Wireless HVAC controls retrofit saves money and energy for students at San Diego State University

CASE STUDY SNAPSHOT

Associated Students of SDSU have reduced electricity use in their recreation center by 18% and natural gas use by 55% using the Vigilent® Intelligent Energy Management System to transform their CAV system to approximate a VAV system.

Building Type: Recreation and exercise facility

Size: 76,000 square feet

Annual energy savings: 268,000 kWh & 9,300 therms

Project Cost: $70,000

Simple Payback: Immediate

Benefits:

- Estimated annual utility bill savings of $38,000
- Greenhouse gas emission reduction of 166.5 metric tons of CO_2e annually
- Supply fan speeds automatically controlled to meet space needs, minimizing energy use
- Energy Management Dashboard shows real-time fan speed, zone temperature, and energy usage

When students exercise in San Diego State University's Aztec Recreation Center, they are giving the building a workout as well—in the form of heating, cooling, and ventilation. Now, thanks to the installation of a sophisticated new HVAC control system, it has become easier for the building to keep up with its 775,000 annual visitors. The quick and simple control system retrofit has shrunk building electrical energy use by 18% and natural gas use by 55%, giving the Associated Students a big boost in their bid to achieve net zero building energy use by 2020.

The Vigilent® Intelligent Energy Management System uses artificial intelligence to dynamically adjust building airflow to respond to changes in demand throughout the day. Air delivered to the facility's spaces now more closely matches actual needs, saving energy through reduced cooling, heating, and fan operation. The retrofit has transformed the building's original constant air volume (CAV) system into one that approximates the performance of a variable air volume (VAV) system.

Facility Profile: Aztec Recreation Center

The Aztec Recreation Center is a 76,000 square foot fitness and gymnasium facility. It is a large, open building with 25-foot ceilings and a variety of fitness areas, including workout machines, weights, group fitness, and a 30-foot climbing wall. The facility is open 24 hours daily except Friday and Saturday, when it is closed from 10 pm to 8 am. Four air handlers, each served by one supply and one return fan, meet the facilities' ventilation requirements. Chilled water from the SDSU campus plant provides cooling and natural gas provides heating.

The building's HVAC system was designed as a CAV system, with sufficient capacity to keep the building cool and well ventilated

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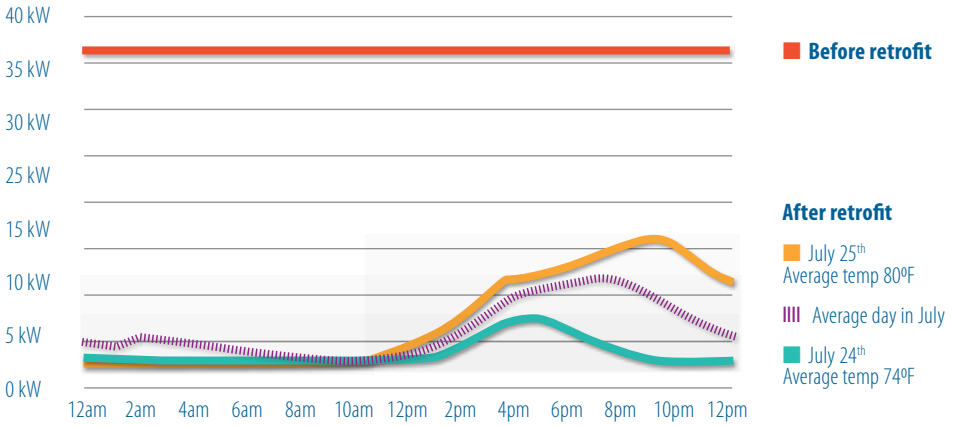
Case Study | SDSU Aztec Recreation Center

> "The energy savings from the Vigilent project at SDSU's Aztec Recreation Center have been more impressive than expected. I check the status of the system regularly and have come to depend on the dashboard to monitor building temperature. In these tight economic times, saving money on our utilities allows us to increase funding for additional programs, facility and equipment upgrades."
>
> Eric Huth, SDSU Associated Students Recreation Director

Fan Energy Use Comparison Before and after Vigilent® wireless HVAC retrofit, July 2011



on the hottest summer days at maximum occupancy. However, an HVAC system that constantly operates at 100% airflow results in significantly more energy and resource use than is required to meet occupant comfort needs for most of the year.

Vigilent Intelligent Energy Management System

The main components of the Vigilent Intelligent Energy Management System used in this project are: (1) wireless thermal sensors placed throughout the facility; (2) a wireless mesh gateway device; (3) the Vigilent Artificial Intelligence Engine, which automatically manages the fan speeds based on inputs from the thermal sensors; and (4) the online Vigilent Energy Management Dashboard, which shows real-time facility data and allows for remote system operation.

At the Aztec Recreation Center, VFDs were installed on each of the four supply air fans (80 HP total) designed to supply 72,000 CFM. A wireless control module was connected to each VFD. Twenty-three wireless temperature sensors were placed throughout the facility to measure zone temperatures as well as supply air and outside air temperatures. The Artificial Intelligence Engine receives signals via the wireless mesh network from the temperature sensors, processes the information, and directs the VFD control modules to adjust fan speeds according to demand in each of the building's four zones. Over the first month of operation, the Artificial Intelligence Engine builds a profile based on input from each of the sensors, which it then uses to anticipate future ventilation demand. The ventilation profile is continuously updated based on facility conditions to maintain and maximize energy efficient operation.

Drive Solutions installed, programmed, and wired the Danfoss VFDs; and Vigilent installed the wireless sensors, gateway, and Artificial Intelligence Engine server. Vigilent also trained facility staff to operate the system.

Energy Savings Due to Reduced Fan Speeds

The Vigilent System enables the facility to save energy by circulating only the amount of air necessary to achieve the desired temperature throughout the building and meet minimum airflow requirements. The


1


2


3

Components of the wireless HVAC system

1 Variable frequency drive (VFD) mounted on a rooftop air handler

2 Vigilent wireless temperature sensor

3 Vigilent Artificial Intelligence Engine (silver box) and Vigilent Wireless Gateway (blue box)

primary electricity savings come from the fans running at a reduced speed. Additionally, both heating and cooling energy is saved because less air needs to be heated or cooled for the space. At the Aztec Recreation Center, supply fan speeds now fluctuate from between 25% to 100% of full output, with the lower speeds occurring during a large portion of the morning and night. Fan speeds ramp up in the late morning through sunset when outside temperatures are the hottest and the facility is more fully occupied.

Project Costs and Savings

The project was completed in June 2011, and facility staff determined that the Recreation Center reduced energy usage by over 30% in July 2011 compared to the previous July. Estimated annual energy savings from the project are anticipated to be 268,000 kWh and 9,300 therms. This represents an annual reduction in total building electricity use of 18%, natural gas use of 55%, and utility bill savings of about $38,000.

The full cost of the project was approximately $70,000. The Energy Technology Assistance Program rebates covered $31,000 of the project cost and the SDG&E UC/CSU/CCC Partnership Program covered the remainder of the project cost. Excluding incentives, the project's simple payback would have been 1.8 years.

SDSU Associated Students Commitment to Sustainability

The Associated Students of SDSU have committed to a series of long term sustainability goals for the nine facilities they manage, including achieving Leadership in Energy and Environmental Design Existing Building: Operations & Maintenance (LEED EB:O&M) silver certification or better and achieving net zero energy operation by 2020. The wireless HVAC retrofit will help move Aztec Recreation Center one step closer to these goals, as the Vigilent System both reduces energy use and provides continuous system monitoring (helpful for LEED EB:O&M certification). Other sustainability efforts at the Recreation Center include a rooftop solar installation and a recent lighting retrofit. Additionally, the Associated Students are retrofitting the SDSU Viejas Arena with a Vigilent Intelligent Energy Management System, based on the success of the Aztec Recreation Center project.

PROJECT DATA

PROJECT SUMMARY

Site: Aztec Recreation Center
Location: San Diego State University
Size: 76,000 square feet
Built: 1997

ENERGY INFORMATION

Annual electricity use before retrofit: 1,512,000 kWh
Annual natural gas use before retrofit: 16,900 thems
Annual electricity savings: 268,000 kWh
Annual natural gas saving: 9,300 therms

PROJECT ECONOMICS

Annual utility cost savings: $38,000
Total project cost: $70,000 ($103,500 including Associated Students internal project management costs)
Utility & CEC Incentives:

- SDG&E UC/CSU/CCC Partnership Program Rebate - $72,200
- Energy Technology Assistance Program Rebate - $31,300

Simple payback: Immediate (1.8 years without rebates)

EQUIPMENT INSTALLED

Basic project components:

- 15 hp (2x), 460 volt, 3 phase Danfoss variable frequency drives
- 20 hp, 460 volt, 3 phase, Danfoss variable frequency drive
- 30 hp, 460 volt, 3 phase Danfoss variable frequency drive
- 23 Vigilent wireless temperature sensors
- 1 Vigilent wireless gateway
- 1 Vigilent Artificial Intelligence Engine system server
- 4 wireless control modules for VFDs

Vigilent® Intelligent Energy Management Systems (www.vigilent.com)

Vigilent provides intelligent energy management systems for data centers, telecommunications facilities and large, commercial buildings. Vigilent energy management systems provide environmental monitoring, configuration and facility advisement, and dynamic closed-loop control to optimize temperature management. Vigilent systems can deliver reductions in energy costs while offering tenant comfort in large buildings. Vigilent is a privately-held firm located in El Cerrito, California.

"Projects like this one are a wise investment for SDSU students. This project has remarkably reduced our energy costs and greenhouse gas emissions offsetting roughly 30% of the total energy used at the facility. With these cost and energy savings we are able to re-invest in new sustainability projects and continue toward achieving our sustainability goals."

Morgan Chan, Sustainability Commissioner for Associated Students of SDSU

TAKING THE NEXT STEP

Additional case studies on the Vigilent Intelligent Energy Management System (previously known as DART)

- **PG&E DART Fact Sheet** (http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/rebatesincentives/DART_FS_Final.pdf)
- **PG&E Field Evaluation of Wireless HVAC Air Distribution Controls at Stanford University** (http://www.etcc-ca.com/images/stories/dart1.pdf)
- **PIER Draft Case Study on DART at UC Santa Barbara** (http://energy-solution.com/etap/wp-content/uploads/2011/03/DART_UCSB_Case_Study.pdf)
- **PIER Draft Case Study on DART at Cal Poly San Luis Obispo** (https://www.vigilent.com/downloads/case_studies/case_study_cal_poly_slo.pdf)
- **PIER Demonstration of Datacenter Automation Software and Hardware (DASH) at the California Franchise Tax Board** (https://www.vigilent.com/downloads/case_studies/case_study_ca_ftb.pdf)
- **Recovery Act: Federspiel Controls (now Vigilent) and State of California Department of General Services Data Center Energy Efficient Cooling Control Demonstration** (http://www.osti.gov/bridge/servlets/purl/1025751/1025751.pdf)

Applicable utility incentives

Contact your utility representative for information specific to your utility. Incentives for wireless HVAC controls projects may include:

- Customized incentive programs providing rebates based on documented kWh, kW and therm savings.
- Demand response (DR) programs paying incentives based on the amount of kW load a building can shed when called upon to do so.
- Automated DR programs providing additional incentives for customers that automate their equipment's response to a requested load shedding event.

Financing assistance

- California Energy Commission low interest loans for energy efficiency projects
- Utility on-bill financing
- Financing from energy service companies (ESCo)

ENERGY SOLUTIONS

Energy Solutions is an energy efficiency consulting firm working to create large-scale environmental benefits by developing and implementing innovative, market-based approaches to increase sustainability through energy efficiency, water efficiency, and renewable energy initiatives. Energy Solutions developed and implements the Energy Technology Assistance Program (2010-2012). Funding has been provided by the American Recovery and Reinvestment Act of 2009 and is administered by the California Energy Commission.