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Environmental Energy Technologies Division NEWS

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

Large Power Savings Found in Automated Demand Response Tests

During summer 2004, Lawrence Berkeley National Laboratory (Berkeley Lab) researchers used two different kinds of technology, a price signal sent over the internet to facility computers, and a hard-wired internet relay box, to test automated demand response. They found up to four megawatts (MW) of savings in 36 buildings located at 18 sites, according to a new report.

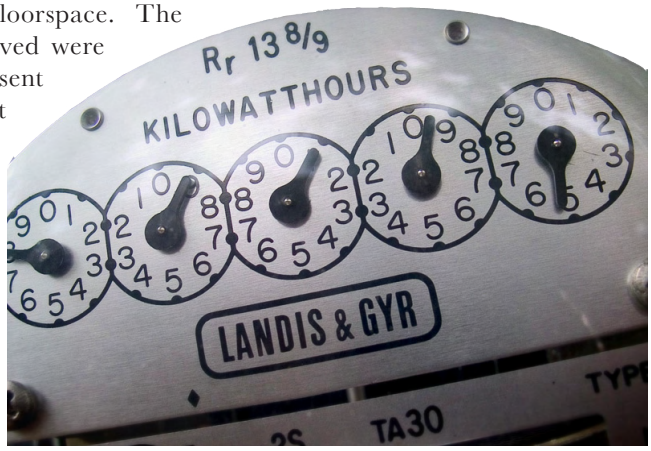
The research, published as *"Findings from the 2004 Fully Automated Demand Response Tests in Large Facilities,"* took place under the auspices of the Demand Response Research Center, which is funded by California's Public Interest Energy Research Program and led by Berkeley Lab's Environmental Energy Technologies Division (EETD).

Demand Response Defined

Demand response (DR) is a set of time-dependent activities that reduce or shift electricity use to improve electricity grid reliability, manage electricity costs, and encourage load shifting or shedding when the grid is near its capacity or electricity prices are high.

Fully automated demand response does not involve human intervention but is initiated at a home, building, or facility by receipt of an external communications signal, which starts pre-programmed load-shedding strategies.

During summer 2004, researchers tested automated demand response at 36 buildings representing 10 million square feet of floorspace. The technologies involved were a price signal sent over the internet to the facilities' computers, and a hard-wired internet relay box. The facilities participating in the test included several office buildings, a supermarket,



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a cafeteria, industrial process sites, a university library, and a postal processing and distribution center. Facility staff at each site pre-programmed the site's Energy Managment and Control Systems to receive the signals.

The research team developed new technology to evaluate control and communications capabilities for automated demand response using energy management control systems (EMCSs) and XML, the extensible Markup Language.

The team found that when the maximum amount of load had been shed at the study sites, a total of about four MW of demand response was available, as shown in Figure 1. Demand savings were more than one MW per site, with up to 42 percent of whole-building power saved. Maximum savings per site were 1.8 W/ft^2, with an average of 0.5 W/ft^2 and 14 percent of the whole-building load.

According to Mary Ann Piette, Director of the Demand Response Research Center and leader of the EETD research team, "This work has shown that today's control and communications technologies can be used to deploy broad-scale demand response that is safe and secure with minimal investment. Automating demand response helps reduce the need for facility staff to manually control equipment in response to utility communications currently based on email, phone calls, and pagers."

About one-third of California commercial building floor area is controlled by an EMCS that could be remotely accessed for automated demand response with this technology.

"The largest individual savings were observed from strategies that used a cooling zone set point increase," adds Piette. Lighting; anti-sweat heaters; and other heating, ventilation, and air conditioning strategies also contributed to the savings.

The research team concluded that "There is significant demand reduction potential in large buildings and commercial facilities during warm weather. No occupant complaints were registered even with these large reductions in whole-building power."

First Automated Demand Response Test Took Place 2003

EETD researchers completed a previous successful evaluation of automated demand response in 2003, at five large California buildings. This was the first test of the use of two-way internet-based communications to reduce electricity consumption in large buildings.

The 2003 test used a fictitious electricity price — a proxy for a critical peak price — to trigger a demand-response event over the internet; no one touched any control systems during the tests. When the price of electricity transmitted over the internet to the buildings reached 30 cents/kilowatt hour, the buildings automatically began to decrease demand by reducing lighting, air conditioning, and other energy-consuming uses.

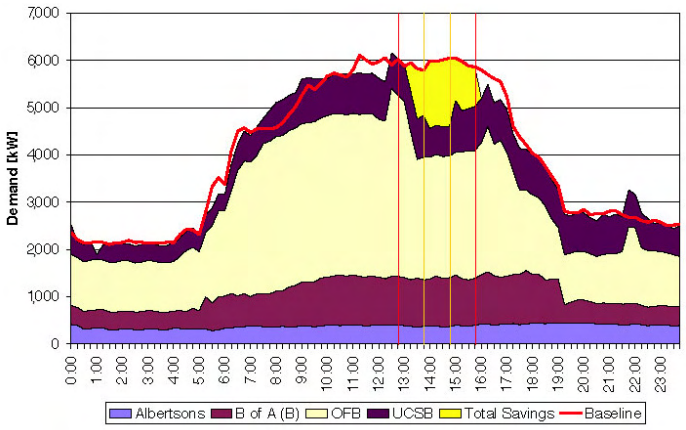

Figure 1. *Aggregated demand savings with a maximum of 1,453 kW shed, Sept. 8th retest*

Two-way communications were used to observe whether each site was receiving and responding to the price signal. When the internet indicated that the price reached 75 cents/kWh, the buildings automatically took additional preplanned actions to further reduce demand.

Current and Future Research

Encouraged by the success of the 2003 test, the research team initiated a new phase of testing during summer 2005, working with Pacific Gas and Electric Company (PG&E). In the 2005 test, demand-response technology was used for the first time in a real utility demand reduction program. About a dozen facilities are participating in this new, fully automated Critical Peak Pricing Program (CPP).

In exchange for a price break during off-peak hours, participating facilities curtail their loads in response to a price signal during peak summertime demand periods. Unlike in earlier tests, the CPP program is a formal utility-pricing program, so its use of automatic demand-response technology is the first test of automated demand response in an existing utility program.

Berkeley Lab collaborated with Itron and PG&E to develop the automated technology that connects PG&E's CPP notification system and the automated price server.

—Allan Chen

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A report titled *Findings from the 2004 Fully Automated Demand Response Tests in Large Facilities* was authored by Mary Ann Piette, David S. Watson, Naoya Motegi, and Norman Bourassa of Lawrence Berkeley National Laboratory (LBNL-58178). Download it at: http://drrc.lbl.gov/drrc-pubs1.html

This research was supported by the California Energy Commission's Public Interest Energy Research Program.

Climate Change and the Insurance Industry

The insured portion of the world's total economic losses from weather-related catastrophes is rising, from a negligible fraction during the 1950s to 25 percent during the past decade, according to a scientist at Lawrence Berkeley National Laboratory's Environmental Energy Technologies Division (EETD). The ratio has climbed more quickly in the United States where more than 40 percent of total weather-related losses were insured during the 1990s.

In an invited "Viewpoint" article published in the August 12, 2005, issue of the journal *Science*, Evan Mills, an EETD scientist who has worked on the issue for a decade, reviews the evidence that the global insurance industry is paying out more in claims resulting from extreme-weather-related natural disasters. Because climate change could lead to an increase in both large-scale and localized extreme weather events, some insurance companies have called for a better understanding of the risks that climate change poses to their business and to society. Mills' article, entitled "Insurance in a Climate of Change," was part of a special issue of *Science* on disasters.

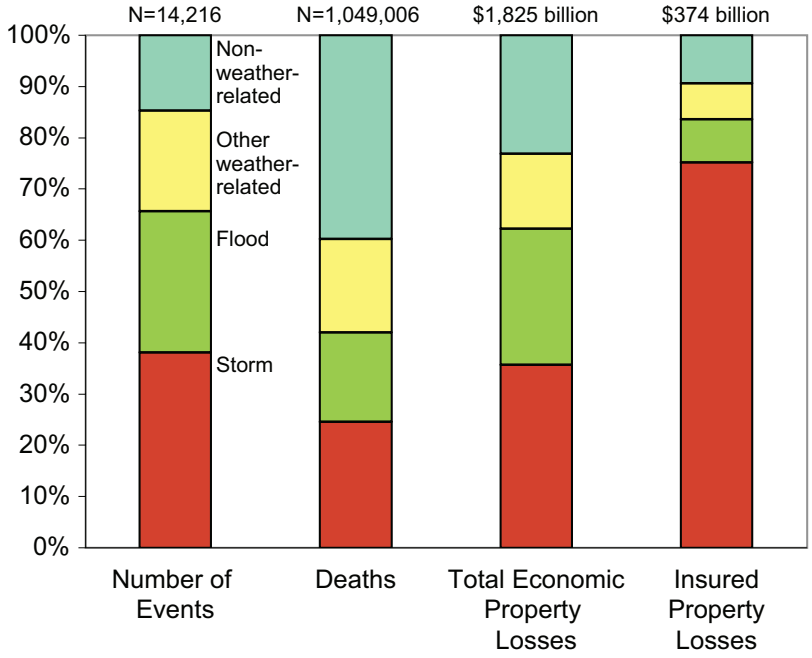

Figure 1. *Global impacts of natural disasters from 1980 to 2004. Insured property losses are dominated by storm events due to risk selection preferences of insurers, coverage of flood and crop exposures by public entities, and low penetration of earthquake insurance. Economic values are inflation-adjusted to 2004 levels.*

Source: Munich Re, NatCatSERVICE

In response to industry concerns, Mills studied insurance claims costs from weather-related and other types of catastrophes. In his *Science* article, he notes that the weather-dependent share of global insured losses (about 90 percent) is even greater than the weather-related losses experienced by the world economy as a whole (about 75 percent).

"Global weather-related losses in recent years have been trending upward much faster than population, inflation, or insurance penetration, and faster than non-weather-related events," Mills writes. "Specific event types have increased far more quickly than the averages. For example, damages from U.S. storms grew 60-fold to $6 billion a year between the 1950s and the 1990s. As the climate changes, populations are moving more into harm's way, but demographic factors do not appear to explain all of the increase" (See Figure 1).

According to Mills, insurance is the world's largest industry with yearly revenues of $3.2 trillion. If that number were a gross domestic product, insurance would be the third largest country in the world.

Climate Change a Strategic Factor for Insurers

Given the increase in the number, cost, and variability of catastrophic losses, some insurers, reinsurers, and their trade associations now view climate change as a "strategic factor" in charting their futures, Mills says. Particularly vulnerable are emerging insurance markets in the developing world. Insurers see these markets, which already represent $400 billion a year in premiums and are growing several times faster than mature markets, as the future of their industry. Yet these regions are also particularly unprepared for and vulnerable to climate change and its associated weather-related catastrophes.

Insurers from wealthy countries share the risks of weather-related damage to developing countries as these insurers take ownership of insurance companies domiciled in the developing world. Weather-related damage can come from disasters such as flood, droughts, mudslides, and wildfires. Storm surges

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Climate Change and the Insurance Industry

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cause coastal damage, and lightning strikes start fires and damage electronic equipment. Both gradual climate changes and abrupt weather disasters cause property, agricultural, and industrial losses as well as risks to life and health.

In his research, Mills found that 60 percent of total weather-related losses are attributable to small events rather than major catastrophes that make headlines. The insurance industry is vulnerable to weather catastrophes in many ways; property damage is only the most obvious source of claims, Mills says. Weather-related disasters also cause disruptions in business and supply chains, loss of utility service, equipment breakdown arising from extreme temperature events, and loss of data from power surges or outages. Extreme weather events can breach pollution containment, leaving industries open to liability, and power outages can disrupt manufacturing and services.

Mills found that from 1980 through 2004, the global economic costs of weather-related events totaled $1.4 trillion (inflation-corrected), of which $340 billion was insured. "To put the burden of these costs on insurers in perspective, recent average annual losses surpass those experienced in the aftermath of the 9/11 attacks in the United States," he notes.

According to Mills, these numbers are probably underestimates for a number of reasons. For one, damages from small events are rarely captured in global statistics. One claim service that aggregates statistics for U.S. insurers captures only events with costs greater than $25 million. In addition, observed losses would have grown even faster if disaster preparedness and recovery services did not exist.

Possible Threats to the Insurance Industry

The availability of insurance helps economies grow and develop by mitigating risk. But as the nature, scale, or location of hazards changes, the insurance system is threatened, particularly if insurers are unprepared for the scale of what can be perceived as "inconceivable" disasters, Mills says.

As the climate changes, there is the risk that weather-related claims will increase because storms could increase in frequency or intensity, several kinds of damage could result from a single event (for example, simultaneous wind, flood, and storm surge-related damage), and shifts in the spatial distribution of events could expose more property and populations to damaging events. In addition, the diversity and potential magnitude of health-related impacts of climate change are only now being appreciated. Of particular concern are a host of respiratory diseases arising from increased pollens, molds, and particulates mobilized by climate change. Actuarial uncertainty about these health issues can lead to rising insurance prices, reduced coverage, and, ultimately, to the uninsurability of certain hazards.

As a result, insurance premiums might, in some cases, not be enough to pay for claims. In a bad year, weather-related claims plus unrelated claims from earthquakes or terrorist incidents, together with uncorrelated declines in financial markets (where insurers hold their loss reserves), could form the kind of "perfect storm" that drives some insurance companies to the edge of insolvency. When insurers cannot pay, the burden shifts to governments and individuals, neither of which wish (or may be able) to assume the losses.

Historical Role: Prevention

"The good news is that the insurance industry has played a valuable historical role in loss prevention," says Mills. "Insurance companies were founders of the first fire departments, building codes, and auto safety-testing protocols. But the role they will play in climate change mitigation and adaptation remains to be seen."

Mills' *Science* article documents innovative steps being taken by some insurers to address climate-change concerns. Recognizing that insurance is a tool that helps society adjust to change, risk, and economic loss, Mills believes that insurers have a significant opportunity to become more engaged with the science of predicting the potential impacts of climate change, for example by coupling their existing "catastrophe models" with climate models.

"It's important that insurers, their regulators, and the policy community develop a better grasp of the physical and business risks from climate change," Mills says. "The most effective solutions will require public-private partnerships."

—Allan Chen

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EETD Evaluates China's Energy-Strategy Options

During the last two decades of the twentieth century, China quadrupled its gross domestic product (GDP) and pulled 50 million people out of poverty, even though the nation's energy consumption only doubled during this period (see Figure 1). Chinese leaders hope to repeat this achievement during the next 20 years, but continuing to increase GDP and reduce poverty without sparking an enormous rise in energy consumption will be challenging. Energy use in China has grown faster than GDP during the past three years, and oil use is rising as well.

In 2004, the Development Research Center of China's State Council concluded the National Energy Strategy and Policy Report (NESP). Researchers Jonathan Sinton, Rachel Stern, Nathaniel Aden, and Mark D. Levine from the China Group of the Environmental Energy Technologies Division (EETD) at Lawrence Berkeley National Laboratory analyzed the policy options presented in the report. Their report, "Evaluation of China's Energy Strategy Options," published by *The China Sustainable Energy Program*, proposes ways for the Chinese government to connect high-level policy goals — energy security, economic growth, equity, and improved citizen well-being — with specific changes in energy investment, supply, and efficiency. The report stresses increased investment, restructured incentives, and strengthened institutions to help maintain efficient and equitable development of the expanding energy sector.

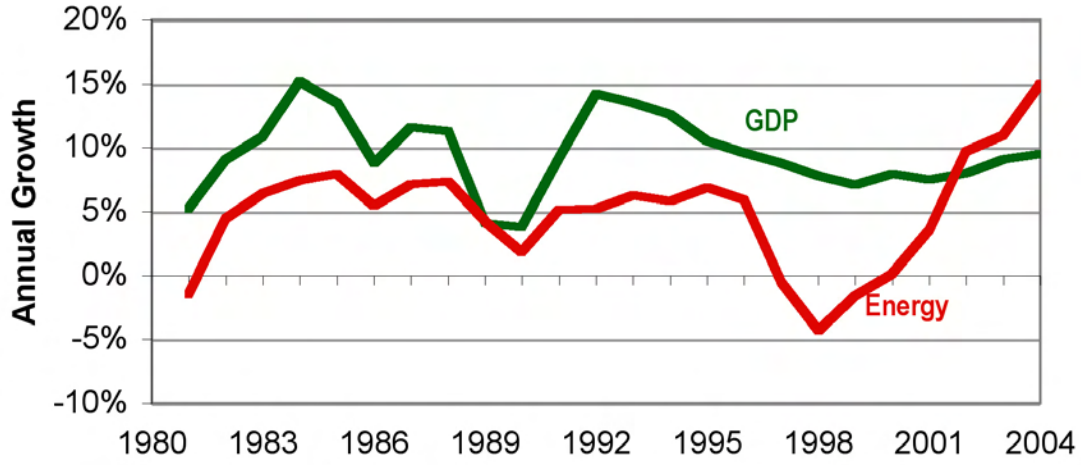

Figure 1. *Energy use in China is now growing faster than GDP, presenting a tough challenge to achieving the nation's sustainable development goals.*

One of the most important factors is efficiency. The influence of strong state-owned energy-supply companies has kept attention focused on fossil fuel supplies and conventional generation technologies; however, simply increasing supply without also focusing on efficiency will undermine China's future development. NESP recommends several proposals that form part of a development strategy. These proposals include: elevating energy conservation to a state policy, raising public awareness, establishing economic incentives to save energy, enacting efficiency standards and labeling, and establishing a resources-savings office. EETD researchers support this last measure and propose the establishment of a Chinese Ministry of Energy (MOE). The MOE could be responsible for such areas as finance, regulation, and advocacy, but its primary goals would be to increase energy supply, cut energy demand, and seriously pursue environmental strategies.

One key element of reshaping China's energy sector would be to restructure incentives, for example by competitively pricing natural gas and renewables and well as restructuring oil and hydropower prices. Changing the price of energy to reflect national priorities will require strengthening institutions. A strong MOE would formalize the government's commitment to energy issues and, acting as a clearinghouse, would help set policy to balance supply and demand policies with environmental protections.

—Ted Gartner

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Groundbreaking Computer Simulation Work Published

Computational and combustion scientists in two divisions of the Lawrence Berkeley National Laboratory (Berkeley Lab) have earned national recognition in the *Proceedings of the National Academy of Sciences* (PNAS) with a cover article about groundbreaking computer simulations of turbulent flames.

The research by scientists in Berkeley Lab's Center for Computational Sciences and Engineering and in the Environmental Energy Technologies Division has led to a three-dimensional combustion simulation of unmatched size without the need for turbulence or turbulence-chemistry interaction models. The PNAS article shows that the simulation closely matches flame behavior in an actual combustion experiment.

Gaining a better understanding of combustion, which powers everything from automobiles to aircraft to power generating plants, can help improve the efficiency of those systems as well as reduce the amount of pollution produced by burning fossil fuels.

"Although collaborations between computational scientists and experimentalists are becoming increasingly common, the results from this project clearly demonstrate how scientific computing is coming into its own as an essential component of scientific discovery," said Horst Simon, Associate Laboratory Director for Computing Sciences at Berkeley Lab. "The simulation is unprecedented in several aspects: the number of chemical species included, the number of chemical processes modeled, and the overall size of the flame. This is truly breakthrough computational science."

The article describes the simulation of "a laboratory-scale turbulent rod-stabilized premixed methane V-flame. This simulation, which models a full laboratory-scale flame by using detailed chemistry and transport, encompasses a domain more than three orders of magnitude larger in volume than that of any previous efforts and represents a major increment in simulation complexity."

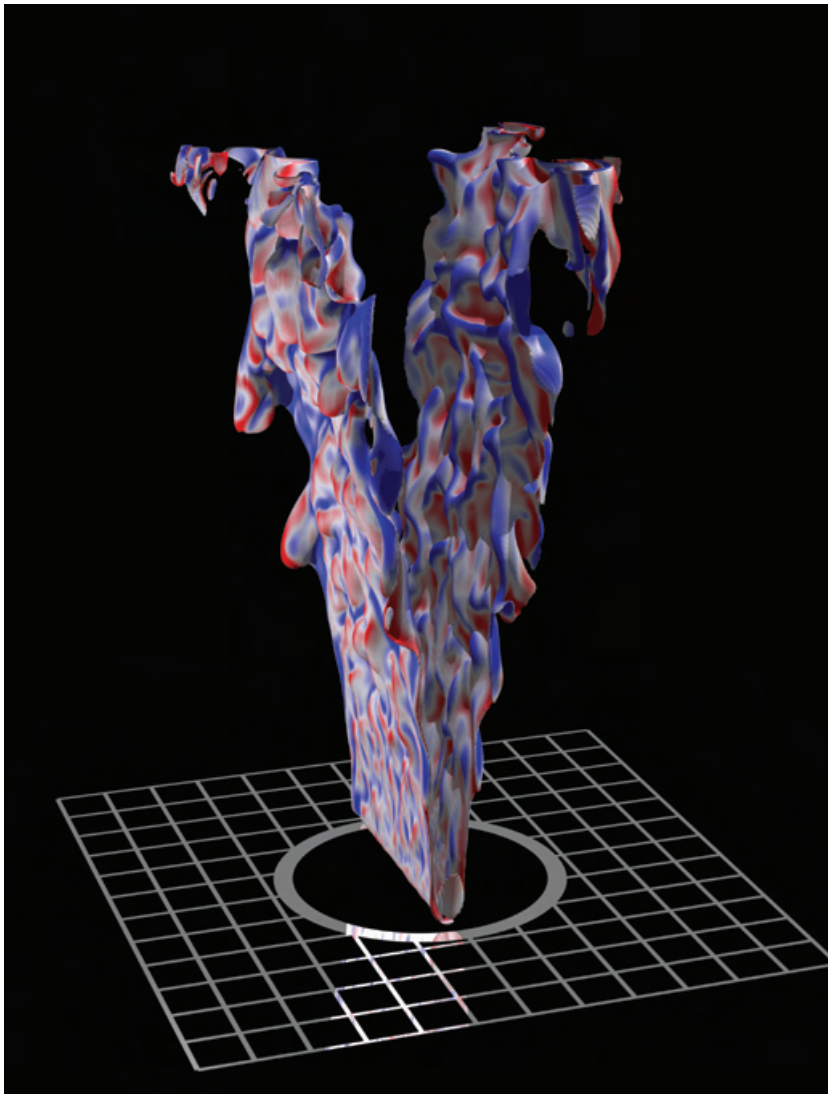

Figure 1. *Scientists with Berkeley Lab's Center for Computational Science, and Engineering and the Environmental Energy Technologies Division, have created unique three-dimensional, time-dependent simulations of turbulent V-flames to gain a better understanding of combustion.*

The Berkeley Lab combustion simulations use a different mathematical approach than has typically been used. Most other combustion simulations without turbulence models use equations that include sound waves, which makes these models very computationally expensive. Because of the cost, such simulations often have been limited to only two dimensions, to scales smaller than a centimeter, or to just a few carbon species and reactions. By contrast, the Berkeley Lab researchers have modeled a three-dimensional flame about 12 centimeters high that consists of 19 chemical species and 84 fundamental chemical reactions, producing results that can be compared directly with experimental diagnostics.

The Berkeley Lab group has developed an algorithmic approach that combines "low Mach-number equations," which remove sound waves, with "adaptive mesh refinement." The combined methodology strips away relatively unimportant aspects of the simulation and focuses computing resources on the most important processes that model flame behavior. Developed with the support of the Applied Mathematics Program of the U.S. Department of Energy (DOE) Office of Advanced Scien-

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Harnessing Wind Energy in Eritrea

Berkeley Lab scientists help African nation pursue alternative energy sources

At the southern tip of the Red Sea, a constriction formed between two mountain ranges funnels wind onto the shores of Eritrea, a small African nation wedged between the sea and Ethiopia. The country has endured its share of hardships over the years, having won its independence from Ethiopia in 1991 after decades of struggle. But it can count among its blessings that relentless breeze.

"It's a wind resource that is better than most wind resources in the U.S.," says Robert Van Buskirk, a scientist with the Lawrence Berkeley National Laboratory's (Berkeley Lab) Environmental Energy Technologies Division (EETD). Van Buskirk develops cost-benefit analysis models of energy policy. Earlier this summer, he spent four weeks in Eritrea to help the nation embark on a $3.8 million pilot project to determine whether a large portion of its energy can be derived from wind-powered turbines. As part of the project, Berkeley Lab has been contracted to help Eritrea create the most efficient procedures for implementing wind energy systems, as well as to develop protocols that track the project's progress.

It's a big undertaking for a nation with a population of 4.5 million and an average annual income of $250 per person. The United Nations and an international consortium of donors called the Global Environmental Facility funds half of the nine-month-old project while the Eritrean government provides the other half. But money isn't the only obstacle.

Figure 2. *Remote Eritrean villages stand to gain the most from the diffusion of wind energy technologies.*

Figure 1. *Eritrean officials hope to someday provide as much as 50 percent of the nation's grid electricity using wind turbines, such as these located near Palm Springs CA.*

"The barriers are mostly technical. We need to determine how to develop sustainable contracts between the people of Eritrea, companies that develop wind energy systems, and technical advisers," says Van Buskirk, who is with EETD's Energy Analysis Department. "Getting these worlds to meet in an economically feasible way is difficult," he adds.

During the project's initial phase, engineers will soon install eight wind energy systems in six villages, some of which have never had electricity. These wind turbines will be used to pump irrigation water, provide electricity for everyday uses such as lighting and making ice, and power desalinization plants that provide fresh drinking water to seaside fishing villages. Engineers will also build a multi-turbine wind-park that feeds into the electricity grid of the southern port town of Assab.

"In diffusing wind technology to Eritrea, we want to pilot-test an array of applications because we won't know which ones will work best," says Van Buskirk.

EETD scientists are also developing conceptual designs for six follow-up installations that include more expansive wind energy systems for remote villages and a large wind-park for the central grid.

Ultimately, Eritrean officials would like to generate as much as 50 percent of the nation's grid electricity via wind power. It's too early to tell whether this goal is technically feasible, but Van Buskirk believes it may be economically viable. He estimates that wind energy will pay for itself in five years if it supplants Eritrea's thirst for foreign fuel oil, which is currently the country's main fuel for generating electricity. Eritrea's quest for a greener energy program isn't purely driven by environmental concerns either: the nation has worked to be as self reliant as possible since gaining independence, meaning it must find alternatives to imported oil.

Van Buskirk is uniquely qualified to help shepherd this transition along. Before joining Berkeley Lab in 1999, he worked for three years at the Eritrean Department of Energy's

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Harnessing Wind Energy in Eritrea

Berkeley Lab scientists help African nation pursue alternative energy sources

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Energy Research and Training Center, which he describes as the Eritrean equivalent of Berkeley Lab, albeit in one small compound. While there, he helped establish research programs in wind and solar energy resource assessment, as well as stove efficiency.

This latter program has evolved into another energy-efficiency project. Eritrean villagers are adopting clean-burning cooking stoves that are three times more fuel efficient than traditional stoves. With help from Harvard University undergraduate student Elena Krieger, a former summer intern at Berkeley Lab who also recently traveled to Eritrea, Berkeley Lab scientists are developing ways to document the economic and health impacts of this program, which installs up to 10,000 new stoves each year. The Eritrean government helps fund the project by selling carbon credits on the international market, a process facilitated with help from Berkeley Lab scientists. These credits are earned because the new stoves emit less carbon, a greenhouse gas.

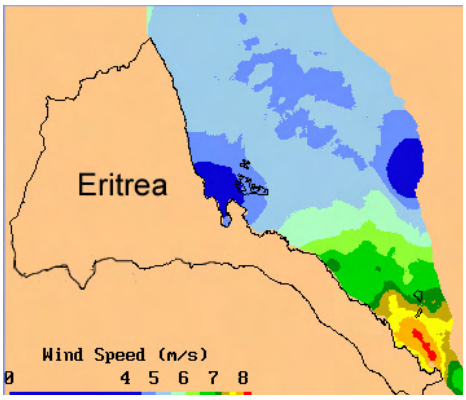

Figure 3. *Analysis of ship-based meteorological data reveals the mean annual speed of winds in the southern portion of the Red Sea. These steady winds could help Eritrea wean itself from imported oil.*

Van Buskirk has also helped several Eritrean students earn Master's degrees in meteorology from San Jose State University. Two of these former students have recently developed computer simulations that assess the wind resources of Eritrea's highlands and southeastern coast, (See Figure 3). The simulations were a feature presentation for a delegation of Eritrean experts and leaders who came to Berkeley Lab in January.

"I'm a communication bridge between this world and that world," says Van Buskirk, adding that language and cultural barriers sometimes pose challenges. "When I go to some remote villages to discuss our work, a local staff member translates my words into the Eritrean language of Tigrinya, then a person from the village translates it into a local dialect, called Tigre."

Overcoming the language barrier is worth it, however, as remote villages stand to gain the most from new technologies. In rural areas that have never had modern luxuries such as electricity and running water, projects that raise living standards while decreasing labor required to complete them often pay for themselves in less than one year.

"It's an extreme case study in technology diffusion. We start with a place that is a world research leader like Berkeley Lab and go to a place that is the largest socioeconomic distance from that, which is rural Africa," says Van Buskirk. "The difficult part is learning how to adapt technologies to a socioeconomic world far removed from our everyday life. We need to create a context in which people can sustain efficient energy systems over the long term. And in terms of evaluating and creating long-term sustainability, we find that the villagers, rather than the scientists, are the real experts."

Other Berkeley Lab scientists and staff involved in the wind energy pilot project and stove replacement project include Bill Golove and Chris Bolduc, also of the EETD.

—Dan Krotz

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Groundbreaking Computer Simulation Work Published

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tific Computing Research, the group's algorithms have slashed computational costs for combustion simulations by a factor of 10,000. Even so, the combustion simulation required substantial computing power, running for about 1,000 hours on 256 processors of the IBM SP supercomputer at DOE's National Energy Research Scientific Computing Center at Berkeley Lab.

The PNAS article, "Numerical simulation of a laboratory-scale turbulent V-flame," was written by John B. Bell, Marc S. Day, Ian G. Shepherd, Matthew R. Johnson, Robert K. Cheng, Joseph F. Grcar, Vincent E. Beckner, and Michael J. Lijewski and appeared in the July 19, 2005 edition. Cheng and Shepard are the EETD authors.

—Jon Bashor

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The research described in the PNAS article was supported by the Applied Partial Differential Equations Center of DOE's Scientific Discovery through Advanced Computation program. The combustion experiments were supported by DOE's Office of Science in the Office of Basic Energy Sciences. The work also received support from Cristina Siegerist and Wes Bethel of Berkeley Lab's Visualization Group.

Berkeley Lab Miniaturized Sensor

The Lawrence Berkeley National Laboratory (Berkeley Lab) Technology Transfer Department licenses a wide range of cutting-edge technologies to companies that have the financial, R & D, manufacturing, marketing, and managerial capabilities to successfully commercialize Lab inventions. It develops and manages an array of partnerships with the private sector.

Identifying and directly quantifying airborne particulate matter (PM) is important for understanding adverse health effects resulting from human exposure to aerosols; until now, available techniques and instrumentation have been complex and expensive.

Michael Apte, a scientist in the Environmental Energy Technology Division's Indoor Environment Department, along with other researchers at Berkeley Lab and the University of California at Berkeley, have developed the first low-cost, miniature devices for measuring the properties of airborne PM.

The new miniature PM sensors on chips are the first PM analysis systems that are small, quiet, and affordable enough to enable population-based exposure assessment for large-scale studies on the health effects of PM such as secondhand smoke, diesel exhaust, or wood smoke. They are ideal for mailing to survey respondents, and, unlike other particulate matter analysis equipment, they can be easily deployed by a study participant for on-person or in-home monitoring.

The Berkeley Lab sensors can also be used for advanced industrial hygiene and process control and to monitor occupational settings, industrial and environmental pollution, and ventilation systems. The devices can replace currently used particle number counters and might also be developed into products like smart respirators, mass sensors for bioassay arrays, asthma warning devices, and stack emissions monitors.

Unlike other monitoring systems, the Berkeley Lab devices simultaneously measure the mass, size distribution, and optical properties of PM. They require less than 100 milliwatts (mW) of power and provide data consistent with the federal reference method for PM 2.5 and PM 10 analysis.

The Berkeley Lab PM monitors can be as small as 2 to 3 cubic centimeters if constructed without optical identification components and can be made inexpensively; one prototype was constructed from materials costing only $100. Because of the very low cost of materials, once scale-up has been achieved, this sensor-on-a-chip will cost significantly less to produce than the lowest-priced devices on the market today, which are more than two orders of magnitude larger.

The miniaturized sensor is available for licensing or collaborative research. Contact Lawrence Berkeley National Laboratory's Technology Transfer Department at http://www.lbl.gov/Tech-Transfer.

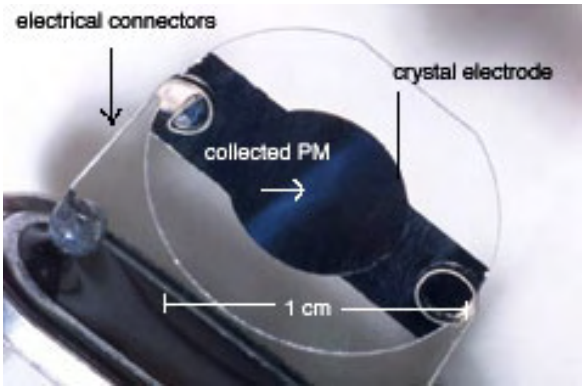

Figure 1. *The blue streak shows a track of particles deposited on the quartz crystal microbalance of a Berkeley Lab prototype. A thermophoretic heater located above the crystal substrate precipitates particulate matter from the air onto the microbalance.*

Technology Transfer

Berkeley and Sandia Labs Airport Protection Guidelines

A report developed by a joint team of researchers from the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and Sandia National Laboratories (Sandia) is being distributed to airport executives and emergency planners to aid security managers of airports and other transportation facilities in reducing the risk of chemical and biological attacks.

"Guidelines to Improve Airport Preparedness Against Chemical and Biological Terrorism" is a 100-page document that makes concrete recommendations on improving security and assessing vulnerable areas and helps its readers understand the nature of chemical and biological attacks. The report has been turned over to Airports Council International (ACI) and the American Association of Airport Executives (AAAE), two organizations that together represent the interests of thousands of airport personnel and facilities in the U.S. and around the world.

The project was an extension of Protective and Responsive Options for Airport Counter-Terrorism (PROACT), a five-year, Sandia-led program most recently supported by the Department of Homeland Security. Berkeley Lab became part of the PROACT effort in 2003 and joined forces with Sandia on the development of the guidance document.

The Berkeley team was headed by Ashok Gadgil and Phil Price of the Environmental Energy Technologies Division. Gadgil is leader of the Airflow and Pollutant Transport Group at Berkeley Lab. They worked with colleagues at Sandia/California's Systems Studies and Systems Research Group, with researcher Donna Edwards and department manager Susanna Gordon in the lead.

"The Berkeley Lab team has had decades of experience in understanding building air flows and indoor transport of gases and aerosols," says Gadgil. "We were able to draw on that depth of expertise and distill it as it applies to airport protection. I am pleased that we could bring to bear our very substantial buildings expertise on the airport security problem. This really gave us a huge head start in this difficult job."

"Over the years, we've done a lot of scientific research concerning airflow and pollutant transport in buildings. For this report, we needed to apply our knowledge to a real-world problem that has a lot of elements we don't usually have to consider, like crowd control, and the chain of command for responding to an event, and so on. It was a challenge to put everything together, but we think we've done a good job," says Price.

To develop the guide, the researchers worked extensively with airport managers at San Francisco International Airport (SFO), who provided insights into their security measures and strategies for improving security. The Berkeley-Sandia team sent the draft document to reviewers at other airports around the country to ensure that it reflected the best thinking of security managers. Although focused on airports, the document is also relevant to transportation facilities such as train and bus stations and ports.

Berkeley Lab Provided Expertise on Airflow in Buildings

The Berkeley Lab team has extensive expertise in airflows and pollutant transport through buildings, including practical knowledge such as the state and capability of a typical facility's heating/ventilation/air-conditioning (HVAC) system, and the value of different types of filtration against biological agents. In addition, Berkeley Lab previously produced a document intended to help building owners understand and defend themselves from chemical and biological threats, experience that proved valuable as the new airport guidelines were developed.

In collaboration with SFO, Sandia conducted research during the past few years to understand how agents would spread through an airport. They also studied the effectiveness of HVAC responses, conducting extensive gas and smoke tracer tests at SFO. Together Sandia and Berkeley were able to create a set of specific prioritized recommendations targeted at improving the preparedness of airports and other facilities that have wide-open interconnected spaces against chemical and biological terrorism.

Berkeley and Sandia Labs collaborated to prioritize possible improvements in facility security (for example, is it more important to prevent access to HVAC mechanical rooms or to provide better video coverage of areas in the terminal building?).

For years, the Berkeley Lab team has been conducting computer modeling to predict airflow through buildings, performing experiments to measure airflow and pollutant transport, and studying the factors that affect speed and spatial distribution of pollutants. Since 1999, they have applied this expertise to the problem of reducing building vulnerability to chemical and biological terrorist attacks.

—Allan Chen and Michael Janes

Michael Janes is a public information specialist at Sandia National Laboratories California.

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Research Highlights

Modeling POPs and Climate

For the first time, a personal computer-based model has evaluated global-scale relationships between atmospheric concentrations of persistent organic pollutants and climatic patterns. The research, published in Environmental Science & Technology, was conducted by Matthew McLeod (now at Swiss Federal Institute of Technology), Thomas McKone of Berkeley Lab's Environmental Energy Technologies Division, and Bill Riley of the Earth Sciences Division. They demonstrated that a new model they developed, Berkeley–Trent (BETR)–Global, can analyze supercomputer data, such as the relationship between the concentrations of the polychlorinated biphenyls (PCBs) in the atmosphere and a global-scale climatic pattern known as the North Atlantic Oscillation.

For more information, see: http://pubs.acs.org/subscribe/journals/esthag-w/2005/jul/tech/kb_pc.html

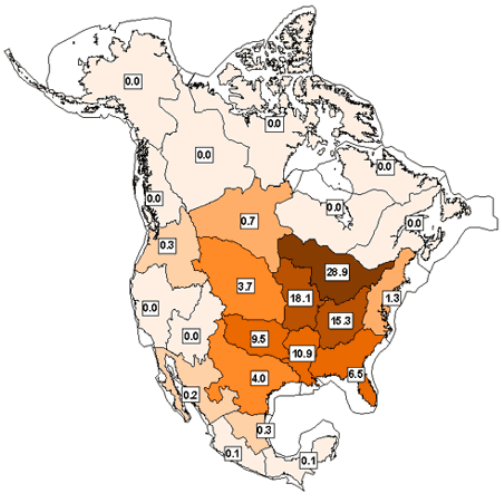
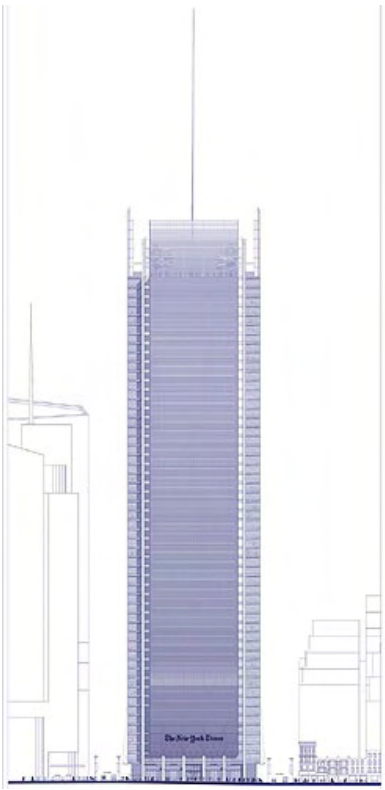


Figure 1. *The BETR model shows how toxaphene, a pesticide that was historically used in the southeastern United States, has spread across North America. The darker region on the map, the higher the toxaphene loadings from the atmosphere to the Great Lakes. Source: Matt MacLeod, Trent University*

New York Times



The New York State Energy Research and Development Authority has decided to fund additional work on a project to develop and test energy-efficient technologies and operational practices for the new headquarters building of the New York Times Company. Environmental Energy Technologies Division (EETD) scientists are writing up research results from earlier phases of this project, involving the testing of automated shading and daylighting controls for the building.

EETD researchers recently worked at the New York Times daylighting mockup in Flushing NY to walk through newly developed instrumentation and protocols with the Times staff, the commissioning agent, and the vendors. They also met with the Times engineering team to develop and evaluate the potential of demand-response strategies for the building.

In the next phase, the researchers will develop commissioning procedures and test protocols to ensure that the installed automated shading and daylighting controls for the building meet the owner's stated specifications before occupants move-in.

A description of the research is at http://www.lbl.gov/Science-Articles/Archive/sb-EETD-NYT-building.html, and the project website is at http://windows.lbl.gov/comm_perf/newyorktimes.htm.

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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 3,800 employees, Berkeley Lab's total annual budget of nearly $500 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 10 Nobel laureates. EETD is one of 17 scientific divisions at Berkeley Lab, with a staff of 400 and a budget of $40 million.

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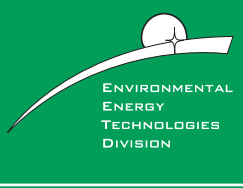

The mission of the Environmental Energy Technologies Division is to perform research and development leading to better energy technologies and the reduction of adverse energy-related environmental impacts.