U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY & RENEWABLE ENERGY

REPORT SUMMARY: Adoption of LEDs in Common Lighting Applications (2017)

LED products are gaining acceptance in different general lighting categories at different paces. Progress in control technologies will be a key to unlocking their full potential.

Opportunities profiled in updated analysis

Products using light-emitting diodes (LEDs) are steadily gaining ground in common lighting applications in the United States, yet the vast majority of their energy- and money-saving potential remains untapped. Realizing the greatest possible benefit from LED lighting will depend not only on technological advances that enhance the performance and efficiency of the products themselves, but also on sophisticated controls that will enable the products to respond dynamically to changing conditions and demands.

These are among the takeaways of *Adoption of Light-Emitting Diodes in Common Lighting Applications*, the sixth such report issued by DOE since 2003. The updated report provides a snapshot of U.S. market adoption in 11 specific LED lighting product categories during 2016: A-type, decorative, directional, small directional (MR16), downlighting, linear fixtures, low-bay/high-bay, parking lot, parking garage, area/roadway, and building exterior lighting. For each category, the report analyzes energy savings in 2016 attributable to LED adoption compared to a scenario in which LED products had never entered the market; it also estimates the technical potential for energy savings if all installations had been switched to the best LED technologies available in 2016.

Steady growth, strong potential

Findings for 2016 show steady growth in LED lighting adoption across all categories when compared to results for prior years. Market penetration climbed to 12.6% overall, up from 3% in 2014 and less than 1% in 2012. LED installations quadrupled from 215 million units in 2014 to 874 million units in 2016. Connected lighting controls were installed in less than 0.1% of lighting systems in 2016. While current market penetration is low, the potential energy-saving impact of this technology is substantial.

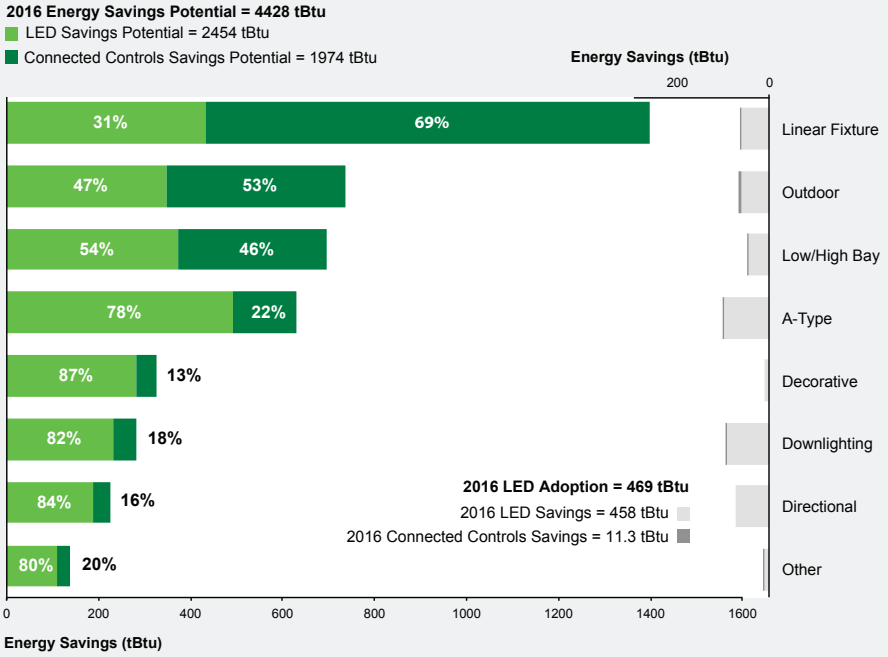
More hours, more savings

Control technologies will be especially impactful in achieving optimal savings in commercial and industrial installations using linear or low-bay/high-bay fixtures. Because these lights are on an average of about 12 hours per day, linear and low-bay/high-bay fixtures offer particularly strong potential for energy savings when replaced with LED products. A-type lamps, in contrast, are on less than two hours a day; but their sheer numbers continue to make them an important target for LED replacement technologies as well.

Faster outdoor adoption

LED products have made faster inroads in outdoor applications (street and roadway lighting, parking garages and lots, and building exteriors) than in indoor applications. In 2016, products

Current and Potential Annual Energy Savings for LED Lighting and Connected Controls



For the first time, the new release of the *Adoption* report separately calculates potential annual energy savings attributable to connected controls for each product category. Potential savings for connected lighting systems (shown in dark green) represent savings beyond those that could be achieved through LED lighting efficacy improvement alone (shown in light green). For comparison, the gray bars show actual energy savings realized in 2016.

2016 LED Lighting Installations and Energy Savings by Application

Application	2016 LED Adoption			2016 Energy Savings Potential (tBtu)
	2016 LED Installed Penetration (%)	2016 LED Units Installed[1] (Millions)	2016 LED Energy Savings (tBtu)	
A-Type	13.5%	436	99.1	491
Decorative	6.7%	58.9	10.3	283
Directional	15.3%	82.4	37.9	129
Small Directional	47.6%	21.0	35.6	58.9
Downlighting	19.8%	137	92.5	231
Linear Fixture	6.0%	68.0	62.0	432
Low/High Bay	9.4%	8.6	46.4	373
Total Indoor	**12.3%**	**812**	**384**	**1998**
Street/Roadway	28.3%	12.5	14.9	106
Parking Garage	32.5%	8.5	14.4	79.5
Parking Lot	26.2%	7.1	18.6	124
Building Exterior	31.2%	18.1	14.0	36.1
Total Outdoor	**29.7%**	**46.1**	**61.9**	**346**
Other[2]	7.7%	15.6	12.4	109
Connected Controls	**<0.1%**	**4.0**	**11.4**	**1974**
Total All	**12.6%**	**874**	**469**	**4428**

While current market penetration is low, connected lighting technology has the potential to greatly magnify the energy-saving impacts of LED lighting.

1. Installations are the total cumulative number of all LED lighting systems that have been installed as of 2016.
2. Includes indoor portable, specialty, and emergency lighting, as well as outdoor signage, stadium, billboard, and airfield lighting.

in the outdoor category reached an overall penetration of 29.7% versus 12.3% for those in the indoor category. However, looking at estimates of installations by application, A-type lamps predominate. This indoor application accounted for about half of the total units of LED lighting products installed in 2016.

Substantial remaining potential

LED products in 2016 delivered 469 trillion British thermal units (tBtu) in source energy savings, equivalent to cost savings of about $4.7 billion. While energy and cost savings are steadily rising with the number of cumulative installations, these levels are a fraction of what could be achieved. If top-tier 2016 LED products configured with connected lighting controls instantaneously reached 100% penetration in all applications, annual energy savings would increase almost 10 fold to a total of 4,428 tBtu or 4.4 quads, saving about $44 billion per year.

Controls magnify benefits

Even though connected lighting controls were installed in less than 0.1% of all U.S. lighting systems in 2016, this technology is pivotal to maximizing future potential energy savings. These controls consist of networked sensors and controllers integrated into an LED lighting system that enable lighting products within the system to communicate with each other and transmit data.

Connected lighting systems will have especially strong impacts on the savings achieved by commercial and industrial LED applications. Since these products rely on high-quality, high-power LEDs, a technology sector where U.S.-based manufacturers have established a relative competitive advantage, accelerating their adoption could be a potential positive factor in domestic job creation in the LED lighting industry.

Download the full report at https://energy.gov/eere/ssl/led-adoption-report.

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DOE/EE-1636 · July 2017