Energy Savings at Harvard - $ 2.5 Million

Reprinted by Mon-Ray, Inc., from the American School & University Magazine

Harvard University has embarked on an exceedingly successful energy conservation program in recent years. For the fiscal year ended June 30, 1975, Harvard's energy bill totaled $8.5 million. Without the measures taken by Harvard, the energy bill, based on 1972-73 energy consumption and 1974-75 costs, would have been $11 million.

Harvard's energy conservation program is under the direction of Stephen S. J. Hall, Vice President for Administration for the University. Previously, Mr. Hall was Vice President of Operations Support for the Sheraton Corporation. He joined Harvard in 1971 and is quick to point out that the steps he has taken at the University are available to anyone who is involved in the operation of buildings.

For one thing, Hall's energy conservation program makes extensive use of computers to keep him and his staff informed, on an immediate basis, as to energy use at Harvard. The most important number on the computer printouts they receive is the Graph Factor, a concept developed by Hall when he was with the Sheraton Corp.

The Graph Factor represents the actual energy usage of each building compared with a theoretical factor. Each building on the campus has a Graph Factor and it is this number that enables Hall and his staff to quickly spot trouble in a building and take action if this figure starts to move upward. The overall Graph Factor for the 1974-75 heating season was 1.48, compared with 1.73 for the 1973-74 heating season, an improvement of 14.45%. For the two heating seasons there was only one degree difference in the total number of degree days.

Sever Hall, in the heart of Harvard yard, was made more energy efficient by installation of new storm windows. However to avoid a "new" look for the building, the windows have a black anodized aluminum finish to retain the old traditional appearance of the building.

"We get a reading everyday on how much steam Harvard is using," says Mr. Hall, "and we make a calculation of the volume of steam each building is using, allowing for the cubic feet in the building and the degree days. We calculate every building once a month, and, since some buildings have labs or kitchens in them, we are able to accumulate experience on the effect these sources of heat have on maintaining proper temperatures in the buildings."

Four Key Factors

Mr. Hall believes that conserving energy is a function of 4 basic elements:

(1) Having a very current awareness of any problems as they develop and the ability to respond quickly to take corrective action - the Graph Factor system of comparing actual vs. theoretical.

(2) Making everyone part of the process - cooperation and awareness on the part of the occupants of the buildings.

3) Making what you have more efficient—How easy or hard it is to control the basic mechanical heating and air conditioning system, and whether or not the system for producing and distributing heated and cooled air is efficient, and is maintained properly.

(4) Making basic capital improvements to the basic system—such things as insulation, storm windows, control of exhaust fans and dampers, or "keeping as much of what you put into a building as you can, inside."

As far as capital improvements are concerned, some 4,340 storm windows have been installed at Harvard, with an additional 10,000 storm windows currently being installed. Also, a computer-controlled building automation system has been installed and connected to 4,500 points, such as fans, vents and dampers on the campus.

"Not many people on the campus are aware of our automation because the connecting lines and cables are underground," says Hall. "They're not aware, for example, that Massachusetts Hall, which was built in 1720, is automated. Harvard is a very traditional University, and that tradition is important to the thousands and thousands of people who are our graduates. Our objective is to modernize, be up to date and ahead of the time, but to maintain the tradition and feel of the campus.

"Storm windows, in particular, are crucial," says Hall. "When you add them to a building you are draping the building with a new architectural component and if you're not careful you can change the entire look of a building. But the window has to perform well thermally, too."

The windows selected by Hall were DeVAC Mon-Ray Model 604. They were selected only after Hall had engaged an independent testing laboratory (L. H. Antoine & Associates, St. Louis) to run tests on 9 different windows. Air infiltration through the windows as well as overall construction and product quality were evaluated, and the Mon-Ray windows came out significantly on top.

Mr. Hall feels that it is almost impossible for the un-informed purchaser of windows to make an intelligent window selection, and that the only way to do so is to have impartial tests run on the window products that are under consideration. Also, the window manufacturer's warranty of products should be studied closely to see what recourse there is if the windows perform unsatisfactorily after installation.

"We calculate the average payback period for the cost of the windows at 5 years," says Hall, "and in some instances, such as Kirkland Hall it's substantially less. In fact, Kirkland Hall has been an interesting building for us. It's a residential dormitory, and when we began planning to install two-track storm windows there, many people on campus told us 2 things: (1) The storm windows wouldn't work because the students wouldn't keep the windows closed, and, (2) The two-track windows, which do not have operating screens, would not work because the students like to stick their heads out of the windows. Both of these statements turned out to be fallacies."

Computer Control

In the control room that houses the building automation system, there is a book which lists every 'point' on campus that is connected to the system. Thus, when a call comes in for air conditioning, it's a simple matter to "punch up" the status of each point in that particular building on the cathode ray tube. If, for example, most of the vents are closed and the fans are not operating, they can be turned on immediately. This may take care of the problem so that chillers won't have to be turned on. The chillers used to run all of the time and were a major consumer of energy at Harvard. Now they are shut down as long as possible by bringing outside air into the building, instead of chilling the air. With automated control, everything is monitored—return air temperature, mixed air, preheated air, delivered air, whether dampers are open or closed, etc.

"We also adjust our schedules to conform to the occupancy schedules of the buildings," Mr. Hall explains, "and when we know we're going to have to turn on the chillers, we wait until the buildings fill up and a certain temperature is reached before turning them on. Air handling is timed by the clock, but with the chillers we use our judgment." Mr. Hall also feels that being able to anticipate the weather is very important. "I feel that a high degree of energy saving can result from anticipating what the weather is going to do, and we have put in some instruments at Harvard to help us forecast the weather—such things as wind direction and speed, relative humidity, outside air temperature and a barometer. It helps tell us whether to turn on the heat early, or hold off. Humidity plays a part, and we also have to learn how particular buildings act. If a building has bad windows, it's going to need more heat when it's windy."

Ivy on the walls may have some insulating value, but the big savings comes from the storm windows on Massachusetts hall, which is reported to be the oldest educational building in the U.S. In replacing the original windows, the frames and muntins had to be duplicated to the exact tolerances specified by the Cambridge Historical Commission.

"All in all, we've reduced energy consumption at Harvard at an 8% compounded rate per year for the last 4 years. There are so many ways in which real energy savings can be made that people are not addressing because they don't understand how to address them. The measures we've taken at Harvard are available to anybody. The capital expenditures that are necessary pay for themselves in a short time and then provide continuing savings into the future."