



Good-Better-Best LED Retrofit Guide

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Puget Sound Energy

May 8th, 2018

Good-Better-Best LED Retrofit Guide

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 - with input from the entire Commercial Lighting Program Manager Work Group and Evergreen Consulting Group

Which Lighting System is Right for You?

LED lighting systems are changing the way we light our indoor and outdoor spaces. LEDs offer significant energy savings and dramatically reduce maintenance costs by lasting two to five times longer than fluorescent and HID bulbs. When LEDs include customizable smart controls, you can save substantially more energy and the lighting can be adjusted to meet your needs. Use the chart below to determine which lighting system best fits your needs.

	 New retrofit LED lamp without controls	 New LED fixture or retrofit kit without controls	 New LED fixture or retrofit kit with integrated controls
COMFORT			
Quality of light	Good	Better	Best
Smart capabilities	On/Off	On/Off	On/Off, Dim, Occupancy, Daylight, Color Tuning
Life	⌚ / ⌚ / ⌚ <small>series by lamp type</small>	⌚ / ⌚	⌚ / ⌚ / ⌚
INCENTIVES AND SAVINGS			
Utility incentives <small>(contact your utility for more information)</small>	Limited	Better	Best
Energy Savings	Good	Better	Best
Total cost of ownership	Good	Better	Best
COST			
Equipment cost	⌚ / ⌚ / ⌚ <small>series by lamp type</small>	⌚ / ⌚ / ⌚	⌚ / ⌚ / ⌚
Installation Cost	⌚	⌚ / ⌚	⌚ / ⌚ / ⌚
Maintenance Cost	⌚ / ⌚ / ⌚ <small>series by lamp type</small>	⌚	⌚

There are many important factors to consider before beginning your lighting upgrade. Your results will vary based on location, facility layout and electricity costs, among other things.

If you're not ready for LEDs, ask your lamp supplier about reduced wattage fluorescent lamps. They use far less energy than standard fluorescent lamps at comparable cost, quality and light levels.

Good-Better-Best LED Retrofit Guide

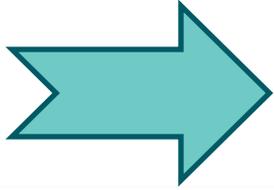
- Which Lighting System is Right for You?
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New retrofit **LED lamp** without controls

New **LED fixture or retrofit kit** without controls

New LED fixture or retrofit kit with **integrated controls**

COMFORT

Quality of light ?

Good

Better

Best

Smart capabilities ?

On/Off

On/Off

On/Off, Dim, Occupancy, Daylight, Color Tuning

Life ?

Ⓛ / Ⓛ Ⓛ *varies by lamp type*

Ⓛ Ⓛ

Ⓛ Ⓛ Ⓛ

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Limited

Better

Best

Energy Savings

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Better

Best

Total cost of ownership

Good

Better

Best

COST

Equipment cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Ⓢ Ⓢ Ⓢ

Ⓢ Ⓢ Ⓢ

Installation Cost

Ⓢ

Ⓢ Ⓢ

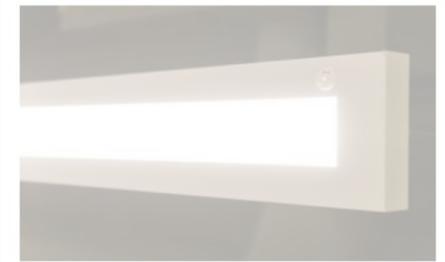
Ⓢ Ⓢ Ⓢ

Maintenance Cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Ⓢ

Ⓢ



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Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Ⓢ Ⓢ Ⓢ

Ⓢ Ⓢ Ⓢ

Installation Cost

Ⓢ

Ⓢ Ⓢ

Ⓢ Ⓢ Ⓢ

Maintenance Cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Ⓢ

Ⓢ



New retrofit **LED lamp** without controls

New LED lamp

- Are replacement lamps for existing fluorescent, HID or incandescent light fixtures. All of these retrofit lamps either use the existing lamp sockets or are otherwise attached to the existing fixture housing.
- Better efficiency
- Longer life
- Easy installation

COMFORT	
Quality of light ?	Good
Smart capabilities ?	On/Off
Life ?	Ⓒ / Ⓒ Ⓒ <i>varies by lamp type</i>
INCENTIVES AND SAVINGS	
Utility incentives <i>(contact your utility for more information)</i>	Limited
Energy Savings	Good
Total cost of ownership	Good
COST	
Equipment cost	Ⓓ / Ⓓ Ⓓ <i>varies by lamp type</i>
Installation Cost	Ⓓ
Maintenance Cost	Ⓓ / Ⓓ Ⓓ <i>varies by lamp type</i>



New retrofit LED lamp without controls

Plug and Play (Type A)

Tubular LEDs: Know Your Bulbs

Plug and Play (Type A)



COMFORT

Quality of light ?

Good

Smart capabilities ?

On/Off

Life ?

Ⓛ / Ⓛ Ⓛ *varies by lamp type*

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Limited

Energy Savings

Good

Total cost of ownership

Good

COST

Equipment cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Installation Cost

Ⓢ

Maintenance Cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

- Also known as in-line ballast LEDs, these lamps use the existing electronic ballast (if compatible) and sockets.
- Installation does not require rewiring or an electrician.
- Typically the fastest and least expensive way to upgrade to TLEDs, but are also the least efficient retrofit option.
- They can be a short-lived solution due to ballast failure, ballast incompatibility or difficulty in finding a ballast replacement.
- If dimming is desired a compatible dimming ballast and dimmable LED lamp is required.

32-Watt Equivalent T8 LED Light Bulb Cool White 4 ft. (10-Pack)

★★★★☆ (16) [Write a Review](#) [Questions & Answers \(8\)](#)

- Produces a cool white light for up to 50,000 hours
- Energy-efficient design uses just 17 watts per bulb
- Offers the ideal combination of brightness and longevity

\$49.97 / set  If you buy 3 or more **\$42.47** / set

I had to return the bulbs. They were not...



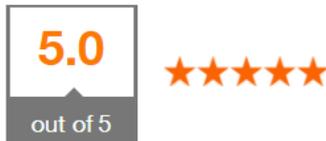
April 17, 2018

Verified Purchase

I had to return the bulbs. They were not compatible with my fixtures, it was very unclear on the package. It said plug and play. They only Way they would work with my fixtures was to change the ballast. Be sure and check your fixtures before you purchase.

Was this helpful? 0 0

Great product! We use a lot of tube bulbs in our building and the simple to use, LED bulbs are gr...



April 17, 2018

Recommended Product Verified Purchase

Great product! We use a lot of tube bulbs in our building and the simple to use, LED bulbs are great and will save us money and labor.

Was this helpful? 0 0



New retrofit LED lamp without controls

Line Voltage (Type B)

Tubular LEDs: Know Your Bulbs



COMFORT

Quality of light ?

Good

Smart capabilities ?

On/Off

Life ?

Ⓛ / Ⓛ Ⓛ *varies by lamp type*

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Limited

Energy Savings

Good

Total cost of ownership

Good

COST

Equipment cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Installation Cost

Ⓢ

Maintenance Cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

- Also known as ballast bypass, these replacements do not use the existing ballast, eliminating the ballast issues seen in plug and play lamps.
- They offer greater energy savings than plug and play.
- Installation costs are higher than Plug and Play LEDs, as an electrician is required to remove the old ballasts and re-wire the fixture.
- To add or maintain dimming, the TLED must be dimmable and a new dimmer compatible with the TLED will need to be installed.



New retrofit LED lamp without controls

External Driver (Type C)

Tubular LEDs: Know Your Bulbs



- Type C lamps use an installation similar to the existing fluorescent lamps except the ballast is replaced with a LED driver.
- Installation costs are higher than plug and play LEDs, as an electrician is required to replace the old ballasts with a new LED driver.
- Dimmable versions are available, but will require a compatible dimmer control.

COMFORT

Quality of light ?

Good

Smart capabilities ?

On/Off

Life ?

Ⓛ / Ⓛ Ⓛ *varies by lamp type*

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Limited

Energy Savings

Good

Total cost of ownership

Good

COST

Equipment cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Installation Cost

Ⓢ

Maintenance Cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*



New retrofit LED lamp without controls

COMFORT

Quality of light ?

Good

Smart capabilities ?

On/Off

Life ?

Ⓛ / Ⓛ Ⓛ *varies by lamp type*

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Limited

Energy Savings

Good

Total cost of ownership

Good

COST

Equipment cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Installation Cost

Ⓢ

Maintenance Cost

Ⓢ / Ⓢ Ⓢ *varies by lamp type*

Type A/B

Tubular LEDs: Know Your Bulbs

Plug and Play (Type A)



Line Voltage (Type B)



- Some TLEDs are designed to be a plug and play Type A lamp when first installed and when the ballast fails can operate as a Type B lamp.
- If the ballast fails the lamp will not operate unless the ballast is bypassed.

New LED fixture or retrofit kit



New LED fixture or retrofit kit without controls

COMFORT

Quality of light ?

Better

Smart capabilities ?

On/Off

Life ?



INCENTIVES AND SAVINGS

Utility incentives (contact your utility for more information)

Better

Energy Savings

Better

Total cost of ownership

Better

COST

Equipment cost



Installation Cost



Maintenance Cost



- New LED fixtures and retrofit kits use LEDs as the light source instead of traditional fluorescent, incandescent or high intensity discharge (HID) sources.
- The LEDs are factory installed directly to the fixture without the use of traditional lamp sockets.
- Since fixtures and retrofit kits come with new drivers, they are typically compatible with dimming controls and networked control systems.
- New fixtures typically offer higher energy savings, are longer lasting and have the lowest failure potential, compared with retrofit kits or lamp replacements.



New LED fixture or retrofit kit without controls

New LED fixture or retrofit kit

COMFORT

Quality of light ?

Better

Smart capabilities ?

On/Off

Life ?



INCENTIVES AND SAVINGS

Utility incentives (contact your utility for more information)

Better

Energy Savings

Better

Total cost of ownership

Better

COST

Equipment cost



Installation Cost

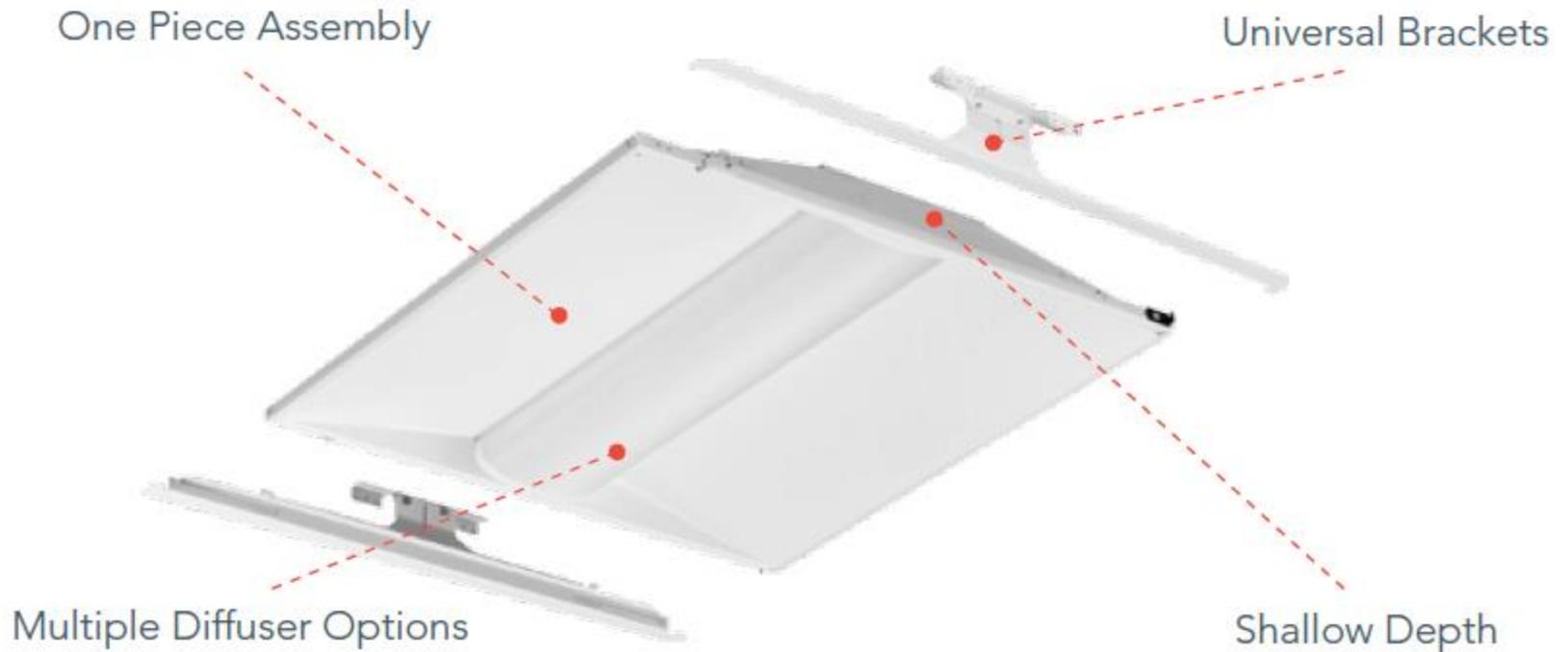


Maintenance Cost



- A retrofit kit is a bundled set of hardware designed to replace all electrical and lens components of an existing fixture while leaving the original fixture housing in place.
- A retrofit kit effectively creates a completely new luminaire, without having to replace the entire fixture, typically resulting in lower equipment and installation costs compared to a new fixture.
- Retrofit kits typically outperform LED replacement lamps installed in existing fixtures, offering longer life, better heat management, lower failure potential and higher efficiency.

Retrofit kit example



New LED fixture or retrofit kit w/controls



New LED fixture or retrofit kit with **integrated controls**

COMFORT

Quality of light ?

Best

Smart capabilities ?

On/Off, Dim, Occupancy, Daylight, Color Tuning

Life ?



INCENTIVES AND SAVINGS

Utility incentives (contact your utility for more information)

Best

Energy Savings

Best

Total cost of ownership

Best

COST

Equipment cost



Installation Cost



Maintenance Cost



- Integrated control fixtures and retrofit kits are generally referred to as Luminaire Level Lighting Control (LLLC) fixtures and kits.
- At minimum, LLLCs incorporate embedded occupancy sensors, daylight sensors and wireless controls into LED light fixtures or retrofit kits.
- Most LLLC products offer additional energy and occupant comfort features such as continuous dimming, task tuning (brightening or dimming each fixture or a group of fixtures to provide the ideal light level for occupants), programmable scheduling, and more.
- The fixtures wirelessly communicate with each other, so can operate in groups or independently.

Quality of light

COMFORT

Quality of light ?

Smart capabilities ?

Life ?

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Energy Savings

Total cost of ownership

COST

Equipment cost

Installation Cost

Maintenance Cost

- From the color of the LED light to the lighting distribution of the fixture, retrofitting to LED can improve the quality of lighting in your space compared with traditional technologies. LED lighting tends to show colors more accurately and vibrantly than fluorescent or HID, improving the look of the space.
- LED fixtures and retrofit kits can also light the space more effectively. The fixture manufacturer can shape the lighting distribution of the fixture (how the light comes out of the fixture) to optimize the lighting in your space. The optimization could be to get more light on the walls, which will brighten the look of the space, or in a higher ceiling space, to increase the lighting intensity by pushing more light to the floor.
- One major benefit of new fixtures is that they don't have to be put in the same locations as the existing lights. Reconfiguring the lighting in the space allows for adding more light to areas that are under lighted or removing lights (or intensity) to over lighted areas.

Smart Capabilities

- When paired with sensors and controls, LEDs can offer a range of “smart” capabilities. These features and functions can improve the lighting quality, enhance the occupant experience, decrease operation costs, help your new system meet building code, improve occupant performance and safety, and even help your business run more efficiently. A few of the more common “smart” capabilities include
 - Dimming
 - Occupancy or vacancy control
 - Daylight control
 - Task tuning
 - Networking
 - Zoning
 - Color tuning (only available with color-tunable LEDs)
 - Automation and tracking
 - Utilities often offer enhanced incentives lighting systems that include controls. Contact your local utility to learn about lighting controls incentives available in your area.

COMFORT

Quality of light ?

Smart capabilities ?

Life ?

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Energy Savings

Total cost of ownership

COST

Equipment cost

Installation Cost

Maintenance Cost

Smart Capabilities

COMFORT

Quality of light ?

Smart capabilities ?

Life ?

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Energy Savings

Total cost of ownership

COST

Equipment cost

Installation Cost

Maintenance Cost

- Dimming: vary the light output of the fixture, enabling energy savings and greater occupant satisfaction.
- Occupancy or vacancy control: regulate lighting based on presence or absence of people in a space, enabling energy savings and reduced maintenance costs.
- Daylight control: regulate the light level in response to changing daylight conditions in the space, enabling energy savings.
- Task tuning: adjust the output of individual lights or group of lights to a set lower maximum level, enabling energy savings, greater occupant satisfaction, and lower maintenance costs thanks to longer system life.
- Networking: connect all fixtures as a network, allowing them to exchange information with each other and with an Energy or Building Management Systems (EMS or BMS). Networked fixtures can be configured and controlled individually or as a group; some allow for remote configuration and control. Networking enables reduced wiring, maintenance and reconfiguration costs and greater energy savings.

Smart Capabilities

COMFORT

Quality of light ?

Smart capabilities ?

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INCENTIVES AND SAVINGS

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- Zoning: ability to configure groups of fixtures to perform the same lighting strategies (same occupancy time-outs, same task tuning, etc.). Zoning often results in reduced cost of wiring, maintenance and reconfiguration and greater energy savings.
- Color tuning (only available with color-tunable LEDs): ability to adjust the color temperature of the lamp, enabling higher occupant satisfaction and performance.
- Automation and tracking: Sensors embedded in light fixtures can be used to perform a wide range of functions, from identifying unused meeting rooms, to automating door operation, to track products in a warehouse, enabling improved space utilization and business efficiency.

Life

COMFORT

Quality of light ?

Smart capabilities ?

Life ?

INCENTIVES AND SAVINGS

Utility incentives *(contact your utility for more information)*

Energy Savings

Total cost of ownership

COST

Equipment cost

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Maintenance Cost

- LEDs offer significantly longer life compared with incandescent, fluorescent and HID technologies, resulting in much less frequent replacement and lower maintenance costs. For Type A plug and play LED lamps that utilize an existing ballast, the ballast may fail before the LED lamp which will require the ballast to be replaced. Unfortunately, there is no visible indicator that the ballast failed and the only way to test is to install the existing LED lamp in a fixture that is operating properly
- LED life ratings are based on the age at which the fixture or lamp will produce 70% of the light produced compared with its original light output. This is shown on manufacturers' specification sheets as the L70 designation. Some manufacturers are listing L90, which is the life when the fixture is still producing 90% of its initial light output. Look for an L70 of at least 70,000 hours or L90 of 50,000 hours.

LLLC Case Study



- 2' x 4' three lamp T8 fluorescents with 3" deep parabolic louvers
- 9.5' ceiling height
- Staggered grid layout
- Low light levels in many areas
- Deep shadows
- Walls appear dark even on a sunny day
- Fixtures mainly controlled by manual toggle switches
- "High" level of worker complaints about lighting

LLLC Case Study



- 2' x 2' LED fixtures
- Grid layout 10' x 10' on center
- More evenly distributed light throughout offices
- Walls brighter, sense of larger space
- Fixtures controlled automatically thru occupancy and daylight sensing
- Fixtures grouped together
- Some conference rooms have individual dimmers for flexibility of space

LLLC Case Study



LLLC Case Study - Final savings

		West Side	East Side	Total			Savings
Fixture change out savings	Existing	0.65	0.68	0.66	W/sf		
	LED	0.37	0.49	0.42	W/sf		36%
	Tuned	0.28	0.39	0.33	W/sf		50%
Fixtures per area	Hall	13	9	22	Fixtures		
	Open Office	25	22	47	Fixtures		
	Daylight	17	14	31	Fixtures		
Control savings	Occupancy		Hall	21%	over tuned	2%	52%
	Occupancy		Open Office	38%	over tuned	15%	67%
	Daylight		Open Office	29%	over tuned	5%	72%
			saved	43%	over tuned		
			saved	72%	over existing		
			Controlled	0.19	W/sf		

LLLC Case Study - Analysis of Project

- Behavioral changes
- Opening blinds more / less
- Cleaning crews don't need to worry if staff is in office
- More even light throughout – no deep shadows
- Overall happier staff – can't please everyone
- Fixtures tuned to
- 77% and 75% in open office
- 66% and 50% in virtual hallway
- Each system has pros and cons of commissioning and aesthetics!!!!
- Large positive response to dimming capability

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Find it at <https://nwlightingnetwork.com/lighting-comparisons/>

Questions?

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