

## REPORT SUMMARY:

## Adoption of Light-Emitting Diodes in Common Lighting Applications

A recent DOE report finds that while adoption of LED products is growing across all lighting applications, market shares remain low overall, leaving substantial headroom to increase market penetration and related energy savings. Looking forward, two commercial and industrial lighting applications—linear fixtures and low-bay/high-bay—offer the greatest energy-savings potential by a large margin.

Published in July 2015, *Adoption of Light-Emitting Diodes in Common Lighting Applications* is the fifth such report issued by DOE since 2003 and provides an update to the 2013 analysis. The 2015 report investigates the current U.S. market adoption and resulting energy savings of LEDs in 10 common white-light applications: A-type, decorative, directional, small directional (MR16), linear fixtures, low-bay/high-bay, parking lot, parking garage, area/roadway, and building exterior. It estimates the energy saved due to current levels of LED penetration as of 2014, as well as the potential energy savings if each of these applications had switched completely “overnight” to the best available LEDs.

### Market-Share Inroads

The new analysis indicates that from 2012 to 2014, LED installations increased in all applications, more than quadrupling to 215 million units overall. Market penetration climbed to 3% overall, versus less than 1% in 2012.



LED cumulative installations were predominantly in indoor (88%) versus outdoor (8%) and other (4%) applications. Outdoor LED applications enjoyed the larger market share at 10%, with street lighting leading all outdoor categories, while LEDs earned a 2.8% share across indoor applications. In terms of units, indoor lighting represents a significantly larger market than outdoor lighting.

Small directional LEDs saw continued growth, with market share more than doubling, from 10% in 2012 to 22% in 2014. While this category has the highest market share of any LED product, growth rates are expected to slow in the coming years.

LED installations were led by A-type lamps (36% of LED units installed) and directional lamps and luminaires (31%). While these two lamp types lead the current LED installed base in terms of units, their overall penetration is still modest (2.4% for A-type and 5.8% for directional).

LEDs have begun to penetrate two commercial and industrial lighting markets, attaining a 1.3% share in linear fixtures and a 2.2% share in low-bay/high-bay applications, evidencing efficacy and other performance gains that have enabled products in these categories to compete against lower-priced incumbents.

### Fertile Ground for Saving Energy

In aggregate, LED installations saved 143 trillion British thermal units (tBtu) of source energy in 2014, reducing the total annual U.S. lighting electricity consumption to approximately seven quads. Energy savings attributable to LED lighting are equivalent to about \$1.4 billion annually.

To date, LEDs in directional applications (including reflector lamps and downlights) have resulted in the greatest energy savings of any of the 10 applications, providing approximately 21% of the total realized energy savings in 2014.

Despite their relatively low market share to date, low-bay/high-bay and linear fixtures rank second and third in 2014 energy savings (after directional applications), accounting for 17% and 16% respectively. Energy impacts in these applications are disproportionately high relative to market share, because of the large number of installations and extended operating hours. In contrast to A-type lamps, which are typically used in residences and average less than two hours per day of operation, low-bay/high-bay fixtures, which are used in the commercial and industrial sectors, operate for an average of about 12 hours per day.

Looking forward, these LED applications lead the pack in energy-saving potential. Indeed, of the 4,896 tBtu of “overnight” potential for all LED products, low-bay/high-bay and linear LEDs account for 2,978 tBtu, more than 60% of the total.

### Challenges Ahead

Realizing the greatest possible energy savings from LED products will require ongoing technology R&D. Linear LEDs, for example, face tough competition from modern fluorescent lamp and ballast systems in terms of efficacy, as well as initial and lifecycle costs. While the best linear LED products now on the market

are more than 50% more efficacious than the best linear fluorescents (~150 lm/W versus ~90/lm/W), many believe these products must climb closer to the 200 lm/W efficacy level to gain market momentum. For low-bay/high-bay products, the main competitive challenge will be to boost lumen outputs, building on recent gains. Progress is also needed in integrating linear and low-bay/high-bay fixtures with building control systems, which will enable further energy savings.

Download the full report at <http://energy.gov/eere/ssl/market-studies>.

Application	2014 LED Installed Penetration (%)	2014 LED Units Installed <sup>1</sup> (Millions)	2014 Energy Savings (tBTU)	2014 Overnight Potential (tBTU)
A-Type	2.4	77.7	17.6	525
Decorative	1.5	17.8	2.3	174
Directional	5.8	67.0	30	324
Small Directional	21.8	10.3	15.4	38
Linear Fixture	1.3	12.5	22.8	<b>1,812</b>
Low-Bay/High-Bay	2.2	3.1	24.1	<b>1,165</b>
<b>Total Indoor</b>	<b>2.8</b>	<b>188</b>	<b>112.3</b>	<b>4,038</b>
Area/Roadway	12.7	5.7	9.0	201
Parking Lot	9.7	2.8	8.4	245
Parking Garage	5.0	1.8	1.7	147
Building Exterior	11.5	7.6	5.5	69
<b>Total Outdoor</b>	<b>10.1</b>	<b>17.9</b>	<b>24.6</b>	<b>662</b>
Other	3.3	8.3	6.4	196
<b>Total All<sup>2</sup></b>	<b>3.0%</b>	<b>215</b>	<b>143</b>	<b>4,896</b>

Linear and low-bay/high-bay LEDs are, far and away, the most fertile ground for future energy savings in lighting, accounting for more than 60% of the “overnight” potential for all LED products.

1 Installations are the total cumulative number of LED lamps and luminaires that have been installed as of 2014.

2 Values may not add up due to rounding.