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

HEARING CHARTER

Real-Time Forecasting for Renewable Energy Development

Wednesday, June 16, 2010
10 a.m. – 12 p.m.
2318 Rayburn House Office Building

Purpose

On Wednesday, June 16, 2010 the Subcommittee on Energy and Environment of the House Committee on Science & Technology will hold a hearing entitled *"Real-Time Forecasting for Renewable Energy Development."*

The Subcommittee will receive testimony on the roles that various federal agencies as well as the private sector play in providing forecasting data and services relevant to expanding the availability of reliable, renewable power, and the extent to which these efforts are coordinated. The hearing will also explore any research, development, demonstration, and monitoring needs that are not currently being adequately addressed.

Witnesses

- **Ms. Jamie Simler** is the Director of the Office of Energy Policy and Innovation at the Federal Energy Regulatory Commission. Ms. Simler will testify on FERC's recent activities to survey the issues surrounding the utilization of intermittent renewable energy sources on the electric grid, as well as viable technical and policy options to address these issues.

- **Dr. Alexander MacDonald** is the Deputy Assistant Administrator for Laboratories and Cooperative Institutes in the National Oceanic and Atmospheric Administration's (NOAA's) Office of Oceanic and Atmospheric Research. Dr. MacDonald will describe the data, information, and services currently provided by NOAA in support of renewable energy, and how these capabilities could be further developed to better serve the needs of renewable energy developers and consumers.

- **Dr. David Mooney** is the Director of the Electricity, Resources, and Building Systems Integration Center at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. Dr. Mooney will testify on NREL's activities with other federal agencies as well as the private sector to identify and address issues with grid integration of renewable energy resources.

- **Dr. Pascal Storck** is the President of 3TIER. Dr. Storck will provide testimony on the role that private renewable power forecasters play relative to and in collaboration with services offered by the public sector.

- **Mr. Grant Rosenblum** is Manager of Renewable Integration for the California Independent System Operator (California ISO). Mr. Rosenblum will testify on his experience in balancing intermittent renewable power with baseload power sources, and on ways to ensure the reliability of a transmission system with significant renewable energy components.

- **Dr. Robert Michaels** is a Senior Fellow of the Institute for Energy Research. Dr. Michaels will testify on economic and other challenges associated with renewable energy sources.

Background

A significant barrier to the widespread adoption of many forms of renewable energy, including wind, solar, and marine and hydrokinetic power (MHK), is that these sources are intermittent. Electric grid managers address this intermittency by adjusting the delivery of other sources of power based on expected changes in renewable power output. These expected changes are called power production forecasts. Such forecasts must take into account changing weather conditions in conjunction with the land's topography near a renewable energy device, along with the device's expected technical performance. The larger the uncertainty in these forecasts, the more baseload[1] power must be kept in reserve or stored to ensure the reliability of electricity to consumers, thus ultimately increasing the total cost of electricity generation. Several recent reports[2] have determined that improving the accuracy and frequency of these forecasts can have a major impact on the economic viability of renewable energy resources.

Wind, Solar, and Marine and Hydrokinetic Power Forecasting Needs

Current observational networks in the United States are relatively sparse and widely spaced, and are therefore not well-suited to forecast wind energy generation. 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. The American Wind Energy Association's (AWEA's) detailed *Action Plan to 20% Wind Energy by 2030*, which is a follow-up to DOE's wind energy report, also notes that there is "currently a disconnect between wind forecasters and grid operators regarding what wind forecasting information is most useful for system operators." The

[1] "baseload" power refers to power that can be delivered continuously. Examples include coal, nuclear, natural gas, and power delivered from energy storage systems such as batteries, fuel cells, and compressed air energy storage (CAES).

[2] Examples include the National Renewable Energy Laboratory's *Western Wind and Solar Grid Integration Study* published in May 2010 and the Department of Energy's 2008 report entitled *20% Wind Energy by 2030*.

plan recommends greater cooperation between these groups and enhanced system operator training, as well as a significant effort to integrate wind forecasting tools into energy management system applications. 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.

Forecasting needs for marine and hydrokinetic energy projects are similar to wind. High-resolution wind data, enhanced frequency in which data is collected, and increased local observation sites near potential MHK projects can improve long- and short-term power forecasts. Wave energy technologies also benefit from accurate ocean surface wind simulations. Although tidal and current energy are more predictable than wave energy, DOE's National Marine Renewable Energy Centers are currently developing numerical models to simulate the mechanics of flow around single turbines and full arrays with the goal of significantly improving their reliability and power forecasts. Finally, meteorological data focused on the surface boundary layer of the water, combined with the already collected astronomical tidal forecasts conducted by the National Oceanic and Atmospheric Administration's (NOAA) National Ocean Service, can assist in providing more accurate tidal power forecasts.

Solar power forecasting is heavily dependent on satellite data, much of which has a resolution that is a factor of 10 or more too course to meet the real-time needs of grid managers. The power output of utility-scale concentrating solar power systems also depends on the level of direct, as opposed to diffuse, sunlight incident on the systems' components, which in turn is dependent on the concentration of aerosols as well as cloud cover in the local atmosphere. This compounds the monitoring and modeling requirements to achieve an accurate forecast.

Public and Private Sector Roles in Renewables Forecasting

NOAA's capability to understand and predict changes in the Earth's environment enables the agency to support renewable energy at multiple scales. NOAA's weather forecasts support energy demand predictions today, and these forecasts are expected to be critical as sources which depend on real-time meteorological conditions such as solar, wind, and MHK power increase in importance. At the most basic level, most renewable energy sources depend on the atmospheric and oceanic data that NOAA provides. NOAA furthers the development and integration of renewable energy sources through models, analysis tools, and by providing reliable weather, hydrological[3], climatic, and ecological data and forecasts. To accomplish this, NOAA employs a diverse array of data collection tools and leverages internal and external partnerships. NOAA utilizes an integrated system of Earth observing networks supplied by such tools as remote sensing and satellite imagery and a surface network of weather radars, upper air balloons, ocean buoys, ships, aircraft, and seafloor observations to enhance observation networks, improve weather forecasts, and incorporate climatic changes into long term resource forecasts for the

[3] Including researching, monitoring, and predicting ocean currents, tides, water levels, ocean circulation, and temperature.

energy industry and utilities. For example, the Earth System Research Laboratory (ESRL) and the National Weather Service (NWS) work to improve the sensing, characterization, and prediction of weather elements in the Planetary Boundary Layer (PBL) through advances in research and implementation of the next generation operational weather forecast model (called the Weather Research and Forecasting computer model, or more commonly WRF). NOAA leverages research capacities across the agency, as well as partnerships with other federal agencies and national laboratories, cooperative institutes, universities, and international research organizations.

The National Center for Atmospheric Research (NCAR), sponsored by the National Science Foundation (NSF), conducts collaborative research in atmospheric and Earth system science, encompassing meteorology, climate science, atmospheric chemistry, solar-terrestrial interactions, and environmental and societal impacts. Since 2009, a priority of NCAR has been to develop its capacity to support a transition to renewable energy sources through its breadth of atmospheric science knowledge, experience with technology transfer, and access to university researchers. For example, NCAR entered into a partnership with DOE's National Renewable Energy Laboratory (NREL) and a regional utility company, Xcel Energy, to develop sophisticated, localized wind forecasts for operational use. These products aim to inform the siting of new wind turbine farms, to better integrate wind-generated electricity into the power grid, and to make critical decisions about powering down traditional power plants when sufficient winds are predicted. In addition, NCAR incorporates observations of current atmospheric conditions from a variety of sources, including NOAA models and meteorological data, satellites, aircraft, weather radars, ground-based weather stations, and sensors on the wind turbines into three powerful NCAR-based tools: WRF (referenced above); the Real-Time Four-Dimensional Data Assimilation System (RTFDDA); and the Dynamic Integrated Forecast System (DICast).

NREL has published several studies on the regional integration of intermittent renewables into the electric grid over the last several years. The laboratory currently works with private renewable technology developers and forecasters to test and supply relevant data on the effect that varying atmospheric conditions can have on particular types of renewable energy systems. NREL also works with NOAA and other relevant agencies to map and update its assessment of renewable energy resources throughout the United States, and it carries out modeling and simulation research activities to better inform the siting and operation of a variety of renewable energy projects. In addition to these ongoing efforts, on June 1st DOE announced funding for up to $6 million over two years to improve short-term (0-6 hour) wind energy forecasting - $2 million of which will be provided to NOAA this year to fund its technical support of the selected projects and $1 million will be awarded to one or two competitively selected teams. DOE anticipates providing an additional $3 million in fiscal year 2011 to NOAA and the recipient team(s) for completing the project.

Private sector companies, often called Forecasting Service Providers (FSP), have been in the business of producing site and technology specific renewable power forecasting products for over a decade. These companies are generally third-party vendors which provide confidential forecasting products. The power forecasting products are usually based on three main inputs. The first input is the foundational numerical weather prediction (NWP) models using NOAA, NASA and NCAR meteorological and atmospheric data. The second input is site specific observations collected from meteorological (or "met") towers and other on-site observation devices. Finally this information is combined with technical specs based on the energy output of the specific renewable technologies (i.e. a certain kind of wind turbine or solar panel). Then using advanced computational techniques, simulations and local scale specific models a power forecasting product is created.

Renewable energy project developers, financiers, energy generators, utilities, and electricity balancing authorities use power forecasts. Generally there are two kinds of products, one is used for long-term planning to build and site new renewable projects and the other is short-term (day-ahead or hour-ahead time frames) for optimization of renewable energy integration onto the grid. The long-term forecast helps assess the amount of energy a specific location may be capable of producing using a certain technology. This information helps determine characteristics of a project such as what technology to install and how large an installation should be. The short-term power forecasts are used for efficient scheduling of generation resources. This is important to energy generators as well as to balancing authorities such a Regional Transmission Organizations (RTO) and Independent Systems Operators (ISO) which are charged with managing the flow of electric power on the grid. Accurate power forecast products help generators maximize profits by making their resources more reliable for scheduling as well as better at precisely predicting their energy output. Increased accuracy may reduce fines, penalties, and eventually the amount of reserve energy required to back-up or firm-up the same quantity of renewable resource. This is important to RTOs and ISOs because it reduces the risk of over or under loading the power grid, which can damage the grid and possibly lead to catastrophic blackouts.

FERC Notice of Inquiry on Variable Energy Resources

To gain further information on these issues, the Federal Energy Regulatory Commission (FERC) issued a Notice of Inquiry (NOI) in January on "the extent to which barriers may exist that impede the reliable and efficient integration of variable energy resources (VERs) into the electric grid, and whether reforms are needed to eliminate those barriers." The NOI goes on to state that:

> "[i]n order to meet the challenges posed by the integration of increasing numbers of VERs, ensure that jurisdictional rates are just and reasonable, eliminate impediments to open access transmission service for all resources, facilitate the efficient development of infrastructure, and ensure that the reliability of the grid is maintained, the Commission seeks to explore whether reforms are necessary to ensure that wholesale electricity tariffs are just, reasonable and not unduly discriminatory."

To date, FERC has received responses to this NOI from over 100 parties, including relevant government agencies and laboratories, electric utilities, RTOs, ISOs, and private forecasting companies.