#3691

SOFTWARE

# Comparing Building Energy Analysis Software

by Peter Weiss and Marilyn Brown

***The U.S. Department of Energy has developed several software packages for energy analysis, which can help auditors, program managers, architects, and others to calculate the energy effects of different design and retrofit options. This article describes four of these packages and notes some of their strengths and weaknesses.***

Early techniques for predicting the energy performance of alternative building design and retrofit options were typically cumbersome and inaccurate. All too often the result was a building that did not perform according to expectations despite the multitude of painstaking and tedious calculations that went into analyzing it. Through the use of computer software tools, architects, auditors, engineers, builders, researchers, and others now are able to more accurately predict how a building will perform.

Because energy software tools reduce the uncertainties associated with investing in energy-saving technologies, the U.S. Department of Energy (DOE) has supported their development. The simulation features of software design and audit tools permit experimentation without the risk and cost of design failure in the field. Moreover, the incorporation of new research results into software programs enables practitioners to put these results to work quickly. Historically, many research results were too complex for easy presentation in a form that people in the field could readily use. With today's software, research results are quickly made usable. This article reviews four software packages originally developed by the U.S. Department of Energy for mainframe computers, that have been adapted for use with personal computers. (While the mainframe versions are in the public-domain, in some cases, when private companies did the modification, the PC packages come with a price tag.)

Dozens of programs have been written for residential applications, varying greatly in price, building type (single-family, multifamily), ease of use, and performance (see Table 1). "DOE-Sponsored Microcomputer Tools for Buildings Energy Analysis: Applicability to Multifamily Retrofit

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### List of Lists: Reports, Reviews, Directories

1. "Residential Energy Simulations In the Pacific Northwest: A Comparison of Four Widely Used Models," a 1986 discussion available from ASHRAE, 1791 Tullie Circle, NE, Atlanta, GA 30329.
2. *Software Catalog for Home Builders*—1989 Edition, NAHB National Research Center, NAHB Bookstore, 15th and M Streets, N.W., Washington, DC 20005-4099.
3. *EnergyWare: The World Directory of Energy Conservation and Renewable Energy Software for Microcomputers*, 1989, Windbooks, P.O. Box 4008, St. Johnsbury, VT 05819; (802) 748-2425.
4. *Suppliers of Residential and Commercial Energy Analysis and Management Software*, National Appropriate Technology Assistance Service, U.S. Department of Energy, P.O. Box 2525, Butte, MT 59702-2525; (800) 428-2525. This is the listing we added to the Mills/Ritschard list in Table 1. The NATAS version gives names, addresses, and phone numbers of 48 suppliers throughout the United States, plus a brief description of the software and services they provide, including prices.
5. *Northeast Sun*, Northeast Solar Energy Association, P.O. Box 541, Brattleboro, VT 05301. *Northeast Sun*'s Drew Gillett has been reviewing energy software since 1984—see the 12/84, 8/85, 10/26, 12/86, 2/87, 6/87, 2/88, and 12/88 issues.
6. "The Best Energy Software," in *Solar Age*, May 1986. This article reviews HOTCAN, SUNPAS, SUNHOUSE, F-CHART, EEDO, DAYLITE, CALPAS3, and MICROPAS.
7. "Commercial Audit Software Comparison," in *Energy Notes*, April 1985, Oregon State University Extension Service. A tabular comparison of ASEAM, SEA, ADM, ESE, ENET, XENCAP, and others.
8. *The National Directory of Energy Software for Microcomputers* lists more than 100 problems for buildings energy analysis.
9. For multifamily, see "Evaluation of SHOW Multi-family Energy Audit Methodology," David Tooze, Portland, Oregon, Energy Office, 1987. (SHOW stands for State Home Oil Weatherization.)

Thanks to NATAS for helping us compile this list.

# SOFTWARE

Evaluation" reviewed four DOE-sponsored programs, including ASEAM 2.0, CIRA (EEDO), COSTSAFR, and PEAR 2.1. Although the draft report's authors, Lawrence Berkeley Laboratory scientists Evan Mills and Ronald Ritschard, focus on multifamily building retrofits, their review contains valuable insights for users working with other building types as well.[1] This article reviews the same four software packages (although we focus on the more recent version of ASEAM, 2.1) and draws heavily upon the conclusions of Mills an Ritschard concerning their relative strengths and weaknesses. If you have an IBM-compatible personal computer (XT or greater) running DOS 2.0 or higher, you may find what you need among these four.

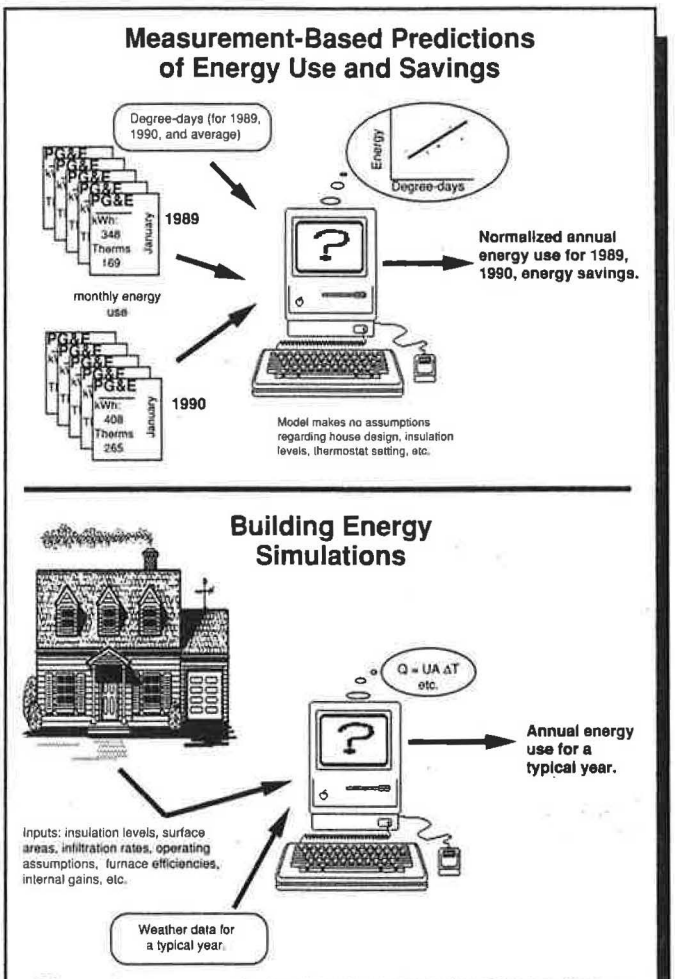


**Figure 1. A comparison of two types of energy software tools—by understanding the differences, the best tool for the job can be selected.** The energy use of a building can be analyzed prospectively, that is, predicted, or retrospectively, that is, based on historical data. The models described in this article, such as EEDO, are prospective. Retrospective models are also useful to track actual energy use and costs. Utility billing data, plus a small amount of other information, can be powerful tools in understanding a building's actual energy use behavior. One commonly-used retrospective tool is PRISM (see *HE*, Nov/Dec '87, p. 27), which compares utility bills to weather.

The LBL report lists 23 other programs that perform building energy analysis, by address and phone number of supplier, intended application, and price. We have brought this list up-to-date, fleshed it out with some new products, and reprinted it here (see p. 15). We've added our own "List of Lists" (see p. 13) to aid those who want to explore the subject still further. It describes reports, reviews, and directories of building energy analysis software.

There are also many programs available to track the energy use of a building (or buildings). These are typically spreadsheet-based, and are designed primarily for accounting, that is, to monitor utility costs, rather than to perform any kind of energy analysis. The energy software using utility bills are completely different from the simulation models discussed in this article. A third type of software analyzes measured savings after retrofits. (See Figure 1.)

## The Programs

### *ASEAM 2.1, A Simplified Energy Analysis Method*

*Developed by W.S. Fleming and Associates, $175 for educators, $225 for others.*

This program is designed to provide architects, engineers, energy-management professionals, code officials, educators, and others with a simplified energy analysis system for residential, commercial, industrial structures. ASEAM 2.1 simulates the heating and cooling requirements of buildings, predicts the energy-saving potential of alternative conservation measures, and can be used to assess energy-code compliance.

Its modeling capabilities range from the simple single-family home to immense and complex structures. In fact, the Department of Housing and Urban Development's headquarters building in Washington, D.C., recently was analyzed using ASEAM 2.1.

W.S. Fleming & Associates of Albany, N.Y., developed ASEAM. The design tool can model up to 10 distinct zones in a building and simulates 13 different types of residential and commercial heating, ventilation, and air-conditioning (HVAC) systems. Annual climate and solar data are provided for 46 cities in the continental United States, and routines for user-supplied weather data are also available.

ASEAM 2.1 is menu-driven, with easy-to-read screens. Unfortunately, a great deal of descriptive data is required to fully capitalize on its algorithms, along with considerable knowledge of building science. ASEAM 2.1 provides a "Quick Input" feature, though, which only requires a simple building description, drawing default values from ASHRAE's commercial standard, 90.1P. (See Figure 2.)

Even though ASEAM 2.1 has only been available as a PC-based program for a year and a half, it is already in widespread use to analyze the retrofit opportunities in buildings that are audited by federal and state programs. DOE's Office of State and Local Programs encourages programs to use ASEAM and will offer workshops to train conservation and weatherization specialists and energy engineers on the software. (See "Hands on Training...") The software was a recent recipient of a DOE National Award for Energy Innovation.

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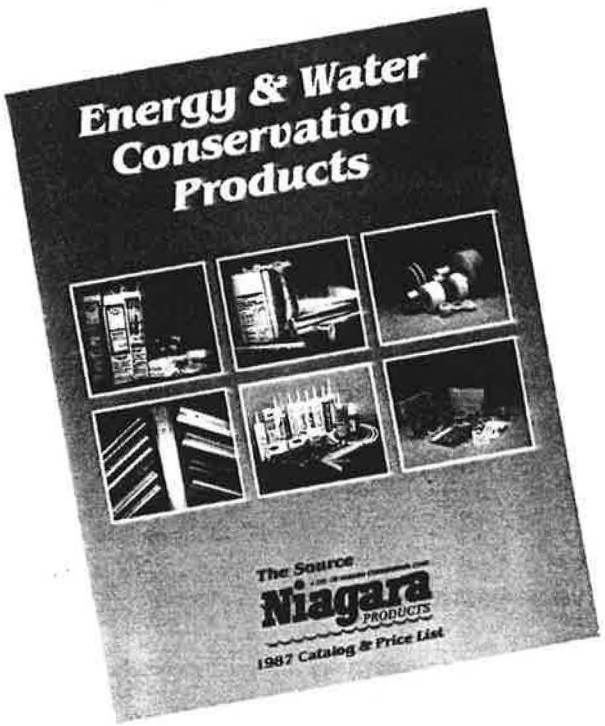


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## Energy Analysis Software

| Name | Contact Information | Price |
|---|---|---|
| ADM-2 | Taghi Alreza<br>3299 Ramos Circle, Sacramento, CA 95827<br>(916) 363-8383 | $595 |
| ASEAM2.1 | Dale Stanton-Hoyle<br>ACEC Research Management Foundation<br>1015 15th St., N.W., Washington, DC 20005<br>(202) 347-7474 | $225, $175 for educators |
| AUDITORx | Infiltec<br>P.O. Box 1386, Falls Church, VA 22041<br>(703) 820-7696 | |
| BESA | Jeff Blake<br>Canadaplan Resources, Inc.<br>393 Rymal Road West, Hamilton, Ontario<br>Canada L9B 1V2<br>(416) 389-3893 | $950 |
| CALPAS 3 & 4 | Maggie Boyce<br>Berkeley Solar Group<br>P.O. Box 3289<br>Berkeley, CA 94703<br>(415) 843-7600 | $795 |
| CARE | Air Quality Labs, Inc.<br>W. 112 Montgomery, Spokane, WA 99205<br>(509) 325-4281 | |
| E20-II | Carrier Corporation<br>P.O. Box 4808, Syracuse, NY 13221<br>(315) 432-3885 | $935 |
| EEDO 1 (CIRA) | Al Sain<br>Burt Hill Kosar, Rittleman Associates<br>400 Morgan Center, Butler, PA 16001<br>(412) 285-4761 | $395 |
| ELECTRICHEAT or RESIDENTIAL LOADS | Tim Smith<br>Cornerstone Energy Group<br>P.O. Box 4904 DTS, Portland, ME 04112<br>(800) 888-8881 | $250 |
| AUDIT (2) | Susan Boher<br>Elite Software<br>P.O. Drawer 1194, Bryan, TX 77806<br>(409) 846-2340 | $395 |
| ENERCALC | Larry Degelman<br>Texas A&M University, Dept. of Architecture<br>College Station, TX 77843<br>(409) 845-7852 | |
| ENERCOM | Nick Kendle<br>Enercom<br>6115 So. Kyrene Rd., Tempe, AZ 85283<br>(602) 831-7779 | variable |
| ENERGY DESIGNER | Dr. M. Ucar<br>7123 Thorntree Hill Drive, Fayetteville, NY 13066<br>(315) 637-0538 | $995 |
| ENERGY-$AVE | Peachtree Associates<br>P.O. Box 1312, Decatur, GA 30031<br>(404) 373-3000 | $195 |
| ENVEST | Alliance to Save Energy<br>1925 K St. NW, Suite 206<br>Washington, DC 20006<br>(202) 857-0666 | $55 |
| ESPRE | R.L. Merriam<br>Arthur D. Little, Inc.<br>25 Acorn Park, Cambridge, MA 02140<br>(617) 864-5770 ext. 5887 | |

| Name | Contact Information | Price |
|---|---|---|
| F-CHART | F-Chart Software<br>4406 Fox Bluff Road, Middleton, WI 53562<br>(608) 836-8536 | $400 |
| FASER | Omni Comp<br>P.O. Box 332<br>336 So. Fraser St., St. College, PA 16804<br>(814) 238-4181 | $990–2990 |
| FREMACS | Pacific Energy<br>319 SW Washington, Suite 1211<br>Portland, OR 97204<br>(503) 224-3020 | $1295 |
| HOTCAN 3.01 | Energy Analysis Software<br>P.O. Box 7081, Postal Station J, Ottawa, Ontario<br>Canada K2A 3Z6 | $149 |
| LOAD 123 | E. Jessup's Assoc.<br>4977 Canoga Ave., Woodland Hills, CA 91364<br>(818) 884-3997 | $120 |
| MICROPAS EASY | Eric Torney<br>Energy Toolworks<br>207 Kent Ave #1, Kentfield, CA 94904<br>(415) 461-8077 | $385 |
| PEAR | Ron Ritschard<br>Lawrence Berkeley Laboratory, Building 90-3125<br>Berkeley, CA 94720<br>(415) 486-6328 | free |
| RL5M | McClintock Corporation<br>MC2 Engineering Software<br>P.O. Box 430980, Miami, FL 33143 | $295 |
| SASEAP | Sud Associates Programmers, Inc.<br>1805 Chapel Hill Road, Durham, NC 27707<br>(919) 493-5277 | $1025 |
| SUNCODE-PC | Mike Kennedy<br>ECOTOPE<br>2812 E. Madison, Seattle, WA 98112<br>(206) 322-3753 | $650 |
| SUNHOUSE | Danny Parker<br>Precision Environments<br>P.O. Box 243, Helena, MT 59624 | $104 |
| SUNPAS/ SUNOP | Bill Ashton<br>Solarsoft, Inc.<br>1406 Burlingame Ave. # 31, Burlingame, CA 94010<br>(415) 342-3338 | $289 |
| TRAKLOAD | Morgan Systems Corp.<br>2560 9th St., Suite 211, Berkeley, CA 94710<br>(415) 525-4736 | $1,485-5,000 |
| TRANSYS | Ruth Urban<br>University of Wisconsin, Solar Energy Laboratory<br>1500 Johnson Drive, Madison, WI 53706<br>(608) 263-1589 | $500-1,000 |
| VAL YOU | Dave Young<br>Val You Systems<br>320 First Ave. S.E. , Watertown, SD 57201<br>(605) 886-3764 | $49-249 |
| VCACS | Rick Ogel<br>Volt Energy, Sacramento, CA<br>(916) 929-8708 | $10,000 |
| XENCAP | Steve Bowles<br>Xenergy Inc.<br>60 Mall Road, Burlington, MA 01803<br>(617) 273-5700 | variable |

# SOFTWARE

ASEAM 2.1 includes 3 introductory disks and 16 disks with program, weather, economic, and source code files on 5 ¼ inch diskettes for IBM and IBM-compatible PCs. It requires 256K RAM, as do COSTSAFR and PEAR 2.1, whereas EEDO only needs 64K.

**Project Data Screen 2**

**Operating Schedules:**
**Typical weekday occupancy starting hour** 8
**Typical weekday operating hours per day** 14
**(Use only 8, 10, 12, 14, 16 hours)**

**Summer thermostat schedule beginning month number** 5
**Summer thermostat schedule ending month number** 9

**Time Zone Number** 5
**(5=Eastern 6=Central 7=Mountain 8=Pacific)**

**Daylight Savings Time Used (Y/N)** Y

**F3 - Delete Entry F8 - Default F9 - Help F10 - Menu**

**Figure 2. ASEAM 2.1's "fill-in-the-blank" menu screens simplify data entry.** There is no need to memorize command structures. The Quick Input feature dramatically reduces the time needed for a first-cut analysis. It automatically provides 80% of the data normally required for energy analysis after you enter the basics, such as building size, type, and location.

The program is available to educators for $175 and to others for $225 from Dale Stanton-Hoyle at the American Consulting Engineers Council (ACEC) Research Management Foundation, 1015 15th St., N.W., Washington, DC 20005. DOE Support Offices also have copies of the software and user's manuals.

## *CIRA, Computerized, Instrumented, Residential Audit*

*Written at LBL. The original version of CIRA runs on CPM machines but for IBM-compatible personal computers, the same program is available as EEDO (Energy Economics Design Options) from Burt Hill Rittleman Associates (Butler, PA); $395.*

EEDO is a collection of programs for energy analysis and energy auditing of residential buildings. It estimates monthly heating and cooling energy for single-family residences of 5,000 sq. ft. or less. EEDO models many HVAC systems, including furnaces, boilers, heat pumps, wood stoves, baseboard heaters, central and room air conditioning, and evaporative coolers, plus various distribution systems: steam, water, forced air, and gravity. It can also be used for houses in many different climates.

EEDO's unique retrofit optimization procedure deserves special note. Given the user's budget, the program will rank retrofit options based on nationally averaged costs, which are part of the program's data base, or on actual costs, entered by the user. Each retrofit is defined by a change in one or more of the following: (1) the building load coefficient, (2) the furnace or air conditioner efficiency, (3) internal gains, or (4) the heating or cooling distribution losses.

EEDO uses sophisticated algorithms, but without the complex input requirements of ASEAM 2.1. EEDO is flexible and easy-to-use, and is also easy to learn: the on-line introduction to the program is so helpful that you rarely need the extensive user's manual. EEDO gives useful output, both in graphs and tables, and offers a built-in calculator and graph-drawing capability (two variables only) so the user can easily make independent calculations and charts.

Mills and Ritschard fault EEDO on its run-time. The program can calculate energy use in about 30 seconds but a more typical run, which includes retrofit optimization, takes seven minutes, making it the slowest of the four programs. EEDO is also unreliable for large, multi-zoned buildings. It works best as a tool for analyzing single-family dwellings.

## *COSTSAFR, Conservation Optimization STandard for SAvings in Federal Residences*

*Created by the Federal Residential Standard Project (Pacific Northwest Laboratories and LBL) and Steven Winter Associates, Inc., free.*

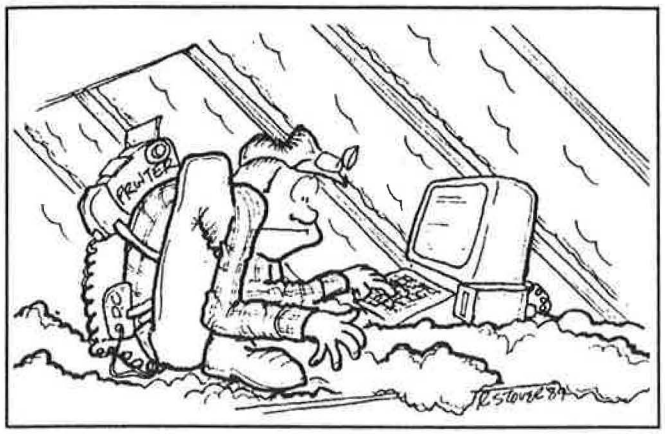
If you were shopping for an energy-efficient house or instituting a home energy rating system, COSTSAFR could

### Hands on Training for ASEAM 2.1

**by Sarah Kirchen**

Managers of local, state, and non-profit residential programs may want to take advantage of a series of hands-on training workshops on ASEAM 2.1 As a result of attending one recent workshop, staff of the New Jersey Division of Energy Planning and Conservation have found several uses for ASEAM. Joe Korb, director of operations, reports that the program assists in the oversight of utility-sponsored residential programs. "Our engineers and other energy professionals find it handy for checking the output of algorithms we propose for utilities to adopt in their audit programs," explains Korb. "It also helps us conduct sensitivity analyses on the various updates of costs that determine what retrofit recommendations result from an audit." Korb went on to explain that the relatively inexpensive software tool is a significant alternative to the hand calculations he and other state energy managers would be likely to use.

Workshops have been held for 11 states' energy conservation, weatherization, and engineering staffs. Several workshop formats are available, from one-and-a-half-day beginners' sessions to two-day sessions for advanced users. All workshops are hands-on, usually with two attendees per computer. Workshops may be tailored to the specific needs of individual offices. The majority of recent workshop participants say they are now better prepared to do conservation-measure assessments and are ready to perform a first cut at modeling a building by themselves, according to Lou Harris of the DOE's Office of State and Local Programs. For more information on workshops contact: Dale Stanton-Hoyle at ACEC, tel: (202) 347-7474; or Harris, tel: (202) 586-9794.




help you rank buildings by energy-thriftiness. But, as an auditor or retrofitter who wants to know actual energy costs or savings, you will find COSTSAFR ill-suited to your needs. "A degree of 'creativity' is required when applying the program to retrofit analysis," note Mills and Ritschard.

COSTSAFR does not output annual energy consumption or savings. Rather it assigns point values to each energy-saving or -wasting feature of a building. The user has to sum these component scores him or herself; the total score indicates the relative energy-efficiency and cost-effectiveness of the building design. COSTSAFR uses a point system because it is intended as a procurement tool for evaluating new construction.

Once the building's point score has been determined, COSTSAFR uses it to compute the 25-year net present value (NPV) of energy costs for the design. Mills and Ritschard say you can "back-calculate" the annual energy savings from the NPV, "given some effort." They point out, however, that attempts to evaluate retrofit options will be stymied by the program's automatic inclusion of energy-saving measures that aren't usually considered as retrofits, such as continuous vapor barriers. COSTSAFR models furnaces, heat pumps, electric resistance baseboard heaters, and central air conditioning, but overlooks distribution, efficiency, and duct-loss variables. It can be used to evaluate single- and double-section mobile homes; ranch, split-level, and two-story homes; or townhouses and apartments.

Beyond its obvious flaws for audit and retrofit applications, COSTSAFR comes under fire by Mills and Ritschard for its slow speed (5 minutes) and for having an apartment model that allows too little user customization. Although it comes with a user's manual and three additional support documents discuss it, the program lacks any other technical support. COSTSAFR also requires your computer to have a math coprocessor.

### *PEAR 2.1, Program for Energy Analysis of Residences*

*Produced by LBL, free.*

PEAR 2.1 is a simple, flexible program for analyzing the annual heating and cooling loads of new single-family homes and townhouses. The program is the simplest to use and fastest of the four programs, according to Mills and Ritschard, with a user-friendly way of displaying its results. Calculated loads appear numerically and as bar charts, which show each building component's contribution to annual energy use. The program calculates simple payback time and savings-to-investment ratio (SIR) and saves and displays previous results to allow easy comparison of a variety of options.

PEAR 2.1 uses a database of more than 15,000 computer simulations compiled for the DOE-sponsored "Energy Guidelines for New Single-Family Residences." Its extensive database enables PEAR 2.1 to estimate the annual energy use of houses that have various combinations of

## New from DOE: Window 3.1

**by Susan Reilly**

Assessing window thermal performance has become even more complicated with the introduction of new products, such as low-emissivity glass coatings. WINDOW 3.1 (the updated version of WINDOW 2.0), simplifies this assessment and allows the consumer, designer, architect, manufacturer, and researcher to consider the multitude of window options available.

WINDOW 3.1 calculates the heat transfer across a window as a function of the inside and outside temperatures and the incident solar radiation. The user inputs the thermal and optical properties of the glass, the type of gas-fill for multiple-pane windows, the frame and spacer type, and the physical dimensions of the system. The program includes "libraries," or data bases, of the thermal and optical data necessary for specifying a window in WINDOW 3.1. It contains a glass library, a filler gas library, a frame and spacer library, and a window library. The program assumes ASHRAE standard winter and summer environmental conditions, and in addition permits the user to enter environmental conditions, including the indoor and outdoor temperatures, the outdoor wind speed, the direction of the wind, and the direct solar radiation incident on the window.

The U-value of a window is proportional to the amount of energy transferred through a window due to the difference between the indoor and outdoor air temperatures. Multiplying the U-value by the temperature difference gives the total energy loss or gain per unit area of the window. WINDOW 3.1 returns the center-of-glass U-value, a U-value for the total insulated-glass unit, and a complete window U-value if a frame is specified. The center-of-glass U-value does not include the effects of the spacer or the frame on the heat transfer through the window; the U-value for the insulated-glass unit accounts for the edge effects; and the window U-value includes the influence of both the spacer and the frame.

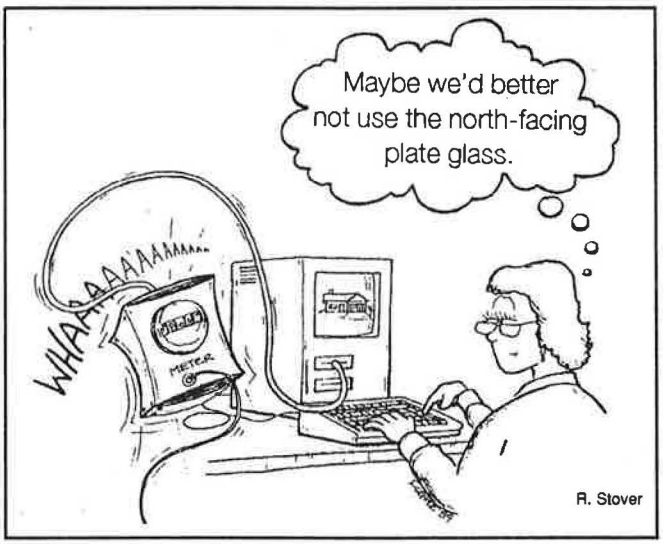
WINDOW 3.1 displays the temperature distribution across the center of the window, and the relative humidity at which condensation will occur on the inside glass surface. The shading coefficient and relative heat gain are calculated for ASHRAE summer conditions. The program also gives the total solar and visible optical properties for the window.

The Windows and Daylighting Group at Lawrence Berkeley Laboratory developed WINDOW 3.1. The program is public domain, works on any IBM PC or compatible, requires 64 kBytes of memory, and can be run by simply typing "W3" in the directory on which the program resides. The program allows the user to enter the window configuration and see the results on one screen. The software can be obtained at no charge from BOSTIK Construction Products. To receive a copy, call 800-523-6530 (in PA call 215-674-5600) or write to the firm at P.O. Box 8, Huntingdon, PA 19006.

ceiling, wall, and floor insulation; window types; infiltration levels; and heating and cooling equipment efficiences. The program can analyze homes heated by oil and gas furnaces, heat pumps, and electric-resistance heating. Users can estimate the more subtle effects of roof and wall color, movable night insulation on windows, whole-house fans, reflective and heat-absorbing glazing, an attached sunspace, and automatic thermostat controls. Adjustments can be made for different building geometries, window areas, orientation, and wall construction.

The program's results are customized to reflect climate conditions of nearly 900 different U.S. locations. In comparison, ASEAM 2.1's database includes more than 60 locations; EEDO, more than 200; and COSTSAFR, about 875.

The PEAR 2.1 program is contained on one diskette and can be used on a PC with at least 128K memory. It is available, along with a user's manual, at no cost from Lawrence Berkeley Laboratory.




## If That Didn't Overwhelm You...

The four programs reviewed in this article make up a tiny sampling of the building analysis software that is available (Table 1). You may find a package adequate to handle your retrofit analysis and audit requirements. However, all of the 27 PC-based whole-building retrofit analysis programs Mills and Ritschard examined shared the following drawbacks:

- None handles cogeneration or demand-reduction retrofits, nor do any include utility rate schedules, energy accounting, or linkages to statistical packages.
- Only ASEAM is compatible with a spreadsheet program (Lotus 1-2-3).
- All the programs could enhance their graphics and retrofit libraries.

Remember that these models are never more accurate than the information entered. They cannot correct errors (although some alert the user to out-of-range values) nor include the consequences of improper installation or operation of equipment. The use of default values, while often greatly speeding up data entry, also increases the likelihood of unrealistic answers. Never, ever, believe any computation beyond the first two significant digits.

## Shopping Criteria

When comparing different software packages, keep in mind the following questions:[2]

- How accurate is the program? Has it been tested for accuracy? Programs can be "validated"—meaning program results have been compared to actual field data, like utility bills, or "intercalibrated"—the results have been checked for consistency with the results of other programs. EEDO and PEAR 2.1 were intercalibrated with DOE-2 simulations.
- Is support available? For example, DOE provides some support for ASEAM 2.1; the price of EEDO includes support from its distributors. This is especially important if you're not familiar with other analysis software from previous experience.
- Does it do what you need it to do? (Do you want to audit existing homes, design new ones, or evaluate retrofit programs?)
- What measures can it model? All those you would normally consider? Those you might consider in the future? Solar, domestic hot water, control systems?
- What are the program's technical capabilities? Are heat transfer methods, building load factors, zoning capabilities taken into consideration? Does the program understand different building types and HVAC systems?
- What level of sophistication does the program offer, and do you need it? Some programs give an illusion of accuracy belied by real-world experience, i.e., by the inconsistency of R-values and thermostat performance.
- Do you want to be able to enter hourly data, monthly, or annual?
- Do you want to calculate the annual energy savings, simple payback, or net present value?
- How much does it cost to use? Does it run on your current hardware or require any additional software? (e.g., for graphics, ASEAM 2.1 requires a color card; COSTSAFR requires a math coprocessor)
- How fast does the program run, and will it slow you down?
- Is the model's output compatible with a spreadsheet?
- Will the graphics and reports help you communicate with customers?

Happy hunting! ■

**Endnotes**

1. To obtain a copy, contact Ron Ritschard, at Lawrence Berkeley Laboratory, Mail Stop 90-3118, 1 Cyclotron Rd., Berkeley, CA 94720.
2. A more scientific system for comparing software was developed by the Building Energy Design Tool Development Council in July 1984, Evaluation Procedure for Building Energy Performance Prediction Tools, Vol. 1.