

# Clean Lighting

Research findings from  
ASAP/ACEEE

## Quick Lighting Background

Linear tubes are designated by their tube diameter in relation to an eighth of an inch, which is given after the letter “T”

- T5 is a narrow tube, 5/8” diameter
- T8 is a medium tube, 8/8 or 1” diameter (most common)
- T12 is a wide tube, 12/8 or 1½” diameter

**Fluorescent lamps contain mercury.**

**LEDs are mercury-free.**



# LED Availability

## LED Models Available

- Over 30,000 LED models available in DesignLights Consortium Qualified Product Database
- Not an exhaustive tally, some models not in this database
- Many options for consumers

| LED Retrofit Lamp Type             | Number of Models in DLC QPL Database <sup>3</sup> |
|------------------------------------|---|
| 4-foot T5 Linear Lamps             | 1,616   |
| 4-foot T5 High Output Linear Lamps | 1,073   |
| 2-foot T8 Linear Lamps             | 3,798   |
| 3-foot T8 Linear Lamps             | 1,041   |
| 4-foot T8 Linear Lamps             | 21,852  |
| 8-foot T8 Linear Lamps             | 983   |
| U-Bend T8 Lamps                    | 1,035   |
| 4-pin Compact Fluorescent Lamps    | 811   |

# LED Availability

## Drop-In Replacements

- UL Type A LED lamps – direct, drop-in retrofit lamps, the easiest / hassle-free option
- Studied compatibility literature from 8 manufacturers, created a database of nearly 900 ballasts
- Found very high level of Type A, drop-in compatibility (93.2%)

| Lamp Type | Ballasts in Database (number) | Compatibility (percentage) |
|-----------|-------------------------------|----------------------------|
| T5        | 143                           | 92.3%                      |
| T8        | 685                           | 92.7%                      |
| T12       | 69                            | 100%                       |
| Overall   | 897                           | 93.2%                      |

# LED Availability

## Manufacturer Statements

An advertisement for Philips LED tubes. The background is a dark teal color. In the top left, the Philips logo is in white on a dark teal background, with the text "LED tubes" below it. In the center, a hand is holding a white Philips LED tube with two pins at the top. A teal circle with the word "New" in white is positioned to the left of the tube. The tube has "PHILIPS" printed on it. At the bottom left, there is a white text box with the following content:

Real pros say  
**farewell to  
fluorescent.**

The new Philips MASTER Value LEDtube Universal T8.  
Maximum value – monumental performance.

“And thanks to a high degree of efficiency and long service life, the MASTER Value LEDtube Universal T8 is the ideal alternative to standard fluorescent tubes for all demanding lighting applications.”

“Up to 65% more energy efficient than conventional TL-D (fluorescent) lamps. Up to 3× longer lasting performance than conventional TL-D (fluorescent) lighting tubes.”

# LED Availability

## Manufacturer Statements

### SYLVANIA Lamps

#### SubstiTUBE® LED T5HO

##### Application

SYLVANIA SubstiTUBE LED T5HO lamps are an energy saving alternative, designed to replace traditional fluorescent T5HO lamps. These LED T5HO lamps mimic the look of traditional fluorescent T5 HO lamps, contain no mercury and provide a uniform light distribution with an optimized glass optic design. SYLVANIA SubstiTUBE LED T5HO lamps are compatible with 120-277V and select 347V ballasts (for complete list of compatible ballasts please see the ballast compatibility list). Engineered to operate on select programmed rapid start electronic T5HO ballasts, these lamps minimize labor costs.



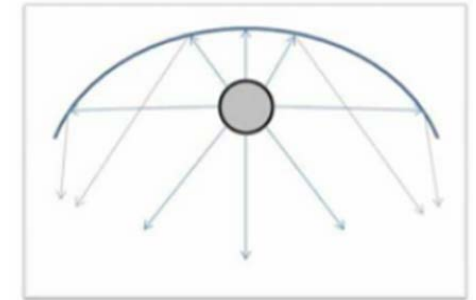
##### Wattage Comparison

## LED Performance

LEDs have the same or better performance as general purpose fluorescents

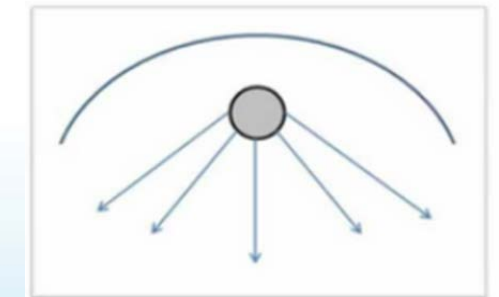
- Light output
- Efficacy (lumens per watt)
- Light quality
- Lifespan
- Mercury content

### Linear Fluorescent Tube



Fluorescent tubes emit light in all directions, requiring a reflector

### LED Tube



LED lamps emit light in desired direction

# LED Economic Analysis

| LED Lamp Type         | Vermont Utility Pricing | Incremental LED Price Compared to Fluorescent (2021\$) | Annual Electricity Savings (2021\$) | Lifecycle Cost Savings (2021\$) | Payback Period (years) |
|-----------------------|-------------------------|--|-------------------------------------|---------------------------------|------------------------|
| 4-foot T12- 40 W      | Residential             | \$2.91   | \$2.73                              | \$25.45                         | 1.1                    |
|                       | Commercial              | \$2.91   | \$13.69                             | \$67.19                         | 0.2                    |
| 4-foot T12- 34 W      | Commercial              | \$4.09   | \$9.95                              | \$55.42                         | 0.4                    |
| 4-foot T8             | Residential             | \$3.31   | \$1.78                              | \$15.41                         | 1.9                    |
|                       | Commercial              | \$3.31   | \$6.01                              | \$35.05                         | 0.6                    |
| 4-foot T5             | Residential             | \$4.51   | \$2.61                              | \$22.93                         | 1.7                    |
|                       | Commercial              | \$4.51   | \$7.92                              | \$51.94                         | 0.6                    |
| 4-foot T5 high output | Commercial              | \$10.69  | \$16.46                             | \$106.83                        | 0.6                    |
|                       | Industrial              | \$10.69  | \$12.69                             | \$57.83                         | 0.8                    |
| 8-foot T12            | Commercial              | \$12.77  | \$23.26                             | \$59.96                         | 0.5                    |
|                       | Industrial              | \$12.77  | \$17.15                             | \$28.58                         | 0.7                    |
| 8-foot T8             | Commercial              | \$13.03  | \$10.49                             | \$52.02                         | 1.2                    |
|                       | Industrial              | \$13.03  | \$8.37                              | \$24.97                         | 1.6                    |
| Pin-based LED         | Commercial              | \$3.02   | \$10.36                             | \$27.38                         | 0.3                    |

\*Vermont electricity prices utilized



## LED Economic Analysis

### Typical School

- 980 fluorescent lamps
- \$3,500 per year savings
- \$20,000 lifecycle savings
- Payback period: < 1 year

### Typical Office

- 240 fluorescent lamps
- \$900 per year savings
- \$5,000 lifecycle savings
- Payback period: < 1 year

\*National average electricity prices utilized

## Vermont Savings Analysis

### Potential Annual Reductions in 2030

|         | Mercury in Lamps Shipped (lbs) | CO2 Emissions (metric tons) | Electricity (GWh) | Electricity Bill Savings (2020\$) |
|---------|--------------------------------|-----------------------------|-------------------|-----------------------------------|
| Vermont | 2.1                            | 7,000                       | 103               | \$12,000,000                      |

### Potential Cumulative Reductions Through 2050

|         | Mercury in Lamps Shipped (lbs) | CO2 Emissions (metric tons) | Electricity Bill Savings (2020\$) |
|---------|--------------------------------|-----------------------------|-----------------------------------|
| Vermont | 32                             | 87,000                      | \$143,000,000                     |

## European Union First Movers

- European Union decision made to phase out general-purpose fluorescent lamps
- ~Sept 2023
- Confident because same findings, LEDs are:
  - Widely available
  - Cost effective
  - Would produce large savings



# Thank You

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