Hearing Charter

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

New Roadmaps for Wind and Solar Research and Development

Tuesday, July 14, 2009
2 p.m. – 4 p.m.
2318 Rayburn House Office Building

Purpose

On Tuesday, July 14, 2009 the House Committee on Science & Technology, Subcommittee on Energy and Environment will hold a hearing entitled "*New Roadmaps for Wind and Solar Research and Development.*"

The Subcommittee's hearing will receive testimony on H.R. 3165 sponsored by Rep. Tonko to authorize a comprehensive research, development, and demonstration program to advance wind energy technologies. The hearing also will examine the status of solar energy research and development programs and the need for a comprehensive plan to guide future solar R&D, including advanced manufacturing techniques for solar equipment.

Witnesses

- **Mr. Steve Lockard** is CEO of TPI Composites and co-chair of the American Wind Energy Association (AWEA) Research & Development Committee. Mr. Lockard will testify on the findings of a recent AWEA report on wind energy research and development needs.

- **Mr. John Saintcross** is an Energy and Environmental Markets Program Manager at the New York State Energy Research and Development Authority. Mr. Saintcross will discuss the current challenges associated with using wind energy systems to meet New York State's renewable portfolio standard.

- **Prof. Andrew Swift** is Director of the Wind Science and Engineering Research Center at Texas Tech University. Prof. Swift will testify on ways to best integrate academic, governmental, and private sector resources to advance wind energy and wind forecasting technologies.

- **Mr. Ken Zweibel** is the Director of the George Washington University Solar Institute. Mr. Zweibel will testify on the current status of solar energy technology and the potential for this resource to have a much larger impact in the nation's energy portfolio.

- **Ms. Nancy Bacon** is a Senior Advisor for United Solar Ovonic and Energy Conversion Devices, Inc. Ms. Bacon will testify on the private sector's view of the federal role for solar energy research and development in manufacturing and materials.

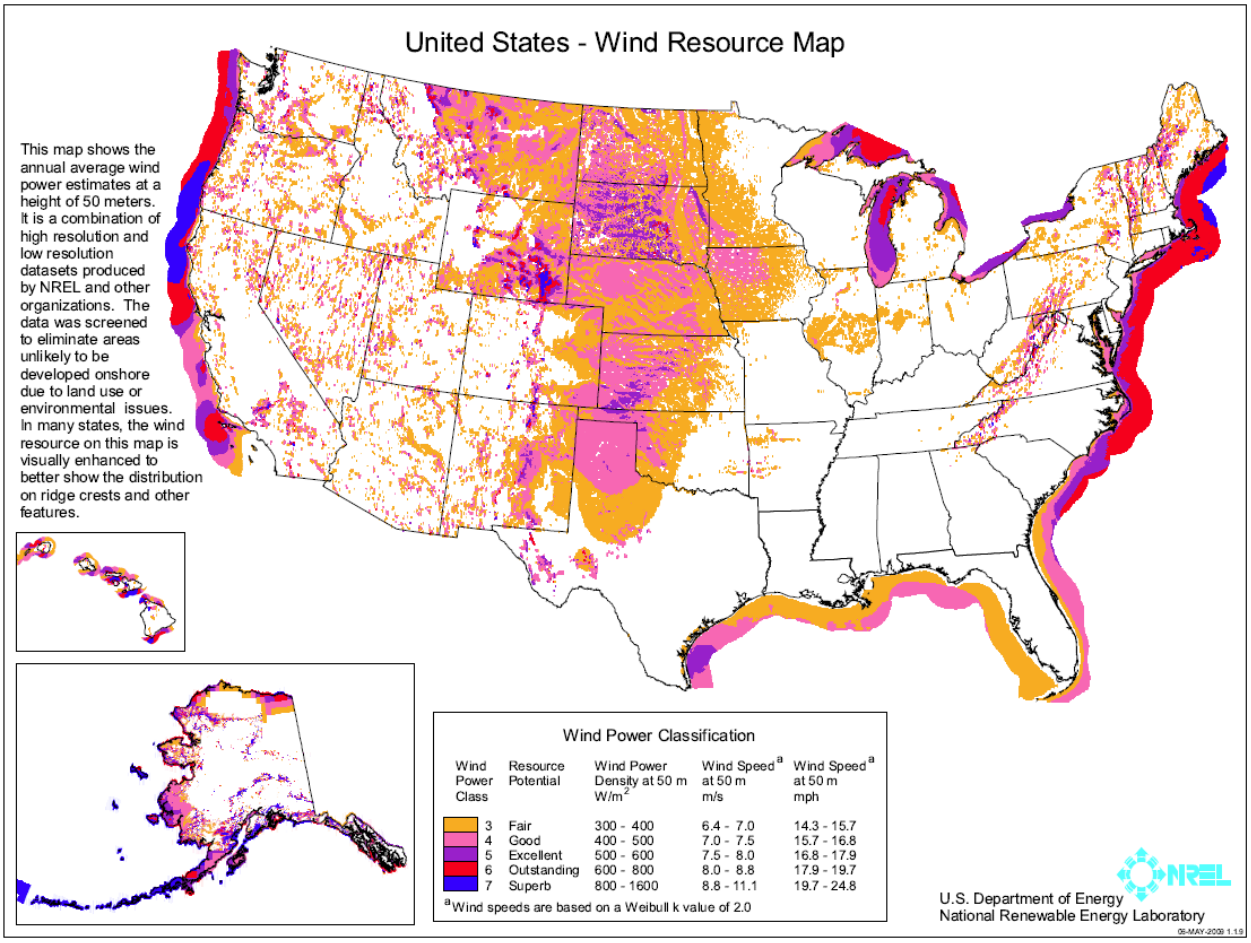

Figure 1: United States Wind Resource Map at an elevation of 50 meters. Produced by the National Renewable Energy Laboratory in May 2009.

Background

Wind Energy Research and Development Needs

Current U.S. land-based and offshore wind resources are sufficient to supply the electrical energy needs of the entire country several times over according to a Department of Energy report published in May 2008 entitled: *20% Wind Energy by 2030*. A map of these resources produced by the National Renewable Energy Laboratory (NREL) can be found in Figure 1. A further illustration of the large wind resource potential in the U.S. can be found in Table 1. Factoring in environmental and other relevant land use exclusions, Pacific Northwest National Laboratory determined that the top 12 states in wind energy potential (in order: North Dakota, Texas,

Top Twenty States for Wind Energy Potential in billion kWh/year

1.	North Dakota	1,210	11.	Colorado	481
2.	Texas	1,190	12.	New Mexico	435
3.	Kansas	1,070	13.	Idaho	73
4.	South Dakota	1,030	14.	Michigan	65
5.	Montana	1,020	15.	New York	62
6.	Nebraska	868	16.	Illinois	61
7.	Wyoming	747	17.	California	59
8.	Oklahoma	725	18.	Wisconsin	58
9.	Minnesota	657	19.	Maine	56
10.	Iowa	551	20.	Missouri	52

Table 1: Top 20 states for wind energy potential as measured by annual energy resource in billions of kWhs, factoring in environmental and land use exclusions for wind class 3 and higher. For comparison, total U.S. electric generation in 2007 was 4,157 billion kWh. ***Sources: DOE Energy Information Administration and "An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States", Pacific Northwest National Laboratory, 1991.***

Kansas, South Dakota, Montana, Nebraska, Wyoming, Oklahoma, Minnesota, Iowa, Colorado, and New Mexico) could theoretically produce more than double the U.S.'s current annual generation of electricity.

However to expand from today's proportion of electric generation from wind (less than 2 percent) to a scenario where the U.S. generates 20 percent or more of its power from wind energy would require several significant advances including: improved wind turbine technology, improved wind forecasting capability, improved energy storage, and expansion of transmission systems to deliver wind power from resource centers to centers of population. In turn, these changes in the power generation and delivery process may involve changes in manufacturing, policy development, and environmental regulation.

Overall performance of wind energy systems can be substantially improved to become more efficient, cost-effective, and reliable. Fundamental technical issues remain even while wind power is competitive with coal and other conventional forms of energy in some markets. As a follow-up to DOE's wind energy report the AWEA Research and Development Committee produced a detailed *Action Plan to 20% Wind Energy by 2030* in March 2009. This plan proposed $217 million in annual federal funding combined with a $224 million industry/state cost share to support specific research and development programs which the AWEA Committee believes are necessary to meet a goal of providing 20 percent of America's electricity from wind by 2030.

This would be a significant increase from the DOE wind program's current annual budget of roughly $50 million, notwithstanding the one-time expenditure of $118 million currently identified by the Department for additional wind research and development activities from the American Recovery and Reinvestment Act of 2009. In recent years much of the federal wind program has focused on testing and evaluation of commercial turbines rather than advanced research, leading to gaps in our national wind R&D portfolio. There is broad consensus among government, academic, and industry leaders that research areas in which greater federal support could have a considerable impact include:

- new materials and designs to make larger, lighter, less expensive, and more reliable rotor blades;
- advanced generators to improve the efficiency of converting blade rotation to electric power;
- automation, production materials, and assembly of large-scale components to reduce manufacturing costs;
- low-cost transportable towers greater than 100 meters in height to capitalize on improved wind conditions at higher elevations;
- advanced computational tools to improve the reliability of aeroelastic simulations of wind energy systems; and
- advanced control systems and blade sensors to improve performance and reliability under a wide variety of wind conditions.

Wind energy forecasting is another important area of concern identified in the AWEA plan and by producers and users of relevant data provided by the National Weather Service. Current observational networks in the U.S. are relatively sparse and widely spaced for the purposes of forecasting for wind energy activities. These networks emphasize data collection at a height of 10 m or less above the surface compared to today's typical wind turbine hub height of roughly 80 m. This makes it difficult to detect and forecast weather events such as large wind speeds over short time periods. In addition, collaborative field and computational modeling research is considered necessary in strategic areas of the country to better detect and forecast complex flow regimes that lead to unexpected turbine outages, long-term turbine performance issues, and wind forecasting errors.

New Directions for Solar Technology Development

Solar energy constitutes the largest global energy resource. Currently the Bureau of Land Management (BLM) has 158 active solar applications, covering 1.8 million acres with a projected capacity to generate 97,000 megawatts of electricity on the public lands that have been fast-tracked for renewable energy development in six western states. These BLM solar projects could provide the equivalent of 29 percent of the nation's household electricity use. In addition, the United States Geological Survey (USGS) estimates that 48 percent of freshwater withdrawals in 2000 were used for electric power generation. The combination of life-cycle analysis of carbon emissions with this land and water usage data has resulted in a boom in the growth of applications for solar energy projects on public and private lands and on residential, commercial, and municipal sites. An array of solar technologies are currently available for use in lighting, heating, and cooling (air or water) as well as to generate electricity on a wide range of scales from the residential level to utility-scale installations.

The solar industry faces a number of challenges to achieving a significant, stable domestic energy supply for U.S. consumers while meeting greenhouse gas emission reduction targets. Reaching these goals will require the coordination of the solar research and manufacturing supply chains. The U.S. solar industry faces a number of barriers to entry in energy markets. Utilities are justifiably risk-averse and need access to best practices and expertise in order to efficiently integrate solar loads especially in urban areas. Some examples of this were identified in the April 2009 NREL publication: *Photovoltaic Systems Interconnected onto Secondary*

Network Distribution Systems – Success Stories. In addition, there are additional opportunities for the solar manufacturing industry to make large gains through technological advancement.

The United States has a long history of leadership in solar energy technology, in part due to development of photovoltaic technologies for space applications. However, in recent years other nations have come to dominate the solar market through aggressive policy and favorable market conditions. Spain and Germany installed the largest amounts of solar energy capacity in 2007 and 2008. And China, Korea, and Taiwan continue to show significant growth in photovoltaic manufacturing capacity.

To help accelerate the widespread deployment of solar technologies in the U.S., the Administration recently dedicated $117 million in Recovery Act funds to projects administered by the DOE solar program. This program currently has a base annual budget of roughly $200 million.

In reviewing ways to support the long-term growth of a domestic solar manufacturing industry the semiconductor industry may provide a model for partnership on R&D between government and the private sector.

In the case of semiconductors, in the mid-1980s the U.S. – and the Department of Defense in particular – became concerned that Japanese semiconductor manufacturers were limiting access to semiconductor chips for two years or longer, delaying or halting the progress of technological advancement. In order to protect its strategic interest in advancing electronics the U.S. opted to support the growth of a domestic semiconductor industry through support for a semiconductor manufacturing technology research consortium. Sematech which still exists today was created along with a National Technology Roadmap for Semiconductors.

These two activities brought together key players within the industry, from semiconductor manufacturers to manufacturing equipment builders and members of the semiconductor materials supply chain. This model of coordination and collaboration helped to keep the technology moving forward at a quick pace, encouraged the industry to adopt cost and time-saving standards, and helped to eliminate the duplication of research efforts on pre-competitive technologies through communication and coordination. The U.S. continues to host some of the world's most prominent semiconductor companies including Intel, AMD, National Semiconductor, and Texas Instruments.

By 1994, the U.S. semiconductor industry had grown considerably and expanded its share of the world market for these products. The membership of Sematech voted to end federal matching funds for its activities in that same year and all federal funding for Sematech ended in 1996. During that same time period, Sematech expanded its membership to include non-U.S. manufacturers and it continues to serve the industry as a global consortium supporting collaborative research.

In late April 2009, the National Academies organized a meeting on "The Future of Photovoltaic Manufacturing in the U.S." At this meeting a large number of industry players including DuPont, Dow Corning, FirstSolar, SunPower, Applied Materials, and IBM expressed the view that the

photovoltaic industry needed to develop a comprehensive R&D agenda in order to grow the industry. They also suggested the government could facilitate these activities.

While there are American solar companies that have emerged as strong players in the world solar market, they do not have the resources to individually support long-term research, development, and commercial application of new solar technologies while sustaining rapid growth and expanding production capacity. A jointly-developed comprehensive solar technology plan with public and private support may provide a framework for strengthening U.S. leadership in renewable energy technology.