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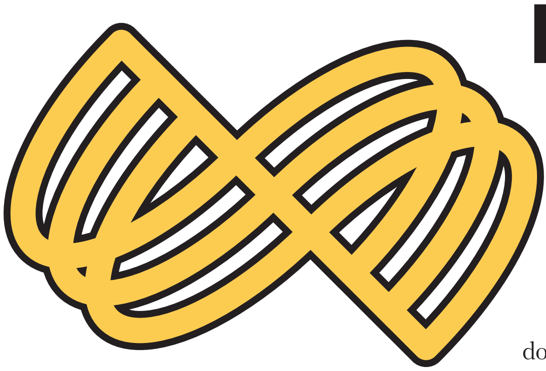
NEWS

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

Electricity Prices and the Tariff Analysis Project (TAP)



Much of the work done in the Environmental Energy Technologies Division (EETD) at Lawrence Berkeley National Laboratory (Berkeley Lab) involves analyzing the costs and benefits of energy-saving technologies and energy-efficiency measures. For the consumer, who pays to implement these measures, their economic benefits depend heavily on the price of electricity that the consumer pays at the *margin*, i.e., for the next kilowatt-hour (kwh) of electricity.

If a consumer is to choose energy-saving technologies wisely, s/he needs information about the economic benefits and the conditions under which savings will be maximized. To be accurate, this information should be based on actual utility tariffs. Although many public utility tariffs are available on the web, the complexity and diversity of tariff structures make it difficult to apply them systematically to analyze costs and benefits of a specific energy-efficiency investment. To address this problem, the Energy-Efficiency Standards group's *Tariff Analysis Project* (TAP) has created a database and web tools that facilitate the use of actual utility tariffs in cost-benefit analysis.

The TAP database is designed to handle tariffs for any kind of utility service and contains data from around the world although the focus to date has been on U.S. electricity prices. The effort was originally undertaken for the U.S. Department of Energy (DOE) as part of an analysis of efficiency standards for air conditioning and distribution transformers. That analysis highlighted the need for tools to accurately and efficiently analyze end-use-dependent prices. Both air conditioners and distribution transformers have peaky loads that strongly correlate to overall system loads. Although the cost of serving peaky loads will obviously be higher than the annual average cost of producing each kwh of electricity, just how much higher and how the price is affected by differing conditions cannot be determined without considerable attention to detail. Moreover, the question of whether retail prices adequately capture these additional costs at the margin is very difficult to answer when tariff structures are complicated, as most non-residential tariffs are. So another goal of TAP is to define analytically robust methods of summarizing price information and to provide researchers with relatively easy access to accurate tariff data.

Tariffs Included in TAP For the DOE analysis, the TAP research group developed a statistically representative sample of 90 electric utilities reflecting industry characteristics that may correlate with electricity rates, including location, ownership type, and company size. Regional variation implicitly encompasses variables such as climate, demographics, historical development, and market structures, so location is one of the most important single factors influencing price. The region definitions used to construct the TAP sample are based on combining nine census divisions with the nine climate divisions defined by the National Oceanic and Atmospheric Administration (NOAA). Different market structures were accounted for by separating out Texas, Florida, New York, California, and the Pennsylvania/New Jersey/ Maryland (PJM) area. Within each region, the number of utilities chosen was

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determined by the relative population living in that area and the proportion of customers served by privately versus publicly owned companies.

Electricity tariffs are typically classed as residential or non-residential. Non-residential may be further subdivided into general service and special-use tariffs (special-use tariffs include street-lighting and agriculture, for example). For the general service category, some utilities explicitly distinguish between commercial and industrial, but most do not. There are usually several general-service tariffs for different customer sizes (size is defined by the value of the annual peak load), and each size class generally has a default tariff. TAP currently contains the default tariff for each customer size and market, including time-of-use (TOU) tariffs whenever they are mandatory. The result is a collection of 247 tariffs for the 90 utilities in the sample; about 30 of the 247 are TOU tariffs. The database also contains the primary voltage tariffs (usually applicable only to very large customers) and residential tariffs for the utility sample, as well as agricultural tariffs for California.

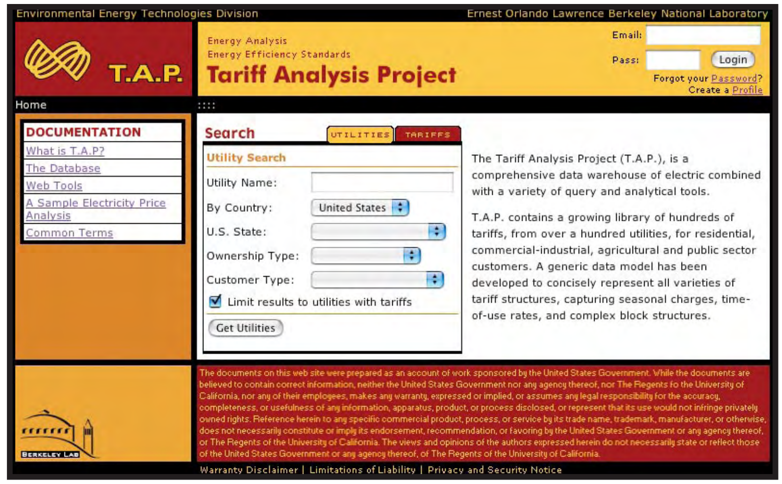

Figure 1. *Screen shot of the TAP web site. This view shows information for a TOU tariff, including season and hour type definitions.*

What Exactly is a Tariff? Rather than a list of prices, a tariff should be thought of as an algorithm that generates a customer's bill from information about their energy use. Given the necessary input data and the bill calculation algorithm, a variety of prices can be defined as needed. The key thing to remember is that the price of electricity depends on the combination of customer data and the tariff. If the tariff consisted simply of a fixed charge per kwh of electricity consumed, this would not be the case, but tariff structures are typically quite complex. Our primary interest for efficiency standards is the calculation of what we call the *effective marginal price*, defined as the total change in the bill under some scenario, divided by the total change in energy consumption. Typically, the dollar value of the benefits associated with an efficiency measure is calculated by multiplying the estimated energy savings by a price for energy. By definition, the effective marginal price is the correct value to use in such a calculation. Any under- or over-estimate of benefits that results from using a different price can be directly determined by comparing that price to the effective marginal price.

An alteration in a customer's energy use patterns will generally result in a change to both average hourly consumption and peak hourly demand, with the ratio of the two determined by the end use or efficiency measure being considered. One of the findings of our analysis is that the marginal price that a customer sees depends very strongly on this ratio, which we call the *marginal load factor*. In practice, electricity prices depend on the customer size and type (which determines the tariff assigned to the customer), the baseline energy use (which determines where within the tariff the customer's margin will be), and the end use or efficiency measure being considered (which determines the marginal load factor). These characteristics may vary systematically for different types of electricity consumers; when we consider policy measures that impact specific subpopulations of the consumer base, ignoring these differences can translate into substantial inaccuracies in the benefits estimation.

Modeling Tariffs in TAP The tariff data model used in TAP is a set of linked tables designed so that any utility rate structure can be represented by assigning values to predefined variables in a generic format. This format captures most of the features of real rate schedules, including demand charges, seasonal rates, variable block rates, and TOU rates. Having a single consistent tariff model streamlines the data-entry process and facilitates the comparison of rate structures across different tariffs and utilities. Except for some approximations made to reduce the complexity of tariff data, TAP represents the tariff directly and includes the ability to link together all information (for example linkage of seasonal rates to season definitions).

The TAP website also includes a simple bill calculator, which allows the user to input energy consumption and demand data and view the bill calculation and breakdown by different types of charges (see Figure 1).

Other tools currently on line include a web interface that allows a user to enter and review data using custom-designed forms and a Simple Object Access Protocol (SOAP) server that enables a direct link between web-based applications and the TAP database.

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Reducing Developing World's Polluting Fuel-Based Lighting

Using highly-efficient, cost-effective white light-emitting diodes as a replacement for inefficient, polluting kerosene lamps common in the developing world could potentially save tens of billions of dollars per year worldwide, according to a scientist in the Environmental Energy Technologies Division of the U.S. Department of Energy's Lawrence Berkeley National Laboratory.

Evan Mills notes in an article in the May 27, 2005, issue of *Science* that more than 1.6 billion people have no access to electricity, and many others have only intermittent access. As a result, those who can afford illumination when it's dark rely on lamps that burn kerosene, diesel, propane, or biomass-based fuels.

In his *Science* article, Mills proposes a lighting option that developing nations might use to reduce the cost of providing effective, cleaner lighting to their citizens. "As they modernize, developing countries can select better technologies, and in so doing surpass levels of efficiency typical of industrialized nation. The latest improvement is the solid-state white light-emitting diode [WLED]." In recent years, R&D performed by private industry as well as the Department of Energy has made these light sources suitable for task illumination.

Figure 1. *Evan Mills holds a prototype white light-emitting diode (WLED) made by a company called Ignite Innovations. This lamp, which grew out of a Stanford-led effort involving several Silicon Valley companies, Berkeley Lab, and others, features a one watt WLED, solar panel and rechargeable AA batteries. (Photo by Roy Kaltschmidt)*

Mills also points out that LED systems are well-suited to developing nations—they are rugged, portable, use direct current, have long service lives, and run on widely available "AA" batteries.

"Evaluated in terms of total cost of ownership (purchase plus operation), WLED systems emerge as the most cost-effective solution for off-grid applications," says Mills. He estimates that solar-powered WLEDs could appear on the market for $25 without need for subsidy. The annual fuel saving for each lantern is on the order of a month's income for the poorest one billion people of the world, who often subsist on less than $1 a day.

According to Mills, the problem of fuel-based lighting has been largely ignored by the energy policy community. Important next steps include more in-depth assessment of the opportunity, designing and field-testing affordable high-performance systems for various applications (e.g., reading, cottage industry, schools, and general social interaction), mounting pilot programs, and developing viable business models for reaching the target markets.

"Studies show that illumination, one of the core end-use energy services sought by society, is available to people in industrialized countries at 1,000 times more energy efficiency than for the un-electrified poor in the developing world," Mills says. Fuel-based sources, such as a wick lantern, generate one-500th the illumination of electric light sources, and their energy efficiency is much lower.

Mills estimates that fuel-based lighting throughout the world consumes 77 billion liters of fuel annually, at a total cost of $38 billion per year, or $77 per household. This, he says, is equivalent to 1.3 million barrels of oil per day, roughly the total oil production of Indonesia, Libya, or Qatar, or half the total oil production of pre-war Iraq.

A single fuel-based lamp used four hours per day emits more than 100 kilograms of carbon dioxide into the atmosphere each year. Mills calculates that fuel-based lighting is responsible for about 190 million metric tons of carbon dioxide per year, equivalent to one-third the total emissions from the United Kingdom.

Despite these large numbers, un-electrified households receive much less light for their money than those in the industrialized world. Kerosene and other fuel-based lighting represents 17 percent of global

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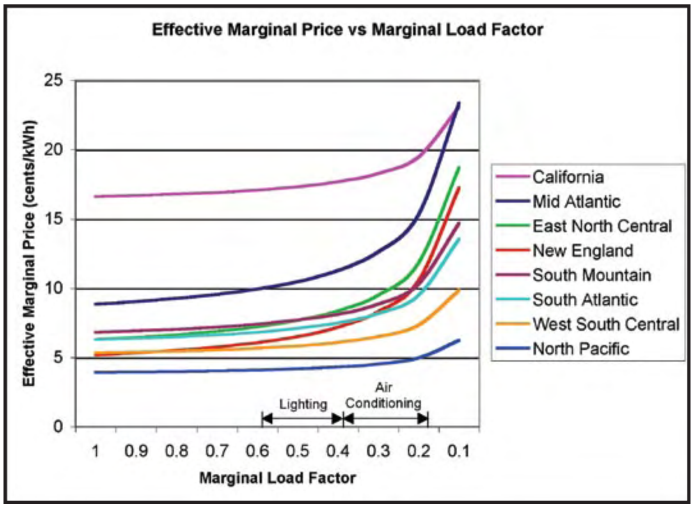

Figure 2. *Effective marginal price as a function of marginal load factor. The load factor decreases towards the right. The North Mountain, East South Central, and West North Central regions are very similar to the West South Central curve, so they are not plotted.*

Calculating Electricity Prices: an Example using Commercial Buildings Using data from the Commercial Building Energy Consumption Survey (CBECS), we created a representative set of customers for use in calculating average and marginal prices by region. Based on these data, the average effective marginal prices by region were calculated as a function of the marginal load factor, as illustrated in Figure 2. The steep rise in marginal price at low load factors is due to the increasing importance of demand charges as the marginal load factor drops. More information about these calculations can be found in a longer version of this article at the TAP website http://tariffs.lbl.gov.

Conclusions As the electricity industry continues to deregulate, tariff structures continue to get more complex, and it is important for the analytic methods used in efficiency cost-benefit estimation to keep up. The tools developed as part of TAP allow a great deal of complex information to be managed and used efficiently so that the real benefits of energy efficiency can be counted accurately.

— *Katie Coughlin*

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United Nations World Environment Day June 1-5, 2005

Figure 1. *California's Governor Schwarzenegger listens to EETD's Ronnen Levinson describe Cool Colors Project research, an effort to develop solar-reflective roofing materials.*

The United Nations' World Environment Day 2005 took place in San Francisco. Actually a set of related events held over five days (June 1 to 5), WED 2005 brought together mayors from all over the world—about 60 in all—in summit meetings to discuss how they could address urban environmental problems.

Figure 2. *EETD's Francis Rubinstein demonstrates for the Governor an automated system for controlling lighting in commercial buildings.*

On June 1st, California Governor Schwarzenegger held a press conference in San Francisco City Hall where he announced an executive order reducing California's greenhouse gas emissions. Just prior to his news conference, the Governor viewed displays of energy-efficient and renewable energy technologies in City Hall's South Light Hall, accompanied, among others, by University of California President Robert Dynes, UC Berkeley Chancellor Robert Birgenau, and Berkeley Lab Director Steven Chu.

http://wed2005.org/

First Energy-Efficient, LED-Based Task Lamp Brought to Market

The first task lamp using energy-efficient light-emitting diodes (LEDs) to provide illumination has hit the marketplace. Research conducted by Stephen Johnson, a scientist at the Environmental Energy Technologies Division of Lawrence Berkeley National Laboratory, helped lamp manufacturer Luxo USA Corporation develop the LED lighting systems that led to the new product.

Figure 1. *Luxo's LED Arketto, the first task lamp to use energy-efficient light-emitting diodes as its light source.*

Luxo's "LED Arketto" uses three 3-watt LEDs but provides more usable light than the comparable 40-watt halogen that it will replace due to the higher efficiency of the source and better optical control of the light. Luxo introduced the lamp at LightFair, the largest U.S. architectural and commercial lighting trade show, in New York City earlier this year.

LEDs are the key to the next generation of energy-efficient lighting in buildings. Small light-emitting chips, once found mainly in old-style electronic displays, are now common in a variety of signal devices—for example, traffic lights, electronic signboards, hazard lights, and in automobiles in blinkers, dashboards, and brake lamps.

Lighting researchers believe that as LEDs improve, their application in both residential and commercial spaces could cut worldwide lighting electricity use in half. The magnitude of this reduction would decrease the world's total electricity use by up to 10 percent, and its emissions of greenhouse gases by about 10 percent as well. Researchers at Berkeley Lab and elsewhere are working to improve the technology to the point where it is a viable commercial alternative to existing technologies for general lighting.

Luxo's Arketto LED resulted from extensive R&D by the manufacturer, with the help of technical advice and support from Johnson. Johnson is head of EETD's Lighting Group. Luxo's corporate headquarters are in Oslo, Norway.

Luxo Corporation was the company that introduced the first adjustable-arm task lamp in the 1930s. The spring-loaded design allowed the user to move the head of the lamp to any position over the table. The company's new LED task light uses LEDs and an advanced reflector design to diffuse the light over a work area about three feet-by-four feet when the head of the lamp is 18 inches from the work plane. At this level, the Luxo LED lamp puts more light on a desk than a 40-watt halogen lamp. The head is mounted on a flexible arm that can be adjusted over the work surface. The Arketto design has won awards for Luxo in a number of interior design competitions.

"This is the most R&D-intensive product that we've developed in the last 20 years," said Luxo's Product Manager Dave Shepard. "We spent the last year figuring out how to turn LEDs into a product for real-world applications."

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First Energy-Efficient, LED-Based Task Lamp Brought to Market

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Johnson's association with Luxo actually began with a research project funded by the California Energy Commission's Public Interest Energy Research Program. The work's purpose was to develop an LED-based task light suitable for the general illumination market. Johnson worked with Berkeley Lab researchers, plus industrial partners Luxo, Cree Lighting (which manufactures LEDs), Advance Transformer, and Permlight. The team built a prototype lamp using commercially available materials, including one-watt LEDs mounted on copper-clad fiberglass-core boards, connected to aluminum heat sinks.

Their prototype generated distribution of light similar to a commercial lamp using a compact fluorescent light source, but it was only half as energy-efficient. They needed better optics to distribute the LED's light, improved color quality, and a better system for removing heat from the LED. If the LED is too hot, its life and light output both decrease.

The project team worked together to solve the problems of the initial prototype, and they ended up with a new prototype that operated at 11 watts of LED power but had the light distribution and intensity of a Luxo task lamp using an 18-watt compact fluorescent lamp (CFL). "The results of this program stimulated Luxo to generate an aesthetically improved version of this concept using their new Arketto task lamp design," says Johnson.

Luxo looked at the results of Johnson's research and developed several prototype designs of its own. The first lamp prototype using the three 3W-LEDs did not put as much light on the surface of the work plane as they wanted, so they developed improved optics.

"We had to figure out how to pick up all of the light from the LED chip," says Shepard. "We did three months of optical modeling to figure out how to do this…We can really bend and shape the light and put it where we want it," says Shepard. He adds that Johnson played an important role in the process. "Steve pushed us into believing that we could use LEDs in a commercial product. The lighting industry believed that LEDs were not yet ready for prime time."

Luxo is hoping to interest the designers of commercial office furniture into using their energy-efficient Arketto lamp for built-in fixtures. "More and more companies are interested in buildings that meet (industry) standards and other energy-efficiency codes," says Shepard.

Members of the Berkeley Lab research team included Akos Borbely, Neil Fromer, Tal Margalith, and Jim Galvin. Sam Gumins of Luxo USA; Erlend Lillelien, Luxo, Norway; Manuel Lynch, Permlight; James Ibbetson, Cree Lighting; and Julio Vera, Advance Transformer, were the industrial partners.

—Stephen Johnson

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lighting energy costs, according to Mills, but only 0.1 percent of lighting energy services, measured in terms of lumen-hours. The cost per unit of kerosene-based lighting is about 150 times higher than the highest efficiency fluorescent lamps.

High-efficiency LEDs provide white light, and the technology is improving as manufacturers devise products with higher light output and energy efficiencies, and lower cost per unit output. "Efficiencies of only 5 lumens per watt in the mid-1990s," writes Mills, "are moving towards 100 lumens per watt (compared to 0.1 lumen per watt for a flame-based lantern). Commercially available 1-watt WLEDs require 80 percent less power than the smallest energy-efficient compact fluorescent lamps and can be run on rechargeable batteries charged by a solar array the size of a paperback novel." Such LEDs could actually deliver more light to tasks than even 100-watt light bulbs.

—Allan Chen

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BEST Winery Tool Helps Reduce Energy and Water Costs

Figure 1. *Wineries have begun to use treated wastewater to irrigate vineyards.*

California wineries now have an easy-to-use, computer-based tool and handbook to help them reduce energy and water costs, thanks to researchers in the Environmental Energy Technologies Division (EETD) at Lawrence Berkeley National Laboratory (Berkeley Lab) and to Fetzer Vineyards, with whom the lab worked to develop the tool.

"BEST (Benchmarking and Energy and Water Savings Tool) Winery" compares the performance of a target winery to that of a similar reference winery. The reference winery is the most efficient winery possible, using state-of-the-art commercially available energy- and water-efficient technologies.

After evaluating how the target winery compares to the reference winery, the user can view the tool's inventory of available efficient practices and technologies and select those that will save money, energy, and water at the target winery. BEST Winery is available as an Excel spreadsheet that can be run on any PC operating Windows 2000® or later.

Figure 2. *Winemaking is an energy- and water-intensive industry.*

The Public Interest Energy Research Program of the California Energy Commission supported development of the tool, which is geared toward small-to-medium-scale wineries. The tool is available for free to all California wineries.

Why produce a tool targeted to wineries? The wine-making business is a significant one in the state. "California has 1,100 wineries that produce more than 500 million gallons per year, contributing about $33 billion to the California economy," says Christina Galitsky, EETD researcher and one of the report's authors. In 2000, California produced 565 million gallons, representing almost 92 percent of all the wine produced in the U.S.

"A lot of the electricity used in winemaking goes to refrigeration for cooling and cold storage," Galitsky points out. "The rest is mainly compressed air, hot water or electricity for pumping, and the bottling line motors. Cleaning barrels and equipment requires hot water, and so does heating red wine ferments and yeast generator tanks." And, as with other commercial facilities, enclosed areas for storage and processing require lighting, and many such areas are electrically cooled.

Wineries are also water-intensive enterprises. Their major water use areas are in the fermentation tanks, barrel washing, barrel soaking, bottling line, cellars, and crush pad. Many wineries have begun to use treated wastewater to irrigate vineyards or for landscaping or for frost and fire protection or dust abatement.

"Energy and water costs have increased rapidly for wineries located in California," Galitsky says, "and this has made energy- and water-efficiency improvement an essential part of the business. Our experience is that more than any other industry, winemakers have started to implement sustainable practices in viniculture and in their wineries."

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Energy-saving Paper Sensor Passes Major Milestone

The paper industry is one step closer to saving millions of dollars each year. An innovative laser ultrasonic sensor that measures paper quality during production was recently successfully tested at a mill in Jackson, Alabama. The sensor was designed and built by scientists in the Environmental Energy Technologies Division (EETD) at Lawrence Berkeley National Laboratory (Berkeley Lab).

Figure 1. *The laser ultrasonic sensor was successfully tested at a working paper mill.*

The sensor measures two hallmarks of paper quality—bending stiffness and shear strength—as paper speeds through the production process. These measurements allow manufacturers to ensure that the optimum amount of raw material is used to make the paper, which could reduce the consumption of trees and chemicals and save the U.S. approximately $200 million in energy costs and $330 million in fiber costs each year.

"This is the first full-scale demonstration of the sensor on a commercial paper-making machine while it's in operation," says Paul Ridgway of EETD, who developed the sensor with fellow EETD scientist and principal investigator Rick Russo, working in partnership with the Institute of Paper Science and Technology at Georgia Tech.

The two-week test of the sensor was conducted in February at a mill owned by Boise Cascade. "Boise Cascade's engineers considered the trial to be quite successful and are hopeful that a six-month trial will be conducted at the same mill," says Ridgway.

Eight years in the making, the sensor was funded by the Department of Energy's Office of Industrial Technologies as part of a partnership to improve the energy efficiency of several industries. Under this program, the American Forest and Paper Association created Agenda 2020, which outlines ways for the forest products industry to streamline its production processes.

Papermaking is a prime candidate for improvement. Currently, paper quality is gauged by manufacturing a 15- to 30-ton roll of paper; a few samples from end of the roll are analyzed to determine how well they bend. If the samples don't meet industry specifications, the entire roll is recycled into pulp or sold as an inferior grade. To avoid this costly outcome, manufacturers often over-engineer paper, using more pulp than necessary to ensure that the final product meets the standards.

This method consumes more raw material and energy than necessary, so the EETD team developed a sensor that tracks paper's flexibility in real time. The laser/ultrasonic sensor measures without touching the paper, an important advantage because the paper moves at 20 meters per second (45 miles per hour) during production, and the slightest contact can break the sheet and cause costly machine downtime or mar lightweight grades such as copy paper and newsprint. The recent sensor trial boasted the highest sample speed ever reported for a commercial application of laser ultrasonics.

The sensor measures the time it takes ultrasonic shock waves to propagate from a laser-induced excitation point on the moving paper to a detection point several millimeters away. The velocity at which the ultrasound waves travel from the excitation point through the paper to the detection point is related to two elastic properties: bending stiffness and out-of-plane shear rigidity.

The sensor works by directing a detection beam from a commercially available interferometer toward a rotating mirror. The spinning mirror reflects the beam onto the paper coursing along the production belt. Because both the beam and the paper are moving at the same speed, the beam remains fixed on the same point on the paper during their brief contact.

Next, an optical encoder determines when the beam is perpendicular to the paper, at which time a circuit fires a pulsed laser. The five-nanosecond pulse causes a microscopic thermal ablation of the paper, which is too small to visibly mar the paper but strong enough to send ultrasonic shock waves through the sheet. The waves propagate until they reach the detection beam. Because the laser is synchronized to fire only when the detection beam is perpendicular to the paper, the distance between the ablation point and detection point is known, which allows the speed of the waves to be calculated.

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HIGH CONDUCTIVITY SINGLE-ION CROSS-LINKED POLYMERS FOR LITHIUM BATTERIES AND FUEL CELLS

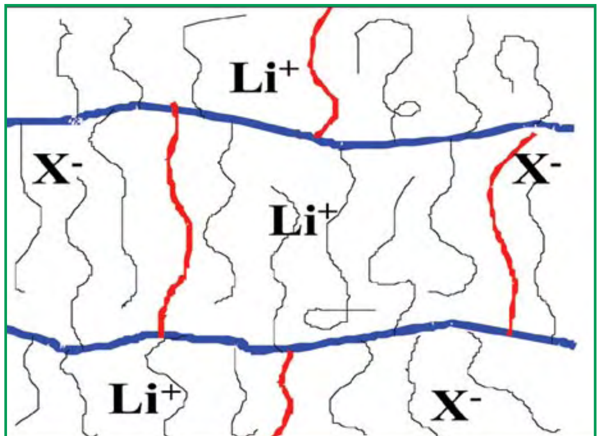
The Lawrence Berkeley National Laboratory (Berkeley Lab) Technology Transfer Department licenses a wide range of cutting-edge technologies to companies that have the financial, R & D, manufacturing, marketing, and managerial capabilities to successfully commercialize Lab inventions. It develops and manages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

Because of their wide electrochemical potential, lithium-ion batteries provide the largest energy density for weight. These batteries are used in multiple applications, from laptop computers to cell phones to defense equipment and electric vehicles and are safer for environmental use than conventional batteries.

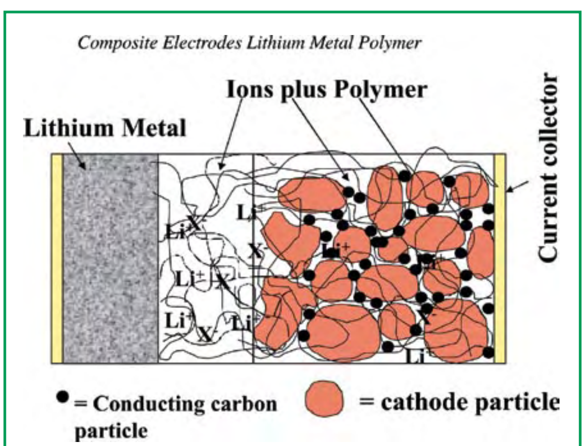
John Kerr and researchers in the Advanced Energy Technologies Group have refined the lithium-ion battery to make it longer lasting and to improve its performance. Through the use of single-ion, cross-linked comb-branched polymer electrolytes as membranes in lithium batteries, the power performance and energy density of the battery can be increased.

Solid polymer electrolytes have been improved by the creation of single-ion polymer conductors. Single-ion conductors avoid the development of concentration gradients that result in low voltage and low energy capacities upon discharge because the anion is immobilized.

The capabilities, materials, and principles used for developing these polymer electrolytes for lithium batteries can be adapted to develop polymer films for fuel cells and electrochromic windows. Kerr's group is developing membranes for fuel cells that can operate at temperatures above 100°C without the need for water in the membrane. This results in significant savings in system complexity and weight that are important considerations for fuel cell-powered vehicles. The new polymer materials also show promise for use in chemical separations, catalysis and sensors, particularly in the area of biotechnology.



Cross-linked comb-branch structure. Heavy horizontal lines represent the comb-branch backbone, heavier vertical lines the cross-links and the lighter vertical lines the solvating ether side-chains. Anions are fixed to the side chains. Mechanical properties are a function of the backbone structure and cross-link density. Ionic mobility is a function of the solvating groups incorporated in the side chains. The molecular structures are infinitely variable in order to provide optimum properties for both bulk membranes and composite electrodes (MEAs).



For more information about this technology, see:

http://www.lbl.gov/TT/techs/lbnl1553.html

Contact Lawrence Berkeley National Laboratory's Technology Transfer Department at:

http://www.lbl.gov/TT/

Technology Transfer

BEST Winery Tool Helps Reduce Energy and Water Costs

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In the benchmarking process, either the energy or water performance of an individual plant is compared to that of a plant that represents "standard" or "optimal" performance, or the energy or water usage figures for a number of plants are compared to each other.

Benchmarking in the BEST Winery tool compares an individual winery to a similar hypothetical optimal winery using energy intensity (energy use per unit of output) as the unit of measurement. The BEST Winery tool applies to a wide range of facilities and compensates for differences in production.

Pacific Gas & Electric (PG&E) Company supported three free BEST Winery tool training sessions in May at the Fetzer Winery in Hopland, the Sonoma Valley Inn in Sonoma, and the Villa Toscana Winery in Paso Robles, California. At the sessions, PG&E provided information on its financial support programs for improving energy efficiency in the state's wineries.

The handbook is titled *BEST Winery Guidebook: Benchmarking and Energy and Water Savings Tool for the Wine Industry*, and the authors are Christina Galitsky, Ernst Worrell, and Anthony Radspieler of Berkeley Lab, and Patrick Healy and Susanne Zechiel of Fetzer Vineyards.

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

Energy-saving Paper Sensor Passes Major Milestone

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The next step for the researchers on the sensor project is to work with Boise Cascade to link the sensor with sophisticated feedback controls that maintain paper's stiffness during manufacture. ABB Corporation, which participated in the recent trial, is also likely to be part of the upcoming phase.

"Our technology will enable this real-time feedback control," says Ridgway. "And the successful mill trial shows we are one step closer to realizing it."

The mill trial is the latest in a string of successful real-world tests of the sensor. In 2003, Ridgway, Russo, and engineers from the Institute of Paper Science and Technology conducted a pilot-scale test of the laser ultrasonic sensor at Mead Paper Company's research center in Chillicothe, Ohio.

This test demonstrated that the sensor's sophisticated hardware can successfully perform in an industrial environment where conditions are much harsher than in the laboratory.

—Dan Krotz

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This research was funded by the Department of Energy's Office of Industrial Technologies.

Research Highlights

Lone Pine Visitors Center Wins Energy Efficiency Award

The Eastern Sierra Inter-Agency Visitors Center, in Lone Pine, California, has received one of eight *2005 Savings By Design Energy Efficiency Integration Awards*, given to non-residential projects in California. EETD's Rick Diamond and colleagues provided energy efficiency design consultation through the Department of Energy's Federal Energy Management Program. The facility is developed and owned by the National Forest Service. The awards are funded by California's power utilities and the American Institute of Architects.

Figure 1. *The design team included light-shelves and sun shades, highly reflective roofing, and fenestration that minimizes heat gain and loss and maximizes views of Mt. Whitney. (Photo: Bill Hustace)*

Says Diamond: "this was a great opportunity where the client, the U.S. Forest Service, was serious about their responsibility for environmental stewardship, looking for the most environmentally sensitive building for their new visitor center—and the design team responded beautifully.

Figure 2. *The Eastern Sierra Inter-Agency Visitors Center, Lone Pine, California (Photo: Bill Hustace)*

For more information, see: http://www.savingsbydesign.com/awards-2005/#highhonor

Behind the Pritzker Prize

When workers move into the avant-garde new Federal Building in San Francisco (now under construction) they will be able to open their windows. Doing so will save more than a hundred thousand dollars in energy costs each year.

When the tower is complete, it will be only sixty-five feet wide. Natural light will flow from one side to another, eliminating the need for much artificial light. Again, more than a hundred thousand dollars in energy costs will be saved annually.

The tower will be sheathed in a stainless steel screen that hangs over its southeast facade, shading the sunny side of the building. Air conditioning will not be needed. Such innovations helped architect Thom Mayne earn the coveted Pritzker Prize for architecture. He is the first American to win the prize in 14 years.

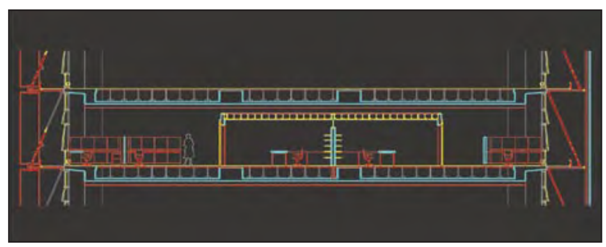

Figure 1. *A cross-section of the building, in which air flows through windows that can be opened.*

But behind the glamour and innovation lie some hard work from EETD's Buildings Technologies Group. Research engineer Philip Haves developed the simulation of opening windows, natural light, and stainless steel screens to predict the energy savings for this design. Using the EnergyPlus simulation tool developed for DOE by a team of research organizations including LBNL, Haves was able to predict the performance of different natural ventilation schemes and help the design team select a scheme that will have better performance and lower first cost than the alternatives. Haves and other EETD researchers are now testing the complex control system, whereby comfortable temperatures are maintained by automatic opening and closing of windows, using a customized version of EnergyPlus.

Overall, the design is predicted to use 45% less energy than a comparable conventional building, an estimated savings of $500K yearly. When completed, the Federal Building is expected be one of San Francisco's "greenest" and most energy-efficient buildings.

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Environmental Energy Technologies Division

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