COMMON INDUSTRIAL LIGHTING UPGRADE TECHNOLOGIES

Due to the phase-out of the incandescent bulb and magnetic ballasts combined with companies' need to find new ways to cut costs, many are reviewing their current lighting arrangements in search of easily replaceable and money-saving opportunities. Fortunately, more advanced lighting technologies become commercially available every year providing numerous options for companies looking to upgrade their office and manufacturing sites with resilient, low-wattage lighting. Often, a lower power light source is able to provide more illumination at a less expensive operating cost. The two most common forms of upgrades in industrial facilities include fluorescent T12 to T8 and high-bay lighting change-outs.

This fact sheet will provide information on the following lighting types and upgrade options:

- Fluorescent Lighting
- High-Bay Lighting

HOW DOES IT WORK?

Providing electricity to a tubular fluorescent lamp creates an electric current between electrodes placed at either end of the lamp. The current causes mercury atoms to ionize generating ultraviolet photons otherwise known as ultraviolet light invisible to the human eye. These photons react with a phosphor coating on the inside of the glass tube to create visible light photons. The phosphor materials can be altered to change the color of the visible light from cool to warm. Once a current has been generated between the two electrodes, a ballast is used to regulate the ongoing electricity provided to the lamp.

Fluorescent Lighting

The primary difference among fluorescent lamp types lies with the diameter of the lamp's tube. In industrial settings, the most commonly replaced fluorescent lamp is the 1.5-inch T12 with magnetic ballast. This has traditionally been upgraded in office and light industrial facilities with the 1-inch diameter T8 lamp mainly because the T8 offers greater illumination using less power and is available in standard lengths equivalent to the T12 being replaced. The ballasts are slightly different, so while the fixture (or outer lamp housing) may not need to be replaced with each new upgrade, the ballast and sockets must be traded in for appropriate T8 models[i]. The 0.625-inch T5 also offers higher light output with less power required over a T12 lamp, but demands new fixtures or a retrofit kit as they do not come in equivalent lengths to the T12.

High-Bay Lighting

"High-bay" refers to ceiling heights of 15 feet or higher that are generally located in expansive areas such as warehouses or manufacturing shop floors. While in previous years high-bay lighting installations consisted mainly of mercury vapor technology, fluorescent and advanced high-intensity discharge lighting such as metal halide and high-pressure sodium lights have become the standard in improvement projects.

High-output T5 (T5HO) lighting is also an appropriate replacement for less-advanced HID light features such as mercury vapor and even metal halide. T5HO can be used in conjunction with dimmers and occupancy sensors making the technology especially convenient in warehouses or other areas with less-frequent activity. When used in damp or dusty high-bay industrial facilities, fluorescent features typically utilize an enclosed fixture to eliminate contamination.

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Exhibit 1. High-bay lighting replacement types.

High-Bay Lighting Common ReplacementTypes	Lamps
Metal Halide, Open Metal Reflector	(2) 400W or (1) Pulse-start 250W
Metal Halide, Open Prismatic Glass Reflector	(1) Standard 400W
T-8 Flourescent, Pendant Industrial Reflector	(4) 8ft, 32W T8
T-5 Flourescent, Pendant Industrial Reflector	(2) 8ft
Metal Halide, Open Reflector, Aisle Lighting	(1) 400W or (1) 250W
Metal Halide, Prismatic Glass Reflector, Aisle Lighting	(1) 400W or (1) 250W

Source: DesignLights Consortium, "High-Bay Industrial Lighting," Accessed April 2010. *http://www.designlights.org/downloads/highbay_guide.pdf.*

HOW DOES IT WORK?

High-intensity discharge (HID) lighting creates an exceptional amount of light within a small package and, as such, is extremely well-suited for high-bay applications. Much like fluorescents, HID technology uses a ballast to regulate ongoing electric current and uses gas to create visible light. The electrodes and reacting gas, however, are placed within a small glass enclosure in the center of the bulb.

Upgrade

Mercury vapor lamps were the first commercially available HID lamp and can be found in many older industrial facilities. However, the better color rendering and increased efficacy (or the efficiency of the light measured in lumens per watt) of metal halide, high-pressure sodium and fluorescent lighting have caused many facilities to exchange their mercury vapor lights.

Standard power density levels are published every three years by the Illuminating Engineering Society of North America (IESNA). The 2007 requirements are shown in Exhibit 2.

Exhibit 2. IESNA standard lighting requirements.

Location	Lighting Power Density (W/ft^2)
Whole Building	
Manufacturing	1.3
Office	1
Warehouse	0.8
Space	
Manufacturing (Low-Bay)	1.2
Manufacturing (High-Bay)	1.7
Office	1.1

Source: EnergyCodes.gov, "ANSI/ASHRAE/IESNA Standard 90.1-2007: An Overview of the Lighting and Power Requirements," January 2008. *http://www.energycodes.gov/training/pdfs/lighting07.pdf.*

The cost-saving opportunities within lighting upgrades have a relatively short payback period and are one of the easiest energy-efficiency programs for industrial facilities to implement. A sample replacement schedule in Exhibit 3 displays common upgrades with simple payback calculated for each. Once in place, the upgraded features will typically provide greater illumination and consume less power creating less carbon dioxide emissions and reducing operating costs.

Exhibit 3. Savings summary of common industrial lighting replacements.

	Current Lighting	Light Output (Lumens)	Current Power Consumption (Watts)	Replaced With	Light Output (Lumens)	New Power Consumption (Watts)	Initial Investment[ii] (US Dollars)	Annual Energy Savings[iii] (US Dollars)	Simple Payback[iii] (Years)
Low-Bay Fixtures	Fluorescent: 4 ft, 2 x 34W T12, 2 mag ballasts	4,800	82	Fluorescent: 4 ft, 2 x 32W T8, 1 elec ballast	6,600	56	$14	$13.29	1.1
	Fluorescent: 4 ft, 4 x 34W T12, 2 mag ballasts	7,900	164	Fluorescent: 4 ft, 4 x 32W T8, 1 elec ballast	8,500	108	$27	$28.62	0.9
	Fluorescent: 4 ft, 4 x 34W T12, 2 mag ballasts	7,900	164	Fluorescent: 4 ft, 2 x 54W T5, 1 elec ballast	9,500	117	$103	$24.02	4.3
High-Bay Fixtures	Mercury Vapor: 250W Lamp	9,075	285	Metal Halide: Standard 175W, Pulse-start	11,200	200	$127	$43.44	2.9
	Mercury Vapor: 400W Lamp	14,400	455	Metal Halide: Standard 250W, Pulse-start	16,600	250	$139	$104.76	1.3
	Mercury Vapor: 400W Lamp	14,400	455	High-Pressure Sodium: 250W Lamp	25,480	300	$169	$79.21	2.1

i Reliant Energy, "Lighting: Full-Size Fluorescent Lamps," Accessed April 2010. *http://www.lrc.rpi.edu/resources/publications/lpbh/063HighIntensityDischarge.pdf.*
ii Prices obtained from online product catalogues.
iii Assumes an electricity rate of $0.10 per kWh and an average annual electricity use of 5,110 hours (equivalent to 14 hour days).