

**tech overview**

- applicable building types  
all buildings
- implementation  
anytime
- fast facts
  - reduces GHG emissions
  - improves quality of light
  - extends lifespan of bulbs and equipment
  - increases utility savings
  - reduces maintenance costs
  - reduces harmful waste

**tech primer**

# LED lighting retrofits

Long lasting, highly efficient lighting upgrades that enhance building performance and occupant well-being.



**cost & benefits**

- GHG savings**  
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- Tenant Experience Improvements**  
★ ★ ☆ ☆
- Utility Savings**  
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- Capital Costs**  
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- Maintenance Requirements**  
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\*ratings are based on system end use, see back cover for details.

## Getting to know LED lighting

LED lighting upgrades are a low-cost, high impact opportunity to improve the performance of a building's lighting system, reduce energy use, enhance occupant comfort, and save money.

## How do LED lights work?

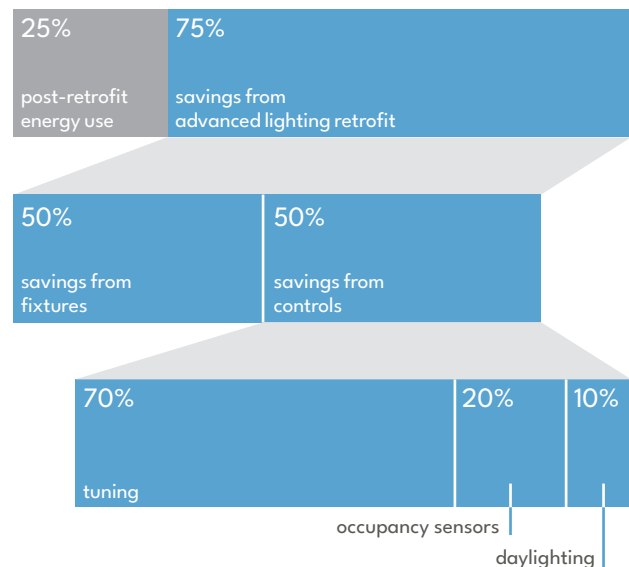
Light-Emitting Diodes (LEDs) are a long lasting and compact type of light source that uses efficient lighting technology to emit light in a specific direction, reducing the need for reflectors and diffusers while generating very little heat (waste). LEDs have several advantages over traditional incandescent or fluorescent lighting, including significant energy savings, longer lifespan, greater durability, smaller size, and equal or greater light quality and color range.

A high performance LED lighting upgrade is among the most cost-effective means for building owners to lower their energy use, cut operating costs, and reduce their carbon footprints. LED lighting upgrades also enhance lighting quality and aesthetics, which can improve occupant well-being and increase property values and rents.

LED upgrades can be completed at varying levels of complexity and cost, from replacing individual components (such as lamps, ballasts, or sensors), to relighting or redesigning entire spaces. Typically, the more comprehensive the retrofit, the greater the improvements to comfort, aesthetics, lighting functionality, and project payback.

LED lighting upgrades typically require collaboration between a building owner, lighting designer, distributor, and contractor. Project teams should identify the right technologies and functions for their specific needs and explore available financing and incentive options. Educating building stakeholders is also crucial to project success.

Fig 1. Upgrading to more efficient fixtures and installing advanced controls can reduce lighting electricity use by as much as 75%. Individual project savings will vary depending on the scope of work and baseline conditions. (Source: BE-Ex analysis, 2017.)



### Assess

Always consult a qualified service provider before undertaking any building upgrades.

### Educate Stakeholders

Close cooperation with building occupants is key to project success. Maintenance personnel, facility managers, and the occupants themselves must be involved in the installation process and educated on system operation.

*Engaging end-users throughout the entire process reduces misunderstandings that can derail projects, ensures a smooth transition, and creates project advocates.*

### Install & Commission

It is crucial for a project manager to oversee the installation process and ensure that systems are properly commissioned prior to full operation. Commissioning by a trained professional will ensure that the system is performing effectively, and occupants are comfortable.

*Systems should be periodically monitored, tuned, and maintained to ensure that they continue to function correctly.*

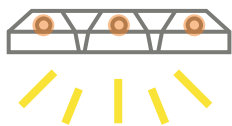
## How to upgrade to LED lighting

Lighting upgrades can vary considerably in complexity and cost. Understanding the process, players, and goals at the beginning of a retrofit can make the project easier and more successful.

### Retrofit solutions

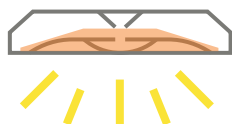
**A Upgrade Lamps and Fixtures** – Incorporating higher efficiency lamps (the components of a light fixture that emits light) and/or fixtures can result in significant savings. There are several ways to incorporate LEDs into an existing space:

1. **Lamp and Ballast Replacement:** Replacing lamps while keeping existing fixtures is an uncomplicated and affordable upgrade option. Ballasts (a device that controls the voltage and electric current in fluorescent lighting) may require replacement depending on compatibility with new lamps.



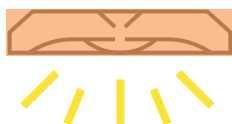
- Low initial cost
- Existing optics
- Existing appearance
- Lighting varies

2. **Fixture Retrofit:** Modifying existing fixtures, in addition to installing LED lamps, can yield further improvements. This involves leaving the housing in place and reconfiguring the interior of a fixture with an LED array and improved optics, typically sold as a kit.



- Moderate cost
- New optics
- New appearance
- Same size/location of light

3. **Fixture Replacement:** Replace the fixture entirely for best performance, improved optics, significant energy savings, and an updated aesthetic. This type of implementation easily integrates with controls and building systems.



- Highest cost
- New optics
- New appearance
- Flexible type/size/location

**B Install Advanced Controls and Sensors** – A control system ensures functionality and integration of the retrofit. Today’s lighting control systems feature myriad options, including real-time

scheduling, occupancy and daylight response, task-tuning and color-tuning.

- Occupancy sensors automatically dim or turn off lights when a space is unoccupied after a programmed amount of time. Vacancy sensors further increase control by requiring lights to be turned on manually.
- Commercial lighting systems should be integrated with a wireless control system that connects all fixtures to a global control station for integrated programming. The control station can program all applicable lights to turn off during unoccupied periods and holidays, create options for overrides if needed, and implement programming on dimmable fixtures to match lighting levels to ambient lighting needs.
- The control station can be tied to utility demand management programs to reduce lighting during periods of high regional electricity demand.

**C Incorporate Daylighting** – Daylight harvesting, or “daylighting,” systems save energy by reducing the level of electric lighting in response to available daylight. Daylighting controls use photosensors to monitor interior lighting levels and reduce electric lighting in proportion to available daylight. Automated shades can be integrated with the system, allowing maximum comfortable daylight into a space while minimizing glare and decreasing cooling loads.

**D Incorporate Interior Design** – Interior design decisions have tremendous influence on lighting efficiency, both in terms of cost and energy usage. Planning smart interior layouts with low-cost, passive design solutions can improve energy savings and enhance occupant comfort.

- Daylighting, open-plan office arrangements, furniture placement, and light colored paint reduce the need for electric lighting by increasing ambient light in the space.

# Costs and benefits of window upgrades\*

## Greenhouse Gas (GHG) Savings



An LED lighting retrofit can greatly reduce lighting related GHG emissions, however specific savings will be dependent on pre-retrofit conditions and other building systems.

## Tenant Experience Improvements



High quality lighting can positively influence occupant comfort and satisfaction. LED lighting has excellent lighting characteristics, offering a broad range of colors and color rendering capability (a light source's ability to reveal true colors of objects). These qualities make LEDs suitable for any space or application, offering a range of aesthetic options that can increase property values and rents.

## Utility Savings



LED lighting uses significantly less energy than incandescent or florescent bulbs, resulting in dramatic utility savings.

## Capital Costs



LED lighting retrofits requires a relatively low capital investment, although costs can vary greatly depending on project scope, degree of disruption, and market forces.

## Maintenance Requirements



LED lights require a low level of maintenance. LED lamps have a long lifespan and are easy to dispose of because they do not contain any of the hazardous heavy metals found in fluorescent lamps. Any re-wiring work that is done should be performed by a trained electrician.

## Take Action

This document is one of more than a dozen High Performance Technology Primers prepared by the Building Performance Partnership (BPP) to introduce decision-makers to solutions that can help them save energy and improve comfort in their buildings.

For more information, contact The Building Energy Hub:  
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The Building Performance Partnership (BPP), created by Building Energy Exchange (BE-Ex) and the Institute for Market Transformation (IMT), supports the creation and operation of local high-performance building hubs that accelerate measurable, equitable, and sustainable action to improve the health, comfort, and performance of buildings. With support from both BE-Ex and IMT, partner hubs serve their respective regions with customized resources that cater to the needs of their communities while benefiting from the existing resources and expertise of our network.

**building  
performance  
par+nership**

\*The Costs & Benefits rating system is based on a qualitative 1 to 4 scale where 1 (🌿🌿🌿🌿) is lowest and 4 (🌿🌿🌿🌿) is highest. Green correlates to savings and improvements, dark blue correlates to costs and requirements. Ratings are determined by industry experts and calculated relative to the system end use, not the whole building.

Note: Assumes mixture of fluorescent and incandescent lighting with no controls.