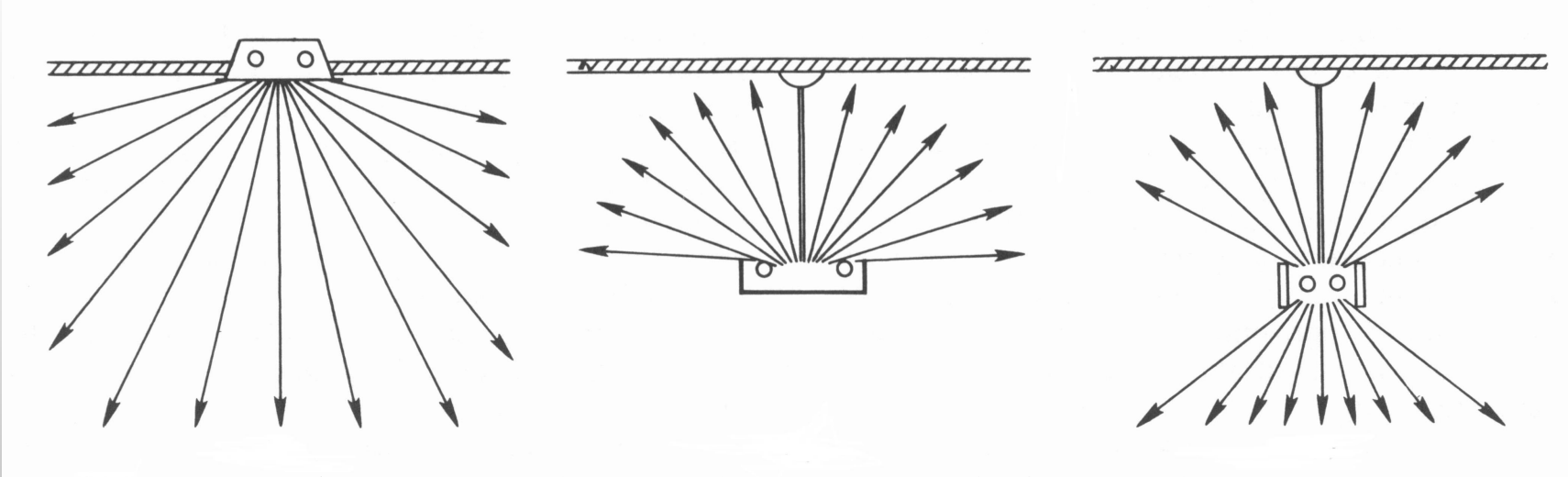
Fundamentals of Efficient Lighting



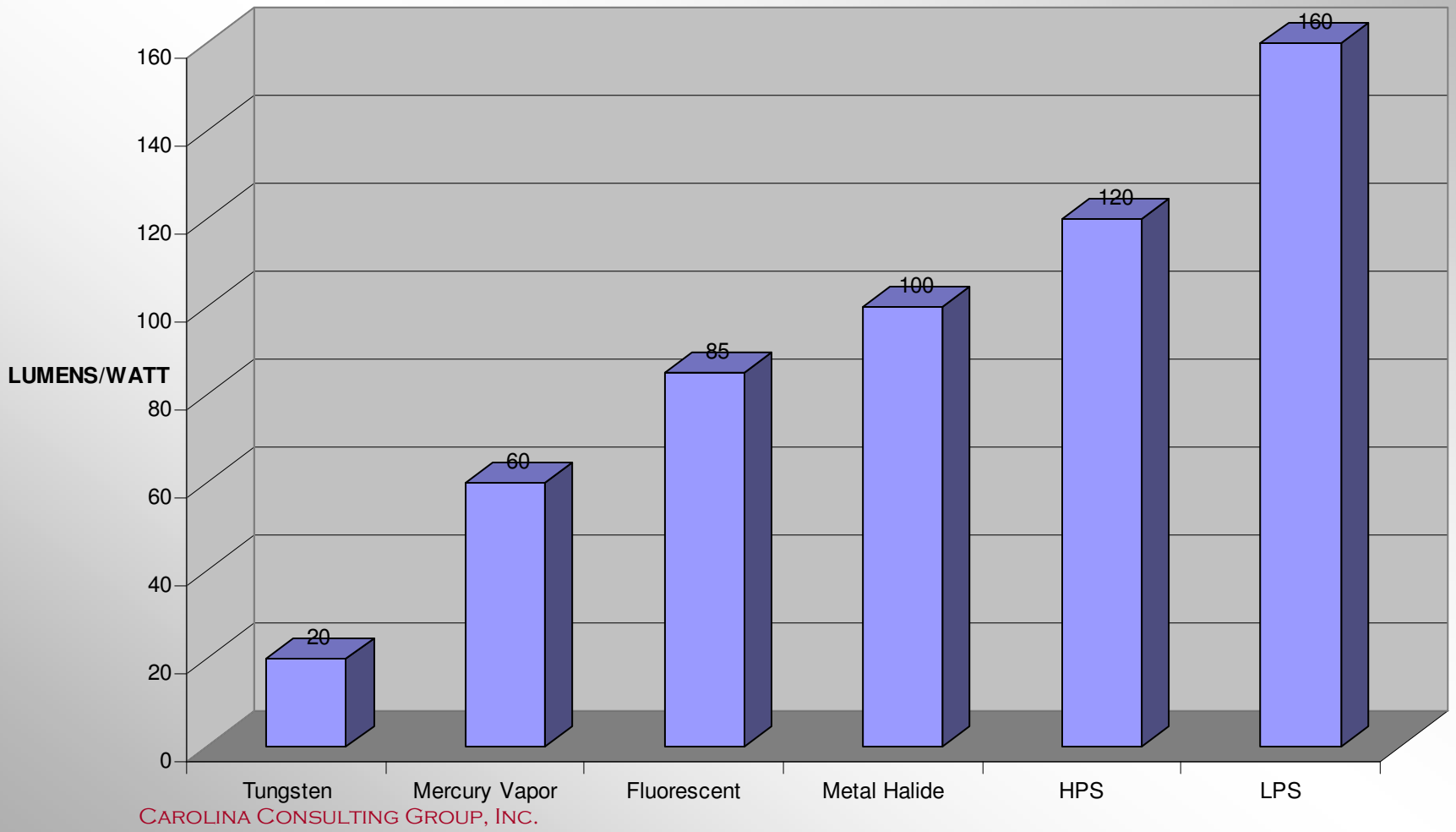
Presented By:

Carolina Consulting Group, Inc.

BASIC LIGHTING SOURCES

- *Incandescent*
- *Fluorescent*
- *High Intensity Discharge*
  - *Mercury Vapor*
  - *Metal Halide*
  - *High Pressure Sodium*
- *Low Pressure Sodium*

SOURCE EFFICACY



INCANDESCENT LAMPS

Advantages

1. Inexpensive

2. Available in many configurations and colors

3. No warm-up required

4. Not temperature sensitive

5. Easily controlled

INCANDESCENT LAMPS

Disadvantages

1. *Inefficient (10 - 25 lumens/watt)*
2. *Short lamp life*
3. *Vibration sensitive*
4. *Over-voltage sensitive*

FLUORESCENT LAMPS

Lamps are available it the following configurations:

T-5

T-8

T-10

T-12

T-17 (PG-17)

Note: In dual pin configurations, T-8, T-10, and T-12 lamps have the same pin spacing. Therefore, they may be used in the same fixture.

FLUORESCENT LAMPS

T-8 Lamps

Tubular lamp 8/8 of an inch, or 1.0", in diameter. This type lamp comes in several lengths and is typically used with electronic ballasts.

Standard Lamp Wattages: 32W and 55W (Note: HO versions are also available.)

FLUORESCENT LAMPS

T-5 Lamps

Tubular lamp 5/8 of an inch in diameter. This type lamp comes in several lengths and is typically used with electronic ballasted in indirect fixtures or metric grid.

Standard Lamp Wattages: 14W, 21W, 24W and 35W

FLUORESCENT LAMPS

Reduce wattage lamps (typically T-12) are usually marked, i.e.

GE lamps - Watt-Miser (WM)

Philips lamps - Econo-watt (EW)

Osram/Sylvania Lamps - SuperSaver (SS)

FLUORESCENT BALLASTS

Ballasts perform two basic functions:

1. *Provide the higher voltage required to start lamps*

2. *Stabilize the lamp current*

FLUORESCENT BALLASTS

Input Wattage Comparison of Four-Lamp Fluorescent Fixtures

Electromagnetic	*Electronic*
144	**110 -124**

Approximate wattage comparisons

FLUORESCENT LAMPS

Advantages

1. *Efficient (75+ lumens/watt)*
2. *Available in many configurations*
3. *Desirable colors available (2,700 ºK to 4,100 K)*
4. *No warm-up required*
5. *Long life (6,000 - 20,000 hours)*

FLUORESCENT LAMPS

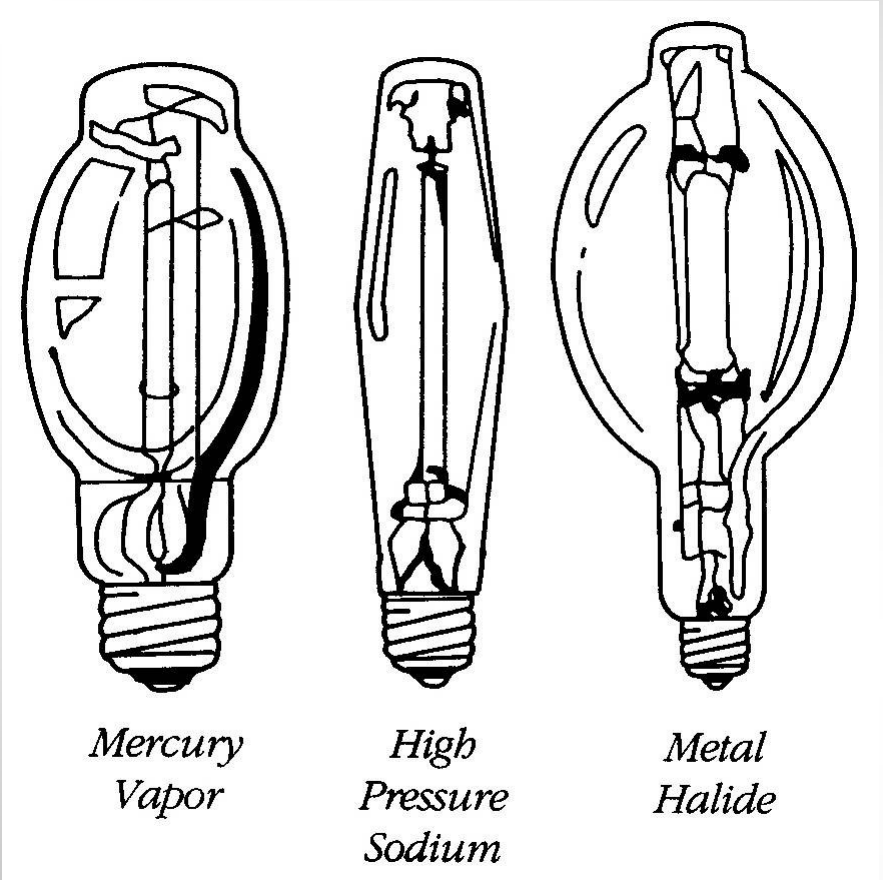
Disadvantages

1. Require a ballast

2. Temperature sensitive

3. May require special controls

HIGH INTENSITY DISCHARGE (HID) LAMPS



HID LAMPS

All HID lamps share certain physical and operating characteristics.

- *All HID lamps utilize an internal arc tube and outer envelope construction.*
- *They all require a ballast for operation.*
- *All HID lamps require a warm-up period.*
- *They all require a cool-down period before they can re-strike.*
- *A stroboscopic effect may occur prior to lamp failure*

MERCURY VAPOR LAMPS

Mercury vapor lamps produce a bluish-green color light. Due to their lower efficacy and poor color rendition they are seldom used in new construction.

Interior applications are minimal. Most current uses are for outdoor area/ parking lot lighting.

MERCURY VAPOR LAMPS

Mercury vapor lamps can provide certain low-cost options for replacing less efficient sources, such as larger incandescent lamps. In some cases self-ballasted MV lamps can be used for direct replacement of incandescent lamp, without changing the fixture.

METAL HALIDE LAMPS

Metal halide lamps are similar in construction to MV lamps. In fact, some MH lamps can be operated off of MV ballasts.

METAL HALIDE LAMPS

MH lamps offer a number of advantages over MV lamps. They include:

- *Higher efficacy (~ 100 lumens/watt)*
- *A crisp clear white light*
- *Excellent color rendition (CRI 70 - 85)*

METAL HALIDE LAMPS

Disadvantages for MH lamps include:

- *Shorter lamp life for equivalent sizes, when compared to other HID sources (6,000 to 16,000 hours)*
- *Higher lamp cost*
- *Orientation sensitive (horizontal vs. vertical orientation*

METAL HALIDE LAMPS

Disadvantages for MH lamps include:

- *Color shift near the end of lamp life*
- *Some lamps designated for enclosed fixtures only*

METAL HALIDE LAMPS

Metal halide is the source of choice for interior or exterior applications where color rendering is critical. Typical installations include car lots, service stations, athletic fields, gymnasiums, industrial manufacturing, etc.

PULSE START MH LAMPS

Pulse start technology is a recent improvement to the metal halide lamp market. Pulse start lamps utilize an improved ballast design, and at least one manufacturer incorporates a new shape, for the internal arc tube to improve operation.

PULSE START MH LAMPS

Benefits of pulse start MH lamps include:

- *Higher efficacy*
- *Faster warm-up and re-strike longer life*
- *Better color uniformity*
- *Energy & maintenance savings (15%)*

PULSE START MH LAMPS

Lamps are offered in a variety of sizes ranging from 50 watts (3,200 initial lumens) to 450 watts (50,000 initial lumens).

Typical lamp sizes include: 50W, 70W, 100W, 150W, 175W, 200W, 250W, 320W, 350W, 360W, 400W and 450W.

HPS LAMPS

High pressure sodium lamps are used extensively for both interior and exterior applications. Due to their high efficacy (~120 lumens/watt).

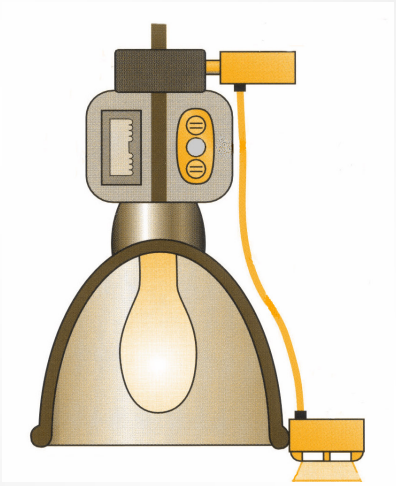
Since the mid 70's HPS fixtures have been the utility standard for street lighting.

HPS LAMPS

High pressure sodium lamps provide a golden-yellowish color light. This is due to the fact that they do not produce light in the blue spectrum (450 - 490 nm). While not a concern in exterior applications, some find the color unacceptable for interior uses, especially if color is a consideration.

HPS LAMPS

Advances in electronics now make it possible to cost-effective dim HPS fixtures in applications such as production areas and warehouses.



LPS LAMPS

Low Pressure Sodium is ***not an HID*** *source. It is a gaseous discharge type lamp, similar in operation to fluorescent lamps.*

LPS LAMPS

While very efficient, (producing about 160 lumens/watt), LPS lamps are a monochromatic light source. They produce only one color of light, a dirty yellow.

LPS LAMPS

Color reproduction is so poor that under the Color Rendering Scale the CRI for low pressure sodium is ***Negative***

NATURAL LIGHTING

EXIT SIGNS

Types of Exit Sign Illumination

Incandescent

Fluorescent

LED

Tritium

CONTROLS

- *Timers*
- *Sensors*
- *Timed Switches*
- *Photocells*
- *Lighting Control Panels*
- *Building Automation Systems*

TIMERS

Timers can be effectively utilized for basic on/off operation of lighting fixtures. By utilizing low voltage relays, large numbers of fixtures can be controlled by a single timer, thereby making it very cost effective.

SENSORS

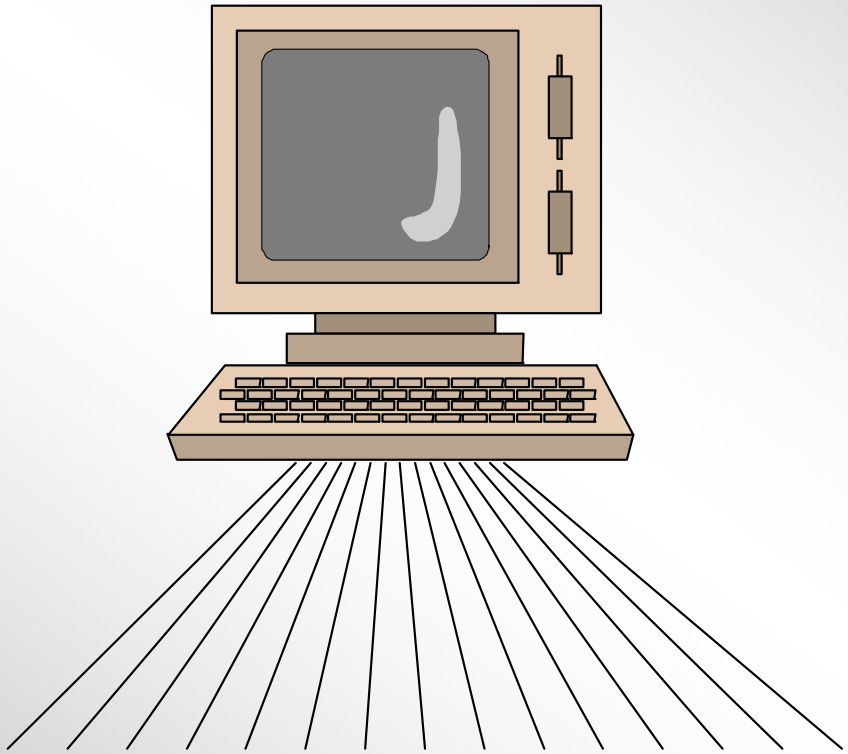
Most sensors in commercial applications utilize either passive infrared (PIR) or ultrasonic technology. There are units on the market that integrate both technologies into a hybrid sensor design.

TIMED SWITCHES

Timed Switches are switches that incorporate a timed function, to ensure that the fixtures are turned off after a preset interval of time, typically one to two hours.

PHOTOCELL

BUILDING AUTOMATION SYSTEMS



Carolina Consulting Group, Inc.

BASIC LIGHTING ENERGY MANAGEMENT

1. ***If you don't need it, turn it off***

   - Employee Awareness, Sensors, Timers, Photocells, Timed Switches, Energy Management Systems, etc.

2. ***Proper maintenance***

   - Group cleaning and relamping

BASIC LIGHTING ENERGY MANAGEMENT

3. Improve lighting controls

- Dimming, ambient lighting control, etc.

4. More efficient sources

- Incandescent to fluorescent,

- Electronic ballasts

- HPS or MH vs MV