Energy Innovators Initiative

Technical Fact Sheet

Lighting Control

Description

One of the simplest ways to conserve energy is to turn lighting systems off in unoccupied areas. However, accomplishing this task can sometimes be a challenge. Building lighting can be controlled by many methods, from simple – local switches, occupancy sensors (Figure 1), photocells and time clocks – to more elaborate computerized lighting control systems which can be tied in to automatic building mechanical and security system controls. This fact sheet discusses the various control types and their operation and application.

Figure 1 – Dual-Technology Occupancy Sensors: Wall-Mount and Ceiling-Mount Types

Technical Specifications

Exterior Lighting

Exterior lighting is typically controlled with photovoltaic sensors (photocells) to ensure lighting operates only at night. Electronic sensors, available at a premium cost, provide additional energy savings by controlling the on-and-off periods more accurately, and reducing daytime running with consistent operations. Exterior lighting can also be controlled by time clocks, computerized lighting control systems or the building's mechanical control systems.

Interior Lighting

Indoor lighting options can be grouped into two categories: manual and automatic. Manual controls can be the most cost-effective systems, but they rely on human intervention. For example, lighting in industrial buildings with regular hours of operation can be most efficiently controlled with a routine of manually shutting off lights at the end of the day. On the other hand, in office buildings with groups of switches located near the elevators, staff leaving the building typically leave the lights on, as they are not sure which lights they are turning off. The task is then left up to the cleaning or security staff. The use of automatic controls takes away the responsibility of the occupant to control the lighting. Of course, each control type has an optimal application.

Energy Information

To justify the use of automatic controls, energy savings compared to the initial cost should be analysed. The following example looks at the cost of installing a wall box occupancy switch (WBS) in a space where the lighting was left on 24 hours a day. Table 1 shows (in the shaded areas) that, in order to accomplish a two-year payback, the operating hours of four or more two-lamp luminaires (59 watts each) would have to be reduced by 50 percent. Although this calculation does not take into account the cost of lamps and equipment maintenance, it does give a good indication of how cost-effective this type of sensor can be.

Table 1 – Payback Estimator for Wall Box Occupancy Switch

Reduction in Hours	Resulting Hours	Number of Luminaires Controlled											
		1	2	3	4	5	6	7	8	9	10	15	20
		PAYBACK IN YEARS											
10%	7884	41.5	20.7	13.8	10.4	8.3	6.9	5.9	5.2	**4.6**	**4.1**	**2.8**	**2.1**
20%	7008	20.7	10.4	6.9	5.2	**4.1**	**3.5**	**3.0**	**2.6**	**2.3**	**2.1**	1.4	1.0
30%	6132	13.8	6.9	**4.6**	**3.5**	**2.8**	**2.3**	2.0	1.7	1.5	1.4	0.9	0.7
40%	5256	10.4	5.2	**3.5**	**2.6**	**2.1**	1.7	1.5	1.3	1.2	1.0	0.7	0.5
50%	4380	8.3	**4.1**	**2.8**	**2.1**	1.7	1.4	1.2	1.0	0.9	0.8	0.6	0.4
60%	3504	6.9	**3.5**	**2.3**	1.7	1.4	1.2	1.0	0.9	0.8	0.7	0.5	0.3
70%	2628	5.9	**3.0**	2.0	1.5	1.2	1.0	0.8	0.7	0.7	0.6	0.4	0.3
80%	1752	5.2	**2.6**	1.7	1.3	1.0	0.9	0.7	0.6	0.6	0.5	0.3	0.3
90%	876	**4.6**	**2.3**	1.5	1.2	0.9	0.8	0.7	0.6	0.5	0.5	0.3	0.2

Assumptions: $0.07 per kWh, 59 watts per luminaire, existing hours 8760 per year, cost to supply and install controls ($150).

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Comparison

Table 2 outlines the most common methods of lighting control and includes comments about general application and operation.

Table 2 – Lighting Control Types and Applications

Control Type	Approx. Cost per 120-V Circuit ($)	Comments/Descriptions
Breaker controlled	0	Lights remain on 24 hours a day or are controlled at the breakers. Industrial or commercial 24-hour operations. Uncommon application.
Line-voltage switches	50–100	Provides local manual control. Most common application, lowest installation cost. Each switch controls one lighting circuit.
Low-voltage switches	50–150	These were originally installed as a means to control higher voltage lighting such as 347 volts and are similar to a standard line-voltage switch. One switch can control many lighting circuits.
Central low-voltage control switching	50–100	Low-voltage switches in a central location, typically at the floor exit such as in the elevator lobby. Usually operated only by cleaning staff. Generally long operating hours.
Computerized or timer control systems	100–200	Controlled on a per-circuit basis, either automatically operated by a timer or PC software. Can keep hours to a minimum if programming kept up to date. Good for office spaces with scheduled times for occupancy, for example.
Infrared lighting control sensors	150–250	Provides automatic lighting control. Senses energy such as human body and movement. Provides cut-off control for more precise readings. Good for areas such as enclosed offices and rooms with high ceilings.
Ultrasonic control sensors	150–300	Uses ultrasonic sound waves. Movement changes the return sound wave, thereby turning on the lighting. Good for areas such as open office spaces, restrooms and large areas.
Dual-technology control sensors (DTOS)	200–300	Combines infrared and ultrasonic sensor technologies. Generally used for areas that are difficult to control with any other base unit. Best applications include computer rooms, large conference rooms and classrooms.
Card-reader-activated control systems	200–300	This method is typically used in conjunction with a PC software-controlled system. Card reader replaces local low-voltage switching. Provides feedback to management when combined with card reader access system. Can be programmed to control lighting only where employee is allowed to work.
Dimming control system	1000–2000	Light dimming has typically been limited to boardrooms, etc. Current systems can control fluorescent lighting on an individual basis via manual dimmer, light sensor or remote control. When used in open areas such as office spaces, these systems can provide additional energy saving. High-cost system that allows users to adjust lighting levels to suit specific requirements.

Case Study

Occupancy sensors are recognized as an important way to reduce energy consumption. Table 3 outlines an example of a typical area and the results of implementing dual-technology occupancy sensors (DTOS) to control lighting. The system comprises 24 fixtures with two T-8 lamps each and serves an area of 140 m^2 (1500 sq. ft.). Installing these dual technology controls gives a simple payback period of three to four years when energy and maintenance (lamp and ballast replacement) costs are considered (see Table 3). These savings are typical for similar applications in small and large buildings.

Table 3 – Savings Estimate for Occupancy Sensors

System: 24 Fixtures, 2-lamp 32-W T-8	**Existing Manual Control**	**Retrofit With DTOS**
Total Power (kW)	1.4	1.4
Annual Hours	6500	4550
Total kWh	9204	6443
kWh/m²	65.7	46.0
	SAVINGS ANALYSIS	
Energy Savings (kWh)		2761
Installation Cost		$550
Energy + Maintenance Savings @ $0.05 per kWh (Payback Period)		$140 (4 years)
Energy + Maintenance Savings @ $0.07 per kWh (Payback Period)		$200 (2.85 years)

For more information, contact

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Cat. No. M92-242/2002-7E ISBN 0-662-31586-3

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