-China summit between focused on ways to cooperate on energy issues.

Thank you, Chairman Bingaman, for your support on this crucial international energy matter and, again, thank you for holding this hearing today.

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Senate Committee on Finance
Subcommittee on Energy, Natural Resources, and
Infrastructure
International Perspectives on Alternative Energy Policy:
Incentives and Mandates and their Impacts

Thursday 12 April, 2007

Written Testimony of

Jonathan Johns

UK Partner, Ernst & Young LLP

Mr Chairman and members of the Committee, I am Jonathan Johns, Partner of Ernst & Young LLP (E&Y) and head of Ernst & Young's Renewable Energy Waste and Clean Energy Unit in the United Kingdom. I appreciate your invitation and the opportunity to testify today on International Perspectives on Alternative Energy Policy. The purpose of this testimony is to discuss the key drivers that may be considered in setting an alternative energy policy, to describe the tools commonly used by countries to stimulate the market, to comment on their relative impacts and to provide commentary on Ernst & Young's Q4 2006 indices. I will use the term renewable energy to describe those technologies which do not consume a finite resource (eg solar, onshore/offshore wind, wave, tidal power, biomass and biofuels, hydro and geothermal). Other technologies which may also be relevant and which are often discussed under the wider banner of alternative/clean tech technologies include: energy from waste, landfill gas, fuel cells, hydrogen, landfill gas, and refuse derived fuel technologies.

E&Y is one of the world's leading business and financial advisors. E&Y has world-wide revenues of US\$16.9 billion, 700 offices in 140 countries, 6,200 partners and over 107,000 employees globally, and 22 offices with 400 partners and over 7,000 members of staff across the UK.

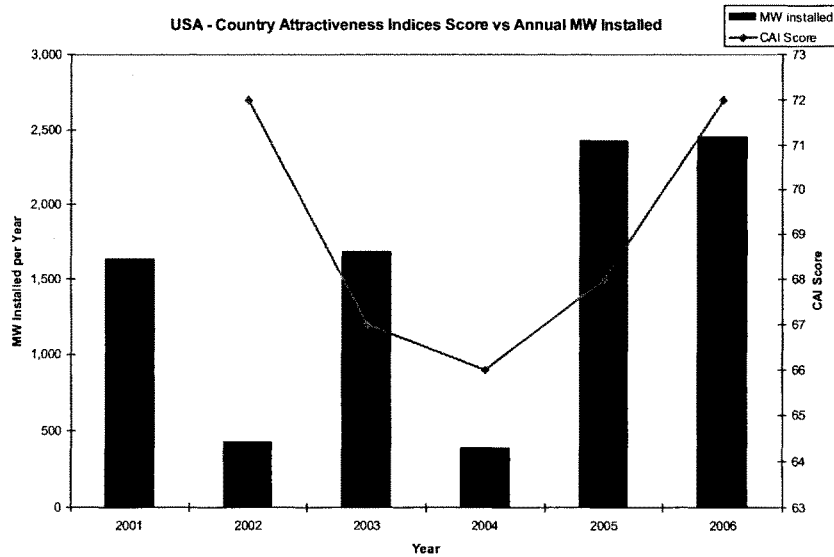
E&Y has had a corporate finance specialist unit focused on renewable energy, waste, clean energy and environmental issues since 2000. The driver behind the creation of the unit, which I lead, was the Kyoto Protocol. The unit, which has grown to some 45 dedicated professionals based in the UK also acts as one of several global knowledge centres for the firm and its private and public sector clients, liaising with a network of over 200 professional worldwide who act in the climate change space. Since 2003, the unit based in Exeter, UK has compiled the E&Y Renewable Energy Country Attractiveness Indices which score, on a forward looking basis, the attractiveness of 20 (soon to be 25) countries for investment purposes based on a number of factors including, regulatory, tariffs, incentives, planning and grid, access to finance, market size and resource quality. The Q1 2007 index is currently in the course of

preparation and will add a biofuels index to the current indices for wind, biomass and other, solar and regulatory infrastructure. At present biofuels are evaluated under the biomass category. I also provide the results from a webcast survey of 200 corporations, largely based in the US held in March 2007.

Summary of Key Recommendations and Observations

1. Renewable Energy Infrastructure represents a long term investment, and thus requires a long term consistent policy framework to ensure sustained development. Stop start mechanisms, or frequent changes in policy direction produce uncertainty in the investment community and have an adverse effect on corporate and individual behaviours. Climate change is a global issue and business is dealing with it on a global basis, the scale of the challenge means that at present there are in all probability insufficient resources in the supply chain to satisfy demand. Consequently, countries are effectively competing with each other for renewable energy resource and most importantly financial and corporate capital which rapidly flows to the most favourable investment climate.

This is illustrated by the score of the US in the E&Y Country Attractiveness Indices over the past few years which has fluctuated as the production tax credit program (PTC) has been either renewed or not renewed and been reflected in subsequent levels of investment. Recently the score for Spain has declined due to regulatory uncertainty (as in the past has Germany's). In the UK, the Government has been at pains to announce an extension of the period of the renewable obligation incentive mechanism at the same time that it has announced the possibility of banding by technology type thus seeking to maintain investment flows in a period of regulatory debate.

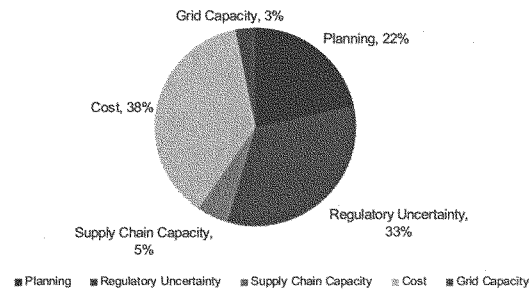


Should legislative change occur, then it is desirable that past projects are protected by appropriate grandfathering mechanisms to ensure past investments are not undermined. Radical change in the suite of mechanisms used by a country does require thought as they do produce an investment hiatus, evolution may be preferable if annual increases in capacity are at satisfactory levels at the time of change.

2. There is an opportunity to use a support mechanism to reinforce or create a strong domestic manufacturing industry with global prospects. There are also many opportunities in the supply chain. Policymakers may wish to consider whether the PTC, investment tax credit and other renewable mechanisms in the US have been effective in this respect. If a renewable policy is not based on creating a strong manufacturing and supply chain capability then existing incentives should presumably be stronger to ensure the flow of resource to that country. Capital grants and R&D incentives are likely to be required in any event for new technologies, although the US does benefit from a relatively strong venture capital community in the clean tech space. Several countries have chosen to focus these on economic development areas with varying degrees of success.
3. Some tax based incentives or feed in tariffs¹, if Government backed, can place strains on government treasuries with the impact that they can be withdrawn on electoral change (as occurred in the Netherlands for example). Climate change arguably requires a more sustained policy than can last beyond the next election. Tax based incentives for individual investment in projects (such as the KG fund structures used in Germany) can create substantial community interest, but can disrupt markets if they are withdrawn or modified (as happened in Germany). Notwithstanding these comments, cost is an important issue and it is important that the public (and business) feel value for money in the incentive mechanisms proposed.
4. It is important to complement a regulatory incentive with appropriate infrastructure. Ease of planning, appropriate grid investment to deal with distributed as opposed to centralised energy production and supply chain can have a very significant effect on the rate of deployment and undermine otherwise effective mechanisms. Micro-generation brings new challenges, for example the need to deploy smart metering as does the need to provide incentives for re-powering where technologies already deployed are reaching the end of their useful life.

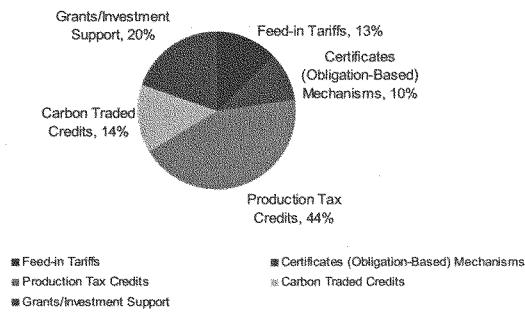
¹ The price per unit of electricity that a utility or supplier has to pay for renewable electricity from private generators. The tariff rate is set by the government.

What are the main causes of the renewables sector failing to achieve its potential?



- 5 There has been much debate over the effectiveness of feed in tariffs compared with other mechanisms. Feed in tariffs tend to leave more risk with the state and usually have a direct effect on the taxpayer or consumer. They have been effective in introducing large volumes of capacity but are arguably most effective in countries with less liberalised energy markets or a strong green lobby. In liberalised markets, a market based green certificate mechanism tends to be preferred. This can cause high energy tariffs to act as an incentive for developers and can lead to price distortion if supply is constrained by other factors such as grid capacity (as has arguably occurred in the UK). Many argue that carbon trading can provide adequate incentives, however, individual projects need visibility of forward prices for 10 or 15 years if investment is to flow in a cost effective manner. The federal tax incentives, when combined with individual state Renewable Portfolio Standards could be effective if applied more consistently.

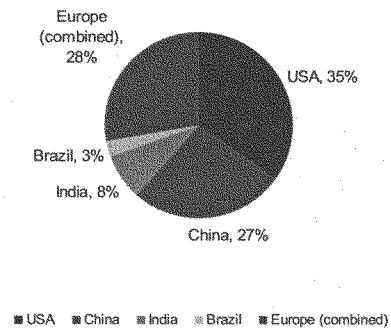
Why do you consider to be the best mechanism to promote renewables?



6. The character of public and corporate engagement is also a consideration. The issue posed by climate change requires active participation by government businesses and the public, balanced by due regard for cost. The democratisation of power whereby consumers, government, corporate and the public become suppliers of renewable energy in their own right as well as consumers is likely to be an increasingly potent force; particularly as many corporations see green energy as integral to their brand values and corporate social responsibility objectives. In many cases, regulatory changes supporting net metering (referred to above) and, the provision of financial incentives for on site capital investment are required. One other significant factor can be to ensure that government itself purchases appropriate volumes of green energy.
7. It is important to have due regard for the quality and availability of the indigenous resource. It is interesting to note that some countries with the greatest natural resource have not always been the most successful at harvesting it, e.g. UK and France with wind, and the US with biomass where the greatest focus to date has largely been on biofuels. In the UK, a technology indifferent structure was set partly to reduce consumer costs, although there are now proposals to introduce banding to facilitate less mature technologies (such as offshore wind and biomass). If other factors such as the creation of a strong domestic industry are important then it may be necessary to set tariffs relatively high – to compensate for poor indigenous resource levels. This has arguably occurred in Germany to great effect in the solar industry. Although the US is criticised by some for having different policies state by state, the inherently different geographic characteristics of individual regions provide strong arguments for a differentiated policy. The lack of renewable portfolio standards (RPS) in some states is more difficult to argue as part of a coherent strategy and there is a strong case to be made for harmonization of key parameters.

- 8 Focus on renewable or alternative energy can lead to insufficient attention being paid to combined heat and power (CHP). That said, there is some interesting work being done in the area of using renewable resources to generate combined heat and power. A number of countries have effective mechanisms to incentivise the use of district heating and on site CHP for domestic and commercial users. We are currently undertaking a review for the UK government on policies for renewable CHP. A further issue is the use of building construction regulation, and equipment standards to promote changes in energy efficiency behaviours. We have for instance recently completed a report for the Greater London Authority on financing mechanisms to create low carbon infrastructure in a metropolitan environment. This is an issue which is clearly gaining momentum in the US as well.

Finally, it is interesting to note the feedback from our webcast survey as to the regions most likely to produce growth in production of energy from renewable resources over the next 10 years.



This bodes well for the US, but also signifies the strong influence that China (and India) is likely to have on the market.

I would encourage the Committee to continue the excellent work it has begun to encourage the production of renewable energy in the US. As you go forward in your deliberations I would ask that you consider the fact that these are capital-intensive businesses competing in the global marketplace for capital. Our experience demonstrates that this market responds best to incentive mechanisms that are long term in nature, are designed to work in harmony with other incentive programs and that reward long term behaviors.

Exhibits

I set out below a summary commentary on the high scoring countries in our Country Attractiveness Indices.

Commentary — High-scoring Countries

USA – Production Tax Credit and State-specific RPS

Success due to increasing number of States adopting RPS mechanism together with good site availability. Biofuels also a strong growth sector.

1st CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	72	73	75	64	76
MW Total	26,803	11,603	200	15,000	-
MW 2006	-	2,454	-	-	-

Source: REN21, GWEC

Spain – Option of fixed price or market based tariff under Regimen Especial

Attractive renewables market resulting from broad-based tariff encouraging different sources of renewable energy. Recent revisions to the regime have made the tariff less attractive to onshore wind.

2 nd CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	63	63	71	57	74
MW Total	13,915	11,615	100	2,200	-
MW 2006	-	1,587	-	-	-

Source: REN21, GWEC

India – Regional feed-in tariffs and tax incentives

Strong uptake of wind power by large power users has driven demand, together with generous State-led tariffs and tax incentives.

2 nd CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	63	64	61	50	65
MW Total	8,870	6,270	0	2,600	-

MW 2006	-	1,840	-	-	-
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Source: REN21, GWEC

Germany – 20 year guaranteed feed-in tariff under the EEG

Currently the biggest market for renewables, particularly wind power, driven by broad-based technology-specific feed-in tariffs.

4th CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	62	62	72	60	58
MW Total	25,621	20,621	1,700	3,300	N/a
MW 2006	-	2,233	-	-	-

Source: REN21, GWEC

UK – Green Certificate mechanism under the Renewables Obligation

High score due to very significant wind resource potential (and to a lesser biomass) and favourably received ROC mechanism with long tenor. However, planning and grid remain key issues in the medium term. Without offshore wind the UK would come behind Italy and China: with France, Canada and Portugal as strong challengers. The forthcoming renewable obligation banding review will be critical to the UK score.

4th CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	62	62	48	57	66
MW Total	3,586	1,963	11	1,612	-
MW 2006	-	635	-	-	-

Source: DUKES, GWEC

Drivers for Alternative Energy Policy

Until the 1990's Renewable Energy ("RE"), the generation of electricity from natural resources such as wind, solar, biomass, hydro, ocean and geothermal, was seen largely as the province of whole earth environmentalists rather than business. Power generation was considered best undertaken by large centralised coal, oil, nuclear and latterly gas installations. With the exception of hydro, RE was regarded as largely uneconomic with technology insufficiently advanced to provide the required economies of scale. Due to the concentrated efforts of pioneering manufacturers and developers and also rising oil and gas prices, the economic performance of many technologies has been transformed, particularly wind, solar and early stage biofuels. In this period, RE was encouraged by the support initiatives of particular governments seeking to encourage new environmentally friendly industries.

Individual states and regions have had a number of criteria in setting RE Policy:

1. Due regard for Kyoto and related agreements driven by a concern over climate change and specifically CO₂ emissions. The EU Renewable Energy Directive is clearly driven by Kyoto and has been very effective in

encouraging individual countries to adopt their own legislation (albeit on a non harmonised basis). The EC Directive 2001/77/EC (Sept.01) which sets targets for increasing the contribution of renewable energy sources ("RES") to gross domestic energy consumption from 6% in 2000 to 12% in 2010, and green electricity contribution to total electricity generation from 14% in 2000 to 22% in 2010 at a European level. The Directive also sets indicative, and non-binding, targets at national level as indicated below.

Targets for electricity from RES (EC Directive 2001/77/EC)

	Renewable Electricity Generated in 1997 (TWh)	Percentage contribution of renewable electricity to total electricity generation in 1997 (%)	Percentage contribution of renewable electricity to total electricity generation Objective in 2010 (%)
Austria	39.05	70.0	78.1
Belgium	0.86	1.1	6.0
Denmark	3.21	8.7	29.0
Finland	19.03	24.7	31.5
France	66.00	15.0	21.0
Germany	24.91	4.5	12.5
Greece	3.94	8.6	20.1
Ireland	0.84	3.6	13.2
Italy	46.46	16.0	25.1
Luxemburg	0.14	2.1	5.7
Netherlands	3.45	3.5	9.0
Portugal	14.30	38.5	39.0
Spain	37.15	19.9	29.4
Sweden	72.03	49.1	60.0
United Kingdom	7.04	1.7	10.0
Community	338.41	13.9%	22%

In March 2007, EU leaders agreed to a 20% mandatory target for renewable energy generation by 2020. Individual country targets are yet to be assigned, but are likely to cover all EU-25 countries. Markets with the most ambitious RES targets by 2010 under the EC Directive include Germany, the UK, France, Italy, Spain and Sweden. The short-term gap in RE capacity is essentially expected to come from wind power (both onshore and offshore), which is currently the most economically viable of all RE technologies (excluding large-scale hydro and geothermal). Other RE technologies, including biomass, solar power, and wave and tidal, are expected to make a significant contribution to the energy mix in the medium to longer term.

The Directive 2001/77/EC gives each member state the freedom to implement the support mechanisms most suitable to national objectives (often set to be in line with the indicative objectives proposed by the EC). This has led to a wide range of support mechanisms including a range of feed-in tariffs, grants, tax and

soft loan incentives, and sometimes technology-specific targets at national level.

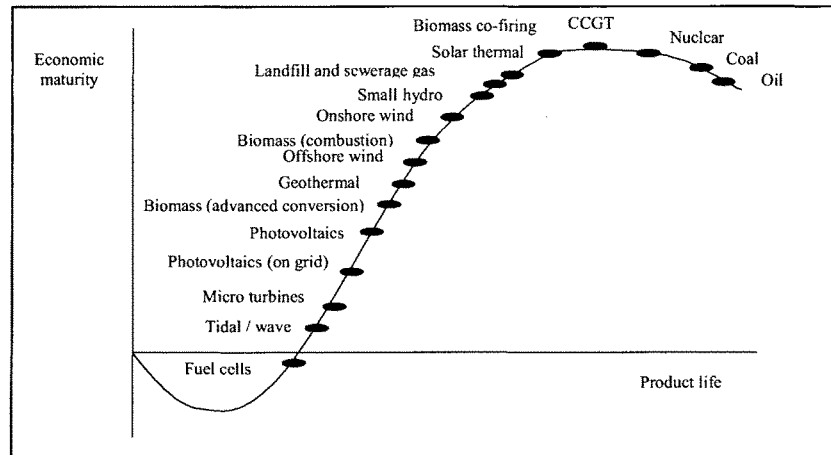
The lack of homogenous support mechanisms does create a significant cost for investors. Although some commentators advocate carbon trading as a solution, others are concerned that there is insufficient certainty as to future carbon prices for this to act as a mechanism for long term investment other than in developing territories.

2. Security of energy supply and the need to maximise indigenous energy production vs dependence on remote sources possibly subject to interruption of supply. This was quoted as the reason for recent incentives for biofuels in the US.
3. Rising oil and gas prices, increasing the cost effectiveness of fuel free resources in particular (this also led to an initial rush towards renewables, pre Kyoto eg California and Denmark in the 1970's).
4. Support for domestic industry:
 - (a) to encourage the research, development and manufacture of alternative energy technologies. Strong incentives for renewables have created significant industries in Denmark, Germany, Spain and more recently India and most likely to follow China.
 - (b) to create a climate which fosters new entrepreneurial businesses or refocuses large corporate activity in renewable energy, development and generation. The Spanish system has created national renewable energy focused champions with Iberdrola and Acciona for example; and
 - (c) to encourage the use of natural resources to provide alternative economic activities for the farming community via Biofuels and Biomass eg Brazil's ethanol market and more recently that of the US.
5. Support for broader environmental objectives: Incentives have been used to support technologies which deal with landfill gas, sewerage gas, coal mined methane, energy from waste and from refuse derived fuel. In some cases, broader environmental concerns particularly in relation to sustainability have raised questions over
 - (a) coal mined and coal bed methane in some countries;
 - (b) the diversion of food crops for the production of first generation biofuels; and
 - (c) In the EU, the incineration of non separated municipal waste is not regarded as a renewable energy source, although other incentives are provided by way of the landfill directive.
6. The degree of maturity of the technology, with new technologies often best supported by way of R&D incentive and capital grants. As they approach commerciality the more revenue or production based incentives are more appropriate.

The position of RE individual technologies compared to conventional power can be shown in terms of the product life cycle below.

Renewable Energy Technologies Life Cycle in comparison to conventional energy

Source: Ernst & Young



NB In Appendix 1, we provide a costing by technology for projects based in the UK. Positioning is necessarily affected by particular support mechanisms.

The economics of RE broadly follow a similar cash flow pattern to other types of power generation; namely a large initial capital outlay, occurring after quite lengthy periods of planning and construction, followed by a relatively predictable operating income stream, usually derived from the sale of electricity to the grid through a power purchase agreement ("PPA"), over periods of 10 to 20 years. As with all power projects, the cost of capital and the efficiency of financial and tax structuring is an important component of project returns, especially when operating costs are low. In the case of biofuels these market dynamics are often complicated by exposure to raw material commodity risk as an input, combined with merchant risk on outputs with long-term contracts having more the characteristic of a tolling agreement than a PPA.

RE differs from conventional power generation in that the source of fuel is often free, and where it is not (eg biomass), there can be additional sources of income (eg gate fees). RE fuel sources are also not vulnerable to price shocks caused directly or indirectly by changes in oil (and gas) prices, although for biomass supply infrastructure can be problematic. The conversion of free natural resources into power requires technologies which often have a significantly lower conversion (or load) factor than the principal fossil fuel competitor, the combined cycle gas turbine. In addition, costs per MW of RE installed are often higher than for conventional technologies as RE technologies are at a still relatively early stage in the product life cycle, and, as yet, lacks the economies of scale of their fossil fuel counterparts. Government incentive schemes (discussed below) seek to compensate for these factors by providing

reliable above market income streams and capital grants for newer technologies, producing attractive returns for RE projects.

The more mature technologies pose fewer difficulties for developers and financiers and consequently schemes involving them require lower levels of credit enhancement through strong equity partners and long term government backed PPA's. Hence, in the right market conditions, merchant plant and lease financing can take place with CCGT, biofuels, landfill gas and in some cases wind, but is unlikely to be acceptable for advanced conversion biomass, wave or on grid photovoltaics projects. As commented above, biofuels projects are particularly dependent on the price of oil and feedstock inputs. These less mature RE technologies are much more likely to require high priced, strong incentive regimes or PPA's, experienced operators and strong counter-parties who may be required to provide financial guarantees or on balance sheet finance.

Many advanced conversion biomass technologies, such as pyrolysis, anaerobic digestion and gasification, are immature and insufficiently proven to meet the naturally conservative requirements of investors and project financiers, with efficacy insurance for example difficult to obtain. A number of equipment manufacturers are at an early stage in their lifecycle and often unable to provide sufficient counter-party collateral for product warranties and EPC commitments. In some cases, where suppliers have suffered significant financial difficulties, developers have had to assume the role of turnkey contractor with attendant system integration risks and significant periods of down-time as teething troubles are ironed out.

Solar technologies can be expensive (depending on resource quality) without support. Nevertheless both on and off grid markets are generating rapid growth. Newer technologies such as wave and marine current turbines offer great prospects for growth, but are often disadvantaged by support mechanisms targeted at more mature technologies closer to cost convergence

Other factors that require consideration

(a) Planning and Permitting

There are significant risks of planning and permitting delaying projects with a costly attrition rate due to permitting failure: after expensive public enquiries and appeals then overall investment returns can suffer. As a consequence some territories with the highest wind resource (eg, the UK and France) do not have commensurate installed capacity: although steps have now been taken to accelerate development in both countries.

(b) Grid infrastructure

This can be an inhibitor to growth in the longer term, requiring further investment, if wind, which is intermittent by nature, is to achieve more than 20% of total generation. This issue could be particularly relevant as large 500 MW plus wind farms become more common place onshore and offshore or in remote locations (eg Scotland).

(c) Supply Chain

The global supply chain is constrained. Inconsistent policies tend to discourage manufacturing investment. Those countries without high levels of domestic manufacture need to be able to satisfy the investors that their mechanisms are sufficiently attractive to ensure appropriate inflow of capital goods. In the past year, the US PTC has been effective at redirecting wind turbine output to the US at the expense of some European countries.

Tools commonly used to stimulate the market

Four generic support mechanisms can be distinguished for renewables and they are:

- Tariff incentives, which provide RE generators with advantageous and sometimes guaranteed offtake arrangements;
- Tax incentives, which influence the financial structure and return that can be expected of such projects;
- Grants, available at either local, regional, national and international levels (eg, EU, federal subsidy at Federal level in the USA) subject to project specifics; and
- Soft loans, which provide investors with subsidised borrowing facilities.

Some support mechanisms deployed in Europe and the US are technology-specific, and may be used in conjunction with other incentives/areas of support to help facilitate the deployment of such technologies. The table below provides an overview of the generic tariff incentives available to wind energy across the European and US markets, and a brief comment on their implications for project financiers.

Tariff incentives overview

Tariff	Description	Examples
Fixed Feed-in Tariffs	Single guaranteed payment per kWh produced	Germany (fixed feed-in tariff)
Fixed Tariffs through Competitive Tendering	Competitive "price-capped" bidding process for predefined generation capacity	France (government set tariff, some awarded by competitive tender) Portugal (government-set tariff awarded by competitive tender)
	Price fixed by bidders, or by legislation	India (set by State) China (competitive tender, typically at lowest price)
Premium	Fixed price premium on top of the market price for power.	Spain (recently restricted premium available to wind operators)
Obligation-based with tradeable Green Certificate	Obligation on utilities to supply a minimum amount of green electricity, historically 'technology blind'	Italy (guaranteed price offered to generator by regulator) USA (RPS varies significantly by State)
	Green certificates traded separately from power.	UK (likely to be 'banded' in future by technology)
Production Tax Credit	Tax credit available to RES operators on income from generation	USA (federal policy to 2008)
Brown Energy Taxes	Levy on brown energy cost	Climate change levy (UK)
Accelerated Depreciation	Incentivised tax depreciations on capital investments	100 % first year allowance for onshore winds
Investment subsidies	Grant or tax-based (ie tax rebate on capex)	Portugal, Greece (on top of feed-in tariff)
		USA (tax credit for solar installation)
Soft loans	Non-commercial loan rates available to RES projects	Germany (offered by KfW bank to RE projects)

Government-backed vs. market-led tariff mechanisms

Feed-in tariffs – or similar – are generally highly attractive in terms of value (eg, Germany with €89/MWh for the first five years of operation for onshore wind) and period of guaranteed offtake (for example twenty years for onshore wind in Germany). Such tariffs therefore provide a very strong incentive for technology deployment as has been seen in countries where they have been implemented (eg, Denmark with just over 3GW installed capacity at end of 2003 and Germany with circa 14.5GW installed capacity at end of 2003). However high priced longer-term tariffs do encourage the development of low wind speed sites, which would otherwise be uneconomic.

GC mechanisms (or RPS) can also be highly attractive for RE generators in occasions where GC prices reflect high demand conditions in a seller's market: this is currently the case in the UK where highly valued short-term ROC prices make for very attractive project economics for generators prepared to take market risks. By contrast to feed-in tariffs, the availability of long-term power

offtake contracts in market-driven environments is crucial to developers wishing to secure project finance. Lenders may indeed require minimum debt service guarantees possibly involving a minimum power offtake price (floor price) and specific credit rating requirements from the offtaker. This creates its own set of difficulties in markets where the energy sector may not be financially very strong or where government targets are not aggressive enough in the medium to long run to create the level of demand that should guarantee pricing. Shifting market risks to a power offtaker may lead to low long-term power offtake prices, which will in turn decrease equity returns.

Ernst & Young Renewable Energy Country Attractiveness Indices

Methodology

The Ernst & Young Country Attractiveness Indices provide scores for national renewable energy markets, renewable energy infrastructures and their suitability for individual technologies. The Indices provide scores out of 100 and are updated on a regular basis.

The main indices are referred to as the 'Long-term Indices'. The Near-term Wind Index takes a two-year view with slightly different parameters and weightings (see below).

The Country Attractiveness Indices take a generic view and different sponsor/financier requirements will clearly affect how countries are rated. Ernst & Young's Renewable Energy Group can provide tailor-made studies to meet specific corporate objectives.

Long-term Indices

The Long-term Indices are forward looking and take a long-term view, hence the UK's high ranking in the Wind Index is explained by the large amount of unexploited wind resource, strong offshore regime and attractive tariffs available under the ROCs system. Conversely, although Denmark has the highest proportion of installed wind capacity to population level, it scores relatively low because of its restricted grid capacity and reduced tariff incentives.

All Renewables Index

This index provides an overall score for all renewable energy technologies. It combines individual technology indices as follows:

- Wind Index and Offshore Wind Index – 85%
- Solar Index — 5%
- Biomass and Other Resource Index — 10%

Individual Technology Indices

These indices are derived from scoring:

- General country specific parameters (the Renewables Infrastructure Index), accounting for 35%

- Technology specific parameters (the Technology Factors), accounting for 65%

Technology Factors

These provide resource specific assessments for each country and comprise four indices providing resource specific assessments for each country, namely:

- Onshore Wind
- Offshore Wind
- Solar
- Biomass and Other Resources

'Other' RE resources include small hydro, landfill gas, wave, tidal and geothermal technologies. Energy from waste is not considered. Each of the indices consider, on a weighted basis, the following:

- Power offtake attractiveness — 19%: This includes the price received, the potential price variation and length of PPAs granted. Higher scores are also achievable if the Government guarantees the power offtake rather than merchant offtakers.
- Tax climate — 11%: Favourable, high-scoring tax climates that incentivise renewable energy generation can exist in a variety of forms and/or structures. The most successful incentives and structures have been direct RE tax breaks or brown energy penalties, accelerated tax depreciation on RE assets and tax-efficient equity investment vehicles for individuals.
- Grant/soft loan availability — 9%: Grants can be available at local, regional, national and international levels; and may depend on the maturity of a technology as well as the geographical location of the generating capacity. Soft loans have historically been used in pioneering countries of RE technologies to kick-start the industry. High scoring is achieved through an array of grants and soft loans.
- Market growth potential — 18.5%: This considers current capacity compared to published targets. Higher scores are given if ambitious targets have been made and policy frameworks are in place to accelerate development. The realism of targets are also taken into account as well as the seriousness with which they are being pursued (eg, penalties in place for non-compliance).

- Current installed base — 8%: High installed bases demonstrate that the country has an established infrastructure and supply chain in place, which will facilitate continued growth and in particular encourage the repowering of older projects.
- Resource quality — 19%: For example wind speeds and the sun index.
- Project size — 15.5%: Large projects provide economies of scale and a generally favourable planning environment, which facilitates project development financing.

Long-term Wind Index

These indices are derived from scoring:

- The Onshore Wind Index – 70%
- The Offshore Wind Index – 30%

Renewables Infrastructure Index

The Renewables Infrastructure Index is an assessment by country of the general regulatory infrastructure for renewable energy. On a weighted basis, the index considers:

- Electricity market regulatory risk — 29%: Markets that are fully deregulated score higher, as they have experienced the market shock on underlying wholesale prices that this transition may exert. Whilst this may not affect current projects, these effects are particularly important when considering long-term investment prospects.
- Planning and grid connection issues — 42%: Favourable planning environments (low failure rates and strong adherence to national targets) score highly. Grid connection scoring is based on the ease of obtaining a grid connection in a cost effective manner. The score also takes account of the degree of grid saturation for intermittent technologies.
- Access to Finance — 29%: A market with a mature renewable energy financing environment, characterised by cheap access to equity and good lending terms will score higher.

This generic Renewables Infrastructure Index is combined with each set of Technology Factors to provide the Individual Technology Indices.

Near-term Wind Index

The Near-term Wind Index takes a forward-looking two-year view based on the parameters of most concern to a typical investor looking to make an investment in the near term. The Index gives scores for onshore and offshore separately.

The scoring follows the same methodology as for the Long-term Index but with a more focused set of parameters and a tailored weighting. Therefore the Indices consider on a weighted basis the following for both onshore and offshore wind separately:

- Power offtake attractiveness – 27%
- Tax Climate – 8%
- Resource Quality – 14%
- Market Growth Potential (to end 2009) – 40%
- Project Size – 11%

In the Offshore Wind Near-term Index, countries with no projects estimated to reach construction in the next two years (to end 2009) are excluded.

It should be noted that the Market Growth Potential score is based on a view taken on the basis of a range of business analysts' forecasts and Ernst and Young's own market knowledge. There is significant variation between analysts' views on each market and within some markets the variation is greater than in others. The forecasts used are a market view only and the scores in no way guarantee that the forecasted capacity will be built.

Whilst comparisons have been made between scores in the Long-term and Near-term Indices it should be emphasized that, due to the different weightings and parameters used, these cross-comparisons are of a narrative nature only and in no means indicate any quantitative valuation.

Global Highlights

All Renewables Index

The US retains the top spot in the All Renewables Index for Q4 2006 following its rise to the position in Q3 2006. Spain's score continues to fall, a result of changing policy taking the shine off investments in onshore wind.

Germany moves into equal 4th position with the UK, as news of streamlined planning rules improves Germany's score in the Renewables Infrastructure Index.

Canada sees a slight improvement in its position because of renewed government support for renewable energy, which had previously halted funding of the WPPI tax incentive programme.

The Netherlands has suffered a significant drop in score again this quarter following confirmation that the tariff regime would close to new applications.

Australia, on the other hand, has recovered given Provincial support for renewables. New South Wales, Victoria and South Australia now have either actual or proposed emissions targets.

The Long-term Wind Index sees India rise to 2nd place behind the US due to the decline of Spain.

Near-term Wind Index

Canada takes equal 4th alongside Germany and Italy and moves into equal 5th position in the Near-term Wind Index beside the UK. High prices awarded to renewable energy output in Italy support this move, and strong near-term targets within Provinces are driving strong demand in Canada.

All Renewables Index at Q4 2006

Ranking**	Country	All Renewables	Wind Index	Onshore Wind	Offshore Wind	Solar	Biomass / Other	Infrastructure***
1	(1) USA*	72	73	79	58	75	64	76
2	(2) Spain	63	63	70	48	71	57	74
2	(3) India	63	64	74	41	61	50	65
4	(4) UK	62	63	62	67	48	57	66
4	(5) Germany	62	62	62	63	72	60	58
6	(6) China	57	60	63	54	44	36	60
6	(7) Italy	57	57	63	43	67	53	64
8	(7) France	56	56	58	52	58	53	55
8	(7) Portugal	56	57	62	45	62	49	63
8	(7) Greece	56	58	62	49	53	43	59
8	(11) Canada	56	59	64	47	41	41	63
12	(11) Ireland	55	57	58	54	35	45	60
13	(14) Sweden	52	52	53	52	44	53	53
14	(13) Netherlands	50	51	49	55	45	39	49
14	(14) Norway	50	51	52	49	31	48	51
14	(16) Australia	50	51	54	43	59	45	54
14	(16) Denmark	50	51	47	59	44	46	61
18	(18) Belgium	49	51	49	55	36	36	53
19	(19) Finland	38	37	37	36	27	50	39
20	(20) Austria	34	31	45	NA	48	48	49

Source: Ernst & Young LLP

* (RPS) This indicates US states with Renewable Portfolio Standards and favourable wind regimes

** Ranking in the Q3 2006 Index in brackets

*** Combines with each set of Technology Factors to generate the Individual Technology Indices

The US retains pole position in the All Renewables Index as investors take a long-term view that political support has now turned firmly in favour of renewable energy. Wind, biofuels and solar are now key growth areas as the Bush Administration seeks to lower the country's dependence on foreign oil. Evidence of this is shown in the 2006 renewal of the Production Tax Credit and Investment Tax Credit, as well as new grant programmes and interest-free loans at federal and state level. Spain's score in the All Renewables Index drops further, making it joint second with India as details of the new tariff regime emerge, with a notable drop in wind tariffs from €97/MWh currently to €67–€84/MWh under the new legislation. Although development is likely to continue, the change has damaged confidence in the sector.

Germany's score in the All Renewables Index is now level with the UK largely as a result of an increase in the infrastructure score with news that planning processes are to be streamlined. The Offshore Wind score has also improved with the German Government's decision to make transmission system operators pay for the cost of connecting offshore wind farms to the grid.

Project news in China dominates, but some interesting political statements have been made such as a goal for biodiesel to make up 10% of total diesel consumption by 2020 and produce 30 million tonnes per annum by this date. Ethanol is also likely to see similar growth from companies such as China National Cereals, Oils and Foodstuffs Corporation (COFCO), which plans on spending US\$1.3bn on new production capacity over the next five years. In Beijing, the work being carried out to tackle emissions will continue up to and after the 2008 Olympics, as the state has capped emissions growth at 18% by 2010. The country's concession programme for wind development made a step forward with 1GW of turbine contracts – all supplied by domestic manufacturers – being awarded for three projects in Inner Mongolia and Hebei provinces. Its position in the Indices recognizes the potential in terms of market size and growth potential, but also recognizes that this is a complex market and that the requirement for local partnering and presence is a barrier to some investors.

Long-term Wind Index at Q4 2006

Ranking**	Country	Wind Index	Onshore Wind Index	Offshore Wind Index
1	(1) USA*	73	79	58
2	(3) India	64	74	41
3	(2) Spain	63	70	48
3	(3) UK	63	62	67
5	(5) Germany	62	62	63
6	(6) China	60	63	54
7	(7) Canada	59	64	47
8	(7) Greece	58	62	49
9	(9) Portugal	57	62	45
9	(9) Ireland	57	58	54
9	(9) Italy	57	63	43
12	(12) France	56	58	52
13	(15) Sweden	52	53	52

Ranking**	Country	Wind Index	Onshore Wind Index	Offshore Wind Index
14 (13)	Netherlands	51	49	55
14 (14)	Norway	51	52	49
14 (16)	Denmark	51	47	59
14 (16)	Belgium	51	49	55
14 (16)	Australia	51	54	43
19 (19)	Finland	37	37	36
20 (20)	Austria	31	45	NA

Source: Ernst & Young LLP

* (RPS) This indicates US states with Renewable Portfolio Standards and favourable wind regimes

** Ranking in the Q3 2006 Wind Index in brackets

Spain's proposed subsidy change will greatly affect the tariff received by wind operators, though it is not believed that this will slow development entirely. Spain therefore drops to 3rd place alongside the UK.

Denmark appears to be strengthening its own position as an established leader in renewable energy stating that it plans to double the contribution of renewable energy to 30% by 2025 and cut the use of fossil fuels by 15%. In Sweden, developers have been gearing up in anticipation of a new energy minister who is pledging €3.3m funding for municipal wind farms. Whilst Green Certificate (GC) prices are not the highest compared to other European markets, Sweden offers a stable regime with ambitious targets of 10TWh by 2015 and a GC market until 2030. Norway, on the other hand, has dropped further in the Indices largely due to a reluctance to commit to a joint green certificate market with Sweden, and a relatively low feed-in tariff rate offered instead.

Wind development activity has stalled in the Netherlands following the Government's decision to halt the MEP tariff regime to new applications, stating that the renewables target would be met without the incentive.

Canada looks to be doing a U-turn on its stalled wind programme as the Canadian Government pledged US\$1.7bn to the ecoENERGY initiative, including around 4GW of renewable power production to be installed over the next four years. The programme will provide a production incentive to renewables generation as well as grants to support micro-renewables and R&D. Ireland has been named as the biggest landfiller in Europe and this opens the door to significant opportunities in the energy-from-waste market, which has increased the Biomass score in this quarter's All Renewables Index.

Near-term Wind Index at Q4 2006

Ranking**	Country	ST Combined Wind Index	ST Onshore Index	ST Offshore Index†
1 (1)	USA*	89	89	NA
2 (2)	Spain	75	75	NA
3 (3)	India	74	74	NA
4 (4)	Germany	55	55	54

Ranking**	Country	ST Combined Wind Index	ST Onshore Index	ST Offshore Index+
4 (6)	Canada	55	55	NA
6 (5)	UK	53	51	82
6 (6)	Italy	53	53	NA
8 (8)	France	52	52	41
8 (8)	China	52	52	NA
10 (10)	Portugal	49	49	NA
11 (11)	Greece	43	43	NA
11 (11)	Ireland	43	43	NA
13 (13)	Australia	42	42	NA
14 (14)	Netherlands	36	33	57
14 (15)	Norway	36	36	NA
14 (17)	Belgium	36	35	40
17 (16)	Sweden	35	35	56
18 (18)	Denmark	31	28	45
19 (19)	Austria	30	30	NA
20 (20)	Finland	27	27	NA

Source: Ernst & Young LLP

* (RPS) This indicates US states with Renewable Portfolio Standards and favourable wind regimes

+ Countries with no offshore development expected to reach construction in the next two years have been excluded from the Near-term Offshore Wind Index

** Ranking in the Q3 2006 Near-term Wind Index in brackets

The Near-term Wind Index takes the perspective of an investor looking to make a commitment within the next two years. The methodology and weightings used to produce the Near-term scores are slightly different to that of the Long-term scores so the two are not directly comparable. The Near-term Index places a greater emphasis on market growth and takes into account a narrower range of parameters than the Long-term Index.

Italian electricity regulator, Gestore dei Servizi Elettrici, has confirmed that renewable operators will receive €125.8/MWh for 2006 Green Certificates. The market is potentially the most lucrative for wind operators in the near term, hence its rise in the Near-term Index. Its position would be higher in the Long term Indices were it to renew its targets beyond 2010.

In Canada, the new eco Energy programme targets significant installation of wind in the next three years, which is good news to investors who had taken a bet on such an incentive being implemented. Significant Provincial efforts will also boost wind investment in the near term. Requests for Proposals in 2007 are expected to come from Quebec (2,000MW), Manitoba (300MW) and Nova Scotia (130MW), and British Columbia is requiring 50% of new power projects to come from 'clean' energy.

Canada joins Germany in 4th place, displacing the UK for the first time since the Indices began four years ago. The UK, with its high ROC prices still makes this an attractive market to invest in, in the near term. UK projects still attract premium pricing and highly competitive bidding, in the hope that the current review of the RO will offer existing projects protection from any reduced incentive for onshore wind.

Commentary — High-scoring Countries

USA – Production Tax Credit and State-specific RPS

Success due to increasing number of States adopting RPS mechanism together with good site availability. Biofuels also a strong growth sector.

Ist CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	72	73	75	64	76
MW Total	26,803	11,603	200	15,000	-
MW 2006	-	2,454	-	-	-

Source: REN21, GWEC

There is no sign of the anticipated slowdown in the US biofuels market after the US Government issued its strategy for developing alternatives to petroleum. Targets have been set to consume 13 bn gallons of renewable fuels by 2015 (more than double that today), with a particular focus on biomass. The Bush Administration has stated its intent in reducing petrol consumption by 20% over 10 years and has asked Congress for US\$2bn to fund cellulosic ethanol R&D.

The renewables sector breathed a sigh of relief for another year as the PTC and Investment Tax Credit were renewed at the end of 2006. This ends a record year for US wind, with nearly 2.5GW wind power projects installed during 2006 taking the country's total capacity to 11.6GW. The growth is likely to continue unabated, with a further 3GW expected to come online in 2007.

A new tax incentive for renewable energy projects has also been announced, to reach those who could not access the PTC – namely rural electric co-operatives and municipal utilities – called Clean Renewable Energy Bonds (CREBs). The CREBs work by raising money from outside investors in the form of a loan (a bond). Instead of receiving interest on their investment, outside investors are able to claim a tax credit against their own tax liability whilst the project raises interest-free capital to finance development. The new scheme is already proving popular, with around US\$2.6bn in CREBs financing nearly 800 projects, with around one-fifth represented by rural co-operatives and the remainder for municipal-owned projects.

Leading American corporations are now turning to renewable energy for reasons of energy security and shareholder demands for more responsible companies. GE has announced that it is undergoing a solar PV makeover at its corporate headquarters and 30 facilities worldwide. Wal-mart has been notably vocal in its green future, looking to increase the use of biofuels for transport, solar and wind for its stores and improving energy efficiency in stores. Other

companies are following suit as they become aware of the potential value in the new 'clean tech' arena.

Spain – Option of fixed price or market based tariff under Regimen Especial

Attractive renewables market resulting from broad-based tariff encouraging different sources of renewable energy. Recent revisions to the regime have made the tariff less attractive to onshore wind.

2 nd CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	63	63	71	57	74
MW Total	13,915	11,615	100	2,200	-
MW 2006	-	1,587	-	-	-

Source: REN21, GWEC

The Spanish Government has cut wind subsidies from €97/MWh to €67–€84/MWh to boost other renewable power sources that co-generate power and heat, as well as solar power and biomass.

New proposals currently being considered by the Government, which would come into force from 2011, could offer a guaranteed 7% profit return for wind and hydro generators on the regulated tariff, and 5-9% from the liberalized market. Biomass, biogas and solar would benefit from higher, guaranteed profit margins.

The Spanish wind giant, Iberdrola, has set a precedent by investing over €3bn in the renewable energy industry. The portfolio includes solar PV installations, but will predominantly consist of wind farm projects, with €891m invested in Andalusia and €781m in Castilla-Leon. The long-term plan is to allocate 38% of funds to renewable projects abroad until 2009, which will increase to 56% by 2011.

In other wind news, Gamesa has signed three new wind deals worth €613m with total generating capacity of 710MW. The deals include 264MW supplied to EDP affiliate Neo Energia in Spain, 166MW to Enel for use in Italy and 280MW to Iberdrola for use in its wind farms in Northern Spain.

Endesa has signed an agreement with Isofoton for 100MW of solar PV equipment. The €250m deal includes the construction of the world's seventh largest polysilicon processing plant, enough for 250MW PV modules per year. Another PV project under way is La Magascaona in Trujillo, which will have the capacity to generate up to 20MW. The €176m project is a joint venture between Qualitas Equity partners and Fotowatio Energia Solar.

India – Regional feed-in tariffs and tax incentives

Strong uptake of wind power by large power users has driven demand, together with generous State-led tariffs and tax incentives.

2 nd CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	63	64	61	50	65
MW Total	8,870	6,270	0	2,600	-

MW 2006

1,840

Source: REN21, GWEC

Renewables in India are becoming a major part of the country's energy mix, and its position in the All Renewables Index is largely a result of a political environment that is friendly to foreigners and even friendlier to an Indian-based renewables industry. Renewables contributed some 7% of India's electricity in 2006, generated from around 9.1GW of renewable capacity – two-thirds of which come from wind power and around 1GW from bioenergy power generation.

India's home-grown renewables industry remains buoyant; MSPL is planning for an IPO and restructuring to focus on renewables, Suzlon is to start on a 1,500MW wind farm in Karnataka, Velkan Energy has obtained permits to build a 10MW waste-to-energy plant in the energy-starved state, and on-site generation continues to be a leading source of projects as Hindustan Zinc – a leading Indian zinc producer – announced plans for a 75MW wind farm in Gujarat or Karnataka.

The Indian president has stated that 16% of India's electricity, amounting to 64GW, could be supplied by wind power within 25 years. A special emphasis on manufacturing is also on the Government agenda, as India sets up another 'Special Economic Zone' (SEZ) targeted at renewable energy plants, offering manufacturers exemptions from excise duties and export licenses. The project, based near Chennai, in Tamil Nadu, expects to attract over US\$600m in new investment over the next four years.

Germany – 20 year guaranteed feed-in tariff under the EEG

Currently the biggest market for renewables, particularly wind power, driven by broad-based technology-specific feed-in tariffs.

4th CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	62	62	72	60	58
MW Total	25,621	20,621	1,700	3,300	N/a
MW 2006	-	2,233	-	-	-

Source: REN21, GWEC

Germany has seen another record year of growth, with renewable energy generation of over 70TWh of power and nearly 100TWh heat in 2006. Wind and hydro continue to dominate electricity production, and bioenergy for heat, but the picture is likely to change as incentives become more significant for bioenergy and solar technologies. Future projects will also benefit from a Bill approved by the Bundesrat to speed up and simplify planning proceedings for all infrastructure projects.

Germany's diverse renewables industry continues to demonstrate that it can be a leading market for both renewable energy generation and technology manufacturing, evidenced by the level of German stock market fundraising activity and project announcements during 2006.

Germany's leading biogas developer, Schmack Biogas, has formed a joint venture with Erdgas Suedbayern to construct a biogas CHP plant in Germany. This follows an announcement that rival biogas developer Nawaro Bioenergie has secured a supply of GE Jenbacher engines for its 20MWe and 22MWt plant in Klarsee.

Leading German PV supplier, Conergy, plans to invest €250m in fully integrated solar wafer & cell production works which are tipped to be 'first of its kind in the world'. Rival Solarworld is planning on doubling capacity at its Freiberg wafer production plant to 500MW per annum to address an order book stretching out to 2018. Further PV production is planned in Germany through a joint venture between Q-Cells and Solibro AB to build a facility capable of producing 25MW–30MW thin-film PV per annum.

UK – Green Certificate mechanism under the Renewables Obligation

High score due to very significant wind resource potential (and to a lesser biomass) and favourably received ROC mechanism with long tenor. However, planning and grid remain key issues in the medium term.

4th CAI Score	All RE	Wind	Solar	Biomass / Other	Infrastructure
	62	62	48	57	66
MW Total	3,586	1,963	11	1,612	-
MW 2006	-	635	-	-	-

Source: DUKES, GWEC

The UK's attractiveness as a market is heavily influenced by its resource potential, in particular for offshore wind: it would come in equal 6th position behind Italy and China if measured against onshore wind only. In terms of MW installed, several markets installed more capacity than the UK in 2006, including China (1,347MW, open tender), France (810MW, fixed feed-in tariff), Canada (776MW, wind power production incentive) and Portugal (694MW, feed-in tariff). Despite this, the UK's high score in the Country Attractiveness Indices reflects the ability of the RO regime to support offshore wind.

In the North West of Scotland, the EU has intervened over the 652MW Lewis wind farm claiming that it is in breach of EU policies regarding protection of wildlife. UK property company and wind developer Peel Holdings reached financial close on the 65MW Scout Moor wind farm, with around GB£70m project financing. This was the UK's largest independent wind financing to date. Meanwhile npower has announced a GB£100m investment in two UK wind farms totaling 76MW capacity.

Bioenergy has been a feature of energy news in Scotland. Ineos plans to construct Europe's largest biodiesel facility in Grangemouth. The project will cost GB£70m, and is expected to fulfill 35% of the UK's biodiesel requirements once fully operational. Also in Scotland, Fife Council has approved the construction of a 100,000 tonne per annum oilseed biodiesel factory in Rosyth.

The Scottish Executive has backed plans by Northern Irish wood supplier, Balcas, to build a GB£24m biomass CHP facility on the site of a former aluminium smelting plant in Invergordon. This is Balcas' second biomass plant – the first being at its Northern Ireland headquarters – and will be one of largest biomass plants in the UK supplying around 5MW to the National Grid and around 3MW will be used to create wood pellets for domestic use.

Welsh Prenergy Power has confirmed a proposed large-scale 350MW biomass-fuelled power station in South Wales, near Port Talbot, which will run on imported feedstock.

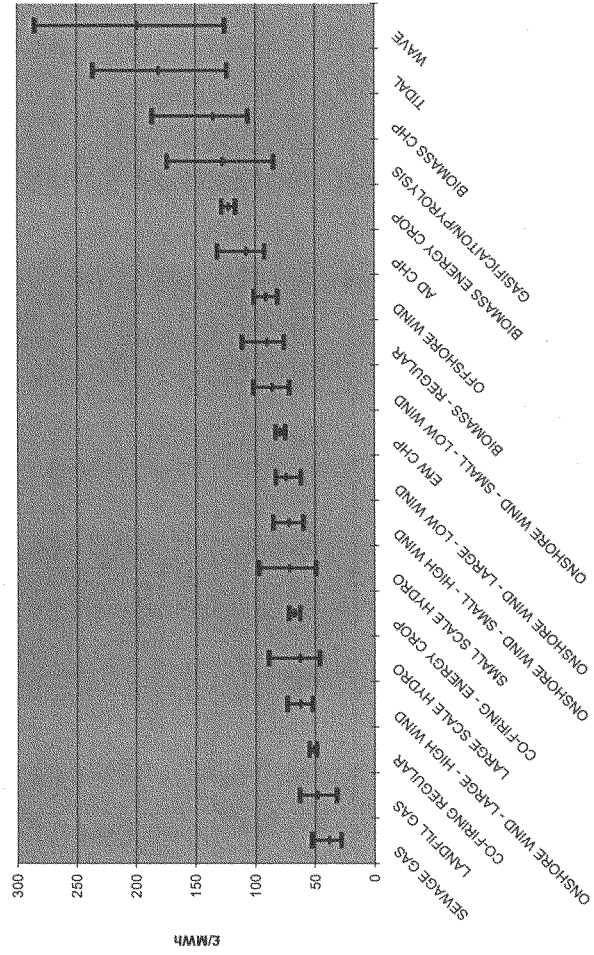
Infinis, which is owned by Private Equity firm Terra Firma, has announced a GB£80m acquisition of UK biogas company RE-Gen, which will include 42MW installed capacity and around 20MW in development.

On site generation took a step forward this quarter with Tesco's announcement that it is to install wind turbines, ranging from 225kW to 3MW, at 43 stores across the UK. AIM investors are also showing interest, such as the Low Carbon Accelerator, which has announced a GB£4.5m investment in small wind turbine manufacturer, Proven Energy.

Compliance with the Renewable Obligation (RO) has reached 76% as a result of the closing gap on the UK's renewables target. The gap could open up again, however, in the advent of the new 10% cap on co-fired ROCs, which will drive demand for other renewables and co-fired energy crops (which will still be eligible for full ROCs).

Jonathan Johns, Ernst & Young LLP

Indicative Levelised Cost 2006 (for UK projects)



Note: The levelised cost for Solar PV has not been included in the graph above due to the costs being much higher than the other technologies, with a typical cost of £635/MWh for UK projects this high cost reflects the poor solar resource in the UK.

Senate Finance Committee

Subcommittee on Energy, Natural Resources and Infrastructure

April 12, 2007

Written Testimony of

John Krenicki, Jr.

President and Chief Executive Officer, GE Energy

Mr. Chairman and members of the Committee, I am John Krenicki, President and CEO of GE Energy ("GE"). In response to the committee's interest in renewable policies in place overseas, I appreciate the opportunity today to offer an overview of European and Asian programs currently driving the deployment of renewable energy technologies.

GE is a power generation technology leader and has been in the energy industry for over 100 years. We currently have over 700 sites operating in more than 100 countries, and a team of 36,000 employees. Our diverse product portfolio consists of steam turbines, gasification systems, gas turbines, civilian nuclear, solar, biomass and wind technology.

We commend the Subcommittee for holding this hearing today to examine the advantages and disadvantages of renewable policies in the EU and Asia. We also appreciate the Committee's early attention to mechanisms – such as the Production Tax Credit (PTC) – that are effectively driving further growth in the use of renewable energy resources in the United States.

Overview

The renewable energy industry is truly a global industry, and there are varying programs in place around the world to require or encourage greater use of renewable energy. Because GE's business is global, we have first-hand experience with programs in Europe and Asia. In preparation for this hearing, we reviewed programs in the EU and several of its member states and in the leading Asian markets – China, India and Japan. Our objective was to share with the Committee information that may help you to identify what, if any, of the approaches adopted overseas might be applied in this country.

Our conclusion is this: the increase in renewable generation in Europe and Asia demonstrates that government incentive programs do work. However, there is no “silver bullet” to be found in these programs that could be easily replicated in the United States. We believe that Congress has already identified an efficient and effective incentive for the growth of renewable generation: the renewable energy production tax credit.

One issue to bear in mind when comparing incentive systems is that the structure of the U.S. electricity market differs from the electricity sector in other countries. In Europe and Asia, many utilities are owned by the national or state governments, which can set the price for power. The U.S., in contrast, features a wholesale market in which power generators compete for power sales, and this competition in turn enables retail electricity providers to offer the lowest prices to their customers. While wholesale market issues are subject to Federal jurisdiction, states have jurisdiction over retail prices, and some power suppliers are regulated in several different states. The federal Production Tax Credit (PTC) works well in this system because it is broadly available for new generation.

There are, however, certain aspects of other systems that can help to improve the US PTC approach. One very important lesson that we can take from the European experience is the importance of long-term and consistent incentives. This is one area in which U.S. policy has not been optimal, as the ‘on again, off again’ nature of the PTC demonstrates.

Another lesson to be learned is that an incentive must be set high enough to be effective. While the “feed-in tariff” mechanism that is in place in Europe has been successful in spurring new renewable generation, it has been less effective in China, which we believe is in part a factor of the level at which the tariff is set. Here again, the U.S. has gotten it about right with the production tax credit. The credit has been high enough to stimulate substantial investment while not putting an undue burden on electricity users.

For financial incentives to work, they must also be paired with sufficiently mature technology. Most of the experience we have with successful incentive programs relates to wind technology. For solar power generation to be price competitive with traditional power generation technologies, technology innovations and even

breakthroughs must continue. GE believes that for this technology to realize its maximum potential, long term material science advancements in cell thickness and efficiency, as well as energy yield must take place. Therefore, we believe that for solar incentive programs to be successful at this point in the technology development cycle, they should be investment based rather than production-based. Also, we recommend they be coupled with government sponsored research and development programs until this technology reaches sufficient maturity to be near price competitive with traditional technologies.

Finally, because this is a global market, we believe it is appropriate for the Committee to consider the effect of tariff barriers on the growth of the renewable energy industry. This type of policy, as well as preferences for particular technologies that are built into some incentive programs, can have the effect of limiting the growth in renewable energy generation.

European Union Renewable Energy Drivers

In 2006, GE estimates the EU led the world with 71 gigawatts (GW) of installed renewable capacity, of which wind energy represented 48GW. By comparison, we also estimate the US had 26 GW of installed renewable capacity in 2006, of which wind energy represented 12 GW. To put this in perspective, one gigawatt of wind is enough energy to power nearly 300,000 average U.S. homes.

Earlier this year, the EU Heads of State adopted a binding target of obtaining 20% of primary energy from renewables by 2020. This represents a sizeable increase from the EU's already challenging 2010 target of 12.5%. The European Renewable Energy Council predicts that reaching the new renewables target in 2020 in the electricity sector would require an installed base of 180GW of wind, 35GW of solar and 54GW of biomass generation.

While the 20% by 2020 and 12.5% by 2010 targets for renewable energy are EU-wide, they are implemented via differentiated national targets for each of the EU member nations. Each member state adopts its own system for achieving its target.

Frameworks being used by the EU member states include the following:

1. Feed-in Tariff

As of April 2007, 16 out of the 27 EU countries utilized a Feed-in-Tariff (FIT) system, under which the electricity supplier or the utility is required to pay a fixed price per kwh for renewable electricity directly to the generator. The leading countries in the EU in terms of wind installations -- Germany, Spain and Denmark -- have used this scheme consistently and successfully for more than eight years to accelerate investments in wind energy capacity.

In Germany, the FIT is worth approximately 8.2 Eurocents per kWh to a generator, which would translate into a payment of approximately 10.25 US cents per kWh. In Spain, the incentive is worth 6.8 €/kWh (\$0.085 US); in Denmark, the FIT is approximately 5 €c (\$.0625US). Compare this to the PTC, which is currently \$0.019 per kWh. Because the US incentive is provided in the form of a tax credit, rather than a payment from an electric supplier, the PTC does not impose as large a burden on electricity consumers as the FIT system does.

The benefits of utilizing a FIT system include the fixed price, which increases certainty for investors and has increased Independent Power Producer ownership of generation. The FIT generally is set well above the otherwise applicable market price. The additional costs of the FIT vs. the power pool price are distributed among all electricity consumers.

At the end of 2006, approximately 55% of global wind installations benefited from the FIT system. This is a relatively simple system, which clearly has been successful in promoting technologies that range from those still far from being competitive with fossil fuel, such as solar, to those that are approaching mainstream status. One of the real benefits of the FIT is its predictability and long-term duration. Because of this, manufacturers are able to invest in their production capacity. This stable market at home has enabled European companies to become major players, for example, in the global wind energy market. With the EU agreement on extension of the renewable mandate to 2020, suppliers have the additional certainty they need to be able to make investments in production capacity.

While the fixed price is a benefit that helps foster growth, it has a potential drawback that the FIT price may not keep pace with rising equipment costs in the scenario of an inflating raw material market. On the other end of the spectrum, FIT prices can sometimes be set at higher levels than required to meet policy objectives, and this can impose unnecessary additional costs on all energy users. The balance is difficult to strike and European policymakers have tended to err on the side of higher prices in order to ensure expansion of their domestic renewable capacity. European governments generally review their FIT levels on a regular basis and adjust them on a prospective basis to reflect changes in technology and costs.

2. Renewable Obligation Credit

Instead of a financial incentive to encourage market penetration of renewable technologies, other European nations have adopted an approach that uses technology mandates to create a market. The main countries in Europe utilizing a Renewable Obligation Credit (ROC) program are the UK, Poland and Italy. These renewable portfolio standard or RPS programs generally require utilities to purchase or generate a certain percentage of their portfolio from renewable energy, and provide for trading among covered entities.

The RPS system has several potential advantages. It has resulted in increased commitments from utilities to incorporate more renewables into their energy portfolios and the approach uses market mechanisms to achieve policy goals at a reduced cost.

However, from the standpoint of a technology provider, there is a concern that the RPS system can also result in market pricing favoring the least expensive technology. In general, the ROC approach has been slower to emerge as a strong driver of renewable deployment, though countries such as the UK remain committed to using and refining this approach.

Asian Renewable Energy Drivers

Together, China, India and Japan had 56 GW of renewable capacity on line in 2005. However, each country uses different mechanisms to foster renewable energy growth:

1. China

In 2005, the National People's Congress (NPC) of China passed the Renewable Energy Law. That law went into effect on January 1, 2006. It sets a goal of 10GW of renewables by 2010, and 50GW by 2020. Wind is expected to comprise over 50% of the new additions.

At present, China utilizes a feed-in-tariff, combined with a government concession, to facilitate renewable growth. The government concession is intended to leap-frog the siting issues that often pose a challenge for renewable energy projects in the United States, by identifying government-approved project sites and then requesting bids for project development.

China faces major challenges with its renewable energy scheme. At present, the feed-in-tariffs for wind projects are too low to effectively incentivize the widespread adoption of renewable energy on the desired scale. The current concession approach of awarding wind projects to the lowest bidder makes it difficult to bring more efficient turbine technology to the market, thus reducing the efficiency and total output of renewable energy generation. Most wind turbines supplied in China today are manufactured by local Chinese firms, but the Chinese renewable energy industry itself is calling for improvements in concession/feed-in tariff system to drive more rapid deployment.

2. Japan

In 2003, the Japanese Diet passed legislation creating a Renewable Portfolio Standard ("RPS Law"). The RPS Law set a target that electric power producers should use "New Energy" for 1.35% of total power generation by FY 2010.¹ New Energy includes wind, solar, biomass, geothermal power and small hydraulic power (less than 1,000 kW). As a point of reference, utilization of New Energy in FY 2005 was 0.44 %.

In 2007, the Ministry of Economy, Trade and Industry ("METI") raised the target for electric power producers to use renewable and other New Energy for 1.6 % of total power generation by FY 2014, a 30 % increase

¹ "New Energy" is generally energy technology which is at or near the technically practical stage, but which is not widely used, and which is especially necessary for introducing alternatives to oil.

over the 2003 target. A penalty is levied on power producers for non-compliance, which provides a significant incentive for companies to use New Energy.

Solar energy receives double credit in meeting the energy usage requirement. METI has a target that wind power and solar power have approximately 50 % and 10 % shares, respectively, for the usage of New Energy in 2014.

In addition to the RPS law, METI provides a subsidy to power producers using New Energy/renewable energy. The subsidy covers a maximum of one-third of all initial costs to build a power generation plant using New Energy, excluding costs for land, buildings and operation.

In the Japanese wind power equipment market, foreign companies had an approximately 80% market share in 2006 because the combination of incentives allows buyers to take into account the advantages of high technology equipment. GE and other global wind turbine suppliers strongly support a level playing field both for all wind power equipment suppliers.

3. India

The current regulatory environment for renewables in India is characterized by three interventions - tax incentives (investment tax credit and tax holiday for power generation), Renewable Portfolio Standards (RPS) and preferential tariffs. The combination of these programs and policies has led to the fourth largest installed base of wind power in the world, although the system has its imperfections.

The dominant renewable incentive in India today is an Investment Tax Credit system. Additionally, there is a 5-year income tax holiday on power generation from renewables. The investment tax credit system rewards initial investments in a project rather than energy production. Because the tax credits are applied at the time of investment, many of the wind farms that have been constructed with the benefit of the investment tax credit are out of commission or under-performing as compared with their electricity output potential. This illustrates an incentive that is not having the desired result of actually increasing the amount of renewable energy used to produce electricity. The system does not encourage manufacturers to advance the reliability and

efficiency of wind technologies. However, a production-based incentive that appropriately rewards advancements in technology and capability, such as the US PTC, is more appropriate for a more mature technology such as wind.

The Indian government is considering a policy shift from an investment tax credit to generation-based incentives, similar to a production credit. This has the potential, if done in the right manner, to incentivize higher quality, higher efficiency wind turbines and larger scale wind power development and pave the way for consolidated growth in the independent power production sector in India.

Today, almost half of India's 28 states have either a RPS or preferential tariff program in place; six states have implemented both. These measures have helped to maintain the momentum for growth in the renewable energy industry. Preferential tariffs range from US\$0.050-\$0.088/kwh for wind power. Currently, these policies yield project opportunities in specific states where the political will for wind is strongest.

The Link Between Technology Maturity And The Effectiveness Of Incentives

The wind production tax credit has been effective and efficient in this country because wind energy technology has matured sufficiently to make its widespread commercial deployment practical. While it might look like it to some, wind is far from an "overnight success." It has taken approximately 25 years to move down the wind energy technology curve.

Today, wind and solar energy technologies are not equally mature. Similar to the wind industry two decades ago, solar is at the beginning of the technology life cycle. Major technology advancements are needed to drive down the cost of electricity significantly to help make solar energy competitive with other power generation technologies. In order for federal and state incentives to become most effective for solar energy, we believe breakthroughs in solar technology and enhancement of the supply chain are needed first.

The solar industry is investing in new plant and equipment as the technology changes and markets grow. It is important to continue

incentives for this investment. As I have testified previously, GE supports S.590 and S.550 and recommends that Congress extend the 30% Federal investment tax credit through 2016 for residential and commercial solar installations. GE also supports changes to the credit as proposed in S. 590, which we believe will make the credit an even more effective incentive for deployment of the technologies that are ready now.

Trade Measures

As the Committee looks for ways to accelerate the deployment of cleaner energy technologies, one mechanism immediately available to governments is to eliminate customs duties on cleaner energy power generation equipment. The United States Trade Representative has supported this initiative in the World Trade Organization, and the European Union has also endorsed the idea in general terms. Applied tariffs on wind turbines and components in most countries are in the 2.5 to 10 percent range. The United States is at 2.5 percent. These tariffs represent an additional cost that governments impose on the types of projects on which they are simultaneously offering incentives to support. In addition to renewable products, GE would support tariff elimination covering all our ecomagination energy products, including gas turbines, wind turbines, biogas solutions, solar and Cleaner Coal IGCC.

While many energy products are manufactured close to final destinations, it is not practical to manufacture in all countries. Tariff elimination in all of those countries will help to cut project costs and improve the rate of technology deployment. We recommend that the Committee support this initiative.

Renewable Energy and Job Growth in the United States

GE foresees that one of the benefits of increasing the use of renewable energy in the United States will be growth in good quality jobs in technology development, engineering and services. Additionally, we believe that growth in the U.S. supply chain could open opportunities for suppliers to provide component parts globally.

The wind industry contributes directly to the economies of 46 states, with power plants and manufacturing facilities that produce wind

turbines, blades, electronic components, gearboxes, generators, and a wide range of other equipment.

In 2004, the Renewable Energy Policy Project (REPP) released a study that suggested boosting U.S. wind energy installations to approximately eight times today's levels could create 150,000 manufacturing jobs nationwide. The REPP also states that some 90 companies in 25 states currently manufacture wind turbine components, and over 16,000 companies in all 50 states have the technical potential to enter the wind turbine market.

The increasing public policy focus on renewable energy has spurred growing demand for wind power. To meet this demand, GE has manufacturing facilities in Tehachapi, CA, Pensacola, FL, and Greenville, SC. We also plan to add a new service center at our facility in Schenectady, New York. This new service center alone will create approximately 70 – 100 new management positions in product strategy and customer service. As demand for wind continues to grow, we expect to explore other opportunities. We believe wind and solar energy are likely to be among the largest sources of new manufacturing jobs worldwide during the 21st Century.

Conclusion

There is strong, global demand for renewable energy technology. Approximately 38 countries have renewable targets and various programs in place to foster further investments in renewable energy.

We believe U.S. Renewable Energy Production Tax Credit is a cost-effective approach that should be maintained to stimulate use of renewable energy in our country. However, we believe a long-term focus and stable policy environment are still needed and support the WTO initiative to eliminate tariffs for renewable products.

Thank you again for the opportunity to testify. I would be pleased to answer any questions.

Opening Statement of U.S. Senator Ken Salazar
Committee on Finance
Subcommittee on Energy, Natural Resources, and Infrastructure
International Perspectives on Alternative Energy Policy:
Incentives and Mandates and Their Impacts
April 12, 2007

I want to thank our Subcommittee chair, Senator Bingaman, and Ranking Member Craig for holding today's hearing on the very important topic of how our country can speed the development and market penetration of clean, renewable energy technologies.

On March 26, 2007, I spoke on the Senate floor about the issue of energy and the importance of energy independence for our country. When I think about energy, I see the dawning of a new age of a clean energy future for America. In my own state of Colorado, we held the Colorado New Energy Summit on March 24, 2007 where over 1000 people gathered to discuss our country's energy challenges and opportunities. The Summit was co-sponsored by a distinguished, bipartisan group of Colorado's elected leaders and a broad sweep of our energy, business and research communities. At the Summit, we freely explored how we can 1) champion a new ethic and goal of setting America free from its overdependence on foreign oil, 2) create economic opportunities in this country through the development of alternative and renewable energy sources, and 3) address the very real threat of global warming by using new technologies that utilize fossil fuels in a more efficient and environmentally sound way and more widely use energy sources that do not harm the environment.

The three energy challenges that face the United States today, and must influence our energy policies are 1) **national security**, 2) **economic security**, and 3) **global warming**. **Energy policy is at the heart of our national security**. The United States imports nearly two-thirds of our oil supplies from abroad, and much of that oil comes from unstable and even politically hostile regions. Our dependence on foreign oil means that we are sending billions of dollars overseas, and financing the very regimes that threaten peace and stability in the world. **Energy policy is also at the heart of our economic security**. While we are not running out of oil, we are running out of cheap oil. The economic competitiveness of our economy will be determined in substantial part by how we cope with increasing energy costs. **Energy policy is at the heart of how we deal with global warming**. Our country's use of fossil fuels is contributing to rising temperatures across the world, and is negatively affecting many natural systems. In my state of Colorado, global warming impacts are manifesting themselves in more extreme droughts, earlier spring peak discharges into snow-fed rivers, and devastating impacts to our native pines from beetle infestations that proliferate when there are no longer extended periods of freezing temperatures.

We must champion a new ethic and goal of setting America free from its overdependence on fossil fuels. With creativity and commitment, there are many actions that we can take that will help America deal with our national security, economic security, and global warming energy challenges. America has led the world in developing renewable energy technologies, but we

have lost much of our advantage because other nations have been much better at implementing those technologies. Most of the renewable technologies using solar energy, wind energy, and biofuels were developed in the United States originally, but other nations have surpassed us in manufacturing and implementing these technologies. But, there is no reason for us to import these technologies when we can manufacture this equipment right here in America.

Our country is extremely rich in renewable energy resources, such as solar, wind, biofuels, and biomass. Colorado's private clean energy sector is taking off. We have added 60 megawatts of wind capacity in the last two years. Since the passage of Amendment 37 in Colorado that requires Colorado's top utility companies to provide a percentage of their retail electricity sales from renewable resources our state has found that we are already exceeding the pace, eight years earlier than expected. Today, Colorado has three plants producing more than 90 million gallons of ethanol a year, and a fourth plant scheduled to come on line in 2007.

The ultimate success of developing a new energy direction for the United States will require national leadership in this 110th Congress. I am enthused by the work of my colleagues on the Finance Committee, Energy and Natural Resources Committee, and Agriculture Committee to address the energy challenges our country faces. I have introduced a series of bills that will help us adopt more energy efficient technologies and combat global warming.

Senate Bill 672 is the Rural Community Energy Bonds Act. I support our big wind farms, but we need a lot of small wind farms, too, and we need a lot of small biomass and solar and other renewable energy projects. This bill will allow small renewable energy projects with at least 49 percent local ownership to qualify for tax-exempt bonds. That will make it easier for locally and community-owned renewable energy projects in rural and small town America to find investors. And local ownership means that more of the profits from those projects will stay on Main Street in Colorado's small towns.

I have also introduced the Rural Wind Energy Development Act, Senate Bill 673. This bill will create a tax credit for every residential wind turbine installed and will also allow for accelerated depreciation on those turbines. For turbines under 100 kilowatts, there's a tax credit of \$1,500 for each half-kilowatt of generating capacity.

I am also working on several other bills to encourage renewable energy production and energy efficiency investments. The Securing America's Energy Independence Act will extend the energy tax credit for solar technologies and for residential energy efficiency improvements through 2016. If we want manufacturers to build these technologies and we want homeowners to buy them, we need to create reliable incentives that encourage planning and investment.

I am also proud to co-sponsor the DRIVE Act with Senator Bingaman and nearly 30 co-sponsors, with equal numbers of Republicans and Democrats. The Drive Act stands for Dependence Reduction through Innovation in Vehicles and Energy. This bill (S. 339), and other related legislation, will reduce oil consumption by 25% by 2025, impose Federal fleet conservation requirements, support research on electric vehicles, require the Federal government to purchase 15% of its electricity from renewable sources by 2015, and would phase-out

incandescent light bulbs in favor of more energy-efficient technologies. I am hopeful that this bill will pass in this Congress.

I'm also working with other members of the Senate Energy and Natural Resources Committee to draft a bill to require the use of 30 billion gallons of renewable fuels by 2020, to increase the funding for bioenergy research and development, and to offer financial support for renewable fuel production facilities, including cellulosic biofuel plants and biorefineries.

We should all recognize that we are going to be dependent on fossil fuels for a significant portion of our energy for the next several decades, so I'm sponsoring legislation to conduct a national assessment of our carbon sequestration capacity. As we continue to burn fossil fuels, we must find a way to reduce the volume of carbon dioxide released into the atmosphere. Integrated Gasification Combined Cycle (IGCC) technology can achieve its promise only if we can effectively sequester the carbon dioxide that's captured.

The Senate Committee on Finance has a key role to play in providing incentives that are needed to build a new energy economy, and that is why today's hearing is so timely. I believe there is much we can learn from our international friends about the incentives and mandates they have put in place to speed the development of clean, renewable energies. Mr. Chairman, I thank you again for holding this important hearing. I look forward to hearing from our witnesses today on their ideas.

