LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division NEWS

SUMMER 2013:
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We cover a lot of ground in the issue of *EETD News* you're now reading. Investing in energy performance upgrades for your commercial building? Read about the Building Performance Database. Wondering about the state of wind power in the U.S.? We've got you covered with the annual Wind Technologies Report. What's new in advanced lithium-ion battery technologies? Check out two articles about recent Berkeley Lab-EETD technologies. Also, our reporter talks to Ed Vine about his 35-year career in energy efficiency project evaluation. And more.

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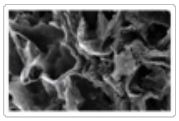
—Allan Chen



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 Newsletter: Vol. 12, No. 1 [http://eetd.lbl.gov/newsletter/nl44/]
Environmental Energy Technologies Division News [http://eetd.lbl.gov/newsletter/]

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Environmental Energy Technologies Division

NEWS

Buildings Performance Database Helps Building Owners, Investors Evaluate Energy-Efficient Buildings

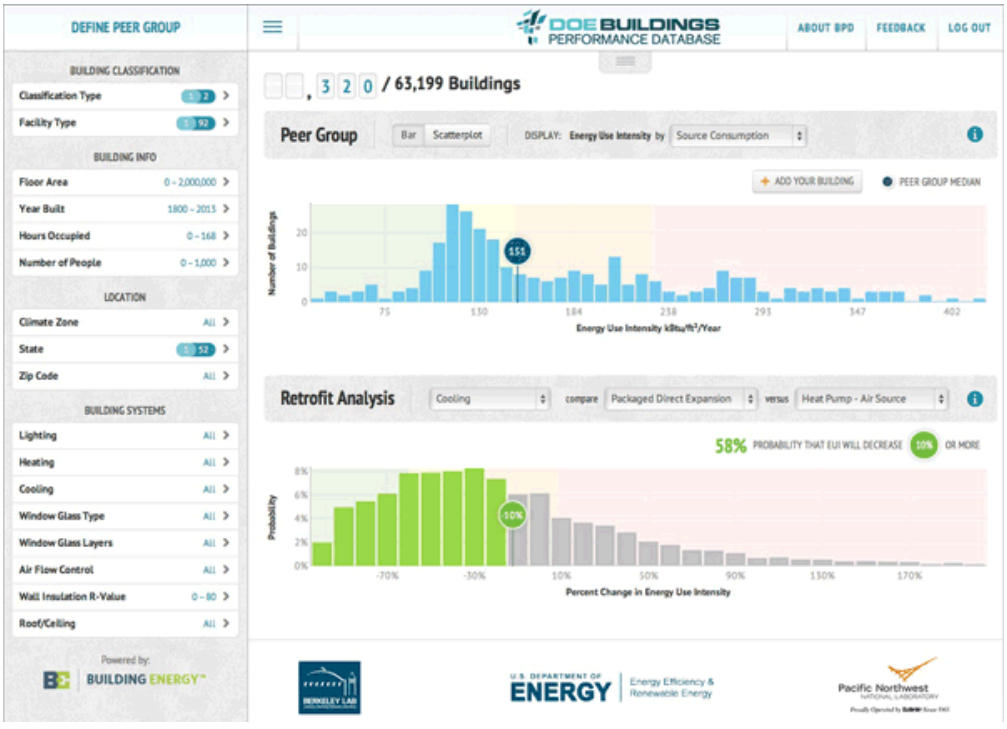
A new database of building features and energy use data helps building managers and owners, real estate investors, and lenders evaluate the financial results of energy efficiency investment projects and identify high- and low-performing buildings.

The U.S. Department of Energy's (DOE) Buildings Performance Database (BPD) is being developed by a team of researchers at Lawrence Berkeley National Laboratory (Berkeley Lab), led by Environmental Energy Technologies Division (EETD) Staff Scientist Paul Mathew. Berkeley Lab is partnering with Building Energy Inc. (Portland, Oregon) for the software implementation. Building Energy Inc. specializes in software solutions to integrate disparate building energy use and characteristics datasets.

"The real estate investment community, building managers, and owners asked the Department of Energy for a tool to help them better evaluate the financial costs and benefits of energy efficiency projects in buildings, to help them guide investment decisions. DOE responded by establishing the Buildings Performance Database, which we are developing under their direction," says Mathew.

The database contains real (not modeled) performance data from more than 60,000 buildings across the United States from both public and private datasets. The BPD currently contains basic building data such as gross floor area, years built, and hours occupied, as well as energy performance metrics, including energy use intensity (for example, kilowatt-hours per square foot), source and site energy consumption, and electricity and fuel consumption. The data have been stripped of identifying characteristics such as street addresses to preserve confidential business information, to encourage private sources to contribute to the database.

"Development of the BPD is ongoing," says Mathew. "More types of information, such as building assets and equipment, and metered interval data from utilities, will become available as the BPD grows."



Screenshot of the Buildings Performance Database

The BPD also has a tool to simplify its use, with more features planned for future releases. The data explorer feature allows users to compare the energy use of their own buildings to a set of BPD buildings. They can choose from such parameters as building type, floor area, age, and occupancy; and by system features such as lighting and heating, ventilating, and air conditioning (HVAC). The tool also enables users to create graphs that compare the energy use of their buildings to that of their user-created building peer group.

The latest release of the tool includes a retrofit analysis feature that compares the energy use of buildings with different technologies. The tool provides users with the probability of achieving different levels of energy savings for retrofits.

The database features an application programming interface (API) that allows external software developers to access the data and incorporate analytical results into their own tools.

"We are building this database to meet the needs of the buildings community-of investors, owners, and building managers, as well as energy efficiency program managers and local, state, and federal government agencies that manage buildings," says Mathew. "The capabilities we're building into the database allow them not only to assess the potential savings from energy performance upgrades, but to increase confidence that planned projects will meet their goals."

The investment community can use the BPD to help quantitatively distinguish between the expected returns from projects and their performance risk. Investors will have the information they need to diversify the risk in their portfolios by investing in a range of buildings and energy-performance project types.

In addition to assessing project opportunities and performance risk, energy efficiency program managers and building managers in federal, state, and local governments can also use the BPD to compare the performance of efficiency projects in their portfolio. They may also be able to use it to persuade local real estate markets to undertake efficiency-performance improvements by sharing data about their projects without revealing building-level information.

"As we add more datasets and functionality, we expect that the Buildings Performance Database will become an essential tool for the buildings and financial industries. It will help provide the confidence in rates of return from energy efficiency performance investments in buildings, to help these investments—and the economic benefits and job growth they bring—to expand," Mathew says.

This research is funded by DOE's Office of Energy Efficiency and Renewable Energy.

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Buildings Performance Database [http://www1.eere.energy.gov/buildings/commercial/bpd.html]: Interested buildings professionals can sign on to become BPD users at this site.

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Full Version of EnergyIQ Released

Lawrence Berkeley National Laboratory (Berkeley Lab) has issued the first full public release of EnergyIQ, its web-based action-oriented benchmarking tool for non-residential buildings. EnergyIQ is free and can be accessed at http://energyiq.lbl.gov/ .

EnergyIQ improves upon typical "whole-building" energy benchmarking tools by providing benchmarking at the end-use level, and enabling users to use the benchmarking data to quickly conduct a high-level assessment of energy-reduction opportunities. It also provides users with decision support information to develop and refine their action plans.

Screenshot of the EnergyIQ website.

"Past users of benchmarking tools such as Berkeley Lab's CalArch and ENERGY STAR's Portfolio Manger will immediately see the benefits of EnergyIQ," says Evan Mills, staff scientist in Berkeley Lab's Building Technology and Urban Systems Department. "Being able to move immediately from gathering benchmarking data to evaluating promising energy-savings activities based on those data helps eliminate the 'what now?' frustration that sometimes accompanies benchmarking."

EnergyIQ's development was sponsored by the California Energy Commission's Public Interest Energy Research (PIER) Program as part of its ongoing efforts to increase the energy efficiency of California's buildings. In the early stages of development, Berkeley Lab surveyed 500 potential users and identified their design and feature preferences. The team also incorporated benchmarking techniques suggested by the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE), and worked with Usability.org to create a clear, professional, and efficient user interface.

Benchmarking can only help energy managers identify problem buildings and save energy when the buildings being compared are similar, so the EnergyIQ developers insisted on including a wide variety of building types and characteristics. The initial database was the California Commercial End-Use Survey (CEUS), which details energy use and building features for about 2,800 buildings and 62 building types. EnergyIQ also draws information from the U.S. Department of Energy Commercial

Buildings Energy Consumption Survey (CBECS), with about 5,200 buildings and 51 building types across the country. Users can browse through tables and charts dynamically generated by these databases to find a peer group and metric(s) to compare to those of their building. Benchmarking peer groups can be further refined by applying building vintage, location, and size filters.

EnergyIQ benchmarks are expressed using metrics for building energy use, cost, greenhouse gas emissions, and characteristics. Users can select either cross-sectional benchmarking (to examine a single point in time) or longitudinal benchmarking (to examine building performance over time). Based on user-provided inputs, EnergyIQ generates a list of energy retrofit opportunities and recommended actions. Users can access best practices, links to other analysis tools, and other aids to refine those actions, create design-intent documentation, and implement improvements. Results can be saved in customizable dashboards, performance can be compared to target levels, and outcomes can be ranked within a user's portfolio of buildings. EnergyIQ also can import energy data previously entered into the ENERGY STAR Portfolio Manager system—a significant time-saver for users.

"Make no mistake, though," says Paul Mathew, staff scientist in Berkeley Lab's Building Technology and Urban Systems Department, "although EnergyIQ can identify potential actions and prioritize areas for more detailed audits and analyses, it is still necessary to perform those analyses and audits to develop a successful game plan."

Now that the tool has been finished and undergone extensive beta testing, it is gaining users, including public agencies, architects, engineers, and property managers.

EnergyIQ includes licensable Application Programming Interfaces (APIs) for software developers or building information system designers who want to integrate EnergyIQ's functionality into their own applications.

—Mark Wilson

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LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

No Evidence of Residential Property Value Impacts Near U.S. Wind Turbines, a New Berkeley Lab Study Finds

Lawrence Berkeley National Laboratory (Berkeley Lab) analyzed more than 50,000 home sales near 67 wind facilities in 27 counties across nine U.S. states, yet was unable to uncover any impacts to nearby home property values.

"This is the second of two major studies we have conducted on this topic [the first was published in 2009 - see below], and in both studies [using two different datasets] we find no statistical evidence that operating wind turbines has had any measureable impact on home sales prices," says Ben Hoen, the lead author of the new report.

Hoen is a researcher in the Environmental Energy Technologies Division of Berkeley Lab.

The new study used a number of sophisticated techniques to control for other potential impacts on home prices, including collecting data that spanned well before the wind facilities' development was announced to after they were constructed and operating. This allowed the researchers to control for any pre-existing differences in home sales prices across their sample and any changes that occurred due to the housing bubble.

This study, the most comprehensive to-date, builds on both the previous Berkeley Lab study and a number of other academic and published U.S. studies, which also generally find no measureable impacts near operating turbines.

"Although there have been claims of significant property value impacts near operating wind turbines that regularly surface in the press or in local communities, strong evidence to support those claims has failed to materialize in all of the major U.S. studies conducted thus far," says Hoen. "Moreover, our findings comport with the large set of studies that have investigated other potentially similar disamenities, such as high voltage transmission lines, land fills, and noisy roads, which suggest that widespread impacts from wind turbines would be either relatively small or non-existent."

The report was authored by Ben Hoen (Berkeley Lab), Jason P. Brown (formerly with the USDA; now with the Federal Reserve Bank of Kansas City), Thomas Jackson (Texas A&M and Real Property Analytics), Ryan Wiser (Berkeley Lab), Mark Thayer (San Diego State University), and Peter Cappers (Berkeley Lab). The research was supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

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Download the new 2013 report [http://emp.lbl.gov/sites/all/files/lbnl-6362e.pdf] "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States"

Download the 2009 LBNL Report [http://emp.lbl.gov/sites/all/files/REPORT%20lbnl-2829e.pdf] "The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis"

More information about DOE's Wind Program [http://www1.eere.energy.gov/wind/index.html]

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Environmental Energy Technologies Division

NEWS

Lighting Control Testbeds at the General Services Administration: Showing Promise for Lighting Energy Reductions

Lighting represents 26 percent of a commercial building's electric load, which roughly translates to 10 percent of a building's operating costs. Advanced lighting controls can greatly reduce that load, but so far, U.S. commercial building owners and operators have not reaped those energy savings—only one percent of those buildings use lighting control systems.

Given the potential savings, why are so few of these systems being used? One reason is that relighting can be costly—especially in existing buildings, where it's impossible to predict what barriers might be encountered during the installation. Unfamiliarity with these systems also deters some potential users from taking advantage of these technologies. Overcoming these two obstacles could greatly increase the use of advanced lighting controls.

Toward Increased User Acceptance

Francis Rubinstein and Joy Wei of the Environmental Energy Technologies Division (EETD) at Lawrence Berkeley National Laboratory (Berkeley Lab) teamed with the U.S. General Services Administration for a Commercial Building Partnership (CBP) study to address the issue. The CBP program was established by the U.S. Department of Energy to demonstrate leading edge technologies, integrated design, and other strategies that could significantly reduce energy consumption in commercial buildings. The study's goal was to develop affordable advanced controls to eliminate wasted lighting energy in existing commercial buildings.

The ambitious goals of the Building Technology and Urban Systems Department's lighting team are to achieve 80 percent lighting energy savings in existing commercial buildings with controls that cost $2 per square foot ($ft^2$) installed by 2015, and to work with industry to create the next-generation controls.

Berkeley Lab addressed this challenge in a couple ways. Rubinstein and others conducted a meta-analysis of estimates of energy savings identified in the literature, spanning 240 savings estimates from 88 papers and case studies, categorized into daylighting strategies, occupancy strategies, personal tuning, and institutional tuning. That study revealed that the average energy savings potential of the various approaches is 24 percent for occupancy controls, 28 percent for daylighting, 31 percent for personal tuning, 36 percent for institutional tuning, and 38 percent for multiple approaches. It also revealed that simulations in the literature significantly overestimated—by at least 10 percent—the average savings obtainable from daylighting in actual buildings.

"There weren't really any surprises," says Rubinstein. "Those numbers were consistent with what we had seen in demonstration projects we had conducted."

Demonstrating Individualized Lighting and Controls

The CBP study then set out to measure energy savings at 10 demonstration sites in seven federal buildings in California and Nevada.

They started by replacing the existing lighting with workstation-specific lighting that consisted of a new energy-efficient luminaire with a built-in occupancy sensor and individual-controlled digital dimming ballast centered over each workstation (Figure 1). This system enables users to control both occupancy sensing and light level tuning for each workstation, so users could set lights as they pleased. Similar relighting arrangements have achieved 40 percent lighting energy savings and greater occupant satisfaction with workspace lighting. Using data loggers at the circuit level, the team gathered pre-retrofit and post-retrofit lighting power use data under various operating scenarios for all of the sites, which enabled them to calculate and compare pre-retrofit and post-retrofit energy use.

Figure 1. Energy-efficient luminaires replaced the existing lights at each site.

They also documented lighting conditions with standard photometric surveys and conducted occupant surveys to gauge user acceptance of the controls, to help determine which controls are most likely to be used. The duration of each demonstration varied from one to two years.

Proven Lighting Energy Reductions

The advanced lighting controls were found to lower energy consumption and lighting energy use intensity (EUI, the energy consumed by a building relative to its size) at all of the sites, although the installation of new fixtures resulted in similar or increased installed lighting power density (LPD; watts per square foot for a given space).

The before-and-after measured lighting energy use differed dramatically from site to site, ranging from a 0.75 kilowatt-hour per ft² per year improvement at the Chet Holifield Federal Building in Laguna Niguel, California, to a 4.29 kilowatt-hour per ft² per year difference at the Roybal Federal Building in Los Angeles, California. The before-and-after energy savings in the buildings studied ranged from 26 percent to 66 percent, with an average savings of 46 percent (Figure 2).

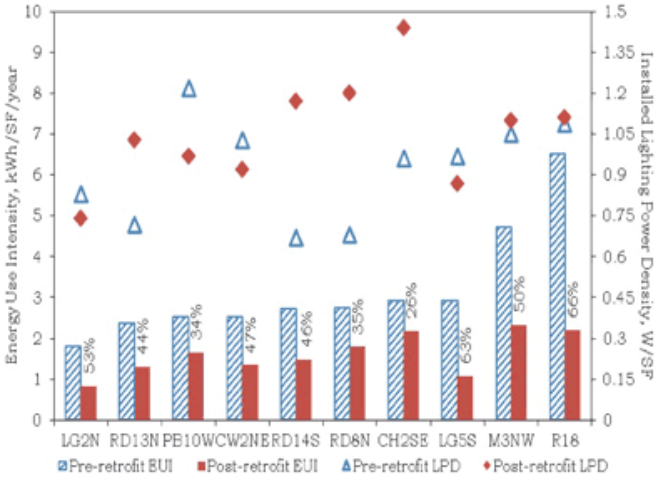

Figure 2: Retrofits typically increased the installed LPD, but the control strategies significantly reduced annual EUIs at all sites.

Given that the controls allowed users to implement institutional tuning and scheduling, personal control, and occupancy sensing, the study also looked at each of these options individually, to determine the energy reductions from each. At the Roybal site, where lights operated almost 24/7, the highest level of reductions came from institutional tuning and scheduling, then from occupancy controls, and to a lesser extent, from the use of personal controls.

In spaces that were used by many people but owned by no one, such as grand jury rooms and filing and conference rooms, occupancy controls resulted in deep energy savings. Often, lighting in such spaces had been left on continually, regardless of whether they were occupied or not. Institutional tuning and scheduling also contributed to energy savings in these spaces.

Some potential energy reductions were not fully realized because some controls were not consistently implemented in similar spaces.

"Lighting in some rooms used occupancy sensors, while others were controlled with a manual switch," said Wei. "In some instances, occupants thought all of the rooms were controlled by occupancy sensors, so they left the conference room lights on all the time. That underscored the need for consistent programming and occupant training."

Further savings were considered to be possible from eliminating standby power at night and through continued fine-tuning of the system throughout the study. For example, three buildings that revised their operational sequences after their initial performance checks were able to increase their savings 6 percent to 14 percent beyond those initial checks.

How Do the Savings Pencil Out?

Energy saving measures are always appealing, but if they aren't cost-effective, they aren't likely to be adopted. In looking at cost-effectiveness, the team chose to estimate savings-to-investment ratio (SIR) over simple payback, because the SIR approach accounts for savings throughout the life of the equipment—past the simple payback time frame.

"The SIR approach looks at the energy savings over the lifetime of the equipment, at least 15 years, accounting for the time value of money," says Wei. "An investment is considered cost-effective if the sum of the benefits is greater than the costs. The GSA, Department of Defense, and other federal buildings generally use such life-cycle cost methods."

The study found that because of high installation costs for the new lighting equipment, only 2 of the 10 demonstration sites proved to be cost-effective using site-specific rates of $0.09/kilowatt-hour (kWh) in Nevada and $0.11/kWh–$0.13/kWh in California. On average, the retrofits would achieve cost-effectiveness with energy rates of $0.24/kWh or pre-retrofit installed LPDs of 1.3 watts/ft^2. However, the lighting EUI in the eight non-cost-effective buildings was lower than the national average, 4.5 kWh/ft^2/year, to begin with, so they were already operating more efficiently than the average lighting system. With less room for improvement, less energy was saved.

If the buildings operated above the national average lighting EUI, all of the retrofits would be cost-effective with energy rates greater than $0.17/kWh—and most would be cost-effective at rates above $0.13/kWh, such as those found in some areas of California.

Strategies for Success

What do these results mean in terms of expanding the use of advanced lighting systems? As previously mentioned, cost-efficient systems and familiarity and ease of use are the most critical considerations to ensure the installation and effective use of such systems, and in those areas, the outlook is promising.

"Equipment and labor are the two biggest cost factors," says Rubinstein. "We can make it cheaper to install the system if we preserve the existing luminaire spacing and avoid redesign. We can reduce labor costs even more by using wireless controls, which will mean we don't have to wire above the ceiling."

"Still, if occupants don't buy into using these controls properly, we won't see those deep energy reductions we're looking for. Good training of occupants and facility managers is essential. If the users understand the benefits and are able to easily control the lighting to meet their needs, there's a good chance these systems will achieve their energy-reduction potential."

Demonstrating the advantages of lighting systems that report energy use in real time for utilities, regulators, and building code compliance are also likely to boost the chances for the success of these systems, as will making commissioning simple, automatic, and transparent.

"The success of advanced lighting controls relies on awareness of their potential benefits, cost of installation and operation, and ease of use for occupants and building management," says Wei. "As that understanding advances, resulting in improvements in responsive lighting systems and allowing for easier installation and greater flexibility, we should begin to see these systems become more widespread."

—Mark Wilson

Additional information:

Alison Williams, Barbara Atkinson, Karina Garbesi, and Francis Rubinstein (Lawrence Berkeley National Laboratory) and Erik Page (Erik Page & Associates). 2011. *A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings*. [PDF [http://efficiency.lbl.gov/sites/all/files/a_meta-analysis_of_energy_savings_from_lighting_controls_in_commercial_buildings_lbnl-5095e.pdf]]

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LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

A Legacy of Energy Evaluation: A Conversation with Ed Vine

Since 1978, Ed Vine has been at Lawrence Berkeley National Laboratory (Berkeley Lab), focused on evaluating how technologies and behavior are helping us move toward a more energy-efficient future. When he began his work, energy evaluation experts were self-trained and few. Today, the profession is well armed with research and protocols—a much more widespread and professional field—in good part due to Ed's hard work and dedication.

After 35 years at the lab—and with a Nobel Peace Prize under his belt—Ed retired this year, leaving a legacy that he hopes will continue where he has left off. Even still, Ed won't stray far from Berkeley Lab for long: after a month's sabbatical, he'll be back part time working with the analysts and scientists he's training to continue his work.

Q: What was it like doing energy evaluation work at Berkeley Lab back in 1978? How has it changed?

A: I started work at Berkeley Lab in the Energy Analysis Program. Back then, the evaluation profession was really just a small group of people around the country talking about how to do this work. I was the only one doing this at Berkeley Lab, and to get conversations going, early on I helped organize a conference—the International Energy Program Evaluation Conference—that we've now held every two years since 1985.

Today, we have a national and international community, and we've held conferences in many places in the United States as well as in Paris and Rome. We have more people entering the work force in this field, employment for energy evaluators has grown in the private sector, and government agencies and nonprofits are promoting this work of finding out which energy efficiency programs work and which do not work. In fact, the U.S. Department of Energy (DOE) has designated energy evaluation as a "key area of research," and Berkeley Lab is now the primary evaluation lab for the DOE.

Generally, there are a lot more people involved, more money is being spent, and the field is more highly valued by policymakers. Energy evaluation is now quite ingrained—you could say it has finally been institutionalized in the world of energy efficiency.

Q: Why is the field of energy evaluation important?

A: Evaluation is important because it provides the necessary feedback to measure the energy and demand savings, as well as costs associated with energy efficiency programs and policies. The feedback provided by program evaluation is essential to improving the implementation of ongoing programs and to improve the design and implementation of future programs—and as input to strategic planning and resource procurement. Without evaluation, we really do not know what works and what does not work.

Q: What are the kinds of projects you've worked on?

A: Most of the projects have revolved around three elements: the evaluation of programs, policies, and technologies (new construction programs, the use of air-to-air heat exchangers, and the operation of residential thermostats, for example); the evaluation of occupant behavior in residential and non-residential buildings—looking at the willingness to accept a technology or invest in energy efficiency technology; and the administration and analysis of household surveys.

Q: I know a recent focus of your work has been on climate change. Tell us how that led to a Nobel Peace Prize for your team.

A: I've been moving my work into the climate change arena—particularly forestry projects. Working with many others, including Vice President Al Gore, our work was [part of] the Intergovernmental Panel on Climate Change (IPCC), and in 2007 [the IPCC was] awarded the Nobel Peace Prize. The IPCC has published seminal studies on climate change, and one of their Special Reports had to do with the evaluation of land use, land use change, and forestry projects. The evaluation methods were adapted from some of the evaluation methods that others and I had developed for the evaluation of energy efficiency projects and programs.

Q: You mention that the evaluation field as a whole is starting to focus more on consumer behavior. What work have you been doing with that focus?

A: It's been enjoyable to see how the focus on consumer behavior has grown in the energy evaluation field, particularly in the last five to six years. In the past, research primarily focused on improving existing technologies and developing new technologies that can reduce energy use and greenhouse gases. Now, there has been more interest in conducting research on the behavior side: how consumers use energy and make decisions about investing in energy efficiency.

Another conference that I helped to organize was the Behavior, Energy, and Climate Change (BECC) conference. This annual conference is usually held in Sacramento or in Washington, D.C., and is jointly hosted by the American Council for an Energy-Efficient Economy (ACEEE), the California Institute for Energy and Environment, and the Precourt Energy Efficiency Center at Stanford University.

This conference brings together researchers and policymakers examining the behavioral aspects of energy efficiency in buildings and transportation. It's interesting to see that the conference is attracting a lot more people from the academic world. Usually, conferences in the field attract consultants, utilities, and government, but this conference has about 40 percent attendees from academia. This is helping to make people more aware of what's going on with behavioral energy programs, and building a new network of practitioners, researchers, and academics. The sixth BECC conference will be held this November in Sacramento.

Q: You have also been working with the California Institute for Energy and the Environment (CIEE) for many years now.

A: Yes, I've been wearing two hats since 1990—my Berkeley Lab hat and my CIEE hat. For the CIEE, I work with the California Public Utilities Commission (CPUC), providing technical assistance for strategic planning and energy evaluation. In that role, one of the projects I conducted was to set up a program that funded nine behavior and energy white papers, now recognized around country as a key resource for what we know about behavior and energy. These papers helped lay the baseline for the CPUC and the utilities in their work on designing and implementing improved energy efficiency programs. As a result of all of this, behavior is now an important part of the CPUC's Long-term Energy Efficiency Strategic Plan for energy use reduction in California.

Q: Of what accomplishment or work are you most proud?

A: From a work perspective, I'm most proud of the technical work with regard to evaluation and behavior. I worked with others in preparing the California Evaluation Framework report and in developing the California Measurement and Evaluation Protocols that utilities and others are using for evaluating their energy efficiency programs. I am also proud of the work that led to governmental support for research on key behavioral issues. Some of this research was funded by the CPUC and represents one important step in a long series of steps for continued research on behavior.

Q: You are in a good position to talk about trends and emerging issues in the energy evaluation world right now. What is your opinion on where the field is going next?

A: On the macro level, because of climate change, I think energy efficiency will continue to be the primary resource for reducing emissions. Moreover, there will be an increased emphasis on spending more dollars quickly to promote energy efficiency technologies, policies, and behaviors. Rather than waiting for 10 or 20 years to see significant results, policymakers and researchers are now asking how can we get more reductions in emissions more quickly.

Another important trend that we've already mentioned is looking at lifestyles and consumer behavior to reduce energy consumption. One big question is if we can reduce our ecological footprint in addition to becoming more efficient. What we're seeing now is that efficiency may not be enough: for example, since refrigerators now use 60 percent less energy than older refrigerators, some people are buying larger ones. And some people have two or three refrigerators and multiple computers and many televisions. So, while these products are more energy efficient than the ones in the past, consumers are buying more products. As a result, consumption lifestyles and related policies are being examined (or should I say "re-examined," since this activity was also conducted in the 1970s and 1980s).

And in the evaluation field, there is a focus on developing the appropriate tests for measuring cost effectiveness. We're now asking, "What is the right test for looking at cost effectiveness?" For example, besides energy savings, the test would include non-energy benefits (like comfort and health benefits), and lower discount rates.

Q: What are the cost-effectiveness tests that you have been examining for evaluating energy efficiency programs?

A: In California, there are two or three tests that we have been examining. The Total Resource Cost (TRC) method primarily looks at the benefits from saving energy. In contrast, the CPUC is examining a new test called the Social Cost Test. The Social Cost Test not only includes all of the costs and benefits of the TRC, but also includes environmental and other non-energy benefits that are not currently valued by the market. People have been talking about changes to the TRC for the last six years, and it appears that some progress will be made on using the Social Cost Test in California—and other states may follow. It's not a trivial exercise, and it may take some time to reach approval for such a test.

Q: What will you do in your "retirement?"

A: For the month of July, my wife and I are going on a birding trip to the Galapagos Islands and then to the Amazon Jungle in Ecuador for a month. When we get to the Amazon, we'll take a small plane, then a boat down the Amazon River, then hike for an hour to a lodge. We're looking forward to the trip—and being "disconnected" from phones and the Internet!

When I get back, I'll be returning to Berkeley Lab as a part-time contractor. One of my mentoring activities over the next year is developing a core team that can carry on the work I've been doing, particularly the work on behavior and evaluation. It would be nice to see these two areas continue at the lab, with increased funding and staff. I hope this work doesn't vanish when I leave.

I'll also be continuing to work on a DOE project managing the evaluation of DOE's Better Buildings Neighborhood Program. In this program, which has been going on for a few years and is ending in 2014, DOE gave money to 40 grantees (cities or nonprofit agencies) to promote energy efficiency retrofits, mostly in residential neighborhoods. From an evaluation perspective, we've learned lots of lessons so far, focusing on what works and what does not work. The program has been successful so far, in that it has really transformed these local markets.

Market transformation is when you go to a store to buy a new refrigerator or clothes washer—and there are *only* energy-efficient versions at the store. DOE's program is working on both supply and demand. That's what this Better Buildings program is doing well; working with consumers, utilities, manufacturers, distributors, and retailers to improve the energy efficiency markets at the local level.

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Berkeley Lab Study Shows Significant Potential for Deployment of Superefficient Air Conditioners

Air conditioning is a rapidly growing end use, especially in emerging economies. The additional electricity demand in 2020 from room air conditioners (ACs) bought between 2010 and 2020 is expected to be over 1.2 terawatt-hours (TWh, equal to 1,200 billion kilowatt-hours) globally. The International Energy Studies group at Lawrence Berkeley National Laboratory (Berkeley Lab), in collaboration with Navigant Consulting Inc., Europe, conducted a new assessment of the potential benefits from deployment of super-efficient air conditioners. The study found significant untapped potential for air conditioner efficiency, equivalent to avoiding over 120 Rosenfelds (i.e., 120 medium-sized [500 megawatt] power plants) by 2020 in the countries that were studied.

This landmark finding may have significant impact on energy-efficiency strategy for countries such as India and China as they attempt to cope with the impacts of the large demand and capacity required to address peak load. In India, China, and Brazil alone, electricity to power room ACs is expected to equal the output of five Three Gorges dams by 2020. Air conditioning also accounts for a significant portion of peak electricity demand-nearly 40 percent to 60 percent in some Indian cities in summer-which contributes to chronic electricity shortages.


Nihar Shah


Amol Phadke

"The main significance of this study is that the estimated future electricity footprint of air conditioners is on par with or surpasses the electricity to be generated from renewable sources such as wind and solar," says Berkeley Lab scientist Nihar Shah, the report's lead author. "This implies that policies to promote more efficient air conditioning equipment should be pursued with a similar seriousness and concern."

The study was conducted in support of the Super-efficient Equipment and Appliance Deployment (SEAD) initiative of the Clean Energy Ministerial. It found that air conditioning efficiency can be cost-effectively improved by 20 percent to 40 percent in most major economies.

"The information collected in the study can be used by governments and utilities to design a variety of air conditioner efficiency improvement policies and programs," said Amol Phadke, a co-author of the study and Deputy Leader of the International Energy Studies Group at Berkeley Lab.

Using the best technology that is already available can significantly improve energy efficiency-reducing energy use by 35 percent to 50 percent compared to the market average—and potentially save 100 Rosenfelds and reduce carbon emissions by about 240 megatons of carbon dioxide equivalent (MT CO_2e)/year in 2020. Using technology that is also cost effective —meaning the electricity savings over the lifetime of the AC unit would pay for any additional cost—can reduce energy use by 20 percent to 30 percent. Adopting energy-efficient AC technology that is also cost effective could save more than 192 terawatt-hours per year (TWh/yr) by 2020—saving 64 Rosenfelds. Widespread adoption of room ACs with variable speed compressors could further increase energy savings.

The study is the basis for a new three-pronged strategy being developed by the SEAD initiative to address the rapidly growing electricity demand from air conditioners: (1) creating common foundations for identifying efficient ACs in different climates by more effectively measuring real-world performance, (2) developing draft efficiency specifications using technology and cost data collected by SEAD, and (3) growing the market for highly efficient ACs by sharing and promoting best practices and providing technical assistance to create or enhance existing market transformation programs.

The study was funded by the U.S. Department of State and administered by the U.S. Department of Energy in support of the SEAD initiative. Researchers from Navigant Consulting, Inc., Europe, contributed to the report. *Cooling the Planet: Opportunities for Deployment of Superefficient Room Air Conditioners* [http://www.superefficient.org/Resources/~/media/Files/SEAD%20Room%20AC%20Analysis/Final%20SEAD%20Room%20AC%20Report.pdf] can be downloaded the Superefficient.org website.

Additional information:

Superefficient.org [http://www.superefficient.org]

For information on getting involved with the SEAD air conditioning strategy, contact standards@superefficient.org .

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Sulfur-Graphene Oxide Material for Lithium-Sulfur Battery Cathodes

Searching for a safer, less-expensive alternative to today's lithium-ion batteries, scientists have turned to lithium-sulfur (Li-S) as a possible chemistry for next-generation batteries. Lithium-sulfur batteries have several times the energy storage capacity of the best currently available rechargeable Li-ion battery, and sulfur is inexpensive and nontoxic. Current batteries using this chemistry, however, suffer from extremely short cycle life—they don't last through many charge-discharge cycles before they fail.

A research team led by Elton Cairns and Yuegang Zhang has developed a new material for the cathode (the positive electrode) that could lead to practical lithium-sulfur batteries. Cairns is a researcher in the Environmental Energy Technologies Division (EETD) of Lawrence Berkeley National Laboratory (Berkeley Lab), and Zhang is a Staff Scientist in Berkeley Lab's Materials Sciences Division (MSD).

Lithium-ion cells are reaching their maximum energy storage capability (~200 watt-hours/kilogram [Wh/kg]) and are still not able to provide a safe, low-cost battery that can power an electric vehicle more than 100 miles. They also don't provide sufficient operating time for many mobile applications, including laptop computers, tablets, and cell phones.

To continue the progress toward a higher-capacity battery that will meet the needs of electric vehicles and mobile electronic applications, the marketplace needs a new generation of battery with a specific energy of at least 400 Wh/kg, a low cost (under $200/kWh), improved safety, and a low environmental impact.

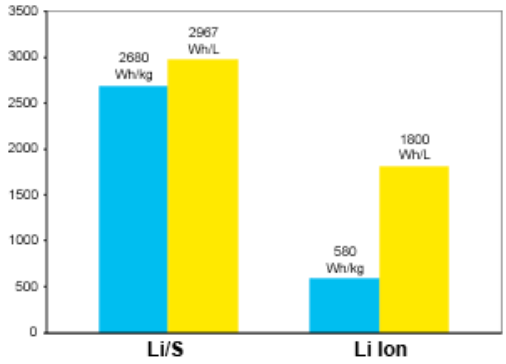

Figure 1. Comparison of the theoretical specific energy and theoretical energy density for Li/S cells and Li-ion cells.

The Li-S cell offers a very high theoretical specific energy (2,680 Wh/kg)—much higher than that of the best Li-ion cell (~580 Wh/kg) (See Figure 1). Thanks to this high energy per weight, Li-S batteries could store more energy, providing greater vehicle range and longer operating times in all applications.

Sulfur is inexpensive, non-toxic, safe, and environmentally benign, so Li-S batteries would be cheaper than current Li-ion batteries, and they would be less prone to safety problems that have plagued some of today's Li-ion batteries, such as overheating and catching fire. But something needs to be done to overcome their current short cycle life—most prototype Li-S batteries lose their ability to store charge after a dozen charge-recharge cycles, or less.

Barriers to Li-S Cell Progress

The brief cycle life has been the main impediment to commercialization. The technology developed by Cairns, Zhang, and their colleagues to address this problem is a sulfur-graphene oxide nanocomposite material (S-GO) for use as the battery's cathode.

S-GO is a nanocomposite material in the form of small particles of sulfur-coated graphene flakes that is designed for use as the cathode in a Li-S battery. As the cathode material, S-GO binds with lithium during the battery's discharge cycle. During battery recharge, lithium returns to the battery's negative electrode.

Overcoming Short Cycle Life and Volume Changes

The cause of Li-S batteries' short cycle lives is that sulfur is highly soluble in the organic solvents typically used as electrolytes, forming lithium polysulfides. The polysulfide ions can diffuse through the electrolyte to the lithium anode where they can form precipitates such as lithium sulfide (Li_2S). This phenomenon reduces the utilization of active materials at the electrodes and shortens battery life.

Another barrier is the significant volume increase (76 percent) within the battery, which takes place as sulfur is converted to Li_2S during discharge, causing loss of electronic contact of the sulfur with the current collector from mechanical degradation.

The S-GO's unique structure improves its performance as a cathode material for Li-S batteries. It can accommodate the volume change of sulfur as it is converted to Li_2S on discharge, and back to elemental sulfur on recharge, while maintaining the bonding between the grapheme oxide surface groups and the sulfur.

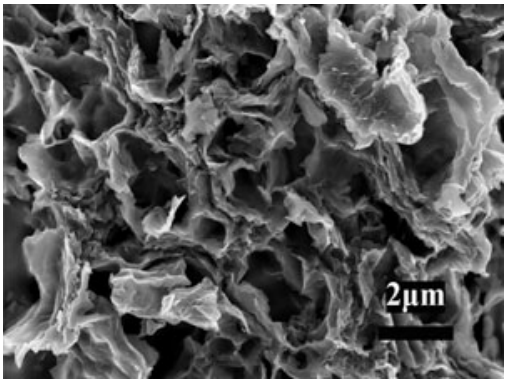

Figure 2. SEM of the GO-S nanocomposite after heat treatment in Ar at 155°C for 12 hours.

The large surface area of S-GO, along with its ubiquitous cavities, establishes more intimate electronic contact with sulfur and avoids particle aggregation and loss of electrical contact with the current collector. (See scanning electron microscope image of S-GO, Figure 2.)

The graphene oxide contains functional groups (including epoxy and hydroxyl) that can strongly anchor sulfur atoms and effectively prevent the lithium polysulfides from dissolving the electrolyte during cycling, which would otherwise lead to the battery's rapid failure. Current tests of the technology have shown that Li-S batteries with S-GO cathodes had stable cycling for many hundreds of deep cycles, with high sulfur utilization.

Potential Benefits of Li-S Batteries

Lithium-sulfur batteries could revolutionize both electric transportation and the electric grid. Because they can store four times more energy than current lithium ion batteries per unit of weight (600 to 800 Wh/kg), they could extend the range of an electric vehicle to that of a gasoline powered car—300 to 400 miles on a single charge. Sulfur is inexpensive, less than $1.00/kg, and Li-S batteries would be significantly lower in cost than Li-ion batteries, creating the potential for rapid and high market penetration.

Stationary battery banks using Li-S technology could provide the high storage capacity at the low cost needed to make large-scale stationary storage of electricity from wind and solar power possible on the grid.

This technology is available for licensing.

Additional information:

Sulfur-Graphene Oxide Nanocomposite Cathodes for Lithium/Sulfur Cells [http://www.lbl.gov/Tech-Transfer/techs/lbnl3096.html]

Ji, L., M. Rao, H. Zheng, L. Zhang, Y. Li, W. Duan, J. Guo, E. J. Cairns, and Y. Zhang. 2011. "Graphene Oxide as a Sulfur Immobilizer in High Performance Lithium/Sulfur Cells. [http://www.lbl.gov/Tech-Transfer/publications/3096pub.pdf]" *Journal of the American Chemical Society* 133 (46): 18522–18525.

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Better Batteries with a Conducting Polymer Binder

Lawrence Berkeley National Laboratory (Berkeley Lab) scientists have invented a new material for use in rechargeable batteries that can boost power storage capacity by 30 percent, a dramatic improvement in a field marked by little progress for more than a decade. It is called a Conducting Polymer Binder, literally a kind of flexible plastic glue that holds electrode materials together while facilitating the shuttling of electrons and positively charged lithium ions.

Today's ongoing revolution in electronics is driven by something engineers call "Moore's Law," the ability to double every 18 months the number of transistors on a silicon chip. It is the reason why computers that once took up an entire building can now fit inside a smartphone.

Unfortunately, there is no Moore's Law for batteries.

The amount of power they can store has increased at a plodding five percent per year. As a result, conventional batteries are becoming the largest and heaviest component of all things mobile and electronic; and in electric cars, they are the costliest. Breaking this bottleneck is enormously important. Cars and trucks account for 30 percent of our nation's carbon dioxide emissions, and wider use of electric vehicles could reduce fossil fuel use and the release of greenhouse gases.

In their effort to make smaller, lighter, and cheaper batteries, a Berkeley Lab team led by Gao Liu of the Environmental Energy Technologies Division (EETD) focused on improving the negative electrode, or anode. During charging of any lithium battery, lithium ions are driven to the anode, causing electrons to build up potential energy at the anode. Complete a circuit by turning on a switch, and those electrons start flowing.

The anodes of conventional lithium-ion batteries are made from a composite of carbon particles, or graphite. Engineering has improved these graphite anodes, but they are rapidly approaching their power storage design limit. In theory, anodes made from lighter-weight silicon could store ten times more energy. But there is a catch: During charging, when silicon absorbs lithium, a silicon anode literally swells to four times its size. On discharge, it contracts. After a just few cycles, this breath-like expansion and contraction causes silicon anodes to break down.

The key to building a better battery, it turns out, is to build a better binder.

The Berkeley Lab technology directly addresses the "volume-expansion" problem by engulfing silicon particles in a rubbery polymer to form an anode composite. Four features make this binder unusually attractive for battery designers: it is strong, elastic, porous, and highly conductive. The elastic material stretches during the expansion of silicon particles as the battery charges and contracts during discharge—giving silicon anodes the flexibility to "breathe." The binder's porosity permits the passage of lithium ions, while its conductivity handles the transit of electrons. Other researchers have tried the flexible-binder approach, but their polymers lose their conductivity in the hostile chemical environment inside a battery. Much of Liu's development effort focused on modifying the polymer binder to maximize its conductivity under a battery's actual operating conditions.

Conducting Polymer Binder is a lightweight, flexible, electrically conducting adhesive polymer. It is blended with particles of silicon in a slurry process to form a silicon composite anode.

The Berkeley Lab team used a soft X-ray beamline at the Advanced Light Source to analyze and solve the loss-of-conductivity problem. These observations were subsequently used to choose molecular structures on binder candidates that become even more electrically conductive in the electron-rich, highly reductive environment of an anode. The optimal design determined by the research is the Conducting Polymer Binder Poly(9,9-dioctylfluorene-co-9-fluorenone-co-methybenzoic ester), or PFM. Subsequent research using this same approach has yielded new binder candidates that offer comparable performance at lower cost.

The promise of silicon lies in its theoretical specific capacity of 4,200 milliamp hours per gram (mAh/g). The theoretical limit for graphite is about one-tenth of that, or 372 mAh/g. The Berkeley Lab team has successfully fabricated silicon composite anodes with a specific capacity of 1,400 mAh/g. Batteries built with this first-generation silicon anode therefore have demonstrated an immediate 30 percent improvement in storage capacity over comparable commercial-grade graphite anode-based cells.

Improved charge capacity is not enough, however. A practical silicon anode design must also be economical. To keep costs down, the Berkeley Lab team designed its binder to be compatible with today's battery manufacturing technology. Graphite electrodes, for example, are made using a slurry of carbon particles, binder, and a solvent, which is spread onto the terminal contact surface and dried like paint. That same strategy can be used to build the silicon composite electrode from a mixture of solvent and silicon particles held together by the Conducting Polymer Binder.

This technology is available for licensing.

—Sabin Russell

Additional information:

Gao Liu, Shidi Xun, Nenad Vukmirovic, Xiangyun Song, Paul Olalde-Velasco, Honghe Zheng, Vince S. Battaglia, Linwang Wang, and Wanli Yang. "Polymers with Tailored Electronic Structure for High Capacity Lithium Battery Electrodes [http://onlinelibrary.wiley.com/doi/10.1002/adma.201102421/abstract]," *Advanced Materials* (2011), 23, 4679–4683.

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Shidi Xun, Xiangyun Song, Vincent Battaglia, and Gao Liu. "Conductive Polymer Binder-Enabled Cycling of Pure Tin Nanoparticle Composite Anode Electrodes for a Lithium-Ion Battery [http://jes.ecsdl.org/content/160/6/A849.abstract]," *Journal of The Electrochemical Society* 160 (6) A849–A855 (2013) A849.

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Research Highlights

Hyundai Engineering and Berkeley Lab Collaborate on Energy-Efficient Buildings Research

From left to right: Mary Ann Piette, Don DePaolo, Ho-kyoo Jo, Kim Dong Ku, and Philip Haves

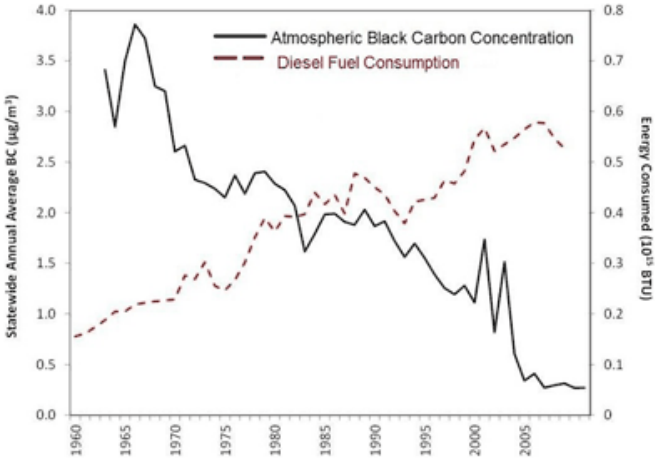
Lawrence Berkeley National Laboratory (Berkeley Lab) will work with Hyundai Engineering & Construction Company to develop and evaluate advanced building technologies and use simulation tools to better understand building performance. Representatives of the two institutions signed a memorandum of understanding to explore mutual research opportunities in the experimental evaluation of building technologies and in computer simulation of building performance. As part of their activities with Berkeley Lab, Hyundai will partner with FLEXLAB, the building system test facility for energy-efficient building technologies, now under construction at Berkeley Lab's Environmental Energy Technologies Division (EETD).

Ho-kyoo Jo, Director of Hyundai's Research and Development Division/Building Works R&D Group, and Kim Dong Ku, senior research engineer in its Green City R&D Team, met with Berkeley Lab's Don DePaolo, Associate Lab Director for Energy & Environment, Mary Ann Piette, Head of the Building Technologies and Urban Studies Department, Philip Haves, Leader of the Simulation Research Group, and others to discuss common areas of interest. The Hyundai delegation viewed the FLEXLAB construction site and discussed startup activities with FLEXLAB Manager Cindy Regnier.

Hyundai Engineering & Construction Co., Ltd., is a South Korean-based general construction company. It provides civil engineering, architectural, industrial, and energy services, and has an interest in R&D and developing green technologies.

California Clean Diesel Programs Slash Black Carbon; Reduce Climate Change

A recent study found that the California Air Resources Board's (CARB's) multi-decade efforts to reduce emissions from diesel exhaust in the state has also reduced black carbon levels, thereby mitigating the state's contribution to climate warming. Lawrence Berkeley National Laboratory (Berkeley Lab) researchers Tom Kirchstetter and Odelle Hadley participated in the study with colleagues from Scripps Institution of Oceanography; the University of California, San Diego; and the Pacific Northwest National Laboratory.



Reductions in emissions of black carbon since the late 1980s, mostly from diesel engines as a result of air quality programs, have resulted in a measurable reduction of concentrations of global warming pollutants in the atmosphere.

Black carbon, which consists of very small soot particles emitted into the atmosphere by burning fuels, has long been shown to have adverse health and environmental impacts, and more recently was identified as a major short-lived contributor to climate change. Much of California's black carbon originates from diesel-burning mobile sources.

Co-author Kirchstetter says, "Black carbon levels have decreased by about 90 percent over a 45-year period, beginning with the establishment of CARB in 1967, mostly as a result of state regulations for diesel engine emissions."

As a testament to the effectiveness of CARB's diesel programs, those deep reductions were achieved over a time frame when diesel fuel consumption increased by about a factor of five. The report, *Black Carbon and Regional Climate of California,* estimates that CARB's efforts to reduce diesel emissions (and therefore, black carbon) had the same result as taking more than 4 million cars off California roads every year would have.

The research team collected air pollution data by aircraft, satellite, and ground monitors and ran that data in computer models. They considered emissions only from diesel-powered trucks and buses, and off-road diesel equipment and vehicles. However, if farming and construction equipment and trains and ships were considered, the carbon dioxide (CO_2) emissions reduction could reach 50 million metric tons per year over 20 years—about a 13-percent reduction in the state's total annual CO_2 emissions.

The study was also the first to show that black carbon emitted in diesel exhaust overcomes the cooling effect observed from other diesel emissions; resulting in a net warming. It also linked brown carbon, a form of organic carbon aerosols from wildfires, to warming, not cooling, as previously thought.

Project leader Veerabhadran Ramanathan believes that more widespread diesel reductions could be an effective strategy for slowing global warming. "If California's efforts in reducing black carbon can be replicated globally, we can slow down global warming in the coming decades by about 15 percent, in addition to protecting people's lives," he said. "It is a win-win solution if we also mitigate carbon dioxide emissions simultaneously."

CARB chairman Mary D. Nichols agrees. "This report makes it clear that our efforts to clean up the trucks and buses on our roads and highways also help us in the fight against climate change."

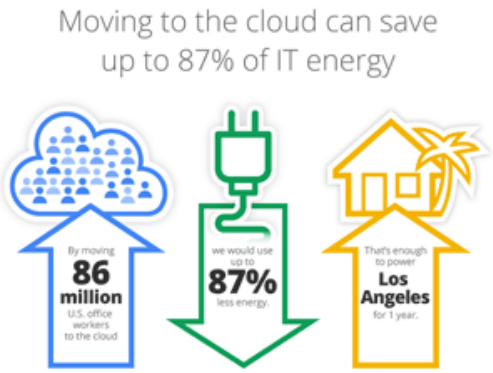
New EETD Websites

Several new Environmental Energy Technologies Division websites have premiered recently.

Come and learn about what the following groups and departments do:

- EETD's Energy Storage and Distributed Resources Department website [http://esdr.lbl.gov/].
- Energy Efficiency Standards Group website [http://ees.lbl.gov/].
- International Energy Studies Group website [http://ies.lbl.gov/home].
- Grid Integration Group website [http://gig.lbl.gov/].

Big Energy Savings from Transitioning Software Applications to the Cloud



A Google-funded study led by Lawrence Berkeley National Laboratory (Berkeley Lab) shows that moving common software applications used by 86 million U.S. workers to the cloud could cut information technology energy consumption by as much as 87 percent—about 23 billion kilowatt-hours—saving enough electricity annually to power Los Angeles for a year.

The study, conducted by scientists in Berkeley Lab's Computational Research (CRD) and Environmental Energy Technologies (EETD) divisions and at Northwestern's McCormick School of Engineering and Applied Science, focused on e-mail, customer relationship management (CRM) software, and bundled productivity software. Google contacted Berkeley Lab to lead the study based on the laboratory's extensive research into data center energy efficiency and, more recently, an assessment of the suitability of cloud computing.

A primary goal of the project was to develop a state-of-the-art model that researchers and the public could use to analyze the energy and carbon impacts of cloud computing. The model accounts for all of the factors necessary for comprehensive assessment of the environmental benefits or costs of shifting from local or physical resources to the cloud. Individuals, program funding agencies, and policymakers all will be able to use the model to assess their computing needs and energy demands. It can be found on the Cloud Energy and Emissions Research Model [http://cleermodel.lbl.gov] website.

"The model, which will be available to a wide audience, allows you to evaluate energy use of various options in a significant way," said Berkeley Lab's Lavanya Ramakrishnan, the study's principal investigator. "By studying the present-day and cloud scenarios, you can see the net energy and carbon-footprint benefits at a range of scales."

Eric Masanet, lead author of the report and former EETD researcher, led the Northwestern research team of Jiaqi Liang, Xiahui Ma, and Ben Walker. Ramakrishnan, a research scientist in the Computational Research Division, led the development of the public model, and the division's Valerie Hendrix and Pradeep Mantha helped develop it. Arman Shehabi, a principal scientific engineering associate in EETD, led Berkeley Lab's analysis component.

"This powerful, public use model is really a foundational tool for the energy analysis community," Shehabi said. "The analytical structure and various assumptions are fully transparent, so users can explore the model's underlying analytics, compare different scenarios, poke at the data, and discuss the results with the community."

"We commend Berkeley Lab for completing such a thorough study of the broader implications of Internet computing," said Michael Terrell, Senior Policy Council for Energy and Sustainability at Google. "We're especially excited that the model will be made available to other researchers and experts interested in doing their own analysis."

Masanet presented the study at the "How Green is the Internet" summit hosted by Google in Mountain View, California. The report can be found online [http://crd.lbl.gov/assets/pubs_presos/ACS/cloud_efficiency_study.pdf].

For more information:

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EETD Researchers Share in Supercomputing Award


William Tschudi


Henry Coles

Members of Lawrence Berkeley National Laboratory's (Berkeley Lab's) Energy Efficient High Performance Computing Working Group (EE HPC WG) have won the Gauss Award of the German Gauss Center for Supercomputing for their paper, "TUE, a New Energy-Efficiency Metric Applied at ORNL's Jaguar." The award is presented for the most outstanding paper in the field of scalable supercomputing at the International Scientific Computing Conference in Leipzig, Germany. Authors included William Tschudi and Henry Coles of Berkeley Lab's Environmental Energy Technologies Division (EETD). The EE HPC WG was conceived and is led by Lawrence Berkeley National Laboratory to promote energy-efficient green computing best practices.

Berkeley Lab EETD to Work With Shenzhen Institute of Building Research on Energy-Efficient Buildings, Low-Carbon Cities

The Shenzhen Institute of Building Research (IBR) of Shenzhen, China, will collaborate with Lawrence Berkeley National Laboratory (Berkeley Lab) on a variety of research and technology development and demonstration projects under a memorandum of understanding (MOU) recently signed in Shenzhen.

National Development and Reform Commission Minister Xie Zhenhua and other dignitaries witness the signing of MOUs, including one between Lawrence Berkeley National Laboratory and Shenzhen Institute for Building Research, and a memorandum of understanding between the California Air Resources Board and the Government of Shenzhen Municipality.

Front row, far right: Ye Qing, Director of the Shenzhen Institute for Buildings Research. To the left is Lynn Price, Leader, China Energy Group; and left of her is Mary Nichols, Head, California Air Resources Board.

Lynn Price, leader of the China Energy Group in Berkeley Lab's Environmental Energy Technologies Division, participated in a ceremony marking the agreement in Shenzhen. The signing took place at the First Shenzhen International Low-Carbon City Forum. Minister Xie Zhenhua of China's National Development and Reform Commission and three other dignitaries attended the signing.

Nan Zhou, Deputy Director of the China Energy Group and Director of the U.S.-China Clean Energy Research Center for Buildings Energy Efficiency (CERC-BEE) also attended the forum. She explained, "This MOU builds on our existing relationship with the Shenzhen Institute for Building Research through CERC-BEE. Berkeley Lab looks forward to continuing our cooperation with Shenzhen IBR, led by Director Ye Qing, a visionary in the area of low-carbon development."

Under the MOU, the two institutions will work together on the planning, construction, and operation of low-carbon cities in China, and on developing and demonstrating technologies for low-carbon cities. The MOU also calls on the parties to explore the provision of training and assistance to incubate industries developing low-carbon technologies. The Shenzhen International Low Carbon City project is the expected focus of this cooperation.

The two-day meeting included a series of forums and exhibitions at the new Shenzhen International Low Carbon City and included the inauguration of China's first pilot Emissions Trading System (ETS), a milestone in China's efforts to combat climate change.

At the same ceremony, the head of the California Air Resources Board, Mary Nichols, signed a separate MOU with the Government of Shenzhen Municipality to assist the city with its carbon-trading program—the first in China. Under that agreement, California and Shenzhen have agreed to work together to share policy design and early experiences from their carbon-trading programs, to build strong, stable, and growing markets for clean energy technology and greenhouse gas emission reductions.

For more information:
CARB press release [http://www.arb.ca.gov/newsrel/newsrelease.php?id=445]

LAWRENCE BERKELEY NATIONAL LABORATORY

Environmental Energy Technologies Division

NEWS

Sources and Credits

Sources

Energy Efficiency & Renewable Energy's Energy Savers

These web pages [http://energy.gov/energysaver/energy-saver] provide information about energy efficiency and renewable energy for your home or workplace.

DOE's Energy Information Administration (EIA)

EIA [http://www.eia.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://www.energystar.gov/]

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

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LBNL/PUB-821 Vol. 12, No. 1 [http://eetd.lbl.gov/newsletter/nl44/], Summer 2013

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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.
