



# **LIGHTING FOR TODAY AND TOMORROW WITH SOLID STATE LIGHTING**

***National Grid and NSTAR - Your Partners in Energy Solutions***

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# LIGHTING FOR TODAY AND TOMORROW WITH SOLID STATE LIGHTING

## *Agenda:*

- *Review the fundamentals of solid state lighting (LEDs)*
- *Discuss what is being done at the Federal and Regional levels to develop standards around this emerging technology.*
- *Overview of SSL technologies that qualify for Prescriptive Incentives under National Grid Retrofit Lighting Initiative*
- *Review Project Opportunities*
- *Summary LED technology*

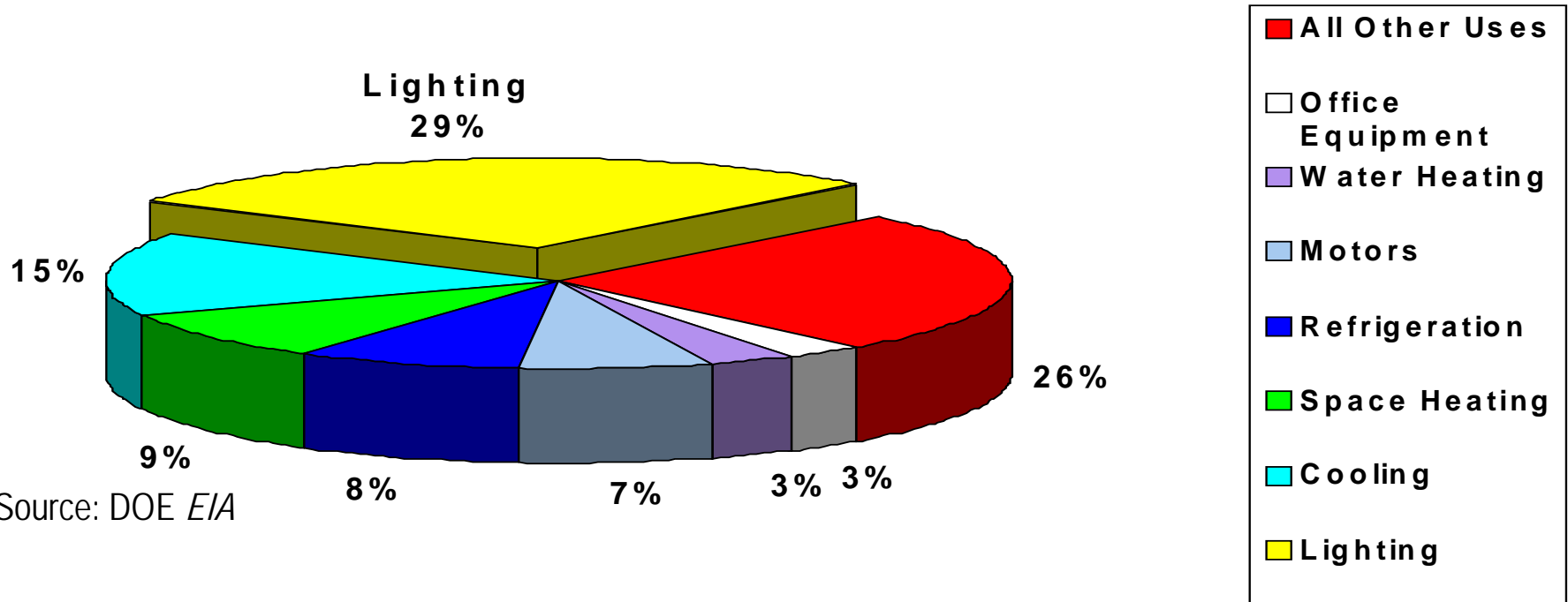


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# Why LED Lighting?

## Energy Usage in Non-Residential Buildings

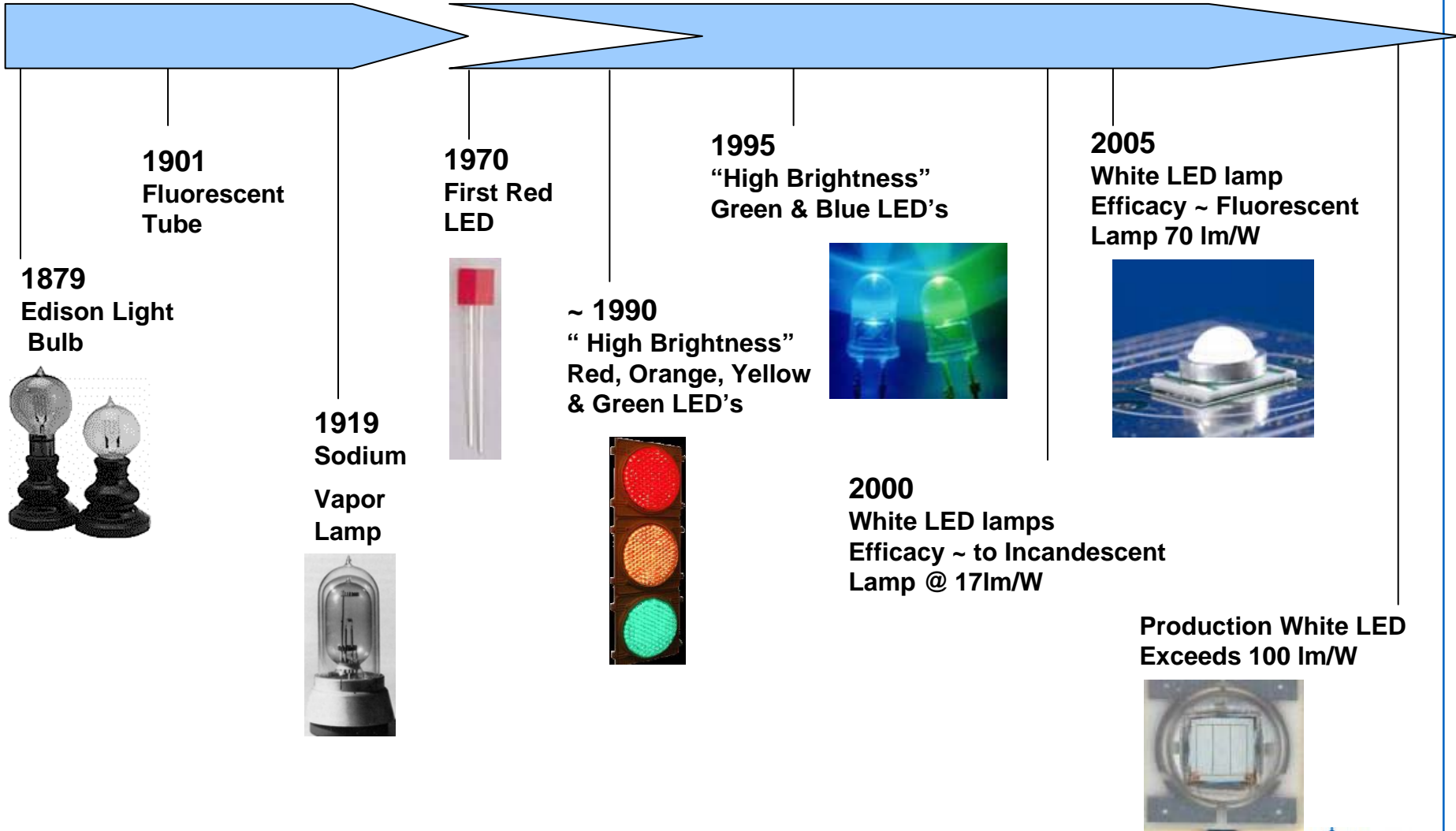


Source: DOE EIA

### The widespread use of LEDs over the next 10 years can:

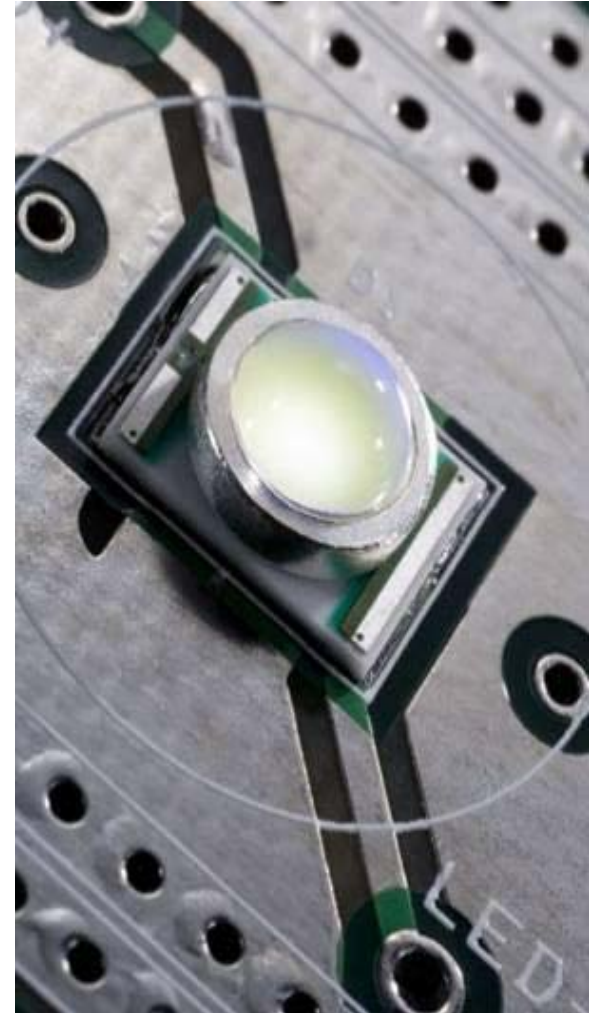
- Save energy (up to 60% Energy savings over standard technology within Lighting sector above)
- Save money
- Help protect the environment (no mercury)

# ...A Brief History of Lighting



# ***Basic Advantages of LED Technology***

- **Directional Light Source**
- **LED's are a semi-conductor  
(non filament source)**
- **Extended Lifetime Rating (>50,000 hours)**
- **Inherently Rugged**
- **LEDs increasing in Efficacy  
( > 100 lm/W)**
- **Instant ON, no re-strike times**
- **Environmentally sound, no mercury**
- **Dimmable**
- **Cold temperature compliant**



# How do I Evaluate LEDs?

- **Review LM-79 photometric test data**
- **Review LM-80-08 LED Package temperature Data**
  - *Defines testing parameters for lumen depreciation of SSL packages over time ( recommends 6000 hours testing)*
  - *Taken at 55° C, 85° C, and Third Temp.*
- **In-Situ Temperature Measurement test (ISTMT) data**
  - *Report indicating the temperature of the hottest LED In-Situ*
  - *“In-Situ” Real-world LED temperature in environment (i.e. fixture or integral lamp)*
  - *Along with LM-80-08 validates lumen maintenance and useful life of product (L70 lifetime determination)*

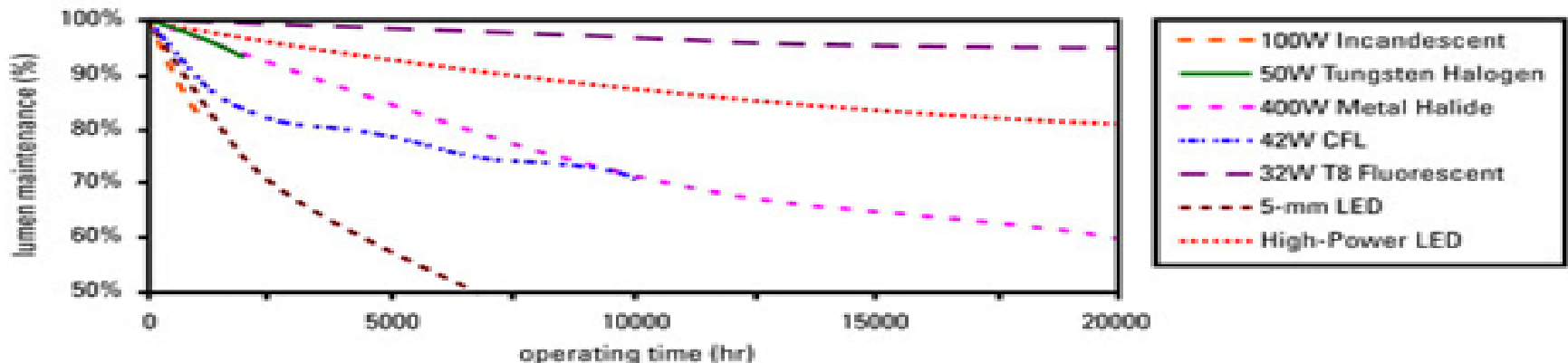


# What is LED “Life”?

## What is Lifetime?

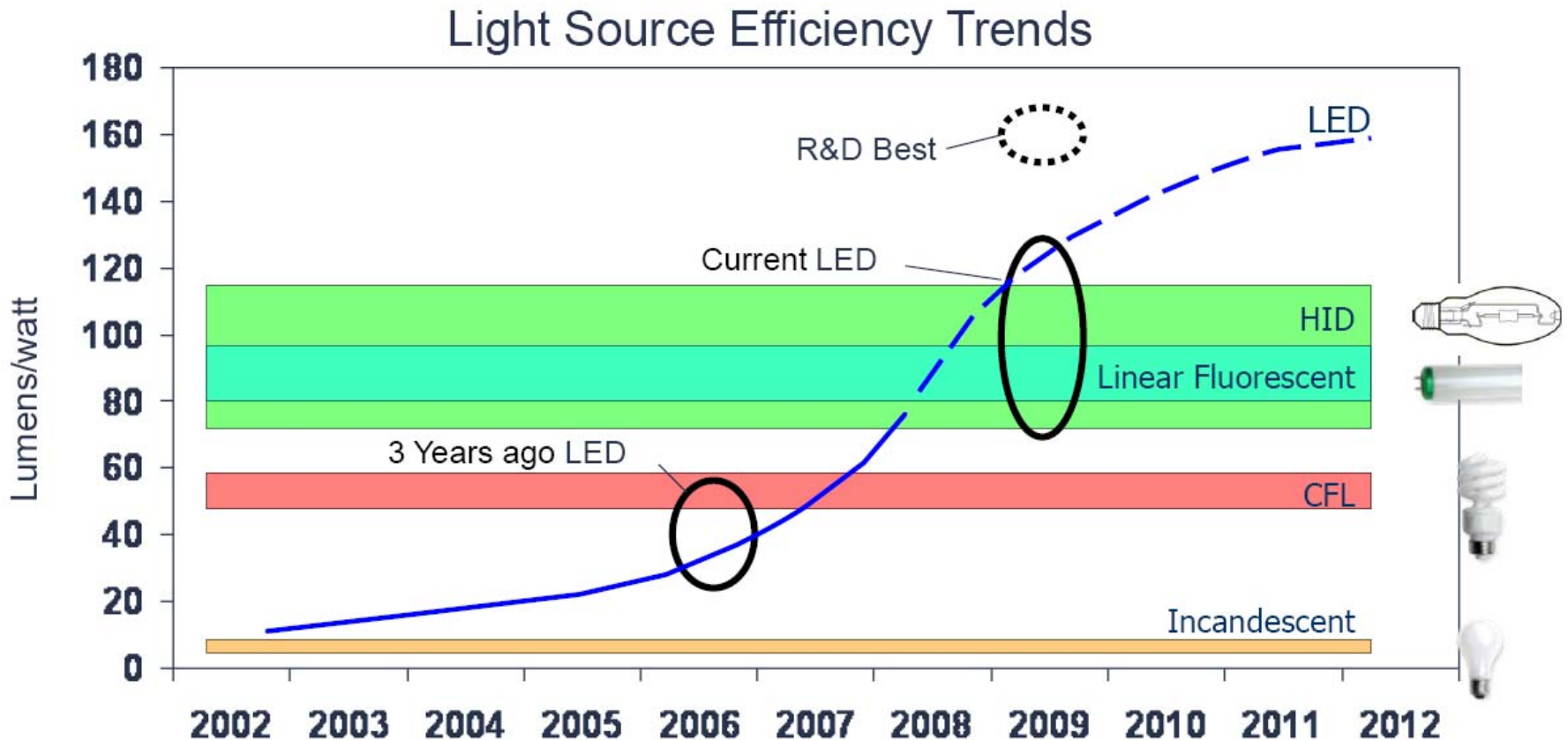
- Industry considers LED life to be the point at 70% of light output ( Based on research indicating the human eye does not detect a decrease in light until it exceeds 30%)
- Manufacturers publish lumen depreciation curves based on testing their products to 6,000 hours and extrapolating to 70% level to determine lifetime (accounting for drive current & LED junction temperature)
- Note: Lifetime Determination for fluorescent lamps is at 25° C burn for 3 hours, off 20 minutes at the point that 50% of the lamps fail

Typical Lumen Maintenance Values for Various Light Sources



Source: Adapted from Bullough, JD. 2003. *Lighting Answers: LED Lighting Systems*. Troy, NY: National Lighting Product Information Program, Lighting Research Center, Rensselaer Polytechnic Institute.

# How do LEDs Compare to Standard Light Sources?



# ***What is being done at the Federal level to develop standards around this emerging technology ?***

## ***Energy Star Kicked off the SSL initiative in Sept. 2008***



- ***Intent on making sure there is consistency in the market***
- ***Developing standards (2 final and 1 draft specifications)***
  - Energy Star Program Requirements for Integral Led Lamps
    - **(dated final: 03/22/10)**
  - Energy Star Program Requirements for Solid State Lighting Luminaires
    - Eligibility Criteria – Version 1.1 **(dated final: 12/19/08)**
    - Energy Star Program Requirements for Solid State Lighting Luminaires
      - Eligibility Criteria – Version 1.2 **(dated draft: 07/01/09)**
        - Additional categories Outdoor Area, Wall Mount & Parking Garage Luminaires
- ***List products by category under Residential & Commercial Groups***
- ***The list is evolving slowly***
- ***Energy Star now governed under EPA not DOE***



# ***What is being done at the Regional level to develop standards around this emerging technology ?***

## ***DesignLights Consortium Kicked off the SSL initiative in Nov. 2009***

- ***Design Lights Consortium will be creating a SSL product qualifying list for products not yet covered under the Energy Star***
- ***The DLC has hired the Lighting Research Center (LRC) to evaluate product***
- ***Developing standards (current technical requirements dated 03/04/10)***
- ***Website: <http://designlights.org/solidstate.about.php>***

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ENERGY-EFFICIENT, COMMERCIAL LIGHTING DESIGN AND INFORMATION!



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# Design Lights Consortium SSL Technical Requirements

Updated April 30, 2010

Technical Requirements Table v1.4

Application	Minimum Light Output	Zonal Lumen Requirements	Minimum Luminaire Efficacy	Allowable CCTs (ANSI C78.377-2008)	Minimum CRI	Minimum LED Lumen Maintenance at 6000hrs <sup>1</sup>	Minimum Luminaire Warranty
1. Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	1,000 lm	=100% 0-90°, <10 % 80-90°	50 lm/W	<6500K	50	95.8%	N/A
2. Outdoor Pole/Arm-Mounted Decorative Luminaires	1,000 lm	95% 0-90°	40 lm/W	<6500K	50	95.8%	N/A
3. Outdoor Wall-Mounted Area Luminaires	300 lm	=100% 0-90°, <10 % 80-90°	40 lm/W	<6500K	50	95.8%	N/A
4. Parking Garage Luminaires	2,000 lm	>=20% 60-70°, >=15% 70-80°	56 lm/W	<6500K	50	95.8%	N/A
5. Track or Mono-point Directional Lighting Fixtures	250 lm	>= 85% 0-90°	30 lm/W	2700K, 3000K, 3500K, 4000K, 5000K	50	95.8%	N/A

# Design Lights Consortium SSL Technical Requirements

6. Refrigerated Case Lighting	Center-mounted*: >=100 lm/ft  End-mounted**: >= 50 lm/ft	>= 95% 0-80°	35 lm/W	2700K, 3000K, 3500K, 4000K, 4500K, 5000K	70	95.8%	5 years
7. Display Case Lighting	End-mounted**: = 50 lm/ft	>= 95% 0-80°	35 lm/W	2700K, 3000K, 3500K, 4000K, 4500K, 5000K	75	94.1%	3 years
8. Linear Panels (2x2 Troffers ONLY)	>3000 lm	>=50% 30°-60°:	55 lm/W	2700K, 3000K, 3500K, 4000K, 4500K, 5000K	80	94.1%	3 years
9. High-bay and Low-bay fixtures for Commercial and Industrial buildings	>10000 lm	>= 30% 20-50 °	60 lm/W	2700K, 3000K, 3500K, 4000K, 4500K, 5000K, 5700K, and 6500K	70	94.1%	3 years
10. High-bay-Aisle Lighting	>10000 lm	>= 50% 20°-50° >= 30% 0°-20°	60 lm/W	2700K, 3000K, 3500K, 4000K, 4500K, 5000K, 5700K, and 6500K	70	94.1%	3 years

# What LED technologies are covered under Commercial Prescriptive Incentives?

- **Measure Code 80: LED Downlights**

- Intent to replace Incandescent and CFL downlights
- Energy Star qualified



- **Measure Code 81A & 81B: Integral LED Directional Replacement lamps**

- Intent to replace Incandescent MR16, PAR30 & PAR38 lamps
- Energy Star qualified



- **Measure Code 82A & 82B: Freezer/Cooler LED fixtures**

- Intent to replace T-12 lamps
- Saves on maintenance & 1.24kW per ton of cooling
- DesignLights Consortium qualified









- **Measure Code 83: Low Bay, Garage and Canopy LED fixtures**

- Intent to replace HID fixtures in 24/7 hour applications
- DesignLights Consortium qualified
- Will these replace Vapor Tight fluorescent fixtures? **Soon**



# Lighting Project Information Form for Retrofit

80	LED Downlight Fixtures - Hard Wired	\$50	This incentive only applies to hardwired LED fixtures on Energy Star's list (for more information see <a href="http://www.energystar.gov">www.energystar.gov</a> )	25	
81A	Integral LED Directional Replacement Lamps - MR16 & PAR16	\$15	Eligible LED Directional Integral replacement lamps for these reflector styles: MR16 and PAR16. Eligible lamps are required to be listed by Energy Star (for more information see <a href="http://www.energystar.gov">www.energystar.gov</a> )	12	
81B	Integral LED Directional Replacement Lamps - PAR20, PAR30 AND PAR38	\$35	Eligible LED Directional Integral replacement lamps for these reflector styles: PAR20, PAR30S, PAR30L and PAR38. Eligible lamps are required to be listed by Energy Star (for more information see <a href="http://www.energystar.gov">www.energystar.gov</a> )	25	
82A	LED Cooler or Freezer Case Fixtures - 5' Fixture	\$50	Eligible LED Cooler and Freezer Case fixtures are required to be listed by Energy Star or Design Lights Consortium (for more information see <a href="http://www.energystar.gov">www.energystar.gov</a> and <a href="http://www.designlights.org">www.designlights.org</a> )	30	
82B	LED Cooler or Freezer Case Fixtures - 6' Fixture	\$65	Eligible LED Cooler and Freezer Case fixtures are required to be listed by Energy Star or Design Lights Consortium (for more information see <a href="http://www.energystar.gov">www.energystar.gov</a> and <a href="http://www.designlights.org">www.designlights.org</a> )	40	
83	LED Low Bay Fixtures - Garage and Canopy Fixtures	\$150	Eligible LED Low Bay fixtures are required to be installed in 8,760 hour applications and be listed by Energy Star or Design Lights Consortium (for more information see <a href="http://www.energystar.gov">www.energystar.gov</a> and <a href="http://www.designlights.org">www.designlights.org</a> )	60	

# LED technology span various Market Segments

**Past**

**Present**

**Future**



Color Specialty

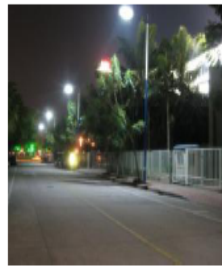


**Colored LEDs**

White Specialty

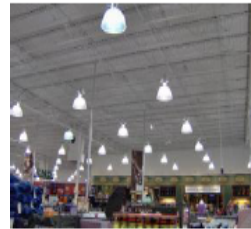


Outdoor Light



**Cool White LEDs**

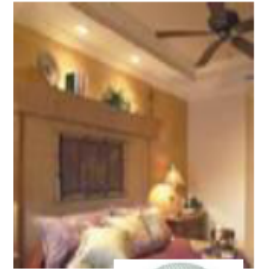
Indoor High Bay



Indoor Commercial



Indoor Directional



**Warm White LEDs**

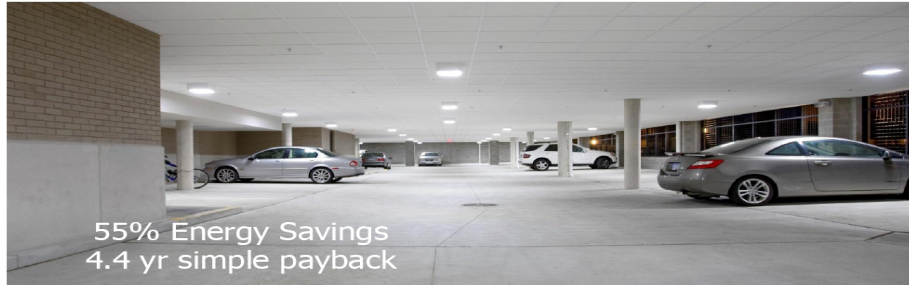


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# LED Lighting- Parking Garages and Industry

## 735 Forest – Birmingham, MI



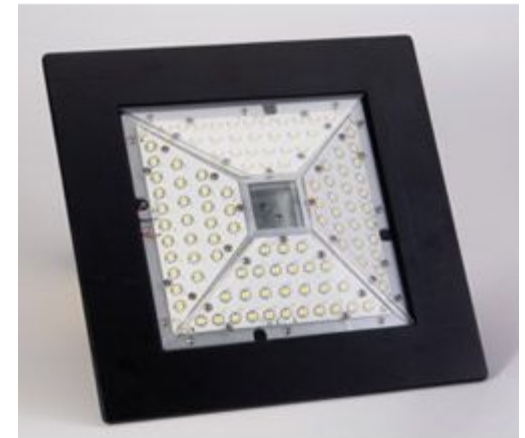
<http://www.735forest.com/>



Image by BetaLED



Lighting Science Lowbay Fixtures at Work



# LED Lighting- Commercial Interiors



Image by Cooper Lighting - Halo



Image by CREE

# LED Lighting – Retail Case Refrigeration



Image by GE



Image by Hussman

# Lighting for Today and Tomorrow with Solid State Lighting Summary

## • **LED Technology Overview**

- Customers understanding & embracing LED technology
- Multitude of LED product available to various market sectors
- Federal & Regional Standards in place
- Performance Increasing (Caliper data)

## • **Viable LED Applications**

- Indoor Downlights (Energy Star qualified)
- Parking Garages (DLC qualified)
- Freezer Cases (DLC qualified)
- Integral Replacement lamps (Energy Star Qualified)

## • **LED Development (next 3-5 years)**

- Higher wattage roadway
- Commercial Interior fixtures ( i.e. recessed 2x4 troffers)

## • **Continuing Education to Market**

- EPA Energy Star standards
- Designlights Consortium technical requirements
- National Grid



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# **LIGHTING FOR TODAY AND TOMORROW WITH SOLID STATE LIGHTING**

***Energy Solutions for Tomorrow: Partnering with National Grid & NSTAR***

- ◆ ***Kelly Cota, LC, LEED AP***  
***phone: 781-907-1554***

***Or Call your local account manager!***



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