LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

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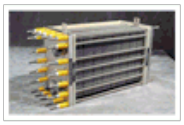
In this issue, you can learn about EETD's work to analyze energy information systems (EIS) and improve their utilization in commercial buildings. We also look at ISO 50001, a new standard that helps industrial and commercial enterprises operate energy-efficiently, and the role played by the Environmental Energy Technologies Division in shepherding it through the consensus approval process. The BEST Dairy tool, as the name suggests, helps dairies maximize their energy efficiency, and the latest assessment of the wind power market in the U.S. looks at the health of the U.S. wind power industry.

If you are new to *EETD News*, please subscribe [http://eetd.lbl.gov/newsletter/sub/newsletter_signup.php].

—Allan Chen







EETD News reports on research conducted at Lawrence Berkeley National Laboratory's Environmental Energy Technologies Division, whose mission is to perform research and development leading to better energy technologies that reduce adverse energy-related environmental impacts. The Division's staff of nearly 400 conducts research on energy efficiency in buildings, indoor environmental quality, U.S. and international energy issues, and advanced energy technologies. The newsletter is published online once a quarter. For more information, contact Allan Chen, (510) 486-4210.

The *Center for Building Science News* was published between 1993 and 1998. It covered news of the Division's research in energy efficiency and buildings, the indoor environment, and energy analysis. You'll find all back issues, from Winter 1993 through Summer 1998, available here [http://eetd.lbl.gov/newsletter/cbs_nl/cbsnews.html].

Summer 2011: Vol. 10, No. 1 [http://eetd.lbl.gov/newsletter/nl36/]
Environmental Energy Technologies Division News [http://eetd.lbl.gov/newsletter/]

LAWRENCE BERKELEY NATIONAL LABORATORY

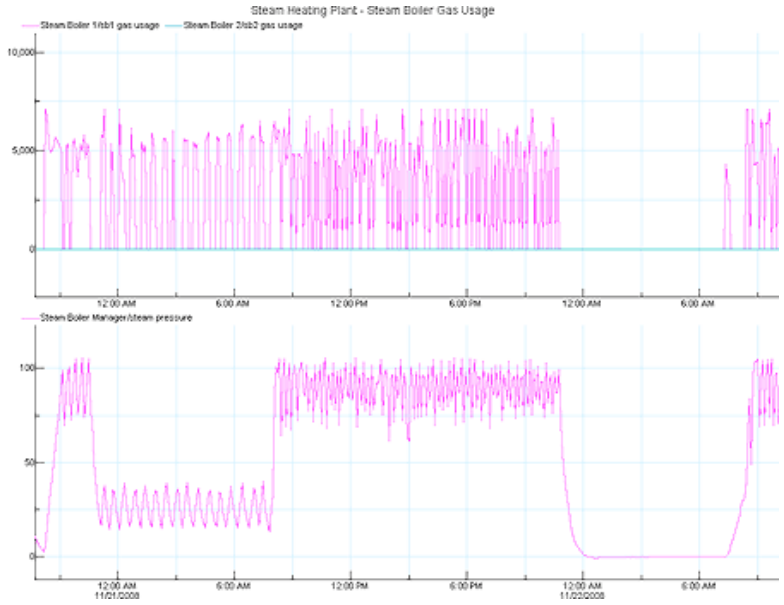
Environmental Energy Technologies Division

NEWS

Energy Information Systems Open the Door to Real-Time Building Energy Management

Berkeley Lab Research Aims to Make EIS Easier for Facilities Managers to Use

Real-time control and continuous high-quality building performance data are the keys to reducing building energy use during day-to-day operations, and to maintaining energy-driven services and occupant comfort. Next-generation highly energy-efficient buildings will be dynamically controlled and monitored.



Web-based energy management and control system trends and energy-saving operational change at the University of California, Merced, showing an overnight drop in gas use from zero overnight pressure.

Energy information systems (EIS) are one type of commercially available system that provides this real-time continuous stream of monitoring information, usually in large commercial and industrial buildings and facilities. Scientists at Lawrence Berkeley National Laboratory (Berkeley Lab) recently studied the capabilities of marketplace EIS, and their use in several large facilities, with the goal of working toward improved systems that will be easier to install and to use; ultimately they will drive buildings toward greater energy efficiency and lower costs. The Berkeley Lab team is developing a handbook and other materials to make it easier for facilities managers to use and specify EIS.

"Energy information systems can process building performance data and turn them into actionable information," says Jessica Granderson, one of the authors of a study on the state of EIS technology. "They make energy data visible to building and facilities managers, helping them reduce unnecessary use and pinpoint problems with systems that are wasting energy." Granderson is a scientist in Berkeley Lab's Environmental Energy Technologies Division (EETD).

Scoping the State of the Energy Information System

With funding from the California Energy Commission, Granderson and her colleagues studied the capabilities of energy information systems available in the marketplace, and conducted case studies of how an EIS was used by campuses or large enterprises—Walmart, Sysco, the University of California (UC) Merced, and UC Berkeley as a contrasting case. Their purpose was to determine how the features of various systems helped managers save energy, and what kinds of improvements could help managers do their job better.

"The typical EIS provides at least hourly whole-building data on electricity use, with weather, gas, and system submeter information, depending on the particular implementation," says Granderson. "They offer the capability to visualize this data graphically, as well as automated analyses. For example, a building's metered use can be compared to its baseline or to billed utility use."

In the field, the team found that an EIS helped motivate facilities managers to achieve major energy savings, isolate and identify problems with equipment, and manage energy use. But energy managers are time-constrained, and the study found that managers don't always have the time and resources to use the full analysis capabilities of their EIS.

Sysco is one of the largest food distribution companies in the U.S. The company had a corporate goal of improving enterprise-wide energy use 25 percent over three years—a goal that it has exceeded. Granderson studied Sysco's use of an EIS in its Stockton, California, food distribution center, which refrigerates large storage areas to keep food fresh.

At the Stockton facility, an "energy champion" on the facilities staff used a single meter monitor (a graphic on the computer screen showing continuous power use) to keep the temperature of the building's conditioned spaces within the required cooling limits, turning the system on and off as needed. Manual control of the conditions in the space saved 36 percent of the cooling demand when the staff member was present and actively managing the system.

The EIS also helped identify excessive energy use—for example, at the end of the work day, when the electric load didn't decrease as expected, building staff were able to trace its cause to lights that weren't being turned off when workers left the building.

Walmart used its EIS for a number of purposes, including verifying the performance of specially designed high-efficiency superstores. The Berkeley Lab team learned of examples from the company's energy managers in which the EIS showed its worth by identifying systems that weren't working right and were wasting energy. One malfunctioning module for dimming the lighting in a Texas facility, after being fixed, resulted in avoided energy costs of $35,000.

And at UC Merced, an EIS helped an operator determine that the steam plant was using excessive gas. The 30 percent reduction in gas use at that steam plant saved about $2,500 per month.

"Large savings are possible with an EIS and an innovative operations staff," says Granderson, "as these case studies demonstrate."

The study notes, for example, that analyzing electric load profiles can reveal historic trends in energy use and opportunities for improvement. Daily forecasting of electricity loads, which some EIS can produce, can help facilities staff carry out a daily energy efficiency strategy, customized to such factors as the forecasted weather and the real-time electricity cost.

Energy Information Handbook in the Works

The EIS scoping study and case studies were the first in a recent EETD research and development program focusing on how to better deploy and scale up the use of the EIS in facilities. With funding from the U.S. Department of Energy, Granderson and her colleagues are developing a handbook for energy managers who have little or no experience in analyzing building energy data. "The handbook will be heavy on application examples—how to interpret what you see in EIS and related performance-monitoring technologies. It also highlights the energy benefits of applying various analysis methods," she says.

The team is also developing a guide specification for EIS and other types of energy-performance monitoring systems on the market such as EMCS (energy management and control systems). "The guide spec will help building owners and energy managers better understand what types of capabilities are available," Granderson says, "and will make it easier for them to specify the technical requirements of these systems when they are ready to acquire them for their buildings."

—Allen Chen

Additional information:

Building Energy Information Systems: State of the Technology and User Case Studies, by Jessica Granderson, Mary Ann Piette, Girish Ghatikar, and Phillip Price, LBNL-2899E, may be downloaded here. [PDF [http://eis.lbl.gov/pubs/lbnl-2899e.pdf]]

More information on energy information systems research at Berkeley Lab:
Building Energy Information Systems and Performance Monitoring Tools [http://eis.lbl.gov/]

This research is supported by the U.S. Department of Energy and the California Energy Commission's Public Interest Energy Research program.

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

ISO 50001 Standard Approved and Released

ISO 50001 provides industry with a tool to improve the energy efficiency of industrial and commercial operations.

ISO 50001 is a sleeping giant just beginning to awaken. The International Organization for Standardization's ISO 50001 energy management standard was published in June, and it now offers a common framework for industrial plants, commercial operations, and other organizations to manage their energy efficiently. Given the breadth of its target users, this voluntary standard's international impact is likely to be substantial and widespread, with the potential to affect as much as 60 percent of the world's energy use.

Pursuing a Common Standard

The need for an international energy management standard became clear in 2007. At that time, some countries had already established their own energy management standards, and others were in the process of developing them. That same year, Aimee McKane, who works for the U.S. Department of Energy and Lawrence Berkeley National Laboratory (Berkeley Lab), prepared an issues paper for the United Nations Industrial Development Organization (UNIDO), analyzing the commonalities and differences of the existing national energy management standards.

"What the paper showed," McKane explains, "is how well aligned the different standards were. There were some differences among them, certainly, but there was also a lot of commonality. It became clear that harmonizing them into an international standard wouldn't be that difficult to do."

That paper served as a trigger for UNIDO to hold a discussion on the topic later that year, and that discussion became the impetus in developing support for ISO 50001. In 2008, the ISO formally set the project in motion by establishing the ISO PC 242 Energy Management project committee to develop an international standard. Members from the United States and Brazil were chosen to guide the process.

The Answer: ISO 50001

Written to enable companies to manage all aspects of their energy operations, ISO 50001 provides technical and management strategies for every level of an organization to set and reach goals to optimize its energy efficiency, lower costs, and meet environmental targets. It follows the examples of ISO 9000 and ISO 14000 by incorporating the Plan-Do-Check-Act approach

to encourage and support continual improvement. That is, it not only provides a framework for addressing energy use and planning, it also includes action plans and identifies methods for measuring and documenting improvements, so that successful activities can be used to further improve processes throughout the organization. In essence, it incorporates energy valuation and continual energy efficiency improvement into a company's everyday activities and decision making—from top management on down. Multinational companies will also able to use it to standardize energy management across operations in different countries.

Widespread Agreement Led to Rapid Development

As Vice-Chair of the U.S. delegation to the ISO's Project Committee 242 (ISO PC 242), McKane spent 2010 working on the ISO 50001 standard, helping to shepherd it into its final form. The fourth meeting of ISO PC 242 was last October in Beijing, China. More than 100 delegates from 23 countries gathered to review and address the hundreds of comments that had been received on the draft standard. Based on further expert input in November and December, the Final Draft International Standard (FDIS) was prepared and released in March 2011. It was approved in June, without a single vote against it.

"The whole process happened in two-and-half years, which is very unusual," says McKane. "Even small standards typically take three years or more to be approved, and this is the biggest standard that the ISO has ever put together. That gives you an idea of the consensus we were able to achieve. Of course, even in 2008, when we began, we had a lot of the information together, so we had a good running start."

The U.S. Department of Energy (DOE) and its government, industry, commercial, and research partners played a strong role in ensuring that the standard was robust. "In particular, the U.S. drove the requirement that ISO 50001 requires organizations to establish an energy performance baseline, explains McKane. "After implementing their action plans, organizations are required to measure their energy performance against that baseline and to establish future targets for continued energy performance improvement."

Strong Interest in Adoption

Now that the standard is published, each country will decide for itself whether or not to adopt it as a national standard, although its strong acceptance throughout the development process virtually guarantees that it will enjoy universal adoption. In the United States, the American National Standards Institute (ANSI) will formally adopt it.

The standard is receiving strong interest among organizations seeking to reduce their energy use. Particularly, it is likely to be adopted by organizations that want an internationally recognized framework to continually improve their energy performance , thus contributing to:

- sustainability programs,
- energy cost reduction,
- promoting energy efficiency throughout the manufacturing supply chain, and
- reducing their carbon footprint, carbon cap and trade programs, and international carbon agreements.

The establishment of this standard is timely, as the need for companies to reduce costs and greenhouse gas emissions rises in response to the world's economic situation and environmental policies. So timely, in fact, that some organizations began to adopt the standard before its final approval.

For example, 26 U.S. industrial facilities are already using the ISO 50001 standard as participants in DOE's Superior Energy Performance (SEP) demonstration program. To participate in the program, organizations must meet a specific percentage improvement in their energy performance over their current practice, which is verified by an independent third party and recertified every three years. The first five facilities have already received SEP certification last year using the ANSI national standard, and will be recertified to ISO 50001.

In addition to the energy and cost benefits that organizations will receive by adopting the standard, they benefit from third-party verification of their energy improvements, which helps them validate their success for purposes such as due diligence, green labeling, corporate carbon footprint reduction goals, and supply chain sustainability. The ANSI-American National Standards Institute-ASQ National Accreditation Board, or ANSI-ANAB, will provide certification of conformance to SEP and the ISO 50001 standard.

The DOE is already reaching out to other countries through the Global Superior Energy Performance Partnership (GSEP) to share information about SEP and exchange best practices on ISO 50001 implementation. For more information on the GSEP, see the article "Berkeley Lab Initiative Opens Clean Energy Ministerial" [http://eetd.lbl.gov/newsletter/nl32/eetd-nl32-7-ministerial.html] from the *EETD News* summer 2010 issue.

Maintaining the Momentum

As a strong vote of confidence, the ISO PC 242 unanimously resolved to create an ISO Technical Committee (ISO TC 242), continuing under U.S. and Brazilian leadership. "The technical committee will develop an ISO family of standards that address guidance, implementation, and other pertinent issues relating to the standard," says McKane. "The goal is that this follow-on work will facilitate ease of use and broad implementation of ISO 50001." The committee's first meeting will take place in

Washington, D.C., in October 2011.

The release of ISO 50001 was celebrated in Geneva, Switzerland, in June. However, for those such as McKane, who represents the United States on the ISO Strategic Advisory Group for Energy and has pursued this vision for years, the real payoff will be in seeing its effect as more and more organizations begin to use it to reduce their energy use.

"It's a groundbreaking international standard that's designed to have a long-term effect on how managers value energy efficiency in their organizations. says McKane. "It's bound to have a noticeable impact on energy use, worldwide."

—Mark Wilson

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Additional information:

Industrial Energy Analysis Featured Research: ISO 50001 [http://industrial-energy.lbl.gov/]
ISO 50001 Energy Management Standard [http://www1.eere.energy.gov/office_eere/energymanagement.html]
Superior Energy Performance program [http://www.superiorenergyperformance.net/]

Aimee McKane's papers supporting the ISO 50001 process can be found at the Industry Energy Analysis [http://industrial-energy.lbl.gov/] website. Her most recent paper can be found here: Industrial Energy Efficiency as Standard Practice [http://industrial-energy.lbl.gov/node/443].

Clean Energy Ministerial: Global Superior Energy Performance Partnership (GSEP) [http://www.cleanenergyministerial.org/GSEP/index.html]

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Berkeley Lab Benchmarking Tool Helps Dairy Processors Find Energy and Water Savings

As the nation's largest milk producer, California dairy farms constitute one of the most important sectors of the state's economy. Because dairy processors are energy- and water-intensive, the Industrial / Agricultural / Water Energy-Use Energy Efficiency group of the California Energy Commission's Public Interest Energy Research (PIER) Program began to work with Lawrence Berkeley National Laboratory (Berkeley Lab) to help dairy processors identify areas where they could trim costs by saving energy and water.

Journal articles of the work were published in *Energy* and *Energy Policy,* and the project culminated in the development of BEST-Dairy, a tool for benchmarking energy and water use. BEST-Dairy helps the processors compile their energy and water use data and compare it to the best references in the tool. It provides a quick assessment of relative energy and water efficiency that dairy processors can use to identify savings opportunities, in the plant and in individual processes.

"We conducted an extensive literature search of public data in many countries, looking at the energy intensity for each product, the process, and the process steps," says Environmental Energy Technologies Division (EETD)'s Investigator Tengfang Xu, who led the project team and developed the tool with Jing Ke, with assistance from Joris Flapper, Klaas Jan Kramer, and Jayant Sathaye. "Given that there has been very limited data available from California dairy processors, we compiled and used national and international data as the reference data for the tool."

Focusing on four products (fluid milk, butter, cheese, and powder milk), the team decided to offer users three assessment options: (1) plant-level (requiring only overall energy and water use data), (2) process block-level (requiring data for a series of steps, or "blocks," and (3) process step-level (requiring detailed data at every process step).

The tool, which was released in mid-May, is free. Users simply enter 12 months of data into an Excel spreadsheet, and it automatically compares the plant's energy and water use to that of the best available reference; showing benchmarking scores for water and energy use, as well as their potential savings and associated cost savings. Xu envisions that dairy processors also can use the tool to assess changes in their energy and water use efficiency over time or, if a company has several plants, they can benchmark their plants against each other, identify the most efficient, and implement the most efficient processes among all their dairies. The dairy processor energy studies and the BEST-Dairy tool are attracting interest from European and South American companies, as well as from Californian and U.S. dairy processing plants. Xu would like to see the tool used much more widely, which eventually will benefit the dairy processing industry in California and in other countries.

"We're in a diligent search for more data," says Xu. "There are still not nearly enough—especially from California dairy processors. We encourage all users to contribute their data to help populate more reference data in the tool. Any data we receive are confidential and presented anonymously."

—Mark Wilson

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Additional information:

BEST Dairy Tool and report [http://best-dairy.lbl.gov/], "User's Manual for BEST-Dairy: Benchmarking and Energy/Water-Saving Tool (BEST) for the Dairy Processing Industry. BEST-Dairy Version 1.2." by Xu, Tengfang, Jing Ke, and Jayant Sathaye.

Xu, Tengfang, and Joris Flapper. 2011. "Reduce Energy Use and Greenhouse Gas Emissions from Global Dairy Processing Facilities [http://ideas.repec.org/a/eee/enepol/v39y2011i1p234-247.html]." *Energy Policy* 39: 234-247.

Xu, Tengfang, Joris Flapper, and Jan Kramer. 2009. "Characterization of Energy Use and Performance of Global Cheese Processing [http://www.sciencedirect.com/science/article/pii/S0360544209003533]." *Energy* 34(11): 1993-2000.

Xu, Tengfang, and Joris Flapper. "Energy Use and Implications for Efficiency Strategies in Global Fluid-Milk Processing Industry [http://ideas.repec.org/a/eee/enepol/v37y2009i12p5334-5341.html]." 2009. *Energy Policy* 37: 5334-5341.

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

New Study Reveals Challenges and Opportunities in U.S. Wind Power Market

Despite a trying year in which wind power capacity additions declined significantly compared to both 2008 and 2009, in 2010 the U.S. remained one of the fastest-growing wind power markets in the world—second only to China—according to a report released today by the U.S. Department of Energy (DOE) and prepared by Lawrence Berkeley National Laboratory (Berkeley Lab).

"The delayed impact of the global financial crisis, relatively low natural gas and wholesale electricity prices, and slumping overall demand for energy combined to slow demand for new wind power installations in 2010," says Ryan Wiser, one of the study's authors, and a scientist at Berkeley Lab. As a result, roughly 5 gigawatts (GW) of new wind power capacity were connected to the U.S. grid in 2010, compared to nearly 10 GW in 2009 and more than 8 GW in 2008.

Wind power comprised 25 percent of new U.S. electric capacity additions in 2010 and represented $11 billion in new investment. It contributes more than 10 percent of total electricity generation in four states, and provides more than 2 percent of total U.S. electricity supply.

The 2010 edition of the DOE's *Wind Technologies Market Report* provides a comprehensive overview of developments in the rapidly evolving U.S. wind power market. Some of the key findings include:

- **Due to the size and promise of the U.S. market, wind turbine manufacturers continued to locate production in the U.S. in 2010, despite the relatively slow year.** "Nine of the 11 wind turbine manufacturers with the largest share of the U.S. market in 2010 now have one or more manufacturing facilities in the United States, compared to just one such manufacturer with a domestic presence as recently as 2004," says Mark Bolinger, a co-author of the study and a Berkeley Lab scientist. In a major shift, the growth in U.S. wind turbine manufacturing capability, combined with the drop in wind power plant installations, led to an estimated *over-capacity* of U.S. turbine nacelle assembly capability of roughly 2.5 GW in 2010, in comparison to 4 GW of *under-capacity* in 2009.
- **As a result, a growing percentage of the equipment used in U.S. wind power projects is domestically manufactured.** U.S. trade data show that the United States remained a large importer of wind power equipment in 2010, but that wind power capacity growth has outpaced the growth in imports in recent years. When presented as a fraction of total equipment-related wind turbine costs, imports have declined significantly, from 65 percent in 2005-2006 to roughly 40 percent in 2009-2010.

- **Wind turbine prices have declined substantially since 2008.** Price quotes for recent wind turbine transactions are in the range of $900-$1,400 per kilowatt, suggesting price declines of as much as 33 percent or more since late 2008, with an average decline closer to 20 percent for orders announced in 2010.
- **Technological advancements have improved wind turbine performance, particularly at lower wind speed sites.** Since 1998-1999, the average nameplate capacity of wind turbines installed in the U.S. has increased by 151 percent (to 1.8 megawatts in 2010), the average turbine hub height has increased by 43 percent (to 80 meters), and the average rotor diameter has increased by 76 percent (to 84 meters). This significant upscaling has increased the performance of wind projects. Substantial curtailment of wind energy output has occurred in some regions, however, while a variety of factors have resulted in a move by wind developers toward lower wind speed sites.

- **Turbine price reductions, coupled with improved turbine technology, are expected to exert downward pressure on total project costs and wind power prices over time.** Wind power cost and price reductions were not evident for projects installed in 2010, on average, as costs were driven by turbines ordered at higher prices in previous years. Early indications from projects built most recently, however, show the promise of substantial cost and price reductions, thereby improving the competitive position of wind energy as compared to the recent past.
- **Looking ahead, projections are for modest growth in 2011 and 2012.** Lower wind turbine and wind power pricing, along with key federal incentives for wind energy that are in place through 2012, are expected to lead to modest growth in annual wind power capacity additions in 2011 relative to 2010, with an even better year predicted in 2012. Capacity growth is expected to remain below the 2009 high, however, due in part to relatively low wholesale electricity prices and limited need for new electric capacity additions. Forecasts for 2013, meanwhile, are highly uncertain and depend in part on assumptions about the possible extension of federal incentives beyond 2012.

Berkeley Lab's contributions to this report were funded by the Wind and Water Power Program, Office of Energy Efficiency and Renewable Energy of the U.S. Department of Energy.

—Allen Chen

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The full report (*2010 Wind Technologies Market Report*), a presentation slide deck that summarizes the report, and an Excel workbook that contains much of the data underlying the report, can all be downloaded here [http://eetd.lbl.gov/ea/ems/re-pubs.html].

The Department of Energy's Progress Alert is available here [http://apps1.eere.energy.gov/news/progress_alerts.cfm/pa_id=568].

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Scientists from Around the World Attend Berkeley Workshop on Cool Roof Research

Researchers, government agencies, and roofing manufacturers from around the world gathered in Berkeley in July 2011 to discuss the latest cool roof research. These solar reflective materials reduce energy use and help cool the planet by reflecting sunlight to outer space. Their use has begun to soar in markets around the world thanks to their economic and environmental benefits.

The audience listens to Berkeley Lab's Ronnen Levinson present "Benefits of Cool Roofs."

The International Workshop on Advances in Cool Roof Research was organized by the Heat Island Group of Lawrence Berkeley National Laboratory (Berkeley Lab) and by representatives of Concordia University, Oak Ridge National Laboratory, and the U.S. Department of Energy.

One focus of the workshop was on understanding how roof materials age, including how quickly their ability to reflect sunlight changes, and how to best simulate this natural aging with accelerated laboratory processes under development at Berkeley Lab and at Oak Ridge National Laboratory.

Currently, the solar reflectance of a cool roof is rated after three years of natural exposure in three different U.S. climate zones, as required by the U.S. Cool Roof Rating Council. Developing accelerated aging test protocols is important to expedite the introduction of new cool roof products to market.

Meeting attendees also discussed how to incorporate cool roof requirements in building codes and how to develop an internationally recognized standard for natural and accelerated aging of roofing materials.

Marc LaFrance, Manager for building envelope and windows research and development programs at the U.S. Department of Energy in the Office of Building Technology, welcomed participants, especially international visitors who had traveled a long way, by audio feed from Washington D.C. He urged the group to work to develop accelerated aging test protocols that provide results faster than the current three-year standard for natural exposure.

Ashok Gadgil, Director of Berkeley Lab's Environmental Energy Technologies Division also welcomed the participants with an overview of EETD's research and a brief description of the Lab's current project of installing cool roof shingles on one of its major national user research facilities—the Advanced Light Source.

Members of the Workshop's organizing committee, volunteers from Berkeley Lab, and a few participants pose to commemorate their meeting. First row, left to right: Sarah Quelen, Mohamad Sleiman, Husnu Kalkanoglu, Ronnen Levinson, Chelsea Preble, George Ban-Weiss and Riccardo Paolini. Rear, left to right: Lea Marlot, Paul Berdahl, Josselin Barbaud, Olivier Rosseler, Hugo Destaillats, Julian Sproul, Tom Kirchstetter, Haley Gilbert, and Keith Hong.

Art Rosenfeld, Distinguished Scientist Emeritus at Berkeley Lab and former California Energy Commissioner, delivered a noontime talk showcasing the growing installation of cool roofs around the globe. He discussed recent Berkeley Lab research quantifying the capacity of cool roofs to cool the Earth's atmosphere. "If we whitened all possible urban roofs worldwide," he points out, "it would be equivalent to removing the carbon dioxide emissions of 300 million cars for 20 years." Or in different terms, it offsets the emissions of 500 medium-sized coal-fired power plants.

Ronnen Levinson discussed the quantitative energy, climate, and economic benefits of cool roofs. Dev Millstein presented his climate simulation studies to better understand the potential impact of cool roofs on the Earth's climate. Berkeley Lab researchers Mohamad Sleiman and Hugo Destaillats presented version 1.0 of their accelerated aging protocols, which combines soiling and weathering cycles and mimics well in only three days the changes in solar reflectance exhibited by three-year-old naturally exposed roof samples.

A second day of presentations highlighted the growing international standardization and use of cool roof materials in the European Union, Japan, Australia, and India. In another session, presenters provided a U.S. perspective on the influence of policies and codes on the adoption of cool roofs. Kurt Shickman, Executive Director of the Global Cool Cities Alliance, described his organization's efforts to promote cool buildings and cities globally, to reduce energy use and the urban heat island, and to mitigate the effects of climate change. Doug Davenport of Berkeley Lab described the San Jose Cool City Pilot project, a partnership between the city, Berkeley Lab, the Global Cool Cities Alliance, and the U.S. Environmental Protection Agency.

Peter Turnbull, Principal Program Manager of Commercial Buildings and Zero Net Energy Program Manager at Pacific Gas and Electric, discussed the lessons learned on how to diffuse this new technology effectively though his company's Northern California service area, and how their experience might be used by other utilities.

—Allen Chen

Additional information:

The meeting's schedule and presentations are available online [http://coolroofs2011.lbl.gov/schedule].

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Research Highlights

Indoor Air Award to Berkeley Lab Researchers

A paper by William Fisk, Anna Mirer, and Mark Mendell has received a "best paper" award from the editors of the journal *Indoor Air.*

According to the citation, "Quantitative relationship of sick building syndrome symptoms with ventilation rates," was "one of the top papers published in the journal during the years 2008-2010."

The authors were honored at one of the plenary sessions of the Indoor Air 2011 conference, which takes place this week in Austin.

Download this paper as an LBNL report. "Quantitative Relationship of Sick Building Syndrome Symptoms With Ventilation Rates [http://eetdpubs.lbl.gov/publications/1/quantitative-relationship-sick-building-syndrome-symptoms-ventilation-rates]" *Indoor Air* 19, 159-165, 2009

Cooling the Roof of Berkeley Lab's Advanced Light Source

A worker installs a cool roof on Berkeley Lab's Advanced Light Source.

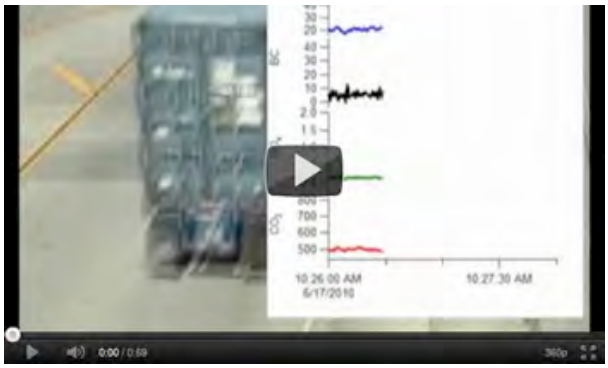
While the light produced for research inside Lawrence Berkeley National Laboratory's (Berkeley Lab's) Advanced Light Source is among the most intense in the world, this summer workers are helping to ensure that the roof of the building stays cooler than most. The project team, managed by Berkeley Lab's Ian White, is replacing the shingles on the roof immortalized on the Berkeley Lab logo with "cool roof" shingles that will help the building reduce its cooling load and heat island effect, while meeting new guidelines for U.S. Department of Energy (DOE) facilities.

The 20,000 square-foot roof is being shingled with Owens Corning Duration Premium Cool Shingles, with an aged solar reflectance index rating of 0.30—about five times the reflectance of the old roof. Berkeley Lab's cool-roof researcher Haley Gilbert helped White select the best shingles with the use of the Cool Roof Rating Council's Rated Product Directory [http://www.coolroofs.org/products/search.php], an interactive online tool for selecting cool roof materials.

The project is expected to be completed by the end of August.

Study of Port of Oakland Truck Emissions Reported at Hearing

Recently, Thomas Kirchstetter, of the Environmental Energy Technologies Division (EETD) at Lawrence Berkeley National Laboratory (Berkeley Lab), and Tim Dallman and Robert Harley, of the University of California, Berkeley, presented the results of a study on the emissions of PM (particulate matter) and NOx (nitrogen oxides) from trucks at the Port of Oakland. The occasion was an August 4 hearing in Oakland, California, convened by Alameda County supervisors to discuss requirements that trucks accessing the Port reduce the pollution they emit.



[http://eetd.lbl.gov/newsletter/nl36/images/port_data.wmv]

The video is taken from the front seat of the research van and shows trucks passing below. Overlaid on the video are real-time and synchronized measurements of four pollutants in truck exhaust. The red line shows CO_2 (carbon dioxide) concentrations, the green shows NOx (nitrogen oxides), the black shows BC (black carbon), and the blue shows PM (particulate matter). There are four discernable peaks in CO_2 that correspond to the passage of four trucks. Looking at the green line, you can see that measureable amounts of NOx were emitted from all four of these trucks. In contrast, BC and PM (black and blue lines) were emitted in clearly measurable amounts from only the first two trucks. The third and forth trucks had very low emissions of particulate matter.

Communities near ports, rail yards, and trucking hubs experience a disproportionately high level of PM emissions. Such emissions can cause or aggravate respiratory diseases.

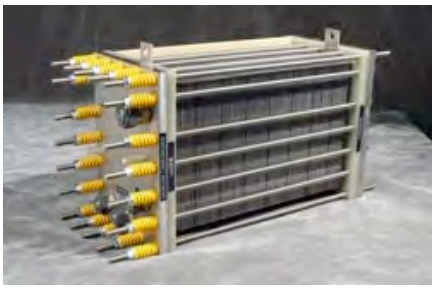
Most of the trucks entering the Port had higher pollution emissions rates than those of new trucks. The California Air Resources Board (CARB) adopted a rule requiring, in its first phase, the replacement or PM-reduction retrofit of trucks of model years 2003 or older that enter the Port by the start of 2010. Pre-1994 models were prohibited. More than 1,300 trucks were retrofit with diesel particle control filters. Retrofits were paid in part by truck owners, and in part by $25 million in grants from CARB, the Environmental Protection Agency, the Bay Area Air Quality Management District, and the Port of Oakland.

The study, conducted by Kirchstetter, Dallman, and Harley, measured the emissions rates of PM and NOx from hundreds of trucks [http://eetd.lbl.gov/newsletter/nl36/images/port_data.wmv] at the Port to determine the effects of the CARB regulation. The team made their measurements in November 2009 and June 2010. Most of the changes to Port trucks occurred between these periods.

At the hearing, Kirchstetter reported their finding that the CARB regulation resulted in decreases in average pollutant emission rates from Port trucks: a 50 percent decrease in PM and a 40 percent reduction in NOx. Moreover, the accelerated clean-up at the Port reduced truck emissions in the span of a few months; in comparison, about the same amount of reductions at another location not subject to the CARB rule took ten years.

EETD Receives DOE Award to Evaluate Fuel Cell Technology

The U.S. Department of Energy has awarded up to $1.9 million to a research team led by the Environmental Energy Technologies Division's (EETD's) Eric Masanet to develop "total cost of ownership" models for low- and high-temperature stationary fuel cell systems up to 250 kilowatts. The work will support fuel cell research and development by assessing the impact of state-of-the-art manufacturing technologies, system designs, and deployment strategies on the life-cycle cost of fuel cells in emerging markets. Other participating Lawrence Berkeley National Laboratory (Berkeley Lab) researchers include EETD's Adam Weber, Max Wei, James McMahon, and Michael Tucker. The award also includes scientists at the University of California at Berkeley and at Ballard Power Systems.



The fuel cell research is an example of how Berkeley Lab, through its Carbon Cycle 2.0 program, is weaving together its development of cleaner energy technologies with R&D to evaluate their potential costs, benefits, and impacts on energy, materials, and climate change.

To encourage more cost-effective design, production, and deployment of fuel cells for stationary applications, researchers and manufacturers need a better understanding of the total life-cycle costs and benefits of this "cleaner" technology option. The team will develop a total cost of ownership (TCO) approach and model for analyzing the life-cycle cost and environmental aspects of fuel cell designs, which can be used to optimize fuel cell systems for maximum economic and energy system benefits. TCO has not been applied to fuel cells much in the past.

"Analyzing the markets, performance, design and manufacturing options, societal benefits, and life-cycle costs of stationary fuel cell technologies will help manufacturers design better technology for specific markets, customers understand the costs and benefits of investing in the technology, and policymakers provide more effective incentives," says Masanet.

Read the press release here [http://apps1.eere.energy.gov/news/progress_alerts.cfm/pa_id=588].

U.S. Department of Energy Fact Sheets Help Benchmark Efficiency Improvements

The U.S. Department of Energy (U.S. DOE) has released six fact sheets to help American Reinvestment and Recovery Act grantees and end users benchmark energy-efficiency upgrade costs and expected annual savings. The fact sheets focus on municipal, state, and federal government buildings; healthcare facilities; and universities, colleges, and K-12 schools. They provide information on the typical range of project installation costs, savings, and payback times from energy retrofits completed by energy service companies (ESCOs).

The U.S. DOE's Technical Assistance Team developed these fact sheets with Lawrence Berkeley National Laboratory (Berkeley Lab) and the National Association of Energy Service Companies (NAESCO) using project-level data from the LBNL/NAESCO Project Database. They are the culmination and summary of more than ten years of database analysis, led by Charles Goldman, leader of Berkeley Lab's Electricity Markets and Policy group.

The LBNL/NAESCO Project Database—funded by the U.S. DOE—is the largest database of ESCO project information in the world, containing more than 3,600 projects. It includes information on project installation costs, savings, measures installed, facility physical characteristics, market segment, and location. Information for 75 percent of the projects in the database came

from NAESCO's voluntary accreditation program. The rest was provided by state and federal agencies that administer performance contracting programs.

"The U.S. ESCO industry is an example of a private-sector business model where energy savings are delivered to customers primarily through the use of performance-based contracts," said Peter Larsen, a researcher at Berkeley Lab's Environmental Energy Technologies Division. "This is our first attempt to widely distribute project-level performance benchmarking information for this growing industry."

The fact sheets provide benchmarking information for four energy retrofit strategies: major HVAC (heating, ventilation, air conditioning), minor HVAC, onsite generation, and a category for an array of other energy-efficient equipment and strategies.

The performance metrics are shown graphically, and they include: project installation cost in dollars per square foot of floor area, annual reported savings in thousands of British thermal units (kBtu) and kilowatt-hours per square foot, percentage of baseline energy saved annually, and simple payback time in years.

By referring to these fact sheets, facilities managers and other officials who are planning energy-efficiency improvements can benchmark estimates of the costs and benefits of various types of improvements for similar types of facilities.

The fact sheets were written by Berkeley Lab's Peter Larsen, Charles Goldman, and Andy Satchwell.

Download the ESCO benchmarking project fact sheets. [http://www1.eere.energy.gov/wip/solutioncenter/buildings/performance_contracting.html]

For more information about Berkeley Lab's Electricity Markets and Policy group, including access to publications, please visit their website [http://eetd.lbl.gov/ea/emp/].

Converting Home Energy Assessments Into Home Energy Upgrades

A new Lawrence Berkeley National Laboratory policy brief describes to energy efficiency contractors and program managers how they can turn more energy assessments into comprehensive home energy upgrades by adding sales and business skills to their toolkit.

The policy brief, written by Megan Billingsley and Elizabeth Stuart the Electricity Markets and Policy Group of the Environmental Energy Technologies Division, features a case study, advice from an experienced contractor, sample phone screening questions, and online resources. The case study focuses on Efficiency Maine, which used a sales training class to increase the rate of conversions from energy assessment to energy upgrade by 50 percent in about nine months.

Download the brief, "Contractor Sales Training: Providing the Skills Necessary to Sell Comprehensive Home Energy Upgrades." [PDF [http://eetd.lbl.gov/EA/EMP/reports/ee-policybrief081711.pdf]]

Energy Efficiency in India—Web Resources

Environmental Energy Technologies Division (EETD) scientists at Lawrence Berkeley National Laboratory (Berkeley Lab) conduct research to analyze energy use in India, evaluate energy- efficiency opportunities in its economy, and develop roadmaps to promote lower-carbon-emitting, sustainable economic development. They also work with their Indian colleagues on joint research and provide technical consulting in a variety of areas, such as energy-efficient building design and operation.

Here are a few resources for further information.

Berkeley-India Joint Leadership on Energy and the Environment (BIJLEE)

The Berkeley-India Joint Leadership on Energy and the Environment is a partnership between the University of California, Berkeley; Berkeley Lab; and the government, private sector, and educational institutions of the United States and India to help both countries adopt pathways and approaches for reducing greenhouse gas emissions while pursuing sustainable economic development. BIJLEE brings together researchers to develop energy-efficient and renewable energy technologies, and policy mechanisms to transfer these technologies to the marketplace, with the goal of combating climate change while promoting clean energy and economic growth.

- Berkeley-India Joint Leadership on Energy and the Environment (BIJLEE) [http://bijlee.lbl.gov/]

EETD's International Energy Studies Group Activities in India

The staff of EETD's International Energy Studies Group engages with the government of India and NGO partners in India on a range of energy efficiency, climate change mitigation, and other environmental and sustainable development projects.

- EETD's International Energy Studies Group Activities in India [http://ies.lbl.gov/India]
- Energy efficiency in India—Publications [http://ies.lbl.gov/node/308]

Recent publications from EETD address high-level energy policy issues, as well as specific sectors of India's economy, forestry's potential to mitigate carbon emissions, and technologies for more energy-efficient economic development. Some useful recent titles:

- India Energy Outlook: End Use Demand in India to 2020 [http://ies.lbl.gov/node/414]
- Using Cool Roofs to Reduce Energy Use, Greenhouse Gas Emissions, and Urban Heat-island Effects: Findings from an India Experiment [http://ies.lbl.gov/CoolRoofs]
- Eliminating Electricity Deficit Through Energy Efficiency in India [http://ies.lbl.gov/node/429]
- Residential and Transport Energy Use in India: Past Trend and Future Outlook [http://ies.lbl.gov/node/417]
- Carbon Forestry Economic Mitigation Potential in India, by Land Classification [http://ies.lbl.gov/node/312]

Energy-Efficient Data Centers and High-Performance Buildings in India

- High-Performance Buildings for High-Tech Industries [http://hightech.lbl.gov/dc-india/india-datacenters.html]

Recent News About EETD's Work With India

- Berkeley Lab Expands Energy Exchanges With India [http://newscenter.lbl.gov/feature-stories/2011/06/10/berkeley-lab-expands-energy-exchanges-with-india/]
- More news about India-related energy and environment research [http://newscenter.lbl.gov/tag/india/]

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division NEWS

Sources and Credits

Sources

Energy Efficiency & Renewable Energy's Energy Savers

These web pages [http://www.eere.energy.gov/consumer/] provide information about energy efficiency and renewable energy for your home or workplace.

DOE's Energy Information Administration (EIA)

EIA [http://www.eia.doe.gov/] offers official energy statistics from the U.S. Government in formats of your choice, by geography, by fuel, by sector, or by price; or by specific subject areas like process, environment, forecasts, or analysis.

DOE's Fuel Economy Guide

This website [http://www.fueleconomy.gov/] is an aid to consumers considering the purchase of a new vehicle.

DOE's Office of Energy Efficiency & Renewable Energy (EERE)

EERE's [http://www.eere.energy.gov/] mission is to pursue a better energy future where energy is clean, abundant, reliable, and affordable; strengthening energy security and enhancing energy choices for all Americans while protecting the environment.

U.S. DOE, Office of Science [http://science.energy.gov/]

U.S. EPA, ENERGY STAR Program [http://energystar.gov/]

California Energy Commission [http://energy.ca.gov/]

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Environmental Energy Technologies Division
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Ernest Orlando Lawrence Berkeley National Laboratory is a multiprogram national laboratory managed by the University of California for the U.S. Department of Energy. The oldest of the nine national laboratories, Berkeley Lab is located in the hills above the campus of the University of California, Berkeley.

With more than 4,000 employees, Berkeley Lab's total annual budget of nearly $600 million supports a wide range of unclassified research activities in the biological, physical, computational, materials, chemical, energy, and environmental sciences. The Laboratory's role is to serve the nation and its scientific, educational, and business communities through research performed in its unique facilities, to train future scientists and engineers, and to create productive ties to industry. As a testimony to its success, Berkeley Lab has had 11 Nobel laureates. EETD is one of 14 scientific divisions at Berkeley Lab, with a staff of 400 and a budget of $40 million.
