

Small Campus Reaps Results through Energy Management

by Glenn Gilbert



Curbing utility costs has become a high priority for all institutions during the last year. While consideration of new forms of energy production such as wind power and solar collection is increasing and evaluating how we purchase energy is important, nothing can reduce energy costs faster than conservation. Goshen College, a small four-year residential Christian liberal arts college operated by the Mennonite Church and located in northern Indiana, has developed a good program of conservation through the use of technology, education, building facility upgrades, and the cooperation of faculty, staff, and students.

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Managing Energy

In 1990, Goshen College applied for and received an energy conservation grant through the State of Indiana to implement the beginnings of a computerized energy management system on campus. Prior to that time, academic buildings were heated as if they were occupied 24 hours a day, seven days a week. It was not practical to shut down equipment or set back temperatures. If mechanical equipment failed in the middle of the night, such as a boiler malfunction or a broken pump or fan, it most likely wouldn't be noticed until a college employee came in the next morning. It was not uncommon for students in residence halls to control their temperature in the winter by opening windows.

The early management system was modest—making simple temperature setbacks based on time-of-day scheduling and adjusting the heating system based on outdoor air tem-

perature. At first, fewer than half of the buildings had any computer controls or monitoring. But slowly, over time, the energy management network grew, until now, 16 years later, hundreds of small controllers spread around campus are networked to larger field cabinets linked via the campus fiber optic network to a server that controls and monitors literally thousands of points of information in every building on campus, including most of the off-campus small group houses.

Not only does the energy management system stop and start equipment and set back temperatures at night; it also:

- Controls most of the outdoor lighting. Goshen College operates over 50 kilowatts of outdoor lighting, which costs about \$4 per hour to operate. By using the energy management system rather than a photocell to turn the lights on at dusk and off at dawn, and turning off about a third of the outdoor lights in no-traffic areas off at 1:00 a.m., the energy management system saves about \$4,400 annually without compromising safety.
- Maintains fresh air by monitoring carbon dioxide levels in the theater, performance halls, church sanctuary, and the library. When those spaces are empty or minimally occupied, air is efficiently recirculated, but when carbon dioxide-producing people are present, the system responds and introduces the required fresh air.
- Measures indoor and outdoor enthalpy to provide "free cooling" with outdoor air in a number of buildings; not all cool outdoor air is appropriate for cooling the indoors if the humidity is too high.
- Determines when heating systems should be shut down and air conditioning systems started up, based on the time of the year and outdoor conditions. Several buildings are "two-pipe systems" requiring changeover from hot water to chilled water seasonally. Automation quickly translates into improved comfort and reduced labor costs.
- Monitors steam pressure in the central power plant and sends an alarm to maintenance staff if a boiler should fail.
- Monitors the campus electrical system, so a one-megawatt emergency generator can be started if needed.
- Monitors refrigerators and freezers in the cafeteria kitchens, and sends an electronic page to maintenance staff if the temperatures get out of range (this has saved thousands of dollars worth of food over the years). This system also alerts kitchen staff when a door is left open too long.
- Detects moisture to anticipate and prevent floods in basements and technology centers. Overflow sensors on condensate pans of air

conditioning units protect ceilings and other occupied spaces from water damage.

- Monitors air flow in fume hoods in the our science building labs. Proper building and room pressurization is also maintained to ensure that fumes travel in the right direction without excessive exhaust.
- Provides control and safety with temperature and humidity sensors located across the campus.
- Stops and starts campus fountains. In one case the height of the fountain is also controlled to prevent overspray, using an anemometer to check the wind speed and reduce the circulation pump speed of the fountain on windy days.
- Monitors CO sensors in mechanical rooms and laundries in our campus housing facilities to protect our students from potential carbon monoxide poisoning.

How Have We Been Doing on Energy Consumption?

We have all heard and felt the impact of the sharp spike in natural gas prices this past year. For a college campus, the ramifications are considerable. In our case, in October 2004, Goshen College consumed 27,368 therms of natural gas at a cost of \$19,165; in October 2005, we consumed 3 percent less gas but it cost the college \$35,564—an 85 percent increase in cost. Electricity prices are also climbing as the utilities make fuel-cost adjustments.

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As a response to the increased energy costs, Goshen College, like most other institutions, looked closely at how we used our energy and how we might be able to make cutbacks. Some institutions arbitrarily set back thermostats system-wide and imposed deep temperature setbacks at night. Such measures can create unhappy building occupants and these changes, while effective in the crisis, are difficult to sustain.

At Goshen College we took a different approach. We chose to meet with representatives from every department in every building on campus to discuss temperature setpoints and occupancy schedules that they thought they could live with. We discussed the particular characteristics of the spaces that they occupied and the possibilities and limitations of the HVAC systems in their buildings. These conversations yielded several important results. As building operators, we learned how the occupants were experiencing their environment. At the same time, the occupants learned more about how the systems functioned. We were able to agree on setpoints and occupancy schedules that they felt were sustainable, and we learned about other ways that they thought energy might be saved. Over time, the good will and cooperation of everyone involved yielded substantial energy conservation.

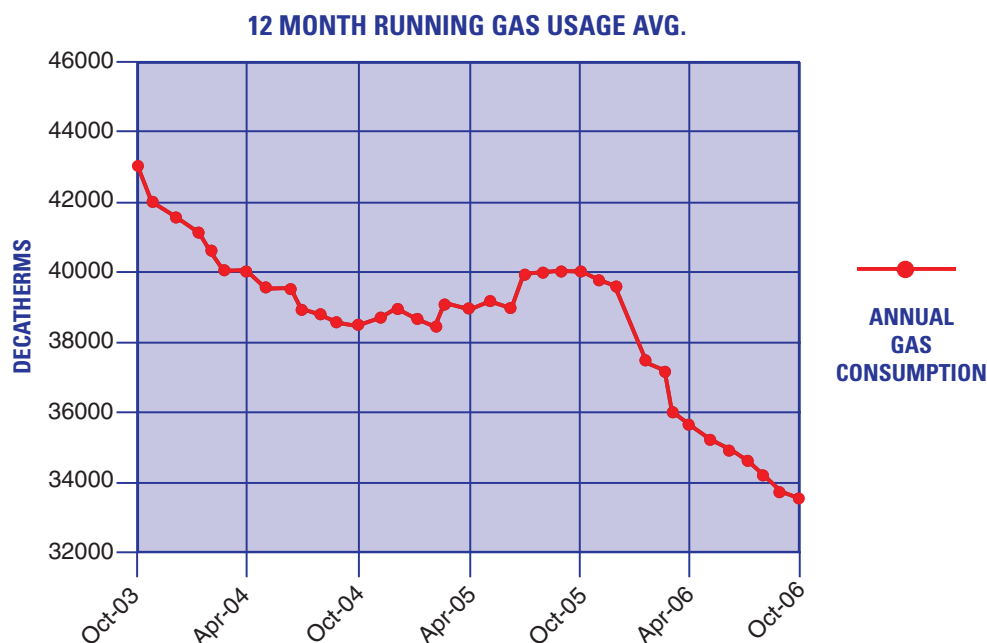
Because Goshen College had invested in computerized energy management over the years we were in a much better position to customize adjustments and tailor temperature settings so that energy could be saved without compromising comfort. Individual classrooms, labs, and offices could have temperatures adjusted from hour to hour, providing heat (or air-conditioning) only when the spaces are occupied. Computerized controllers can look at outdoor and indoor temperatures and anticipate how soon heating and air-conditioning needs to be started to bring a space to satisfactory temperatures at the time of occupancy.

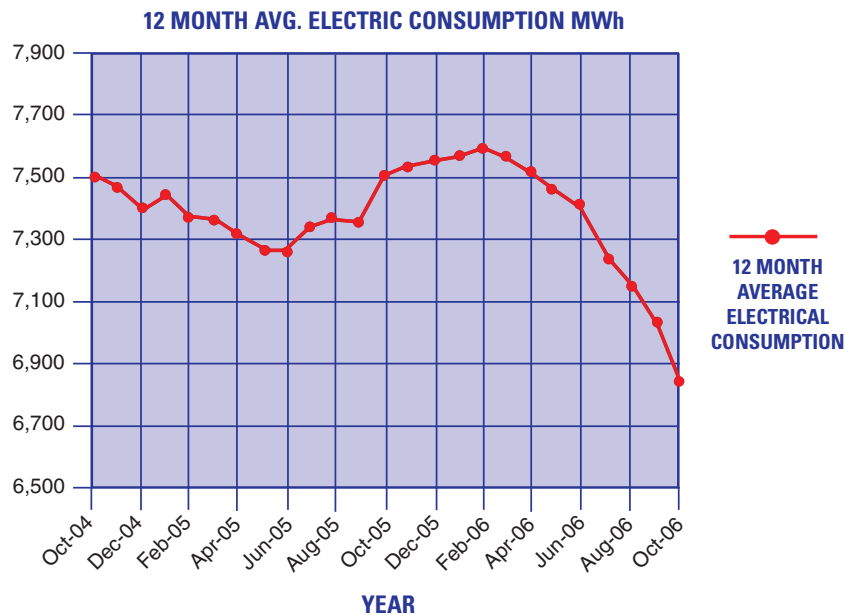
In addition to the commitment to reduce consumption through the utilization of our building control systems, Goshen College has made numerous other investments to our infrastructure to reduce energy costs. In addition to switching off unneeded lights, dialing down thermostats, and using less air-conditioning, some of the other energy conservation measures we have taken recently, or are currently in progress, include:

- Building envelope improvements such as window upgrades and additional insulation in our roofing systems
- Conversion from antiquated steam heat to high efficiency local hydronic boilers
- Lighting retrofits in the gymnasium and exercise areas of the recreational fitness center
- Conversion to higher efficiency lighting throughout campus
- Increased use of motion detectors and timers for controlling lighting in restrooms, library stacks, and other public spaces with intermittent usage
- Installation of variable frequency drives on circulator pumps and fans to reduce electrical consumption
- Additional capacitors for power factor correction
- Improved ambient lighting controls to reduce the unnecessary lighting during daylight hours
- Installation of an automatic swimming pool cover, to reduce dehumidification and heating costs.

The following graphs of our central gas and electric meters show the results of these initiatives. In the last three years our overall gas consumption has declined 23 percent in spite of increasing our campus square footage by over 42,000 square feet.

Our electrical consumption in the last two years has declined almost 10 percent while at the same time we have





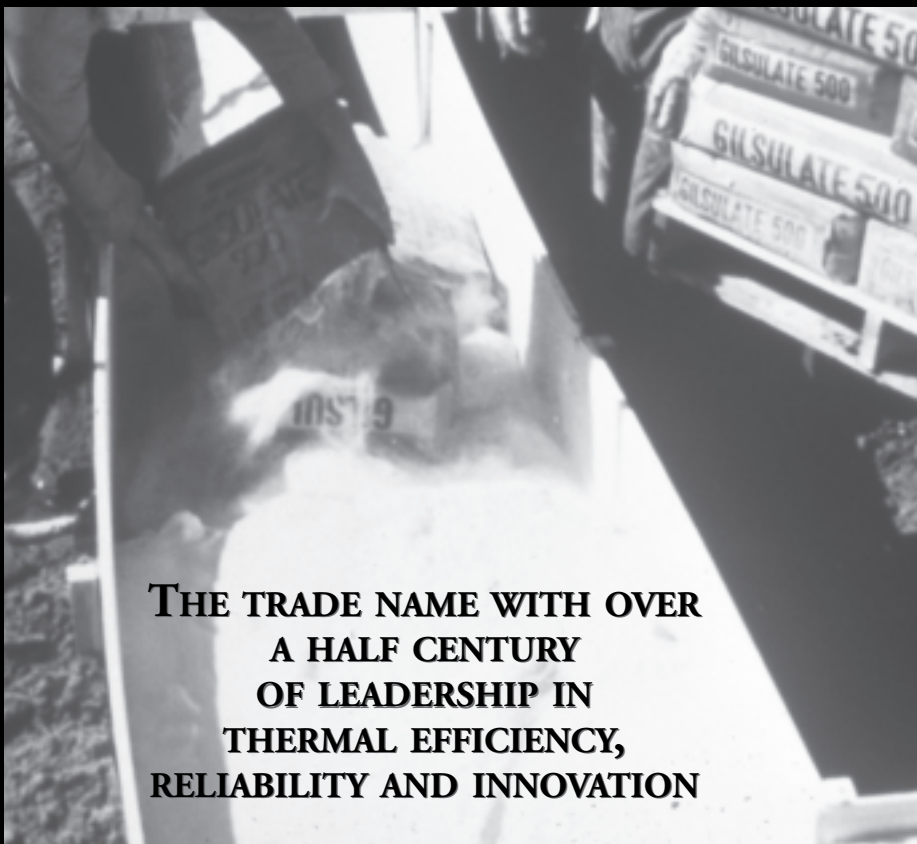
added air conditioning to our major residential halls and built new housing facilities.

While there are good reasons to be apprehensive about high energy costs these days, this is also a great opportunity to reevaluate our lifestyle choices and day-to-day habits to find new ways of being better stewards of our limited resources. Certainly technology can help us make better uses

of energy, but the best means of conservation come through the personal choices we make. At Goshen College, through the use of available technology, we have found many ways to reduce our consumption of our energy resources resulting in both immediate and long-term savings to our operating budget. 🏠

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