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RESEARCH, EDUCATION AND TRAINING PROGRAMS TO FACILITATE ADOPTION OF SOLAR ENERGY TECHNOLOGIES

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

JUNE 19, 2007

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TUESDAY, JUNE 19, 2007

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:05 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Gabrielle Giffords [Vice-Chair of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
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Subcommittee on Energy and Environment

Hearing on

Research, Education and Training Programs to Facilitate Adoption of Solar Energy Technologies

Tuesday, June 19, 2007
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

Witness List

Mr. Herbert Hayden,
Solar Technology Coordinator, Arizona Public Service Co

Mr. Rhone Resch
President, Solar Energy Industries Association

Ms. Jane Weissman
Executive Director, Interstate Renewable Energy Council, and Vice-Chair, North American Board of Certified Energy Practitioners

Professor Joseph Sarubbi
Chair, Building Systems Technology Department, Hudson Valley Community College

Dr. Daniel Arvizu
Director, National Renewable Energy Laboratory, Department of Energy

HEARING CHARTER

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

Research, Education and Training Programs to Facilitate Adoption of Solar Energy Technologies

TUESDAY, JUNE 19, 2007
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Tuesday, June 19, 2007 the House Committee on Science & Technology, Subcommittee on Energy and Environment will hold a hearing to receive testimony on the Discussion Draft sponsored by Rep. Giffords which establishes several important research, education, and training programs to facilitate the adoption of solar energy technologies.

This bill addresses issues in solar research, education, and training not covered by the *Energy Policy Act of 2005*. These include a research and development program on thermal energy storage technologies for concentrating solar power, a study to determine the necessary steps to integrate concentrating solar power plants with the regional and national electric grid, a program to ensure that a sufficient number of people are properly trained to install and maintain solar energy equipment, and the establishment of a solar energy research and information program, modeled on similar such programs for the beef and dairy industries. The program is supported by pooling funds from the private sector for the research and promotion of the solar power industry as a whole.

This hearing will seek to address the following issues relating to the discussion Draft:

- Is thermal energy storage technology important to the viability of concentrating solar power? Would the increased research and development on thermal storage proposed significantly accelerate the advancement of this technology?
- Would a study on how to integrate concentrating solar power plants with the regional and national electric grid be useful?
- Is there a sufficient number of people trained to install and maintain solar energy equipment to meet the current and future needs of the solar industry? Are such programs necessary or useful for prospective solar panel installers and potential consumers?
- How would the solar research and information program for the solar industry authorized in the bill help to support research and promote the adoption of solar power across the Nation?

Background

The Discussion Draft contains 4 basic components, as described above. The first two are specifically related to concentrating solar power (CSP). A 2006 report by the Western Governors' Association assessed the overall near-term potential for CSP capacity in the American Southwest, taking into account areas of high solar ray intensity, near-level land, non-sensitivity to CSP use, and proximity to transmission. The resulting set of potential plant sites totaled 200 GW of potential power production. To put this in perspective, the electric generating capacity of the entire United States is currently about 1,000 GW. Some significant challenges remain to widespread implementation of CSP, however.

CSP plants produce electric power by converting the sun's energy into high-temperature heat using various mirror configurations. The heat is then channeled through a conventional generator. These plants consist of two parts: one that collects solar energy and converts it to heat, and another that converts heat energy

to electricity. Thermal energy storage technology allows this heat to be retained for later use in generating electricity, such as during periods of passing clouds or into the evening. The *Energy Policy Act of 2005* establishes a CSP research and development program, but storage is not included in the language. Section 3 of the Discussion Draft authorizes a program dedicated to advancing research and development in thermal energy storage for CSP. Section 4 of the Discussion Draft tasks the Department of Energy (DOE) with conducting a study on methods to integrate concentrating solar power with regional electricity transmission systems, and to identify new transmission or transmission upgrades needed to bring electricity from high concentrating solar power resource areas to growing electric power load centers throughout the United States. The results of this study will help define a roadmap for large-scale implementation of CSP to meet the Nation's growing energy needs.

The other two components of Discussion Draft address the solar industry in general. Having a certified, well-trained workforce to install and maintain solar energy products is critical to the success of the industry. Some states, such as New York and Florida, working with local community colleges, businesses, the Interstate Renewable Energy Council (IREC), and the North American Board of Certified Energy Practitioners (NABCEP) have recently established successful programs to create a workforce to meet local demand, however there is currently no federal program to help establish or improve these training programs across the Nation. Section 5 creates such a program, authorizing $10 million in each year from FY08 through FY12. This section instructs DOE to ensure sufficient geographic distribution of training programs nationally, and to only award grants for programs certified by the Institute of Sustainable Power or equivalent industry-accepted quality-control certification institution, or for new and growing programs with a credible path to certification.

A successful model for promoting a particular U.S. commodity, rather than an individual brand, has been demonstrated by the agriculture industry. Funded entirely by a small portion of industry revenues and overseen by the USDA, organizations such as the Cattlemen's Beef Promotion and Research Board and the National Dairy Board were created to coordinate mutually beneficial research efforts and increase awareness of their industry as a whole, as well as ensure that consumers knew the proper certification standards to seek out before making a purchase. Modeled after these examples, Sections 6–13 create the Solar Industries Research and Promotion Board, overseen by DOE, which would similarly plan and conduct mutually beneficial solar industry research efforts, increase awareness of solar as an energy option across the Nation, and ensure that consumers know what certifications a technician should have for installation or maintenance of solar energy equipment. The Solar Energy Industries Association (SEIA) has expressed a strong interest in creating such a program.

Witnesses

- **Mr. Herbert Hayden** is the Arizona Public Service (APS) Solar Technology Coordinator. Mr. Hayden will testify on how thermal storage research and development and the bill's proposed studies on grid integration and water usage will help advance the implementation of concentrating solar power.
- **Mr. Rhone Resch** is the President of the Solar Energy Industries Association (SEIA). Mr. Resch will testify on how the proposed research and information for the solar industry would help to support research and promote the adoption of solar power across the Nation.
- **Ms. Jane Weissman** is the Executive Director of the Interstate Renewable Energy Council (IREC), and the Vice-Chair of the North American Board of Certified Energy Practitioners (NABCEP). Ms. Weissman will testify on the current status of workforce training in solar installation and maintenance across the country, and the need for a national solar workforce training program.
- **Prof. Joseph Sarubbi** is the Chair of the Building Systems Technology Department at Hudson Valley Community College. Prof. Sarubbi will testify on his ground-level experience in creating a solar workforce training program, including his partnership with local businesses and the State of New York in developing a successful curriculum.
- **Dr. David Arvizu** is the Director of the Department of Energy's National Renewable Energy Laboratory. Dr. Arvizu will testify on the DOE's current solar research and development activities, and on his views regarding the proposed legislation.

Ms. GIFFORDS. Welcome to today's hearing entitled "Research, Education and Training Programs to Facilitate Adoption of Solar Energy Technologies." I want to thank Chairman Gordon, Ranking Member Hall, Chairman Lampson and Ranking Member Inglis for holding this hearing on solar energy this morning. Solar energy offers one of the best solutions to the greatest challenges facing our nation, global warming, dependence on foreign oil and concerns about American competitiveness.

It has tremendous potential across the United States, especially in regions like Southern Arizona, where we have over 300 days of sunshine every single year.

Solar energy, as we all know, is a nonpartisan issue. The sun beats down on Republicans and Democrats and Independents with equal intensity, and we could all benefit from harnessing the power of the sun. It stimulates business development. It creates new jobs, helps protect our environment, and promotes energy independence.

My legislation, entitled the *Solar Energy Research and Advancement Act of 2007,* will move solar energy forward by targeting some of the gaps that several experts have identified in our national solar energy strategy.

Today we are going to hear from experts on the discussion draft that was earlier circulated. This is a great first step in the overall solar energy agenda for the 110th Congress. I am considering other pieces of legislation and I know that other House committees are looking at solar-related bills as well. As we move forward, the cumulative efforts to focus on the use of solar energy should be very positive.

Let me briefly summarize the four components of this bill. The first component would establish a Thermal Energy Storage Research and Development Program within the Department of Energy. This will help us solve perhaps the most significant problem with concentrated solar power technology: energy storage. We need more advanced technology so that we can store solar energy produced during the day and use it at night or on a cloudy day. This is all about energy reliability and viability. We need to assure the public that they will have enough electricity when the sun goes down and when they need it.

The second component would require DOE to conduct two concentrating solar power commercial application studies. One would study methods to integrate concentrated solar power energy into regional electricity transmission systems. The best time of the day to produce and use solar energy is from 10 a.m. to 5 p.m. We need to research how to connect the major solar power plants to the electric grid, relieve expensive demand on electric utilities and use solar energy during these peak hours. It also makes sense to examine how to bring electricity from high solar resource areas like Arizona and Nevada to other parts of the United States that have other energy needs as well.

The other study would require DOE to inform Congress on methods to reduce the amount of water consumed by concentrating solar power systems. CSP has its greatest potential in the southwest United States, and like all power plants, it requires tremendous use of water. Given the strain on water resources already in this

region, we must research ways to research water consumption so that we can realize the benefits of CSP technology.

The third component of the legislation will authorize a competitive grant program at DOE to create and strengthen solar industry workforce training and internship programs in installation, operation and maintenance of solar energy products. The goal of this program is to ensure an adequate supply of well-trained individuals to support the expansion of the solar energy industry. If we want to increase our use of solar energy, we have to make sure that we have a trained and qualified workforce. This section will promote job growth in a fast-growing solar industry.

Lastly, we have got beef for dinner and we have all got milk, but who has gone solar? The fourth component of this bill will create a Solar Energy Industries Research and Commercial Application Board to plan and coordinate projects of research and commercial application, certification, information and other purposes of benefit to the application of solar technologies and educate people on why we need to be doing this. This public-private partnership will also help the general public understand how they can benefit from solar energy technology. I want to note that this program will be paid for by the solar industry and will cost the taxpayer absolutely nothing. It is important to my constituents and all the other people's constituents as well.

I look forward to working with my colleagues on both sides of the aisle to pass this important legislation.

[The prepared statement of Ms. Giffords follows:]

PREPARED STATEMENT OF REPRESENTATIVE GABRIELLE GIFFORDS

I want to thank Chairman Gordon, Ranking Member Hall, Chairman Lampson, and Ranking Member Inglis for holding this hearing on solar energy today.

Solar energy offers one of the best solutions to the greatest challenges facing our nation—global warming, dependence on foreign oil, and concerns about American competitiveness.

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The second component would require DOE to conduct two "Concentrating Solar Power Commercial Application Studies."

One would study methods to integrate concentrating solar power energy into regional electricity transmission systems. The best time of the day to produce and use solar energy is from 10 a.m.-5 p.m. We need to research how to connect major solar

power plants to the electric grid, relieve expensive demand on electric utilities, and use solar energy during these peak hours. It also makes sense to examine how to bring electricity from high solar resource areas, like Arizona and Nevada, to meet energy needs throughout the United States.

The other study would require DOE to inform Congress on methods to reduce the amount of water consumed by concentrating solar power systems. CSP has its greatest potential in the Southwest United States, and like all power plants, it requires the use of water. Given the strain on water resources in this region, we must research ways to reduce water consumption so that we can realize the benefits of CSP technology.

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I look forward to working with my colleagues on both sides of the aisle to pass this important legislation.

Ms. GIFFORDS. The Chair now recognizes the Ranking Member from South Carolina, Mr. Inglis, for an opening statement.

Mr. INGLIS. I thank the Chair for holding this legislative hearing on facilitating the adoption of solar energy technologies.

Solar energy occupies just a sliver of the global energy market. However, when you consider the Earth receives more energy from the sun in just one hour than the world uses in a whole year, it makes sense that we should look into making that thin sliver into a big piece of the energy pie. With some advancements in technology and conversion efficiencies, solar will fit the bill for our energy goals: clean, renewable and abundant.

Today we are going to discuss draft legislation that seeks to address ways that the Federal Government can help speed commercial viability of solar energy. I look forward to hearing from our expert panel of witnesses as to how we might meet our goals.

Madam Chairman, as we discuss these proposals today and move to markup, I hope we give adequate time to make this bill as good as it can be. America's scientists, engineers, inventors and entrepreneurs realize the potential of solar power and other renewable sources, and I hope we can set policies that facilitate the development, the best development of those sources.

Thank you again for holding the hearing and I look forward to hearing from our witnesses.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Good afternoon. Thank you, Mr. Chairman, for holding this legislative hearing on facilitating the adoption of solar energy technologies.

Solar energy occupies just a sliver of the global energy market. However, when you consider that the Earth receives more energy from the sun in just one hour than the world uses in a whole year, it makes sense that we should look into making that thin sliver into a big piece of the energy pie. With some advancements in technology and conversion efficiencies, solar will fit the bill for our energy goals: clean, renewable, and abundant.

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Thank you again, Mr. Chairman and I look forward to hearing from our witnesses.

Ms. GIFFORDS. Thank you, Mr. Inglis.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

I am very pleased to be here this morning to discuss the legislation proposed by my colleague from Arizona, Rep. Giffords. Solar energy holds great promise and potential to deliver clean, affordable electricity to homes and businesses across the Nation.

Rep. Giffords has identified several areas where federal support could further the goal of diversifying our energy supply by expanding the adoption of solar energy technologies. The basic and applied research and development programs that we have invested in through the Department of Energy over the years have yielded significant advancements in solar energy technologies. Our challenge now is to move these technologies into the market place more aggressively.

I also serve on the Committee on Agriculture. In the agricultural sector, USDA has managed numerous promotion programs for agricultural commodities that have helped to educate consumers about the nutritional benefits of different foods and have expanded markets for all commodity producers. I believe it provides a good model for solar energy technologies and will deliver additional applied research and information designed to communicate with the general public to support the entire solar industry.

My home State of Texas has moved aggressively to encourage the development of renewable energy. We have abundant solar resources that could be used to further expand our renewable energy portfolio. As several of our witnesses will point out today, the U.S. has significant solar potential that we are not yet taking full advantage of. We can no longer afford to overlook obvious opportunities to diversify our energy supply.

I commend my colleague for her work on this legislation and I look forward to moving it forward in our committee very soon. We have an excellent panel of witnesses today that will help us to refine this legislation and expand our use of the abundant, clean source of energy.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good Morning. Thank you Mr. Chairman for holding today's hearing to receive testimony on the discussion draft legislation sponsored by Congresswoman Giffords. The bill establishes research, education, and training programs to facilitate the adoption of solar energy technologies.

My home State of Illinois has a plentiful supply of coal, which is why our region specializes in clean coal research and demonstration projects. In the West, solar energy and thermal energy storage is also an environmentally friendly energy source. Regardless of where you live in the country, I believe it is important to invest in multiple energy sources to ensure the U.S. has diverse a energy portfolio.

Specifically, the Discussion Draft with regard to thermal energy storage addresses an important issue related to solar energy and its impact on utilities. Adding thermal storage to concentrated solar power (CSP) plants enables solar energy to be a potentially provided at a low cost, which is critical for our nation's economy. Further, the discussion draft also addresses transmission integration, an important issue for CSP plants.

Similar to clean coal technologies, cost is the greatest obstacle with regard to producing solar power. I look forward to hearing from our witnesses on how the solar research and information program for the solar industry authorized in the bill would help to support research and promote the adoption of solar power across the Nation. With that, I again thank the Chairman for calling this hearing.

Ms. GIFFORDS. At this time I would like to introduce our fabulous, fabulous panel of witnesses with some Arizona connections, I would also like to point out. I always bring it back to Arizona. We have Mr. Hayden, who is Solar Technology Coordinator for Arizona Public Service Corporation. Mr. Rhone Resch is the President of the Solar Energy Industries Association. Ms. Jane Weissman is the Executive Director of the Interstate Renewable Energy Council and the Vice-Chair of the North American Board of Certified Energy Practitioners. I just have to mention that Ms. Weissman earlier has talked about 1991 at the Westford Look Hotel in Tucson where a lot of this work actually began, so I think that is pretty interesting. We also have Professor Joseph Sarubbi, who is the Chair of the Building Systems Technology Department at Hudson Valley Community College, and Mr. Daniel Arvizu, who is the Director of the Department of Energy's National Renewable Energy Laboratory and originally from Douglas, Arizona. So that is very cool.

So as our witnesses should know, spoken testimony, we would like to try to limit to five minutes after which the Members of the Committee will have five minutes to ask questions, and as far as I know, we are okay on time in terms of votes, so no particular pressure here to speed through this. But let us get going with Mr. Hayden, please.

STATEMENT OF MR. HERBERT T. HAYDEN, SOLAR TECHNOLOGY COORDINATOR, ARIZONA PUBLIC SERVICE COMPANY, PHOENIX, ARIZONA

Mr. HAYDEN. Madam Chairman and Members of the Committee, my name is Herbert T. Hayden. I am the solar technology coordinator for Arizona Public Service Company, APS, in Arizona. Thank you for the opportunity to testify to you today regarding concentrating solar power, or CSP. CSP is a technology of great interest to APS for its potential to provide lower cost and more-reliable solar power in the desert Southwest.

I would like to submit my written comments to you and briefly summarize them now on the main points, which are, number one, the importance of thermal energy storage to the viability of concentrating solar power; number two, the importance of reduction of water use to the viability of concentrating solar; and number three, how a study to integrate concentrating solar power plants with the electric grid can facilitate the commercialization and implementation of large-scale CSP.

APS is the largest and longest serving electric power utility in Arizona, the fastest growing state in the Nation. We are adding customers at three times the national average and electricity demand is growing at four times the national average. To meet this rapid growth in electricity demand, Arizona's electric utilities are investing over $2 billion a year in infrastructure. Plans for the future include conventional generation, new transmission and distribution, and an increased focus on conservation and cost-effective renewable energy resources.

In Arizona, our most abundant renewable resource is sunshine. For the past 15 years, my responsibility has been to work with the solar industry and researchers around the United States and the world to bring lower cost and reliable solar electricity to our customers. From a technology perspective, our primary focus has been on technologies that can be lower cost on a utility scale in the near-term. As early as 1995, the APS STAR Center was a test site for dish Stirling systems and for the advancement of concentrating PV systems, both of which are forms of concentrating solar power. Based on inquiries from companies around the world, it seems clear that our work has helped stimulate the growing interest in concentrating solar power technology.

One of the most successful CSP technologies to date are the solar trough systems that use solar heat to drive turbine engines and generators. For more than a decade, solar trough plants in California have been the largest collection of solar power in the world and they have operated well. CSP is currently the most cost-effective solar technology for large-scale use and has the potential to compete with conventional generation in the near- to mid-term.

Because of this potential, last year APS completed the first solar trough plant in the United States in over 14 years, the one-megawatt APS Saguaro Solar Trough plant near Tucson, Arizona. Our intent of that project was to help reestablish and again advance the U.S. solar trough technology. In short order, the APS plant was followed by a much larger project in Nevada which has benefited from the new solar collector design experience gained in the APS project.

An important attribute of the CSP systems is the ability to incorporate thermal storage into the design to improve the reliability of power output. This is an extremely important feature that many intermittent renewable resources such as PV and wind do not have. All renewables have value for the ability to help reduce the use of fossil fuels but the ability to store the thermal energy for times when it is needed provides for a reliability that does not exist with intermittent resources. This is especially critical to utilities because they have the obligation to provide reliable power at all times. It is commonly considered that solar provides power when it is needed the most, during the daytime. This is largely true but there are fluctuations due to clouds and a rolloff of solar before the late day hours of high power consumption. For example, power consumption in Arizona reaches a peak in the months of July, August and September and the summer heat results in heavy air conditioning loads. During that period, Arizonans use the most energy between 5 and 7 p.m. when they go home, increase the air conditioning and do things for their lives. But unfortunately, the solar resource peaks sometime in the mid-afternoon and tails off significantly as the sun lowers on the horizon. Thermal storage has the potential to bridge the gap between maximum solar generation and peak customer demand by extending the hours of operation sufficiently to cover much of the evening demand.

There has already been some support in the national labs for the development of thermal storage concept and we recognize and appreciate that past support. However, the resources are apparently limited in comparison to the substantial expense of a meaningful development and test plant. Certainly a dedicated research and de-

velopment program on thermal storage could significantly accelerate the use of this promising technology.

Another key area for improvement of CSP is water use. The current design of large CSP plants use water simply for cooling a power plant in the same way that water is used for conventional power plant cooling. Though CSP technology has been successful with its current water cooling approaches, growth in the desert has placed ever-increasing demands on water use and reductions in water use would increase the attractiveness of CSP.

On the third topic relating to CSP of the study of integrating large CSP plants into the regional and national electric grid, it is true that planning for CSP does raise numerous issues including the availability of land, land-use issues such as water and permitting, and increasingly, the availability of transmission facilities and transmission capacity to deliver the energy to load centers from the areas where solar might be developed. Transmission is generally constrained in much of the West and significant new transmission investment is needed in the coming years for all types of generation, renewable or conventional. The Southwestern states and utilities, including APS, are considering the needs and benefits for transmission to ensure a robust grid to meet the needs of the West's rapidly growing population. A federal study of the potential for the integration of CSP into the transmission plans would be timely and supportive of the further commercial implementation of CSP and could help address the same kind of issues that have been encountered in the successful growth of the wind industry.

So finally, we are currently leading a group of southwestern utilities in the exploration of a 250-megawatt CSP plant to be built in the Southwest. In the process, we have run into these issues—transmission, water, et cetera. Also, land on federal land could be considered.

So finally, I would just say that we believe, APS believes that large-scale CSP has very good potential to provide cost-effective energy to the United States. We also believe that the U.S. industries have still been a leader in concentrating technologies and have the opportunity to benefit by that, and finally that CSP can be improved with the additional of thermal storage and with reduction of water use and the proper integration of CSP in the national grid.

Thank you, Madam Chairman and the Members of the Committee for the opportunity to share these observations with you, and I would be available to answer questions if I can. Thank you.

[The prepared statement of Mr. Hayden follows:]

PREPARED STATEMENT OF HERBERT T. HAYDEN

Mr. Chairman, Members of the Committee, it is a pleasure to provide testimony to you regarding 1) the importance of thermal energy storage technology to the viability of concentrating solar power, and 2) how a study to integrate concentrating solar power plants with the electric grid can facilitate the commercialization and implementation of large-scale CSP.

Arizona Public Service Company (APS) is the largest and longest serving electric power utility in Arizona. Arizona is also the fastest growing state in the United States. APS is adding customers at three times the national average and our customers' electricity demand is growing at four times the national average. To meet this rapid growth in electricity demand Arizona's electric utilities are investing over $2 billion a year in infrastructure. Plans for the future include conventional generation, new transmission and distribution and an increased focus on conservation and cost effective renewable energy resources.

In Arizona our most abundant renewable resource is sunshine. And, for the past 15 years, my responsibility has been to work with the solar industry and researchers around the U.S. and the world to bring lower cost and reliable solar electricity to our customers.

APS' first work in the solar technology area was .in 1954 when APS helped organize the first International Solar Energy Exposition in Phoenix, AZ that lead to the formation of the International Solar Energy Society. In the 1970's, APS applied early solar PV technology in remote off-grid telecommunications applications, and since the early 1980's APS has been an active participant in the study and development of solar energy for large scale utility use.

In 1988, the APS Solar Technology Applied Research (STAR) center was developed to support the advancement of solar resources, including field operation of both photovoltaic (PV) and concentrating solar technologies. Our early work at STAR gave APS the expertise and experience to undertake several noteworthy projects including Arizona's first customer-sited PV systems tied to the grid, and Arizona's first utility scale grid-tied solar PV system. APS is proud to provide solar services to the National Park Service and several military bases in Arizona to assist with the use of PV in support of remote off-grid operations. And, we currently have over five MW of PV tracker power plants in operation providing reliable solar energy to our customers.

From a technology development perspective our primary focus has been on large scale solar technologies. As early as 1995, APS STAR center was a test site for the dish Stirling systems, and the advancement of Concentrating PV (CPV) systems. We have more then 10 years experience operating silicon CPV, and three years ago installed the Nation's first grid-tied triple-junction high concentration PV system. Based upon inquiries from companies around the world it seems clear that our CPV work has helped stimulate new interest in CPV technology. And while there is significant CPV work now being undertaken in other countries, it is my belief that the United States remains in the technological lead of this very promising solar technology.

In another very promising technology area, APS has supported the advancement of concentrating solar power (CSP). These technologies are "thermal electric systems" that use solar heat to drive engines and generators. CSP thermal systems include solar trough concentrator systems and central receiver (power tower) systems that use many mirrors to focus light on a central solar collector. CSP also include solar dish Stirling systems and other advanced solar concepts.

The solar trough systems are worth particular note. For more then a decade solar trough systems in California have been the largest collection of solar power in the world, and they have operated well. CSP is also currently the most cost effective solar technology and has the greatest potential to compete economically with conventional generation in the near to mid-term.

Because of this potential, just last year, APS constructed the first solar trough plant in the U.S. in over 14 years. Our intent was to help to re-establish and again advance the U.S. solar trough technology. The plant is the one MW APS Saguaro Solar Trough plant, near Tucson, Arizona.

While not part of the Saguaro design, an important attribute of the solar thermal CSP systems is the ability to incorporate thermal storage techniques into the design to improve the reliability of power output. This is an extremely important feature that many intermittent renewable resources such as PV and wind do not have. While all renewables have value for their ability to help reduce the use of fossil fuels, the ability to store the thermal energy for times when its needed provides a level of reliability that does not exist with intermittent resources. This is especially critical to utilities that have an obligation to provide reliable power at all times.

Common wisdom is that solar technologies produce power when it is needed the most, during the daytime. While this is largely true, there are exceptions that are not obvious such as fluctuations due to clouds and a mismatch to late-day power consumption. This latter exception is the norm for Arizona and most of the desert southwest. In the southwest, power consumption reaches its peak in the months of July, August and September, when the summer heat result in heavy air conditioning loads. The correlation between power consumption and high summer temperatures are a good match for CSP however the correlation is not as perfect as one might expect. In a 24 hour period, Arizonan's use the most energy in the early evening, between 5 and 7 p.m., when they return home from work, turn down the air conditioning, cook dinner, do laundry and generally go about their lives. Unfortunately, solar electricity production, even from CSP, does not match this hourly demand profile very well. Solar electricity production reaches its peak levels sometime in the mid-afternoon and tails off significantly in the early evening as the sun low-

ers on the horizon. Thermal storage has the potential to bridge the gap between maximum generation and peak demand.

Without the availability of solar energy during the peak, utilities must look to other reliable resources like natural gas to meet customer demand. But, thermal storage has the real potential to change utility resource decisions because with storage CSP systems will be able to reliably serve customers when electricity costs are the highest.

There currently exists some support in the national labs for the development of the thermal storage concept, which we recognize and appreciate. However the resources are apparently limited in comparison to the substantial expense of a meaningful development and test plant. Certainly a dedicated research and development program on thermal storage could significantly accelerate the use of this promising technology.

The second topic of discussion relating to CSP is the integration of large CSP plants into the regional and national electric grid. This topic raises numerous issues including availability of land for large scale installation, land-use issues such as water use and permitting and the availability of transmission facilities and transmission capacity to deliver the energy to load centers. The cost, timing and risks associated with each of these factors must also be considered.

One additional aspect of large scale CSP that must be considered is the status of financial incentives. Currently, the 30 percent Investment Tax Credit (ITC) for solar has resulted in projected project costs that are significantly more competitive than any time in the past. But without a long-term extension of the ITC, many large scale CSP projects will never be launch due to the time it takes to address the issues noted in the preceding paragraph. Large scale CSP plants require three to five years from commitment to start up Today, the ITC is set to expire at the end of 2008. The one to two year ITC extensions that have been typical in previous years, will not provide sufficient certainty to enable major CSP development. Long-term extension of the ITC is critical to CSP development.

One critical aspect of the ITC is the fact that it is not available to public utilities. The restriction needlessly narrows application of the credit and is unfair to U.S. citizens because the vast majority purchase power from a public utility, as it is defined by the tax code. Therefore, a utility wishing to plan a large CSP resource would need to assume no ITC, or secure a third-party owner of the plant. This current policy forcing a third-party relationship to take advantage of the ITC creates unnecessary uncertainty and costs to the system. It forces the utility and regional grid to consider the operational and financial risks inherent in any third party relationship thus affecting the utility operating strategies. These risks can certainly be analyzed and managed but create a potential sub-optimum situation when they are the only strategy available.

While there are numerous issues to be addressed, APS is bullish about CSP and is leading a group of southwestern utilities exploring a 250 MW CSP plant in the desert southwest. We have found several constraints to a successful project including the financial factors associated with the end of the ITC in 2008, and the lack of transmission capacity. In fact, transmission is generally constrained in much of the west and significant new transmission investment is needed in the coming years for all types of generation be they renewable or conventional generation. New transmission is being planned throughout the west and in California and Texas specifically to access renewable resources including wind and geothermal. Others states and utilities, including APS, are studying their needs for both intra and interstate transmission to ensure a robust grid to meet the needs of the West's burgeoning population. The studies include the ability to reach those areas of the west with abundant low cost renewable resources.

Answers to the questions about CSP, and indeed renewables in general, are not simple. Intermittent renewable resources such as wind and solar present special economic challenges for transmission investment because they do not efficiently utilize the transmission investment at all times. Wind integration studies have and are being performed. We believe CSP has a significant potential to provide large amounts of renewable energy to the U.S. and that a federal study on transmission for large scale CSP would be beneficial and appropriate.

Finally the issue of locating large scale CSP on federal land should be investigated and analyzed. By its nature, solar technologies require significant geographic footprints. A general rule of thumb for a solar installation is five to 10 acres per megawatt. That means for a single 250 megawatt facility, 1,250 to 2,500 contiguous acres of land would be required. Considering that the Federal Government is the largest land owner in the U.S., a study of federal land in high solar resource areas that may be made available for CSP development would also be beneficial and appropriate.

In summary, APS is proud of its contributions to the advancement of solar technologies including CSP, but more needs to be done. APS believes that large scale CSP has the best potential to provide cost effective solar energy to the U.S. and this potential improves dramatically with the addition of thermal storage. Understanding how these large CSP installations will impact the regional and national grid must be understood. We support federal funding for a CSP integration study. We encourage additional federal attention and support for CSP and welcome the opportunity to continue to work with the U.S. national labs and the solar industry on the further advancement of solar resources into our national energy portfolio.

Thank you Mr. Chairman and the Members of the Committee for the opportunity to share these observations and opinions with you.

BIOGRAPHY FOR HERBERT T. HAYDEN

Since 1993, Herb Hayden has led the development, construction and operation of solar power plants for APS, the largest and longest-serving electric utility in Arizona. Over six Megawatts (MW) of solar generation has been installed to date by APS, including photovoltaic (PV) and advanced concentrator solar power systems (CSP). These CSP systems include Concentrating PV (CPV) and one MW of Concentrating Solar Trough thermal generating systems.

Herb has managed the development of new solar technologies that have placed APS in a leadership role for solar systems of particular promise for utility use. These include larger-scale PV tracking systems using present-day commercial PV panels, and the high concentration PV (CPV) and dish-engine systems that are emerging to address the price and supply limitations of conventional PV products. Much of this work is visible at the APS Solar Test And Research (STAR) center, where new solar technologies are under test in the Arizona environment.

In addition to grid-connected solar, Herb initiated the development of the APS Remote Solar Electric Service. This program provided off-grid solar power services to 50 homes and ranches in Arizona, as well as several unique larger scale "solar hybrid" systems for military, national park and commercial customers in the U.S. southwest and Mexico.

Herb is a PE in Arizona, having received his BSEE with honors from Arizona State University in 1983. Prior to his solar work at APS, Herb performed project management and engineering for APS telecommunications systems, and worked four years at Motorola in the development of advanced electronic systems.

Solar technology participation areas:

- Over six MW of solar generation currently installed and operating
- Development and operation of 500 kW of CPV, in collaboration with Amonix Inc.
- Formation of Concentrating Technologies LLC, developing an advanced new triple-junction CPV product in collaboration with Spectrolab
- First Dish Stirling utility installation in Arizona, in collaboration with SAIC and Stirling Thermal Motors, plus studies of advanced Dish Turbine concepts
- Demonstration of the solar generation of hydrogen using Dish Stirling, and the reversible use of hydrogen to generate electricity using the Stirling engine
- Development of the APS large two-axis tracker system for high concentrating solar (320 m2 per unit tracking area)
- Development of APS Single-Axis horizontal tracker PV system
- Development of APS Single-Axis Tilted Tracker PV system
- The first use, and APS development role in Shingleton single-axis tracker, which later was purchased by Powerlight and sold as their Powertracker
- Formation of FWR LLC, manufacturer of solar tracking control electronics, and data acquisition equipment
- Development of APS Remote Solar Electric Service, providing and maintaining small hybrid PV systems for service to remote homes, ranches and larger scale uses
- Working relationships with NREL, Sandia National Labs, Arizona State University, University of Nevada Las Vegas, Weizmann Institute of Science Solar Institute
- Served as member of DOE Concentrating Solar Power Peer Review Commission, 2002
- Several patents, and several papers on high concentration PV and solar tracking systems, numerous international presentations

Patents:

- Four patents awarded for solar tracking systems and controls
- Four additional patent applications in process

Ms. GIFFORDS. Thank you, Mr. Hayden.
Mr. Resch, please.

STATEMENT OF MR. RHONE RESCH, PRESIDENT, SOLAR ENERGY INDUSTRIES ASSOCIATION

Mr. RESCH. Thank you, Chairman Lampson, Congresswoman Giffords and the Members of the Subcommittee for providing me the opportunity to testify on these important issues this morning.

My name is Rhone Resch. I am President of the Solar Energy Industries Association, a trade group here in Washington that represents over 500 companies and over 20,000 people employed in the U.S. solar energy industry including hundreds of small businesses throughout the United States.

I would like to thank the Committee and its staff for providing true leadership in advancing solar energy in the United States. A key element of leadership is providing the opportunity to empower others to lead and today you seek to empower individual Americans to strengthen our energy independence, to become high-tech workers, adopters and advocates for solar technologies that can help meet America's energy challenges in the 21st century.

With regard to the establishment of a check-off program for solar, I would like to convey three points. First, the high priority—the highest priority for the solar energy industry is the creation of a long-term incentive for solar to help lower costs and provide a clear market signal to manufacturers to actually expand production. Only then will we have a supply to meet the demand of an educated market and only then will a check-off program succeed. Second, solar energy technologies provide significant energy security, environmental, and economic benefits to the American public and must be a significant part of our energy portfolio going forward. And third, the solar industry would greatly benefit from the creation of a federal check-off program just as dozens of other U.S. industries have benefited from these programs.

While solar prices have dropped by 90 percent in the last 25 years, solar is still two to three times as expensive as the national retail electricity rates. Furthermore, the United States has been eclipsed by Germany, Japan and China in the manufacturing and use of solar. Incredibly, Germany installs eight times the amount of solar each year as the United States despite having the same amount of sunlight as Anchorage, Alaska, as you can see from this map here. When you do look at that map, you can see that the United States really does have world-class solar resources in all 50 states. Certainly if you can make solar work well in Germany, you can make it work well in all 50 states in the United States. But Germany enjoys market leadership because its government has enacted long-term incentive policies that have jump-started the installation market. Congress is currently considering legislation to extend the federal solar investment tax credits for homeowners and businesses, H.R. 550, the Securing America's Energy Independence Act. Specifically, these bills will create an eight-year extension in expansion of the ITC for commercial systems and an eight-year ex-

tension in expansion for the residential systems. I want to commend Chairman Gordon, Subcommittee Ranking Member Inglis, Congresswoman Giffords, Congressman Udall, Congressman Baird, Congressman Bartlett, Congressman McCaul for co-sponsoring this important legislation without which a check-off program would not galvanize in the United States. We need to have this policy support in place to make the domestic industry competitive in the global marketplace for solar technologies, and I respectfully request that the Committee reach out to Chairman Rangel of the Ways and Means Committee and ask him to support the provisions in H.R. 550 and the tax title of the energy bill which will be marked up tomorrow.

Solar energy is the Nation's most abundant energy resource and it can greatly improve the U.S.'s ability to have a secure and reliable energy supply. Solar requires no field to operate and our panels are warrantied to last for 20 to 25 years, and you will see a panel being put up here in just a minute, and this is one of the things to point out. Once you install—once you buy and install a solar system on your house, it is like buying a car with all the gas you will need for it for its entire lifetime. Sure, it has most of a cost upfront but it will hedge the consumer against rising energy prices in the future. And on a community scale, solar can help stabilize volatile electricity prices and relieve tight markets for natural gas by reducing demand during midday peak when the most expensive, least efficient generation is used.

Moreover, solar is the cleanest method of electricity generation. Electricity for solar produces no air pollution, no water pollution, no noise pollution, no radiation, no solid waste, has no impact on wildlife, except maybe inconveniencing the squirrels that are running around on your roof, and uses no water for generating electricity, an increasingly important issue for the fast-growing communities of Arizona, Nevada, New Mexico, California and Colorado, as Herb just pointed out.

As we begin to tackle climate change in a real manner, keep in mind that over the 40- to 50-year life of a solar electric system, every kilowatt of solar electric power reduces 217,000 pounds of CO_2.

Finally, as today's hearing demonstrates, there are tremendous economic benefits to be gained form increasing our use of solar energy. Solar photovoltaic creates 32 jobs per megawatt, more than any other form of energy. Solar could provide more than tens of thousands of new jobs in the coming decade in manufacturing, engineering, construction and installation, investing America's energy dollars in America's workers.

If we are to begin harnessing this potential, we must significantly increase consumer education and awareness of solar technologies. While the public strongly supports the increased use of solar, market research shows a broad gap in the understanding that solar electricity operates just like regular electricity and that solar can work anywhere in the United States. Many outdated misconceptions exist that the technology must be overcome in order for consumers' use to increase of solar. As you can see, this is a solar electric panel. Most people still think that solar looks like the technology on Skylab, checkerboard pattern, inefficient use. This is

made by a company in the United States. It looks like a flat-screen TV. It is the most efficient panel made in the world, 22 percent efficient, absolutely gorgeous. I actually put it up on my house last year. It generates about 85 percent of my electricity right here in Washington, D.C. It is very exciting. But consumers lack the information on how to find solar companies and what solar products might be available, and most solar installation companies are small businesses, typically employing no more than a few dozen people and lacking the budget to reduce a broad swath of consumers.

So in short, the solar industry needs to launch a national awareness campaign and numerous other industries have provided us with a blueprint to do so. Congressionally created check-off programs have served as the backbone of many industries' successful promotion campaigns. Mr. Chairman, I am sure we are all familiar with the dairy industry's "Got Milk," the cotton industry's "Cotton, The Fabric Of Our Lives" and the National Pork Board's "Pork, The Other White Meat." But Mr. Chairman, no pork was involved in the creation of these campaigns, at least no Congressional pork. Rather, these industries pooled their resources through a comprehensive program to fund consumer education. A "Got Solar" program, if you will, would provide major benefits to the American public. Consumers would be able to obtain market information on product and company quality and become educated about local and national energy use patterns. Meanwhile, local solar installers would benefit from broad public outreach that they would otherwise be unable to afford and see the resultant growth in their business.

To be clear, consumer awareness is only one major obstacle to the widespread use of solar and a check-off program can only work if we have proper market incentives and market mechanisms in place.

I want to thank the Committee for giving me the opportunity to speak, and I am available to answer any questions that you may have.

[The prepared statement of Mr. Resch follows:]

PREPARED STATEMENT OF RHONE RESCH

Thank you, Mr. Chairman and Members of the Subcommittee, for providing me the opportunity to testify today.

On behalf of over 500 companies and more than 20,000 employees in the U.S. solar energy industry, I would like to express support for the *Solar Energy Research and Advancement Act of 2007,* legislation that would help solar energy to make major strides in contributing to a clean, domestic, renewable supply of electricity that is of, by, and for the American people. SEIA applauds Congresswoman Gabrielle Giffords for her visionary leadership in introducing this bill.

My comments today will focus on the importance of a solar check-off program, or "Got Solar," to the future utilization of solar energy resources in the U.S. Aside from cost, the greatest obstacle to solar reaching a wider domestic market is education and public awareness. With respect to a "Got Solar" program, I would like to convey the following points:

- Greater use of carbon-smart, domestic solar energy would have myriad energy security, economic, and environmental benefits for the American public.
- While the public broadly supports the greater use of solar energy, most Americans do not have a basic understanding of solar technology products or how to purchase them.

- Educating the public on solar energy is primarily the responsibility of the solar industry, but most solar installers are small businesses that lack the means to reach a broader swathe of consumers.
- Building on dozens of U.S. industries' successful examples, Congress should establish a coordinated program of promotion and research, funded by industry at no cost to the government, to increase consumer education about solar energy.
- Finally, a check-off program will only succeed if appropriate incentives are in place, including an eight-year extension of the federal investment tax credits (ITC).

Public Benefits of Solar Energy

The U.S. solar energy industry is growing and providing more carbon-smart, domestic energy every year. Solar energy technologies can provide major energy security, environmental, and economic benefits to the American public, all of which will be realized with broader consumer awareness and adoption of solar.

Energy Security

As Congress looks to increase the use of carbon-smart renewable energy, it is critical that priority be placed on technologies that also improve U.S. energy security. Solar energy, in all of its forms, is a technology that can greatly improve the U.S.'s ability to have a secure and reliable energy supply.

The electricity infrastructure in the U.S. is aging and energy consumers are increasingly subject to outages that affect critical infrastructure and disrupt business. The blackout of August 2003 in the Northeast, triggered by a tree limb landing on power lines, cost consumers and businesses tens of billions of dollars. Unfortunately, this event is not unique and will occur with greater frequency if Congress does not take steps to diversify our energy portfolio.

The good news is that this event could easily have been avoided through greater use of solar energy. A 2004 Department of Energy (DOE) study entitled *Solution to the Summer Blackouts?* concludes that if solar energy had met just one percent of local peak demand, we would have avoided the August 2003 blackout and other local brown-outs. DOE's explanation was simple: high air conditioning loads stressed the grid and created the circumstances for the blackout. This extreme load occurred on one of the hottest and sunniest days during the summer—the exact time when output from solar systems is greatest. DOE also concluded that over reliance on central generating stations led to grid fatigue and failure. This infrastructure vulnerability could have been minimized through greater reliance on distributed solar energy.

Photovoltaic (PV) and solar water heating systems are distributed generation (DG) technologies. Like other DG technologies, they provide energy at the point of consumption rather than at a central power plant hundreds of miles away. As such, DG does not rely on vulnerable regional transmission lines and local distribution networks. By producing energy at the source of consumption, solar power alleviates stress and vulnerability on the grid.

The DOE study also concluded that investing in solar energy is a more economically efficient and cost effective way to improve our energy infrastructure than capital intensive and often community-opposed transmission line upgrades and brand-new transmission lines. In sum, using solar energy is a cost-effective, affordable way to alleviate stress on the electricity grid and improve the overall reliability of our electricity infrastructure.

Solar is also the most reliable source of energy. This reliable track record has resulted in wide deployment of the technology in applications where power interruptions are unacceptable, including: oil and gas industry use of solar energy to power pumps and meters at remote locations; telecommunications industry use of solar to power relay stations and remote equipment; and, every satellite that has been sent out into space in the last 30 years has been powered by solar energy.

Ironically, energy industry acceptance of the technology stands in stark contrast to consumer behavior. Consumers are investing hundreds of millions of dollars in small gasoline-powered generators. During grid failure and electricity outages, electronic gasoline pumps at the gas stations do not operate, rendering many generators idle because of fuel shortage. Solar energy is a technology that can provide reliable power during power outages.

Finally, solar stabilizes volatile energy prices, a critical energy security issue affecting the U.S. today. In the last five years, consumers have seen electricity prices escalate between 20 and 78 percent. At the same time, we have seen the price of natural gas triple and the price of gasoline routinely exceed $3.00 per gallon. Each

year the cost of energy is taking a larger percentage of a family's income than at any other time in U.S. history. This energy inflation vulnerability especially impacts the poor and elderly on fixed incomes.

Solar can help address this vulnerability because it requires no fuel to operate. Although a solar system is more expensive up front, there are no additional costs for operating a system once installed. Furthermore, solar panels are guaranteed for 20–25 years, allowing consumers to "lock in" their electricity prices for decades. Recognizing the upward trend in energy costs, incentivizing the use of a technology that requires no fuel inputs is an important element of any energy security plan.

Energy Independence

Solar energy is a domestic and abundant energy source in the U.S. The U.S. has the best solar resources of any developed country in the world. Proportionally, U.S. solar energy resources exceed those of fossil, nuclear or other renewable energy resources. Despite this tremendous advantage, the U.S. has failed to capture and harness this free and readily available energy. In 2006, solar energy produced just 1/30th of one percent of all electricity in the U.S.; Germany in contrast, with the solar resources of Alaska, installed seven times more solar energy property than the entire U.S.[1]

Figure 2: Germany Insolation

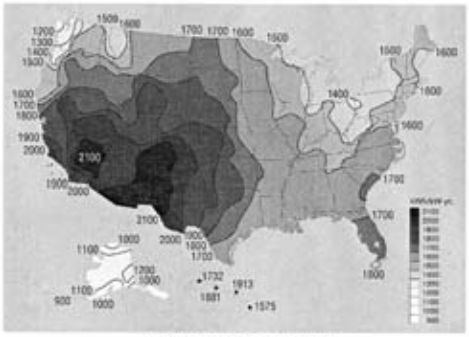


Figure 3: U.S. Insolation

The U.S. is over-dependent on foreign sources of energy. Demand for natural gas continues to rise, primarily for electricity generation. Increasingly we are turning to countries like Algeria to provide us with liquefied natural gas (LNG) to meet our growing demand. According to the Federal Energy Regulatory Commission, 41 new LNG terminals are proposed for construction in U.S. harbors and off U.S. beaches. Constructing these plants will exacerbate our addiction to foreign sources of energy. Our desire for energy independence demands a different course.

Solar energy directly displaces natural gas used for heating homes and water. In a home, solar can directly replace natural gas used to heat radiant systems and can displace up to 70 percent of the natural gas used to generate hot water. Many countries that do not have a domestic source of fossil fuels, including Spain and Israel, mandate that all new homes must have solar water heating systems installed. The U.S. can demonstrate similar energy independence by using market incentives that spur solar investment and market growth.

Solar energy also displaces natural gas used to generate electricity. Almost all intermediate and peaking electricity plants use natural gas as the source of energy. These plants are often very inefficient and produce expensive electricity. Solar energy, which generates electricity from 8 A.M.–7 P.M. daily, can displace these inefficient, high cost power plants, and become a reliable source of firm, dispatchable power. Given the high price of natural gas to key industrial sectors and consumers, the U.S. can no longer afford to neglect its abundant solar resources.

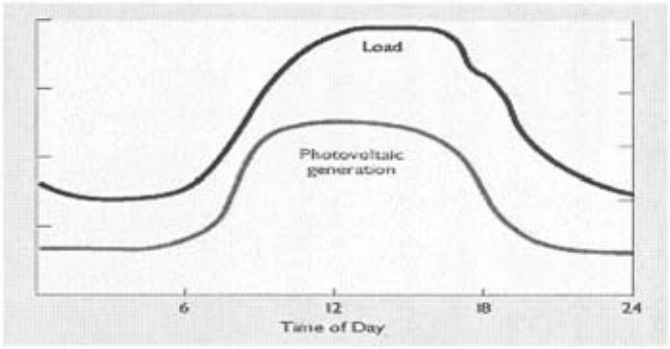
In addition to tempering natural gas demand growth, solar can also generate electricity to be used by plug-in hybrids and electric vehicles, thereby displacing gasoline derived from foreign oil supplies. Imagine a gasoline-free electric vehicle that

[1] Energy Information Administration, Net Generation by Energy Source by Type of Producer, October 2006.

also uses electricity derived from the sun rather than a coal-fired plant. The technology is advancing rapidly in this direction.

Environmental Benefits

Though the environmental benefits of solar energy might be considered a given, it is worth highlighting several points. Solar is the cleanest method of energy generation, in terms of avoided air, waste and noise pollution, energy payback, water conservation, avoided radiation and harm to wildlife, or environmental risk in the event of an accident.



Utility load and PV output versus time of day.

Solar energy produces no greenhouse gases, no acid precipitation or toxic emissions, and no other air pollution of any kind. Over the 40–50 year life of a solar electric system, every kilowatt (kW) of solar electric power reduces 217,000 pounds of carbon dioxide, 1500 pounds of sulfur dioxide, and 830 pounds of nitrogen oxides emissions as compared to electricity produced by conventional generation.[2]

Photovoltaic solar energy generates electricity without use any water. In contrast, fossil fuel and nuclear based electricity generation use substantial amounts of water to run steam turbines. Across the western United States, approximately 40 percent of fresh water withdrawals are used for electric generation.[3] If water-starved communities like Phoenix and Las Vegas are to continue growing, we must place greater emphasis on water-free electricity generating technologies.

Concerns have been raised whether the energy used to produce solar panels is surpassed by the amount of energy generated from the panels. This energy relationship is referred to as the "energy payback period." Currently, the energy payback for PV panels varies from 1–4 years depending on different manufacturing variables. This means that a PV panel with a life expectancy of 40–50 years will generate between 10 and 50 times more energy than was required to create the panel. Despite this superior "energy return on investment," the manufacturing process is still growing more efficient every year as the scale of production increases.[4]

Strong Public Support Exists for Greater Solar Development

Polls consistently reflect that the American public strongly supports the accelerated use of solar technologies. For example, a 2005 poll by the Yale Center of Environmental Law and Policy 2005 found that 90 percent of Americans support building more solar power facilities to help reduce U.S. dependence on energy imports. A Roper Public Affairs poll conducted in May 2007 found that nearly 90 percent of Americans believe home builders should offer solar power as an option for all new homes constructed. And 73 percent of those surveyed in another Roper survey in 2006 said that solar energy technology is more important today than ever in responding to America's energy challenges.

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[2] NREL report, "Distributed Energy Resources for the California Local Government Commission," October 2000.

[3] Sandia National Laboratories, Energy-Water Nexus, *http://www.sandia.gov/news-center/news-releases/2006/environ-waste-mgmt/mapwest.html*

[4] NREL Report No. NREL/FS–520–24619: "Energy Payback: Clean Energy from PV"

In general, Americans would like to see the Federal Government take a more active role in promoting solar development. A February 2006 poll by the Pew Research Center found that 82 percent of respondents favored increasing federal funding for research on wind, solar and hydrogen technology. A March 2006 ABC News/Time/Stanford University poll found that 87 percent favored tax breaks for companies to produce more electricity from water, wind and solar. Note that these policies would require the use of taxpayer funds, unlike a check-off program.

Finally, polling surveys demonstrate that Americans are willing to pay more for solar technologies under certain conditions. An April 2007 study by the *New York Times* and CBS News found that 75 percent of Americans were willing to pay more for solar electricity if it helped reduce global warming. Meanwhile, one-half of respondents in the May 2007 Roper survey said they would spend up to 10 percent more for a solar-equipped house when told that solar homes have a proven higher resale value. A majority of respondents cited the financial and energy savings of a solar system as the main benefit of buying a solar system, indicating that consumers are assessing solar for its potential savings benefits and would support a program that drives down the cost of solar.

Need for Improved Consumer Education About Solar

However, while 87 percent of respondents to the *New York Times*/CBS News poll supported the use of solar to generate electricity, just three percent of respondents said that they used solar to generate heat, hot water, or electricity. That is actually a far higher solar use percentage than amongst the American public at large, but it nevertheless illustrates the gap between broad public support for solar and its *de minimis* use today.

Though growing exponentially and constantly innovating, the U.S. solar industry is still in a nascent period. As mentioned above, solar PV provides less than 1/30th of one percent of the current U.S. electricity supply. Furthermore, PV is primarily a distributed generation technology that is installed on the rooftops of homes and businesses throughout the U.S.—a paradigm shift from the traditional model of centralized electricity generation. Most solar installation companies are small businesses, typically employing no more than a few dozen people, and lacking the budget to reach a broad swathe of consumers.

Thus, even as consumers embrace the idea of solar power, they are usually not fully aware of its capabilities and they have misconceptions about how a solar energy system works in a home. Market reports demonstrate a lack of consumer understanding that solar electricity operates just like regular electricity and is the same kind of electricity that a local utility company provides. 29 percent of respondents to the May 2007 Roper survey were not aware that solar energy can power common electric devices like computers or appliances. A number of common myths persist about modern solar technology, such as the belief that solar will not work in places outside of the Sunbelt or that solar devices require more energy to manufacture than they produce in their lifetime, and these myths often inhibit consumer consideration of solar as a viable energy source.

Furthermore, consumers lack information on how to find solar companies or what solar products might be available. On a daily basis, the most common phone calls to SEIA come from consumers who ask, "Where can I find solar for my home?" The industry has taken a number of steps to centralize this type of information, including the development of a national solar installer directory, Findsolar.com. Individually, several companies have undertaken consumer awareness campaigns that focus on basic technology education. Yet these efforts clearly do not equate to the potential reach of a national consumer awareness campaign.

Benefits of a Solar Check-Off Program

A "Got Solar" program, based on a successful model used by other industries, would address the above concerns by creating an industry-funded national education campaign on the benefits of solar energy. Collectively, the industry would pool its resources through an industry-wide program to fund this educational effort.

SEIA anticipates major benefits both to the consumer and to the industry with the creation of a check-off program. Consumers would increasingly have the information they need to "go solar." As the availability of market information increases, consumers would be better able to conduct due diligence on product and firm quality before purchasing a system. Educated consumers could convince their businesses, local utilities, and public representatives to adopt solar energy and promote its use. And the program would also help to drive down the costs of solar to the consumer over time, creating a market demand signal that would help companies to rapidly increase production for the U.S. market and achieve economies of scale.

The solar industry would also reap the benefits of increased consumer education and focused demand, which would translate into industry growth. A vibrant and well-functioning market system would greatly help to make the domestic industry competitive in the global marketplace for solar energy technologies. The benefits of increased awareness of solar would accrue to a wide group of small-to mid-sized industry players (installers, local integrators, equipment suppliers), many of whom would not be able to afford this type of broad public outreach and education.

Successful Precedents for a Solar Check-Off Program

The "Got Solar" program is based on a very successful model used in other industries to increase consumer awareness of their product. Check-off programs have helped fund the dairy industry's "Got Milk" campaign, the American Egg Board's "Incredible Edible Egg," the America's Cotton Producers and Importers' "Cotton, the Fabric of Our Lives," and the National Pork Board's "Pork, the Other White Meat." In each case, a piece of legislation similar to the "Got Solar" program created a board that collects a small assessment from each of the industry's members.[5] The funds are then directed toward education and public awareness campaigns.

Two examples of well-functioning check-off programs can be found in the oil heating and beef industries. The oil heating industry pushed for passage of the *National Oilheat Research Alliance (NORA) Act of 2000,* which assesses a charge of $.002 per gallon produced on members of the oil heating industry. The program has allowed an otherwise fragmented industry to pool its resources for advertising and also for crucial research and development. NORA uses the funds to help development new oil heating technologies, bringing better products with higher efficiencies to the public.

In another well-known example, the *Beef Promotion and Research Act of 1985* charges cattle producers and importers $1 per head of cattle, with the assessments overseen by the Beef Board and going to fund the National Cattlemen's Beef Association. The program brings in millions of dollars per year to fund public education and advertising campaigns, including the popular "Beef, It's What's for Dinner" campaign. This check-off program has been the backbone of the modern beef industry in the United States.

The beef industry's check-off program has undergone close economic analysis since it was established. The most recent report, by Dr. Ron Ward of the University of Florida, studying the check-off program from 2000–2004, showed the program to be an exceptionally good method of growing an industry's market. The study found that for every dollar invested in the check-off program, there was an industry return of $5.[6]

Need for Legislative Authority

For a solar check-off program to be effective, it must be established through the legislative process. Historically, industries have organized voluntary check-offs, but they account for only a small share of all funding for generic efforts. Hundreds of mandatory farm commodity promotion programs have been legislated by states or the Federal Government. Nine out of ten U.S. farmers were contributing to one or more of these efforts by the mid-1990s.[7]

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[5] Examples of statutes establishing check-off programs include: *National Oilheat Research Alliance Act,* 42 U.S.C. §§ 6201; *Commodity Promotion, Research, and Information Act,* 7 U.S.C. §§ 7401; 7411–7425; *Cotton Research and Promotion Act,* 7 U.S.C. §§ 2102–2118; *Potato Research and Consumer Information Act,* 7 U.S.C. §§ 2611–2627; *Egg Research and Consumer Information Act,* 7 U.S.C. §§ 2701–2718; *Beef Research and Information Act,* 7 U.S.C. §§ 2901–2911; *Wheat and Wheat Foods Research and Nutrition Education Act,* 7 U.S.C. §§ 3401–3417; *Floral Research and Consumer Information Act,* 7 U.S.C. §§ 4301–4319; *Dairy Production Stabilization Act,* 7 U.S.C. §§ 4501–4538; *Honey Research, Promotion, and Consumer Information Act,* 7 U.S.C. §§ 4601–4613; *Pork Promotion, Research, and Consumer Information Act,* 7 U.S.C. §§ 4801–4819; *Watermelon Research and Promotion Act,* 7 U.S.C. §§ 4901–4916; *Pecan Promotion and Research Act,* 7 U.S.C. §§ 6001–6013; *Mushroom Promotion, Research, and Consumer Information Act,* 7 U.S.C. §§ 6101–6112; *Lime Research, Promotion, and Consumer Information Act,* 7 U.S.C. §§ 6201–6212; *Soybean Promotion, Research, and Consumer Information Act,* 7 U.S.C. §§ 6301–6311; *Fluid Milk Promotion Act,* 7 U.S.C. §§ 6401–6417; *Fresh Cut Flowers and Fresh Cut Greens Promotion and Information Act,* 7 U.S.C. §§ 6801–6814; *Sheep Promotion, Research, and Information Act,* 7 U.S.C. §§ 7101–7111; *Canola and Rapeseed Research, Promotion, and Consumer Information Act,* 7 U.S.C. §§ 7441–7452; *National Kiwifruit Research, Promotion, and Consumer Information Act,* 7 U.S.C. §§ 7461–7473; *Popcorn Promotion, Research, and Consumer Information Act,* 7 U.S.C. §§ 7481–7491; *Hass Avocado Promotion, Research, and Information Act,* 7 U.S.C. §§ 7801–7813.

[6] Dr. Ronald W. Ward, "Beef Demand and the Rate-of-Return to the U.S. Beef Checkoff," September 2004, *http://www.beefboard.org/uDocs/wardstudy-2004.pdf*; Agricultural Marketing Service of the Department of Agriculture, *http://www.ams.usda.gov/lsg/mpb/beef/beefchk.htm*

[7] Armbruster, Walter J., and John P. Nichols. *Commodity Promotion Policy.* 1995 Farm Bill

The adoption of a check-off program would ensure that all companies, both domestic and foreign, participate in a campaign to educate consumers on solar energy technologies. Authority to collect assessments is facilitated by the government for the practicalities of dealing in interstate commerce and the realities of enforcement to eliminate the problem of "free riders," or nonpaying companies that might otherwise benefit economically from programs that others have funded.

The establishment of legislative authority would help ensure that a solar check-off program would succeed. Though it may be viewed as an industry-imposed "tax," it is a tax that is established by the industry, with the blessing of members of the industry, and for the benefit of the industry. Thus, the industry would have the power to periodically evaluate the effectiveness of the program, with a focus on its economic benefits to industry members.

Comments on the Solar ERA Proposal

SEIA requests a few key modifications to the proposed check-off program in the *Solar ERA Act.* First, current language would exclude SEIA from nominating its member companies to the Board of the new organization, and SEIA would not be able to have a representative participate on the Board. As the national trade association representing the industry, SEIA would appropriately play a significant role in a national industry consumer awareness and education campaign. Therefore, we request that the criteria for eligible groups be modified to provide SEIA with the opportunity to nominate candidates and directly participate in Board activities.

Second, while we support a scheduled industry referendum on the continuation of the program, we believe that the current 22-month target date does not provide enough time for the creation of a new organizational infrastructure and the development, testing, and execution of a national campaign. We request that the target date be set no earlier than four years from the passage of legislation. Additionally, we believe that the current 10 percent threshold of companies needed to request future referenda is too low and could potentially derail the program from being effective, and we propose that the threshold be raised to a minimum of 25 percent.

Conclusion

A "Got Solar" program would be a sound investment in our country's energy future. By providing a mechanism to increase consumer awareness about solar energy products, we can empower the American consumer to become part of the solution to the energy challenges we face as a society. A check-off program would see more of our energy purchasing dollars go towards an economically vibrant domestic manufacturing and installation base, and promote a carbon-smart, domestically produced energy source from the most abundant source on the planet—the sun.

Thank you very much for your consideration of my testimony. I look forward to answering any questions you may have.

BIOGRAPHY FOR RHONE RESCH

Rhone Resch is the President of the Solar Energy Industries Association (SEIA), the national trade association of the solar energy industry. In this capacity he is responsible for managing all aspects of the trade association and ensuring their success in advancing solar energy in the U.S.

SEIA represents all solar technologies and serves as the voice of solar energy in the United States and is responsible for all market analysis and lobbying on behalf of the solar industry with Congress and the Administration. SEIA's recent successes include the creation of the residential and commercial tax credits in the 2005 *Energy Policy Act* and an expansion of the Department of Energy's solar program budget from $84 million to $175 million. SEIA also orchestrates public campaigns working with the media to help shape public support for solar energy.

Mr. Resch has over 15 years of experience in clean energy and energy efficiency, both in the private sector and the Federal Government. Prior to coming to SEIA, he was Senior Vice President of the Natural Gas Supply Association, a trade association that represents both major and independent companies that produce and market natural gas.

In addition he has served as Program Manager at the EPA's Climate Protection Division in the Office of Air and Radiation, where he developed and implemented energy efficiency programs to reduce greenhouse gas emissions and hazardous air pollutants from the petroleum industry.

He also sits on the boards of the Business Council for Sustainable Energy, the Global PV Solar Energy Council, and is Chairman of the Western Governors Association Solar Energy Task Force.

He holds an MPA in Management from Syracuse University's Maxwell School, a Master of Environmental Engineering from SUNY Syracuse, and a B.A. from the University of Michigan. He lives in Washington, D.C. with his wife Lisa and two children and has a six kW photovoltaic system on his home.

Ms. GIFFORDS. Thank you.

Ms. Weissman, please.

STATEMENT OF MS. JANE M. WEISSMAN, EXECUTIVE DIRECTOR, INTERSTATE RENEWABLE ENERGY COUNCIL; VICE CHAIR, NORTH AMERICAN BOARD OF CERTIFIED ENERGY PRACTITIONERS

Ms. WEISSMAN. Madam Chairman, Chairman Lampson, Members of the Committee and staff, I am very encouraged to be here this morning and I really thank you for the opportunity.

This is a perfect time to be talking about training and building a confident and strong workforce for solar energy. Solar electric installations grew by over 40 percent in 2006. If we meet the goals of the photovoltaic industry roadmap, direct employment will increase from 20,000 now to 62,000 in 2015. By the U.S. Department of Energy's own estimates, as many as 5,000 trained installers may be needed to accomplish their new Solar America Initiative. Many recent and well-documented reports and research show continued and robust investment and growth for the solar energy market, but as the market grows, so does the need for quality and accessible training opportunities for these new green collar jobs.

The good news is that the framework is in place to give us the tools we need to develop a strong workforce. NABCEP, the North American Board of Certified Energy Practitioners, offers professional credentials for renewable energy installers. Since 2003, NABCEP has certified 365 solar electric installers from 40 states. NABCEP certifications are based on strict psychometric guidelines and credentialing principles. The process is rigorous for the applicant and requires documenting experience and passing a four-hour exam. NABCEP's competency standard sends a clear message to consumers and public officials that the industry stresses safe and ethical business practices and high-quality workmanship standards. The bar has been raised for professional services in the solar industry.

While NABCEP certifies the installer, IREC, the Interstate Renewable Energy Council, accredits the training programs and certifies the instructors. Credentials are awarded using standards developed by the Institute for Sustainable Power. These standards ensure legitimacy of what is being taught and by whom. A system of review and audit provides a means to compare content, quality and resources across a broad range of training.

We see promising trends for new practitioner programs. Community colleges, as my colleague, Joe Sarubbi, will talk about, and technical schools are offering renewable energy courses. These range from stand-alone courses, new energy certificates and associate degree programs. Classes are expanding from three- to five-day workshops to semester-long courses.

The Committee asked me three questions. Question number 1: Is there a sufficient number of people trained? As market performance continues to grow, the number of current training opportuni-

ties falls far short of meeting the demand for qualified workers. We need more classroom and hands-on training tailored to meet local labor needs. Alliances need to be developed and advisory committees established between training centers and local business. The curriculum needs to include real-world preparation with field and on-the-roof internships.

Question 2: Are such programs necessary or useful? The current training programs are a start at providing a critical service that supports a strong and growing solar industry. However, their reach is limited and training opportunities need to be broadened. We must make sure that training programs are teaching students the right skills to do a good job, that the facilities include the right equipment and hardware, that safe practices are utilized and that teachers are qualified. While many states support workshops and training programs, New York provides a national model for us. Installer training is a top priority for NYSERDA, the New York State Energy Research and Development Authority. To date, NYSERDA has invested nearly $1 million to develop seven accredited solar training centers across the state. NYSERDA's program is one to emulate and replicate as it serves as a proven model for future training programs.

Question 3: How can the quality of training programs be ensured? Training needs to be based on industry standards so that students are taught the right skills with the right equipment. We recommend the following. Training should lead to defined workplace knowledge, skills and abilities. Training should address issues of safety, codes and core competencies of an industry-approved task or job analysis. Training should be in an environment with appropriate facilities, tools and safe practices. Training should offer a formal and planned learning structure where the learner receives some sort of feedback and their progress is monitored and training programs and learning objectives should be assessed and receive independent approval or accreditation.

We have the foundation in place for training and developing a strong workforce. NABCEP's third-party certification programs are a means for consumers to identify qualified workers. NABCEP has set industry standards high. Now we need to provide the training to meet these standards.

Madam Chair, I thank you for this opportunity. Members of the Committee, thank you, and I would be happy to answer any questions.

[The prepared statement of Ms. Weissman follows:]

PREPARED STATEMENT OF JANE M. WEISSMAN

Mr. Chairman, Representative Giffords, and Members of the Committee, thank you for the opportunity to appear before you today to discuss education and training programs to facilitate the adoption of solar energy technology.

I am the Executive Director of the Interstate Renewable Energy Council, a non profit organization working with state agencies, communities and industry across the country. Along with technical assistance, targeted outreach, promoting uniform guidelines and standards, and consumer protection, we focus on some of the current and often difficult issues facing expanded renewable energy use such as connecting small-scale renewables to the utility grid and developing quality assessment programs for renewable energy professionals, products and training programs. The Interstate Renewable Energy Council offers third-party verification of training programs and instructors using an application and audit assessment process based on standards developed by the Institute for Sustainable Power which is used inter-

nationally. This framework of standards and metrics verify that training programs and instructors have met predetermined and consistent criteria. The Interstate Renewable Energy Council is celebrating its 25th anniversary this year.

I also serve as the Vice Chair of the North American Board of Certified Energy Practitioners, NABCEP, a national, non profit corporation offering professional credentials for renewable energy installers. NABCEP was started in 2002 with the first certification program for solar electric installers launched in 2003. To date, there are 365 certified solar electric installers from 40 states. Both the photovoltaic and solar thermal programs are based on strict, psychometric principles and credentialing guidelines. It is a rigorous process requiring documentation of experience and/or training and the passing of a four-hour exam. NABCEP's competency standards for certification sends a clear message to consumers and public officials that the Industry stresses high quality, safe and ethical business practices and workmanship standards. The bar has been raised for professional services for the solar industry.

This is a perfect time to be talking about training and building a competent and strong workforce.

The solar industry reports that solar electric installations grew by over 20 percent in 2006. If the goals of the Photovoltaic Industry Road Map are met, total installed capacity could increase to 9,600 MW by 2015. Direct employment would increase from 20,000 now to 62,000 by 2015.[1]

The U.S. Department of Energy estimates that as many as 5,000 trained installers may be needed by 2015 to accomplish their new Solar America Initiative.[2]

A survey conducted by the investment bank Jefferies & Company in February 2007 said that among renewable energy sources, solar power is viewed as likely to contribute most to the world's primary energy supplies by 2020.[3]

According to a report released in March 2007 by Clean Edge, global clean-energy markets are ready to quadruple in the next decade, growing from $55.4 billion in revenues in 2006 to more than $226.5 billion by 2016 for four technologies—biofuels, wind power, solar photovoltaics and the fuel cell and distributed hydrogen market.[4]

Add to these facts and market-based predictions rising retail electric grid prices, volatile pump prices, climate change, the increasing value of energy independence, and new and expanded state and federal policies. All of these influences are resulting in new "green-collar" jobs.

Training Trends

Over the years, the renewable energy industry has been fortunate to have a number of training centers—the Florida Solar Energy Center, Solar Energy International, the Midwest Renewable Energy Association, the North Carolina Solar Center and the Great Lakes Renewable Energy Association. These dedicated programs have provided us with experienced instructors and well-trained students. But as the market grows, so does the need for quality and accessible training opportunities.

We are starting to see encouraging trends.[5]

- More and more Community Colleges and Technical Schools (high schools and private) are offering Renewable Energy Courses. These range from standalone courses, new energy certificates, associate degree programs, and customized training for business and industry.
- Classes are expanding from three- to five-day workshops to semester-long courses.
- Students range anywhere from 18–45 years of age. They may be existing college students in energy programs, other technology disciplines, existing trades people, those looking at changing careers or those who are currently working in the industry and are upgrading their skills and knowledge.
- Some Community Colleges are incorporating renewable and alternative energy technology into existing trade programs such as construction, electrical, Heating, Ventilation & Air Conditioning, and industrial maintenance trades programs.

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[1] Our Solar Power Future. PV Energy Road Map. *www.seia.org*

[2] DOE Solar America Initiative (SAI) Funding Opportunity Announcement, October 11, 2006. The goal of the SAI is to reduce the cost of solar photovoltaic technologies so that they become cost-competitive by 2015.

[3] March 7, 2007. *RenewableEnergyAccess.com*

[4] *Clean Energy Trends 2007.* Authors: Joel Makower, Ron Pernick and Clint Wilder, Clean Edge.

[5] *Trends in Practitioner Training for the Renewable Energy Trades.* Weissman, J.M. and Laflin, K. Proceedings American Solar Energy Society Conference, July 2006, Denver, CO.

In Eugene, Oregon, Lane Community College Energy Management Program offers a degree and certificate program with a concentration for Renewable Energy Technicians.[6]

Cape Cod Community College Construction Technology program was recently relocated under the umbrella of the Environmental/Renewable Energy Program. All of the Renewable Energy and Energy Efficiency courses will be electives for the Construction Tech program.

The curriculum at two technical high schools on Cape Cod in Massachusetts has been developed so that renewable energy is integrated into existing shops and academic areas with articulations at Cape Cod Community College.

In January 2006, Austin Community College and the Texas State Energy Conservation Office advertised the offering of a 48-hour, 14-week course in solar electricity. The class at Austin Community College sold out two weeks ahead of the official start date prompting Austin Community College to offer a second section for the 2006 winter semester.

In November 2005, Hudson Valley Community College in Troy, New York opened its photovoltaic laboratory providing students hands-on experience installing photovoltaic systems. The courses are included in the college's Electrical Construction and Maintenance program curriculum.

Madison Area Technical College's Consortium for Education in Renewable Energy Technology is a partnership among multiple institutions to share instructional resources and expertise. The curriculum is designed to supplement traditional degree and apprenticeship programs and serve the needs of workers and employers.

The Renewable Energy Diploma Series at North Carolina State University is structured so that intensive technology training covers not only the technical aspects but also the policy and business parts of the industry.

Through internship programs, students are gaining in-field, on-the-roof installation experiences in New York through the state and industry mentor/student program. The program is administered by the New York Solar Energy Industry Association and supported by the New York State Energy Research and Development Authority (NYSERDA).

And the National Joint Apprenticeship & Training Program, the training arm for the IBEW, offers its members and local unions quality training in photovoltaics. In fact, they just published a text book on Photovoltaic Systems, which is an important contribution to training around the country.

Question 1. Is there sufficient number of people trained and if not, is there a sufficient number of training programs?

If market past performance continues and current projections are realized, these emerging training opportunities fall far short of expected demand for qualified workers. The Solar Energy Industries Association predicts that direct employment could increase from 20,000 now to 62,000 by 2015. The U.S. Department of Energy estimates that 5,000 trained installers could be needed to meet their goals. To date, we have just 365 certified solar electric installers and 40 certified solar thermal installers. While there are more installers who have not become NABCEP-certified, and while some of them hold licenses providing evidence of competency, there is still a growing demand for trained and qualified workers.

And, even though we are seeing more Community Colleges and other educational providers offer training programs and even with distance learning and web-based instructional opportunities, we need more classroom and hands-on training tailored to meet local labor needs. We need to see alliances developed and advisory committees established between training centers and local business and industry. Curriculum needs to include real-world preparation for solar installers with field and laboratory experiences provided.

Question 2. Are such programs necessary or useful for prospective solar panel installers and consumers?

The programs described above are providing a critical service to support a strong and growing solar industry. However, their reach is limited and training opportunities need to be broadened.

As part of the Solar America Initiative (SAI), the DOE Solar Energy Technologies Program is analyzing the current situation to identify needs for the training and certification of photovoltaic system designers and installers. A task force has been convened to study and report on these issues.

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[6] *Workforce Education for Renewable Energy: Lessons Learned from a National Gathering of Educators.* Weissman, J.M., Ferranti, A. and Laflin, K. Proceedings American Solar Energy Society Conference, July 2007, Cleveland, OH.

As training programs are offered by a variety of educational providers, how do potential students know that they will be taught the skills and knowledge they will need to do a good job? Do the facilities include the right equipment and hardware for training? Are there procedures that ensure safety and safe practices? Are the programs managed in a fiscally responsible way? Are the teachers qualified? These are some of the questions that come to mind as more courses are offered and enrollment increases.

While many states support workshops and training programs, New York provides a national model. Installer training is a top priority for the New York State Energy Research and Development Authority. NYSERDA is supporting the development of an in-state network of training programs to provide accessible and quality instructional opportunities for those already in the renewable energy trades or for those who are planning to enter the profession. To date, NYSERDA has invested nearly $1,000,000 in developing seven accredited solar training centers and continuing education programs across the state, partnering with SUNY Delhi, SUNY Farmingdale, the Ulster County Board of Cooperative Educational Services (BOCES), Alfred University, Hudson Valley Community College, the City University of New York and local Joint Apprenticeship & Training Committees/IBEW.

The NYSERDA program is one to emulate and replicate as it serves as a proven model for future training programs.

Question 3. How can the quality of training programs be ensured?

Training needs to be based on industry standards so that students are taught the right skills with the right equipment.

The Interstate Renewable Energy Council, with input from industry and education subject matter experts, recommends the following guidelines for practitioner training:

- Training should be designed to provide educational, training, and skill development experiences that lead to defined workplace knowledge, skills, and abilities.
- Training should appropriately addresses issues of safety, codes, and core competencies of an industry-approved task or job analysis.
- Training should be taught in an atmosphere with appropriate facilities, tools, safe practices as well as administrative and managerial quality.
- Training should offer a formal and planned learning structure where the learner receives some sort of feedback and the learner's progress is monitored.
- Training should be taught under the administration of a legally registered entity.
- Training programs and learning objectives should be assessed and receive independent approval or accreditation.

Closing Remarks

The foundation is in place for training and developing a strong workforce. NABCEP's third-party verification and certification programs result in a means for consumers to identify qualified installers and encourage the development of a well-qualified workforce. NABCEP has set industry standards high. . .now we need to provide the training to meet these standards.

Mr. Chairman, Representative Giffords and Members of the Committee, this concludes my prepared statement. I would be happy to take any questions.

BIOGRAPHY FOR JANE M. WEISSMAN

POSITIONS

- **Executive Director, Interstate Renewable Energy Council (IREC). 1994–Present**

  Responsible for all policy directions, operations, and management for this non-profit, membership organization. Developed the strategic route that resulted in national recognition of the Council for its education, procurement, and market-based programs. Collaborate with the U.S. Department of Energy, National Laboratories, state energy offices, other state and municipal offices, community groups, industry, and national organizations to promote the procurement and use of renewable energy resources. Developed expertise in quality assessment through the development of certification and accreditation programs.

- **National Director, Photovoltaics for You Program. 1991–1994**
  Directed this national commercialization initiative. Worked with utilities, regulators, government, consumer advocacy groups, and the photovoltaic industry.
- **Executive Director of the Massachusetts Photovoltaic Center of Excellence. Commonwealth of Massachusetts. 1985–1991.**
  Directed this multi-million dollar solar electric high-tech, public/private initiative. Responsible for all policy, marketing, operations, and program development.

EDUCATION

- Harvard University, John F. Kennedy School of Government, Program for Senior Executives of the Commonwealth of Massachusetts, 1989.
- Suffolk University, Business and Public Administration Graduate Courses, 1974.
- B.A. Hood College, Frederick, Maryland. 1970.
- ANSI Standards Training Course: Requirements of the ISO/IEC 17024
- ANSI Standards Training Course: Standards Development Process

PUBLICATIONS

- Jane M. Weissman (IREC), Kirk Laflin (PETE). *Trends in Practitioner Training for the Renewable Energy Trades.* Proceedings at the ASES Solar 2006 Conference. July 2006.
- Jane M. Weissman (IREC). *Defining the Workforce Development Framework & Labor Market Needs for the Renewable Energy Industries.* Proceedings at the ASES Solar 2004 Conference. July 2004.
- Ward Bower (SNL), Jane Weissman (IREC), Wendy Parker (ISP). *Certification Programs for the Photovoltaic Industry—Status and Plans.* February 2003.
- Barbara Martin (FSEC), Jane M. Weissman (IREC), Mark Fitzgerald (ISP). *A National Program for Certifying Solar Electric Practitioners.* Proceedings at the 8th International Symposium on Renewable Energy Education. August 2002.
- Wendy Parker (ISP), Ward Bower (SNL), Jane Weissman (IREC). *Costs and Benefits of Practitioner Certification or Licensure for the Solar Industry.* Proceedings of the IEEE 29th PV Specialist Conference, New Orleans, LA, May, 2002.

AFFILIATIONS

- Board Member & Vice Chair, North American Board of Certified Energy Practitioners. 2001–Present
- Board Member, Solar Rating and Certification Corporation. 2005–Present.
- Elected as a Fellow of the American Solar Energy Society. 2004.
- Board Member & Secretary, Institute for Sustainable Power. 2004–Present.
- Member, *Solar Today Magazine* Advisory Council. Present.

Ms. GIFFORDS. Thank you.
Mr. Sarubbi, please.

STATEMENT OF MR. JOSEPH T. SARUBBI, PROFESSOR/DEPARTMENT CHAIR, BUILDING SYSTEMS TECHNOLOGY DEPARTMENT, HUDSON VALLEY COMMUNITY COLLEGE

Mr. SARUBBI. Thank you. Madam Chair, Members of the Committee, it is certainly an honor and a pleasure for me to appear before you today to discuss the value of training programs for the installation and maintenance of photovoltaic systems. I truly believe the timing is right for our country to invest in renewable energy technologies. We are witnessing a renaissance in thinking about

the way we generate and use energy in America and solar power is a key component of this new mindset.

As we continue to embrace solar power, we need a well-training workforce to be responsive to this fast-growing industry to ensure success and our country has the educational infrastructure at the post-secondary level capable of creating a skilled workforce in photovoltaic installation and maintenance.

At the forefront of this training are community colleges. With the right resources, I have witnessed firsthand the ability of community colleges to quickly take action and develop credit and non-credit courses, certificate programs as well as associate's degrees to develop a skilled workforce in myriad occupations. Hudson Valley Community College can certainly be viewed as a case study for developing a successful solar energy training program. We have gained national and international recognition for our PV installers programs and our training facilities. Our success was based on three variables. First, a government agency such as the New York State Research and Development Authority, who provided the funding stream through grant opportunities as well as tremendous guidance to help ensure success along with other organizations such as the Interstate Renewable Energy Council and the North American Board of Certified Energy Practitioners, who are guiding us toward accreditation. The second variable is collaborating with the local certified PV companies with the expertise to recommend the best equipment for training, advice on curriculum and on-the-job training for our students, and third, well-trained faculty to deliver high-quality education.

Now, we weren't sure what was going to happen when we started this process but to steal the baseball analogy, build it and they will come, certainly held true for our solar training programs. Once the word got out, interest came quickly and is growing fast in many ways. From PV companies expressing interest in hiring our students, from individuals interested in gaining the solar training, from homeowners seeking information about having solar systems installed, and from other schools interested in learning from our success, there has been tremendous synergy surrounding the development of our solar training program, so much so that Hudson Valley Community College hosted the first-ever national conference for educators and trainers on renewable energy training and energy efficiency workforce education, and that happened last November with educators and school administrators from other 30 states and six countries. We had somebody come from Australia who was interested in seeing what we were doing. It was tremendously successful and we are hosting a second conference in March 2008, and I share that because great things have come out of us starting a training program in the solar industry. Members of the community now have another career path. Solar companies are happy because they can expand their services as more and more homeowners clamor for solar power, all leading to job growth and economic development. Furthermore, our success has opened the door to develop wonderful partnerships with local solar installation companies as well as large solar manufacturing companies such as Sun Power, who uses our facilities for training, and they are a Cali-

fornia-based company and they come to Troy, New York, to utilize our facilities.

In closing, I can't emphasize enough the importance of solar—you know, certified solar training programs in ensuring the continued growth of the solar industry. It is a critical cog in the wheel of success. Without sound training programs, that wheel might keep rolling for a while but it will break down. I ask the Members of this Committee to please consider supporting this exciting bill and thank you for giving me the opportunity to present my thoughts on this, and I will certainly entertain questions afterwards.

[The prepared statement of Mr. Sarubbi follows:]

PREPARED STATEMENT OF JOSEPH T. SARUBBI

Mr. Chairman, Members of the Committee, it's an honor and a pleasure for me to appear before you today to discuss the value of training programs for the installation and maintenance of photovoltaic systems.

The timing is right for our country to invest in renewable energy technologies and develop a workforce that will meet the demands of the ever-growing solar energy industry. We are witnessing a renaissance in thinking about the way we generate and use energy in America and solar power is a key component of this new mindset. In fact, there is a real grassroots effort to increase the use of "green" energy technology and its time for a national policy to keep this momentum. Moreover, our country has the educational infrastructure at the post-secondary level to respond to the challenges of creating a skilled workforce in photovoltaic (PV) installation. What we need is a comprehensive national plan for training that will help spur further development and interest in solar energy.

At the forefront of training a workforce to meet the needs of this emerging industry are community colleges. While most four-year institutions gain notoriety for research and development, it's community colleges that are, and will continue to be, responsive to national, state and local initiatives that drive the development of training programs. With the right resources, I've witnessed first-hand the ability of community colleges to quickly take action and develop credit and non-credit courses, certificate programs, and new associate's degrees that act as a catalyst for economic growth by providing skilled workforces. For example, Hudson Valley Community College is a comprehensive institution that serves the greater Capital Region of upstate New York. With more than 70 degree and certificate programs and more than 12,000 students, Hudson Valley Community College has positioned itself as a true partner with businesses and government agencies in the region and across the state. The college has received national and international recognition for its world-class technologies programs, and its photovoltaic training program is no exception.

At the forefront of the college's success with solar energy training, are the partnerships forged with government agencies such as the New York State Research and Development Authority (NYSERDA), which offers numerous grant opportunities in renewable energy technology training. In fact, NYSERDA's funding program for the development of photovoltaic installers was the catalyst and mechanism that allowed Hudson Valley Community College to invest in PV training. By reaching out to local PV Companies, Hudson Valley Community College was able to tap into experts in the field who are Certified PV installers as recognized by the North American Board of Certified Energy Practitioners (NABCEP). With their help, as well as assistance from NYSERDA, Hudson Valley Community College was able to create, in a rather short period of time, a nationally recognized facility to train PV installers (see exhibits 1–3). The college developed credited PV courses to augment its Electrical Construction and Maintenance Associate's Degree program, as well as a State University of New York (SUNY) approved Photovoltaic Installers Certificate Program. In addition, through the college's Workforce Development Institute, numerous non-credit PV installer training programs have been developed and are offered on an on-going basis.

Demand for Solar Energy Training

This collaborative effort between government, education and business has generated significant interest and demand throughout New York State and the entire northeast. The perfect analogy to this venture: "build it and they will come" could not be anymore true. The college was cautious in its approach to the number of skilled PV workers it planned on training, not yet understanding the market demands. Today, it's safe to say that the college underestimated the public interest

and PV company needs as the solar industry has witnessed exponential growth in the number of installations of the past few years. For example, in 2003, NYSERDA received 80 applications for funding assistance of solar installations. By 2006 that number grew to 286 applications, and 2007 is on pace to well exceed 400 applications (source: NYSERDA). Other agencies such as Long Island Power Authority observed similar growth. Ever since Hudson Valley Community College began to showcase its photovoltaic program and corresponding facilities, interest has grown at the same rate. I receive inquiries from individuals seeking to obtain photovoltaic skills via e-mail and phone on a regular basis. During the past year, five (5) companies from throughout the region have inquired about the availability of PV students for employment. One local certified photovoltaic installation company started its business in 2004 and had $80,000 in sales. In 2005 the company increased its sales revenue to $300,000 and by the end of 2006 it reached $1.2 million. This same company has a sales revenue projection for 2007 that will exceed $2.4 million. Another PV company stated that they need to hire three (3) installers for every $1 million increase in PV sales procured. Hudson Valley Community College is witnessing this growth first hand and is positioning itself to meet the increase demand for installers.

Students Finding Jobs in the Solar Industry

As I stated earlier, Hudson Valley Community College was originally unsure of the potential growth of the photovoltaic industry and decided to move cautiously towards training a workforce that exceeded demand. Our strategy was to supplement an already popular and successful Electrical Construction and Maintenance associate's degree program by introducing photovoltaic courses as an additional load to students' schedules. The college limited the number of students who could enter the "PV Program" to eight to 12 students a year. The college just completed its second year of training. Of the eighteen (18) students who completed the PV program four (4) chose to immediately enter the PV field while the others sought employment with the myriad opportunities in the electrical industry that each student is afforded upon graduation, such as electricians, electronic technicians, electric line workers, electrical estimators, assistant project designers, etc. This spring, one particular PV company alone sought to hire four installers and two designers, but they inquired too late to capture a good portion of our electrical students who had the PV installation skills, as many already secured employment in other areas. The college is starting its PV Installers Certificate program this fall and is currently accepting applications of students for the one-year program. This certificate program, coupled with our Workforce Development Institute non-credit PV training programs, should help reduce the current shortage of trained PV installers.

Involvement of Local Business and the State of New York in Building Curriculum

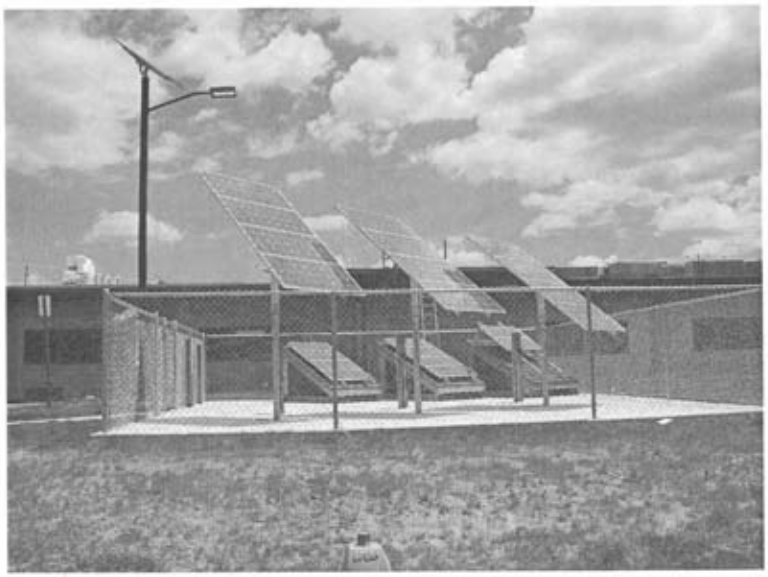
The success of Hudson Valley Community College's PV training programs and the development of its photovoltaic laboratory wouldn't be possible without the funding initiatives and guidance provided by NYSERDA, as well as the expertise offered by local PV companies. Both were instrumental and paramount to the advancement of a first-class training program. In addition to the excellent laboratory facilities, which were funded through a NYSERDA grant, our partnership with a local PV company created the opportunity for students to work out in the field on actual residential installations thereby augmenting their training skills (see exhibits 4 & 5). Such a relationship has helped ensure that our students enjoy high passage rates for the North American Board of Certified Energy Practitioners Photovoltaic Entry Level Certificate of Knowledge. Furthermore, Hudson Valley Community College is currently working with the Interstate Renewable Energy Council (IREC) as it positions itself to become a national accredited training institution as well as offering accredited training programs. The college expects to be accredited near the end of the year.

Yet it's the local and state partnerships that allowed Hudson Valley Community College to be responsive to the needs of the community. Through NYSERDA's networking Hudson Valley was able to forge a solid partnership with California-based SunPower Corporation. SunPower, seeking an East Coast presence for their growing business, donated equipment for the faculty and students of the College to utilize in exchange for SunPower's use of our photovoltaic laboratory at intermittent times throughout the year (see exhibits 6–8). This relationship gave our students greater exposure to more types of photovoltaic equipment and practices. SunPower has enjoyed their relationship with the college and is currently seeking additional avenues of training with Hudson Valley. Moreover, other types of training associated with photovoltaic installations have emerged that is equally important to the success of

solar technologies. Local building inspector training as well as augmented training on electrical codes will ensure quality installations. When New York State, educational institutions and businesses are all invested in developing beneficial training programs such as photovoltaic installation, then the link between job growth and economic development becomes transparent.

Photovoltaic training programs, much like other technology training programs are expensive by nature. Yet, if done right, the high academic quality of such programs becomes apparent and is usually successful in fulfilling its mission. Community colleges are the best fit to offer such training programs, but because of the shear nature of funding community colleges need financial assistance to develop first class training programs. Continued partnering with government agencies and businesses that have a vested interest in such programs could help build a national program that will facilitate the adoption of solar technology.

Exhibit #1



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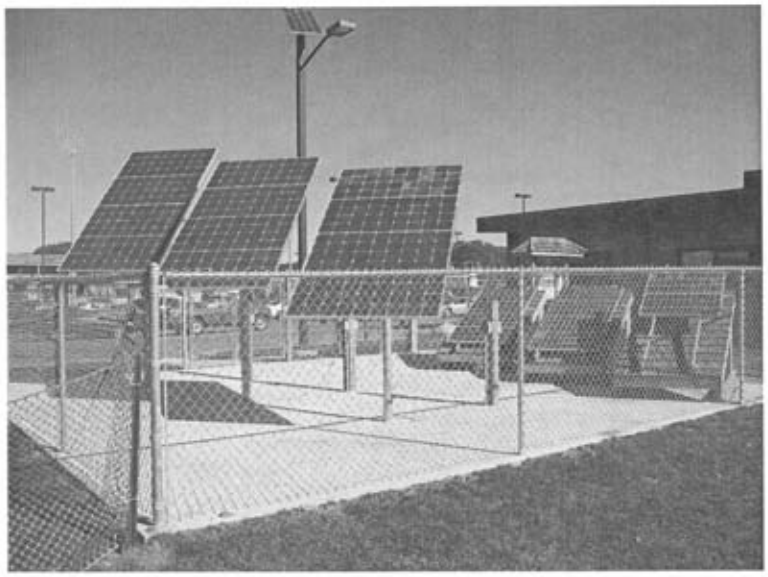

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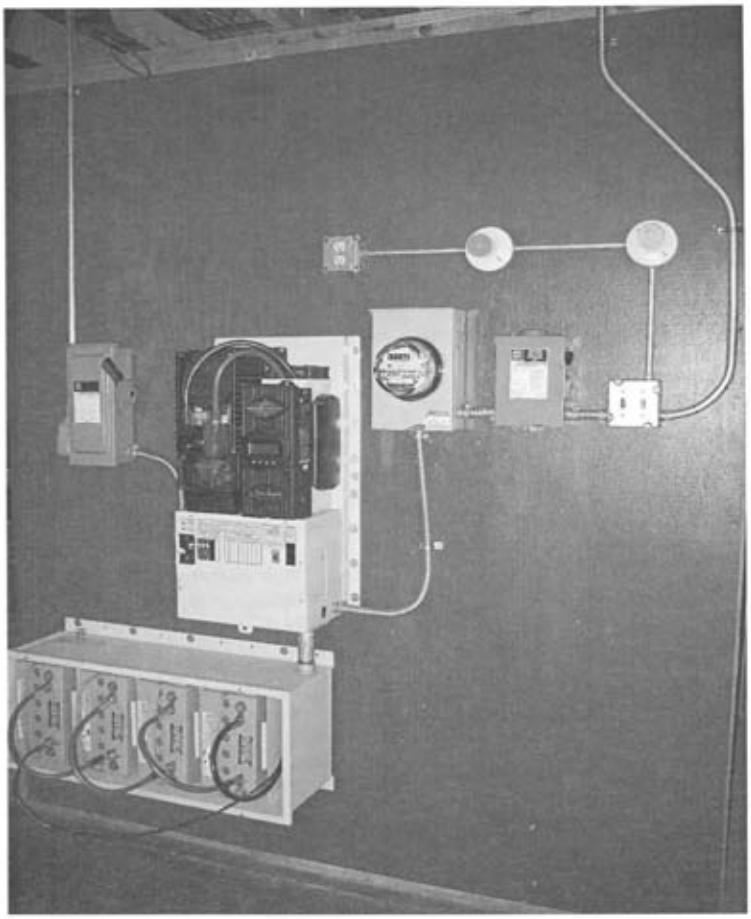
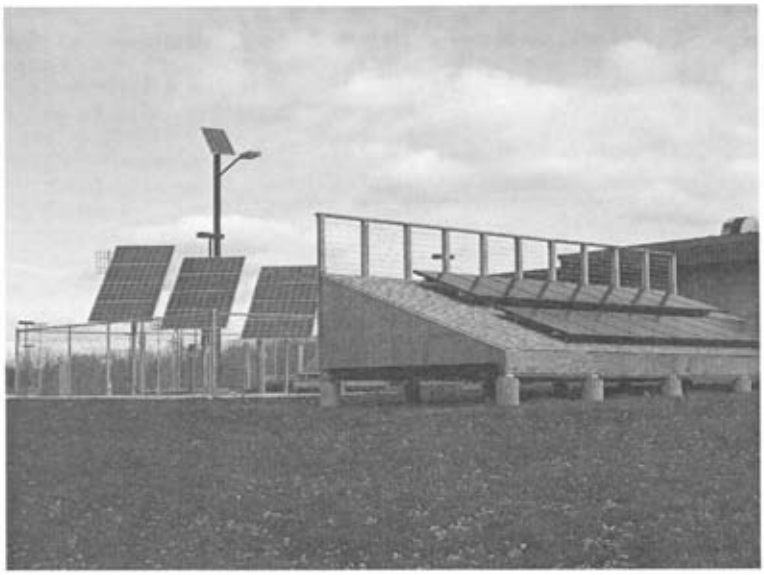


Exhibit #4

Exhibit #5

Exhibit #6



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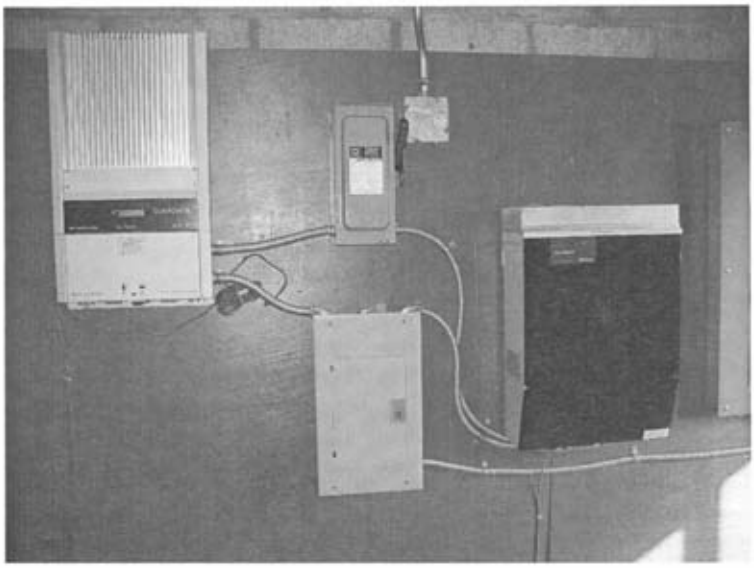

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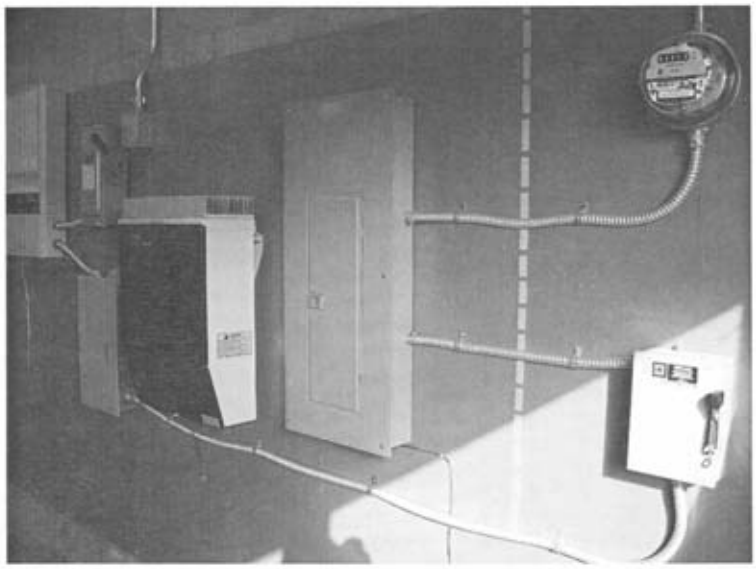

BIOGRAPHY FOR JOSEPH T. SARUBBI

Joseph T. Sarubbi of East Greenbush, NY, is a Professor and Department Chair of the Building Systems Technology department at Hudson Valley Community College. He is a seasoned educator with more than 35 years' experience in education and the electrical construction and maintenance industry, and has more than 20 years' experience developing customized training programs for firms such as General Electric, Owens Corning, National Grid, and Georgia Pacific.

Through a strong partnership with the New York State Energy and Research Development Authority, Mr. Sarubbi has emerged as a leader in New York State in developing credit and non-credit instructional programs in renewable energy technology in the areas of photovoltaic installation and energy efficiency, and is currently establishing training programs for the installation and maintenance of geothermal heat pumps, and wind energy systems. Under his leadership, in 2006, Hudson Valley Community College hosted the first-ever Renewable Energy & Energy Efficiency Workforce Education: A National Conference for Educators and Trainers. It was attended by individuals from 30 states and six countries. The college will play host to the conference again in 2008.

Mr. Sarubbi has a Bachelor's degree in vocational technical education from State University of New York Institute of Technology in Utica, NY and a Master's degree in education administration and policy studies from University at Albany. He also earned his journeyman electrician certificate through the International Brotherhood of Electrical Workers.

Ms. GIFFORDS. Thank you, Mr. Sarubbi.

Dr. Arvizu.

STATEMENT OF DR. DANIEL E. ARVIZU, DIRECTOR, NATIONAL RENEWABLE ENERGY LABORATORY, U.S. DEPARTMENT OF ENERGY

Dr. ARVIZU. Thank you, Madam Chair, and thank you, Members of the Committee, for this opportunity to discuss important issues related to the Nation's energy policies to meet our future energy needs. I am the director of the National Renewable Energy Laboratory in Golden, Colorado, and NREL, as we call it, is the U.S. Department of Energy's primary laboratory for research and development of renewable energy and energy efficiency technologies. I am honored to be here to speak with you today. I might note, as I preface my remarks, that I started in the solar business more than 30 years ago as a young engineer working on solar power towers, concentrating solar power at Sandia National Laboratories, and we have come a long way in that time.

I applaud the Committee for its continuing examination of solar and other resources of renewable electricity and fuels. If we are to ensure the Nation receives the full range of benefits from renewable energy technologies, we need to carefully balance and blend new technology, market acceptance and government policies. It is not a question of whether to rely on the market, on the research or on the government action. As we work together, we need to solve our energy problems by deploying all of these things simultaneously. DOE's Solar Energy Research Program supports the development and deployment of solar energy technologies and systems that can help meet our nation's electricity needs and reduce stress on our electricity infrastructure. The solar program supports research at NREL as well as other institutions in photovoltaics, concentrating solar power, solar heating and lighting. Through the President's Solar America Initiative, the SAI, the Nation's goal is to reduce the cost of solar photovoltaic technologies so they become cost-competitive and effective with other sources of electricity in all major U.S. markets by the year 2015. Although the bulk of the U.S. national program is focused on photovoltaics, I will focus my remarks today, oral remarks, that is, on concentrating solar power, CSP, since that is really the topic of the discussion draft. It is primarily addressing where CSP fits into the overall portfolio.

Recent developments in the western U.S. illustrate the growing concern over greenhouse gas emissions, consequently a market climate is opening up that is furthering the encouragement to deploy concentrating solar power certainly in the U.S. Southwest. In the United States, nine CSP power plants totaling 354 megawatts have been operating reliably in California for the past 16 years and there seems to be—we seem to be poised for some growth. These plants are especially interesting because with the addition of thermal storage, they are ideally suited to meet peak demands of energy use in the Southwest. Until recently, however, this CSP technology has been stagnant, and as with all new energy technologies, cost is the issue. CSP has had additional challenges in that this technology requires scale to achieve its ultimate cost-effectiveness. Couple the scale issue with high upfront capital costs and what you have is a pretty high investment risk that really is difficult in the traditional marketplace. In 2003, the solar program at the Department of Energy addressed cost by commissioning a detailed tech-

nical analysis of what this technology could produce, and it was reviewed subsequently by the National Academies and I participated on that panel. The cost of CSP at that point was concluded that even though at that time it was around 12 to 14 cents a kilowatt-hour, that it could ultimately be down in the six to five cents a kilowatt-hour, and we believe that today even though costs could be exceeded.

The discussion draft language on thermal energy storage addresses an important issue related to the intermittent nature of solar energy and its impact on utilities and the potential for low-cost and efficient thermal storage is one of the key long-term attributes of large-scale CSP technologies. The ability of CSP technologies to store energy presents an opportunity for DOE and NREL to establish an R&D effort that focuses on solar technologies that can produce baseload power at five cents a kilowatt-hour, and these systems could include storage of up to 17 hours that would compete for firm power from coal power plants, especially when they are outfitted with carbon sequestration technology. So it is expected that an aggressive R&D program could achieve these cost goals by the year 2020.

The discussion draft also addresses transmission integration, and an important issue for CSP is that CSP is best when the sun is most intense and you have cloudless days, as we do in the sunny Southwest. So plants are often located in desert or semi-arid locations where very few people live. Transmission lines are required to bring that power from remote locations to the urban load centers. Throughout the West, access to transmission is generally limited because many lines operate at or near capacity. While transmission is a problem, it is particularly difficult for solar because solar power plants need to be located where the solar resource is and they do not always have close access to existing transmission lines. Additional transmission lines would allow solar energies from the Southwest to provide a very significant fraction of the overall total electricity needs of the country. So early market penetration of CSP could be driven by long-term extension of 30 percent investment tax credits for commercial solar technologies, but if the cost of CSP power is too high when the tax credits expire, the market will be significantly impacted because there will be a downtown in that technology. An objective of our program is to see that the Department of Energy's CSP R&D activities would be to decrease the cost of the technology in a timely fashion so the market remains healthy when tax credits might expire.

The Solar America Initiative of the Department has doubled the effort to accelerate the deployment of photovoltaics in the marketplace and earlier this year 12 technology pathway partnership projects were selected to receive up to $168 million over the next three years and the awardees contributing over 50 percent of the funding. The new portfolio continues our historic investment in thin films and increases support significantly for concentrating photovoltaics and silicon technologies.

In summary, to address our near-term needs in solar power, we need a national strategy that promotes deployment of solar systems and processes that are ready to serve us today. At the same time, to address our longer-term needs and achieve a truly significant

contribution from solar power technologies, we must make a new major commitment to the research required to deliver the next and subsequent generations of concentrating solar power, photovoltaics and other new technologies. We also need to invest in the infrastructure and in the workforce required to promote sustainable businesses and job creation. The good news is that the U.S. can take back the global leadership that it once had in the solar energy field. What is likely to be one of the most important new industries of the century is solar energy through investing wisely now and in the future. The timing is fortuitous because by most accounts, the next big major market for global renewable energy use is here in the United States.

I would be happy to answer any questions. Thank you.

[The prepared statement of Dr. Arvizu follows:]

PREPARED STATEMENT OF DANIEL E. ARVIZU

Mr. Chairman, thank you for this opportunity to discuss important issues related to the Nation's energy policies to meet our energy demands for the future. I am the director of the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL is the U.S. Department of Energy's primary laboratory for research and development of renewable energy and energy efficiency technologies. I am honored to be here, and to speak with you today.

We applaud the Committee for its continuing examination of solar and other sources of renewable electricity and fuels. If we are to ensure the Nation receives the full range of benefits that renewable energy technologies can provide, we will need a carefully balanced blend of new technology, market acceptance and government policies. It is not a question of whether to rely solely on the market, or on new research, or on government action, as we work to solve our energy problems. To accelerate deployment of renewable energy technologies, we need to effectively combine all three.

It's also crucial that this mix of technology, markets and policies be crafted so that each works in conjunction with the others. The reality is that distinct renewable energy technologies—be they solar photovoltaic, solar thermal, wind, biomass power, biofuels or geothermal—are in different places in terms of their economics, technological maturity and market acceptance. While a broad range of policies are needed to spur on these varied technologies, the specifics of policies and incentives to be enacted ideally must be tailored to fit the unique requirements of each of the systems and devices we are seeking to deploy.

My testimony will address the Committee's Solar Discussion Draft, share with you related activities underway in the Solar Energy Program of the Department of Energy's Office of Energy Efficiency and Renewable Energy and provide some specific reactions to the draft from our laboratory's perspective. I should note that on behalf of DOE, the Administration has not had sufficient time to coordinate interagency views on the Discussion Draft, but the Department wants to provide some preliminary comments.

SOLAR POWER: CURRENT RESEARCH AND DEVELOPMENT PROGRAM AND POTENTIAL CONTRIBUTION TO THE NATION'S ENERGY PORTFOLIO

DOE's Solar Energy Program sponsors research, development, and deployment of solar energy technologies and systems that can help meet our nation's electricity needs and reduce stress on our electricity infrastructure. The Solar Program supports research in photovoltaics (PV), concentrating solar power (CSP), and solar heating and lighting. Through the President's Solar America Initiative (SAI), a major effort within his Advanced Energy Initiative, the Solar Energy Program goal is to reduce the cost of solar photovoltaic technologies so that they become cost-competitive with other sources of electricity in all major U.S. markets by 2015.

The SAI is being implemented at a critical time in the evolution of the global solar market. Worldwide growth rates for photovoltaics have averaged well over 35 percent for the last five years, which means the amount of installed solar power doubles every four years or less. However, this rapid growth is from a very small base; PV still accounts for less than one percent of electricity generation worldwide. Presently, several nations—including China, Germany, India, Japan, South Korea, and Taiwan—are attempting to attain larger shares of the global photovoltaic market by

making significant public investments to spur private industry. At the same time, technology improvements and State incentives are stimulating domestic demand for photovoltaic systems in the U.S. The Solar America Initiative will provide the investment needed to expand U.S. advantages in product design and manufacturing, assuring that American technologies play a leading role in the growing domestic and global markets for solar electricity.

The SAI provides a unique opportunity to focus our efforts on accelerating cost reductions and manufacturing scale-up of the domestic photovoltaic industry to capitalize on this opportunity. As we work to increase our energy independence and reduce our impact on environmental resources, solar technologies offer an attractive carbon-free, pollution-free energy resource.

In Fiscal Year 2007, President Bush requested $148 million for SAI—a 78 percent increase over pre-initiative levels—and the significant Fiscal Year 2007 Congressional appropriation demonstrated that our nation's leaders are in agreement that developing cost-competitive solar technologies is an important priority. The SAI R&D efforts supported by this funding are expected to expand domestic installed PV generating capacity up to 10 GW by 2015. Beyond enabling increases in manufacturing capacity, these projects will help put U.S. industry on track to reduce the cost of electricity produced by PV—from current levels of $0.18—$0.23 per kWh to $0.05—$0.10 per kWh by 2015—a price that is competitive in markets nationwide.

STATUS OF CONCENTRATING SOLAR POWER (CSP) MARKETS

Recent developments in the western United States illustrate the growing concern over greenhouse gas emissions, and consequently, a market climate that is open to further deployment of concentrating solar power (CSP) in that region of the country.

In September 2006, California enacted the *California Global Warming Solutions Act of 2006,* which requires the state to reduce its greenhouse gas emissions by 25 percent by 2020.[1] In March 2007, California and four other western states (Arizona, New Mexico, Oregon, Washington) announced the Western Regional Climate Action Initiative[2] in which they agreed to work together to cut their states' greenhouse gas emissions. With the large solar resources available in the Southwest, CSP-generated electricity could play an important role in helping these states meet their emissions reduction goals. In the longer-term, CSP-generated electricity could help all the states reduce their greenhouse emissions.

Solar energy is the southwest's most abundant renewable resource. In fact, California, Arizona, and New Mexico have enough combined solar energy to provide all the power needed by the entire country. CSP technology is the least expensive solar technology for providing large quantities of electrical power, and with sufficient storage, it can deliver baseload power. At a time when large quantities of carbon-free power will be needed; CSP power plants, constructed primarily of concrete, glass, and steel, can be quickly constructed and brought on line. The yearly CO_2 emissions from a 1,000 MW coal plant are approximately 2,300,000 tons. The yearly CO_2 emissions from a 1,000 MW CSP plant would be nearly zero (there may be some need for grid power during the operation of the plant). With access to adequate transmission, CSP could even provide inexpensive carbon-free electricity beyond the Southwest to other regions of the U.S.

In the U.S., nine CSP power plants totaling 354 MW have been operating reliably in California for over 16 years, and CSP seems poised to grow significantly in the state. Each of the three major California utilities (Southern California Edison, San Diego Gas and Electric, and Pacific Gas and Electric) have signed power purchase agreements for a CSP project or have indicated an intent of doing so. In August 2005, Southern California Edison (SCE) signed a power purchase agreement for 500 MW of CSP dish-engine systems on a 4,500 acre site near Victorville, CA, with an option to expand the project to 850 MW. In September 2005, San Diego Gas & Electric (SDG&E) signed a power purchase agreement for a 300 MW dish-engine project in California's Imperial Valley, with an option of expanding the project to 900 MW.[3] In August 2006, the Pacific Gas and Electric Company initiated plans with Luz II, LLC, to purchase at least 500 MW of solar energy beginning in the spring of 2010.[4]

The State of Nevada has put in place tax credits enabling the construction of a 64 MW CSP project near Las Vegas that recently came on line. Nevada Power will purchase the power from the plant. A one MW CSP system, completed in 2006, is

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[1] "AB 32 Assembly Bill," California Legislature, Retrieved on September 31, 2006, from *http://www.leginfo.ca.gov/pub/bill/asm/ab_0001-0050/ab_32_bill_20060831_enrolled.html*

[2] Western Regional Climate Action Initiative, Feb. 26, 2007. Retrieved on April 3, 2007 from *http://www.climatechange.ca.gov/documents/2007-02-26_WesternClimateAgreementFinal.pdf*

[3] "SDG&E Signs Solar Power and Other Renewables Energy Pacts," San Diego Gas & Electric Press Release, September 7, 2005.

[4] "PG&E Announces Significant New Green Power," PG&E Press Release, August 10, 2006.

operating in Arizona for Arizona Public Service. In addition, several other utilities, under the leadership of Arizona Public Service, are investigating the potential of forming a consortium that would buy power from a 250 MW CSP plant built in Arizona.

The southwestern states also have strong renewable portfolio standards (RPS) which require that a specific portion of a state's electricity consumption be met by renewable energy by a certain year. RPS' are chief among the state policies that promote renewable energy, and some even specify that a certain amount of power must come from solar energy.

CONCENTRATING SOLAR POWER TECHNOLOGY STATUS

As with all new energy technologies, cost is an issue. But CSP has an additional challenge: the technology requires scale to achieve its ultimate cost effectiveness. Couple the scale issue with high up-front capital costs and the investment risk is too large for current market conditions.

The Solar Program addressed the cost issue by commissioning a detailed technical analysis of CSP by an independent engineering firm and then having the analysis reviewed by the National Research Council. Sargent and Lundy (S&L) was selected to conduct this analysis on the basis, among other factors, of its independence from the CSP industry and its recognized performance in conducting due diligence studies for the fossil power industry. S&L estimated that the cost of CSP technology can be significantly reduced from 12–14 cents/kWh (as of 2003). Sargent & Lundey predicts projects ultimate costs for CSP troughs at 6.2 cents/kWh and power towers at 5.5 cents/kWh. Sandia and NREL (Sunlab) predict costs could be even lower.

Since the S&L report was completed in 2003, the experience gained from trough plants being built in the U.S. and Spain is enabling industry to lower their cost through mass production and building larger plants. Since the S&L report was written, the price of steel, concrete, copper, and other commodity materials have risen. Although the numbers, as of 2007, are low, the figure continues to show the potential for CSP cost reduction.

Because sunshine is most intense during the hot summer months when air conditioners are working the hardest, solar energy is a good match for a utility's peak load. With 3–5 hrs. of storage, CSP is also a good match to a utility's intermediate load. After gaining market penetration within the intermediate and peak load markets, however, CSP could expand into baseload generation markets through the expanded use of thermal storage, thereby providing a renewable alternative to baseload coal power. CSP technologies convert solar energy into thermal energy which is then stored in large tanks. This is an efficient way of keeping the energy until it's needed, at which time the hot fluid, often a molten salt mixture, is pumped to a power block where it is converted to electrical power through a turbine.

The Role of Thermal Energy Storage and Transmission Integration

The Discussion Draft language on thermal energy storage addresses an important issue related to the intermittent nature of solar energy and its impact on utilities. Adding thermal storage to concentrating solar power (CSP) plants enables solar energy to be provided any time, day or night, that power is needed. Thermal storage also has the potential for being low cost. An independent study by Sargent & Lundy concluded that CSP costs could be reduced to between 4.3 and 6.2 cents/kWh by 2020 for technology that utilizes thermal energy storage.[5]

The potential for low-cost and efficient thermal storage is one of the key long-term attributes of large-scale CSP technologies. Key advantages of thermal energy storage are:

- *High Value Dispatch of Electricity:* Without thermal energy storage, solar power is an intermittent power resource, dependent on when the sunshine. Thermal energy storage allows the collection of solar energy to be separated from the generation of electric power, providing the ability to dispatch generation when the value for electricity is highest.
- *Firming Delivery for Solar Power:* The ability to store energy and dispatch solar power when it is needed helps make solar power plants a more reliable or firm power resource for the utility. Firming of delivery is an important aspect of supporting the economics of solar power plants through utility capacity payments.
- *Increasing the Annual Capacity Factor:* Solar power generating systems without thermal storage achieve capacity factors in the range of 25–30 percent.

[5] Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts, Sargent & Lundy Consulting Group, SL–5641, May 2003.

With the addition of advanced, low-cost thermal energy storage, systems can be economically sized to allow capacity factors of 75 percent or higher. As a result, with the addition of thermal energy storage it is possible for solar power plants to operate at or near baseload conditions.

The ability of CSP technologies to store energy presents an opportunity for DOE to establish an R&D effort that focuses on a solar technology that can produce baseload power at about five cents/kWh. Such systems would include 13–17 hrs. of thermal storage and would compete with the cost of power from coal plants using carbon sequestration technology. It is expected that an aggressive R&D program could achieve the cost goal by 2020.

The Discussion Draft also addresses transmission integration, an important issue for CSP plants. CSP works best where the sun is most intense and there are few cloudy days, so plants are often located in desert or semi-arid locations where few people live. Transmission lines are required to bring the power from these remote locations to urban load centers. Throughout the West, access to transmission is generally limited because many lines currently operate at or near capacity. While transmission is a problem for all new power generation, it is particularly difficult for solar because solar power plants need to be located where the solar resource is best and these are not always near existing transmission lines. Addition transmission lines could allow solar energy from the Southwest to provide up to 6,800 GW of electricity to the U.S.

POTENTIAL R&D AND MARKET STRATEGY FOR CSP TECHNOLOGY

During the last three years, representatives of the DOE and NREL solar programs have met with the energy and economic advisors to governors, energy regulators, state legislators, utilities, and other stakeholders in California, Nevada, Arizona, and New Mexico. These meetings were to provide the states the economic, environmental, and energy benefits of CSP. Each state expressed an interest in CSP, although their interest was tempered by the high cost of the technology. They were, however, encouraged by the Program's projections of significant cost reduction and also showed interest in finding ways to encourage the deployment of CSP in their states. Nevada subsequently implemented tax incentives that have led to the construction of a 64 MW CSP plant outside of Las Vegas.

Utilities have demonstrated a serious interest in CSP for several reasons:

- The widespread availability of solar energy throughout the Southwest provides utilities with flexibility in locating CSP plants near existing or planned transmission lines.
- Placing CSP plants on the "right" side of congestion can reduce grid congestion and increase grid reliability.
- CSP electricity production aligns closely with periods of peak electricity demand, reducing the need for investment in new generating plants and transmission system upgrades.
- Thermal storage or the hybridization of CSP systems with natural gas avoids the problems of solar intermittency and allows the plant to dispatch power to the line when it is needed.
- Large centrally-located power plants are the types of systems that the utilities have operated for years and with which they are most comfortable.
- Once the CSP plant is built, its energy costs are fixed; this stands in contrast to fossil fueled plants that have experienced large fluctuations in fuel prices during the last several years.
- The economic studies performed by the states show that a relatively small upfront investment can result in downstream tax revenues for the State and local governments.

Utility representatives expressed particular interest in CSP because its ability to store energy enables solar power to be dispatched to the grid through their entire period of peak demand, or whenever else it is needed. CSP was also attractive to them because of its size (50–250MW), use of conventional steam turbine power blocks, and the ability to hybridize CSP plants with natural gas.

Utilities have indicated that even with storage and the other advantages mentioned above, it is hard for them to justify purchasing CSP power above 10 cents/kWh when they can buy less expensive wind power. In California, utilities can pass along the higher cost of renewable energy to their rate payers as long as it's under about 10 cent/kWh. Reaching 10 cent/kWh is thus important for early market penetration. The federal investment tax credit is important because it does much to bridge the cost gap. It is also important for the cost of CSP power to be at 5–7 cents/

kWh by 2015. So early market penetration of CSP could be driven by a long-term extension of the 30 percent investment tax credit for commercial solar technologies. But if the cost of CSP power is too high when the tax credit expires, the market will take a significant downturn or become completely stagnant. An objective of the DOE and NREL CSP R&D activities would be to decrease the cost of the technology in a timely enough fashion so the market remains healthy when the tax credits expire.

To achieve this objective, we must reduce CSP costs to provide intermediate power at 5–7 cents/kWh with 4–6 hrs. of thermal storage. These activities would focus on developing the solar collector, receiver, and other components of trough plants to attain the system goal.

To reach the long-term objective of providing baseload power, we will need to establish feasibility, develop components, evaluate, and test new system concepts beyond the trough plant design. The concepts likely to be examined include power towers, distributed power towers, concentrating line focus receiver (linear Fresnel), and dishes w/storage. The criteria for developing these technologies will include a detailed analysis that defines the current state of the technology, the needed advancements in efficiency and cost of each component, the development and manufacturing pathways needed to achieve the goal, the time to achieve the advancements, and the ability of the industry partner to commercialize the technology.

THE PHOTOVOLTAICS R&D STRATEGY

Prior to January 2006, our research focused on technical progress through increasing the conversion efficiencies of solar cells and reducing the manufacturing costs of photovoltaic modules. Our national laboratories—NREL and Sandia—implemented this R&D, which included providing relatively stable funding to companies and universities, resulting in steady, incremental progress. Hundreds of individual projects were funded at the national laboratories, universities, and companies that generated continued interest in photovoltaics throughout the country.

But this picture changed after January 2006. We began with a change in program strategy, along with a fresh look at the solar energy industry by the investment community, and supportive policies from numerous State and local programs. The focus of our research shifted from technical progress on components to integrated PV systems. Under the new strategy, companies funded by SAI are expected to develop products for priority markets, and industry is expected to influence the research agenda for the national laboratories and universities.

Dramatic progress is anticipated from multiple competitive solicitations, coupled with an aggressive process to evaluate results and eliminate awardees showing less than substantial progress. The first set of large awards, called Technology Pathway Partnerships, will support multiple industry-led partnerships over the full value-chain, whereas smaller projects will target earlier-stage technologies. Public attention will be attracted to these high-visibility projects, with the intent of stimulating consumer interest and eliminating barriers to PV deployment.

Perhaps the most dramatic evidence of this new strategy was DOE's significant investment in a new funding opportunity for industry-led Technology Pathway Partnerships. Entrance criteria for commercial applicants included prototype components, pilot production demonstration, and an established business case. At the end of three year projects, awardees were expected to have commercial PV systems and subsystems with annual production of greater than 25 MW. These partnerships include collaboration with national laboratories, universities, and suppliers to focus on the development, testing, demonstration, validation, and interconnection of PV components, systems and manufacturing equipment. Through these efforts, the Partnerships are expected to reduce the installed cost to consumers to $0.05–$0.10 per kWh by 2015—a price low enough to open up all major U.S. electricity markets.

Earlier this year, 12 Technology Pathway Partnership projects were selected to receive up to $168 million in DOE funding over the next three years, with the awardees contributing over 50 percent of the funding for these projects. Representing a broad cross-section of U.S. industry, the projects involve more than 50 companies, 14 universities, three non-profits, and two national laboratories in 20 states. The selected projects' leaders are Amonix, BP Solar, Boeing, Dow Chemical, General Electric, Miasole, Nanosolar, SunPower, United Solar Ovonic, Konarka, GreenRay and Soliant. This new portfolio continues our historical investment in thin films and increases support significantly for concentrator photovoltaics and crystalline silicon technologies. The portfolio is intended to deliver on the near-term potential in residential markets and commercial markets, which are targeted by 32 percent and 48 percent of the funding, respectively, with longer-term utility markets following at 20 percent.

In addition to the Technology Pathway Partnerships, DOE will be releasing a variety of other funding opportunities to round out the PV R&D pipeline. These opportunities will focus on developing new materials and processes for solar electric conversion, transitioning fundamental science studies into the fabrication of new PV devices, shortening the timeline for companies to transition pre-commercial PV module technologies into full-scale manufacturing, supporting university materials science and process engineering research and improving inverters and power electronics in distributed PV systems.

THE NREL PHOTOVOLTAICS R&D PROGRAM

The Solar Energy Research Institute (SERI), now NREL, was originally created to develop the technologies needed to foster a dynamic solar industry. Our Laboratory has succeeded in large part at fulfilling this charter and has been vital to the development of the PV industry. In recent years, this industry has seen dynamic change and significant growth—thanks to past R&D successes at NREL.

Importantly, this change has included the emergence of significant internal R&D at start-up and established companies, as well as a proliferation of PV research at university laboratories around the country. With the industry and academic elements of the domestic PV R&D community changing significantly, in early 2007 we began to reexamine our research strategy to ensure that it will be complementary and relevant in years to come.

During spring of 2007, we began formulating a new multi-year research plan—with associated personnel and equipment plans—that recognizes this changing market context and is being developed with input from industry and academic collaborators. This planning process is intended to ensure the long-term vitality of NREL's research and its mission to help foster and sustain a strong American industry.

The new plan resulting from this process will improve on the existing concept for managing NREL's PV R&D portfolio in several critical ways: (1) For a given technology development "roadmap," the plan will more explicitly link the parameters targeted for device performance or process development to the market impact they would make if commercialized (e.g., in terms of change to commercial module costs, manufacturing equipment capital cost, or manufacturing bills of materials); (2) It will specifically identify the conditions and parameters under which a given device technology or process will be sufficiently proven to be transferred via licensing or other means for commercialization; (3) It will exhibit changing priorities over time, as research tasks in various areas are planned to be completed and as new technologies emerge for further development; and (4) The plan will explicitly identify research tasks that will be performed in industry, academia, or other institutions that are relevant to the activities and outcomes of NREL research activities.

We are extremely excited about our progress thus far under the new strategic planning process. And we look forward to sharing the resulting R&D priorities and management procedures in October 2007, at the start of our next fiscal year.

PHOTOVOLTAICS PROGRAM OUTCOMES AND BENEFITS

Upon realizing the SAI goal, it is expected that roughly two million metric tons per year of carbon emissions will be avoided by 2015 and PV will provide approximately five GW of electricity generating capacity—displacing roughly the equivalent of five coal-fired power plants—enough to energy to power about 1.25 million households. This is equivalent to 10 times the amount of PV installed today.[6]

Distributed solar technologies will enable our ultimate goal of affordable zero energy homes and buildings which fulfills the President's Advanced Energy Initiative vision of changing the way we power our homes and businesses. Net-zero energy homes and buildings produce as much energy as they consume through improved efficiency combined with renewable energy, such as solar, providing needed power and offsetting any utility-provided energy over the course of a year. Optimizing the balance of energy efficiency improvements and solar PV will result in the most cost effective net zero energy home or building and connecting the solar PV system to the grid can allow customers to sell the excess solar energy back to the utility.

Highly efficient buildings with distributed technologies reduce peak demand, and will ease the need for expensive new generating capacity, transmission and distribution lines as our economy grows. Building-integrated PV can make the buildings sector a source of energy diversity and low carbon electricity (the building sector cur-

[6] DOE's Office of EERE uses two energy-economy models—NEMS–GPRA07 and MARKAL–GPRA07—to estimate the impacts of EERE programs on energy markets as part of its annual benefits analysis. The NEMS–GPRA07 model is a modified version of NEMS, the midterm energy model used by the EIA. The MARKAL–GPRA07 model is a modified version of MARKAL, a model developed by Brookhaven National Laboratory.

rently accounts for 39 percent of U.S. energy use). Total energy use in the buildings sector is projected to increase an additional 30 percent through 2025, and we believe that solar PV can meet much of this demand.

As the Committee's Discussion Draft notes, educating energy consumers is critical to achieving the market goals I have previously indicated. One of the ways we educate Americans about the new choices they have in heating, cooling and powering their buildings is a unique project that encourages the development of zero energy homes called the Solar Decathlon. The Decathlon, sponsored by DOE, challenges schools of architecture and engineering to design solar powered, zero-carbon, self-sustaining houses from the ground up to see which house is the most aesthetically pleasing and which house performs the best. Twenty collegiate teams from the United States, Canada, Puerto Rico, Spain, and Germany will participate in this year's competition, which will be held on the National Mall from October 12–20, 2007. The public is invited to visit the solar village and tour the houses, which showcase the latest green building and energy efficient technologies.

BUILDING ON MOMENTUM: STRATEGY & PRIORITIES FOR 2007

During the first 18 months of the Solar America Initiative, DOE and NREL have worked together to implement a broad-reaching change in strategy with one clear purpose: to make PV technologies cost-competitive in all major domestic grid-tied markets by 2015. We emphasize that this change was not implemented simply for the sake of change. But rather, to take advantage of progress in module efficiency and fabrication principally achieved by industry, universities, and the national laboratories over the years. These successes form the foundation for the PV systems that we will be supporting in the future.

Priorities in 2007 include continuing to implement the funding opportunities described above. We will also establish the framework for additional university involvement in the Technology Pathway Partnerships and calibrate our Laboratory's research portfolio and future role. And finally, we will ramp-up our efforts in testing and evaluation of new product designs—an activity that is critical to assuring the reliability of the new products we are developing with industry.

SUMMARY: BALANCING SHORT- AND LONG-TERM R&D INVESTMENTS IN SOLAR POWER

To address our near-term needs in solar power we need a national strategy that promotes the deployment of solar systems and processes that are ready to serve us today. At the same time, to address our longer-term needs and achieve a significant contribution from solar power technologies, we must make a major new commitment to the research required to deliver the next, and subsequent, generations of CSP, PV and other new technologies.

The good news is that the United States can take back the global leadership it once had in the solar energy field—what is likely to be one of the most important new industries of this century—through investing wisely now and into the future. The timing is fortuitous, because by most accounts the next big market for global renewable energy in here in the United States.

Thank you.

DISCUSSION

Ms. GIFFORDS. Thank you so much all of you for your opening remarks. We have a good amount of Members here so I want to get going pretty quickly. Let us try to limit questions and answers to five minutes and see how far we get.

SOLAR ENERGY IN GERMANY

I would like to kick off with some of the comments Mr. Resch made in terms of what we can be doing as a country in comparison to Germany. What happened in Germany, and for the panel, you know, what can we learn from them, what are the take-aways, what are some of the mistakes and the pitfalls?

Mr. RESCH. Thank you, Congresswoman. What Germany did first and foremost was to make a long-term investment in solar energy and they did it during the worst economic downtown since World

War II. So what they basically said is, we need to diversify our energy portfolio, we are becoming increasingly dependent upon natural gas coming from Russia, and they felt it was very important to look at what natural resources they did have in place, and that is certainly solar, although their resources are lower than ours was one of those resources, and they looked at all renewables including wind and geothermal and biomass. They created a structure which is a 20-year incentive structure to encourage the use of renewables. It is called a feed-in tariff, or the EEG is the acronym in Germany, and what it does is provide again a fixed incentive over a long period of time. It doesn't really translate, if you will, to the United States because our electricity laws are very different but the most important thing that they did was to give a long-term incentive structure. Now, what has happened is, manufacturing has expanded rapidly in Germany and they have created almost 40,000 new jobs in Germany in the last five years because of the EEG. These are manufacturing jobs in eastern Germany, a lot of installation jobs. You are seeing solar go up on barns, on homes, on factories, really all over the country, and they have gone from being a country that ignored, if you will, solar to being the global leader. They install eight times as much PV as we do each year. They install about 80,000 solar water heating systems each year. In the United States, we install about 6,000 solar water heating systems. And because of that, they have really created an economic force and growth in Germany that frankly hasn't been seen since the high tech, frankly the chip industry is a classic example, the U.S. technology invented in the United States being commercialized by the Germans and the Japanese and increasingly the Chinese. So what they have done is provide a long-term incentive and structure for encouraging people to use solar.

SOLAR CHECK-OFF PROGRAM

Ms. GIFFORDS. Thank you. How would the proposed solar research and promotion program or the check-off program enable industry to promote the use of solar power in a way that it currently cannot, and why is the involvement of the Department of Energy for this program so useful?

Mr. RESCH. The check-off program really does several things. First and perhaps most important is, it allows all of the industry to collectively pool its resources together. So when you look at all of the individual companies that are out there, they just don't have the budgets, if you will, to do a national campaign on their own or even a branding or marketing campaign but the beautiful thing about a check-off program, it is a very, very small surcharge that then collectively and certainly over time creates a pool of money that then can be used for education and outreach. The second is really the public perception on solar. When you do the polling and you ask people what do they think of solar, they want to see more solar, they want to use more solar. My gosh, you know, you inventory—you ask anybody in this audience behind me, I guarantee half the people would say—or more would say I want to put solar on my house at some point in the future. But they need to figure out how to do that. We need to have a mechanism that allows consumers to learn more about solar, to learn that this is what solar

looks like. It is a beautiful thing. It is elegant technology, you know, that it has incredible environmental benefits, that although the costs may be high up front in the long run, it does pay for itself over time and can be a good hedge against let us just say higher energy prices. So that type of mechanism needs to be pulled together, and what we have found is that programs like "Got Milk" and the pork program and the cattlemen's programs have worked. They have worked effectively for agriculture and industries that again are diverse, that have, you know, literally thousands of small farmers or that have hundreds of major, you know, agricultural providers but that collectively when they pool their resources can get something done. I think the Department of Energy becomes a critical entity because it allows, let us just say the government input and coordination on research and public perception and so what we would want to make sure is anything that we are doing with this program is operating in a very consistent manner with the Solar America Initiative and research and development programs that are going on in the DOE, in large part to make sure that there is no duplication and that the federal resources are used as effectively as possible but also to get the insight from the researchers around the country into this program.

Ms. GIFFORDS. Thank you.

The Chair now recognizes Ranking Member Hall. Thank you for being here.

Mr. HALL. Thank you, ma'am. Thank you very much, and thanks for a good panel here, and Rhone, good to see you again. You are too young, but——

Mr. RESCH. That is changing quickly, sir.

Mr. HALL.—I think you are going to be a fast learner, and I like your natural-gas background.

COMPARISON OF SOLAR ENERGY TO ANWR

Mr. Hayden, in your testimony you have advocated a study on locating large-scale concentrated solar power on federal land, and you said a single 250-megawatt facility would occupy 1,250 to 2,500 contiguous acres of land. With the hard, cold facts being that the proposed drilling areas for ANWR is 2,000 acres, I believe that is the correct figure, with the potential for recovering over 10 billion barrels of oil, a possible 50 percent increase in total U.S. proven reserves creating roughly one million jobs here in the United States, my question is, can a solar installation produce this much of a return on the same amount of land or more?

Mr. HAYDEN. Thank you, Congressman, for the question.

Mr. HALL. Did you write the question? You didn't send me the question, did you? I really want a good answer.

Mr. HAYDEN. You asked the question in terms of I think productivity of the land is, and obviously we all understand that that is a very complex topic to look at productivity of land use and so I think there would be a very imperfect comparison between an ANWR drilling site and a solar site. In fact, if we look at what the challenges are to making solar actually competitive, you know, just on shear costs, we are challenged in the sense that nature has put together the fossil fuel resources into highly dense form and extracting it with, you know, resource extraction may not have a

large footprint but the counterbalance, the land use of the solar does not deplete the resource. It is working in real time to harvest sunlight. Secondly, there is a ripple effect where the technology is advanced into bringing the solar into play. So I would agree with you that if you look at the footprint alone as one metric competing against fossil fuel in a highly dense form is very challenging for any renewable but if you look at how fossil fuel over its entire life cycle of being replaced could compete with solar, then solar now has an advantage because the technology is very efficient in terms of, say, nominally 25 percent conversion of sunlight into energy where fossil fuel has a much lower efficiency on its entire basis. So all these things are of course arguable in how you look at it but the solar technology does have the opportunity to deliver forever and——

Mr. HALL. They could exist and be compatible together?

Mr. HAYDEN. I think that is a very important point. We have seen in my work of trying to combine mining uses, for example, where they have buffer zone and land with productive uses of solar.

Mr. HALL. With us being so totally dependent upon people that really don't trust us and we don't trust, sitting here with a fear that China will offer them a buck a barrel more than we are paying them, do you like the comparison when they say don't disturb little ANWR, the pristine little area of ANWR when it is 19 million acres and we are using 2,000. Did you hear the comparison that it would be like putting a postage stamp at the end of a tennis court and saying that ruined the whole tennis court? The good combination of the two with solar would be the same. It doesn't hurt the land at all.

Mr. HAYDEN. Well, I am not sure that Alaska would be a great place for the solar equipment. It would generate pretty good during half the year and not so good during the other half of the year, but I think there is a lot of opportunity for hybrid composite uses of land.

MORE ON SOLAR CHECK-OFF PROGRAM

Mr. HALL. But you make another point there. If it is dark half the year, what are they hiding up there anyway?

I have one other question of Dr. Arvizu on the neutrality of the Department of Energy on check-offs. Are there any other check-off programs at DOE? Should there be a generic renewable check-off program? Is that a good use of DOE's resources? I will just give you the full barrel.

Dr. ARVIZU. Thank you. Actually there are merits to what I believe are intended in terms of the value that check-off programs bring. I think the rationale at the Department of Energy is what is the role of the Department and how should it endorse or otherwise encourage what we think are very appropriate education programs, and I think Mr. Resch actually articulated very nicely the benefits and the value that educating the public has in terms of promoting the use of renewable energy. The question is still I think an open one inside the Department as to whether or not the Department has, you know, a role that couldn't be satisfied by perhaps closer coordination with the private sector. One of the things we are trying to do at the National Renewable Energy Laboratory

is connect very closely with the industry and with the private sector to make sure that our goals and objectives are aligned and these public-private partnerships provide as much benefit both to the taxpayer as well as to the private sector. In the end, this is about making investments. This is about having return on those investments, putting market signals where the value is extracted, and we have got a lot of work to do in those particular areas. So the check-off program, although it is important, isn't the highest priority that we are working on but we see the merit and the value of it and open for discussion as to——

Mr. HALL. My time is up. If I had more time, I would ask you if being open, you mean they are going to remain neutral on check-off, and question, why shouldn't DOE be focused on research? And I may write you a letter and ask you those things.

Thank you, Madam Chairman.

Ms. GIFFORDS. Thank you, Mr. Hall, and let me also note that in this draft legislation, no money would come directly from DOE from the check-off. It would all come from the private sector.

The Chair recognizes Mr. McNerney.

Mr. MCNERNEY. Thank you, Mrs. Chairwoman, and I just want to say that I am very excited about the future of solar and I applaud you for the bill. It is a nicely crafted bill.

MANUFACTURING COST FOR SOLAR ENERGY

You know, the real limitation for solar. You have talked about education. Education is a limiting factor but the real limitation is the price. I come from the wind industry and what happens in that industry is that as we get on the manufacturing curve, the cost goes down just out of production volume, but I am not convinced that is the case with solar, especially with photovoltaic. So my question I guess for Dr. Arvizu is, do you see the technology in photovoltaic and in CSP leading to lower cost with increasing volume or again is some type of technical limitation going to prevent the cost from coming down, and if not, could you kind of go into that a little bit for me?

Dr. ARVIZU. Yeah, sure, and I know that Mr. Resch has something else to say as well. I would offer that the incentive programs that have been put in place both in Germany and in Japan have demonstrated very clearly that with these policy measures and incentives and encouraging a market which now has exponential growth does in fact reduce the cost, and what we are seeing is that the costs are coming down, things like balance assistance cost inverters and installation costs and things that relate to siting and installation are all in fact now a much smaller fraction of the overall system cost than they used to be. So it does inform our research programs because I think there is plenty of space and opportunity to reduce costs both on what I call the business end of the technology which has to do with the conversion process from solar to electricity, and whether that is at the cell level for crystalline silicon technology or at the module level when it is thin-film technology, we see tremendous progress being made there, and it is a matter of a lot more volume, a lot of learning curves. Clearly first-generation technology is on an S curve, if you are familiar with how technology finds its way into the marketplace, and you prob-

ably need to jump onto second-generation technology, which is a different S curve with different learning curves.

Mr. MCNERNEY. We are past second-generation technology with solar photovoltaic now, aren't we?

Dr. ARVIZU. Well, not in the parlance that we use. You know, first-generation technology is the technology I started with in the 1980s and it is the staple. I sponsored this research literally in 1985 with Dick Swanson at Stanford University. It is now commercial product. Technology that we are working on in the laboratory now is what we call second generation—thin films, concentrating, a variety of high-efficiency technologies. There is yet a third generation. That is the organic, really high efficiency, I call it revolutionary. It is maybe a few years down the road but we are right now trying to get second generation into the marketplace. So there is a lot of room to be had and I think what you will find is maybe these companies are investing in second-generation technology today.

Mr. RESCH. And Congressman, if I could just add a couple of points in response. We have seen historically the price of solar come down so when the incentives for solar were dropped in 1983, the market continued. I mean, it dropped but, you know, we continued to use solar energy, and since 1983 we have seen the price of photovoltaics come down by 90 percent. The learning curve that we have seen is for every doubling of manufacturing capacity, we see about a 20 percent reduction in the price of photovoltaics. So what is really needed is a long-term stable driver for the market so that if I am a manufacturer, I am going to scale up my production. I mean, most of the manufacturing facilities are 20-, 30-, 40-megawatt plants. That is pretty small. We need gigawatts-scale plants, and the only way you are going to get that is by providing a long enough incentive so that you can make sure your investment in that plant is actually returned. And the example I use for wind, I think we are probably a decade behind wind. Wind has had the production tax credit, granted on and off, but they have had the production tax credit for 14 years. Solar has had the investment tax credit for about 17 months. So, you know, the market is really just starting in the United States with respect to any kind of market incentives coming from the Federal Government, so we are hopeful we will see a long-term incentive that will spur manufacturing, then drive down costs.

TAX INCENTIVES FOR SOLAR ENERGY

Mr. MCNERNEY. And, you know, in wind, the tax credits had a big impact. The initial tax credits were investment tax credits and they caused a lot of substandard equipment to be put in the field and it kind of hurt the industry's reputation for years and years. What sort of tax incentive do you think would be the most effective for solar then, given that history?

Mr. RESCH. Because solar tends to be distributed generation and having a very high upfront cost, we found that the investment tax credit works best. At the end of the day, the investment tax credit isn't large enough for you to put in expensive non-operating equipment. Everything is UL listed. Everything comes with, you know, certification. Everything has to be grid connected, and with the in-

vestment tax credit, it still has to pay for itself in a reasonable period of time. So we are seeing the commercial segment of the marketplace, so think of Lowe's, think of Home Depot, Fresh Field stores putting solar up on their roofs where you have got an energy manager and you have got an account watching to make sure the system performs, very sophisticated equipment that is performing, so the ITC works best for us.

Mr. MCNERNEY. I mean, basically what you have just said is that the investment tax credit is probably more effective than production tax credits for solar?

Mr. RESCH. That is correct. The production tax credit is—the bottom line is yes, the ITC works better than the PTC.

Mr. MCNERNEY. Thanks for your honesty there. I am out of time.

Ms. GIFFORDS. Mr. Inglis.

TAX INCENTIVES AND NET METERING OF SOLAR ENERGY

Mr. INGLIS. Following up on Mr. McNerney's questions, what should be more effective, some kind of tax credit or a net metering kind of proposal?

Mr. RESCH. You really need both. Net metering allows the system to work effectively, so just to give you an example, on a day like today, even though I am using air conditioning at my house, I am generating excess electricity. If Jane was living next door to me, it would be going into her house and it would be going into Hal's house as well, and what that does is, it really stabilizes the grid. It allows utilities, if you will, although they are still going to buy peak demand, to have less congestion, less constraint on the distribution grid.

Mr. INGLIS. It also makes it much more attractive for me to put into a system, right, because——

Mr. RESCH. Then you wouldn't have to buy a battery backup system that would store, so it actually is a lower cost. You almost use the grid, if you will, as your battery or as your reserve.

Mr. INGLIS. Right, and I would also have the capacity to recoup some of my investment. I mean, we have to figure out a way to pay for this thing, putting it on my roof, and so a tax credit is one possibility. Another possibility is net metering.

Mr. RESCH. Net metering, it differs by every state. Right now we don't have net metering laws so what exists in Maryland is very different from what we have in Virginia, which is very different from what we have in D.C. And so it is very difficult from a business model to determine which one is the right one. If we had uniform net metering, that would make a very big difference, and if you had time-of-use rates, which means that you are paying for the price of—the real cost of the electricity on a day like today, I guarantee Pepco as they are pulling in new demand isn't paying eight cents per kilowatt-hour. They are probably paying 20 cents a kilowatt-hour.

MORE ON SOLAR CHECK-OFF PROGRAM

Mr. INGLIS. Something tells me that our friends at Energy and Commerce would say they have jurisdiction over that, that net metering thing, but it is fun to dream about such topics. Anyhow, so

how about—speaking of jurisdiction, is this a voluntary check-off or a mandatory check-off?

Mr. RESCH. It is a mandatory check-off program that companies then have the option of opting out and so it becomes voluntary after it is created.

Mr. INGLIS. And how does that work?

Mr. RESCH. You would pay into it and then you have the opportunity to request a refund. So what this—the way the structure works, and this is a very important part, especially as the U.S. market continues to develop is, we are importing—we may be importing more and more panels from China to avoid a free ridership use structure of the program so that everybody pays into it initially. If they decide they don't want to support the program for whatever reason, then they can opt out and get a reimbursement for the money that they paid in.

Mr. INGLIS. So what free rider would not go to that extra step of asking for a refund? Just a lazy free rider that doesn't realize their opportunity or——

Mr. RESCH. It forces them to get involved. It forces them to see the merits of a program. It forces them to either sit on the board or at least engage with the board as to what the program is all about and at least they understand it so they are making a conscious decision as opposed to an ignorant, I don't want to get involved decision, and there is probably peer pressure that would keep people to participate. I am sure that exists in agriculture too.

Mr. INGLIS. I ask this question—does anybody know, is this a sequential referral or something or—to Energy and Commerce. Do we have jurisdiction over it? I don't know. It is an interesting question if we would have jurisdiction over such a mandatory check-off.

I yield to the Chair.

Ms. GIFFORDS. Mr. Inglis, when we put this legislation together, we were obviously looking at jurisdiction. Because we had a panel that was qualified, we thought it was important to come and have a discussion about this because this is one of the main parts of what would be so helpful for the industry. That is why we are still working on that.

STORAGE AND EFFICIENCY OF SOLAR ENERGY

Mr. INGLIS. And a question for the panel is, which is more crucial to it? Is it a storage question or the efficiency question—efficiency of conversion? As I understand it, the solar cells—I wish I knew how to explain it. Roscoe will explain it to us next. He has got the next question, to explain this conversion issue and the efficiency of it. I don't know how to express it. But we are talking a lot about storage here and we are not talking much about the efficiency of the conversion.

Mr. ARVIZU. Let me take a stab at that. I think it really comes down to the economics. It really comes down to how many cents per kilowatt-hour am I paying life cycle for the power. When you add storage to concentrating solar power, you improve or increase the value by a tremendous amount because, as Rhone talked about earlier, you are putting—you are allowing there to be essentially power generation at a time when you may in fact have peak power use, which there is a higher value on that certainly to the utility.

I know that in Spain there is a feed-in tariff as well and they put a big premium on having storage, in other words, being able to generate electricity even past the normal sunlight hours, and by putting in the generation, the developers actually get an 18—I am sorry—an 80 percent additional return on investment by putting in the storage, so that is just in economic terms. The efficiency is important. Typically the cost is important so it is the efficiency and a cost tradeoff so sometimes you have high efficiency, high cost, sometimes you have low efficiency, low cost. Sometimes those are equivalent, and if there is a tradeoff, I think you need to go back to how many cents per kilowatt-hour life cycle, you know, all in, all out kind of a metric to determine which one has the most attractiveness to it.

Mr. HAYDEN. If I could jump in, there is a—Congressman, there is a diversity of technologies in the solar field which is a good characteristic of the technology space. We are going everywhere from the photovoltaics that Rhone brought the example of to concentrating solar power, which is large scale, and if I can kind of put the example out there of, people are very concerned about what their price of electricity is primarily until the lights go out and then all of a sudden they start having concern about the reliability of electricity, and so around the world prices of electricity and reliability both vary situationally. As we start with solar today, the primary focus outside of this proposed work is on efficiency. Everyone is looking at cost. But as solar becomes more successful, just like wind has become more successful, then greater attention gets paid to the reliability. So it depends on where you are in the development. First you worry about cost. Then you worry about cost plus reliability, and I think that is what is looked at here is that we are starting to be more realistic about solar than we were a few years ago.

Ms. GIFFORDS. Mr. Bartlett, please.

CHARACTERIZATION OF SUPPORT FOR SOLAR ENERGY

Mr. BARTLETT. Thank you very much. Thank you for your testimony. There are three groups in our country that ought to have common cause in wanting to move away from fossil fuels to renewables, solar included, and I am wondering if those three groups have joined—have locked arms or are they now criticizing the other group's premise. One is the global warming people, and of course, after you have paid the carbon price of producing the solar panel, there is no carbon emission in producing power. There are the national security people, who lament the fact that we are so dependent on foreign oil and to the extent we can use solar, we are going to use less foreign oil. And there are the peak oil people who believe that although we may muddle through the global warming and the national security, there is no muddling through peak oil. If it is not there, it is not there. And these three groups ought to have common cause. Have they locked arms or are they still criticizing each other's premise?

Mr. RESCH. I think everyone has been very busy and focused on their own respective issues, but having said that, there is a very clear unification that these three issues need to be addressed in a very similar fashion. They are not mutually exclusive. They have

to be dealt with at the same time, and I would say that the groups working on global warming, national security, peak oil and certainly solar, we are engaged with all three of those groups.

COMPARISON OF CENTRALIZED TO DISTRIBUTED SOLAR ENERGY

Mr. BARTLETT. Well, the solutions to those problems are exactly the same: move away from fossil fuels to sustainable renewables and of course solar is a big one of those. If you have grid tie, what is the advantage of a large, centralized production rather than putting it over 1,000 home rooftops? I would think that the most widely—the more widely dispersed it is, the better off it is. So why are we focusing on these big facilities out in the desert that are a long way from populations, and of course the further you move these electrons over the wire, the fewer of them reach the other end of the wire, unlike you putting a gallon of oil in the pipeline 1,000 miles away, you get a gallon of oil. You put electrons in a wire, and if you are far enough away you get none of them out the other end of it. So I am having trouble understanding why we are focusing on these large, centralized productions rather than distributing them widely over thousands of house roofs.

Mr. ARVIZU. Let me start. I think our infrastructure today is based on a concept of big power plants, big wires, and so a lot of it has to do with, so how do we assimilate into the infrastructure of today. There is actually a cost issue, the larger scale and certainly in the case of concentrating solar power, one can make the case that there is actually better economics if you aggregate large scale, put this thing all centrally located. There is a value of distributed generation, which I think is to your point that I think we probably miss and don't fully appreciate, and to a large degree we kind of discriminate against distributed generation because it is difficult to hang those onto the grid today. We do need an intelligent grid. We need a grid that can accommodate a distributed set of generation facilities but it is more difficult today to do that. I think ultimately we get to a point where I think distributed generation is valued at perhaps a premium as opposed—because it allows you lots of other flexibilities. But in today's environment, central station power is what utilities like, and when you start—you are talking about RPSs and those things as we have in Colorado. The way you get there most quickly is large solar farms, large wind farms, and that is the kind of thing that people are looking at. I think ultimately we will get to, I think, the broader question that you are asking, which is the value of distributed generation.

NET METERING

Mr. BARTLETT. Thank you. Unless you are producing more electricity this month than you use, don't you automatically have net metering? If you take the meter out and reverse it, you run it backwards. So if you—that is why they put a seal on it, by the way, so you can't do that. Don't you automatically have net metering whether the power company wants it or not if you have solar panels on your roof?

Mr. RESCH. No, you do not. It depends entirely on your meter. If you have your standard spinning meter, the answer is yes, you have the capability of net metering, but it is entirely dependent upon the law of that state. Each state has different net metering laws. In some cases you might spin it backwards and they are only going to pay you wholesale electricity prices rather than retail electricity prices. In some cases they are going to charge you a surcharge for transmission and distribution. It differs by state, every state.

RELIABILITY OF SOLAR ENERGY

Mr. BARTLETT. I have a question—we need to standardize that, of course, but I have a question about grid tie and reliability. I have a wind machine I put up and I find out that it is a grid-tie wind machine and it has to see 120 or it won't produce any electricity. As soon as it stops seeing 120, it stops producing electricity. Now, I understand the reason for that is you don't want to electrocute the poor lineman who has come to fix the wire because you are still pumping juice into it after it is down, but just when I need it most, it is not there. Wouldn't you think that we would be interested in some backup wherever you have solar panels on your roof, and shouldn't we have systems where you can now isolate yourself from the grid and produce electricity for yourself with some storage on site? Just when I need it most, now it is not there.

Mr. RESCH. I think you are seeing significant advancements certainly in the private sector, also the National Renewable Energy Laboratory (NREL) with respect to storage technologies so your typical lead acid batteries, your car batteries are your best option today. I think within a couple of years you will see some very sophisticated storage technologies at a much lower price that allow you to do that, sir.

Mr. BARTLETT. Even if I have the storage facility, my wind machine stops working when it doesn't see 120, or 240. It just quits.

Mr. RESCH. I am afraid that is a subject for another panel. This is just a solar group.

Mr. BARTLETT. When you talk of turning that off, I understand the need for it. You don't want to be pumping electricity into the wire when the lineman thinks it is dead so you are going to electrocute him. I understand that. But you need a way to isolate your home so you still can run your freezer and have lights and so forth when the power is off, don't you?

Dr. ARVIZU. You do, and there is power electronics that we are now working on to solve those kinds of problems so that it is much more user friendly. We have not really focused on those standalone power applications as effectively as we can or should have because other things have taken priority but we are working on those.

Mr. BARTLETT. Thank you.

Ms. GIFFORDS. Thank you, Mr. Bartlett.

SOLAR WORKFORCE TRAINING PROGRAM

A couple questions for Ms. Weissman and Mr. Sarubbi. Arizona is now the fastest-growing state in the Nation, a lot of home build-

ing, and people are really interested obviously. They come out there to get out of the cold and the rain and the snow and people want to take advantage of, you know, the wonderful sunlight we have. So in terms of this training, what kind of skill shortage do you predict in the future related to solar installation and maintenance with this increased demand, and can this legislation address this looming shortage? And also if the two of you would address the question on whether or not we have communities with these training programs that have actually seen an improvement in terms of the quality of the installers of the solar panels.

Ms. WEISSMAN. Thank you for the question, Madam Chair. I think without a doubt, you know, what we are starting with, our goal here is to have a strong market. In order to have a strong market, we need to have qualified installers. We need to make sure that consumer confidence is ensured, that you pay the money that you are paying for a system that is installed properly and that you don't have to come back for service calls or for fixing the initial installation. In order to get to that point, you need training to make sure that we have a good installer population as well as good product to put out on the roof or in the field. We are certainly finding that those installers that go through the North American Board of Certified Energy Producers (NABCEP) certification program are demonstrating a higher level of quality of installation. Now, that does not mean that people who are not NABCEP certified are not qualified. I don't want to imply that. But we are finding that having to go through the NABCEP credentialing process really takes a hard look at some of the most important issues including familiarity with the national electrical code, making sure that—you know, understanding orientation, understanding attachment to the roof, understanding wiring, understanding all the different major tasks and subtasks that are necessary to do a competent job so that we are finding that what the NABCEP certification program is doing is not only certifying and making sure that we have qualified workers but we are making sure that the training is set to those standards to make sure that they know what they are doing, and I think that what NABCEP has done in addition to elevating the workforce, it has also increased the need for good training and education. And we get calls all the time, we get e-mails all the time, where can I get training so I can become NABCEP certified. So what we are seeing is that not only is the credential a great signal to consumers but it is also increasing the need for better training.

Mr. SARUBBI. If I could add to my colleague Jane here, New York State Energy Research Development Authority (NYSERDA) has tied their incentive package to people who are certified, NABCEP certified. So at least the homeowners who are reaping the benefits of this incentive are at least assured that they are getting it from a certified installer, so that is helping improve the standards. And as Jane mentioned, we are getting a lot of phone calls for training in Hudson Valley with the sponsorship of the Interstate Renewable Energy Council (IREC) as well as NYSERDA are doing national electrical code training seminars, you know, for the electrical inspectors out there but also building inspectors. We are doing specific training in that area, bringing as many building inspectors into the fold and the type of solar systems that they are going to

have to go out and approve in the community. So that in itself is helping the standards increase alone. And it is amazing. We had a web site put up just a few months ago as we were getting our solar program off the ground and the amount of hits that we are getting on that web site, you know, showing the interest, you know, from the community out there is tremendous and I am getting nervous from the amount of e-mails that I am receiving on a daily basis from people who are interested in the training, either to receive the training or homeowners who are interested in actually have somebody who is certified, you know, to be able to install it, so they are coming to Hudson Valley. That is where they looking for that information because they are going out in the web: who can I get to come install a nice solar system on the house that I know it is going to be a credibly installed system and it is going to be—you know, meet all the standards of industry. So we are seeing that growth.

Ms. GIFFORDS. The Chair recognizes Mr. Udall.

MORE ON SOLAR WORKFORCE TRAINING

Mr. UDALL. Thank you, Madam Chair. I wanted to come and hear from the panel today. This is an area, as you all know, of great fascination but also great potential. I also wanted to show my solidarity with Dr. Arvizu, who heads up the National Renewable Energy Laboratory, which is in part located in my district in Colorado. This is such an exciting time for us I think as a country and as a broad industry. In Colorado we recently passed Amendment 37, which put a renewable portfolio standard (RPS) in place for the State of Colorado, and I took advantage of that opportunity. I now have a three and one half kilowatt system on my roof. It is fun to make electricity and at the right time of day to go out and see the meter running backwards and knowing that you are not only reducing your own bill but you are putting some power back on the grid. So I want to thank the Chairwoman for holding this really, really important hearing and giving us the opportunity as Members of Congress not only to learn more about what the potential is but also what we can do to help provide greater incentives. Having arrived late, I don't know all the questions that have been asked but I am curious, given the great team that came to install the system on my home, what sorts of stories that the panel has heard both positive and in some cases negative about workers without training attempting to install solar panels. I don't know who would be best to speak to that question. Ms. Weissman?

Ms. WEISSMAN. Thank you, Congressman. Well, there are always stories to tell, and I think that we were finding problems. We are seeing the problems. You know, shading is a big issue. Certainly in some parts of the country with, you know, the trees, a small tree today could be a big tree tomorrow and so are seeing that those, you know, installers who are not properly trained are not, you know, realizing that shading is a real issue, and if they don't see the tree and the leaves and even the trees in the winter when there are no leaves in certain parts of this country that this will be a problem. Most states do require that a licensed electrician do the final hookup of the system, and we think that is great and that is how it should be, but what we are also finding is that different

trades who know their trade very well may not know solar very well, and so certainly training is very important on the actual, you know, the characteristics of solar and the technology and what is needed to put up a good system. So what we are finding and you know, what we are seeing now too with more incentives going on both at the State level and the federal level, is what we want to prevent is any guy or gal with a truck and a ladder to think they can put this stuff up on the roof. That is not true. You know, it is going to be a problem. So that even those people that may feel that they are doing a good job may in fact not be. It was interesting, when we started NABCEP, the certification program, we had a lot of the old timers say, you know, I am not going to take a test, I know what I have been doing, I have been doing this for 20 years, grandfather me in, and we said absolutely not; we are not going to give you a seal of approval. You know, if you know what you are doing, you are going to pass this four-hour exam and, you know, that will show proof that we can give you the certification mark. So we are pretty serious in terms of making sure that if we are going to certify somebody, they know what they are doing and prevent some of the stories that we have heard or that we have seen, some of the mistakes that have been made, some of the stupid mistakes that have been made out in the field. What we want to make sure is customers are going to get, you know, a well-run system that is going to last a long time.

Mr. RESCH. And just to add one other comment. The IBEW has done, I think an excellent job in training in certain key markets but starting to go national training their members to certify and install solar systems in an appropriate manner. So I think that—when you start to see that shift where you have large trade unions, where you have, you know, large roofer groups starting to reach out and train and educate and, if you will, give them new skill sets, I think that is a fundamental sea change in the capability of installers going forward. Certainly linking with Jane's program at NABCEP is absolutely critical as well.

Ms. WEISSMAN. But if I can just add onto Mr. Resch's comment, the International Brotherhood of Electrical Workers (IBEW) and the National Joint Apprenticeship and Training Committee (NJATC) do sit on the board of directors of the North American Board of Certified Energy Practitioners so we have been very involved with the union from day one. In addition, the NJATC, the training arm for the IBEW, just published a fantastic textbook on photovoltaic systems which I know that a lot of the community colleges are beginning to use as their main learning tool.

Mr. UDALL. I see my time has expired. If the Chairwoman would indulge me for 30 more seconds?

Speaking to your comment about shading not only with leaves on trees but the tree branches themselves, that was one of the processes we had to go through. We had a big old cottonwood tree that was blocking at certain times of the day the system, and I found out in the process of installing the system that if you have any shading on any part of the system, it affects the overall system in very dramatic ways. So we had to make the decision. It was almost like letting go of your firstborn child, taking down this tree, but I was convinced that taking down the tree was worth the pain be-

cause of the benefits that you accrue, and I was told that taking down the tree but at the same time installing the system was the equivalent of planting 100 more trees. So I hope that sales job was accurate. This was a learning process for myself and my family.

I thank the Chairwoman for her indulgence and for holding this very, very important hearing. These technologies and what our economic future will involve. It is also about energy security and about environmental benefits, so this is very, very important. Thank you.

Ms. GIFFORDS. Mr. Inglis.

Mr. HAYDEN. Could I add to some of those comments, Madam Chair? Some comments have been made including yours just now which I would like to kind of try to—understanding though that the issues that we are running into about the shading, the tree, distributed—point up that there is need for more than one piece of the solar solution and the distributed solution that has a lot of public popularity has its limits that are important for us to overcome to get a large percentage of our energy to come from solar. For example, we have our solar test site in Tempe, Arizona, and I can tell you that the college students that live in the condos and the urban area, they do not have the option of having solar on their roof. I live in Tempe, and even though I work on solar, my solar panels are with APS's site at Prescott, Arizona, and the reason is, as an engineer I know that they are far more productive than they would be on my roof, and that is important to me. If I am going to see a lot of our resources put into a very important solar panel and also find storage options, I don't want to see them wasted in an imperfect application. So to address some of the points made, there is—about 85 percent of the energy that comes from a Four Corners power plant makes it to the customer in Phoenix. The highest fraction of that energy goes over the wires. The wires are very good at delivering energy. So even though we do see the value of rooftop solar, it certainly won't get us to the 40 percent-type number that solar I think could get if we are allowed to build larger facilities that are more efficient, bring the power in to where it is needed, and secondly, to bring in the storage technologies that would allow the utility to help provide that backup power that otherwise these panels can't do on their own. So it underscores I think one of the values of this discussion is that it is not a one size, one solution fits all. If we want mainstream America to use solar, we have got to make it easy. We can't just make it for us environmentally motivated folks to be the only ones using solar. Thank you.

EFFICIENCY OF SOLAR ENERGY

Mr. INGLIS. A follow-up on that. If the efficiency of the conversion were higher, it would make the distributed more attractive, right?

Mr. HAYDEN. No, not at all. The efficiency is a good parameter but the fluctuation is the issue that talks about reliability. In fact, when we build a project of any size, we have to look at the reliability on customers. The Congressman talked about the wind system tripping. That also affects things like your power electronics, manufacturing businesses, power quality. So if you do have an efficient system that is good for its economics but there will be interruptions from clouds. There will be interruptions for other reasons and we have to match the load.

STORAGE FOR SOLAR ENERGY

Mr. INGLIS. Which brings me to the other question which is about the storage issue which, from what I have been hearing this morning, is crucial. It seems that the section of the bill—sections of the bill dealing with that are relatively brief. Is there something else we should be saying in those sections about storage besides what we are saying here?

Mr. HAYDEN. We discussed that before. We provided testimony on that very subject because we see more than just the thermal being possible storage solutions. The thermal is worth mentioning because in the case of certain technologies, thermal is very directly used but there is other proven large-scale solar technology for storage—I am sorry—storage technologies such as compressed air energy storage, other things that while we are all waiting and working on the new batteries, there are things that can be done sort of on a regional basis.

Mr. INGLIS. I suppose these battery breakthroughs really could also be the—I mean, there are a number of things that if they broke could make it so that there—if we had the breakthroughs in a various number of areas, you would have wide scale—more use of the resource, right?

Dr. ARVIZU. There is no question about that. Storage has continued, as I call it, to be the Achilles heel of renewable energy in general. If we just had a better storage system—we have been working on batteries for a very long time, literally, you know, decades. And progress is slow. Progress—we are making progress but progress is slow, and I think ultimately, you know, converting wind and the other intermittent type of resources to some sort of energy carrier like hydrogen or compressed air, whatever it might be, is really going to change the economic equation considerably. I know I sit on the National Science Board and we are doing things for—actually trying to provide power at the South Pole while we are doing some fairly energy-intensive experiments, and what are looking for stand-alone systems that are not polluting, because right now we have got—we are polluting in the southern hemisphere because of all the diesel fuel that we are using down there. And we are looking for, you know, some of these advanced concepts that down there you would pay an exorbitant amount of money for that particular application and there are some things—we are looking at how can you convert wind energy to hydrogen and to use it when you essentially—when the wind doesn't blow or solar energy to hydrogen or a variety of other technologies and things, and I think ultimately you need to look at that whole system's architecture. So you need to look at them in the broadest context. You know, I am very bullish on the fact of zero-energy buildings. We use more energy in buildings than in most any other application that we have and so the distributed value on a building that is efficiently designed with its own power generation source and its own storage has great value and benefit. At the systems level, is it still a little bit costly although we are making huge progress and we have got examples of Habitat for Humanity homes that generate more energy that they consume, and so it can be done on a modest building, and it is a matter of changing a variety of things. It is what

we talked about earlier, bring the price signal where the decisions are being made. You know, construction for buildings is not incentivized to save energy. And so all those things need to be part of the package and I think we need to look more holistically at the whole issue.

CONVERSION TO HYDROGEN

Mr. INGLIS. To the objection I hear, and when I talk about hydrogen, about why convert, just out of curiosity, it is not exactly a subject of this hearing but why convert to hydrogen in those cases you talked about, particularly at the Poles where Dr. Bartlett and I saw the same thing you are talking about, diesel fuel being brought in belching out the smokestacks when we got a lot of wind and a solar there.

Dr. ARVIZU. The why convert part is because it really is an elegant solution. You don't pollute anything, obviously. You convert—you know, you change water to hydrogen and oxygen and then you use the energy and it converts back to water. It is very costly at this point and that is the reason that we don't do it more, you know, uniformly elsewhere. But in that particular environment, the cost that you pay for the energy of transporting fossil fuel down there is exorbitant and there is just no reason why you wouldn't in terms of economics do the thing that is less environmentally insulting than the other thing.

Mr. INGLIS. Thank you.

Ms. GIFFORDS. Mr. Hall.

Mr. HALL. Thank you.

MORE ON SOLAR CHECK-OFF PROGRAM

Mr. Resch, you know, as in some other fields, global warming, for instance, everybody talks about the cost and the fears and the projections and predictions and all but most of those people that are recommending that we just go all out on global warming fail to talk about cost. They shy away from that. They don't want to talk about who has to go by the cash register at a time when China is polluting on an increasing ratio with coal. So I will ask you something. How about the industry? Has anyone expressed any concern about planning the assessment, and will this result in increased cost to the consumer? I don't see how you can keep from it, but you would have to answer that. And how much would the assessment be and how is it going to be done, case-by-case basis or individually?

Mr. RESCH. Thank you for your question, and with respect to the check-off program, I think there is initially concern about what is the right way to structure it, where do you assess within the solar stream, how far upstream, how far downstream, do you assess at the installer or do you assess at the manufacturer, should it include all equipment, should it just include PV modules, what about solar water heating. There are a lot of questions and I think good questions that need to be resolved and I think the way this program is structured is, it has flexibility, that all the rules are not set in stone, that there is an opportunity to adjust the rate or determine an appropriate rate that would actually produce an appro-

priate amount of money that, you know, first the industry is willing to spend and raise and that it doesn't penalize the consumer or penalize the manufacturer to the greatest extent. So, you know, I would say we don't have all the answers but part of that is the discussion with the Department of Energy and getting the board together to determine what is the right level and just make sure all the right players are involved. I mean, we have a couple of suggestions in our written testimony for improvements to the program and I think what you will find is that most or all of the manufacturers will agree that what is needed is a campaign along these lines. They may disagree on timing when that program should be in place but all of them want to participate and make sure they have a voice in the development of that program.

Mr. HALL. Well, we got airliners that, all except Southwest, are going broke flying full and going broke because of fuel and they have to turn to the consumer. You might hear in the city of Washington the cab drivers I think at midnight last night increased their minimum fee to $2.50 instead of $1.50. That has gone up almost 50 percent. How are we going to keep the assessment from going to the consumer? Why wouldn't it?

Mr. RESCH. Well, there is two ways to look at it, one of which is that as there is more competition, there is a lot more pressure on the price downward, and when you look at the oil and gas industry other than propane, they shy away from any kind of structure along these lines because it actually goes back to the producer, that the costs are passed back to the producer, not onto the consumer because the consumer is only willing to spend so much, and what we have really seen in the solar industry in the last couple of years is increased competition, increased competition to put cheaper panels. They are scaling up manufacturing. Prices are coming down. You know, feedstock materials are starting to increase in supply and again putting downward pressure on the price. It is unclear. I mean, I think if you were to step back with an economist, you would have one—two economists, one of them would say it is going to be passed on to the consumer, the other would say that the manufacturers will absorb the cost. But I think what we are looking for, you know, is a level of assessment that is small enough so that it is not a major hit on either side, the manufacturer's side or the installer's side but yet collectively as this industry grows, we can use those resources to educate the public on the benefits of solar energy.

Mr. HALL. To be continued?

Mr. RESCH. To be continued. Absolutely.

Mr. HALL. Let me ask the panel, if I have some more time here. The language of the bill provides for criminal penalties for release of information obtained under the authority of the Act to "any agency or officer of the United States for any purpose other than implementation of this Act." What information do you think they are seeking to protect here? What is being protected, and do you agree that criminal penalties are necessary?

Mr. RESCH. Well, I think a lot of it is confidential business information and, you know, I think that part of that provision you are referring to goes back to the hey, you know, we need you to open your books in order for us to make sure that what you are report-

ing to us is accurate if you are participating in this program and that if that information leaks out-a lot of it is CBI that you would want to make sure that companies are comfortable with the government looking into their books with respect to confidential business information, if I am referring to the section of the bill that you are.

Mr. HALL. It is a mandatory program?

Mr. RESCH. It is a mandatory program that companies can opt out of.

Mr. HALL. And it is pretty strong language, "any agency or officer," that provides for criminal penalties. That is pretty strong. Do you agree that criminal penalties are necessary?

Mr. RESCH. I think that what——

Mr. HALL. You may not have an opinion.

Mr. RESCH. This program is modeled after the existing agriculture programs and, you know, what I would say is, certainly we can discuss the right way to ensure compliance and maybe that is an overly aggressive way and maybe the way it works in agriculture shouldn't—you know, we shouldn't be doing it in energy. But I would say this is modeled after existing programs. So it seems to have worked previously but certainly there is opportunities to modify it if necessary.

Mr. HALL. My time is up. There is a lot more we could discuss, but I can do that with you by letter. I thank you.

Ms. GIFFORDS. Thank you, Mr. Hall.

MORE ON SOLAR CHECK-OFF PROGRAM

And Mr. Resch, just to clarify, how many other programs are out there that we are looking at? I know we talked about milk, we talked about beef.

Mr. RESCH. There are 17 programs right now between energy and agriculture that are promotion programs along these lines.

Ms. GIFFORDS. And have there been problems with companies and confidentiality and issues like this in the past that we know of?

Mr. RESCH. I would have to get back to you on that. I don't have specific examples. I imagine that they are consistently written in the same manner in order to address concerns that have been raised in the past but I am not entirely sure.

Ms. GIFFORDS. Mr. Hall, we will get back to you on that because I am curious as well.

Mr. Bartlett.

Mr. BARTLETT. Thank you very much. I would just like to note that if there were an unending succession of ANWRs and we were willing to pay the price for sequestering the CO_2, we wouldn't need to be talking about solar, would we? But the reality is that there is not an unending succession of ANWRs. I have ten kids, 15 grandkids and two great-grandkids, and wouldn't it be nice if I left them a little energy for their future, which is one of the reasons I won't vote to drill in ANWR until they commit to me they are going to use all the energy from ANWR to invest in alternatives because today we have no surplus energy to invest in alternatives or oil wouldn't be $69 a barrel, right?

I would also like to note that unless you are making hydrogen from a non-fossil fuel, using hydrogen probably results in a larger carbon footprint than not using it unless you are going to use it in a fuel cell, which we don't yet have because you will always get less energy from the less hydrogen that you get from the energy source in which you produced it. If that is a fossil fuel, obviously burning hydrogen in a reciprocating engine is going to leave a larger carbon footprint than if you hadn't used the original fuel. Just noting how we are creatures of habit, I was at the South Pole twice in the last five years. For six months the sun shines all day, every day and the wind never stops blowing, and we create essentially all of our power there from flown-in diesel. Now, is that dumb? We are really creatures of habit, aren't we?

You know, the sun is 93 million miles away. I have a place in West Virginia. My friends are amazed that I make ice from the sun. I have a Sun Frost refrigerator hooked up. But I put my first solar panels on the roof. I have 153 acres. They said, why in the devil are you doing that. You know, the sun is 93 million miles away. If I put it on the roof or on the ground beside the building, it makes no difference as far as the sun is concerned. It is very much cheaper and easier to put it down on the ground. So unless you are in a subdivision and have got to put it on your roof, don't put it on your roof. It is a whole lot easier to maintain on the ground. A big cost, a big part of the cost of putting in these solar panels is just the carpentry or whatever you want to call it to mount these things, and you don't need to have some guy do that, you know. The Home Depot has a great slogan, "You can do it. We can help." We need to be telling these people how to mount it. I don't have any problem with a certified electrician hooking up the power. Wiring them and hooking it is a very small part of the cost of putting them in, and you don't need to have somebody come put it in. If you can change a faucet washer, you can install solar panels. It really isn't that tough. So I would just encourage you, you don't need to further increase the cost of putting these in. You can do it; we can help, and we need some help out there like, you know, you don't put it where it is going to be shaded and so forth.

MORE ON STORAGE FOR SOLAR

Let me ask you a question about storage. Isn't it true that for these large facilities, it is hard to beat the battery that never fails, which is—unless you have to replace the pump or the turbine. Why don't we just pump water uphill and then let it flow back when we need the energy? Isn't that about as good a battery as we can get with about as high efficiency as any battery we have got?

Mr. HAYDEN. Simple answer, yes.

Mr. BARTLETT. Yes. If the project permits it, why shouldn't we be doing that everywhere?

Mr. HAYDEN. Well, everywhere including desert climates where water is—Arizona is an example where it is done today on hydro plants that exist. Creating a new hydro plant just for that purpose would require a high reservoir, a low reservoir, water, et cetera. So those are the practical issues. I do recognize pumped hydros being a very excellent efficient solution when you can do it. Compressed air is another one that we are looking at it because it has similar

favorable attributes, different implementation. But in terms of Arizona as an example, most of the lakes, water flows downhill so there are those places where it has been done, Roosevelt Lake and others, I believe, but I think that in terms of creating new lakes just for that purpose, that would be quite a challenge on the water side.

Mr. BARTLETT. There are a lot of places where the topography and the water available——

Mr. HAYDEN. If I may, I know that those discussions have been taken to the dam operators and they have had challenges in terms of their most economical operation of that asset. So you would have to take that question to some of the existing dam operators.

Mr. BARTLETT. I would just like to note that if you don't have electricity, the thing you miss the most is lights, and it is very easy, and I would encourage—I would hope that we would encourage people if they are putting in a stand-alone system that they use direct current lights. You don't need an inverter. It is really simple. You have a solar panel and you have lights, and if they are direct current, they work, and there is really nothing to fail. So the first thing you miss in your home when the electricity goes off is the lights go off, and if you are looking at those things that make life comfortable, you know, being able to see and have lights is very essential, and that is pretty much a failsafe system if you have direct current, DC. If you have 120 volts, you got that really complicated inverter full of—I don't trust computers in these little things. They may or may not work. The lead acid battery works all the time, doesn't it? And you don't need anything in between the battery and your 12-volt or 24-volt or 48-volt valise on your fluorescent lights, do you? It is a very efficient use of electricity and very failsafe, and I think more people ought to be encouraged to put those in, and that is so you can see your way around the house when the lights go out, right?

Thank you very much, Madam Chair.

Ms. GIFFORDS. Thank you, Mr. Bartlett.

WATER USE FOR CONCENTRATING SOLAR POWER

We don't have a tremendous amount of time left and I would like the panel to focus a few minutes on this issue of water, and Mr. Hayden, perhaps Dr. Arvizu as well. You know, obviously out west we do have some real issues in terms of just not having the water. We have got 25 million users on the Colorado River right now. We are in a drought. We have increased demands of the current water supply that we do have. So I am interested in terms of the requirements for a CSP plant. Can they be built to use air cooling instead of water cooling enabled to eliminate the water requirements, and are water constraints an obstacle to the wider adoption in your opinion of CSP technologies?

Mr. HAYDEN. Thank you, Madam Chair. Yes, water is an issue. It is one of the issues that is on the sequence of working through the biggest challenge of cost just to get us started which fortunately, in my years of working this, I see a lot of progress right now so I am happy to hear that we are starting to look at the water, meaning that we are serious about this moving forward, and it is absolutely an issue. The present day CSP systems use water

for cooling to about the extent that a conventional power plant does, and therefore it is acceptable in some views but we would like to do better. Obviously a lot of farmland is getting converted for residential largely because of water so the water situation is not static. It is becoming more of a pressure. So in every sense if we want to use more of this energy technology, reducing water use is important. In terms of the present-day designs, there is something called air cooling where they replace the water evaporation cycle with fans and just move the air through a radiator-type structure. That can be done today but it wasn't the economical solution for the present-day installations. It is available today but we would like our cake and eat it too. We would like it to be available and also more efficient and less costly. Secondly, I will mention that other concentrating solar power technologies including concentrated photovoltaics, dish engine technologies don't use water cooling at all. So when we again talk about CSP, usually we are talking about the trough technology with water cooling but there are other technology solutions that will compete with the trough and so a trough needs to try to move itself forward with water reduction and at the same time these other technologies might come forward and be low-water-use technologies. In fact, we sometimes notice how little water is valued on a dollar basis and yet how much it is valued on an emotional basis, and that sort of contradiction is what we are grappling here with on its application with solar.

Dr. ARVIZU. If I could add just a little bit on that. Absolutely, I think we have been looking at technologies that really don't use, you know, any water that is not self-contained in the system. You know, for a long time, I can remember in the 1980s we looked at a variety of gas-cooled reactors. We looked at—we have actually the best heat transfer medium for these concentrating thermal systems is typically a molten salt or something that has got a very high specific heat to it. So you don't have really a contained water need for the actual, you know, working end of those particular plants and there are ways to get around having to use any water if you really chose to do that, but it is a matter of economics. It is a matter of pushing the technology and making it most cost-effective. And there is in fact as Mr. Hayden says this whole idea that you can put concentrating photovoltaics. The biggest problem with these concentrating systems, as I mentioned in my testimony, is the upfront capital cost, and one of the things that we are looking at is how can you reduce that cost dramatically in some of these concentrating—troughs in fact are some things that are being pioneered right now in Australia that are I think very cost-effective and also can be done in a manner that is very, very miserly relative to the water use. So this is not a problem that I believe is in any way a showstopper or couldn't be overcome but for the will and the R&D program that goes along with trying to stand up with some pilots to make sure that it operates the way we think it ought to.

CONCENTRATING SOLAR POWER

Ms. GIFFORDS. A couple other questions, because I know we are running out of time. First of all, APS, Mr. Hayden, I understood

took 14 years to construct the solar trough, 14 years, I think. Why was the hiatus so long, and is that something that we can learn from as well?

Mr. HAYDEN. Well, the proper way to look at that 14 years is, no one had done it in 14 years and we chose to pursue that, and I will give you a pragmatic answer. I have been going to DOE meetings for all my career and having the solar industry run up and say buy 100-megawatt power plant and everything will be fine. Now, we are talking about hundreds of millions of dollars when they do that and we under a regulated structure do not have the opportunity to just spend hundreds of millions of dollars that is not least cost so what we chose to do was to challenge those solar companies to make a small-scale plant just to prove that they could get on their feet again because the present regime of folks making the trough is not the same folks that built it decades ago and they actually needed to give a new start. So literally when they built our first megawatt, it was all of a sudden kind of a deer in the headlights moment when oh, you mean we really have to build this thing, and they had fundamental decisions such as were they going to use aluminum or were they going to use steel, who were they going to get their tubes from. So fortunately, even though one one-megawatt is a very small project, it gave them the opportunity to start getting it together, and then when they had the 64-megawatt opportunity in Nevada, they had momentum. All I can say that we did was, we broke the ice. We didn't have dollars available under our regulated structure to buy hundreds of megawatts but we did have the dollars available to break the ice.

MORE ON SOLAR WORKFORCE TRAINING

Ms. GIFFORDS. Before I turn to Mr. Inglis, Mr. Resch, if you could address Mr. Bartlett's comments about—and I know he had to leave—about just anyone being able to kind of put on these solar panels and—I mean, I am not an expert but it sounds—what I have seen is pretty complicated stuff.

Mr. RESCH. There is two points I will make there. First is that Home Depot does sell solar panels in New Jersey and in California, and if you wanted to go out and by a solar system, you could do it. Say you have a garden shed and you wanted to put lights up in the back, very simple, you know, something you could do. You are dealing with electricity so you have got to be smart about it and so you don't want anybody—you don't want your kids running out there and playing around with it. I mean, it is electricity. But when you really do step back and understand electricity, it is fairly understandable. Now, he is referring to a direct current, a DC, versus what we actually use in our homes, which is alternating current, so it gets a little more complicated. You have more equipment. I decided to use a contractor to install the solar system in my house because I don't want to climb up on a roof, first of all. Second of all, I don't really understand electricity all that well in the sense of how I install it in my home, and just like anything else, I went out and I got three bids, and so when Congressman Udall was talking about shading and all the rest, well, you know, there is a little bit of the buyer beware. You want to get three bids, just like you would for any system. When you install an air condi-

tioning system in your house, a hot water heater, you are going to get a couple of bids and then find out which one is the best and which one seems the most knowledgeable. So I would tend to say that we are not quite there with the technology to say it is plug and play, any consumer could go out and just quickly install it on their house with respect to photovoltaics. I think we will get there at some point in time. We are not there yet.

Mr. SARUBBI. Can I just add to that? Teaching electricity in my entire career and former electrician, I would be a little nervous to know that homeowners were going to go out on a regular basis and install systems, you know, when we talk about grounding needs, when we start talking about liability because the first time there is a fire at somebody's house, the thing you hear most often is that it came from electricity, it was an electrical problem. So we certainly don't want to create that environment with the solar industry where people are going to Home Depot and not that they can't buy that small type of system but if I am going to be putting a 3KW, seven or even 10KW system on my house, I want to know that it is installed by a certified, you know, company that I have got longevity with that system and so I would be a little leery about moving in that direction at this point in the industry. And DC in reference to AC, converters today are so much more efficient and reliable, you know, that I don't see the conversion of moving to DC, you know, in our house, direct current power and retrofitting all our lights for that, you know, environment, as opposed to staying with alternating current just doesn't make sense at this point.

MORE ON SOLAR CHECK-OFF PROGRAM

Mr. INGLIS. Just one quick follow-up. We were talking earlier about the reporting requirements and the disclosure of information, and did anybody want to make any further comments about that? Is there something about the disclosure of information that was of concern in previous programs, these 17 programs?

Dr. ARVIZU. I am not exactly sure what the major issues were. We are aware of some lawsuits that have been brought against the U.S. Department of Agriculture based on those programs. It kind of—it highlights the fact that there is a liability issue or risk that comes along with monitoring or administering one of these programs, and I don't have the details of that but I would suggest that there is a lot more to be—to explore regarding what assumption of liabilities there are in administering the program.

Mr. INGLIS. I have no further questions, Madam Chair.

Ms. GIFFORDS. Before bringing this hearing to a close, I just want to thank all of our panelists and I really want to thank you for the time and the effort that went into preparing for your testimony today and for helping to craft this legislation. I also want to thank the other Members for being here and asking some great questions. I learned a lot and I hope that Members did and the general public as well.

The record will be held open for additional statements from the Members and for answers to any follow-up questions the Subcommittee may ask the witnesses. The witnesses are excused and the hearing is now adjourned. Thank you all very much.

[Whereupon, at 12:00 p.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Herbert T. Hayden, Solar Technology Coordinator, Arizona Public Service Company, Phoenix, Arizona

As the Solar Technology Coordinator for APS, my field of activity has been on the technological assessment and advancement of solar technologies. I am pleased to offer my views on the technical topics such as thermal energy storage, solar integration to regional transmission grids, and reduction of water consumption as these issues relate to larger scale solar technologies such as concentrated solar projects (CSP).

However, there are other aspects of the proposed legislation pertaining to workforce training and the promotion of solar power anti certification, which are policies more directly impacting manufacturers and installers of photovoltaic systems (PV), and other solar-related equipment. Those questions would be better answered by those individuals who are more familiar with the public policy concerns associated with the development of the solar industries. My answers in those areas are limited and I respectfully defer to others who may feel qualified to address those issues.

Questions submitted by Representative Ralph M. Hall

Q1. Are you familiar with the Institute of Sustainable Power? Do you feel comfortable having them run a certification program? What type of a fee would you envision would be required for them to "certify" workforce training programs?

A1. I am not familiar with the Institute of Sustainable Power

Q2. Have you reviewed the legislation being proposed here today? Do you think it makes sense to create two additional layers of bureaucracy for the Secretary of Energy to promote solar power or do you feel it would be easier to just give DOE a grant to promote solar power? Please explain.

A2. We believe the objectives of the legislation regarding thermal storage and CSP are appropriate and productive. I have not reviewed the referenced legislation in regards to the education and promotion of solar power, and I do not have an opinion on those aspects.

Q3. Do you think solar power needs to be promoted in order to be successful as an energy resource?

A3. I believe that solar power is a proven energy technology, however the costs of solar are still too high for it to compete as an energy resource of substantial scale. Solar costs can be further reduced as the technology advances and matures, and incentives for the use of solar will allow that to happen more quickly. Promotion of the benefits of solar power can also encourage the use of solar.

Q4. Do you support the language in the bill that requires private companies to open their books and records to Members of the Board for inspection?

A4. I have no opinion on this question.

Q5. The language of the bill provides for criminal penalties for release of information obtained under the authority of the Act to "any agency or officer of the United States for any purpose other than implementation of this Act." What information do you believe this language is seeking to protect? Do you agree criminal penalties are necessary?

A5. I have no opinion on this question.

Q6. The language of section 9 requires the continuation of the solar promotion board and committee should be contingent upon a vote by the manufacturers and importers. Would you support a referendum prior to creation of the Board and Committee? Why or why not?

A6. I have no opinion on this question.

Q7. What enforcement by the Secretary of Energy do you envision that might warrant a civil penalty for noncompliance under section 10 of this bill? Is this section necessary?

A7. I have no opinion on this question.

Q8. What type of investigation do you believe it would be necessary for the Secretary of Energy to conduct under Section 11 of this bill?

A8. I have no opinion on this question.

Q9. How will your organization benefit from this legislation?

A9. APS, as a public utility with a strong commitment to the development of renewable energy resources would derive benefits from a comprehensive energy bill that a) provided incentives for utility use of solar, such as the ITC, and b) aided in technical areas such as thermal energy storage, reduced water consumption, and the integration of CSP facilities with regional transmission grids.

Q10. What kind of yearly revenues does the solar industry have which could be used in a promotion program as envisioned by the legislation?

A10. I do not have the knowledge of the facts pertaining to solar industry revenues.

Q11. Where does each of you see solar power as a part of the Nation's energy mix by 2015 by percentage if this bill is enacted?

A11. Solar is the largest renewable energy resource in Arizona. If you add the possibility of integrating solar energy into the regional transmission grid and improving its availability with storage or other methods, the contribution of solar energy in sunny regions like the southwest could help states in the southwest and west reach their overall renewable energy goals, which currently range from 10 percent to 20 percent or more. I am not in a position to determine how this would translate to the Nation's energy mix as a whole, where other renewable energy resources may also contribute a substantial share of the Nation's energy mix. However, from a technical perspective, the intermittent nature of solar energy resources requires utilities to rely heavily upon conventional energy resources to meet customer demands and to protect infrastructure. If technology is developed to allow for solar energy storage or other means of making the output of a solar plant firm and reliable, this would make solar energy more viable for a greater share of the Nation's energy mix.

Q12. What is your view of cost sharing of the training programs between the states and Federal Government?

A12. I have no opinion on this question.

Q13. Are the unions opposed to the training provisions in the bill?

A13. I have no information on this topic.

Q14. Is the Draft discussion draft duplicative of any current programs? If so which ones? What are the metrics that will evaluate success of the training or solar programs?

A14. I have no information on this topic.

Q15. Recognizing the scarce resources of the Federal Government, would you rather see tax dollars go to innovative technologies or advertising solar power?

A15. From my perspective as a technologist, federal support for innovative technologies is critical. However, the question about whether advertising is a more effective way to use tax dollars is outside of the purview of my work and is an issue better answered by others.

Q16. In your opinion why does the contribution of solar power remain relatively low? Is it ultimately due to the cost?

A16. Cost is certainly a major reason the contribution of solar power in the overall energy mix remains low today. In addition, most solar technologies generate electricity only when the sun is shining so other sources of electricity are necessary to provide firm electric power in response to customer demand. For those solar power technologies that include storage capability, cost continues to be a factor since the cost of storage adds to the overall cost of the infrastructure. Both issues will need to be addressed for solar to become a larger part of the electric energy mix for any electric power utility.

Q17. The Thermal Energy Storage Section of the discussion draft is quite brief and your testimony seems to focus on the need for a great deal of research and development into the area of thermal energy storage. What elements do you feel should be addressed in a thermal energy storage research and development program?

A17. As to the elements that should be addressed in a thermal research and development program, the key is that the market related to this technology responds to demonstrated solutions. Therefore, even existing technology concepts could be more

rapidly accepted as economically feasible if there was a commercial demonstration, and one that exhibited favorable cost, environmental and reliability features. Studies and lab validations are an essential first step. However, to attract the kind of up-front capital needed for a commercial project, a significant demonstration with an ongoing field operation may prove necessary to satisfy investors.

Q18. Are you supportive of a check off program for solar energy as included in the discussion draft? Would ASP be a participant?

A18. My understanding is the term "check-off program" relates to a program for solar education and promotion that would apply to manufacturers and importers of solar products. Whether APS would be a subject to such a check-off program will depend on a variety of factors, therefore we would seek clarification of how the program could apply to a utility that could be working with solar products.

Q19. You mention the use of federal land for locating large scale CSP. What environmental, including siting concerns, do you see being faced by such a project? 2,500 contiguous acres of land is how big of an area? Can you give me a frame of reference?

A19. In regards to the reference to 2,500 acres of land, consider that a square mile "section" of land is 640 acres. The 2,500 acre suggestion would be about four square miles, and could accommodate sufficient CSP facilities for the generation of approximately 500 MW of power. The factors that would have to be considered as part of a site selection would be an Environmental Impact Statement, consideration of impacts on adjoining property uses, the available natural resources, zoning restrictions, taxes, etc.

Q20. You've testified that CSP is "the most cost effective solar technology" and the one that has the "greatest potential to compete economically" with conventional generation. What are the relative costs between CSP and conventional generation? Could you elaborate on the figures you are using? Follow up—You have testified in favor of a long-term extension of the 30 percent Investment tax credit (ITC). How long is "long-term" in your mind? And as you've said the potential for CSP to be competitive is so great, would it be so without the ITC in place.

A20. Projects with commercially demonstrated CSP technologies are being offered at less than twice the cost of conventional generation, sometimes significantly less, but not quite competitive with conventional generation. These current project costs are dependent on the 30 percent ITC, currently available to third-party owners. The ITC reduces the cost sufficiently to make large scale CSP attractive to many utilities. If the ITC is not extended, we believe large scale CSP plants will be simply too expensive and will not be constructed in the foreseeable future. Large scale CSP plants take a minimum of three to five years to site, permit and construct. Consequently, the ITC should be extended for a minimum of five years, but ten years would be preferable. We believe that ten years would be sufficient to generate numerous projects resulting in greatly reduced costs and a sustainable industry, independent of tax credits.

Q21. Would you favor extending the 30 percent ITC to public utilities? If it were to be extended to these entities, would it make sense to place greater costs for research, training, land use and environmental concerns and the overall promotion of solar power on these public utilities?

A21. Generally, we favor the use of a meaningful ITC program as an incentive to public utilities for the investment in renewable energy facilities such as CSP. However, an ITC has to be carefully weighed by an organization contemplating using the ITC to see if its operations qualify, and whether the conditions on the ITC can be met.

Q22. Mr. Hayden, you mention in your testimony that one of the main issues with solar and wind energy is their intermittency. You suggest that we need more R&D into the area of storage. Are the storage issues different between wind and solar energy? Should we focus our energies on storage for stationary applications generally so that we could use the research for more than just solar technologies? Without adequate storage technology, how much growth can reasonably be expected in the solar energy market?

A22. Wind and solar energy definitely have different storage issues in terms of availability and compatibility with current technologies. Wind energy technologies and the various kinds of solar energy technologies would integrate differently with the known available storage technologies, such as thermal, compressed air, pumped

hydro, and batteries. For example, any source of electric energy could be used to drive the compressor of a compressed air storage system, or to pump water for a hydro-storage system, which stores the energy for later use. However, since the CSP systems use thermal processes, they have a unique opportunity to use thermal storage more directly by storing solar heat before it is used to make electricity.

In summary, a broad support of stationary storage solutions in conjunction with the development of CSP resources is a good idea, and thermal storage technology is particularly well associated with current CSP plans. Without some means of addressing the availability of intermittent renewable energy sources, and providing incentives such as ITC and rate recovery, public utilities like APS will continue to find it difficult to expand solar energy in its energy mix. APS regards all of these issues as important to the further development of renewable energy resources and without some changes in these areas, electric utilities will continue to primarily rely upon traditional energy resources to meet their customer needs and protect existing infrastructure.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Rhone Resch, President, Solar Energy Industries Association

The Solar Energy Industries Association thanks the Subcommittee for the opportunity to testify and to provide written responses to questions asked by the Committee Ranking Member. On the questions pertaining to workforce training, we would defer to those expert witnesses who appeared before the Subcommittee to testify specifically on the workforce provisions in the discussion draft. Should you have additional questions either relating to or independent of the responses below, please do not hesitate to contact our offices at your convenience.

Questions submitted by Representative Ralph M. Hall

Q1. Have you reviewed the legislation being proposed here today? Do you think it makes sense to create two additional layers of bureaucracy for the Secretary of Energy to promote solar power or do you feel it would be easier to just give DOE a grant to promote solar power? Please explain.

A1. SEIA reviewed the discussion draft prior to the hearing and has since had the opportunity to review the provisions that were passed out of the Committee. Based on our reading of the draft, the primary composition of the Board, and the direction it is to provide, will come from industry. The participation of the Secretary of Energy on the Board seems appropriate, given the large role the DOE plays in the development of solar technologies, but it seems clear that the solar industry will (appropriately) remain the lead agent in disseminating information about solar products.

Q2. Do you think solar power needs to be promoted in order to be successful as an energy resource?

A2. Solar power, particularly in the distribution generation model, requires increased consumer awareness in order to achieve greater deployment. As we have stated in written testimony to the Committee,

> Though growing exponentially and constantly innovating, the U.S. solar industry is still in a nascent period. . .solar [photovoltaics] provides less than 1/30th of one percent of the current U.S. electricity supply. Furthermore, PV is primarily a distributed generation technology that is installed on the rooftops of homes and businesses throughout the U.S.—a paradigm shift from the traditional model of centralized electricity generation. Most solar installation companies are small businesses, typically employing no more than a few dozen people, and lacking the budget to reach a broad swath of consumers.
>
> Thus, even as consumers embrace the idea of solar power, they are usually not fully aware of its capabilities and they have misconceptions about how a solar energy system works in a home. Market reports demonstrate a lack of consumer understanding that solar electricity operates just like regular electricity and is the same kind of electricity that a local utility company provides. 29 percent of respondents to the May 2007 Roper survey were not aware that solar energy can power common electric devices like computers or appliances. A number of common myths persist about modern solar technology, such as the belief that solar will not work in places outside of the Sunbelt or that solar devices require more energy to manufacture than they produce in their lifetime, and these myths often inhibit consumer consideration of solar as a viable energy source.
>
> Furthermore, consumers lack information on how to find solar companies or what solar products might be available. On a daily basis, the most common phone calls to SEIA come from consumers who ask, "Where can I find solar for my home?" The industry has taken a number of steps to centralize this type of information, including the development of a national solar installer directory, *Findsolar.com.* Individually, several companies have undertaken consumer awareness campaigns that focus on basic technology education. Yet these efforts clearly do not equate to the potential reach of a national consumer awareness campaign.

Therefore, we believe that a national campaign promoting solar energy would significantly increase solar's market growth.

Q3. Do you support the language in the bill that requires private companies to open their books and records to Members of the Board for inspection? The language of the bill provides for criminal penalties for release of information obtained

under the authority of the Act to "any agency or officer of the United States for any purpose other than implementation of this Act." What information do you believe this language is seeking to protect? Do you agree criminal penalties are necessary?

A3. All corporations have confidential business information that must be safeguarded in order to encourage companies to do business in the U.S. The relevant provisions of this discussion draft are designed to facilitate the collection of market data for purposes of levying assessments on producers, while safeguarding data from dilatory or improper use. We perceive that this approach borrows largely from the legislation used to create other industry check-off programs and would welcome a continuing dialogue on how best to achieve effective reporting and compliance.

Q4. The language of section 9 requires the continuation of the solar promotion board and committee should be contingent upon a vote by the manufacturers and importers. Would you support a referendum prior to creation of the Board and Committee? Why or why not?

A4. SETA would be open to a referendum prior to the creation of the Board and Committee. Furthermore, it is our understanding that the industry would have the power to periodically evaluate the effectiveness of the program, with a focus on its economic benefits to industry members. This is appropriate given that then solar check-off program is funded by a tax that is established by the industry, with the blessing of members of the industry, and for the benefit of the industry as well as the general public.

Q5. What enforcement by the Secretary of Energy do you envision that might warrant a civil penalty for noncompliance under section 10 of this bill? Is this section necessary?

A5. In studying existing check-off programs, it appears common that enforcement powers are granted to eliminate the problem of "free riders," or nonpaying companies that might otherwise benefit economically from programs that others have funded. Without enforcement provisions, programs would be less likely to ensure that all companies participate.

Q6. What type of investigation do you believe it would be necessary for the Secretary of Energy to conduct under Section 11 of this bill?

A6. Most likely, any such investigations would be pursuant to issues of compliance with the assessment process.

Q7. How will your organization benefit from this legislation?

A7. SETA is a 501(c)(6) non-profit association that works to make solar power a mainstream and significant component of the U.S. energy supply. As the discussion draft currently provides, SETA would be able to serve on the promotion board and play a role in designing and implementing a national consumer awareness campaign. In doing so, SEIA would address one of its core functions: to educate consumers on the benefits of solar technologies.

Q8. What kind of yearly revenues does the solar industry have which could be used in a promotion program as envisioned by the legislation?

A8. Globally, the solar photovoltaic industry manufactured 2.2 Gigawatts of product in 2006. The U.S., with seven percent market share, manufactured PV products worth slightly more than $1 billion, with a net export of 10 percent of product.

Q9. Where does each of you see solar power as a part of the Nation's energy mix by 2015 by percentage if this bill is enacted?

A9. As stated in SEIA's testimony, a check-off program will only succeed if appropriate incentives are in place, including an eight-year extension of the federal investment tax credits (ITC). Over the past decade, due to a lack of progressive national policy, the U.S. has lost global leadership in the race to attract solar energy manufacturing, installation, and jobs. Long-term demand-side incentive policies in Japan and Europe have spurred the formation of hundreds of new companies and tens of thousands of new solar industry jobs in those countries; Germany, with the solar resources of Anchorage, AK, installs eight times more PV each year than the entire U.S. With appropriately designed incentive policies and increased consumer awareness, we anticipate that solar power could provide 10–15 percent of new incremental generating capacity annually in the U.S. by 2015.

Q10. I note that, as indicated in Section 2(7), the program is generally intended to improve the "competitive position. . .of solar energy products in the market-

place." Because the program includes importers, apparently this means promoting all solar products (including German) against other technologies. Does this matter to American producers?

A10. We anticipate that U.S. companies would, by far and away, benefit the most from a strong demand signal in the U.S. market. One of the realities of solar commerce is that companies generally prefer to manufacture high-tech products close to where the markets are, rather than ship them overseas and go through an extensive distribution system. In Germany, a national feed-in tariff incentive program for solar PV has helped to industrialize some of that country's most economically depressed regions. In the U.S., the states with the best-designed and long-term incentive programs have attracted the most development. Thus, in the current race for global solar energy leadership, increasing consumers' awareness and demand for solar is one of the optimal methods for growing the U.S. industry.

Q11. Has the SEIA tried to do a voluntary check-off program?

A11. SEIA has not tried to implement a voluntary check-off program. In formulating our testimony on the discussion draft, we looked at other industries that had implemented check-off programs. Historical examination shows that industries have indeed organized voluntary check-offs, but they account for only a small share of all funding for generic efforts. It seems likely that the establishment of legislative authority helps ensure the efficacy of check-off programs. This authority facilitates the practicalities of dealing in interstate commerce and, as mentioned above, helps to eliminate the problem of "free riders," or nonpaying companies that might otherwise benefit economically from programs that others have funded.

Q12. In your testimony, you talk mostly about distributed generation technologies of solar energy. Do you see more of a potential for solar energy on this smaller scale or as a large solar power plant?

A12. We believe that there is a vital role both for distributed solar generation and for concentrating solar power (CSP) in the U.S. energy portfolio. Both PV and CSP provide high-value electricity during peak demand hours, from 10 A.M. to 5 P.M. on hot, sunny days, thus helping to conserve the use of valuable natural gas. The Western Governors' Association Solar Task Force recently identified 200 GW of prime potential sites for CSP in the Southwest, including several sites in Texas. Furthermore, a study by Navigant Consulting found that eligible rooftop space in the U.S. could provide 700 GW of PV. We encourage the greater use of CSP and PV alike.

Q13. How many members does the SEIA have? How many member organizations I companies would benefit from additional funding for research? How many member organizations/companies would not?

A13. SEIA represents over 550 companies involved in the U.S. solar energy industry. Through our weekly newsletters and alerts, we actively encourage our members to participate in collaborative R&D efforts with the Department of Energy under the President's Solar America Initiative, announced by the White House in the 2006 State of the Union and first funded in FY 2007. The DOE Solar Energy Technologies Program has, at the time of this writing, announced two rounds of funding awards. The recipients are consortia of industry (usually several companies per award), national laboratories, universities, and non-profits. While it would be imprecise to guess how many companies would benefit from future research funding, we anticipate that such funding would continue to be directed towards collaborative research teams incorporating companies from throughout the solar value chain.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Jane M. Weissman, Executive Director, Interstate Renewable Energy Council; Vice Chair, North American Board of Certified Energy Practitioners

Questions submitted by Representative Ralph M. Hall

Q1a. Are you familiar with the Institute for Sustainable Power?

A1a. Yes.

The Institute for Sustainable Power's (ISP) accreditation and certification programs began 1996. International renewable energy, education, training, and accreditation experts worked to create ISPQ Standard #01021, which provides the guidelines and sets the bar for the accreditation of training programs and the certification of trainers in the renewable energy field. The objectives of the Standard are:

- to provide training programs worldwide with a harmonized training content- and delivery-guide for the knowledge and skills competencies for renewable energy workforces;
- to increase the confidence level that industry, employers, consumers, financiers, and governments can have in the participating training programs and trainers by providing a globally accepted process of evaluation and surveillance (audit and periodic re-evaluation) of training programs and trainers, and periodic re-evaluation of the standards; and
- to encourage safety and the training of safe practices within the industry.

In 2005, ISP decentralized operations and created licensees for operations in the United States, the UK and the Asia-Pacific area.

As of July 2005, the Interstate Renewable Energy Council (IREC) is the North American Licensee for the Institute for Sustainable Power's Quality (ISPQ) International Standard #01021 for Renewable Energy Training Accreditation and Instructor Certification programs. IREC is responsible for the full accreditation and certification cycle including processing applications, assigning registered auditors, awarding the credential, and maintaining all records of applicants, candidates and certificants.

IREC awards formal recognition for five (5) ISPQ designations:

1. Accreditation for Training Programs
2. Accreditation for Continuing Education Providers
3. Certification for Independent Master Trainers
4. Certification for Affiliated Master Trainers
5. Certification for Instructors

Using the ISPQ International Standard #01021 as a guide, with an approved Task Analysis as the content standard, IREC's ISPQ-Registered Auditors evaluate candidates for accreditation and certification through a desk and/or on-site audit. The Auditors prepare the results of their evaluation and report to the IREC ISPQ Award Committee which is responsible for the final decision on training accreditation and trainer certification.

Two attached documents demonstrate the rigor and depth of the ISPQ process: Standard #01021 and the Candidate Handbook. For further information, please visit *www.isaausa org.*

Q1b. Do you feel comfortable having them run a certification program?

A1b. Yes. The Interstate Renewable Energy Council has been working for over two decades as a non-profit organization committed to moving renewable energy resources into the marketplace. IREC emphasizes education and outreach, stakeholder coordination, technical assistance, workforce development, the adoption and implementation of uniform guidelines and standards, and consumer protection. IREC is known for its ability to identify critical issues, build networks, and develop and disseminate information tools that make the work of solar energy stakeholders more effective. The Council has a proven track record for producing material and products with the highest professional standards, meeting deadlines and managing its operations efficiently and effectively. *(www.irecusa.org)*

IREC's Accreditation and Certification Programs receive counsel and oversight from a national, 10-person advisory board which includes trainers, industry, and credentialing and education experts.

Q1c. What type of fee would you envision would be required for them to "certify" workforce training programs?

A1c. To date, below is the current fee application and maintenance fee structure. The fees are purposely kept low. In this early stage of operation, the fee structure does not support the full management and administration of the ISPQ process.

Candidate Application Fee for the ISPQ Credential

	Candidate Fee (Due with Application)	Earmarked for Desk Auditor	Time Expectation	Earmarked for On-Site Auditor	Time Expectation	**Annual Fee (Maintenance)**
Accredited Program	$2,400	$1,000	2days @ $500/day	$500	1 day @ $500/day plus travel reimbursement	$250
Certified Independent Master Trainer	$2,400	$1,000	2days @ $500/day	$500	1 day @ $500/day plus travel reimbursement	$250
Certified Affiliated Master Trainer	$350	$250	1/2 day	N/A	N/A	$50
Certified Trainer	$350	$250	1/2 day	N/A	N/A	$50
Accredited Continuing Ed	$450	$250	1/2 day			$250

Q2. How will your organization benefit from this legislation?

A2. IREC's goal is a simple one—to guarantee quality training for the solar energy practitioner. The ISPQ process is a rigorous one and there has been considerable resources spent to make this credentialing process fair, based on industry-developed standards, and provide non bias, third-party assessment of training programs. All documents and procedures have received subject-matter expert and legal review. We would like to see this legislation encourage the ISPQ assessment process but our goal is to make sure that there is assessable, quality training available for solar energy installers.

Q3. What is your view of cost sharing of the training programs between the states and Federal Government?

A3. When possible, IREC encourages cost sharing especially for states with System Benefit Funds. However, we do not think that states without these funding resources should be penalized. We recommend that cost sharing is encouraged but not required.

Q4. Are the unions opposed to the training provisions in the bill?

A4. We have not had any direct conversations with the unions in regard to this bill. However, the National Joint Apprenticeship and Training Committee (NJATC) supports ISPQ goals and its mission, and intends to facilitate voluntary JATC participation in the ISPQ framework. NJATC is presently seeking Accredited Training Program status under ISPQ for Solar Photovoltaic (PV) Systems. The scope of this accreditation will cover the new NJATC Solar PV System curriculum, its ITC facilities in Alcoa, TN, NJATC instructors, its program administrative policies and courses offered by NJATC. We would be happy to provide contact information to the NJATC.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Joseph T. Sarubbi, Professor/Department Chair, Building Systems Technology Department, Hudson Valley Community College

Questions submitted by Representative Ralph M. Hall

Q1a. Are You familiar with the Institute for Sustainable Power?

A1a. Yes.

Q1b. Do you feel comfortable having them run a certification program?

A1b. Yes. The Institute for Sustainable Power has worked hard to ensure that companies, installers, and training institutions meet rigorous standards that will make certain the type of reliability needed for positive industry growth and consumer confidence. I have intimate knowledge of ISP's standards and believe they do well to manage quality assurance/quality control (QA/QC).

Q1c. What type of fee would you envision would be required for them to "certify" workforce training programs?

A1c. An exact figure is difficult for me to ascertain. To ensure that all institutions applying for accreditation meet ISP standards a site visit to the institution seeking accreditation by the ISP evaluation team is essential. In Hudson Valley Community College's situation, the New York State Energy Research and Development Authority provided the resources to allow the College to position itself for Accreditation. National sponsorship of ISP could reduce the costs associated with institutional accreditation and help these institutions move swiftly, yet responsibly, towards accreditation. The Interstate Renewable Energy Council (IREC) developed a fee structure for evaluation of solar programs and institutions seeking accreditation, and Hudson Valley Community College is working within these fee guidelines. I am confident in IREC's ability to manage the costs associated with accreditation and certification.

Q2a. Have you reviewed the legislation proposed here today?

A2a. Yes.

Q2b. Do you think it makes sense to create two additional layers of bureaucracy for the Secretary of Energy to promote solar power or do you feel it would be easier to just give DOE a grant to promote solar power? Please explain.

A2b. The Solar Energy Industries Research and Promotion Board, as well as the Solar Energy Industries Research and Promotion Operating Committee make sense in that they will be strong advocates for the advancement of the solar industry. The members of the Board, as well as the Committee, will be stakeholders in the solar industry and will provide a platform for sound solar energy initiatives. While an argument could certainly be made that we are creating more levels of bureaucracy, in this case, I believe the layers are valid; especially knowing that (1) no Board and Committee members will receive compensation for their service, and (2) most, if not all, Board and/or Committee members will be utilizing the resources, staffs, and facilities of existing organizations.

Q3. Do you believe solar power needs to be promoted in order to be successful as an energy resource?

A3. Yes. There is a certain level of complacency that exists in our society and I've learned throughout the years that an effectively promoted initiative has positive outcomes. There are many examples to point to, some of which were identified during the hearing. I truly believe that an educated public is our strongest asset and right now I don't believe that the Nation yet fully understands the value of investing in solar power, especially the younger generation. The same could be said for other renewable energy resources.

Q4. Do you support the language in the bill that requires private companies to open their books and records to Members of the Board for inspection?

A4. I don't have the expertise to adequately answer this question.

Q5. The language of this bill provides for criminal penalties for release of information obtained under the authority of the Act to "any agency or officer of the United States for any purpose other than the implementation of this act." What information do you believe this language is seeking to protect? Do you agree criminal penalties are necessary?

A5. Again, I believe I don't have the expertise to adequately answer this question.

Q6. The language of section 9 requires the continuation of the solar promotion board and committee should be contingent upon a vote by the manufacturers and importers. Would you support a referendum prior to creation of the Board and Committee? Why or why not?

A6. Again, I believe I don't have the expertise to adequately answer this question.

Q7. What enforcement by the Secretary of Energy do you envision that might warrant civil penalty for noncompliance under section 10 of this bill? Is this section necessary?

A7. Again, I believe I don't have the expertise to adequately answer this question.

Q8. What type of investigation do you believe it would necessary for the Secretary of Energy to conduct under section 11 of this bill?

A8. Again, I believe I don't have the expertise to adequately answer this question.

Q9. How will your organization benefit from this bill?

A9. Hudson Valley Community College received a grant from the New York State Energy Research and Development Authority to establish our solar program. As a leader in solar training Hudson Valley Community College will be able to seek additional resources to develop new solar training programs that are responsive to the industry, as well as expand our existing program offerings. As the solar industry grows, Hudson Valley Community College would seek additional funding for solar programmatic initiatives which include resources for additional faculty, curriculum development, and enhanced training facilities to react to industry trends.

Q10. What kind of yearly revenues does the solar industry have which could be used in a promotion program as envisioned by the legislation?

A10. Again, I believe I don't have the expertise to adequately answer this question.

Q11. Where does each of you see solar power as a part of the Nation's energy mix by 2015 by percentage if this bill is enacted?

A11. This bill will go a long way towards making the United States a national player in the solar power generation industry, and inform the world that we are serious about renewable energy.

Q12. What is your view on cost sharing of the training programs between the states and Federal Government?

A12. Again, I believe I don't have the expertise to adequately answer this question.

Q13. Are the unions opposed to this training bill?

A13. Quite the contrary. The International Brotherhood of Electrical Workers, for example, is very invested in training their journeyman in solar installation technology. They see economic growth and job creation with this bill. One only has to look at New York City's "Million solar roofs" initiative to see the impact on job creation as a valid example.

Q14. Is the draft discussion draft duplicative of any current programs? If so which ones? What are the metrics that will evaluate success of the training or solar programs?

A14. A handful of states, such as California, New Jersey, and New York, have solar training initiatives that have proven track records, but the United States needs a national program to ensure the type of growth that it aspires to reach by 2015. A national program will ensure other states will have the opportunity to enhance job creation in the solar industry.

Q15. Mr. Sarubbi, you have demonstrated that the photovoltaic program at your community college is in high demand and has been able to seek out several business partners. Does the Federal Government need to be involved to "spur" further collaborations?

A15. Absolutely! Our success was driven by a collaborative effort between a State government agency, as well as national organizations such as IREC, with the resources and guidelines to establish an effective solar training program, and an educational institution with the vision to see the value of this training. The government resources gave the college the confidence to move forward, which made attracting support from local solar companies viable. Our growth is still contingent on procuring resources that would allow the College to expand its offerings and further

develop partnerships. It's all about confidence. Having the DOE as a sponsor of solar training programs will spur confidence and ensure industry growth.

Q16. As your program has grown, have you had to advertise your services?

A16. Interestingly, the College has gained significantly in "free" advertisement as news agencies continue to report on the success of our solar training programs, further spurring interest in the community. The "press" has helped us "get the word out" and the College has been the beneficiary of this exposure. The College also maintains a website link dedicated to solar training which continues to garner attention from those seeking information about gaining solar training.

Q17. What we've heard today from a number of experts that explain that solar technologies are rapidly changing and evolving. Do you offer a continuing education program to meet these changing demands?

A17. Absolutely! Hudson Valley Community College has a Workforce Development Institute that seeks to continuously provide training to meet the needs of industry and solar training is no different. For example, as state and local building and electrical codes change to adapt to the changing solar technology, the College provides workshops for code inspectors to keep them abreast of these latest technological advances. The College is currently developing "advanced" solar training courses that will be offered through Workforce Development to keep Certified Installers "fluid."

Q18. Has the Department of Energy assisted you in anyway? If so, how?

A18. At this stage I am not aware of any direct assistance from the Department of Energy.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Daniel E. Arvizu, Director, National Renewable Energy Laboratory, U.S. Department of Energy

Questions submitted by Representative Ralph M. Hall

Q1. Are you familiar with the Institute of Sustainable Power? Do you feel comfortable having them run a certification program? What type of a fee would you envision would be required for them to "certify" workforce training programs?

A1. I am familiar with the Institute for Sustainable Power which coordinates, develops, and maintains international standards for the evaluation and qualification of renewable energy, energy efficiency and distributed generation training providers. ISP has a solid reputation for the quality of the work it does. I am not in a position to comment on an appropriate fee for certifying workforce training programs.

I would suggest, however, that the Department of Energy (DOE) Solar Program be consulted on options for improving training and certification of solar energy professionals. As part of its Solar America Initiative, the DOE has created a program to improve and expand solar installer training in cooperation with the North American Board of Certified Energy Practitioners (NABCEP). The DOE's efforts in this area may be of interest to the Committee.

Q2. Have you reviewed the legislation being proposed here today? Do you think it makes sense to create two additional layers of bureaucracy for the Secretary of Energy to promote solar power or do you feel it would be easier to just give DOE a grant to promote solar power? Please explain.

A2. I will defer to DOE on this question.

Q3. Do you think solar power needs to be promoted in order to be successful as an energy resource?

A3. As Americans begin to enjoy more options as to where they get their power and fuel, I believe they need clear, credible and consistent information about *all* energy sources to help them make informed decisions about which options to choose.

Q4. Do you support the language in the bill that requires private companies to open their books and records to Members of the Board for inspection?

A4. I will defer to DOE on this question.

Q5. The language of the bill provides for criminal penalties for release of information obtained under the authority of the Act to "any agency or officer of the United States for any purpose other than implementation of this Act." What information do you believe this language is seeking to protect? Do you agree criminal penalties are necessary?

A5. I will defer to DOE on this question.

Q6. The language of section 9 requires the continuation of the solar promotion board and committee should be contingent upon a vote by the manufacturers and importers. Would you support a referendum prior to creation of the Board and Committee? Why or why not?

A6. I will defer to DOE on this question.

Q7. What enforcement by the Secretary of Energy do you envision that might warrant a civil penalty for noncompliance under section 10 of this bill? Is this section necessary?

A7. I will defer to DOE on this question.

Q8. What type of investigation do you believe it would be necessary for the Secretary of Energy to conduct under Section 11 of this bill?

A8. I will defer to DOE on this question.

Q9. How will your organization benefit from this legislation?

A9. NREL will not directly benefit from this legislation.

Q10. What kind of yearly revenues does the solar industry have which could be used in a promotion program as envisioned by the legislation?

A10. I will defer this question to the Solar Energy Industries Association.

Q11. Where does each of you see solar power as a part of the Nation's energy mix by 2015 by percentage if this bill is enacted?

A11. This bill addresses, and in some cases expands on, a number of important areas of solar energy research, development and demonstration currently sponsored by the DOE. It identifies critical research on thermal storage for concentrating solar power technologies that will make those technologies significantly more valuable to utilities interested in integrating them within their system. It also calls for continuing studies of that integration with a particular focus on water issues critical items for successful market penetration of CSP.

I would suggest that the DOE be consulted regarding the additional demonstration programs the bill mandates for daylighting, solar air conditioning, and photovoltaics. The DOE is currently expanding its efforts on demonstration and deployment of distributed solar and building efficiency technologies, and I believe that commercialization of these technologies will occur most rapidly if it is pursued within the context of the broader requirements and opportunities in the buildings sector.

Together, these various efforts will reinforce the DOE programs to move solar energy into position to make a significant contribution to the U.S. energy picture by 2015. The amount of solar power in our future energy mix will depend on a number of factors, but supporting legislation can help accelerate the amount we have in 2015.

Q12. What is your view of cost sharing of the training programs between the states and Federal Government?

A12. I will defer to DOE on this question.

Q13. Are the unions opposed to the training provisions in the bill?

A13. NREL is not qualified to answer this question.

Q14. Is the Draft discussion draft duplicative of any current programs? If so which ones? What are the metrics that will evaluate success of the training or solar programs?

A14. I will defer to DOE on the first part of the question dealing with duplication of current programs. As to metrics for evaluating the success of training and other solar programs, the major metric for the Solar Program is the levelized cost of electricity. The attached slide presents the goal of the solar program to have competitive prices of electricity in the three market sectors (residential, commercial, and utility) by 2015. A secondary goal is to have about 4 gigawatts of installed solar power by 2015.

Q15. In your testimony you state that the "Solar Energy Program goal is to reduce the cost of solar photovoltaic technologies so that they become cost competitive with other sources of electricity in all major U.S. markets by 2015." Are you on track to reach this goal? What major hurdles would prevent you from doing so?

A15. The current DOE Solar Program in photovoltaics is designed to make solar electricity cost competitive in the three major markets—residential, commercial, and utility—by 2015 through the President's Solar American Initiative. This initiative builds on the experience with bringing down the costs of solar electricity from successful programs in Japan and Europe. The program is currently on track to meet these 2015 targets for the U.S. consumer. Technology investments and consistent policies are both important, but to ensure success, to increase the technical leadership of the U.S. in this expanding high-technology business, and to build a solid technical workforce in the U.S. economy, the investment in R&D both in the short- and long-term, must be strong, consistent and sustainable.

Q16. You mention that CSP power plants can be quickly constructed. How quickly and how much do they cost to build? Are there any NIMBY issues involved with their siting and construction?

A16. SolarGenix recently completed construction of a 64 MW plant near Las Vegas, Nevada. Construction of the 64 MW plant took approximately one year to complete. This matches previous experience in the late 80'slearly 90's where nine CSP plants were built in the Mojave Desert over a period of six years.

It is hard to predict NIMBY issues. CSP plants tend to be located in desert regions not ideal for residential development. However, as is the case in California, concerns have risen over the development of CSP on sensitive habitats (e.g., Desert Tortoise). As with other forms of conventional or renewable generation, construction

of new transmission or upgrades of existing transmission can raise regional concerns.

Q17. Are there any CSP plants with thermal storage in operation today? Are any hybrid CSP/natural gas plants in operation? If not, when can we expect to see them running?

A17. All of the existing nine parabolic trough plants operating in the Mojave Desert are hybridized with natural gas, therefore supplying 100 percent of their rated capacity during peak utility periods. Two plants under construction in Spain (anticipated to be operational in 2008 and 2009) will use 6–7 hours of two-tank indirect molten salt storage. However storage costs need to be reduced before such plants would be considered economically competitive.

Q18. How does this legislation fit within the Administration's energy initiatives? I know that the Administration announced $168 million to help reduce the cost of solar energy.

A18. I will defer to DOE on this question.

Q19. Has the Administration done a cost estimate of the bill? Page 20 calls for an unlimited authorization. What is your estimate?

A19. I will defer to DOE on this question.

Q20. Solar power has had problems with environmental concerns with toxic like cadmium used in some photovoltaic cells. Does CSP use cells that contain these kinds of materials that might cause environmental concerns? Are there any environmental concerns as to land use, etc.?

A20. Concentrating Solar Power systems use thermal energy to drive an energy conversion device (steam/gas turbine or Stirling engine) rather than solar cells. Heat transfer fluids used by some systems can consist of synthetic oils or molten salts can both be considered hazardous but have been widely used and permitted in commercial or demonstration plants in California. Land use can be a concern where plants are being considered near sensitive habitat areas (e.g., the Desert Tortoise in California's Mojave Desert). Parabolic trough and power tower plants require water for cooling (as with conventional generation) although dry cooling designs have been studied and are being considered for future plants.

Appendix 2:

Additional Material for the Record

[DISCUSSION DRAFT]

JUNE 14, 2007

110TH CONGRESS
1ST SESSION

H. R. _____

To promote the development and use of solar energy products, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

Ms. GIFFORDS introduced the following bill; which was referred to the Committee on

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A BILL

To promote the development and use of solar energy products, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "_____ Act of 2007".

SEC. 2. DEFINITIONS.

For purposes of this Act:

(1) The term ''Board'' means the Solar Energy Industries Research and Promotion Board established under section 6(b)(1).

(2) The term ''Committee'' means the Solar Energy Research and Promotion Operating Committee established under section 6(b)(4).

(3) The term ''consumer information'' means information that will assist individual consumers, businesses, and other persons in making evaluations and decisions regarding the purchasing, installation, operation, and maintenance of solar energy products.

(4) The term ''Department'' means the Department of Energy.

(5) The term ''importer'' means any person who imports solar energy products from outside the United States.

(6) The term ''order'' means a solar energy product research and promotion order issued under section 6.

(7) The term ''promotion'' means any action to advance the image and desirability of solar energy products with the express intent of improving the competitive position and stimulating sales of solar energy products in the marketplace.

(8) The term "Secretary" means the Secretary of Energy.

(9) The term "solar energy products" means solar water heating components and systems and photovoltaic components and systems.

SEC. 3. THERMAL ENERGY STORAGE.

The Secretary shall establish a program of research and development to provide lower cost and more viable thermal energy storage technologies to increase the production of concentrating solar power electric generating plants and enable the shifting of electric power loads on demand.

SEC. 4. CONCENTRATING SOLAR POWER STUDY.

The Secretary shall conduct a study on methods to integrate concentrating solar power into existing electricity transmission systems, and to identify new transmission or transmission upgrades needed to bring electricity from high concentrating solar power resource areas to growing electric power load centers throughout the United States. The study shall analyze and assess approaches for concentrating solar power to improve electric reliability, to efficiently manage load, and to reduce demand on the natural gas transmission system for electric power. The Secretary shall submit a report to Congress

on the results of this study not later than 12 months after the date of enactment of this Act.

SEC. 5. WORKFORCE DEVELOPMENT GRANTS.

(a) ESTABLISHMENT.—The Secretary shall establish in the Office of Solar Energy Technologies a competitive grant program to create and strengthen solar industry workforce training and internship programs in installation, operation, and maintenance of solar energy products. The goal of this program is to ensure a supply of well-trained individuals to support the expansion of the solar energy industry.

(b) AUTHORIZED ACTIVITIES.—Grant funds may be used to support the following activities:

(1) Creation and development of a solar workforce training curriculum appropriate for the local educational, entrepreneurial, and environmental conditions.

(2) Establishment of certification programs for individual solar energy system installers, instructors, and training programs.

(3) Internship programs that provide hands-on participation by students in commercial installations.

(4) Activities required to obtain certification of training programs and facilities by the Institute of

Sustainable Power or an equivalent industry-accepted quality-control certification programs.

(5) Incorporation of solar-specific modules into traditional occupational training and internship programs for construction-related trades.

(c) ADMINISTRATION OF GRANTS.—Grants may be awarded under this section for up to 3 years. The Secretary shall award grants to ensure sufficient geographic distribution of training programs nationally. Grants shall only be awarded for programs certified by the Institute of Sustainable Power or an equivalent industry-accepted quality-control certification institution, or for new and growing programs with a credible path to certification.

(d) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Secretary for carrying out this section $10,000,000 for each of the fiscal years 2008 through 2012.

SEC. 6. SOLAR RESEARCH AND INFORMATION PROGRAM.

(a) ISSUANCE OF ORDERS.—

(1) PROPOSED ORDER.—Not later than 30 days after receipt of a proposal for a solar energy product research and promotion order, the Secretary shall publish such proposed order and give due notice and opportunity for public comment on such proposed order. Such proposal may be submitted by any orga-

nization meeting the requirements for certification under section 7 or any interested person, including the Secretary.

(2) FINAL ORDER.—After notice and opportunity for public comment are given, as provided for in paragraph (1), the Secretary shall issue a solar energy product research and promotion order. The order shall become effective not later than 120 days after publication of the proposed order.

(b) REQUIRED TERMS IN ORDERS.—An order issued under subsection (a) shall contain the following terms and conditions:

(1) The order shall provide for the establishment and selection of a Solar Energy Industries Research and Promotion Board. Members of the Board shall be solar energy products producers and importers appointed by the Secretary from—

(A) nominations submitted by eligible organizations certified under section 7; and

(B) nominations submitted by importers under such procedures as the Secretary determines appropriate.

The Secretary shall ensure adequate representation of all geographic regions of the United States on the Board.

(2) The order shall define the powers and duties of the Board, which shall be exercised at an annual meeting, and shall include only the following powers:

(A) To administer the order in accordance with its terms and provisions.

(B) To make rules and regulations to effectuate the terms and provisions of the order.

(C) To elect members of the Board to serve on the Committee.

(D) To approve or disapprove budgets submitted by the Committee.

(E) To receive, investigate, and report to the Secretary complaints of violations of the order.

(F) To recommend to the Secretary amendments to the order. In addition, the order shall determine the circumstances under which special meetings of the Board may be held.

(3) The order shall provide that the term of appointment to the Board shall be 3 years with no member serving more than 2 consecutive terms, except that initial appointments shall be proportionately for 1-year, 2-year, and 3-year terms; and that Board members shall serve without compensation,

but shall be reimbursed for their reasonable expenses incurred in performing their duties as members of the Board.

(4)(A) The order shall provide that the Board shall elect from its membership 10 members to serve on the Solar Energy Research and Promotion Operating Committee.

(B) The Committee shall develop plans or projects of research, information, and promotion which shall be paid for with assessments collected by the Board. In developing plans or projects, the Committee shall, to the extent practicable, ensure that all segments of the solar industry receive equitable and fair treatment under this Act.

(C) The Committee shall be responsible for developing and submitting to the Board, for its approval, budgets on a fiscal year basis of its anticipated expenses and disbursements, including probable costs of research, promotion, and information projects. The Board shall approve or disapprove such budgets and, if approved, shall submit such budget to the Secretary for the Secretary's approval.

(D) The total costs of collection of assessments and administrative staff incurred by the Board during any fiscal year shall not exceed 5 percent of the

projected total assessments to be collected by the Board for such fiscal year. The Board shall use, to the extent possible, the resources, staffs, and facilities of existing organizations.

(5) The order shall provide that terms of appointment to the Committee shall be 1 year, and that no person may serve on the Committee for more than 6 consecutive terms. Committee members shall serve without compensation, but shall be reimbursed for their reasonable expenses incurred in performing their duties as members of the Committee. The Committee may utilize the resources, staffs, and facilities of the Board and industry organizations. An employee of an industry organization may not receive compensation for work performed for the Committee, but shall be reimbursed from assessments collected by the Board for reasonable expenses incurred in performing such work.

(6) The order shall provide that, to ensure coordination and efficient use of funds, the Committee shall enter into contracts or agreements for implementing and carrying out the activities authorized by this Act with established national nonprofit industry-governed organizations to implement pro-

grams of research, promotion, and information. Any such contract or agreement shall provide that—

(A) the person entering the contract or agreement shall develop and submit to the Committee a plan or project together with a budget or budgets that shows estimated costs to be incurred for the plan or project;

(B) the plan or project shall become effective on the approval of the Secretary; and

(C) the person entering the contract or agreement shall keep accurate records of all of its transactions, account for funds received and expended, and make periodic reports to the Committee of activities conducted, and such other reports as the Secretary, the Board, or the Committee may require.

(7) The order shall require the Board and the Committee to—

(A) maintain such books and records, which shall be available to the Secretary for inspection and audit, as the Secretary may prescribe;

(B) prepare and submit to the Secretary, from time to time, such reports as the Secretary may prescribe; and

(C) account for the receipt and disbursement of all funds entrusted to them.

(8)(A) The order shall provide that each manufacturer of a solar energy product shall collect an assessment and pay the assessment to the Board.

(B) The order also shall provide that each importer of solar energy products shall pay an assessment, in the manner prescribed by the order, to the Board.

(C) The assessments shall be used for payment of the costs of plans and projects, as provided for in paragraph (4), and expenses in administering the order, including more administrative costs incurred by the Secretary after the order has been promulgated under this Act, and to establish a reasonable reserve. The rate of assessment prescribed by the order shall be determined by the Secretary in consultation with the Solar Energy Industry Association.

(9) The order shall provide that the Board, with the approval of the Secretary, may invest, pending disbursement, funds collected through assessments only in obligations of the United States or any agency thereof, in any interest-bearing account or certificate of deposit of a bank that is a member

of the Federal Reserve System, or in obligations fully guaranteed as to principal and interest by the United States.

(10) The order shall prohibit any funds collected by the Board under the order from being used in any manner for the purpose of influencing governmental action or policy, with the exception of recommending amendments to the order.

(11)(A) The order shall require that each manufacturer or importer making payment to the Board maintain and make available for inspection such books and records as may be required by the order and file reports at the time, in the manner, and having the content prescribed by the order. Such information shall be made available to the Secretary as is appropriate to the administration or enforcement of this Act. All information so obtained shall be kept confidential by all officers and employees of the Department, and only such information so obtained as the Secretary deems relevant may be disclosed by them and then only in a suit or administrative hearing brought at the request of the Secretary, or to which the Secretary or any officer of the United States is a party, and involving the order. Nothing in this paragraph may be deemed to prohibit——

(i) the issuance of general statements, based on the reports, of the number of entities subject to the order or statistical data collected therefrom, which statements do not identify the information furnished by an person; or

(ii) the publication, by direction of the Secretary, of the name of any person violating the order, together with a statement of the particular provisions of the order violated by the person.

(B) No information obtained under the authority of this Act may be made available to any agency or officer of the United States for any purpose other than the implementation of this Act and any investigatory or enforcement act necessary for the implementation of this Act. Any person violating the provisions of this paragraph shall be subject to a fine of not more than $1,000, or to imprisonment for not more than one year, or both, and if an officer or employee of the Board or the Department, shall be removed from office.

(12) The order shall contain terms and conditions, not inconsistent with the provisions of this Act, as necessary to effectuate the provisions of the order.

SEC. 7. CERTIFICATION OF ORGANIZATIONS TO NOMINATE.

(a) ELIGIBILITY.—The eligibility of any national, regional, or State organization to represent manufacturers and to participate in the making of nominations under section 6(b) shall be certified by the Secretary. The Secretary shall certify any national, regional, or State organization that the Secretary determines meets the eligibility criteria established under subsection (b), and such determination as to eligibility shall be final.

(b) CRITERIA.—An organization may be certified as described in subsection (a) if such organization meets all of the following eligibility criteria:

(1) A majority of the organization's total paid membership are manufacturers of solar energy products in the Nation, region, or State.

(2) The organization represents a substantial number of manufacturers of solar energy products in the Nation, region, or State.

(3) The organization has a history of stability and permanency.

(4) A primary purpose of the organization is to promote the economic welfare of the solar energy products industry.

(c) BASIS FOR CERTIFICATION.—Certification of an organization shall be based upon a factual report submitted by the organization.

SEC. 8. REFERENDUM.

(a) INITIAL REFERENDUM.—For the purpose of determining whether the initial order shall be continued, not later than 22 months after the issuance of the order (or any earlier date recommended by the Board), the Secretary shall conduct a referendum among persons who have been manufacturers or importers of solar energy products during a representative period, as determined by the Secretary. The order shall be continued only if the Secretary determines that it has been approved by not less than a majority of the manufacturers voting in the referendum who, during a representative period as determined by the Secretary, have been engaged in the manufacturing of solar energy products. If continuation of the order is not approved by a majority voting in the referendum, the Secretary shall terminate the collection of assessments under the order within 6 months after the Secretary determines that continuation of the order is not favored by a majority voting in the referendum, and shall terminate the order in an orderly manner as soon as practicable after such determination.

(b) SUBSEQUENT REFERENDA.—After the initial referendum, the Secretary may conduct a referendum on the request of a representative group comprising 10 percent or more of the number of manufacturers of solar energy products to determine whether manufacturers favor the

termination or suspension of the order. The Secretary shall suspend or terminate collection of assessments under the order within 6 months after the Secretary determines that suspension or termination of the order is favored by a majority of the manufacturers voting in the referendum who, during a representative period as determined by the Secretary, have been engaged in the manufacture of solar energy products, and shall terminate or suspend the order in an orderly manner as soon as practicable after such determination.

(c) PROCEDURES.—The Department shall be reimbursed from assessments collected by the Board for any expenses incurred by the Department in connection with conducting any referendum under this section, except for the salaries of Government employees. Any referendum conducted under this section shall be conducted on a date established by the Secretary, whereby manufacturers shall certify that they were engaged in the production of solar energy products during the representative period and, on the same day, shall be provided an opportunity to vote in the referendum.

SEC. 9. REFUNDS.

(a) IN GENERAL.—During the period prior to the approval of the continuation of an order pursuant to the ref-

erendum required under section 8(a), subject to subsection (f) of this section, the Board shall—

(1) establish an escrow account to be used for assessment refunds;

(2) place funds in such account in accordance with subsection (b); and

(3) refund assessments to persons in accordance with this section.

(b) AMOUNTS PLACED IN ACCOUNT.—Subject to subsection (f), the Board shall place in such account, from assessments collected under section 7 during the period referred to in subsection (a), an amount equal to the product obtained by multiplying the total amount of assessments collected under section 7 during such period by 15 percent.

(c) FULL REFUND ELECTION.—Subject to subsections (d), (e), and (f) and notwithstanding any other provision of this Act, any manufacturer or importer shall have the right to demand and receive from the Board a one-time refund of all assessments collected under section 7 from such manufacturer or importer during the period referred to in subsection (a) if such manufacturer or importer—

(1) is responsible for paying such assessment; and

(2) does not support the program established under this Act.

(d) PROCEDURE.—Such demand shall be made in accordance with regulations, on a form, and within a time period prescribed by the Board.

(e) PROOF.—Such refund shall be made on submission of proof satisfactory to the Board that the manufacturer or importer—

(1) paid the assessment for which refund is sought; and

(2) did not collect such assessment from another manufacturer or importer.

(f) DISTRIBUTION.—If the amount in the escrow account required to be established by subsection (a) is not sufficient to refund the total amount of assessments demanded by all eligible persons under this section, and the continuation of an order is approved pursuant to the referendum required under section 8(b), the Board shall—

(1) continue to place in such account, from assessments collected under section 7, the amount required under subsection (b), until such time as the Board is able to comply with paragraph (2); and

(2) provide to all eligible persons the total amount of assessments demanded by all eligible persons under this section.

If the continuation of an order is not approved pursuant to the referendum required under section 8(b), the Board shall prorate the amount of such refunds among all eligible persons who demand such refund.

SEC. 10. ENFORCEMENT.

(a) IN GENERAL.—If the Secretary believes that the administration and enforcement of this Act or an order would be adequately served by such procedure, following an opportunity for an administrative hearing on the record, the Secretary may—

(1) issue an order to restrain or prevent a person from violating an order; and

(2) assess a civil penalty of not more than $5,000 for violation of such order.

(b) JURISDICTION.—The district courts of the United States are vested with jurisdiction specifically to enforce, and to prevent and restrain a person from violating, an order or regulation made or issued under this Act.

(c) ATTORNEY GENERAL.—A civil action authorized to be brought under this section shall be referred to the Attorney General for appropriate action.

SEC. 11. INVESTIGATIONS.

The Secretary may make such investigations as the Secretary deems necessary for the effective administration of this Act or to determine whether any person subject

to this Act has engaged or is about to engage in any act that constitutes or will constitute a violation of this Act, the order, or any rule or regulation issued under this Act.

SEC. 12. ADMINISTRATIVE PROVISION.

The provisions of this Act applicable to the order shall be applicable to amendments to the order.

SEC. 13. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated such sums as may be necessary to carry out this Act. Sums appropriated to carry out this Act shall not be available for payment of the expenses or expenditures of the Board or the Committee in administering any provisions of the order issued under section 6.