

Purdue University

CASESTUDY

Purdue Controls Energy Costs and Ventilation with CO₂ Sensors



“It was easy to install, easy to maintain, and saved energy by not conditioning more outside air than was necessary”

Luci Keazer
Controls Systems Engineer, Purdue.

Project

Indoor air quality (IAQ) is a high priority for Purdue University, so much so that an IAQ team comprised of supervisors, industrial hygienists, mechanical engineers, and other interested staff hold monthly meetings to discuss IAQ issues. To further this dedication to healthy environments, Purdue recently installed Telaire carbon dioxide (CO₂) sensors to monitor and control the ventilation in six of its largest lecture halls. Demand Controlled Ventilation (DCV) was seen as the way to provide both the desired air quality and to keep a rein on energy costs.

“It is a win-win technology,” according to Luci Keazer, Controls Systems Engineer at Purdue. “I applied for a Venture Grant (from the physical facilities budget) to provide a technology that would deliver the right amount of air for the space usage”.

A coeducational, state-assisted system in Indiana, Purdue University is one of the nation’s leading research institutions with a reputation for excellent and affordable education. This dual goal of excellence and affordability pervades the institution, right down to its facilities management.

Client Goal

Purdue University sought a way to provide the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)-recommended ventilation rate in an economical way. Maintaining the ASHRAE recommended ventilation rate can be difficult and expensive with the variable occupancy of a classroom. Using a CO₂ sensor allows ventilation to be controlled based on the actual number of people in a classroom. The sensor is wired to the ventilation system and automatically provides the right amount of fresh air so students will not experience drowsiness and headaches, which can impair productivity as well as be uncomfortable.

According to Keazer, "The best applications are lecture halls and classrooms. While use is pretty solid from 9 a.m. to 4 p.m., it falls off in the evening. But the air handlers are still in the 'occupied mode' until 10 p.m." This change in occupancy resulted in using an unnecessary amount of energy to heat and humidify air in the winter, and to cool and dehumidify air in the summer. The university had, in fact, suffered a shortage of chilled water provided to the cooling coils on especially hot days.

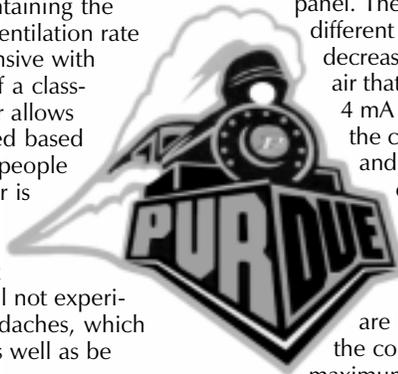
Scope of Work

Purdue has over 100 buildings on campus with several types of existing automation systems. The university was looking for a CO₂ sensor that did not need much maintenance or calibration, and would work with all the existing automation systems. After researching the different sensors available, Purdue purchased six Telaire® Ventostat® 8002W CO₂ sensors.

The Venture Grant covered the cost of the equipment and the associated installation costs for each of the six locations. The installation was done by university maintenance technicians and involved installing wiring and power from the control panel to the equipment.



Class of 1950 Lecture Hall



A CO₂ sensor is duct-mounted in the return air duct for each room that is being controlled. The 4-20 milliamp (mA) output signal from the CO₂ sensor is wired to the control panel. The control panel reacts to the different mA signals by increasing or decreasing the amount of outside air that is brought into the room. A 4 mA signal from the sensor tells the control panel that CO₂ levels and occupancy are low, so the control panel calls for the minimum amount of outside air. A 20 mA signal tells the control panel that CO₂ levels and occupancy are high. When this happens the control panel calls for the maximum amount of fresh air. If the outside air temperature allows for free cooling, the CO₂ signal is ignored and the maximum amount of outside air is brought into the room.

Equipment

The Telaire® Ventostat® 8002W CO₂ Ventilation Controller features a five year calibration guarantee, multiple output options, on-board programming, and is specified for accuracy of ± 50 parts per million (PPM) at 1000 PPM. The five year calibration guarantee was an important factor in Purdue's decision making. "We wanted to be able to trust the equipment and not have to check it very often," according to Keazer.

Employees can monitor CO₂ levels and students are ensured that CO₂ concentration levels remain at or below 700 PPM above the outdoor air level of 375 PPM. This reading indicates that ventilation rates of 15 cubic feet per minute (CFM) per person are maintained at all times, as recommended by ASHRAE.

Benefits to owner

Purdue used energy analysis software to determine the estimated energy savings from using the Telaire® Ventostat® 8002W. They provided input including occupancy, room size, and expected occupancy levels, and projected that there would be a 50% reduction in ventilation with a cost savings of \$0.14 to \$0.23 per square foot in the lecture halls.

Keazer stated that the university doesn't measure energy on a room or building level, but is convinced that the reduced need for conditioning ventilation air has provided a 1 to 2 year payback on the equipment. "We are ventilating adequately by demand, not by a schedule."

Another unexpected result was noted. One sensor indicated that there was an under-ventilated space of which the facility management was unaware. "We added

another outside air damper as a result of the troubleshooting we were able to do with the CO₂ sensor."

Project Status

The Ventostat® 8002W sensors were installed and were operational in the spring session of 1999. The calibration was checked, and found to be in line with expectations. Purdue University is completely satisfied with the sensors that have been operational for over a year. They have identified 10 more locations in which they plan to use the equipment.

Applications/Feedback

Educational institutions are finding the many reasons for using CO₂ sensors to provide both improved air quality for employees and students and to reduce energy costs. Most classrooms are partially empty some of the time, full for a period of time, and empty for more than half of the day. Sensors fit into most existing automation systems with the addition of simple wiring.

Purdue University, like many other schools and academic institutions, found a sensor that would reliably provide the right amount of fresh air needed, based on the sensing of occupancy in a room. "It was easy to install, easy to maintain, and saved energy by not conditioning more outside air than was necessary" is how Keazer summed up the project. The Telaire® CO₂ sensors make sense for schools and classrooms.

TELAIRE®

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It is our intention to keep the product information current and accurate. We can not cover specific applications or anticipate all requirements. All specifications are subject to change without notice. For more information or questions relative to this Specification Sheet, contact Telaire.

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