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

FIELD HEARING CHARTER

Options and Opportunities for Onsite Renewable Energy Integration

Monday, November 15, 2010
9:30 a.m. – 11 a.m. Central Standard Time
Dirksen Federal Courthouse, 219 S. Dearborn Street, Chicago, Illinois
Ceremonial Court Room 2525

Purpose

On Monday, November 15, 2010 the House Committee on Science & Technology will hold a field hearing entitled *"Options and Opportunities for On-site Renewable Energy Integration."*

The hearing will examine the integration of renewable energy systems in the built environment. Witnesses will discuss the state of the building industry and how federal research programs can help continue the industry's efforts to adopt renewable energy into their designs and practices. Opportunities for the adoption of simulation-driven design, storage integration, and measurement and verification technologies will also be discussed. Furthermore, the hearing will consider research, development, and demonstration needs that are not currently being adequately addressed by the industry or the U.S. Department of Energy (DOE).

Witnesses

- **Mr. Joseph Ostafi IV** is the Regional Leader for the Science and Technology Division and also Group Vice President of HOK a global architectural firm that specializes in planning, design, and delivery solutions for buildings and communities. Mr. Ostafi will provide a broad overview of what it means to integrate renewable energy into buildings and discuss some technical issues which need additional research to ease integration.

- **Mr. Michael Lopez** is the Director of Facility Operations for Bolingbrook High School, the first Leadership in Energy and Environmental Design (LEED) Certified School in Illinois and the third high school in the United States. Mr. Lopez will discuss the environmental and energy efficient initiatives of the Valley View School District.

- **Mr. Daniel Cheifetz** is the Chief Executive Officer of Indie Energy Systems Company, which is a global leader in smart geothermal technology for heating and cooling both existing and new buildings. Mr. Cheifetz will discuss the incorporation of geothermal energy and related system integration technologies into the built environment.

- **Dr. Jeffrey P. Chamberlain** is the Department Head for Electrochemical Energy Storage and is also the Energy Storage Major Initiative Leader of the Chemical Sciences and Engineering Division at Argonne National Laboratory. Dr. Chamberlain will discuss how research in vehicle storage technologies relate to stationary storage technologies used in buildings.

- **Ms. Martha G. VanGeem, PE,** Principal Engineer & Group Manager of Building Science and Sustainability of CTL Group a industry leader in engineering and scientific services. Ms. VanGeem will discuss the role of industry and federal research programs in developing technologies and standards to integrate renewable energy into buildings.

Background

In 2009 the Department of Energy (DOE) reported that buildings accounted for 80 percent (or $238 billion) of total U.S. electricity expenditures. From 1980 to 2006, total building energy consumption in the United States increased more than 46 percent, and is expected to continue to grow at a rate of more than 1 percent per year over the next two decades. Carbon emissions from buildings in the U.S. approximately equal the combined carbon emissions of Japan, France, and the United Kingdom. This is about 38 percent of the emissions emitted in the country. Tackling public concerns about the high costs of energy, the looming threat of global climate change, and the nation's economic wellbeing requires continual assessment of federal building technology programs.

The importance of energy efficiency and sustainability in buildings has been recognized in various federal laws, executive orders, and other policy instruments in recent years. Among these are the energy policy acts (EPAct) of 1992 and 2005 (P.L. 102-486 and P.L. 109-58), the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140), and the American Recovery and Reinvestment Act of 2009 (P.L. 111-5). Through these laws the DOE is authorized to carry out a range of activities to increase energy efficiency in a number of economic sectors.

While these programs continue to demonstrate success in developing technologies and practices for high-performance buildings, advancing the state of technology far beyond what is currently available will require the programs to incorporate entirely new technologies and approaches into their R&D agendas.

Steps to first reduce total energy consumption, and then to use the remaining energy more efficiently, have been and continue to be the country's first line of defense to reduce the cost of energy and to cut carbon emissions in the building sector. As the country has become more effective in using these techniques, new approaches to drastically reduce traditional energy consumption by integrating on-site renewable energy into the built environment have garnered more attention and have been incorporated into public law and into practice.

Modern practices of using energy efficient technologies and addressing other environmental concerns have generally been termed "green building design." While the concept has existed for a long time, the practices did not really emerge until the 1990s. Since then terms such as "green building," "high-performance building," and "high-performance green building" have been defined in public law, both by several different Federal agencies and by stakeholders in the building community. For example, a "high-performance building" is defined by EISA as a building that integrates and optimizes, on a life cycle basis, all major high performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality and operational considerations. To move beyond energy efficiency and into integrating renewable energy into building design, new terms have been developed, such as “net-zero energy,” which also has been defined in many ways.

Net -Zero Energy

In general, a net-zero energy building produces as much energy as it uses over the course of a year. Some building scientists intended for these buildings to have no net environmental impact or even a “minus-impact” which would mean the building would provide a net environmental benefit. The National Renewable Energy Laboratory (NREL) has studied four different definitions including: net-zero site energy, net-zero source energy, net-zero energy costs, and net-zero energy emissions *(Box.1).* The diversity in these definitions illustrates that these are fairly new concepts still under discussion by the building community.

Net Zero Site Energy: A site ZEB produces at least as much energy as it uses in a year, when accounted for at the site.
Net Zero Source Energy: A source ZEB produces at least as much energy as it uses in a year, when accounted for at the source. Source energy refers to the primary energy used to generate and deliver the energy to the site. To calculate a building’s total source energy, imported and exported energy is multiplied by the appropriate site-to-source conversion multipliers.
Net Zero Energy Costs: In a cost ZEB, the amount of money the utility pays the building owner for the energy the building exports to the grid is at least equal to the amount the owner pays the utility for the energy services and energy used over the year.
Net Zero Energy Emissions: A net-zero emissions building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.

Box.1 NREL Zero-Energy Buildings: Definitions.[1]

DOE’s Net-Zero Energy Commercial Building Initiative aims to realize marketable net-zero energy commercial buildings by 2025. The program brings architects, engineers, builders, contractors, owners, and occupants together to optimize building performance, comfort, and savings through a whole-building approach to design and construction. The program is divided into three interrelated strategic areas designed to overcome technical and market barriers: research and development, equipment standards and analysis, and technology validation and market introduction. Key research areas include: commercial lighting solutions; indoor environmental quality; building controls and diagnostics; and space conditioning. These types of research will help decrease the cost of integrating renewable energy in the built environment.

Federal programs to deploy renewable technologies have helped owners incorporate renewable energy systems into their buildings. For example, financing the cost of a residential photovoltaic (PV) system through home equity loans, mortgage loans, or cash in combination with state and utility incentives has helped reduce the cost of systems. Nevertheless, right now not every owner is ready to make the necessary up-front financial investment in a renewable energy system.

[1] Torcellini, P.; Pless, S.; Deru, M. (NREL); Crawley, D. (U.S. DOE). (2006). Zero Energy Buildings (ZEB): A Critical Look at the Definition. NREL/CP-550-39833. Golden, CO: National Renewable Energy Laboratory.

Renewable Ready Buildings

One concept which may help ease the adoption of renewable energy systems for building owners who are not ready to make the up-front investment is the idea of “renewable ready” buildings. As with many of the approaches in the green building sector, “renewable ready” is not well defined, but some builders are beginning to take this approach into consideration as they look toward “greening” their building designs. In general, this means that the construction of new buildings or renovations of buildings should be constructed "ready" for future renewable energy installations. Advocates of this approach believe that planning ahead for a renewable energy system maximizes the potential of that renewable energy source in the future.

It is in the planning for a renewable energy system where there is a wide variety of elements that could be considered to make a building “renewable ready.” The variety of elements is highly dependent on the kind of renewable energy system to be installed in the future. The design and element differences between making a building ready for solar panels versus a geothermal energy system may be very different.

Moreover, there are building codes which may impede the ability to design and adopt renewable energy systems for buildings. For example, codes pertaining to roof heights and slopes could be barriers to the adoption of PV. In contrast, some building codes could also be used to encourage the adoption of “renewable ready” designs. For instance, in March of 2010 the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) released *Standard 189.1 – Standard for the Design of High-Performance, Green Buildings*. This new standard includes a provision for “renewable energy ready” elements and is the first set of model codes and standards for green building in the U.S.

Finally, another barrier to the adoption of “renewable ready” buildings is the siting of the building. For example, the orientation and location of a building’s axes and surfaces, and the building’s proximity to trees and other plantings, affect its heating and cooling requirements. Siting may also impact the ability to incorporate renewable energy generation on the building or on-site.

Community Planning

Consequently, renewable energy experts including scientists at NREL have been working on “net zero-energy communities” which are defined as “one that has greatly reduced energy needs through efficiency gains such that the balance of energy for vehicles, thermal, and electrical energy within the community is met by renewable energy.” In some cases, planning a community where the renewable energy systems can be sited in a variety of ways may ease the adoption of renewable energy systems. For example, NREL has explored siting renewable energy system within the built environment (rooftop), on-site (parking structure, along roadways, etc.) or on unbuildable areas such as brownfield sites. This flexibility could also allow for the adoption of a variety of integrated renewable energy systems such as solar PV and a wood biomass boiler.

Systems Integration

Even after building completion, systems are rarely optimized together to improve overall energy efficiency and environmental performance. A typical building is comprised of a complex array of components (wood, metals, glass, concrete, coatings, flooring, sheet rock, insulation, etc.) and subsystems (lighting, heating, ventilation and air conditioning, appliances, landscape maintenance, IT equipment, electrical grid connection, etc.), all of which are developed individually by independent firms that do not often design and test their performance in conjunction with other components and systems. Adding renewable energy generation as well as storage capacity to these systems is complicated, yet is already being done. But the inefficiencies attributable to this fragmentation of the building components and systems, and the lack of monitoring and verification of a building performance, point to a critical need for a more integrated approach to building design, operation, and technology development. An approach that couples buildings sciences, architecture, and information technologies could lead to entirely new buildings with subsystems that are able to continuously communicate with each other and respond to a range of factors including renewable energy generation. Wide-scale deployment of these types of net-zero energy high performance buildings may require federal programs to play a larger coordinating role in the development of the common technologies, codes, and standards.