



# Lighting, LEDs and Smart Lighting Market Overview

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# Who is PennWell?



## Market Research

World leader in LED, laser and photonics market research and custom Research



- Global circulation 63,800
- 9 issues annually including the Suppliers Directory



- Page views : 349,667
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- North America – Nearly 5,000 registrants
- Europe – Nearly 1,000 registrants
- Las Vegas—2,300+ attendees, 90 exhibitors

# Reports from Strategies Unlimited



<http://www.strategies-u.com/leds-lighting.html>

# PACKAGED LED, COB, CSP AND MODULES MARKETS

**The Worldwide Market for LEDs**  
Market Review and Forecast 2015



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**The World Market for Chip on Board (COB) LEDs in General Lighting**  
Market Analysis and Forecast 2014



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**LED Modules & Light Engines**  
Market Analysis and Forecast 2015



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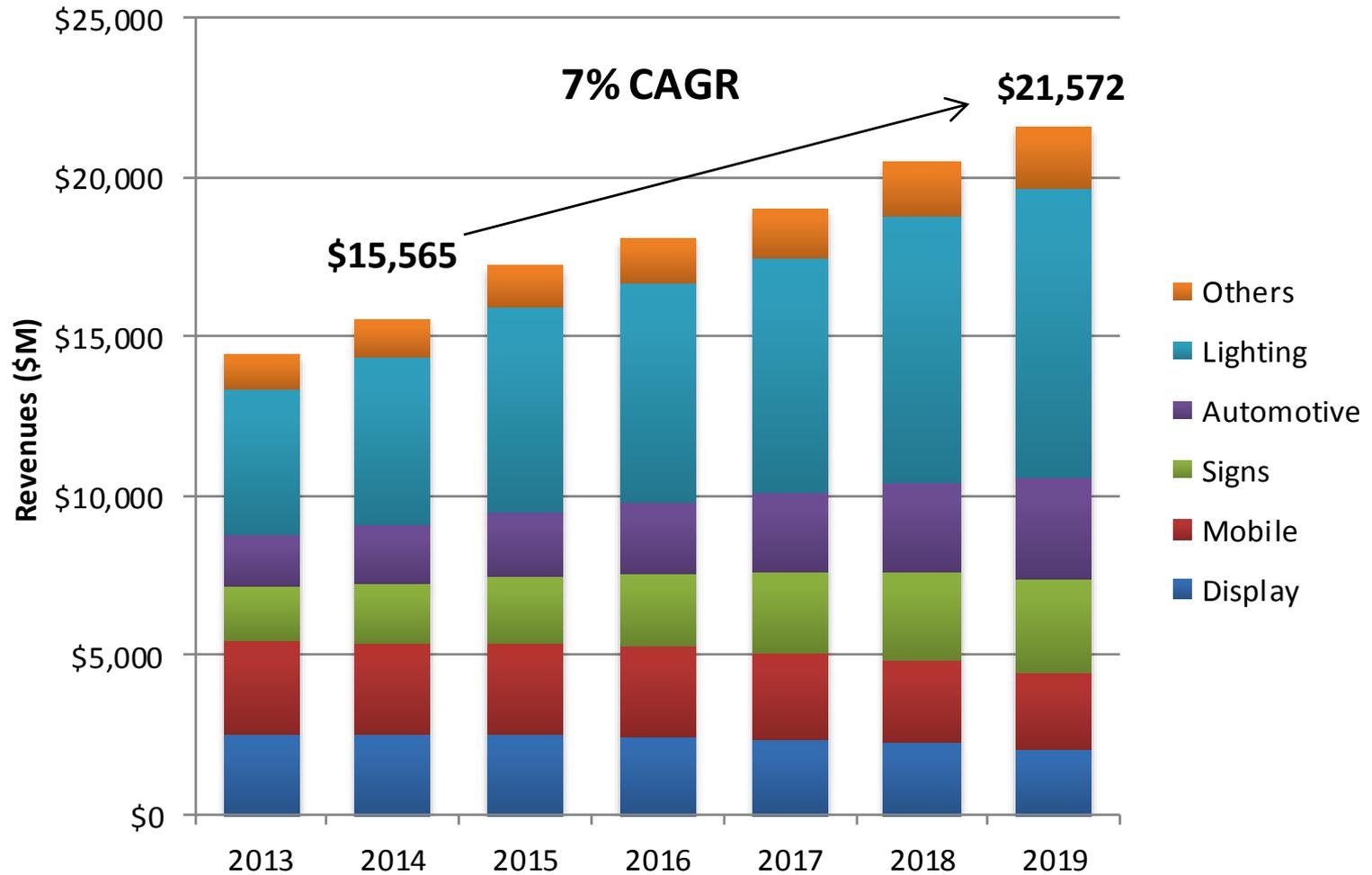
**LEDs in Lighting Applications**  
Market Analysis and Forecast 2015



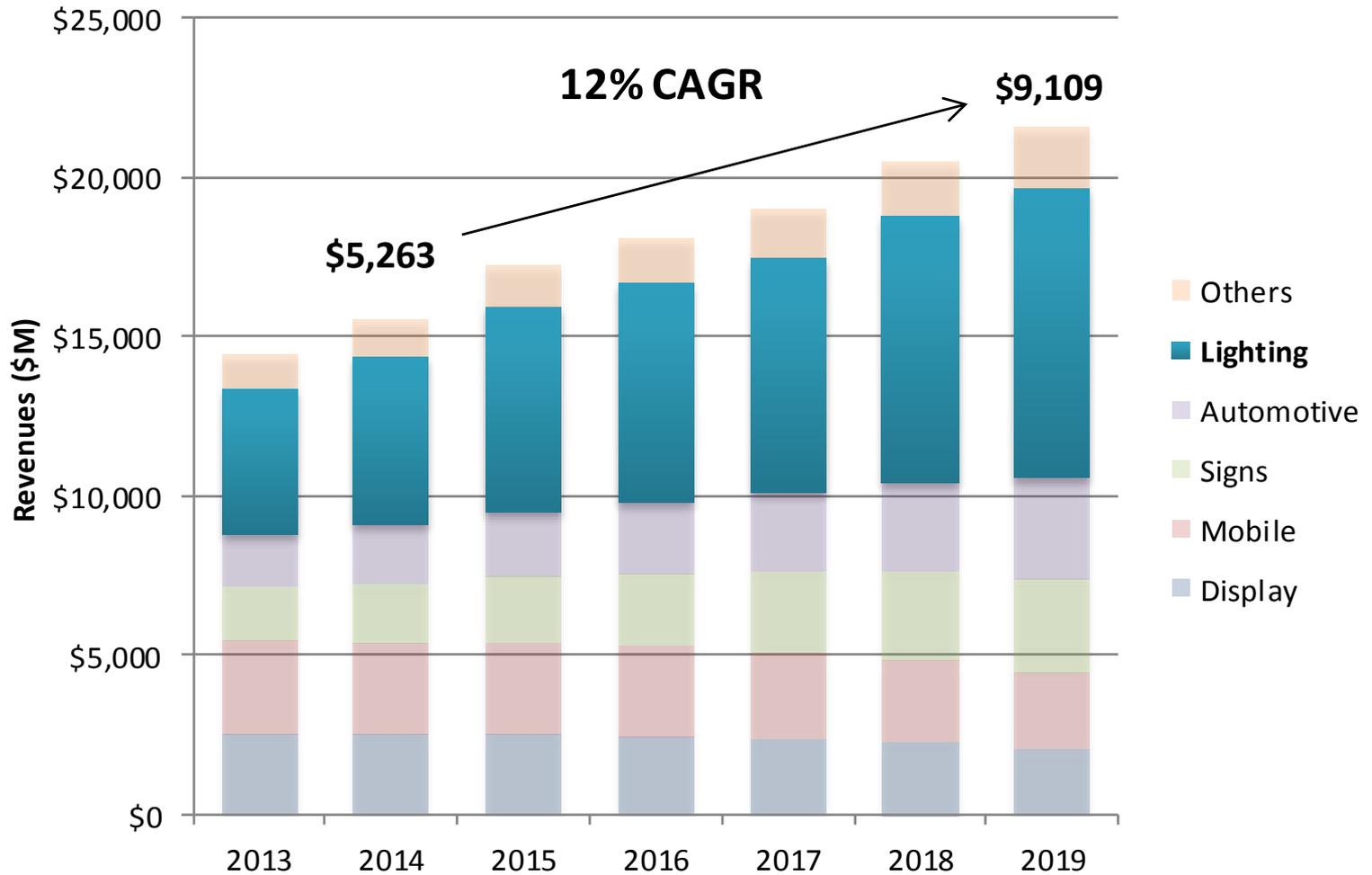
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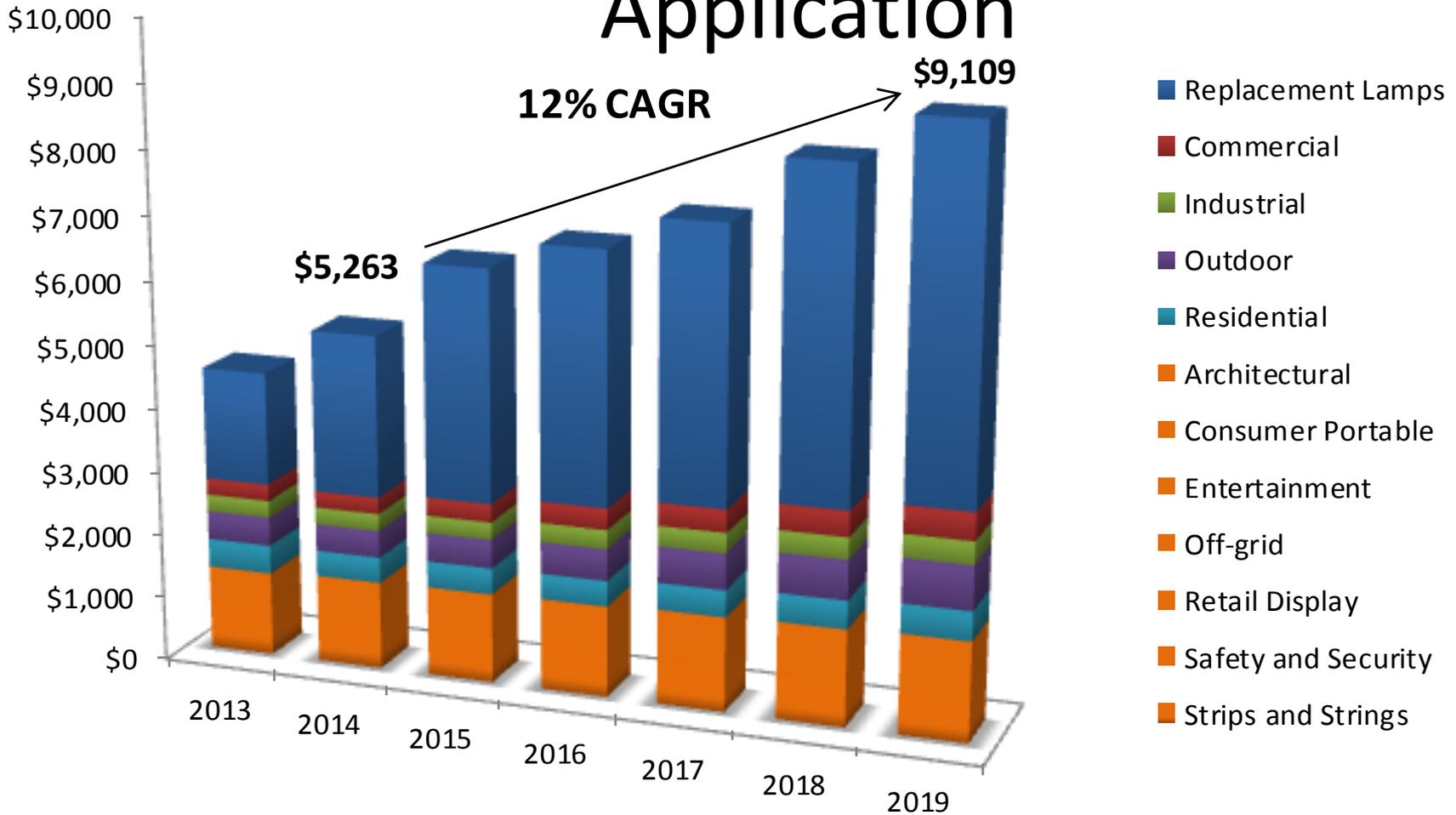
# Global Revenues for Packaged LEDs 2014 - 2019



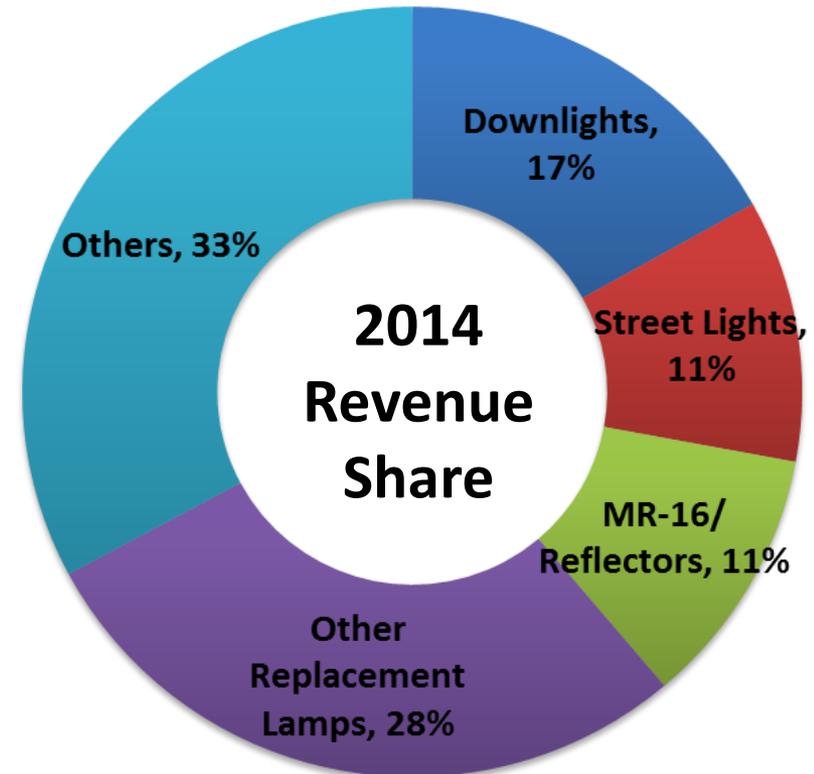
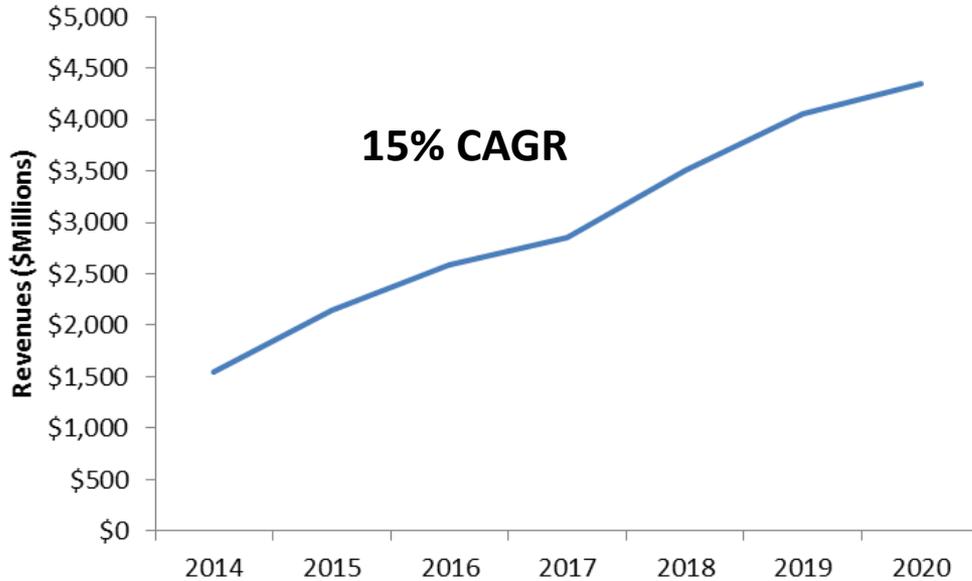
# Lighting Revenues



# Revenues for LEDs in Lighting – by Application



# COB Revenue Forecast in Lighting



# Module and Light Engine Definition

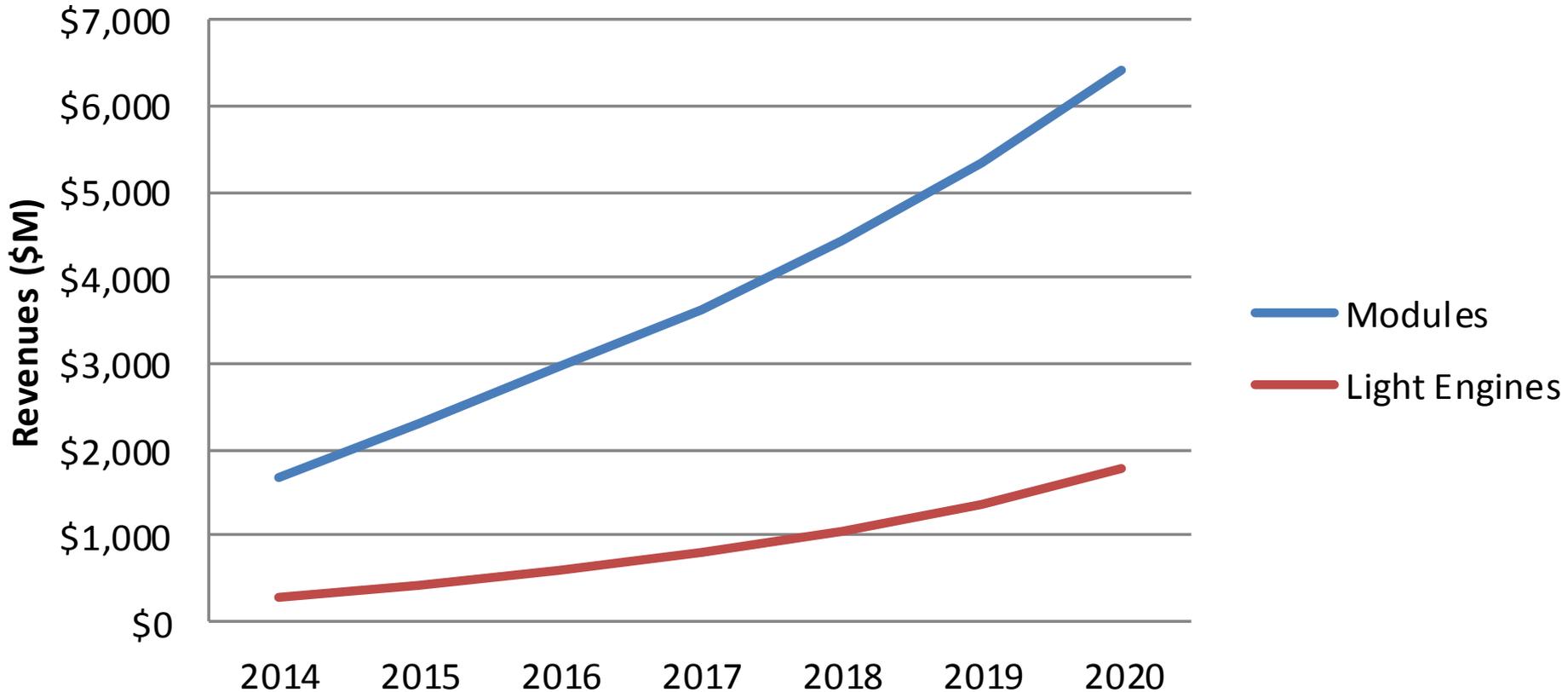
## LED Module

- A number of packaged LEDs mounted onto a printed circuit board (PCB) that has NO driver electronics.
- The module can have any level of integration including optics, thermal management, housing enclosures, etc., as long as it does not have the driver electronics on board.

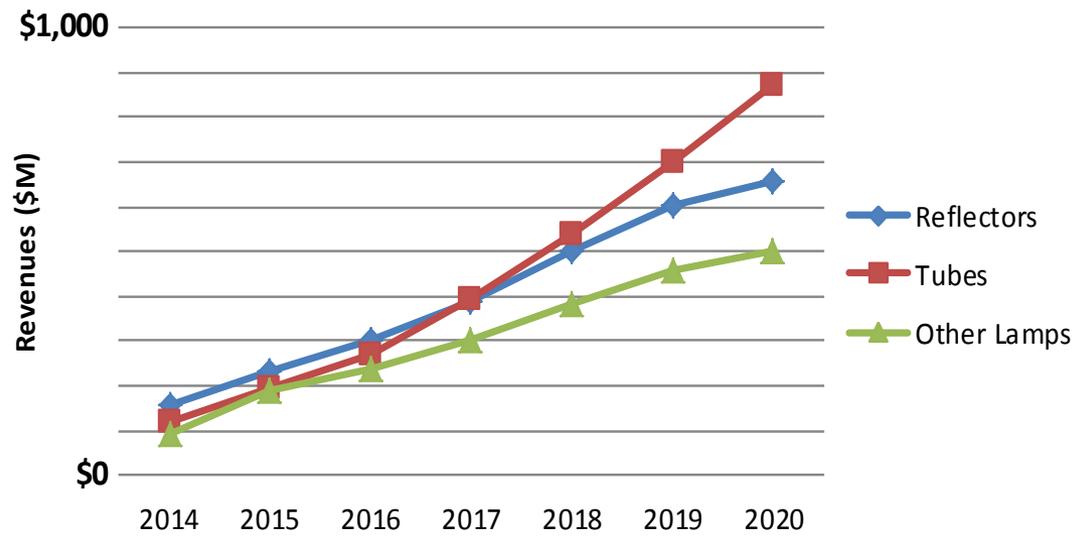
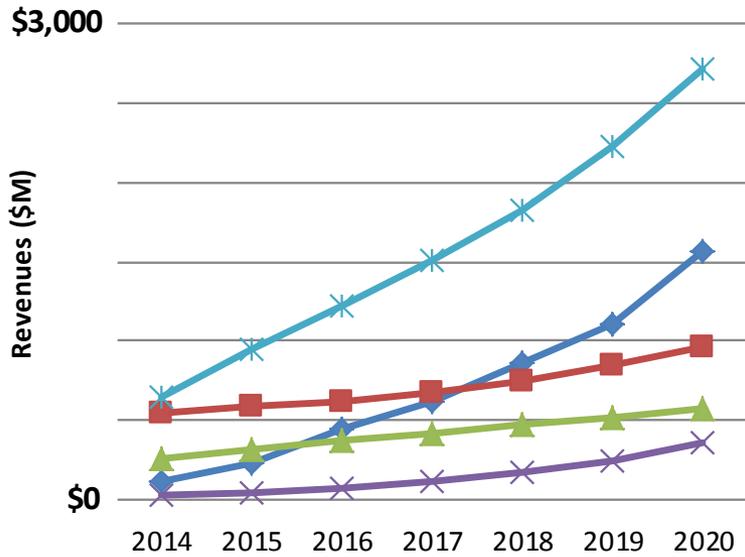
## LED Light Engine

- An LED module with the added driver electronics, whether on board, integrated, or separate, as long as it's sold as a complete unit.
- AC light engines will also be included under this definition. An AC light engine connects directly to the AC mains while delivering photometric and electrical performance similar to that of DC-driven designs.

# Total Market by Product Type



# Total Module and LE by End Application



# Chip-Scale Package (CSP)

- CSP is done at the wafer level, eliminating the separate step of having manufactured LEDs go through a packaging line (packaging can sometimes be 60% of the total cost).
- The CSP LEDs can have the exact same footprint as the LED die, a wider beam angle, more design flexibility, and it can be overdriven.
- However, CSP LEDs are not as efficient as high-power LEDs and low yields result in much higher prices, currently.
- Many large LED chip and packagers are investing in this technology including Samsung, Lumileds, LG Innotek, Seoul Semiconductor, Epistar and Lextar

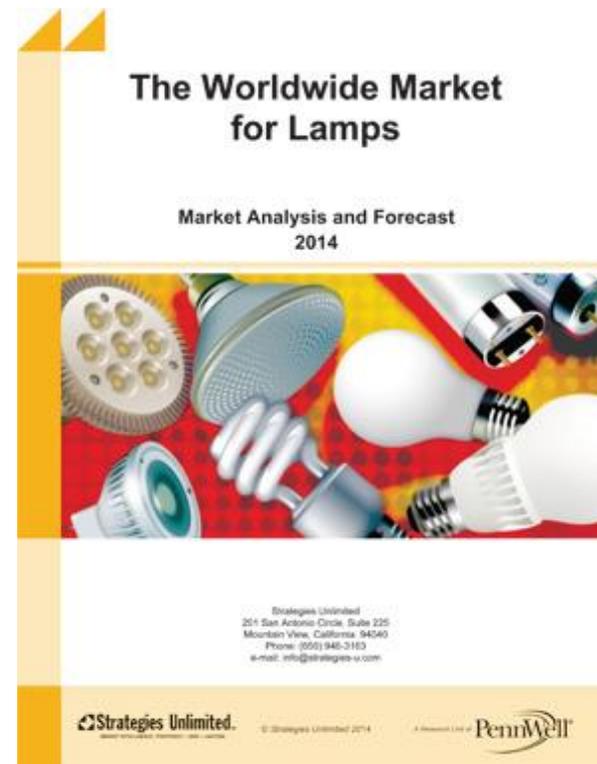
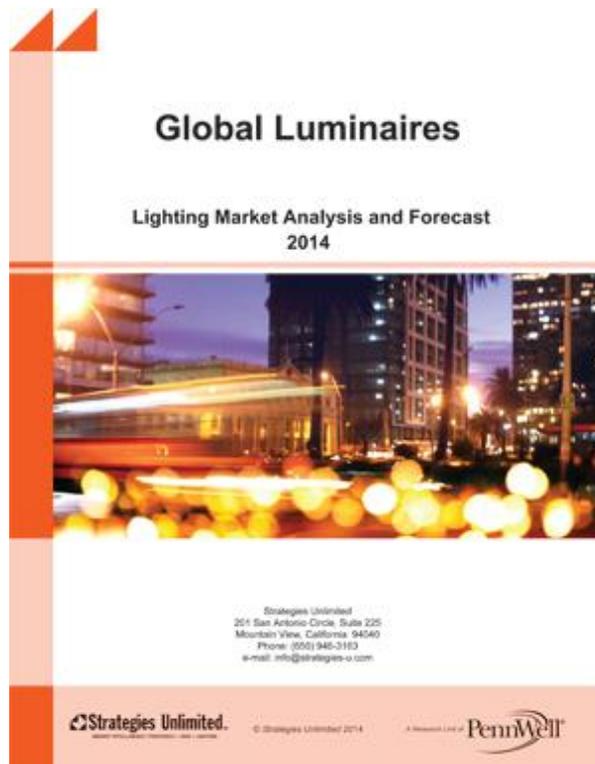


Traditional 3030 mid power package



CSP LED

# LAMP AND LUMINAIRE MARKETS



# LEDs in Lamps and Luminaires

## Replacement Lamps

A-Lamps

MR-16

Reflectors

T-Lamps

Others

## Commercial & Industrial Luminaires

Downlights

Troffers

Suspended Pendants

Track Lights

High Bays

Others

## Outdoor Luminaires

Street Lights

Tunnel Lights

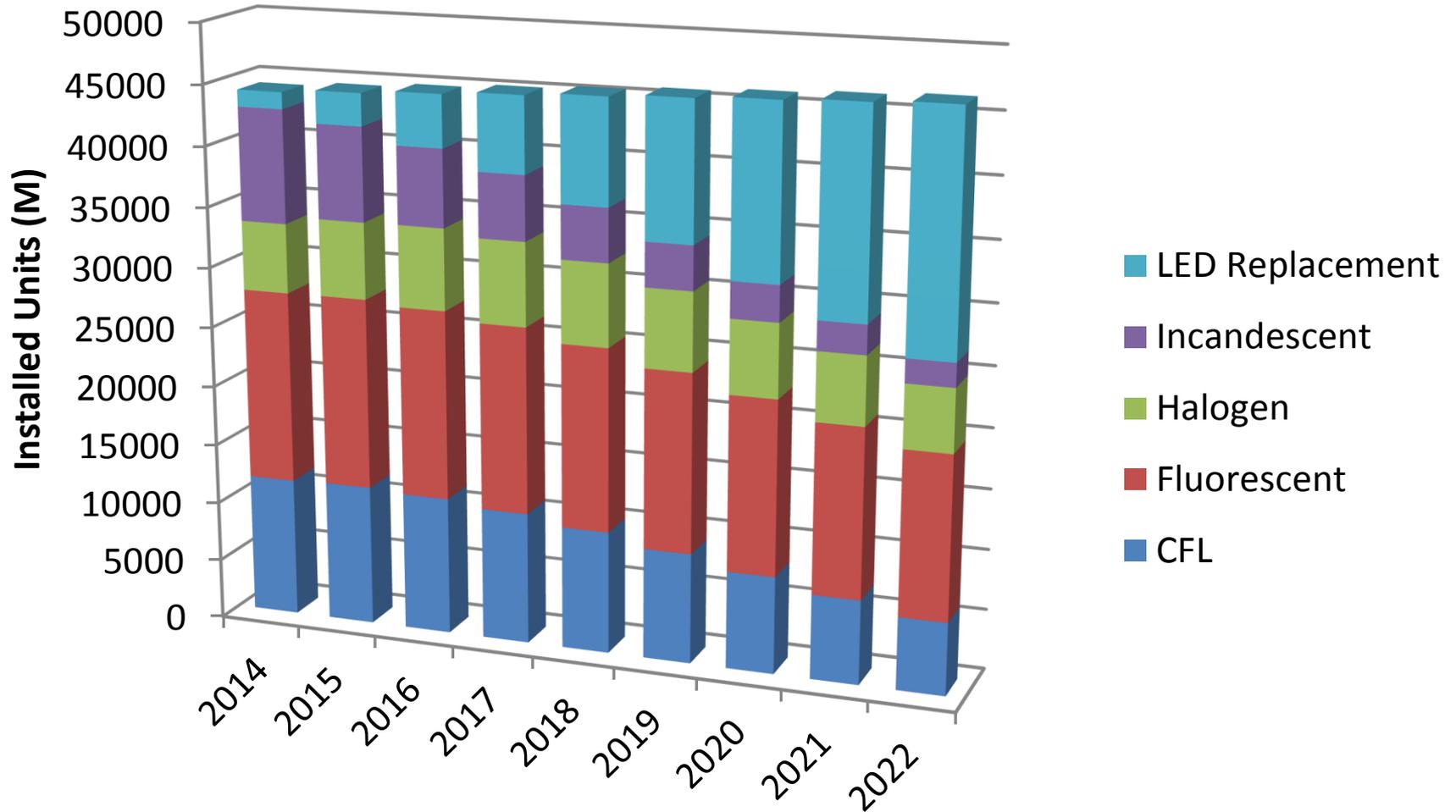
Parking Garages

Parking Lots

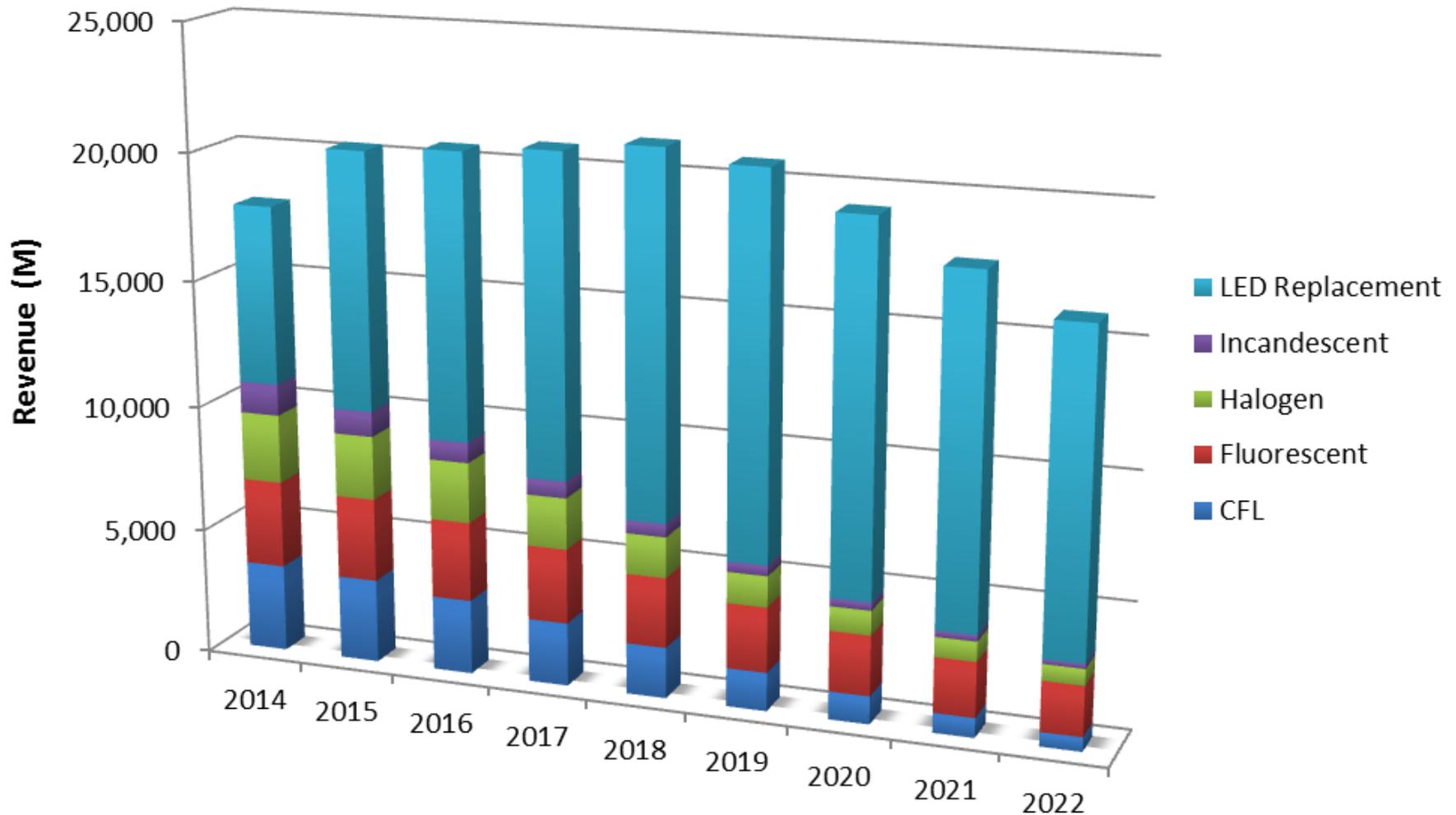
Canopies

Wall Packs, Soffits, and Floodlights

# Global Lamp Installed Base



# Global Lamp Revenue by Technology



# LEDs in Lamps and Luminaires

## Replacement Lamps

A-Lamps

MR-16

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## Outdoor Luminaires

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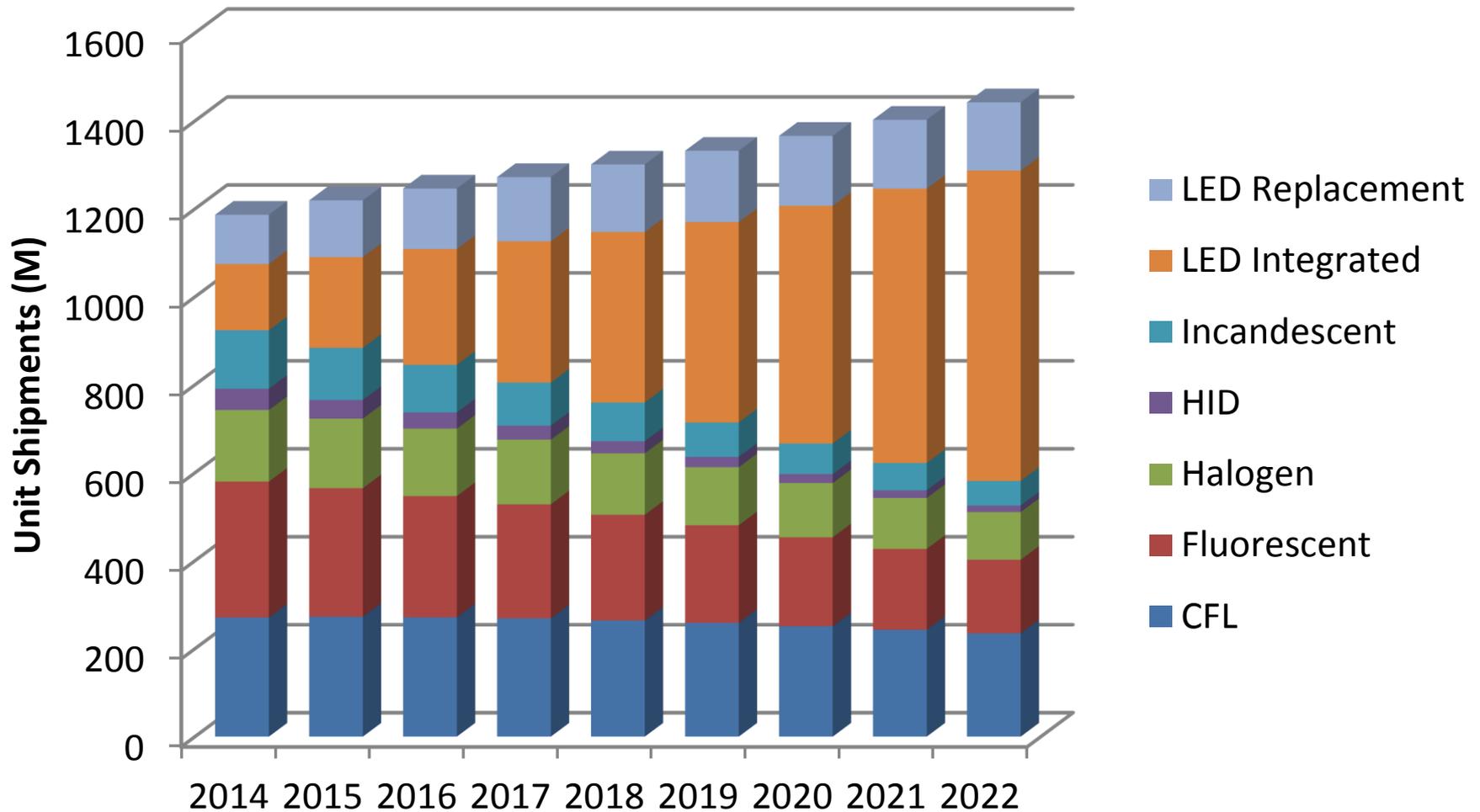
Parking Garages

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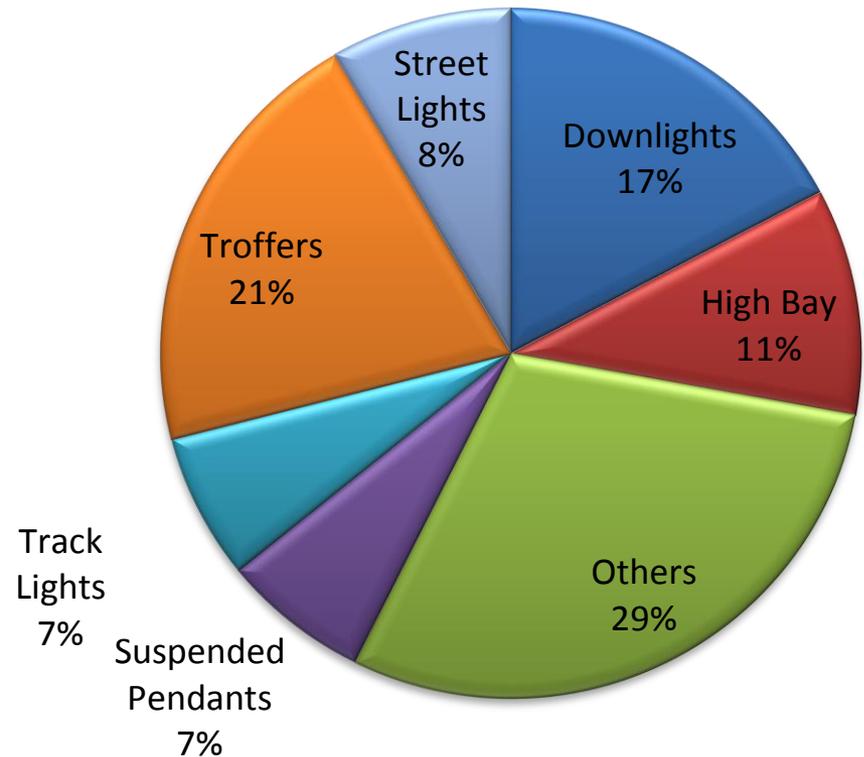
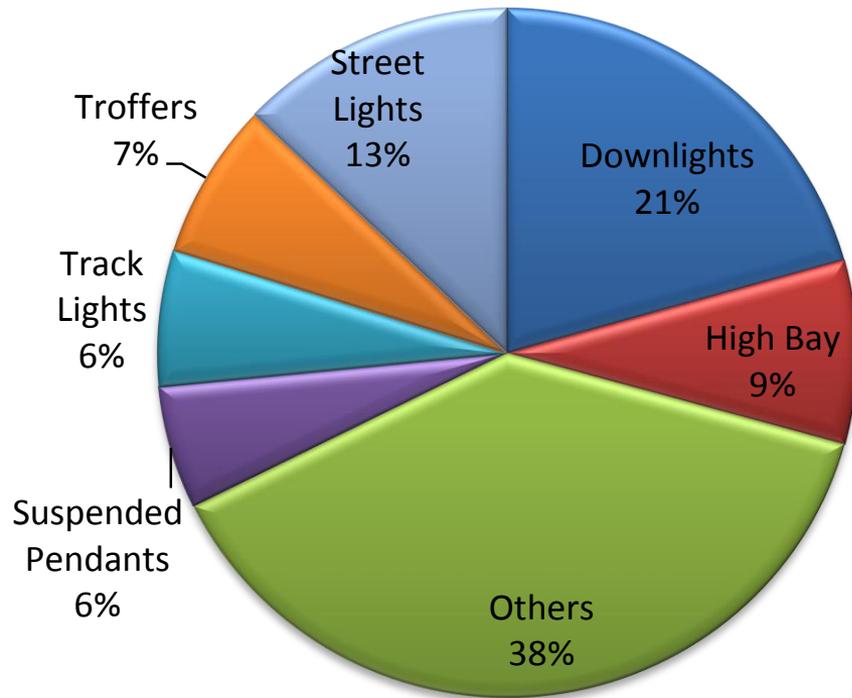
# Global Luminaire Unit Shipments



# Global LED Luminaire Revenue Forecast

2014 LED Revenues = \$19,751 M

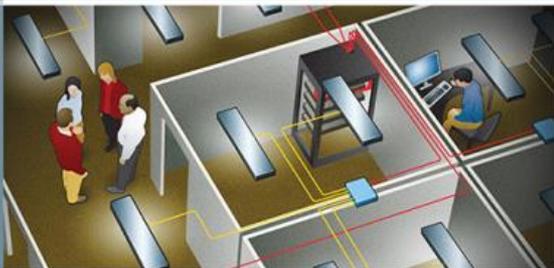
2022 LED Revenues = \$45,548 M



# CONNECTED LIGHTING MARKET

## Connected Indoor Lighting

Market Analysis and Forecast  
2015



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## Connected Lamps

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## Connected Outdoor Lighting

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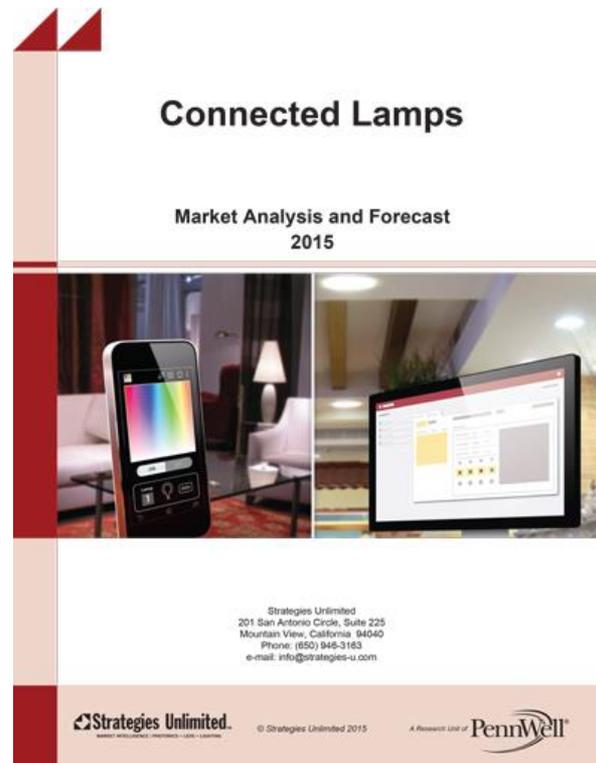
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# Connected Lighting

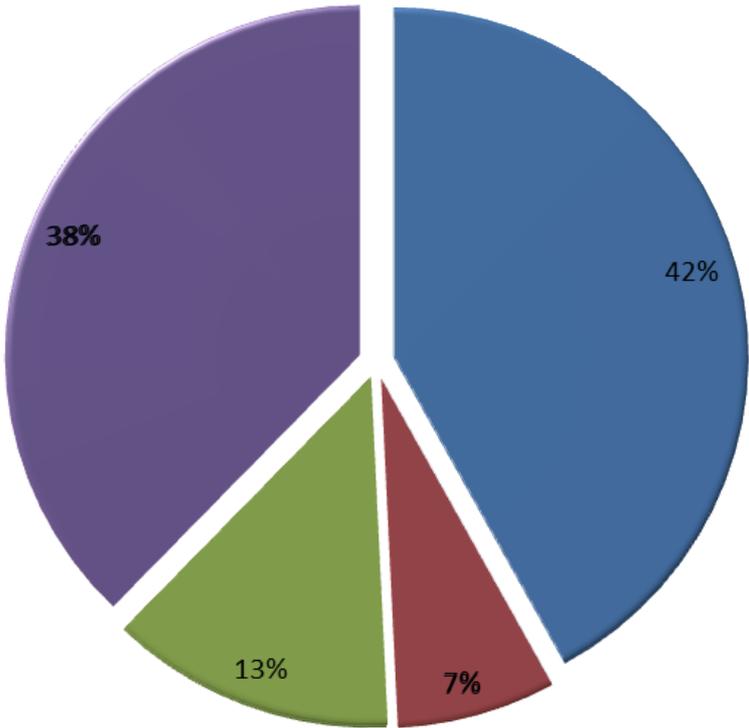
Connected LED Reflector & A-Lamps		Connected Outdoor Luminaires		Connected Indoor Controls	
Features	Protocols	Hardware	Protocols	Protocols	
Basic Tunable White	ZigBee	Programmable Scheduling/ Switches	Power Line Communication	Power Line Communication	Bluetooth
Complex Tunable White	Bluetooth	Photocells/ Photo Sensors	ZigBee	Power Over Ethernet	EnOcean
Simple Dimming	Wi-Fi	Occupancy Sensors	6LoWPAN	DALI	Wi-Fi
Color Changing	6LoWPAN	Dimmers	Other 802.15.4 based protocols	ZigBee	Proprietary/ Other
	Hybrid	Hybrid	Proprietary/ Other	6LoWPAN	Hybrid

# CONNECTED REFLECTOR AND A-LAMPS



# Global Installed Base by Lamp Shape

■ A-Lamps ■ MR-16 ■ Reflectors ■ T-Lamps



- Total Installed Base = 44 billion lamps
- Reflector and A-lamps comprise 55% of this (24 billion)

# Definitions

- **Simple Dimming Connected Lamp** – LED lamps that are wirelessly controlled to dim, with no control over the color temperature or CRI of the light emitted by the lamp.



- **Basic Tunable White Connected Lamp** – LED lamps that are wirelessly controlled to dim using a linear tuning mechanism. Linear tuning products cannot track the blackbody curve (i.e., they cannot maintain a constant Duv as CCT is adjusted).

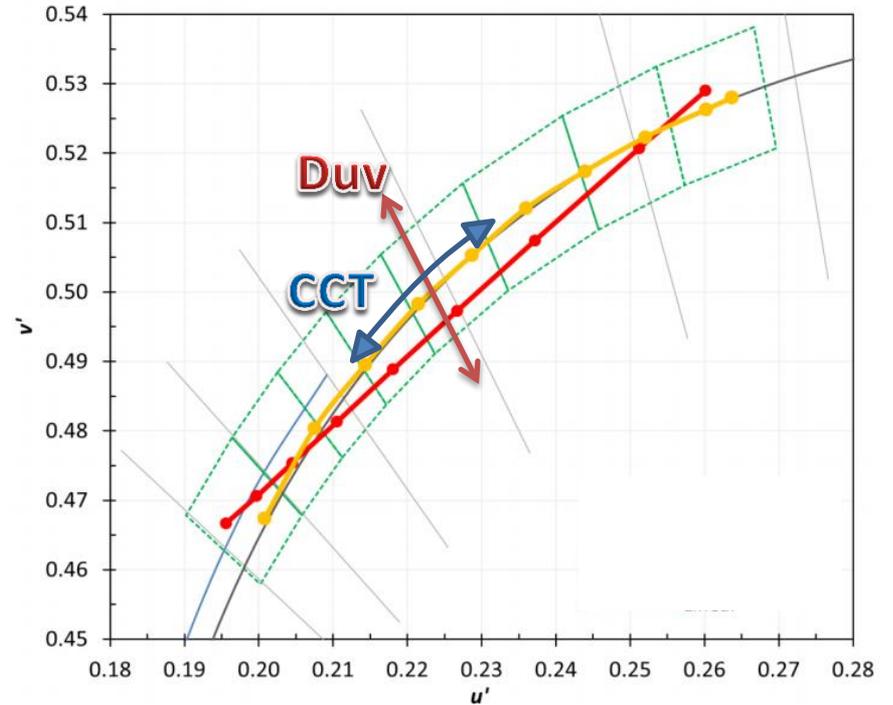
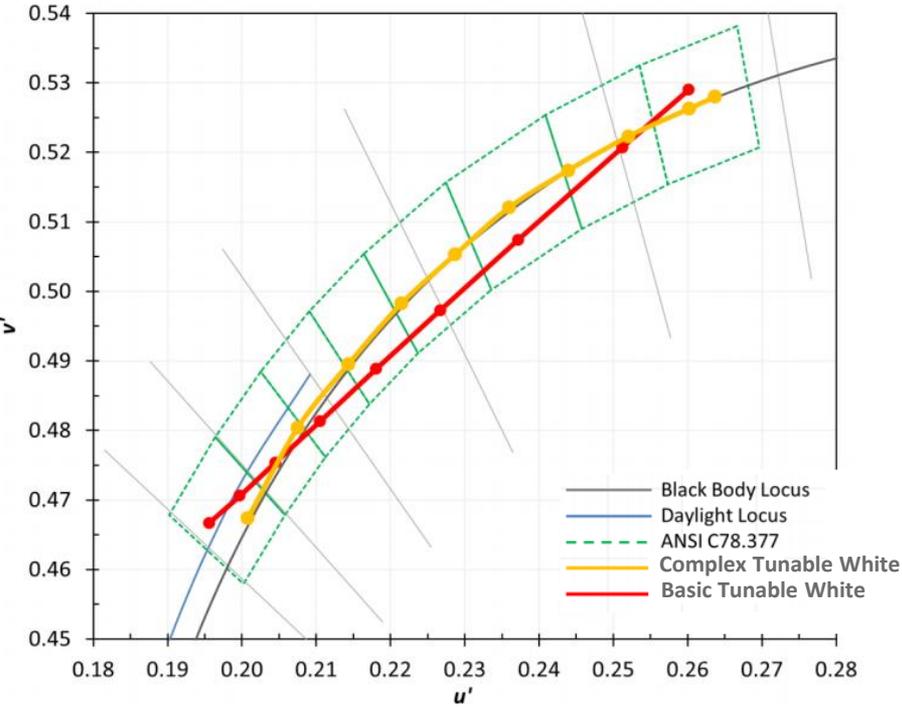


- **Complex Tunable White Connected Lamp** – LED lamps that are wirelessly controlled to dim by using a non-linear mechanism, that are effective at following the blackbody curve. Some products can be adjusted over a range of CCTs and can be dimmed at a constant CCT.

- **Color Tunable Lamp** – Wirelessly controlled LED lamps that can be adjusted to create white or colored light.



# Lamps Features – Black Body Curve

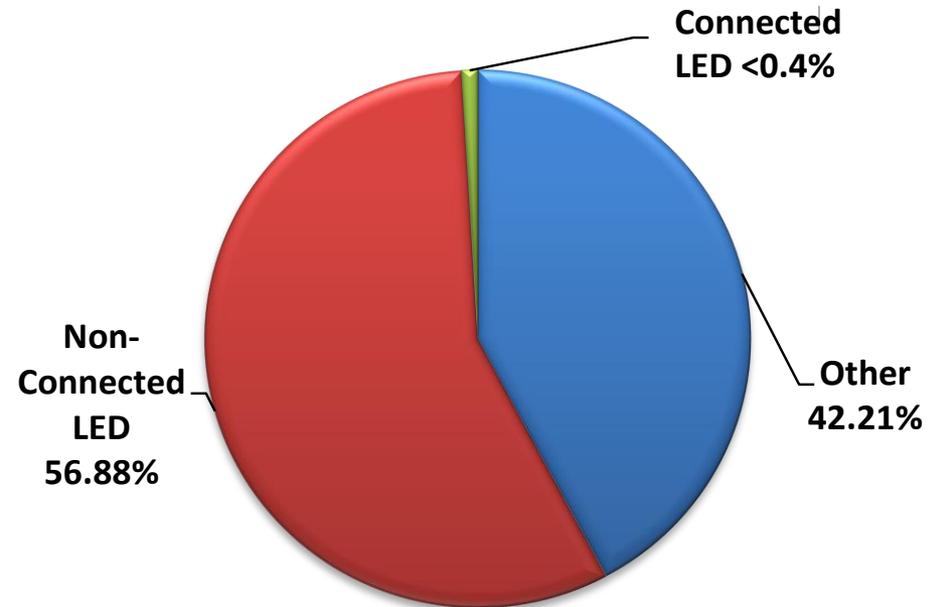
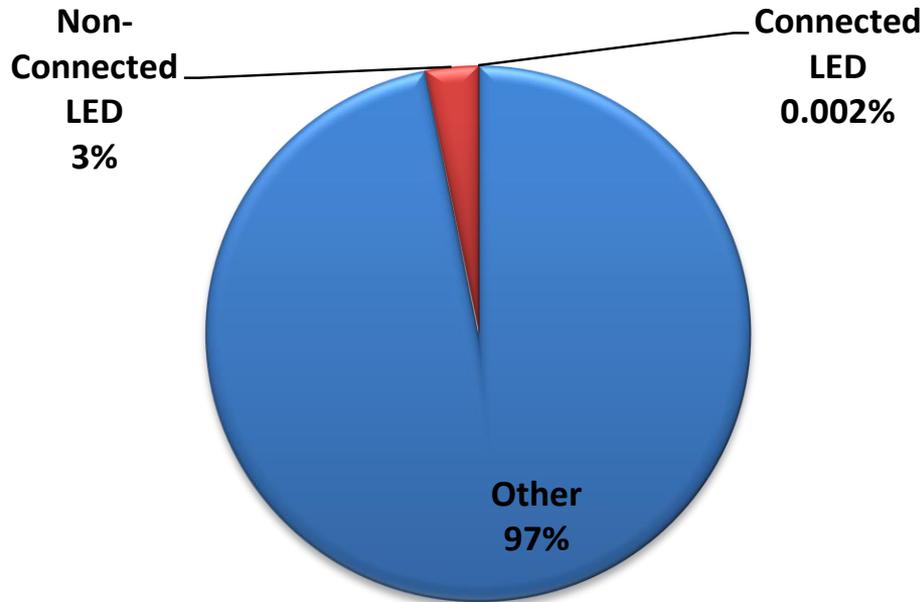


[http://energy.gov/sites/prod/files/2015/09/f26/caliper\\_23\\_white-tunable-led-luminaires.pdf](http://energy.gov/sites/prod/files/2015/09/f26/caliper_23_white-tunable-led-luminaires.pdf)

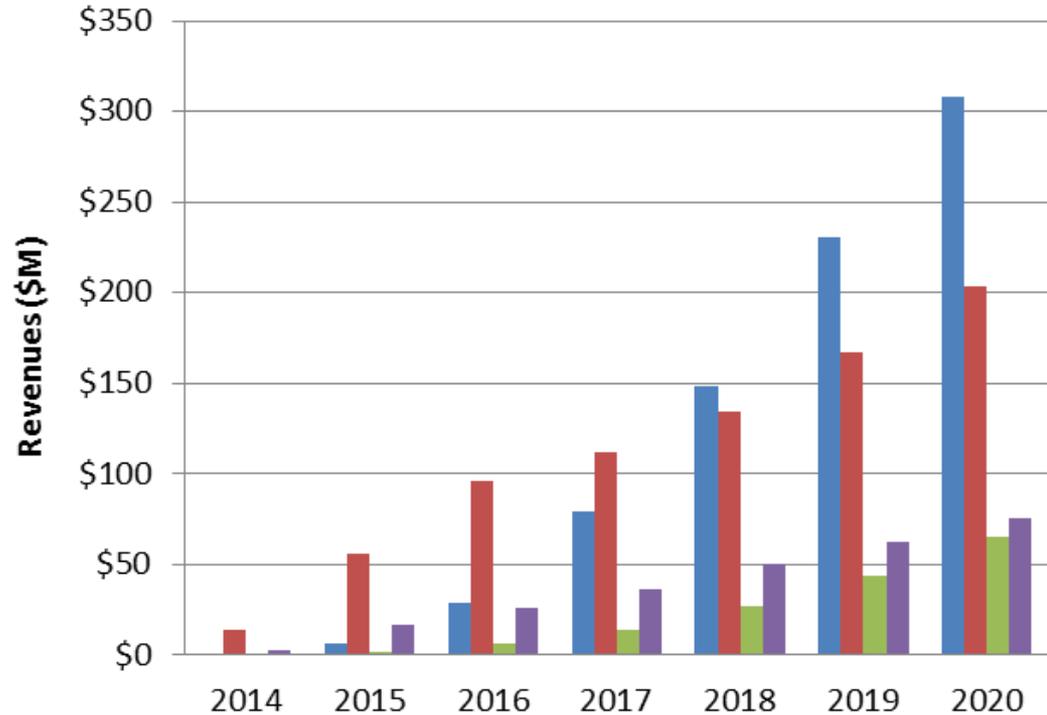
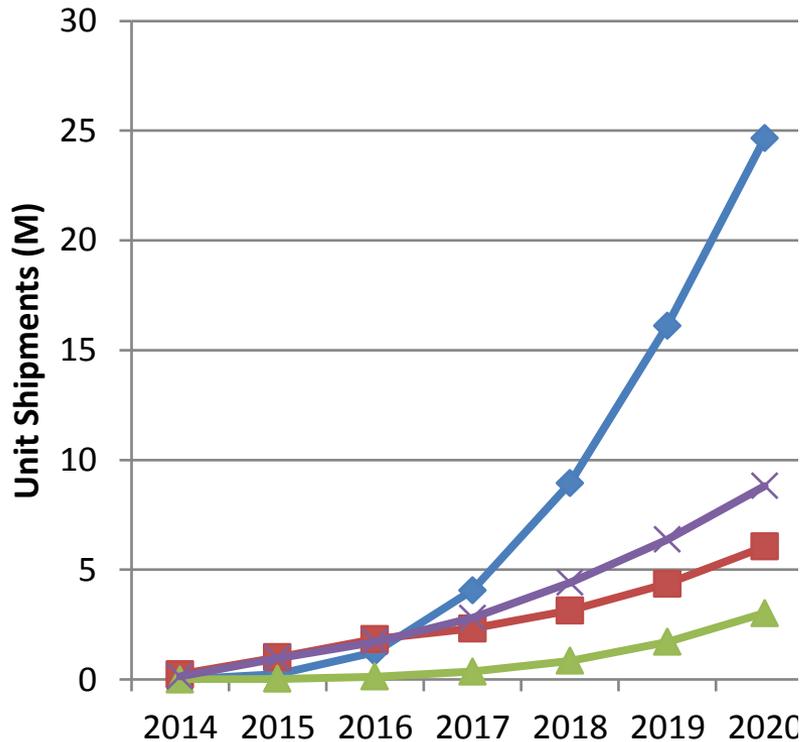
# Connected LED A and Reflector Lamps Installed Units Forecast

2014 Total A and Reflector  
Installed Base = 23.8 Billion Units

2020 Total A and Reflector  
Installed Base = 25.0 Billion Units

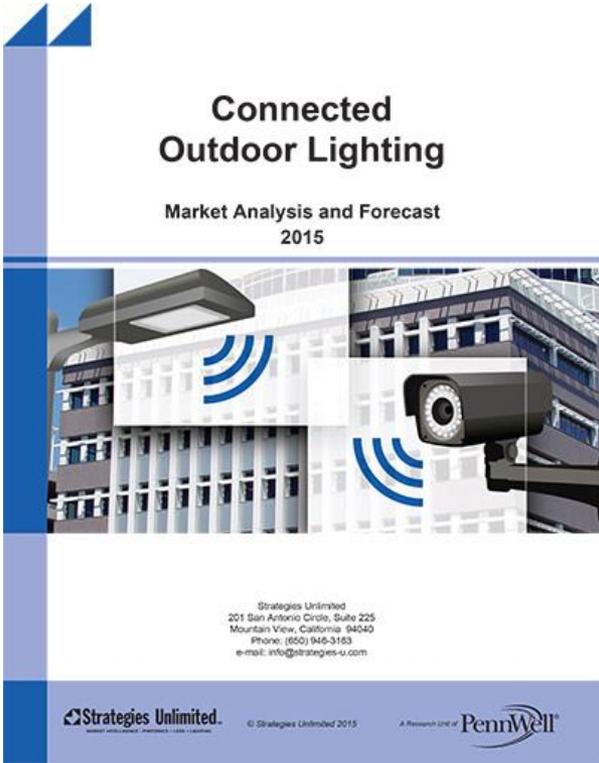


# Connected LED A and Reflector Lamp Unit Shipments & Revenues



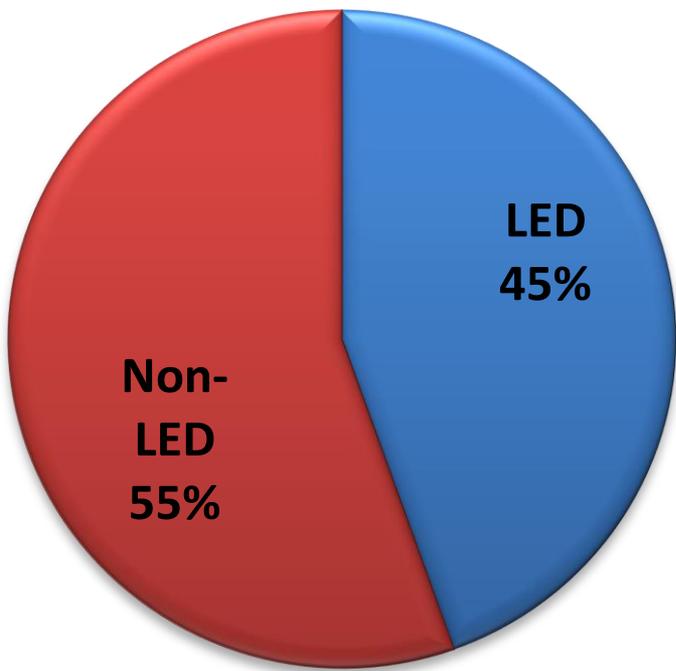
■ Basic Tunable White 
 ■ Color Changing 
 ■ Complex Tunable White 
 ■ Simple Dimming

# CONNECTED OUTDOOR MARKET

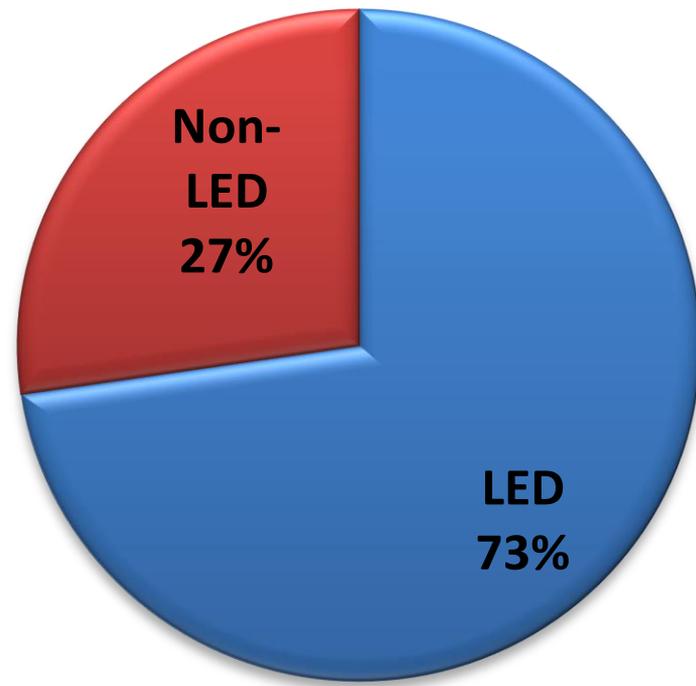


# Connected Outdoor Luminaire Unit Shipments

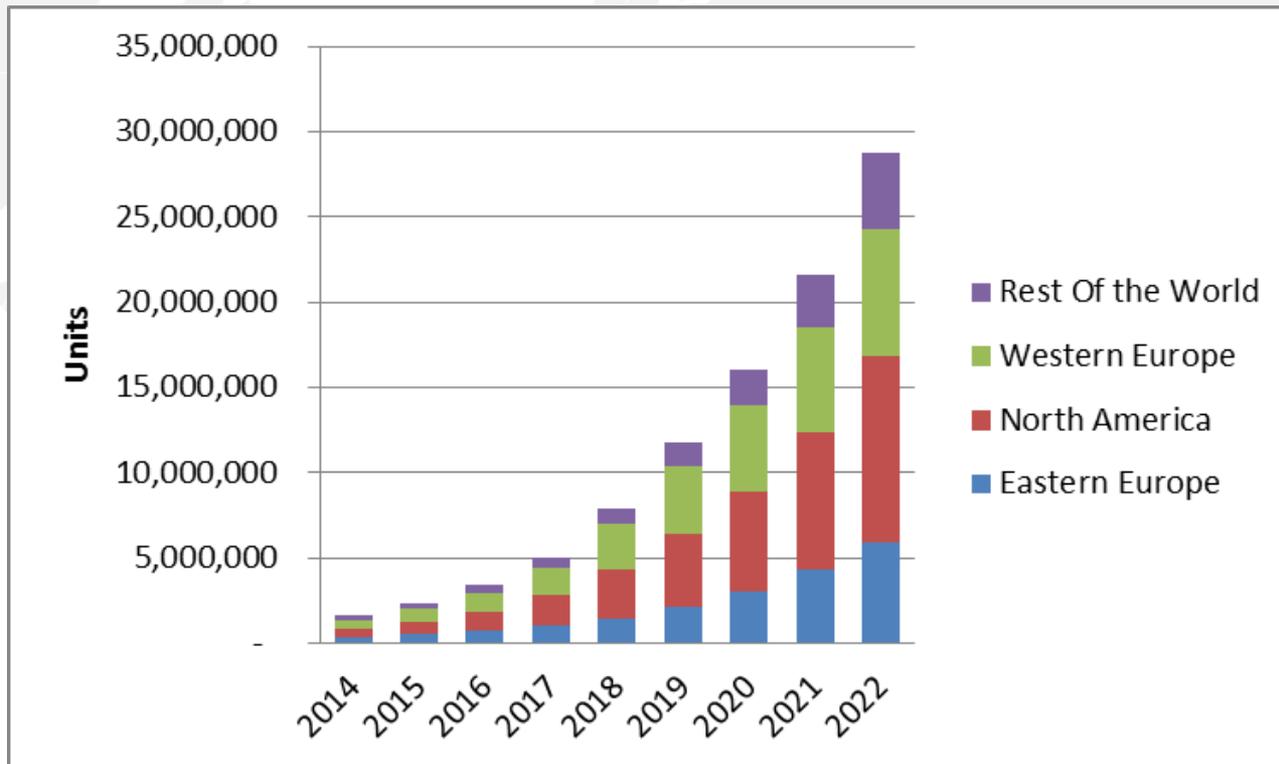
**2014 Connected Outdoor Luminaire Shipments = 1.66 Million Units**



**2022 Connected Outdoor Luminaire Shipments = 30.0 Million Units**



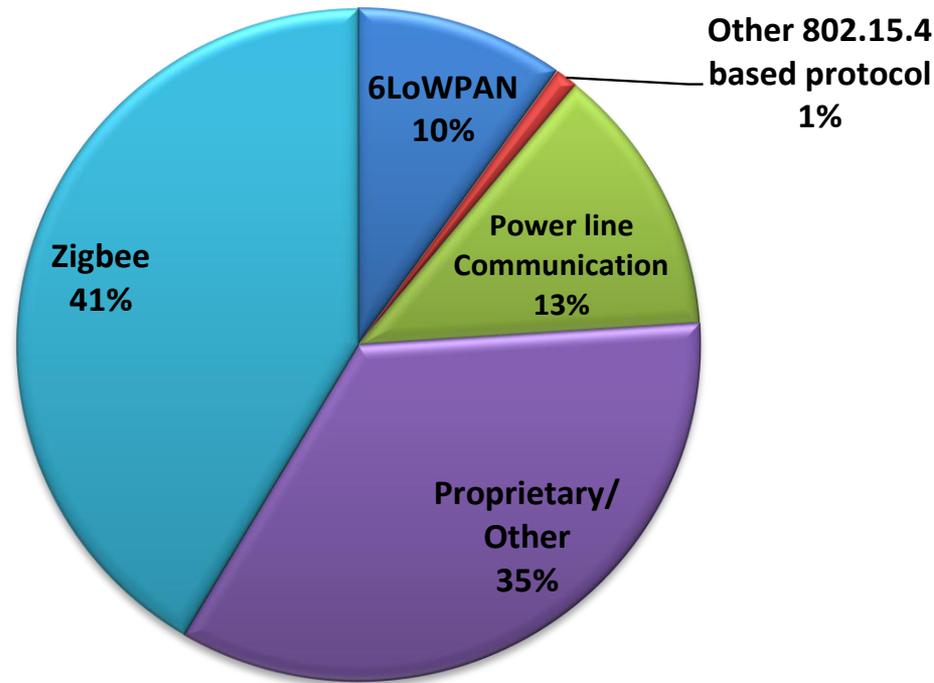
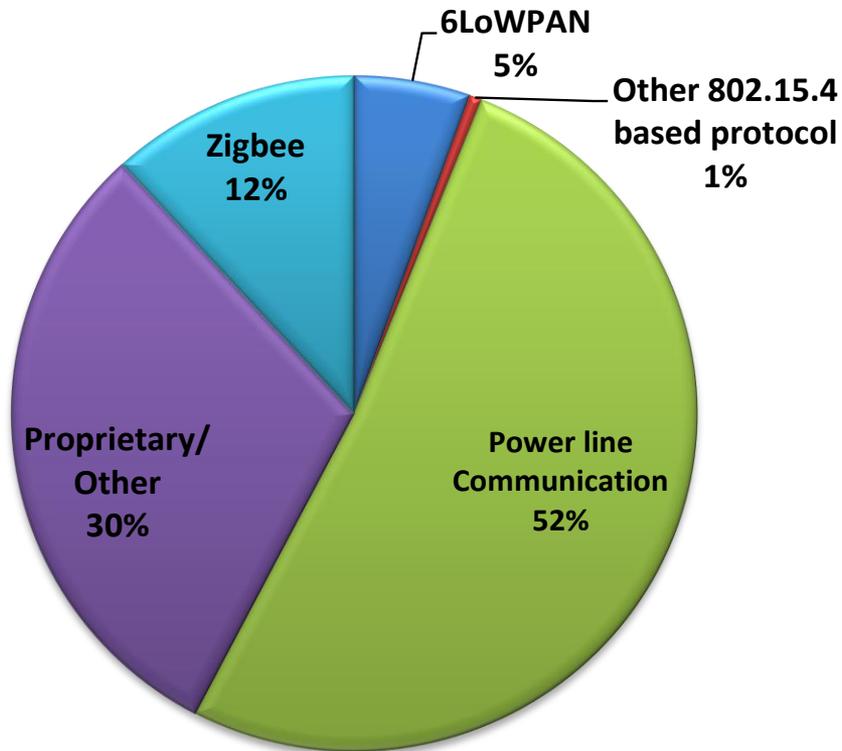
# Total Connected Outdoor Luminaire Shipments



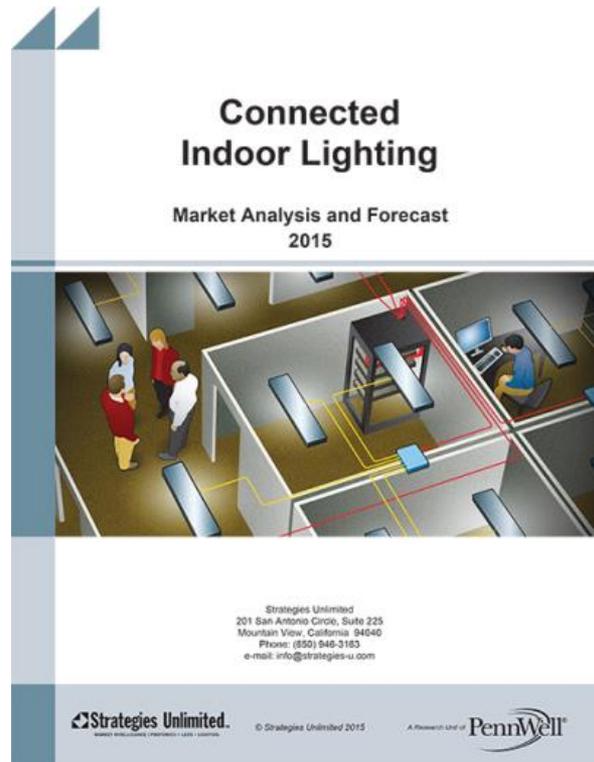
# Connected LED Outdoor Luminaire Unit Shipments

2014 Connected LED Outdoor Luminaire Shipments = 0.74 Million Units

2022 Connected LED Outdoor Luminaire Shipments = 21.75 Million Units

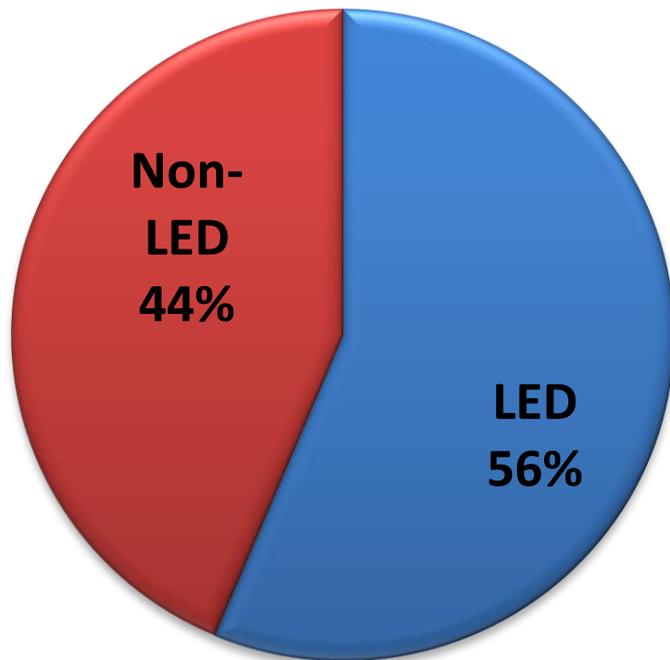


# CONNECTED INDOOR MARKET

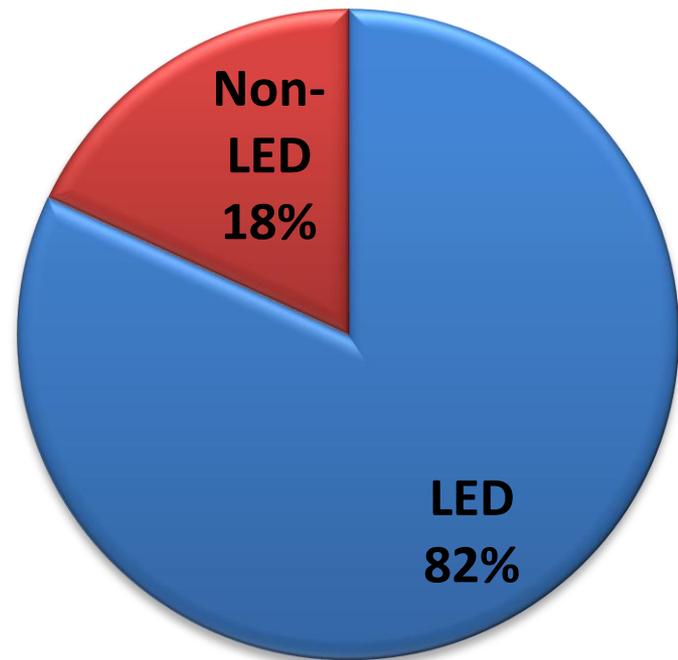


# Connected Indoor Square Feet Installations

2014 Square ft. using connected controls = 1,256 Million Sq. Ft.

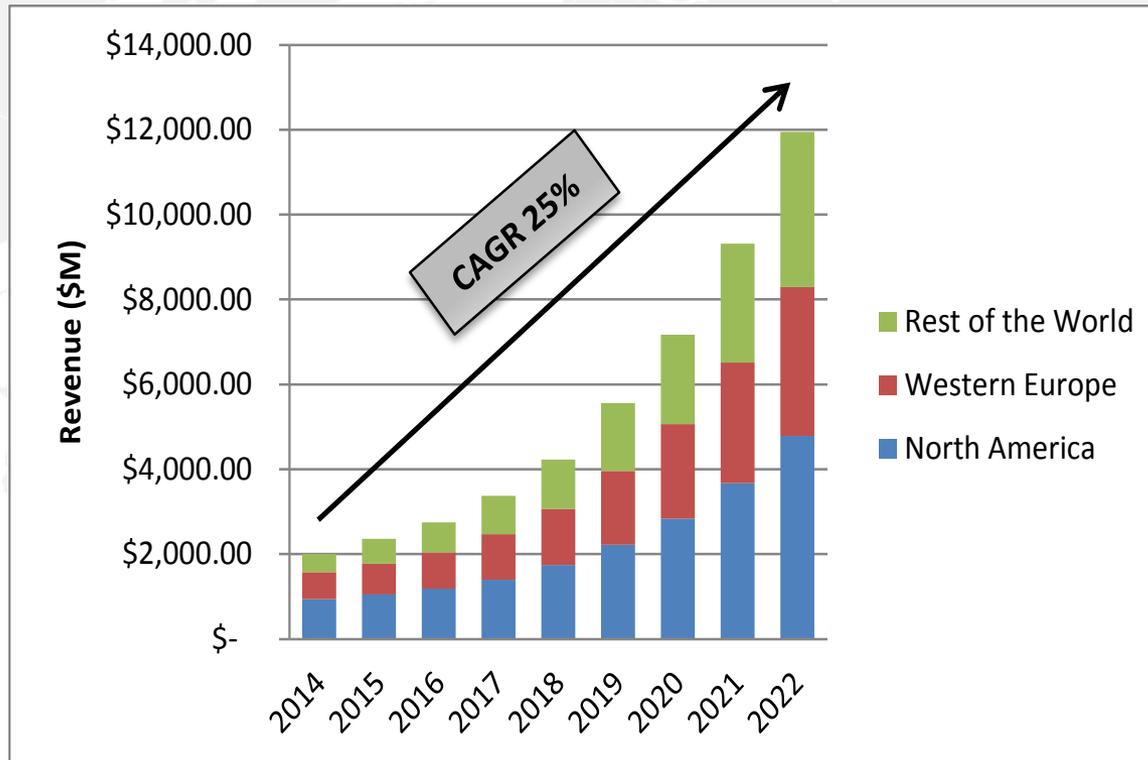


2022 Square Ft. using connected controls = 16,464 Million Sq. Ft.

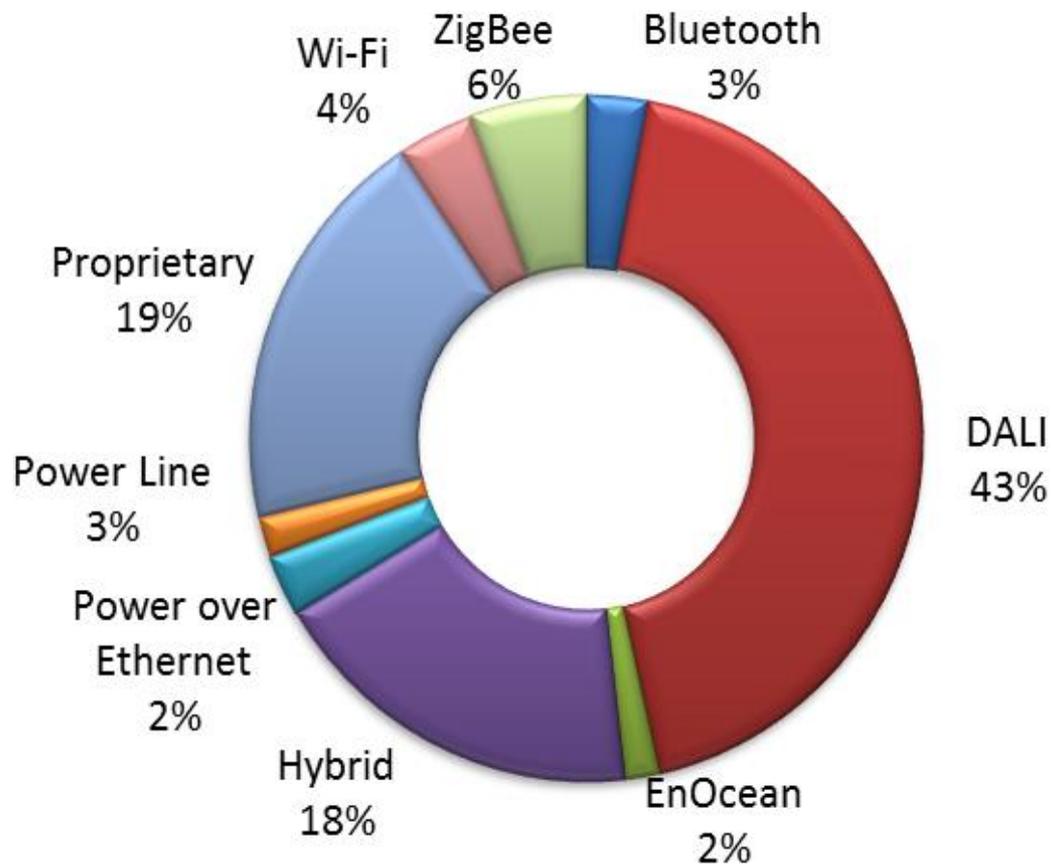


# Overview of Connected Indoor Lighting Market

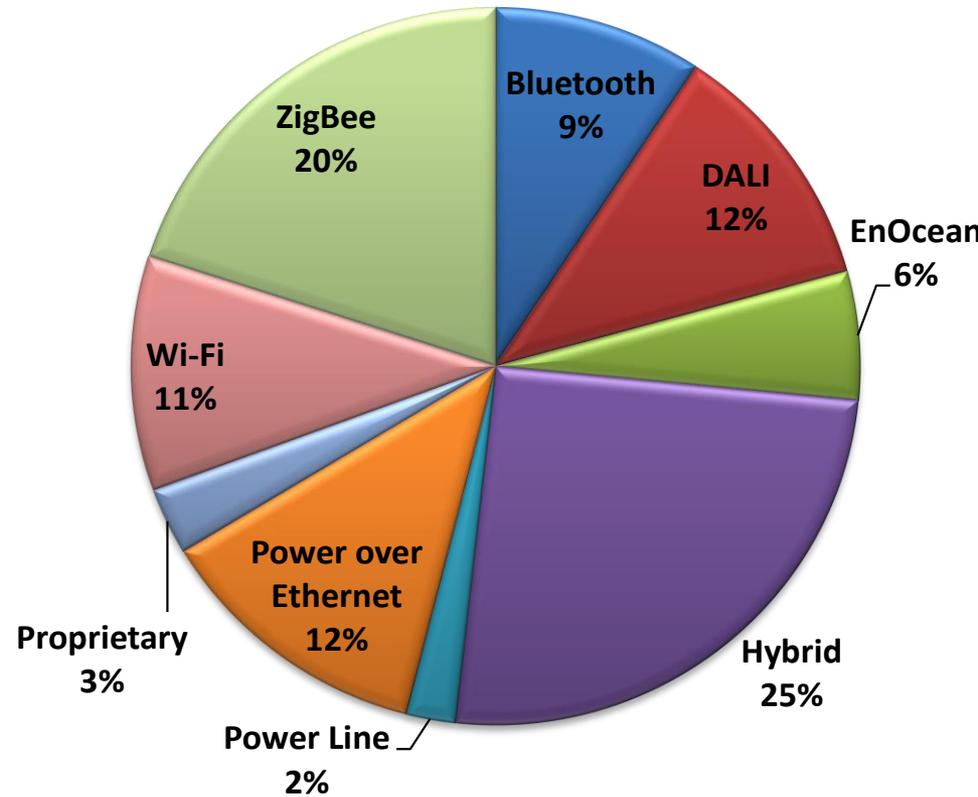
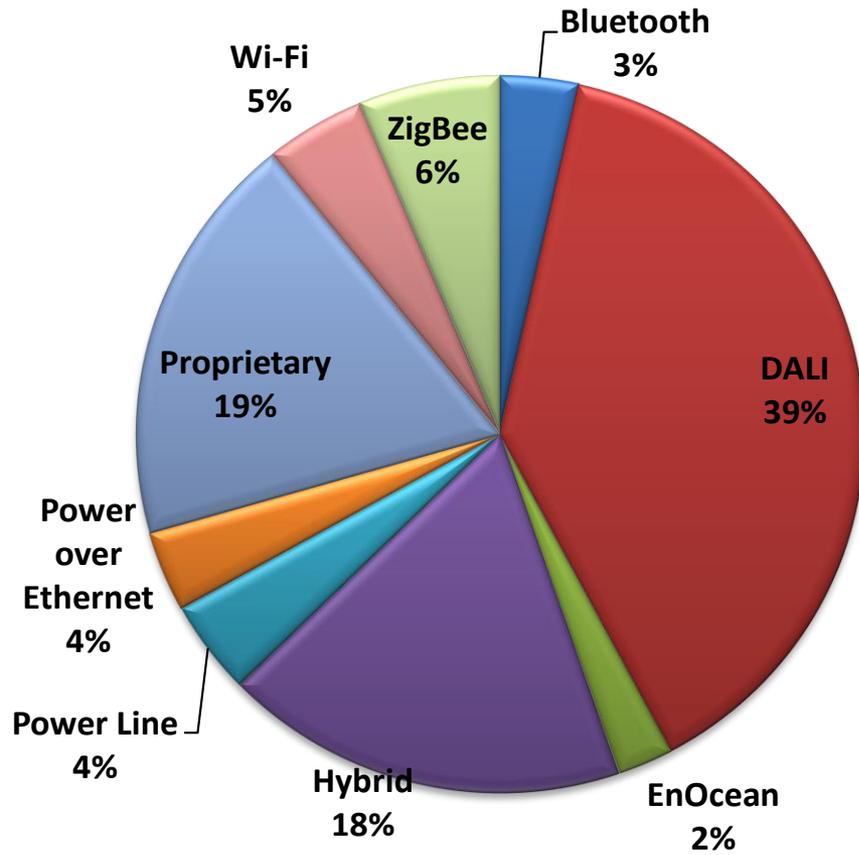
Total Revenue Forecast



# 2014 Connected Indoor Lighting Market



# Connected LED Indoor Controls





# Thank You!

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