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NEWS

ADVANCED TECHNOLOGIES | ATMOSPHERIC SCIENCES | BUILDING TECHNOLOGIES | ENERGY ANALYSIS | INDOOR ENVIRONMENT

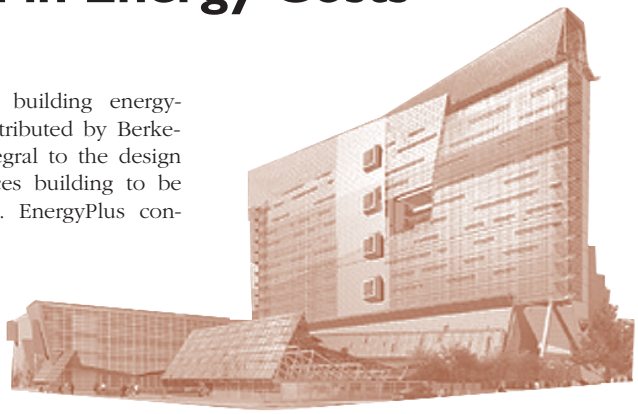
ENERGYPLUS Saves Federal Building $9 Million in Energy Costs

In this Issue

ENVIRONMENTAL ENERGY TECHNOLOGIES DIVISION

The mission of the Environmental Energy Technologies Division is to perform research and development leading to better energy technologies and the reduction of adverse energy-related environmental impacts.

EnergyPlus software—a building energy-simulation program distributed by Berkeley Lab—has been integral to the design of a new federal offices building to be built in San Francisco. EnergyPlus contributed to nearly $9 million in energy savings projected over 20 years, according to Tim Christ, project manager for the building's lead design firm, Morphosis. The modeling tool was also used to simplify the building's facade, saving taxpayers an additional $1.5 million in construction costs. Groundbreaking for the building took place on July 15, 2002.



The simulation program allows designers to calculate the impacts of different heating, cooling, and ventilating systems, as well as the impacts of various types of lighting systems and windows.

EnergyPlus was developed as a collaborative effort between EETD's Simulation Research Group led by Fred Winkelmann, the University of Illinois at Urbana-Champaign, and the U.S. Army Construction Engineering Research Laboratory, with assistance from other research organizations. The DOE Office of Building Technologies funded the project.

"We are the first people to use EnergyPlus to model natural ventilation flows for a major building," notes Philip Haves of EETD's Commercial Buildings Systems Group.

The new San Francisco building will use natural ventilation to provide cooling without the use of fans or refrigeration. Most of the year the building will be cooled by natural airflow through the windows. In hot weather, interior heat is absorbed during the day by exposed heavy-weight ceiling slabs; the stored heat then dissipates at night when the air is cooler. Cooling and ventilation were maximized by orienting the building and its windows to take advantage of natural wind conditions.

Erin McConahey of Arup, the engineering consultants on the project, says, "Basically, other energy-simulation programs can't deal with the natural ventilation issues. The combination of airflow and energy modeling in a single package not only allowed us to predict energy performance, but also to calculate surface temperatures, track air change rates, and predict thermal comfort. The Berkeley Lab modeling tool provided crucial corroboration of our design work."

Implementation of natural ventilation required a complete rethinking of interior office space design. "Instead of having cellular offices around the outside of the building and open-plan office space in the interior, free airflow required open-plan office space on the exterior and cellular offices and other enclosed spaces along the spine. These enclosed spaces have lowered false ceilings with space above to allow air driven by wind pressure to flow from one side of the building to the other," explains Haves. Although this stands traditional hierarchical office structure on its head, the concept was ultimately accepted

Note: There will be no Fall 2002 issue of the EETD News. *The current issue, Winter 2003, begins Volume 4.*

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"We are the first people to use EnergyPlus to model natural ventilation flows for a major building."

—Philip Haves

by the General Services Administration, the federal client for the project.

In 2000, when the San Francisco federal building project was in its infancy, architects with Morphosis were interested in using only natural ventilation for the top 13 floors. Security concerns mandated that the lower floors be completely sealed. They were hesitant to move forward with the idea, however, without some validation through modeling to assure them that the building could meet comfort standards without air conditioning. An EnergyPlus modeling analysis conducted by Haves convinced the design team and its clients that natural ventilation would keep the building comfortable during San Francisco's brief but significant episodes of hot weather.

"When we started, we weren't sure which modeling program would enable us to gain a full understanding of how the building systems would come together," says Christ. "The EnergyPlus model gave us a more accurate picture and led to a considerable increase in efficiency and direct savings in construction costs. We would not have been able to get there without Phil's input."

Although Berkeley Lab's contribution to the design of the building has been completed, Haves is still working on the project, helping the designers with strategies to optimize indoor comfort by opening and closing windows at different times of the day.

One problem designers still need to address is how to reconcile these automated strategies aimed at overall building comfort with the desire to allow individuals to open and close windows near them. The use of operable windows and day-lit interiors was found to contribute to the productivity, health, and workplace satisfaction of building occupants, according to studies conducted by Gail Brager, a professor at UC Berkeley's College of Environmental Design.

Since Berkeley Lab first released the EnergyPlus software in April 2001, the program has been licensed by 12,000 end users, 60 collaborative developers, and five commercial distributors. Seth Rosen of Berkeley Lab's Technology Transfer Department explains, "Our software licensing strategy for EnergyPlus was designed to create a community of contributing developers whose skill and expertise could complement the core EnergyPlus development team. It's gratifying to see this strategy succeed."

—Robin Johnston

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This design assistance work was supported by GSA Region IX and FEMP's Design Assistance Program.

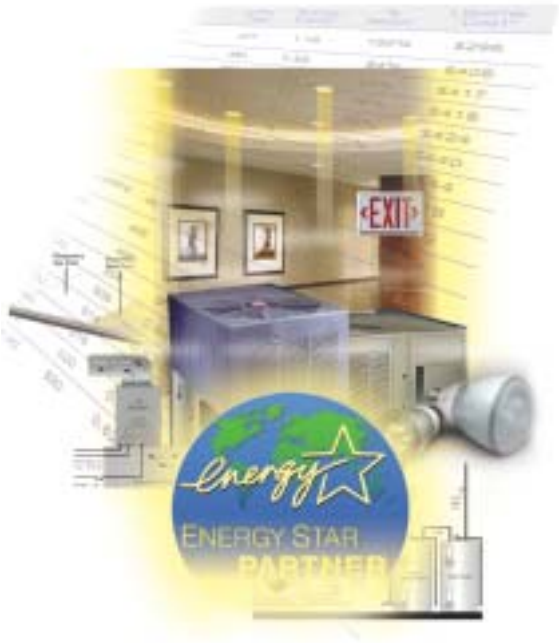
Robin Johnston is a science writer with the Technology Transfer Department.

Computer rendering of the new Federal Building to be built in San Francisco. The building was designed with the aid of the EnergyPlus software distributed and partly developed by Berkeley Lab.

D.C. Office Tackles FEMP Initiatives on Government Energy-Efficient Procurement

To help reduce taxpayer dollars and the federal energy bill, presidential Executive Order 13123 and Federal Acquisitions Regulation (FAR Part 23) direct agencies to purchase ENERGY STAR® labeled products. For product groups where ENERGY STAR programs do not yet exist, agencies must buy products that are in the upper 25% of energy efficiency as designated by the Federal Energy Management Program (FEMP). Since 1995, researchers at Berkeley Lab's Washington D.C. Projects Office have been providing FEMP with technical and analytical support for the directives in the executive order. The author and Donald Mauritz, under Jeff Harris' supervision, have been helping federal agencies identify energy-efficient technologies. The team does this by analyzing appropriate products, developing FEMP efficiency recommendations, training agencies in the use of the recommendations, and researching various agency guide specifications for energy-efficiency performance levels. Guide specifications are used by many federal agencies for new construction and renovation projects.

There are two ways for purchasers to identify energy-efficient equipment: the ENERGY STAR label, based on efficiency criteria set by the U.S. Department of Energy (DOE) and Environmental Protection Agency (EPA) with input from manufacturers and retailers, and FEMP's *Product Efficiency Recommendation*.



FEMP Recommendations *for federal procurement of energy-efficient, ENERGY STAR products include chillers, boilers, fluorescent luminaires, and exit signs.*

The Berkeley Lab team focuses on procurement initiatives at FEMP. Primary responsibilities include analyzing efficiency performance levels for various HVAC products and training procurement officials at federal agencies to identify and procure these energy-efficient products. It is not only important to evaluate the marketplace so that agencies can easily identify energy-efficient products, it is also essential to disseminate the information to federal buyers, ensuring that agencies understand the resources provided by the Berkeley team and use them in their daily procurement activities.

Although FEMP collaborates with ENERGY STAR initiatives, Berkeley's team in Washington D.C. works primarily for FEMP to develop the popular series of *Product Efficiency Recommendations* and analyze the upper 25% of efficient models for products not yet covered by ENERGY STAR. The Berkeley team creates databases of various products, ranks efficiency from best to worst, and draws a line at the efficiency level that beats 75% of the models in the data set: FEMP has placed restrictions on the analysis. Levels can only be published if there are at least three manufacturers that can meet the level; also, FEMP requires that all the models in any data set meet at least the DOE national standard (if applicable) or ASHRAE's 90.1, a voluntary, widely used, building efficiency code.

FEMP's *Recommendations*, typically two pages long, show the top 25th percentile levels and identify the federal supply sources (e.g., the General Services Administration or the Defense Logistics Agency) that offer these energy-efficient products. Federal buyers will also find a cost-effectiveness example to help them compare annual and life-cycle energy savings. In addition, Berkeley Lab's team developed interactive, web-based cost calculator tools from these cost-effectiveness examples, allowing purchasers to calculate lifetime energy costs associated with improved efficiencies. FEMP's *Recommendations* also offer tips to help buyers save energy in specifying, installing, and using the products. According to Beth Shearer, FEMP's Director, "FEMP's *Recommendations* provide agencies with an excellent screening resource to help in their energy-efficient purchasing decisions."

FEMP has also tasked the Berkeley team with researching federal guide specifications to ensure that energy-efficiency performance levels are incorporated. Mauritz has been the lead researcher on federal guide specifications. He explains the importance of guide specifications: "The FEMP procurement program focuses primarily on energy-efficient purchases as viable replacement options. However, guide specifications target the initial design phase of a project and identify what *must* be installed during construction, which can

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Energy-Related IEQ Research: Setting Priorities

The indoor environment—inside office buildings, schools, commercial buildings, and residences—is where people spend 90% of their time. The quality of the indoor environment, including pollutant concentrations and thermal conditions, affects the health and productivity of a building's occupants. Indoor environmental conditions are largely determined by the design, operation, maintenance, and use of buildings and by the surrounding outdoor environment. The same factors determine building energy performance; thus, energy and indoor environmental quality (IEQ) must be addressed in a coordinated manner.

Because of the complex linkage between IEQ and building energy use, the U.S. Department of Energy (DOE) has for many years recognized the need for research on IEQ. DOE's research goals include ensuring that energy programs do not degrade IEQ and supporting development of energy-efficient technologies and practices for maintaining a high level of IEQ. With growing evidence that large health and productivity gains could be attained from practical improvements in IEQ, a group of state energy organizations has recently expressed its support for an expanded program of energy-related IEQ research. Consequently, the Association of State Energy Research and Technology Transfer Institutions and DOE have jointly supported the development of an agenda for high-priority energy-related IEQ research. Locally, the California Energy Commission, with assistance from the California Institute for Energy Efficiency, has taken a lead role in sponsoring this agenda. William Fisk, Head of EETD's Indoor Environment Department, has led a multidisciplinary team of scientists and building engineers from around the country in the development of this agenda.

The resulting research agenda, available at http://eetd.lbl.gov/ied, describes how building energy use and IEQ are linked, summarizes ongoing research, and identifies a set of 35 highest-priority research areas related to the following goals:

- identifying IEQ problems and opportunities;
- developing and evaluating energy-efficient technologies and practices for improving IEQ; and
- encouraging or assisting the implementation of technologies or practices for improving IEQ.

The agenda document includes a one- to three-page description and justification of each research priority. Consistent with the focus on "energy-related" research priorities, building ventilation, and HVAC (heating, ventilation, and air conditioning) systems are very prominent in the agenda. Research related to moisture and microbiological problems, particularly in hot and humid climates, is also prominent in the agenda. The agenda tends to emphasize research on residences, small commercial buildings, and schools because these types of buildings have been underrepresented in prior research. Most of the research areas apply to both new construction and existing buildings. Nearly all of the recommended priority research and development project areas include tasks intended to facilitate the communication and implementation of the research results. In addition, the priority agenda includes several projects specifically designed to facilitate or stimulate the use of existing energy-efficient technologies and practices for improving IEQ. Recently, the California Energy Commission has used the agenda to develop its first solicitation for energy-related IEQ research.

—Ted Gartner

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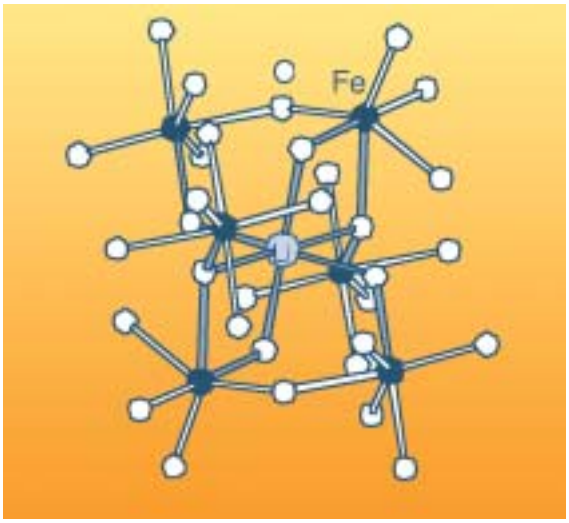
Towards Understanding Atomic and Electronic Structure of Battery Materials

This is an exciting time in the history of vehicular transportation. The recent commercial introduction of hybrid electric vehicles coupled with the huge international effort to develop batteries and fuel cells for automotive use has made the dream of widespread electric vehicle use a real possibility. The last decade has seen the introduction of a variety of promising new materials for lithium rechargeable batteries. Application of these materials to electric vehicle batteries requires that they be inexpensive, lightweight, environmentally compatible, and able to withstand years of electrochemical use. The research groups of Jeff Reimer and Elton Cairns have focused on the application of nuclear magnetic resonance (NMR) spectroscopy to the study of up-and-coming lithium battery electrode materials.

NMR allows direct observation of lithium in the bulk of a battery electrode, providing insight into the local atomic and electronic environment surrounding the lithium ion. Studying the changes in this local environment and their relationship to electrochemical cycling and abuse of the material elucidates the critical connection between the atomic-scale structure of the electrode and the resulting electrochemical performance. Our recent research in this area has ranged from fundamental to applied and focuses on both novel and well-studied materials.

One type of electrode material we have explored is the lithium-manganese-oxide spinel ($LiMn_2O_4$) system. It is well known that these materials show a greatly increased number of charge-discharge cycles before failure when chromium (Cr), aluminum (Al), or other metal ions substitute for some of the manganese in the spinel crystal. The mechanism of failure and the role of metal substitution are still subjects of debate. We have used NMR and other techniques to study the evolution of the atomic-scale structure of spinel materials on charge-discharge cycling and after failure. Our results suggest that the dominant mode of failure is dissolution of manganese via a lithium-for-manganese ion-exchange process. We furthermore surmise that substitution of the manganese promotes covalence in the Li-O-Mn bond, producing a more robust material that can withstand the rigors of long-term electrochemical cycling.



The local atomic structure for $LiFePO_4$.

Our most recent research is in collaboration with Marca Doeff of the Materials Sciences Division and includes study of a novel electrode material, $LiFePO_4$–type olivines. We have just published a new model for understanding the NMR properties of the pristine material (as a communication in the *Journal of the American Chemical Society*). We expect this work to lay the foundation for future applied studies of the effects of synthesis technique and electrochemical history on the performance of this promising material.

—Jeffrey Reimer

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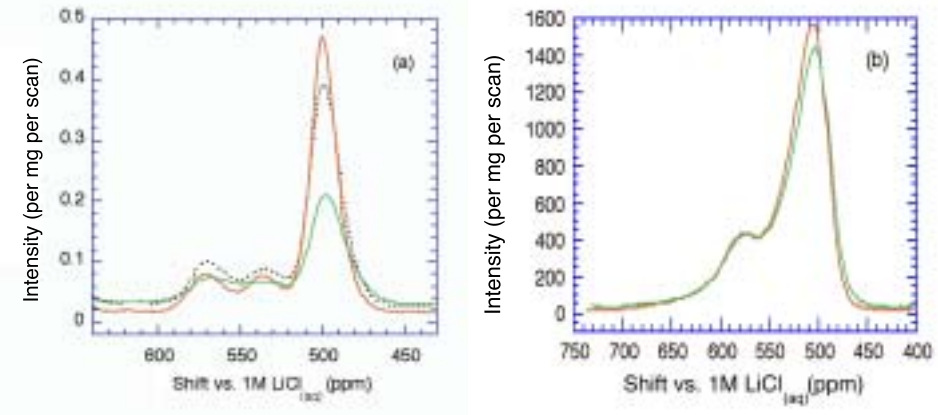
The early portions of this research were supported by the Director, Office of Basic Energy Sciences, Chemical Sciences Division of the U.S. Department of Energy. The more recent work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of FreedomCAR and Vehicle Technologies of the U.S. Department of Energy.



^{7}Li MAS NMR isotropic peaks for (a) $LiMn_2O_4$ and (b) $LiCr_{0.1}Mn_{1.9}O_4$: fresh (solid orange line), charge/discharge cycled once (dashed black line), and cycled 100 4V times (green line). Notice that the spectrum changes much more for $LiMn_2O_4$, which showed rapid failure.

Climate Change May Increase U.S. Crop Damage From Higher Precipitation

A team of scientists, including EETD's Evan Mills, have found that increased precipitation, an expected outcome of climate change, may cause a doubling in losses of U.S. crop production over the next 30 years. This damage could cost agriculture $1.4 billion per year.

The team, including researchers from Environmental Defense and NASA-Goddard Institute for Space Studies (GISS) at Columbia University modified a widely used crop model called CERES-Maize to simulate crop yields with projected future higher precipitation. They have just published their findings in the journal *Global Environmental Change.*

"The climate record shows that both extreme precipitation events and total annual precipitation in the U.S. have increased over the last 100 years, especially the last two decades," says Mills. "The further increased precipitation expected in a changing climate regime could lead to increases in crop damage. The goal of our study was to estimate the potential magnitude of this damage and corresponding policy implications."

The study focused on excessive soil moisture, which leads to damage beyond the direct impacts of the extreme precipitation events themselves because excessive moisture interferes with plants' nutrient flows, increasing the risk of plant disease and insect infestation and delaying planting or harvesting (Figure 1). If the direct damage of flooding, drought, and other anticipated impacts of climate change was included, the increase in damage would be even greater.

"The Federal Crop Insurance Corporation paid out $21 billion between 1981 and 2000," says Mills, "Increased damage to crops will probably result in an increase in payments from government insurance programs like these."

Estimating crop losses from heavy precipitation

They simulated maize growth in the U.S. Corn Belt in nine states, which represent about 85% of total U.S. maize production. Using data from a study period of 1951 to 1998, the team determined that because excess precipitation events are currently relatively rare, they have reduced maize yields by a relatively small amount, about 3%. This corresponds to losses of $600 million per year on average. Extended to other major U.S. crops, including wheat, cotton, soybeans, and potatoes, their results suggest that the current loss caused by excess moisture is about $1.5 billion per year.

General climate model (GCM) simulations published in the most recent U.S. National Assessment predict precipitation increases for the continental U.S. of 30% above present levels by 2030 and 65% by 2090 (Figure 2). Using the CERES-Maize model, the research team projects that the probability of damage to crops from excess soil moisture could be 90% greater in 2030 and 150% greater in 2090. This implies an average in the 2030s of $1.4 billion in losses per year beyond the current level.

The results are also significant in illustrating the importance of properly accounting for the time-differentiated patterns of events resulting from climate change. If the anticipated increases in precipitation were assumed to be distributed evenly over the year, an increase in corn yields would result, as opposed to the sharp decline in yields that would result from the tendency for the increases to occur in the form of torrential precipitation events. Some prior studies have overlooked this factor.

The paper "Increased crop damage in the U.S. from excess precipitation under climate change" by Cynthia Rosenzweig (NASA-GISS), Francesco Tubiello and Richard Goldberg (GISS at Columbia University), Evan Mills (Berkeley Lab), and Janine Bloomfield (Environmental Defense), was published in *Global Environmental Change* (vol. 12 pp. 197-202). Additional information can be found at http://eetd.lbl.gov/emills/PUBS/PDF/Crops_GEC.pdf

—Allan Chen

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This research was supported by Environmental Defense and the U.S. Environmental Protection Agency.

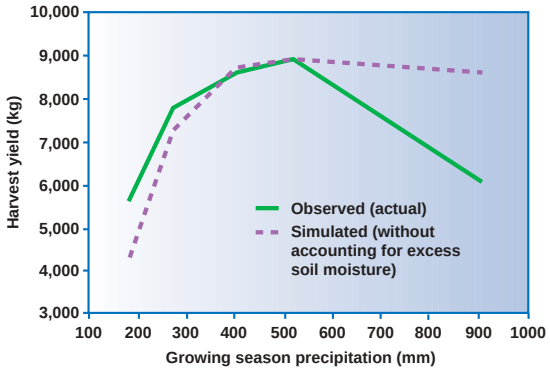


Figure 1. Unmodified crop model and observed response to precipitation during the growing season. Simulations were performed using the CERES-Maize model without excess soil moisture effects on crop growth and yield. Input data were taken from the U.S. National Assessment study showing simulated versus county-level yields of corn for the period 1951-1998 at Des Moines IA.

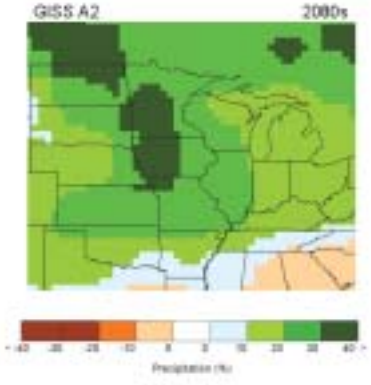


Figure 2. This image shows projections of rainfall changes from a NASA global climate model for the 2080s. This more aggressive scenario includes influences from higher population and related greenhouse gas emissions growth rate. Credit: NASA/Goddard Space Flight Center Scientific Visualization Studio.

Data Center Energy Use: Truth versus Myth

At the height of the electricity crisis of 2001, Californians were greeted over their morning coffee with headlines like:

Digital Economy's Demand for Steady Power Strains Utilities

Data Servers Crave Power: High-Tech Electricity Needs Amplify Crisis

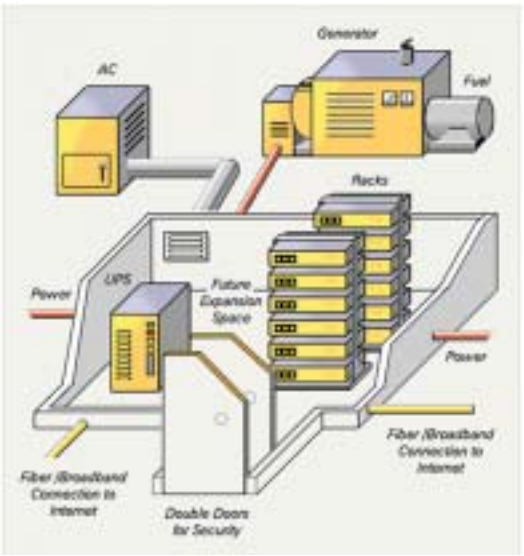
and

Net Blamed as Crisis Roils California.

One of the biggest misconceptions about the crisis was that the energy use of computers and other internet-related hardware played a significant role.

But early in 2001, research by Jon Koomey of Berkeley Lab's Environmental Energy Technologies Division (EETD) showed that widely discussed estimates of the energy use of computer- and networking-related hardware were exaggerated. Koomey is leader of EETD's End-Use Energy Forecasting Group. His work proved that this equipment used about three percent of the electricity consumed in the U.S.—a striking contrast to the 13 percent figure widely cited in the media.

Schematic layout of an internet data center (Sun Microsystems).



New information on data centers

Questions persisted about the use of energy by data centers, facilities also known as "web server farms," which have become more common as the internet has expanded as a commercial entity. Data centers can house thousands of computers that store and transmit the data and web pages available on the internet.

Two recent developments at Berkeley Lab focus new attention on data centers.The first is a study by Jennifer Mitchell-Jackson, Koomey, and others. This study concludes that the energy use of data centers is often overestimated. The second development is the announcement of a $500,000 grant to Berkeley Lab from the California Energy Commission to study the data centers in California, benchmark their energy use, and develop a research and development "roadmap" with the objective of reducing their energy use by 30 percent.

"Many reports of data center energy use are exaggerations," says Mitchell-Jackson. "They arise from a lack of measured data from operating data centers, inconsistent definitions of the power consumption in these facilities, and use of rated or design power instead of actual power when estimating total consumption. Rated power is typically several times greater than actual power use."

"These overestimates of data center power use can leave utilities with expensive generation, transmission, and distribution capacity sitting idle," says Koomey.

Total electricity use about one-tenth of one percent

"The research found that in the U.S. there were about 9.5 million square feet of hosting-type data-center space in 2000. Our measurements suggest that these data centers have computer rooms that use an average of 50 watts per square foot or less," says Mitchell-Jackson.

She continues, "The total use of electricity by hosting-type data centers in 2000 was less than 500 megawatts of power or 0.12 percent of the total electricity use in the United States in 2000." Total electricity used by these facilities is therefore small in the aggregate although the clustering of data centers in certain regions may strain local electricity distribution and supplies.

Server-farm power density exaggerated

During the past few years, utilities in California, New York, and Washington state have received requests for tens to hundreds of megawatts of electric capacity for new data centers. The requests created concern that these new power demands would overwhelm generating capacity in these states.

The power use of a data center is often measured by its power density—the number of watts per square foot or square meter in the building. "We reviewed power bills of five data centers from across the country and found that the average computer power density is three to four times lower than the maximum power density that the facility was designed to accommodate," says Mitchell-Jackson. "Unfortunately, it is often this maximum power density that is cited in the media."

The team studied one data center in the San Francisco Bay Area in detail, measuring energy consumption of

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heavily affect the installation of energy-efficient products in new or renovated buildings."

FEMP continues to rely on the Berkeley team in the D.C. office. Since 1994, FEMP has funded 100% of the Berkeley team's work on the Buying Energy-Efficient Products Program. As of November 2002, FEMP had published 45 *Recommendations* for various energy-efficient commercial and residential products.

Berkeley Lab's development of FEMP's efficiency recommendations helps ensure that federal buyers can have confidence that the equipment they buy will help agencies achieve the goals of Executive Order 13123, save taxpayer dollars, and have minimum impact on the environment. In a report to FEMP on energy savings associated with government and institutional purchasing, Jeff Harris adds, "to put it in dollars and sense, assuming there is 100% market penetration of the FEMP-designated products purchased by 2010 by the federal government, there is a potential for $1 billion dollars in energy savings."

—Michelle Ware

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This work is funded by the U.S. Department of Energy's Federal Energy Management Program.

Energy-Efficient Product Recommendations are available at http://www.eren.doe.gov/femp/procurement or in print as a loose-leaf binder, *Buying Energy-Efficient Products.* For more information on the recommendations or to obtain a copy of the binder, call 1-800-363-3732 or visit the FEMP web site.

Download the detailed report Harris, J. and F. Johnson. *Potential Energy, Cost, and CO_2 Savings from Energy-Efficient Government Purchasing*, LBNL report 42719 at http://www.dc.lbl.gov/

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servers, power distribution units (PDUs), uninterruptible power supplies (UPSs), air distribution, and other building loads. To express energy use accurately, Mitchell-Jackson developed a measurement called "total computer-room power density," a metric that is most representative of a data center's power needs because it includes power drawn by computers and all supporting equipment, including PDUs and UPSs; heating, ventilation, and air-conditioning systems; and lighting.

Measurements at the center in the Bay Area revealed that total computer-room power density at the facility was 33 watts per square foot. In the five facilities for which billing data were available, the figure was always below 40 watts per square foot.

"Our hope is that the data center industry and electric utilities will use this research to better estimate their energy needs, resulting in more efficient use of energy in these facilities, more reliable supplies to the data center operators, and more accurate planning for utilities," says Koomey.

The research was conducted by Jennifer Mitchell-Jackson, a graduate student in the Energy and Resources Group at the University of California at Berkeley, working with Jon Koomey and Bruce Nordman of Berkeley Lab's Environmental Energy Technologies Division. Their results are contained in two refereed journal articles, one recently accepted by *Energy—The International Journal* and one that appeared in a recent special issue of *Resources, Conservation, and Recycling.*

—Allan Chen

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For more information, see: http://enduse.lbl.gov/Projects/InfoTech.html

This work was funded in part by the U.S. Environmental Protection Agency, Office of Air and Radiation.

RESEARCH HIGHLIGHTS

Energy Champion

The American Council for an Energy-Efficient Economy (ACEEE) named Stephen Selkowitz, one of five winners of this year's Champions of Energy Efficiency Awards. Selkowitz is the head of EETD's Building Technologies Department. The awards were presented at ACEEE's annual Summer Study Conference on Energy Efficiency in Buildings at Asilomar, California. In their citation, the organization's board of directors said, "Steve has been a tireless, persistent, gently persuasive leader in the energy efficiency R&D field. His work has led to major advances in such areas as windows, lighting, building controls, and building design tools."

The board cites Selkowitz's major contribution as developing low-emissivity, energy-efficient windows and helping bring this technology to the marketplace. A recent National Academy of Sciences study cited low-e windows as one of the most successful research programs of the past 25 years. The award also recognized his crucial role in bringing electronic lighting ballasts to the market in the 1980s. DOE's 1999 energy efficiency standard for ballasts will convert the market to energy-efficient electronic ballasts by 2010.

More information:
http://www.aceee.org/press/0208eechamp.htm

EETD Scientists Garner Awards

Recently the U.S. Department of Energy (DOE) Advanced Technology Development (ATD) program called for nominations for two awards: one for the best ATD paper published in 2001 and the second for the best individual research accomplishment in 2001. The winners for the best paper were the nine authors of "Diagnostic Characterization of High-Power Lithium-Ion Batteries for Use in Hybrid Electric Vehicles," (*J. Electrochem. Soc.*, 148, A463-70 (2001)). They are LBNL's XueRong (Sherry) Zhang, Phil Ross, Robert Kostecki, Fanping Kong (deceased), Steve Sloop, John Kerr, Kathryn Striebel, Elton Cairns, and Frank McLarnon. All are from EETD's Advanced Energy Technologies Department, except Phil Ross who is in the Materials Sciences Division.

The winner for best individual accomplishment was the Advanced Energy Technologies Department's Robert Kostecki for his work using Raman microscopy as a new diagnostic tool.

In the Advanced Energy Technologies Department of EETD, researchers experiment with the conversion and storage of energy (batteries and fuel cells), processes to reduce the environmental impacts of energy technologies (reducing the emissions of air pollutants), advanced materials to make energy use more efficient, and biological methods of environmental remediation.

An important part of their research involves developing electrochemical power sources (batteries) suitable for electric and hybrid electric vehicles (EVs and HEVs). At present, batteries don't hold enough electric charge to drive a vehicle the same distance as a comparable gasoline-powered automobile. Fuel cells can also power cars, trucks, and buses without emitting harmful tailpipe emissions and may also provide energy to factories and homes without creating smokestack pollution. Much of the funding for this research comes from DOE's Office of Advanced Automotive

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Technologies (OAAT), a part of the Office of Transportation Technologies.

The ATD Program has three major objectives: to develop and demonstrate the practical application of diagnostic tools at the national laboratories to identify factors that limit calendar life and abuse tolerance for lithium-based battery technology; to assist in the development of practical solutions; and to develop innovative solutions for reducing cell costs. In cooperation with automobile manufacturers, DOE's FreedomCAR & Vehicle Technologies Program is working to develop and deploy advanced transportation technologies that reduce the nation's use of imported oil and improve air quality.

New Design Tool Analyzes Cost of Operating a Building over its Lifetime

Imagine being able to estimate the energy life-cycle costs of a new building by simply entering numbers into a software program. Thanks to the new Energy-10 design tool, this is now possible.

The new software, Energy-10 Version 1.5, contains seven upgrades, including a discounted cash-flow evaluation of a building over its lifetime and a more powerful graphing package. The cash-flow evaluation of a building is determined and discounted to the present value, taking into consideration such factors as the initial cost of construction, mortgage payments, annual electricity costs, and annual tax benefits. Costs can be estimated using simple scaling laws, or users can supply their own cost estimates.

Energy-10 allows the user to play "what if" games while designing a building or home. "What if I change the windows?" "What if I add energy-efficient equipment?" "What if I let the daylight in and turn down the lights?"

Helping architects and engineers understand the energy implications of their work is critical in any strategy to reduce greenhouse gas emissions and global warming. The life-cycle cost feature helps designers make the case for incorporating energy-efficiency features by evaluating the cost effectiveness of these features, which is usually very attractive.

Energy-10 now has 2,061 registered users and has been licensed to 60 colleges and universities where it is being used as a teaching tool for architects and engineers.

Energy-10 allows an architect to watch a detailed simulation of how a building will use energy and shows ways to reduce energy consumption. The software simulates a year of hour-by-hour operations, which entails about one billion calculations performed in a few seconds and displays annual, monthly, or hour-by-hour energy performance graphs.

The software incorporates detailed historical weather data for 239 locations around the country, (expandable to 3,945 locations), enabling architects to accurately match their buildings with a site's weather patterns.

The new software - Energy-10 Version 1.5 - is an upgrade to the original program developed at the U.S. Department of Energy (DOE) National Renewable Energy Laboratory (NREL).

Energy-10 Version 1.5 is the result of collaboration among NREL, Lawrence Berkeley National Laboratory, and the Berkeley Solar Group. It is being distributed by the Sustainable Buildings Industry Council (SBIC) in Washington, D.C., which also provides training workshops and user support. SBIC can be reached at 202-628-7400, ext. 210; the web site is http://www.sbicouncil.org

New Version of ProForm Released

ProForm v.3.1

ProForm is a software tool designed to support a basic assessment of the environmental and financial impacts of renewable-energy and energy-efficiency projects. Given the necessary data, ProForm calculates basic financial indicators and avoided emissions of CO_2 and local air pollutants expected from a project. A new release, Version 3.1, is now available for downloading at: http://poet.lbl.gov/Proform/

ProForm can be used for renewable energy projects that involve either electricity generation or non-electric energy production, and for energy-efficiency projects that save electricity and/or fossil fuels.

ProForm, a spreadsheet-based tool is designed to be simple enough to be easily usable yet sophisticated enough to provide credible results. A typical application of ProForm would be in preparation of a project proposal that developers might submit to potential investors, financiers, or a national climate change office. ProForm allows project developers, financial institutions, and other parties to investigate how changes in basic assumptions affect the key parameters of a project.

For more information about ProForm, please contact Bill Golove (Tel: 510-486-5229; Fax: 510-486-6996); Anita Milman (Tel: 510-486-7041); or Bryan Lehman (Tel: 510-495-2266).

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Quality, Not More Weight, May Make Vehicles Safer

Tom Wenzel, an EETD scientist, and University of Michigan physicist Marc Ross are questioning the belief that bigger and heavier vehicles are automatically safer than other cars and trucks. They recently released a report which shows that vehicle quality is actually a better predictor of safety—both for the driver and for other drivers—than weight.

Most cars are safer than the average sports utility vehicle (SUV), while pickup trucks are much less safe than all other types. Minivans and import luxury cars have the safest records, according to the report, "An Analysis of Traffic Deaths by Vehicle Type and Model."

"A shortcoming of many safety analyses has been that only risks to drivers of a given kind of vehicle are evaluated while the risks imposed on others are ignored," says Wenzel. "We focused on the risk not only to occupants of the vehicle model in question in all types of crashes, but also on the risk to the drivers of other vehicles involved in crashes with the model in question."

Many factors affect safety

"Safety is a challenging concept. It includes the design of the car itself, driver demographics and behavior, the kinds of roads, the time of day—a whole host of factors," Ross said. "What we need to do is move away from the idea that bigger and heavier vehicles are automatically safer."

Recent Senate hearings on Corporate Average Fuel Economy standards focused on the increased risk Americans would face if they had to give up their SUVs for vehicles that weigh less. "We set out to see whether that risk is real, whether SUVs really are safer than cars. The answer, by and large, is no," Ross said.

The first major result Ross and Wenzel found is that SUVs are no safer for their drivers than cars. Popular midsize cars, minivans, and import luxury cars have the safest records while SUVs are about as risky as the average midsize or large car and are no safer than many compact and subcompact models. The researchers defined 'risk' as the number of deaths per year per million vehicles. The study found that, when measuring the combined risk to drivers of the car and risks imposed on others, most cars are safer than SUVs while pickup trucks are much less safe than all other types of vehicles.

To determine quality, Ross and Wenzel used quantifiable parameters such as new car price, used car price, *Consumer Reports* safety ratings, and country of origin. "It is extremely difficult to determine the inherent safety of a vehicle type or model because it is too hard to separate the contribution of driver characteristics and behavior from the contribution of vehicle design. We can say, however, that quality is a much better predictor of safety than weight," Ross said.

"It turns out that relatively inexpensive light cars do tend to be unsafe, but more expensive light cars are much safer and are as safe as heavier cars and SUV models. In any event, the argument that lowering the weight of cars to achieve high fuel economy has resulted in excess deaths is unfounded. If designers pay careful attention to safety in vehicle design, smaller cars can be, and indeed have been, made as safe as larger ones," Ross said.

University of Michigan and Berkeley Lab public information staff contributed to this report.

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Sources

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