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Environmental Energy Technologies Division News

Air Quality Advanced Technologies Building Technologies Energy Analysis Indoor Environment

BETR North America: A Multimedia Contaminant Fate Model

Progress in understanding contaminant concentrations observed in remote locations requires the development of a computer simulation model that can link these concentrations with long-range transport potential at a continental scale. Researchers at Trent University's Canadian Environmental Modeling Center and Berkeley Lab's Environmental Energy Technologies Division are now developing such a model, the Berkeley-Trent North American contaminant fate model (BETR North America).

BETR is a regionally segmented multi-compartment, continental-scale, mass balance chemical fate model. The model's framework links contaminant fate models of individual regions that encompass a larger, spatially heterogeneous area. It models North America's environment as a group of 24 ecological regions with boundaries based on geographic features mainly waterways and soil types. (See Figure 1.)

The environment within each region is modeled as a system of seven compartments: upper atmosphere, lower atmosphere, vegetation, soil, fresh water, coastal water, and freshwater sediment. A database of hydrological and meteorological data, organized using geographic information systems software, provides the basis for modeling transport between regions in the atmosphere, freshwater, and coastal water media. The model's environment is flexible enough to be adapted to other environmental settings.

Seven equations describe the contaminant fate in each region of the model, so 168 mass balance equations are needed to constitute the model for the 24 regions of North America.

Relation to other models

BETR North America is the first model that can track the movement of persistent organic pollutants on a continental scale. Most existing multimedia models describe the transport and fate of contaminants on a smaller, regional scale, and make the assumption that the region is homogeneous. Examples of these multimedia models include ChemCAN, CalTOX, and SimpleBOX, the model used by the European Union. Like these other models, BETR uses the fugacity-based mass balance concept first proposed by Don Mackay in 1979. Fugacity is a way of representing chemical activity at low concentrations. Fugacity-based multimedia models have been used extensively for modeling the transport and transformation of chemical contaminants in complex environmental systems. Other models focus on air-transport patterns, without accounting for the interaction of the contaminant with water and soil.

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Figure 1. Regional segmentation of the BETR North American model.

In this Issue

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.

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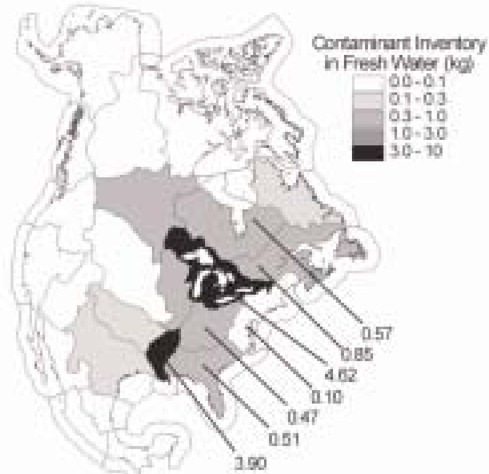
Toxaphene example

An example of the model's results is provided in Figure 2, showing the distribution of the now-banned pesticide toxaphene, which was used extensively in the southeastern United States. Toxaphene is a widely studied persistent organic pollutant and is suspected to be accumulating in the waters of the Great Lakes and their aquatic food chains as the pesticide volatilizes from the soils in which it was deposited. The figure shows the steady-state distribution of toxaphene throughout the 24 regions as a result of a hypothetical release of 10,000 kg/year to the lower air compartment of the Mississippi Delta region.

Figure 2. Calculated steady-state inventory of toxaphene in fresh water due to a 10,000 kg-year release to the lower air compartment of the Mississippi Delta region.



Conclusions

The BETR North America model can be a valuable tool for assessing long-range transport potential of persistent organic pollutants and other contaminants. Once the model has been fully parametrized, its results can be compared with measured concentrations of contaminants in remote locations, to validate the model's results and deduce continental-scale mass balances. Researchers are currently working to complete its parameterization, including the incorporation of human exposure calculations.

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High-Performance Rechargeable Batteries for Electric Vehicles

Developing an advanced battery for automotive applications is a difficult undertaking. Identifying the limitations and understanding the performances and lifetimes of batteries are required to guide scaling up and other activities. High cell potentials and demanding cycling requirements lead to chemical and mechanical instabilities—important issues that must be addressed. The recently reorganized Batteries for Advanced Transportation Technologies (BATT) Program addresses fundamental issues of chemistries and materials that confront all lithium battery candidates for Department of Energy electric vehicle and hybrid electric vehicle applications. The Program emphasizes the synthesis of components into battery cells with determination of failure modes, coupled with strong efforts in materials synthesis and evaluation, advanced diagnostics, and improved electrochemical models. The selected battery chemistries are monitored continuously with periodic substitution of more promising components.

Battery research with these lofty goals has been underway at Berkeley Lab for more than 20 years. The electrochemical programs in the Environmental Energy Technologies and Materials Sciences Divisions have traditionally focused on interfacial studies of ideal systems and materials invention. The research also characterizes very small cells, using measurements pertaining to one electrode, often in a thin film form. However, the two electrodes in a cell frequently affect the performance of each other, and materials and systems that look good in the ideal lab experiment sometimes do not translate into a practical battery.

For these reasons, EETD researchers have begun a new cell fabrication and testing task. The goal is to take new materials, developed at Berkeley Lab and elsewhere in the DOE-supported Electric Vehicle (EV) Battery program, and build them into a full cell that resembles something that could be built commercially for an electric vehicle. These efforts are not targeting the production of 40 kWh batteries required to run a standard sedan automobile. Rather the work focuses on single cells with two electrodes, and energies in the realm of 40 mWh.

Figure 1. Cycle performance of a high-power cell at 25 and 60 °C.

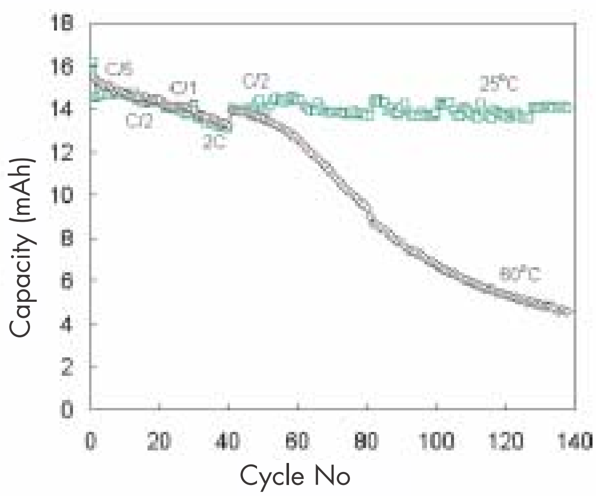
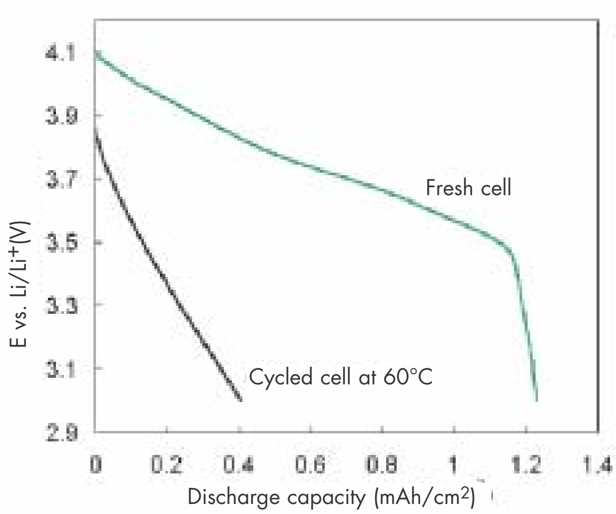


Figure 2. Analysis of cathode sample in a separate cell shows the source of the performance degradation.



The first year of effort has been devoted to gathering the equipment required for lithium-ion cell production, developing electrode preparation and cell-assembly techniques, and testing protocols. The tools used include commercially produced lithium-ion cells and a battery cycler capable of cycling 64 cells simultaneously. Rechargeable lithium-ion batteries are available commercially, in sizes suitable for cell phones and portable computers. However, this technology costs more than 30 times that for a practical vehicular power source and has severe safety issues on the large scale. Materials in the cathode such as Li_xCoO_2 need to be replaced with oxides or phosphates containing manganese or iron, and the designer graphites in the anode with materials derived from naturally occurring graphites. In addition, the liquid electrolyte should be replaced with a gel polymer electrolyte for improved safety. Cells with all these different components can be assembled and tested with consistent protocols in EETD laboratories.

A nearer term battery chemistry, being developed for the hybrid car (the Partnership for a New Generation of Vehicles (PNGV) program) has been already been assembled at LBNL. Figure 1 shows the cycling performance of this cell at 25 and 60 °C. These cells were disassembled and the electrodes were tested individually in a separate diagnostic cell. The voltage profiles for the cathode samples, tested against fresh lithium electrodes (Figure 2), show clearly that the source of the full cell capacity loss noted in Figure 1 for the cell cycled at 60 °C is due to the cathode.

Together with the diagnostic capabilities within EETD and the materials development efforts in the MSD arm of the Electrochemical Program, this cell fabrication and testing task should provide a real boost to the larger DOE effort to produce an all-electric car.

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Climate Change and Wildfire Severity in California

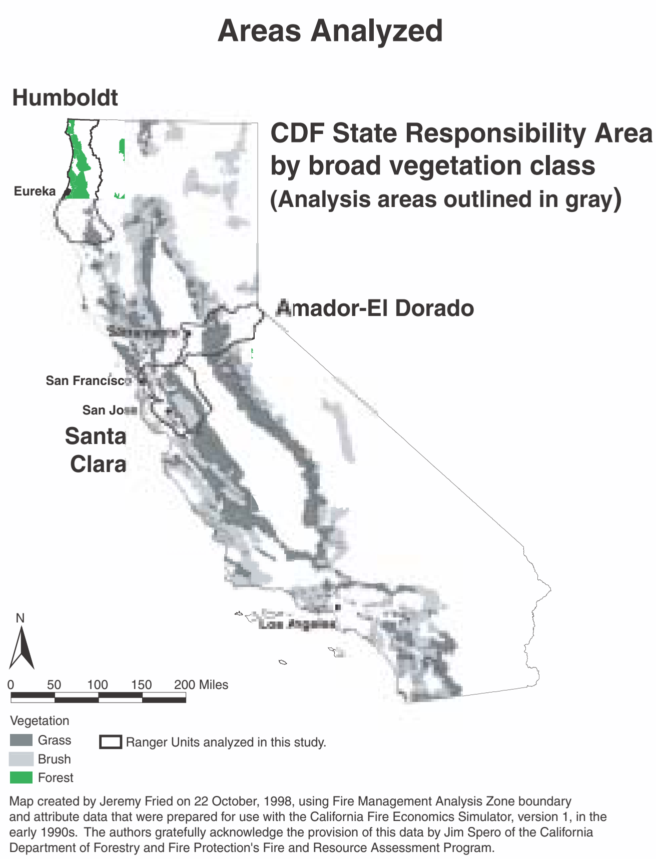
Producing realistic and useful predictions of climate change impacts calls for a systems view that accounts for the combination of direct effects of climate on biogeophysical processes and likely human responses on a regional scale. As a case in point, we estimated the impact of global warming on wildland fire in northern California (Figure 1) by linking general circulation climate model (GCM) output to local weather and fire records, and then projecting fire outcomes with a fire suppression model.

Wildfires are a pervasive risk in the U.S., consuming an average of five million acres per year. The ongoing expansion of low-density residential development into areas covered by flammable vegetation creates wildland/urban interface environments that place more and more people and property at risk from wildfire. Between 1985 and 1994, wildfires destroyed more than 9,000 homes in the U.S. at an average insured cost of about $300 million per year, nearly an order of magnitude greater than during the previous three decades.

The California context is a fertile one for in-depth analysis because it contains a broad continuum of ecosystems where fire plays an important role, and because of the extent of the wildland/urban interface phenomenon. California experiences greater economic losses from wildfire than any other state. Its population growth is strongly concentrated in areas that would be most affected by climatic change.

Climate is one of the main determinants of wildfire regime. By warming and drying vegetation, and by stirring the winds that spread fires, global warming and associated climate change have the potential to increase the severity and extent of wildfires. Researchers applying predictions of general circulation models (GCMs) have consistently found that climate change will lead to increases in the frequency of weather conditions associated with high wildfire hazard and to corresponding changes in weather-related indices of potential fire intensity and rate of spread (Figure 2), increases in fire ignitions, and a lengthened fire season.

Figure 1. Vegetation areas of California analyzed for this study.



However, because prior studies were based on weather indices and not actual fires or fire behavior in specific locales, they could not take into account the complex interaction of wildfires and suppression efforts or the skewed probability distribution of fire severity, in which large and extreme fires are rare and small fires are common. As a result the likely changes in area burned or suppression activity have not previously been quantified.

We employed analytical tools based on the California Department of Forestry and Fire Protection's Changed Climate Fire Modeling System (CCFMS) to extend what was learned from previous studies in new and important directions. Fire and the full suite of relevant climate variables—temperature, wind, humidity and precipitation—are fully integrated into the model. In addition, CCFMS incorporates inputs and provides outputs at a comparatively fine geographic scale which allows analysis by vegetation and/or population density (Table 1 and Figure 3). We tested the sensitivity of results to the outputs of three GCMs, and

Table 1. Annual fire outcomes under present and future double CO_2 climates. Effect of population density shown with the analysis zones demonstrating the greatest impact of climate change.

	Escaped Fires (number)			Average Size of Contained Fires (acres)		
	Present	Future	% Change	Present	Future	% Change
Santa Clara, Grass						
Low Population	2.6	4.7	80%	12.0	16.0	33%
Moderate Population	1.9	2.2	16%	15.4	24.8	52%
Amador—El Dorado, Chaparral						
Low Population	2.4	8.2	242%	5.9	15.5	161%
High Population	2.6	2.9	11%	1.3	2.1	65%

chose one—the Goddard Institute for Space Sciences (GISS) GCM—that yielded relatively conservative impact results.

The warmer and windier conditions corresponding to a $2xCO_2$ climate scenario produced fires that burned more intensely and spread faster than current-day fires. Despite enhanced fire suppression efforts (a.k.a. "dispatch"), the number of "escaped" fires (i.e., those exceeding initial containment limits) increased 51% in the south San Francisco Bay Area, 125% in the Sierra Nevada, and were unchanged on the northern coast (Figure 4). Changes in area burned by contained fires were 41%, 41%, and -8%, respectively. Interpolation of these results to the entire northern California state protection area produced increases of 110 escapes in an average year (a doubling of the current number), and an additional 5,000 hectares burned by contained fires. California already spends $300 million per year on initial attack fire protection; it is conceivable that this might have to be increased by 50% or more to maintain the current escape rate.

By using conservative climate model projections and disregarding hard-to-model secondary impacts such as long-term changes in vegetation dynamics (which would most likely exacerbate wildfire severity by increasing the geographic extent of high flammability fuels such as grass), our estimates represent a best-case forecast.

Fire severity of this magnitude would have widespread impacts on vegetation distribution, forest condition, and carbon storage, and would necessitate costly augmentation of fire-fighting infrastructure, and greatly increase the risk to property and human life.

By generating predictions of changes in escape frequency and area burned that reflect the interaction of fire growth and suppression, our approach goes a step further than previous fire danger index-based techniques in addressing changes in fire statistics of interest to fire and resource planners, and insurers concerned about climate change. These statistics, along with output on the utilization frequency of firefighting resources, can be used by planners and economists to evaluate likely outcomes. Escapes and area-burned statistics for specific geographic areas can also serve as the basis for estimates of impacts on ecosystems, smoke emissions, and economic losses.

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Figure 2. Change in frequency of fires by spread rate (percentage points). Fires tend to spread faster under climate change, especially in the Santa Clara (Bay Area) region.

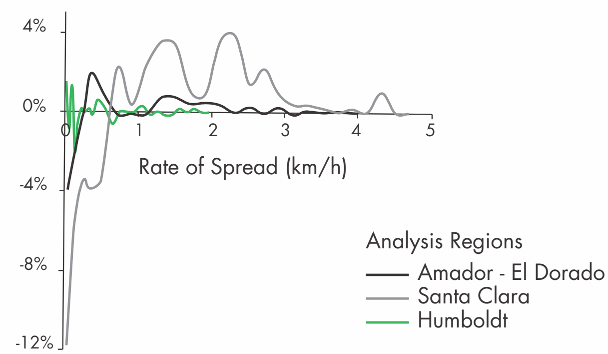


Figure 3. Number of fires at each dispatch level (El Dorado, grass, low-population-density zone). "Dispatch" refers to the level of firefighting effort employed. More high-dispatch fires occur under climate change.

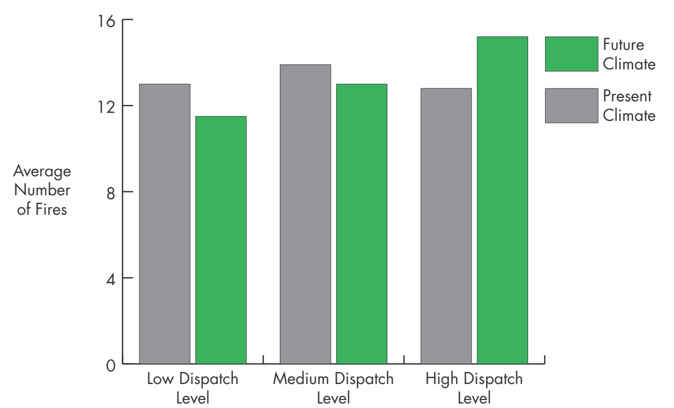
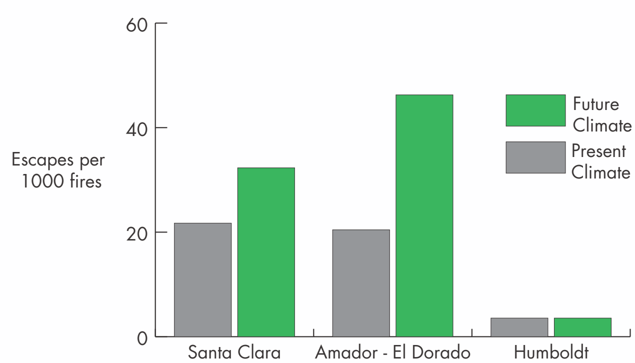


Figure 4. Average frequency of escaped wildfires under present and future (double CO_2) climate scenarios, by region. More fires escape initial containment efforts under climate change.



Cleanroom Energy Benchmarking

Cleanrooms are common in universities, government labs, hospitals, and in the automotive, aerospace, biotechnology, pharmaceutical, and electronics industries. Although energy costs are high, cleanroom owners and operators have little information about how to improve their efficiency. Likewise, little information is available to highlight best practices for the design of new systems. To evaluate the energy efficiency of heating, ventilation, and air-conditioning (HVAC) systems, simple comparisons of energy use per square foot are of little value, since process-related energy (heat load for the HVAC systems) varies greatly from one facility to another.

An EETD research team has conducted a study to benchmark energy performance in cleanrooms. The project developed a benchmarking strategy to obtain the energy end-use breakdown in various industries, and to enable comparisons between cleanrooms housing various processes. Metrics were developed to allow comparison of energy performance of key systems and components.

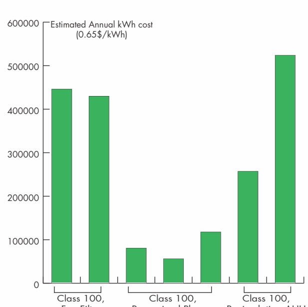
Study method

The metrics allow comparison of widely varying HVAC systems regardless of the design configuration, cleanliness class, or the cleanroom process. By using metrics compiled from design or measured data, this methodology facilitates direct comparison of energy-intensive systems and components.

HVAC performance was measured in terms of cubic feet per minute (cfm) per kW. In a few cases, actual measurement of airflow was not possible due to operational concerns. In those situations, balance reports, energy management control systems data, or design values were used along with actual power measurement. This metric (cfm/kW) was useful for comparing operating efficiency in spite of wide variations in process loads in the room, HVAC system and component design, cleanliness requirements, and other environmental variations. Similar metrics were useful to evaluate other systems performance, such as kW/ton or kW/gal, which were used to compare HVAC water systems.

The team obtained benchmark data for fourteen cleanrooms in semiconductor manufacturing, semiconductor equipment manufacture, electronics research, and disc drive manufacturing. Different cleanliness classes were included in the study; however the sample size of the study was too small to draw conclusions by a cleanliness grouping. Where design data were available, the actual operating efficiency was compared to the design values.

Figure 1. Estimated annual kWh cost for a 1,000,000 cfm class 100 re-circulation system based upon actual measured efficiencies.



Discussion

Energy end use was determined for each of the cleanrooms. The data made apparent that the electrical loads serving the HVAC system and the process systems account for the majority of the energy use. As expected, the relative percentages for each end use varied based on the type of process and variations in the HVAC system design. HVAC energy use in the measured cleanrooms accounts for 36 to 67% of the total facility energy. While the relative percentages vary primarily because of the magnitude of the process system energy consumption and the cleanliness class of the room, the HVAC systems clearly are the dominant contributor to energy intensity in cleanrooms.

Comparison of system efficiency results showed that variation by up to factors of 10 was occurring in the study even though the study covered a small sampling of rooms. To illustrate the potential operating cost ranges for one of these systems (the air recirculation system), a theoretical room size and electricity cost were assumed resulting in a range from $40,000 to over $400,000 annually (see Figure 1).

Recommendations

Although the benchmarking results are useful to begin to bracket the range of operating efficiency, the sample size is not large enough to truly begin to identify best practices. As a result of the study, several recommendations emerged to make energy benchmarking a more robust tool for industry use. Recommendations for further work in cleanroom benchmarking are

- Expand the data set to include a statistically significant number of cleanrooms in each industry or process that uses cleanrooms.
- Expand the data set to include a statistically significant number of cleanrooms of each cleanliness class.
- Develop an energy self-benchmarking protocol for general industry use.
- Develop a web-based data-base of energy benchmark data.
- Develop and publicize best practice metrics from expanded data set.
- Publicize the non-energy benefits identified through benchmarking in case studies.

Energy benchmarking is an effective tool to identify the energy-intensive systems and components in cleanrooms. Through benchmarking, a baseline can be established and then monitored to track energy performance over time. High energy use can highlight attractive energy efficiency improvement areas, maintenance or operational problems, and can lead to identification of best practice values.

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The complete report of this research is available at http://ateam.lbl.gov/cleanroom/benchmarking/index.html

BDA: Integrated Decision Support for the Building Life Cycle

Building Design Advisor (BDA) is a decision-making tool that addresses multiple performance considerations through an entire building life cycle. Over time, BDA has evolved to provide the theoretical basis for developing integrated decision-making tools. Such tools permit architects, engineers, facility managers, and other decision-makers to consider multiple building-performance aspects and their interdependencies. With BDA they can also consider multiple points of view, collaborate toward setting priorities and making decisions, and maintain a dynamic virtual model of a building with all the historical data needed for optimizing the design, operation, and maintenance.

A conceptual model that addresses both data management and process-control requirements for integrated decision-making has been developed for BDA. A single, object-based representation of building components and systems supports the data requirements of multiple simulation and analysis tools. The activation of multiple simulation tools and data exchange is automatically handled by integrating the mechanism for process control within the data schema for the building representation.

Data management and process control

The foundation of the BDA model is an integrated, object-based representation of both data and processes, in the form of a Meta Data Schema. Processes are modeled as objects that are related to parameter objects through input/output relations. Data and processes can be added to this environment without any restructuring of the code, because the code operates on a model with an abstraction of processes as relations among data, rather than on the specific contents of data and processes. Including the "Process Object" as a part of the Meta Data Schema, with input and output links to data objects allows keeping track of interdependencies between the processes and data, and streamlining and automating the activation of processes.

The conceptual model for data management and process control has been implemented and tested as the BDA software, which is now successfully linked to daylighting, lighting, and energy-simulation tools. Most important, the BDA allows use of the output of one simulation program (e.g., daylighting or lighting) as input to another (e.g., energy). Although the underlying concepts involve great complexity, the BDA software is easy to use. Users can analyze and compare the energy and lighting performance for multiple, alternative designs with a few button-clicks.

User interface

The BDA has a simple graphical user interface that is based on three main elements: the Schematic Graphic Editor, the Building Browser, and the Decision Desktop.

The Schematic Graphic Editor (Figure 1) allows designers to specify basic building geometric parameters. Through a default value selector, the BDA automatically assigns "smart" default values to all non-geometric parameters required by the simulation and analysis tools. These values are selected from databases of alternative building components and systems, based on building location and building/space type. These default values can be easily reviewed and changed through the Building Browser.

The Building Browser (Figure 2) allows building designers to navigate the multitude of descriptive and performance parameters addressed by the simulation tools linked to the BDA. Through the Browser the user can edit the values of input parameters and

Figure 1. The Schematic Graphic Editor

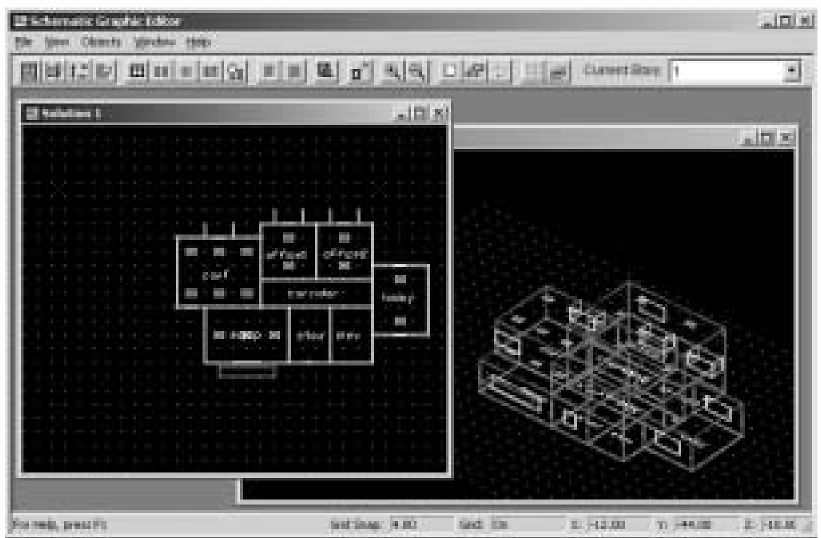
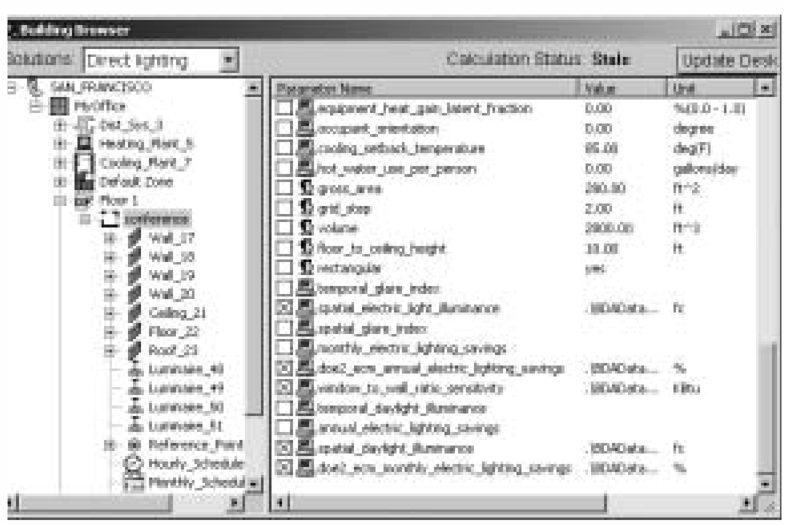


Figure 2. The Building Browser



select input and output parameters to display in the Decision Desktop.

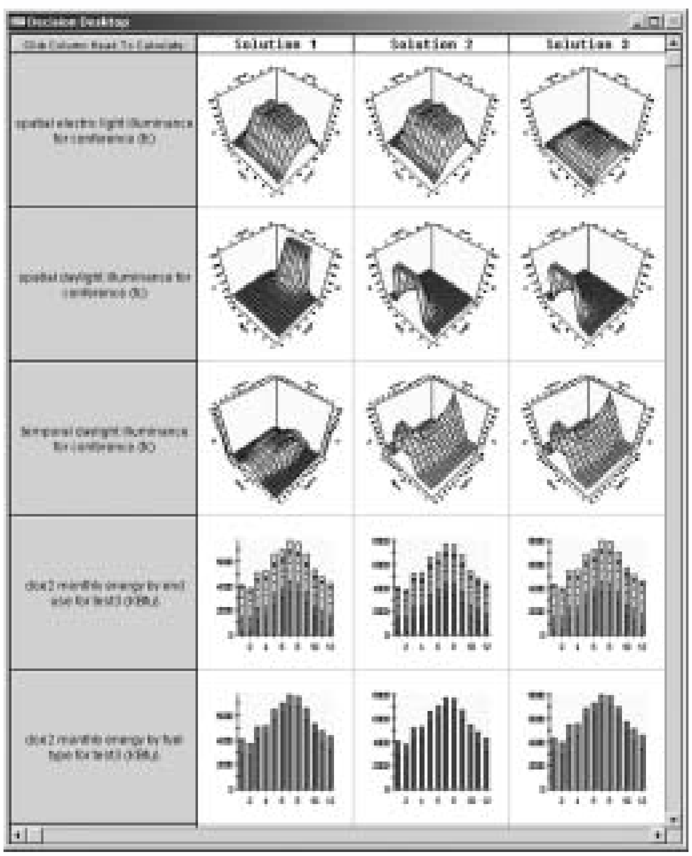
The Decision Desktop (Figure 3) allows designers to compare multiple designs with respect to multiple parameters, as addressed by the simulation tools linked to the BDA. The Decision Desktop offers a graphic display of data, supporting a large variety of data types, including 2-D and 3-D distributions, images, sound, and video. It is structured as a matrix of cells, where the matrix rows correspond to the parameters selected by the user in the Building Browser and the columns correspond to alternative design solutions that have been defined by the user.

Performance prediction and analyses

The latest version of the BDA software (BDA 3.0) supports performance prediction with respect to various performance considerations, through links to a simplified Daylighting Computation Module, a simplified Electric Lighting Computation Module, and the DOE-2.1E Building Energy Simulation software.

For lighting and daylighting analyses, BDA users can define spaces and place luminaires, windows, overhangs, and vertical fins in the Schematic Graphic Editor. Sensor points may be added to observe lighting levels at particular points. Users can select various performance parameters to be computed, e.g., spatial illuminance from daylight, temporal illuminance from daylight, spatial illuminance from electric lighting, and spatial or temporal glare values from daylighting. BDA also supports analysis of control strategies and sensor placement for maximizing energy savings from lighting control while providing visual comfort.

Figure 3. The Decision Desktop



For energy analyses, BDA supplies DOE2.1E with hourly weather information along with a description of the building and its HVAC equipment and occupancy patterns. The energy-related performance parameters that can be computed include annual and monthly energy-use values broken down by end use and by fuel type. BDA 3.0 also supports DOE2.1E parametric evaluations of energy requirements by end use as a function of window-to-wall ratio, allowing quick and easy optimization of window size.

Current status and future directions

Currently, the BDA software is in its 3.0 release and is available free of charge at http://gaia.lbl.gov/BDA.

The BDA software is continuously evolving. Current development plans focus on developing links to the Window 5 databases and the Radiance lighting/daylighting simulation and rendering software. Radiance is one of the most accurate lighting simulation tools available today and allows modeling of spaces of arbitrary complexity. The current tools linked to the BDA (Daylight Computational Model and Electric Lighting Computation Module) can only model simple rectilinear spaces.

The most prominent areas for future research and development are

- streamlining the process control mechanism and allowing user-defined rules for the automation of value assignment, including default values.
- linking the BDA to commercial CAD systems that are already in use by the building industry and will allow greater freedom in specifying geometrically complex spaces.
- addressing collaborative decision-making by allowing concurrent use by multiple users, as well as management of argumentative processes to address multiple positions and arguments for and against them.
- developing a distributed computing environment that would allow use of the BDA software over the Internet, which will be especially useful for collaboration among geographically dispersed participants.

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New Residential Clothes Washer Energy-Efficiency Standard

In January 2001, the U.S. Department of Energy promulgated a new minimum efficiency standard for residential clothes washers. The new mandated efficiency levels will become effective in two stages: in the years 2004 and 2007. In 2004, the standard will mandate an energy reduction of 22% and in 2007, 35%, as compared to the current minimum efficiency standards in effect since 1994. Manufacturers may achieve these reductions in laundry energy use by selecting any design options they like. Many manufacturers are introducing new energy-efficient washers that meet future minimum efficiency requirements even before the required date. These energy savings are being met by modified vertical axis or top-loading designs with a spray wash, as well as by front-loading, horizontal axis washers, sometime referred to as tumble washers.

The new metric for clothes washer efficiency, the Modified Energy Factor, MEF, is expressed as cubic feet of basket capacity divided by energy use, in kilowatt-hours per cycle. MEF includes the energy to heat the water for the clothes washer, as well as the motor energy and a calculated dryer energy.

Most of the energy used in a typical clothes washer is used to heat the water. Therefore, efficiencies are primarily being met by reducing hot water consumption. When hot water energy is reduced, total water use is often reduced as well. Other methods to increase efficiency are to use auto-fill features, better temperature control, and faster spin speeds. The latter spins out more water in the washer so the dryer needs less energy to complete the drying. Data collected from manufacturers show that, on average, they expect to reduce the washer energy by approximately 68%, and the dryer energy by 11%, to achieve an overall laundry energy reduction of 35%.

EETD Role

The Energy Policy and Conservation Act, as amended, mandates that the Department of Energy establish minimum efficiency standards for clothes washers. Researchers in EETD's Appliance Standards Group provide the analysis for the DOE to determine the highest energy-efficiency standard that is technologically feasible and economically justified. EETD's work includes analyzing the impact of technological options on consumers, manufacturers, and the nation as a whole.

This analysis includes several methodology improvements including using distributions for the variables needed in the life-cycle cost (LCC) and payback period analysis. In addition, a distribution of marginal electricity prices was used instead of the usual national average price. The marginal price is the actual price a consumer would have paid for the increment of electricity saved. Using all of the input variables in a Monte Carlo analysis allowed the resulting LCC to be presented as a distribution. Rather than just an average change in LCC, we can now show the percentage of consumers that would benefit from a new efficiency standard and by how much (Figure 1).

In addition to looking at impacts on the consumer, impacts to the nation as a whole were also determined. Cumulative energy savings to the nation, forecasted to the year 2030, were estimated at 5.5 quadrillion BTUs (Quads). In addition, the standards are expected to save 11.6 trillion gallons of water through 2030. A cost-benefit analysis shows that on a national basis, the reduction in the operating costs of washers compliant with the standard outweighs the increase in the initial cost of the clothes washers. Analysis included a forecast of future shipments based on a decision tree model that accounted for price elasticities, operating cost elasticities, forecasted fuel prices, housing starts, increased sales of used washers, and other variables. The existing clothes washer stock was modeled using a retirement function that provided input into how many new washers would be purchased in future years. Detailed charts were created showing trends in future clothes washer shipments and national costs and benefits to the year 2030 (Figure 2).

In addition to the consumer and national impacts described, researchers analyzed national emissions, employment, and alternatives to national standards.

—Peter Biermayer

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Figure 1 .Distribution of consumer life-cycle cost impacts due to a new efficiency standard. The distribution is skewed heavily toward consumer benefits (to the right of $0 on the x-axis).

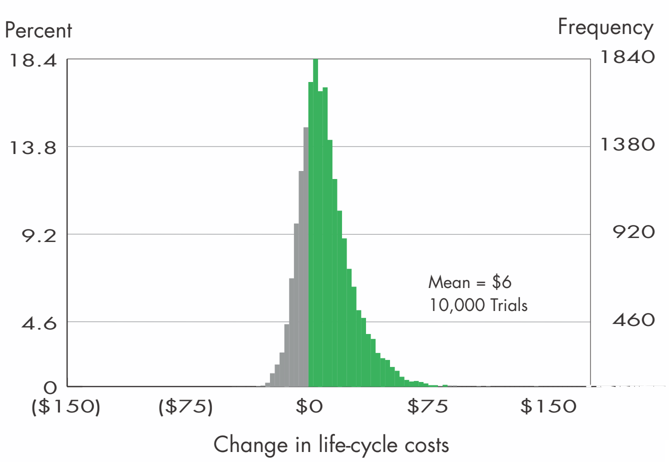

Figure 2. Cost and savings from clothes washer standards.

Research Highlights

World's Smallest Laser

One of the smallest lasers ever made—far too small to be seen even with the aid of the most powerful optical microscope—has been successfully tested by a team of researchers from Lawrence Berkeley National Laboratory, including members of the Environmental Energy Technologies Division and the University of California at Berkeley. This device, which emits flashes of ultraviolet light, is called a “nanowire nanolaser” and it measures just under 100 nanometers in diameter, or about one ten-millionth of an inch.

The nanowire nanolasers are pure crystals of zinc oxide that grow vertically in aligned arrays like the bristles on a brush. These crystal wire “bristles”" range from two to 10 microns in length, depending upon the duration of the growth process. By comparison, the tiniest solid-state lasers in use today are fashioned from thin films of either gallium arsenide or gallium nitride and generally run several microns thick, or about one hundred thousandths of an inch. A typical human hair is about 100 microns thick.

Peidong Yang, a chemist with Berkeley Lab's Materials Sciences Division and a professor with UC Berkeley's Chemistry Department, was the lead scientist on this project. Collaborating with Yang from Berkeley Lab were Henning Feick and Eicke Weber, also with the Materials Sciences Division, and Samuel Mao and Rick Russo of the Environmental Energy Technologies Division. Joining them were Michael Huang, Haoquan Yan, Yiying Wu, and Hannes Kind, of the UC Berkeley Chemistry Department. A paper reporting this work appeared in the June 8, 2001, issue of the journal *Science.*

This research was supported by funds from the Chemical Sciences Division and the Materials Science Division of the Office of Basic Energy Sciences in the U.S. Department of Energy; UC Berkeley, the Camille and Henry Dreyfus Foundation, the 3M Corporation, and the National Science Foundation.

For more information, see the following websites: http://www.lbl.gov/Science-Articles/Archive/nanowire-laser.html and http://www.pnl.gov/energyscience/10-01/brf.htm#brf5

Indoor Air 2002

Staff members of the Environmental Energy Technologies Division's Indoor Environment Department are helping organize *Indoor Air 2002.* This meeting is the largest multidisciplinary international conference series in the field of indoor air sciences. Past conferences have typically attracted about 1000 delegates plus exhibitors and accompanying persons. The Organizing Committee anticipates the largest gathering in its 24-year history—up to 900 papers and 1500 participants. Indoor Environment Department Head William Fisk and senior scientists Richard Sextro and William Nazaroff (also of the University of California, Berkeley) are members of the organizing committee. Hal Levin, a scientist in IED, is serving as the Conference President.

For more information, see http://www.indoorair2002.org

EETD Hosts ACEEE Attendees

In conjunction with the American Council for an Energy-Efficient Economy's (ACEEE) annual meeting, researchers from the Division presented some results of their work at a reception held at LBNL. In the photos, (top) Alan Meier discusses standby electricity losses and (bottom) Charlie Williams and Katie Coughlin demonstrate real-time electricity and supply conditions in California.

Berkeley Lamp Saves Berkeley Money

The energy-efficient Berkeley Lamp developed by scientists at EETD is now saving the City of Berkeley some good money, according to measurements made by EETD researchers and the city's Energy Office.

The announcement was made at an October 30, 2001, ceremony marking the donation of Berkeley Lamps to the city. The event was attended by Berkeley Mayor Shirley Dean, City Manager Weldon Rucker, City Energy Officer Neal De Snoo, the Lab's Acting Public Affairs Director David McGraw, as well as the lamp's developers—Michael Siminovitch and Erik Page of EETD.

Mayor Dean called the lamp “quite impressive,” and said that "it is enormously gratifying that [Berkeley Lab], a great public resource, is working with the city" to help to reduce its energy bill. City Manager Rucker, acting as master of ceremonies at the event, praised the Lab's cooperation with the City.

McGraw thanked the mayor and the city manager "for giving us this opportunity to inaugurate a new era in our relationship with the City of Berkeley."

The Berkeley Lamp combines energy efficiency with high-quality lighting, using two fully dimmable compact fluorescent lights, specially designed optics, and separate light switches to provide room illumination through both "uplight" and "downlight" (table) illumination.

The ceremony was held in the lobby of the building housing the city's Engineering Office, across the street from the Berkeley Civic Center. A large, open office area housing city engineers has been "re-lamped" by the lighting researchers. The 2,200-square-foot space has very little natural light. Thirteen Berkeley Lamps and a pair of compact fluorescent torchieres (also developed by the Berkeley Lab group) have replaced the room's overhead lighting.

"The lamps have reduced peak demand by 50 percent, and kilowatt-hour consumption by nearly 60 percent, saving $915 per year in this room," said De Snoo during a tour of the retrofitted facility. Prior to the retrofit, the space used about 30 kwh/day of energy and 2500 watts of power. "After the retrofit, the space uses a little more than 10 kwh/day for lighting, and we have cut peak power use in half. We have also reduced carbon emissions from the burning of fossil fuels from six tons of carbon dioxide per year to 2.5 tons," he said.

De Snoo added that the city will make these lamps available to Berkeley residents through its energy-efficient purchasing program, in addition to installing more of them in city offices. "By early next year, you'll be able to buy these at the Berkeley Farmer's Market," he said.

(left to right) Erik Page, Berkeley Mayor Shirley Dean, Michael Siminovitch, and David McGraw at the Berkeley Lamp ceremony.

Berkeley Lab Scientist Profiled in Book on American Inventors

Inventing Modern America: From the Microwave to the Mouse, a new MIT Press book highlighting the contributions of 35 major American inventors, includes a chapter on Environmental Energy Technologies Division scientist and inventor Ashok Gadgil.

Gadgil is the inventor of UV Waterworks, a device that disinfects drinking water inexpensively and energy-efficiently using ultraviolet light. He developed the idea for this device after an outbreak of cholera in 1992 in India killed 10,000 people. The technology has won a *Discover* magazine for technological innovation award and *Popular Science's* "Best of What's New" award.

Inventing Modern America: From the Microwave to the Mouse profiles inventors who exemplify the rich technological creativity of the US over the past century. The book was developed by the Lemelson-MIT Program for Invention and Innovation, whose mission is to inspire a new generation of American scientists, engineers, and entrepreneurs.

Others profiled in the book include George Washington Carver, Henry Ford, Steve Wozniak, and Douglas Engelbart, inventor of the mouse.

For more information on *Inventing America,* see http://web.mit.edu/invent/www/ima/. For UV Waterworks, see http://eetd.lbl.gov/CBS/archive/uv/index.html.

Another honor was recently bestowed on Ashok Gadgil when the American Physical Society elected him to Fellowship. The Society elects only one half of one percent of the total APS membership to Fellowship in the Society each year. Gadgil was elected for his outstanding work modeling air and pollutant transport inside buildings, analyzing energy issues in developing countries, and developing UV Waterworks.

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EETD News is also available on-line (http://eetd.lbl.gov/News/). Starting with this issue, the *News* will be available in two electronic formats: we will continue to publish the stories on the Environmental Energy Technologies Division's site, and we will also provide a downloadable PDF document that will have the same look as the print version. In future, we will e-mail you when a new edition is available. To receive *EETD News* electronically, e-mail EETDinfo@lbl.gov, putting "Electronic Copy" in the subject line and providing your name and mailing address. Thanks for your interest in the *EETD News*.

—Editorial Staff

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Ron Reade Receives DOE OPT Young Investigator Award

Ron Reade of EETD's Advanced Energy Technologies Department received the DOE Office of Power Technologies (OPT) Young Investigator Award.

Ron was one of five National Lab researchers who received these first-ever awards. He was nominated by LBNL Director Charles Shank for the work that he—along with fellow researchers Rick Russo and Paul Berdahl—is doing for OPT on developing a new method for ion beam texturing (ITEX) of buffer layers on flexible non-magnetic substrates. A high temperature superconductor can then be deposited on the buffer layer. The ultimate goal is mass production of a cost-effective thin film superconducting wire for electricity transmission. More information about OPT and superconductivity is available at http://www.eren.doe.gov/power. Ron is a member of the Physical and Chemical Technologies Group in AETD (http://eetd.lbl.gov/AET.html).

Sources

EREC: Energy Efficiency and Renewable Energy Clearinghouse

P.O. Box 3048, Merrifield, VA 22116

call toll-free: (800) 363-3732; **fax:** (703) 893-0400

email: doe-erec@nciinc.com; **http://www.eren.doe.gov**

Energy Crossroads

Energy-efficiency resources on the Web:

http://eetd.lbl.gov/EnergyCrossroads

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