Green thinking in commercial building is evidenced by environmental incentive programs and regulations that advocate or require energy-saving technologies and sustainable building designs.

Many commercial building owners and architects strive for certification in new and renovated construction through the LEED incentive program, the driving force behind sustainable building design. Added to that are several local, state, and national regulations including the California Energy Commission's (CEC) Title 24, the ASHRAE/IESNA 90.1 energy-efficiency code and the International Energy Conservation Code.

Energy savings is one of the most significant goals of these initiatives, and one area for accomplishing that goal is lighting. In the U.S., lighting consumes 8% of all energy and 22% of electricity, representing $40 billion/yr. in energy costs. The use of occupancy sensors and daylighting controls, which control lighting based on motion and the amount of natural light, have the potential to save as much as 90% of lighting energy in today’s commercial facilities.

**Occupancy sensors**

Occupancy sensors save energy by automatically turning lights on when a room is occupied and off when a room is vacant. Today’s occupancy sensors use advanced technology to self-adjust, reduce false on-and-off conditions, and better meet a variety of application needs.

Adaptive technology uses microprocessors and internal software to constantly monitor a controlled area and adjust sensitivity and timer settings based on environmental history. These automatic adjustments eliminate the need for multiple manual adjustments by maintenance personnel as seasons, air-flow, furniture layout, and occupancy change. Adaptive technology constantly monitors an environment's activity signature and readjusts sensitivity and delay to decrease false-ons for a true install-and-forget experience.

Ultrasonic technology senses occupancy by bouncing sound waves (32 to 45 kHz) off objects and detecting a frequency shift between the emitted and reflected sound waves. Movement by a person or object within a space causes a shift in frequency that...
the sensor interprets as occupancy. While ultrasonic occupancy sensors have a limited range, they are excellent at detecting minor motion such as typing and reading, and they do not require an unobstructed line of sight. This makes them ideal for applications such as an office with cubicles or a restroom with stalls.

Passive infrared (PIR) technology senses occupancy by detecting the difference between heat emitted from the human body and the background space. Unlike ultrasonic, PIR sensors require an unobstructed line-of-sight and have longer range detection. These sensors use a segmented lens, which divides a coverage area into zones. Movement between zones is interpreted as occupancy. PIR sensors are ideal for detecting major motion, e.g., walking, and they work best in spaces with high levels of movement.

Dual technology combines PIR and ultrasonic. Dual-technology sensors minimize false-ons when a space is unoccupied. Continued detection by only one technology then keeps lighting on as necessary. While somewhat more expensive, dual-technology sensors offer the best performance for most applications.

Daylighting control
Daylight increases productivity and results in higher levels of employee satisfaction and retention due to brighter working conditions. For LEED certification, architects strive to maximize interior daylighting through the introduction of natural light into a building’s occupied areas. The LEED rating system for new construction provides points for maintaining a direct line of sight to the outdoor environment in occupied areas. Daylighting controls use photocell technology to maintain required lighting levels based on available natural light in these spaces.

Daylighting switching controls turn lights on and off depending on the sufficiency of natural light available. These controls are typically recommended for areas with non-stationary tasks such as atriums, lobbies, and parking facilities.

Ideal for offices and classrooms, daylighting dimming controls maintain a more precise level of lighting by continuously adjusting light output based on changing daylight conditions. Lights dim when there is enough daylight, and brighten when there is not enough daylight.

At work in the office
In addition to gaining points toward LEED certification and illustrating a company’s commitment to saving energy, occupancy sensors and daylighting controls are ideal for office buildings, where lighting accounts for 39% of electricity use. Using occupancy sensors alone saves an average of 16% when properly deployed in supply closets, restrooms, break rooms, conference rooms, office areas, and even hallways. Adding daylighting controls to a system can more than double the savings in climates with sufficient natural light.

Supply closets and restrooms are typically occupied less than 50% of the day, and because they are isolated, it is difficult to determine if lights have been left on inadvertently. Using occupancy sensors in restrooms helps promote healthy buildings because traditional light switches are a common touch point for transmitting germs. In supply closets, people entering and leaving are also often carrying supplies, making it difficult to manually turn off lights.

For small closets, a wall-switch occupancy sensor with PIR technology is adequate, while larger storage areas should use ceiling-mounted sensors. Small, single restrooms can typically be served by a wall-switch occupancy sensor with PIR technology, while sensors with US or dual technology are recommended for larger restrooms with stalls due to the ability of the devices to see around obstructions.

The increased use of flexible work hours, telecommuting, and adaptable workspaces provides modern office spaces with constantly changing patterns. Sensors equipped with adaptive technology constantly monitor and adjust to the changes, while dual technology is ideal for office spaces where false-ons are not tolerated. Open offices where natural light is abundant can experience increased energy savings using a combination of occupancy sensors and daylighting controls.

The irregular occupancy pattern of conference rooms makes the spaces ideal for occupancy sensors. Even day-long meetings break for periods of time, and lights are often left on when meetings adjourn. In these spaces, daylighting controls can also ensure productive natural light when enough is detected. Sensors equipped with manual on/off controls prevent lights from going on during audio-visual projec-
Electricity bills are second only to payroll in today's restricted educational budgets. Systematically turning lights off whenever possible, with occupancy sensors and daylighting controls, significantly reduces a school's utility bill. As in office buildings, storage closets, bathrooms, and stairwells are ideal locations for occupancy sensors in the school environment. Classrooms, cafeterias, gymnasiums, and laboratory spaces can also benefit from occupancy sensors and daylighting controls.

Classrooms are multiuse spaces that have constantly changing occupancy patterns. At the same time, seasonal environmental conditions are always changing. Classrooms typically require adaptive technology sensors with dual technology that provide the most reliable operation during periods of low activity, such as testing, and high activity, such as group projects. Optional manual control is also needed in these spaces for audio-visual presentations. Additional energy savings can be gained by using daylighting controls in conjunction with occupancy sensors.

Laboratories are unique environments with special lighting requirements. Occupancy sensors have smooth surfaces that can be easily cleaned in these environments. Adaptive dual or ultrasonic wall switches, or ceiling sensors, are the best option for labs due to obstructions such as large filing cabinets or air flow hood units.

Cafeterias and gymnasiums are usually not occupied all day long. They also use high-intensity lighting that is a major source of energy waste, and that cannot be readily switched on and off. High-bay occupancy sensors can be used in these environments to save significant energy during periods of vacancy.

In an effort to comply with CEC Title 24 requirements and a campus-wide initiative to save energy, the Univ. of California Los Angeles (UCLA) installed Hubbell occupancy sensors throughout campus spaces, including offices, storage areas, bathrooms, dorm rooms, research labs, and stairwells.

“...turning lights off whenever possible, with occupancy sensors and daylighting controls, significantly reduces a school's utility bill.”

“...The high illumination required in research labs means we are forced to design lighting systems that consume more energy. To meet Title 24 requirements and save energy in these spaces, we need to deploy occupancy sensors,” explains Rick Almonte, senior electrical engineer for UCLA’s capital programs. “We also use them in stairwells where it’s a huge waste to have the lights on all day—we maintain the required minimal and egress lighting in these spaces, and use occupancy sensors to turn the lights up only when someone enters the staircase.”

Healthy controls

Hospitals are a 24/7 critical operation where decisions and actions regarding the wellness of patients are top priority, and turning lights off should be the least of the worries. Consequently, lights are often left on when not needed. Nevertheless, there are several areas throughout hospitals that can realize substantial energy savings with occupancy sensors, such as administration offices, storerooms, break rooms, restrooms, laboratories, and even patient rooms.

In exam and operating rooms, light switches are one of the most commonly touched surfaces, spreading diseases and bacteria. Installing occupancy sensors eliminates the need to touch a switch, which can help reduce the spread of pathogens. At the same time, healthcare staff benefit from a simple, user-friendly method of controlling the lights.

Staff entering and exiting patient rooms are often pushing medical equipment or food-service carts, making it difficult to manually operate the lights. These spaces benefit from adaptive dual-technology sensors for maximum performance, but also require optional manual-on control to prevent lights from accidentally going on during evening hours when patients are sleeping.

Retail and hospitality

Retail establishments use a lot of energy for overhead lighting and displays. After all, customers need to clearly see the products being marketed. However, there are numerous areas in stores that don’t need to be lit all day, including stock rooms, restrooms, break rooms, and fitting rooms. Deploying occupancy sensors in these areas can reduce a store's electric bill and increase profit.

Lunds and Byerly’s, which owns and operates 21 high-end supermarkets in Minneapolis-St. Paul and the surrounding area, is currently retrofitting their lighting as part of an energy saving and innovation initiative.

“As part of our commitment to lowering energy consumption, Lunds and Byerly’s supermarkets are embarking on a complete lighting retrofit. Occupancy sensors in break rooms, restrooms, office areas, and storage rooms are a big part of that,” said Wally Lindeman, facilities manager. “Supermarkets are energy hogs, and we hope to save money while reducing our impact on the environment.”

Another ideal application for occupancy sensors and daylighting controls is hotels, where keeping lights on contributes to more than 50% of the electric bill. Hotel guests are on the go and often away from their rooms, yet room lights are often left on, even in broad daylight. Specifically developed with the hospitality industry in mind, occupancy sensors with manual-on controls provide guests with a traditional light-control experience, but automatically turn off lights once a room is unoccupied for a period of time. This ensures lights are off when necessary but prevents them from going on during evening hours when guests are sleeping.

Several other areas throughout a hotel can benefit from occupancy sensors, including storage closets, bathrooms, and meeting spaces. Daylighting controls are also ideal for areas with abundant natural light, like hotel atriums and lobbies.

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