

Building Applications Team

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The A-Team marshals the expertise and resources of energy efficiency experts from the Lab to help clients deploy advanced energy-efficient technology and

indoor environmental quality concepts in buildings both in the United States and abroad. Leading by example, the group has achieved 40% energy savings in the Lab's own buildings. An important area of expertise is assistance with performance contracting for energy-saving projects in government facilities. The Applications Team brings together LBNL's unique capabilities and networks to conduct field projects aimed at deploying advanced energy efficiency and indoor environmental quality concepts in both the U.S. and overseas buildings sectors.

Rebuild America Technical Support

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LBNL provides technical support to this Department of Energy program to help community partnerships make profitable investments in energy efficiency projects. LBNL staff advise communities on the best technologies and approaches for building energy projects throughout the U.S., including a contracts sourcebook and model contract documents, a guide to energy-efficient ventilation in high rise multi-family buildings, and one-on-one technical assistance to local organizations, including Native American tribes.



Voluntary Programs

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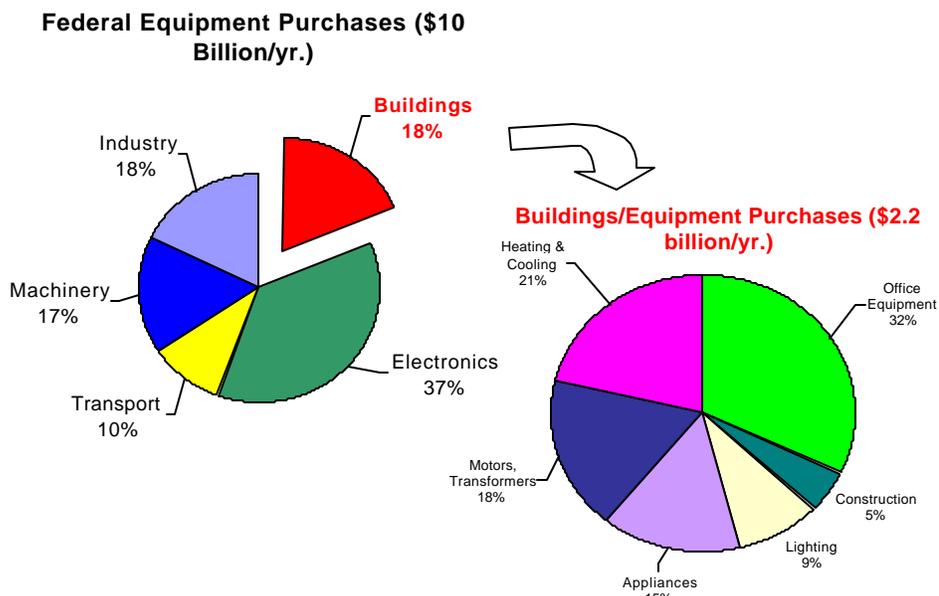


Berkeley Lab researchers provide analytical support for the voluntary ENERGY STAR® programs in appliance labeling and new homes, administered by the U.S. EPA and U.S. DOE. By putting ENERGY STAR labels on their products, manufacturers harness market forces to promote energy-efficient products.

Energy Efficient Government Purchasing

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LBNL supports DOE and EPA programs to encourage federal, state, and local agencies to purchase energy-efficient products - generally in the top 25% of efficiency. Specific efficiency levels are recommended by DOE, in coordination with ENERGY STAR labels and other programs. Technical information, including sources of energy-efficient product listings, is available to any state or local jurisdiction through the Energy Star Purchasing program; for information on Energy Star Purchasing, contact Jennifer Dolin (202/564 9073, dolin.jennifer@epamail.epa.gov).



Appliance Efficiency

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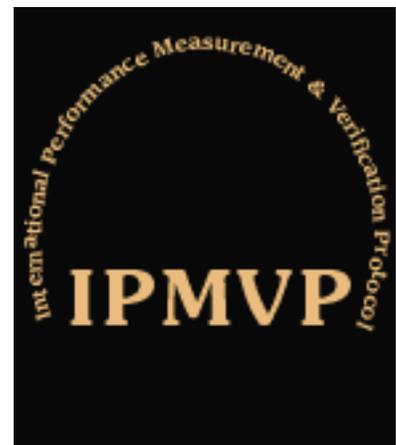


Appliance efficiency standards and energy efficiency provisions in building codes in the U.S. save consumers billions of dollars each year. LBNL research provides impartial technical information on the energy use of appliance technologies for consideration by the Department of Energy in its appliance standards development process, and to other nations around the world that have appliance standards in place or under consideration.

Measuring and Verifying Energy Savings

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The International Performance Measurement and Verification Protocol (IPMVP) provides practical guidance to building owners, energy service companies (ESCOs), and financiers of energy efficiency projects in quantifying energy conservation measure performance and energy savings. The IPMVP is designed to support the growth of energy and water efficiency industries, and performance contracting in general.



CoolSense

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Well over 60,000 chillers in the US are currently using ozone-depleting (CFC) refrigerants, with a retrofit/replacement market estimated in the billions of dollars. The 1996 moratorium on CFC production is expected to bring about 20,000 chiller replacements or conversions. These chiller replacements or conversions offer a great opportunity to address other energy-saving opportunities in the building. Reduced cooling loads and cooling system improvements will allow the chiller to be significantly downsized for even greater savings. The Cool \$ense network is designed to provide building owners, contractors, vendors, and energy managers with important tools and information to undertake successful integrated chiller retrofits. A Web site and training workshops offer technical information, links to design and analysis tools, equipment selection guidelines, and help in understanding financing and procurement options, as well as a calendar of workshops and related events.

Healthy Buildings

<http://eetd.lbl.gov/CBS/NEWSLETTER/NL2/HealthyBuildings.html/>

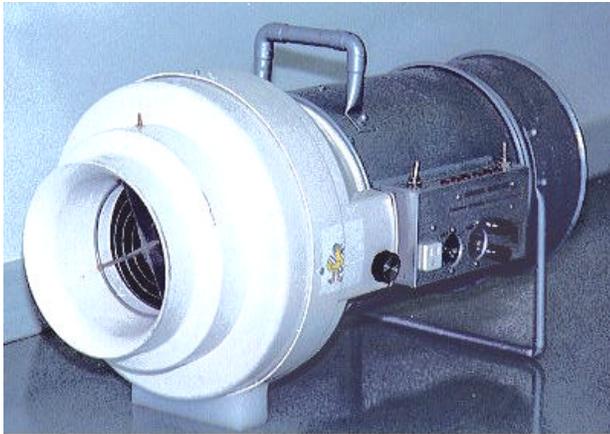


To help improve health and productivity in buildings while also saving energy, LBNL researchers quantify indoor pollutant emissions, transport, and human exposure; develop measurement tools and models; generate the research data needed for industry standards and guidelines; and identify building designs and operating practices that save energy while maintaining or enhancing the indoor environment. An LBNL study estimates that improving the environment inside US buildings could lower annual health care costs by \$4 to \$10 billion and increase worker productivity by \$40 to \$240 billion. The California Healthy Building Study, conducted in 12 large buildings with 880 occupants, was the first research project to

examine the relationships among health symptoms, job performance, and indoor air quality in typical ("non-sick") buildings, with a long-term goal of understanding how to create "healthy" office buildings which contribute to office worker productivity.

Sealing Leaky Air Ducts

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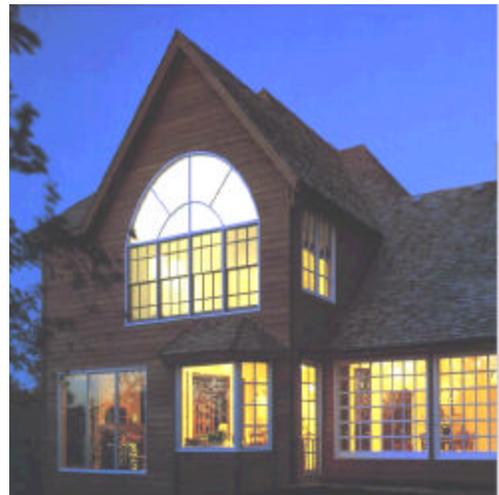
A prototype of the aerosol injector

A typical house with ducts located in the attic or crawlspace wastes approximately 20 percent to 40 percent of heating and cooling energy through duct leaks, and uses about 0.5 kilowatts more electricity during peak cooling periods. Reducing this duct leakage could save close to one quad (10^{15} Btu) of energy per year. With support from State R&D organizations, EPA, and DOE, **LBNL** developed and helped commercialize a major new duct sealant technology that uses aerosols to reach and seal inaccessible duct runs. Related research has demonstrated that duct tape is useful for many purposes, but not for sealing leaky ducts!

Efficient Windows Collaborative

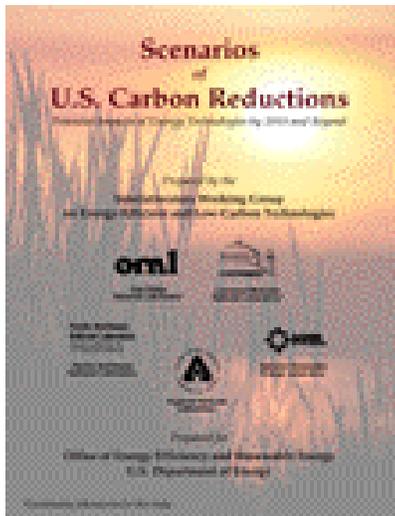
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LBNL supports the DOE-sponsored Efficient Windows Collaborative, an industry-based group organized by the Alliance to Save Energy with a goal of doubling the market share of efficient residential windows by 2005. Efficient windows utilize low-emissivity coatings, double-glazing, gas-fills and insulating frames where appropriate, resulting in significant increases in comfort as well as energy savings. In addition to their technical support role for the Collaborative, LBNL researchers develop advanced optical and electrochromic materials for future windows, study the energy performance of windows and window systems, and create and validate computer tools used in the design process and for rating and labeling.



Energy Efficiency and Climate Change

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A strong emphasis on studying energy use and the emissions of greenhouse gases (GHGs) has made Berkeley Lab an important source of information to global climate change policymakers. Researchers have analyzed the potential of energy-efficient technologies in buildings and industry to reduce GHG emissions. Results are documented in the 5-Lab study "Scenarios of U.S. Carbon Reductions," as well as reports by the UN-sponsored Intergovernmental Panel on Climate Change Science Assessments. LBNL also provides technical support to developing nations in reducing GHG emissions through energy efficiency in countries such as India, China, the Philippines, and Mexico.

Energy Efficiency and the Insurance Industry

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LBNL staff work with the insurance industry to promote energy efficiency and improved indoor air quality as a strategy for reducing insured losses from property, health and liability. Insurers are also significant owners of real estate. Another reason for insurer interest in energy efficiency is that nearly 50% of all insured property losses from natural catastrophes over the past 40 years have occurred since 1990. Some insurers are concerned that this increasing rate may be due in part to global climate change, which can be mitigated by improved energy efficiency that reduces carbon emissions as an attractive "no-regrets" opportunity. The project is co-sponsored by EPA and DOE.

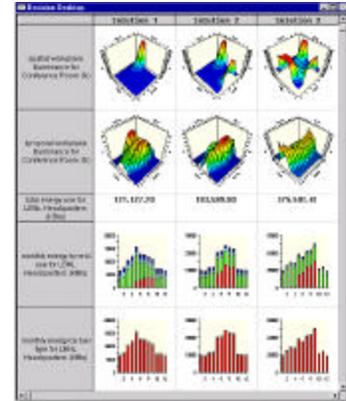
Energy Efficiency = No-Regrets Insurance Loss-Prevention



Building Design Analysis

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The BDA is a Windows® computer program that addresses the needs of building decision-makers from the initial, schematic phases of building design through the detailed specification of building components and systems. The BDA is built around an object-oriented representation of the building and its context, which is mapped onto the corresponding representations of multiple tools and databases. It then acts as a data manager and process controller, automatically preparing input to simulation tools and integrating their output in ways that support multi-criterion decision making.



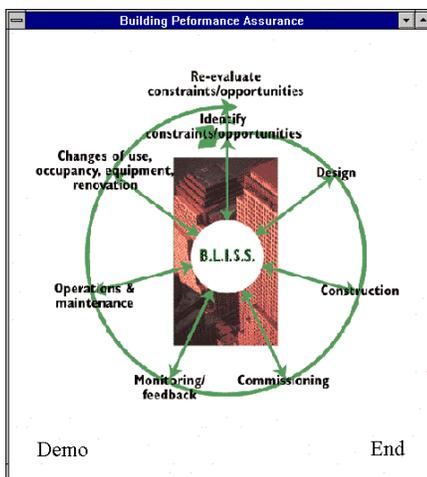
Performance Diagnostic and Verification Tools

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Commercial buildings generally do not operate as intended. Performance monitoring projects have shown whole-building energy savings of 20% or more through improved controls and O&M practices. Some savings opportunities are associated with the lack of feedback from today's Energy Management and Control Systems (EMCS) which are designed for real-time control but with limited capabilities in data archiving, analysis, diagnostics, and visualization. LBNL is leading a multi-institution team to develop and demonstrate an Information Monitoring and Diagnostics System (IMDS), designed to address common operational problems facing office building owners and managers. The IMDS includes about 50 points of whole-building and cooling plant data, plus a set of standard diagnostic plots to evaluate trends in key performance metrics. Related projects address whole-building performance verification using simulation models, automated component diagnostics, and controls optimization.

Building Performance Assurance - Building Life-Cycle Information Systems

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Despite significant advances in building technology and stricter building codes, commercial buildings consume about 15% of all U.S. energy at a cost of \$85 billion/year. Half of this energy is wasted. Achieving the full, cost-effective level of building energy performance is possible, but requires rethinking the ways buildings are designed, built, commissioned, and operated. A life-cycle perspective on information management provides useful insights and opportunities for achieving full performance potentials. To address these challenges LBNL created the Building Performance Assurance (BPA) project to develop prototype solutions for assuring building (energy and non-energy) performance, create building industry interest, and establish private sector partnerships. The immediate goal is to develop a standard set of interoperable information tools that enhance building performance throughout the life cycle.

Design Analysis Tools

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LBNL researchers developed DOE-2, a computer program that analyzes the energy performance of buildings. This program is used extensively by architecture and engineering firms to design more energy-efficient buildings. According to a survey of buildings designed with DOE-2, the program has helped save 20% of energy use, on average. Other LBNL software focuses on improving building performance in the areas of lighting (Radiance), windows (RESFEN and THERM), HVAC systems and controls (SPARK), whole buildings (EnergyPlus), ventilation (COMIS), design assistance (Building Design Advisor), interoperability (Industry Foundation Classes), and design parameter optimization (GenOpt).

Power Purchasing in a Competitive Retail Market

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LBL studies utility-related public policy issues related to utility restructuring which include organization of bulk power and retail energy service markets, pricing of various services, market power, and system stability and reliability, and the role of renewables and energy efficiency. Analyses and modeling tools provide useful information to regulators, policy-makers, and large government or institutional power purchasers. LBNL also provides technical assistance to Federal and other institutional customers on implications of restructuring on their energy service choices, development of competitive solicitations to select retail energy suppliers, etc.

Compressed Air Challenge

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Berkeley Lab is the technical lead for DOE's Compressed-Air Challenge, an industry-government partnership dedicated to improving the efficiency and performance of industrial compressed air systems and reducing energy use and costs. The Challenge helps corporations and their plant managers achieve these goals through education, technical training, and certification. Almost every industrial plant, from a small machine shop to an immense pulp and paper mill, has some type of compressed air system that is vital to plant operation. Yet the energy efficiency of compressed air systems is often overlooked. System optimization can easily yield 20 to 50% energy savings while maintaining or improving system performance and reliability.



Native American Renewable Energy Education Project - NAREEP

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NAREEP is a joint project of LBNL and U.C. Berkeley that provides research, education, and technical assistance to Native American communities on renewable energy and energy efficiency. It responds to the desire of Native Americans for cost-effective, culturally appropriate, environmentally benign energy services for tribal community needs and economic development. Project activities include:

- a handbook, *Native Power*, on energy efficiency and renewable energy for tribal decision makers and staff;
- a quarterly newsletter, *Indian Sustainable Energy News* with feature articles, interviews, and resources written around a theme chosen for each issue;
- an information clearinghouse with phone, email, and web-based information services available to tribes;
- an extensive survey of tribal energy issues and needs;
- two studies: electric utility restructuring issues from the tribal perspective and home weatherization on reservations, detailing the Rosebud Sioux reservation in South Dakota;
- workshops on energy efficiency and renewable energy issues, finance and project development, held periodically.

Lab and Clean Room Design, Operation, Retrofit

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The Design Guide for Energy-Efficient Research Laboratories is intended to assist facility owners, architects, engineers, designers, facility managers, and utility demand-side management specialists in identifying and applying advanced energy-efficiency features in laboratory-type environments. The Guide, sponsored by California Utilities, focuses comprehensively on laboratory energy design issues with a "systems" design approach, while also

considering important sub-system design issues.

Home Energy Saver

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The Home Energy Saver is the first Internet-based tool to calculate energy use and advise on energy efficiency measures for all major residential end-uses, based on either a generic or detailed description of the user's home. An extensive Making it Happen module connects the user to many other information resources on the Web, while the Answer Desk gives quick responses to common questions. The project is cosponsored by EPA and DOE in support of the Residential ENERGY STAR Programs.



Energy Efficient CFL Torchieres

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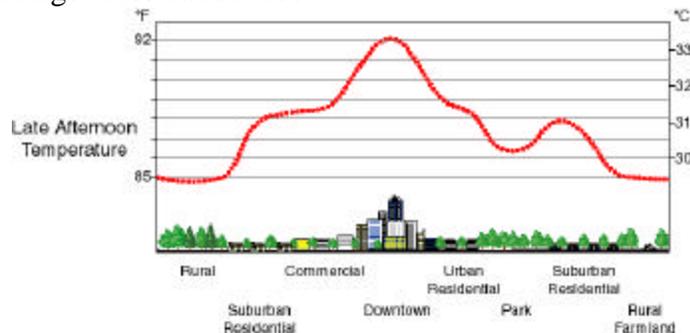


Lighting systems researchers at LBNL conduct R&D on fixtures, controls, and software and help industry and government commercialize and promote energy-efficient lighting. One recent project to replace the widely used halogen floor lamp (torchiere) with high-efficiency, fire-safe compact fluorescent lighting (CFL) recently won the "Best of What's New" Grand Prize Award for Home Technology from *Popular Science* magazine. The 40 million halogen torchieres in the United States consume 20 billion kWh annually, 5 times the energy generated by wind turbines and photovoltaics, and have contributed to 189 fires, resulting in 11 deaths, because of their high temperatures. The CFL torchiere produces 25% more light output than a 300-watt halogen torchiere, while using only one-fifth the energy and operating 500° F cooler.

Cool Roofs Cool Communities

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Cities are urban heat islands' zones of higher temperature relative to the surrounding countryside. Costly air conditioning is then needed to lower the temperature inside our buildings. Higher outdoor air temperature also increases smog formation over cities. LBNL researchers have pioneered an effective, simple approach: use reflective roofing materials and shade trees to keep buildings cooler. If enough buildings in cities adopt these measures, the cooling effect could save billions of dollars in peak electricity costs and reduce smog in large cities nationwide.



Residential Infiltration and Ventilation

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LBL research on energy-efficient residential infiltration, ventilation, and indoor air quality aims at incorporating appropriate credits for air tightness in building energy codes such as California's Title 24. The research includes provisions for air tightness (with good indoor air quality) in residential commissioning and home energy ratings. It is co-funded by DOE and the California Institute of Energy Efficiency.

Clean and Efficient Gas Combustion

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LBL combustion research helps generate the fundamental physical and chemical knowledge necessary to reduce emissions and increase efficiency. Experimental and modeling studies (including use of the LBNL's National Energy Research Scientific Computing Center, NERSC, for advanced modeling of combustion processes) in turn support practical applications such as the design of new combustion devices. By studying the properties of turbulent fluid motion in combustion chambers, LBNL researchers have devised two premixed natural gas burners that emit 20 times less nitrogen oxide than current technology. The burners could be used in residential and commercial process heaters and furnaces, as well as industrial applications and gas turbines.



Daylighting for Commercial Buildings

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Daylighting is both an architectural design strategy and an energy-efficiency measure that has been demonstrated to save 60 to 80% of the lighting energy use in commercial buildings, while improving occupant satisfaction and job performance. Although daylighting can be applied to a large fraction of new and existing buildings, it is used effectively as an energy management strategy in only a small fraction of commercial floorspace. LBNL is initiating a more aggressive effort, with partners nationally and internationally, to

address the critical technical and market barriers that limit the achievement of full-market potential for daylighting.

Other core capabilities:

Appliances – Jim McMahon (510.486.6049; JEMcMahon@lbl.gov)

- FEMP – William Carroll (510.486.4890; WLCarroll@lbl.gov)
- Measurement & Verification – Steve Kromer (510.486.6619; JSKromer@lbl.gov)
- IAQ & Ventilation – William Fisk (510.486.5910; WJFisk@lbl.gov)
- Utilities – Charles Goldman (510.486.4637; CAGoldman@lbl.gov)
- Rebuild America – Rick Diamond (510.486.4459; RCDiamond@lbl.gov) & Dale Sartor (510.486.5988; DASartor@lbl.gov)
- Forecasting – Jon Koomey (510.486.5974; JGKoomey@lbl.gov)
- Procurement – Jeff Harris (202.484.0883; JPHarris@lbl.gov)
- International/ CO² - Jayant Sathaye (510.486.6294; JASathaye@lbl.gov)

LBNL is currently working with an international research team, with utilities in California, the Energy Center of Wisconsin and others to develop collaborative projects in each of these areas.