Lighting Consumer's Conundrum

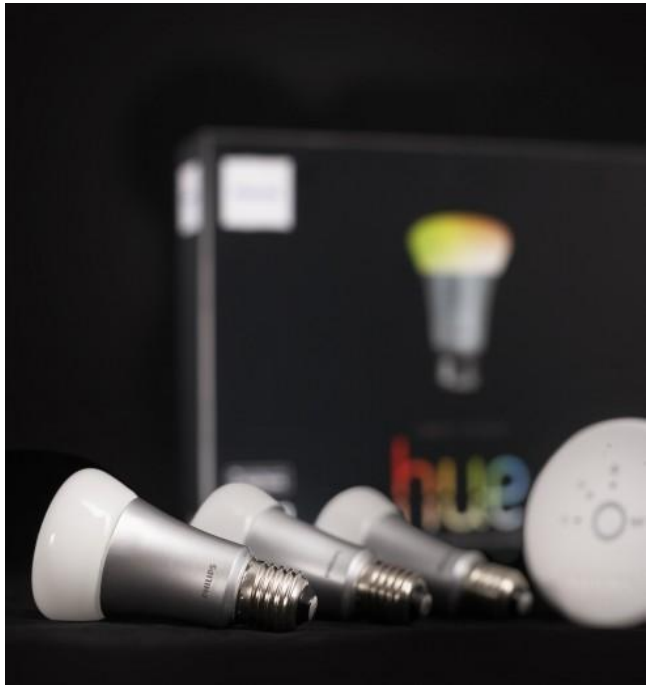
Thursday, March 10, 2016 1:30 pm to 2:30 pm

What does the label mean… for a light bulb?

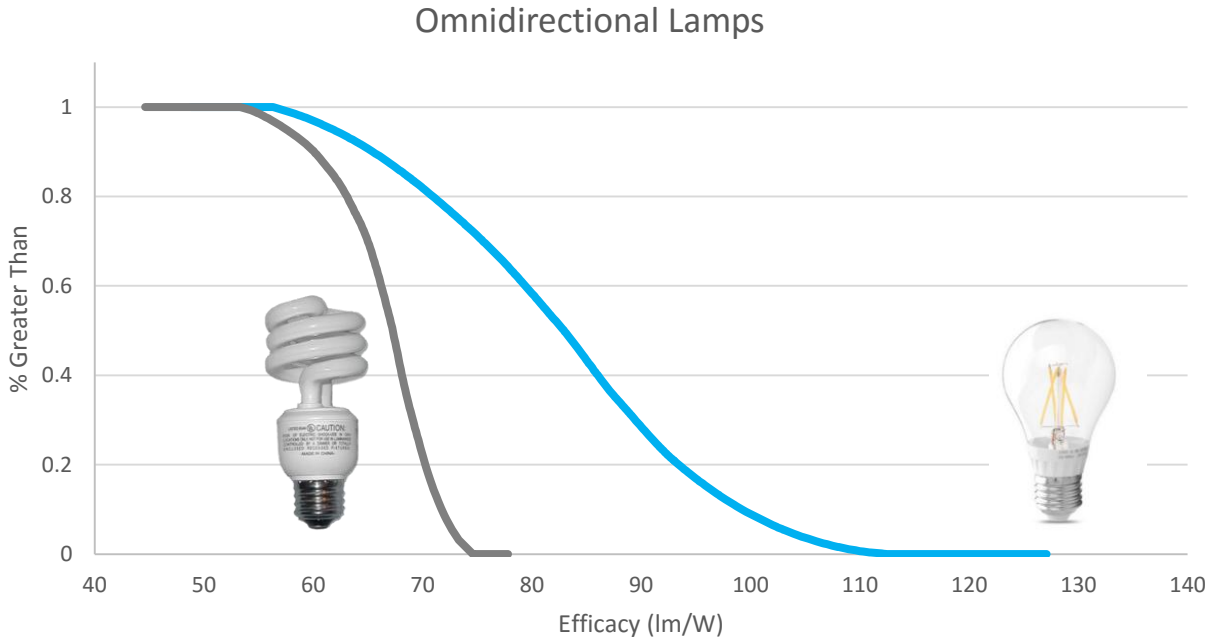
Trends & Specification Updates

- ENERGY STAR Luminaires Version 2.0
  - Shift away from pin-based fixtures
    - 3 options (serviceability encouraged)
      1. Fully integrated LED fixture
      2. Retrofit kits
      3. Fixture with replaceable light sources, LED light engines or screw based ENERGY STAR bulbs
- ENERGY STAR Lamps Version 2.0
  - Finalized Dec 31st 2015
  - Effective January 2017

Connected (IoT) and controllable lighting! Also new shapes and styles



Omni-directional ENERGY STAR Bulbs



Omni/A lamp/General Purpose

- **67% of sockets**
- Federal standards in 2020 for all technologies
  - backstop 45 lm/w or lumen based equation in GSL NOPR
- Current ENERGY STAR: 55 or 65lm/w (15W break)
- **2017 ENERGY STAR:**
  - **70 (90+CRI),**
  - **80 (80-90CRI) lm/w**

You may have heard in the news

Dear CFL,

I find myself staring at the paper, not sure what to say. Maybe that's th
but we kept our issues in the dark.

You were on again, off again. It was fun and new at first, and I fell head
me. Looking back, maybe we let ourselves get too comfortable.

Things change. You know that. And I never imagined this day would cor
a whole new light. You don't want to hear this, but I need to tell you ... I'

I'm in love with LED!

It feels like I've woken up to find my world instantly bright. LED is so inte

The time we spend together is like nothing I've experienced before. My r
mood – day or night. What's more, LED really understands the value of
draining my energy.

I know that wasn't easy to hear, but it's the truth and I have to be hones

CFL, I'll always remember the first time I saw your sweet spiral shape ar
our relationship is over, but I can see clearly now that LED is my future,

Fondly yours,
GE

Goodbye, **CFLs**: **General Electric's** Ditching Them for **LE**...
Motley Fool - Feb 7, 2016
General Electric's (NYSE:GE) Appliances and Lighting division ... light (**CFL**) bulbs on Amazon.com, and into a specialist in **LED** lighting today.

Lights go out for energy-efficient fluorescent bulbs as **GE** focuses on **...**
BT.com - Feb 5, 2016
GE slowly phasing out **CFL** bulbs in favor of **LED**
Global LEDs/OLEDs (press release) - Feb 5, 2016
GE Cuts Compact Fluorescent Bulb Production
Manufacturing Business Technology - Feb 5, 2016
Say goodbye to spiral fluorescent bulbs
Elko Daily Free Press - Feb 6, 2016


BT.com Global LEDs/... Manufacturin... Elko Daily Fr...

Explore in depth (15 more articles)

GE To Stop Producing **CFLs** In Favor Of LEDs
CleanTechnica - Feb 3, 2016
GE will soon cease manufacturing its line of compact fluorescent **lights**, or **CFLs**, as it switches favor to the manufacture of LEDs. My, oh my!
GE to phase out **CFL** bulbs
Boston.com - Feb 3, 2016
GE is phasing out **CFL** bulbs so that **LED** can take off
Highly Cited - The Verge - Feb 1, 2016
GE Lighting says goodbye to U.S. **CFLs**, embracing LEDs (photos)
In-Depth - cleveland.com - Feb 2, 2016
It's the Beginning of the End for **CFL** Bulbs
Blog - Slate Magazine (blog) - Feb 1, 2016
GE Will Stop Making **CFL** Lightbulbs Because LEDs Are Better
Highly Cited - Gizmodo - Feb 1, 2016

CityLab USA TODAY Gizmodo The Consum... Slate Magazi... cleveland.com

Explore in depth (99 more articles)

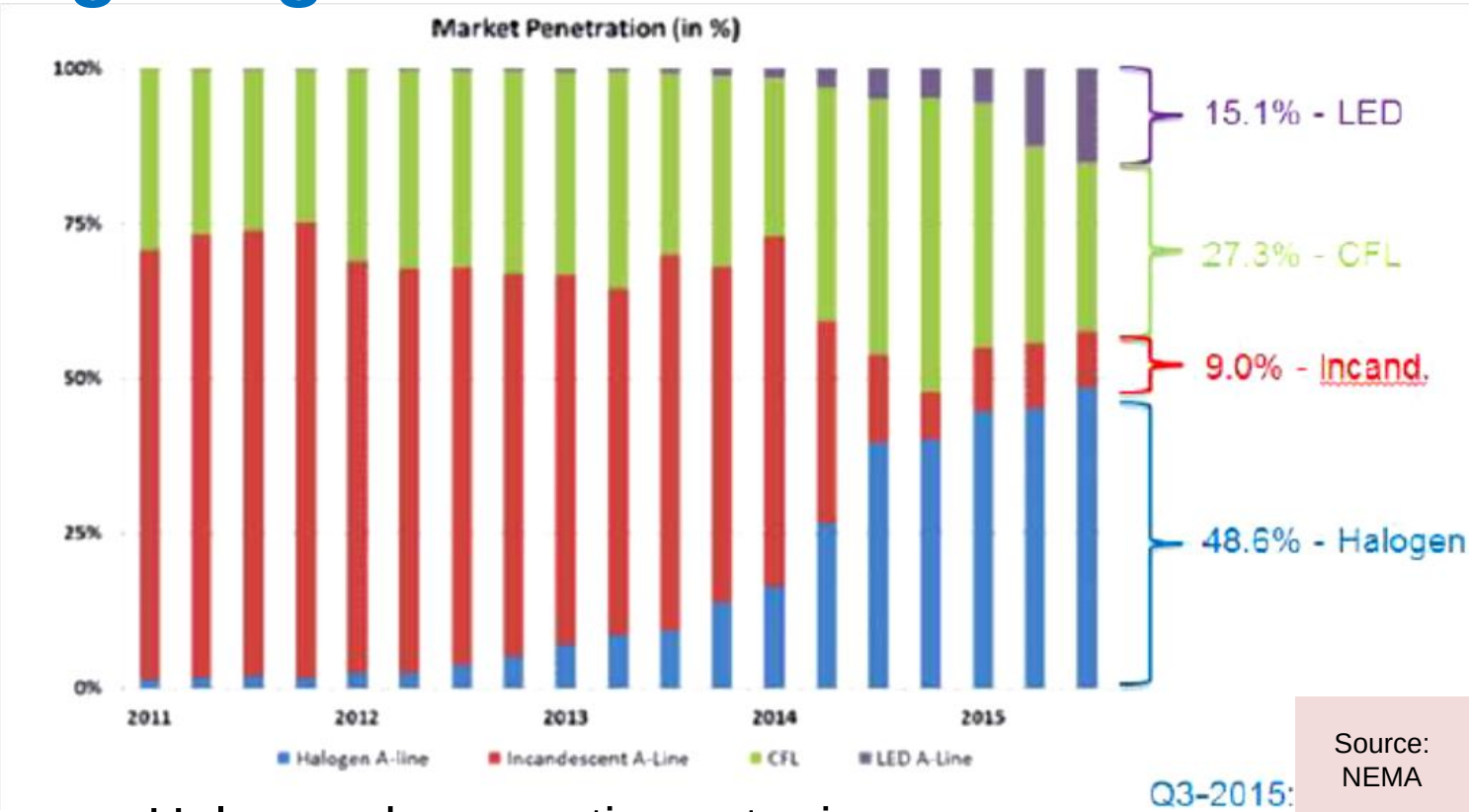
GE Announces "Farewell" to **CFL** Bulbs by Year's End
Justmeans (blog) - Mar 2, 2016
(3BL Media/Justmeans) – Compact fluorescent **lights** (CFL) were the

Light bulb market trends

- Price: Quality LED lighting will be cost-comparable to CFL.
  - 2016 will see sub-$1 ENERGY STAR certified lamps with rebates.
  - 2016 will see $3 or less certified lamps, reaching cost-parity with incandescent.
  - Why have prices dropped? Automation.
- Performance….CFLs vs. LEDs:
  - LED bulbs don't have the same technical challenges as CFLs
    - Though they do have their own unique technological challenges they are far superior to CFLs and incandescent bulbs
  - New ENERGY STAR specification sets efficacy levels above today's CFLs
  - No one is investing in CFL technology anymore

Sources: Discussions with industry, LEDinside Market Trends, 11/10/2015, and LEDinside presentation on R&D presented at DOE, January 2015

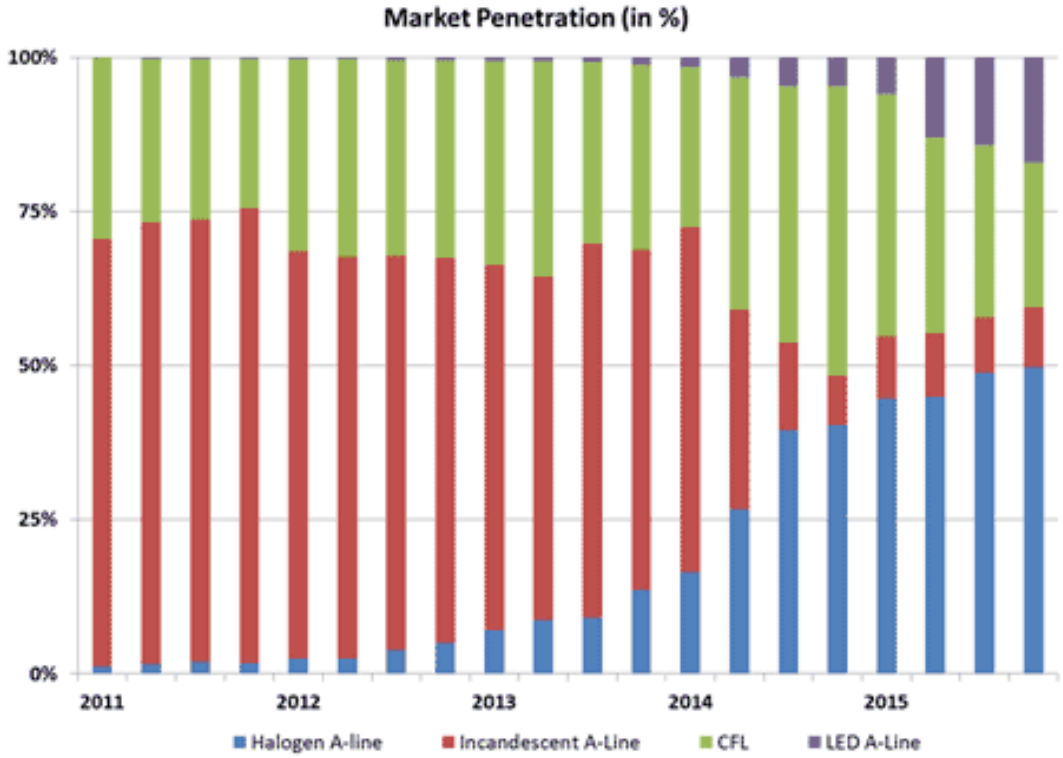
Lighting Market Overview: A-Line



Source: NEMA

- Halogen share continues to rise
- LED market penetration continuing to gain momentum
- Approximately 1.9 billion lamps were shipped in the US in 2014. only 15% were ENERGY STAR certified -2014 EPA ENERGY STAR

Lighting Market Overview: A-Line



17%LED

23.4% CFL

7.8% incandescent

49.7% Halogen

Source: NEMA http://www.nema.org/news/Pages/LED-A-Line-Lamp-Shipments-Posted-Another-Strong-Quarter-to-Close-2015.aspx

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THE END
IS
NIGH

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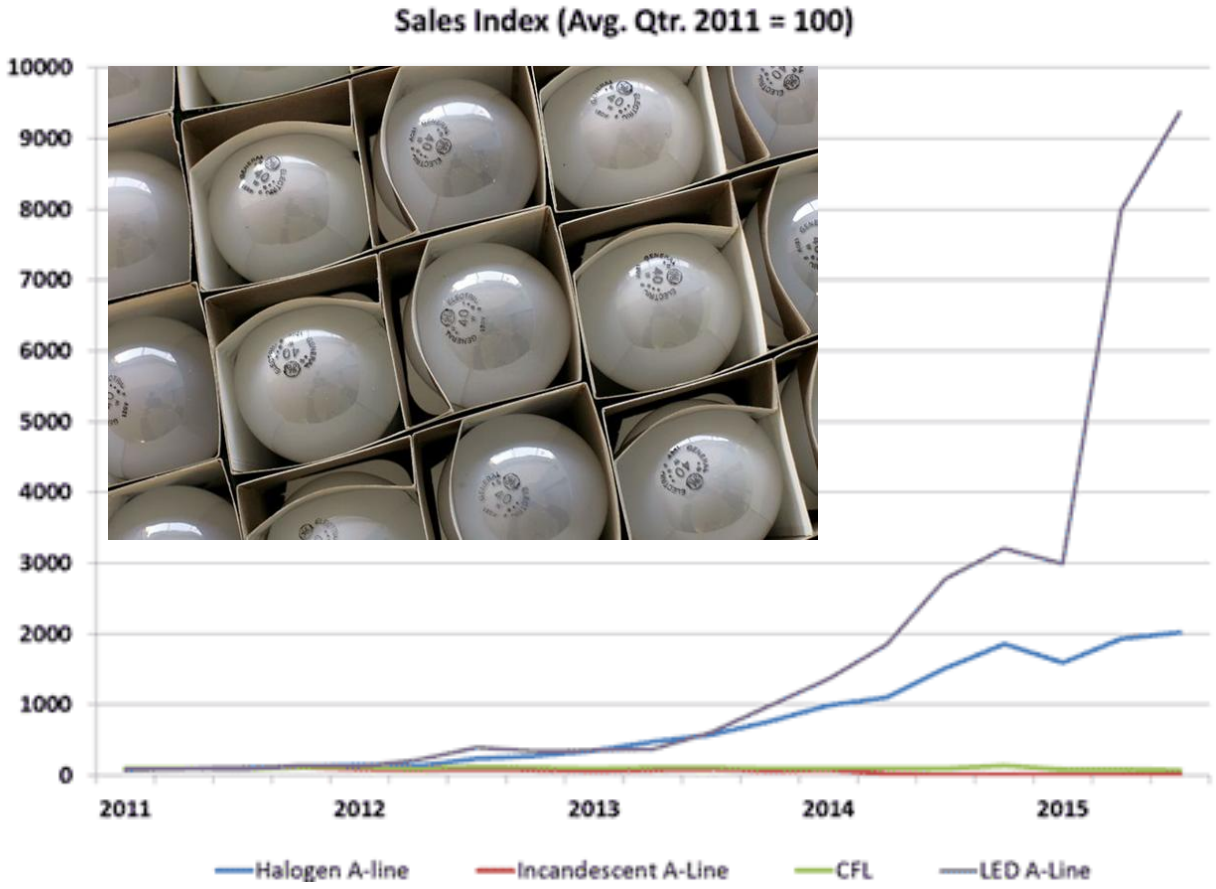


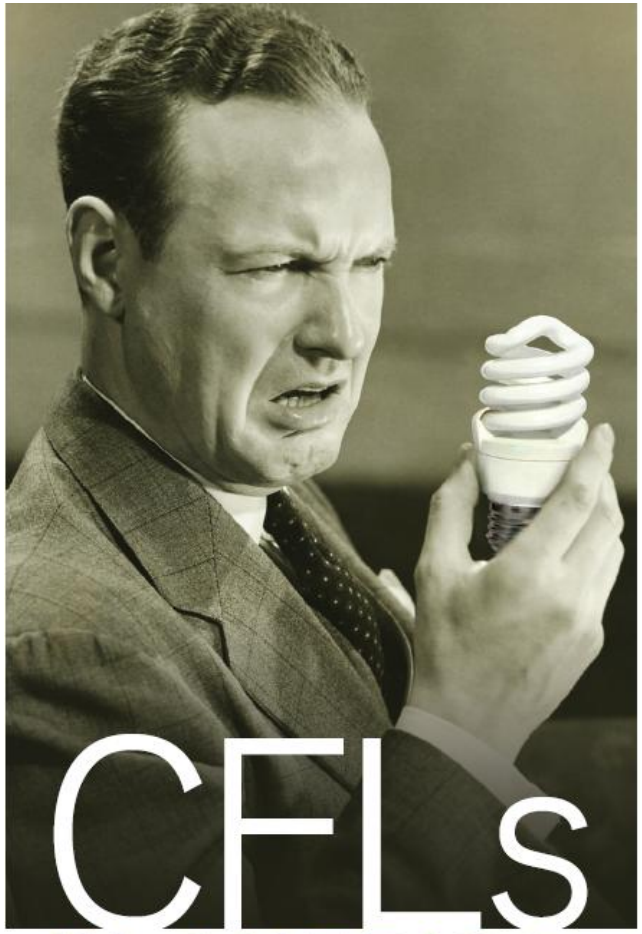
LED A Line

CFL

Incandescent

Halogen

Source: NEMA (U.S. association of electrical equipment and medical imaging manufacturers)
http://www.nema.org/news/Pages/Another-Strong-Quarter-for-LED-A-Line-Lamp-Shipments.aspx



"Actions by DOE, voluntary energy-efficiency programs, and standards organizations have helped the U.S. market to avoid some problems with early SSL products. Standardized testing, minimum performance and reporting requirements, and publication of testing and demonstration results have made it more difficult for poor-performing products to remain on the market, and rewarded manufacturers whose products perform well."

Need help buying a new bulb?

Handy Resources

LIGHTING MADE EASY

Just Look for the ENERGY STAR®

Only bulbs that have earned the ENERGY STAR label have been independently certified and undergone extensive testing to assure that they will save energy and perform as promised.

- ★ Use 70-90% less energy than incandescent bulbs
- ★ Save you $30 to $80 in energy bills
- ★ Provide the same brightness (lumens) with less energy (watts)
- ★ Last 10 to 25 times longer than incandescent bulbs
- ★ Help protect the environment and prevent climate change

ENERGY STAR certified CFL and LED bulbs are available in a variety of shapes and sizes for any application—including recessed cans, track lighting, table lamps, and more. You can even find certified bulbs that are dimmable.

Use this chart as a guide to finding the right ENERGY STAR certified bulb for your light fixture and remember to always check the packaging for proper use.

BULB TYPES

TABLE OR FLOOR LAMPS	SPIRAL	A SHAPE				
PENDANT FIXTURES	SPIRAL	A SHAPE	GLOBE	MR16	CANDLE	
CEILING FIXTURES	SPIRAL	A SHAPE	CANDLE			
CEILING FANS	SPIRAL	A SHAPE	CANDLE			
WALL SCONCES	SPIRAL	A SHAPE	GLOBE	CANDLE		
RECESSED CANS	MR16	SPOT	FLOOD			
ACCENT LIGHTING	MR16	SPOT				

BRIGHTNESS

For brightness, look for lumens, not watts. Lumens indicate light output. Watts indicate energy consumed. ENERGY STAR certified bulbs provide the same brightness (lumens) with less energy (watts). **Use this chart to determine how many lumens you need to match the brightness of your old incandescent bulbs.**

Old Incandescent Bulbs (Watts)	ENERGY STAR Bulb Brightness (Minimum Lumens)
40	450
60	800
75	1,100
100	1,600
150	2,600

COLOR/APPEARANCE

ENERGY STAR certified bulbs are available in a wide range of colors. Light color, or appearance, matches a temperature on the Kelvin scale (K). Lower K means warmer, yellowish light, while higher K means cooler, bluer light.

2700K 3000K 3500K 4100K 5000K 6500K

WARM COOL

Warm White, Soft White
Standard color of incandescent bulbs.

Cool White, Natural White
Good for kitchens and work spaces.

Natural or Daylight (think blue sky at noon)
Good for reading.

www.energystar.gov/lighting

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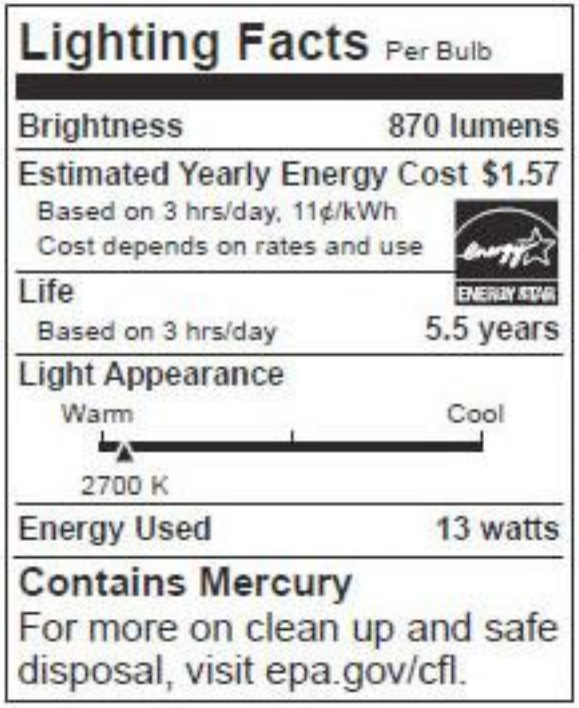
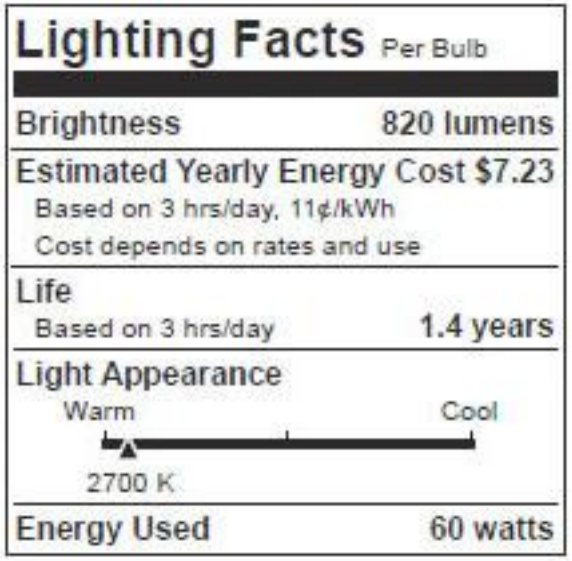
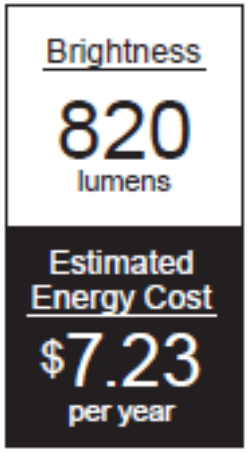
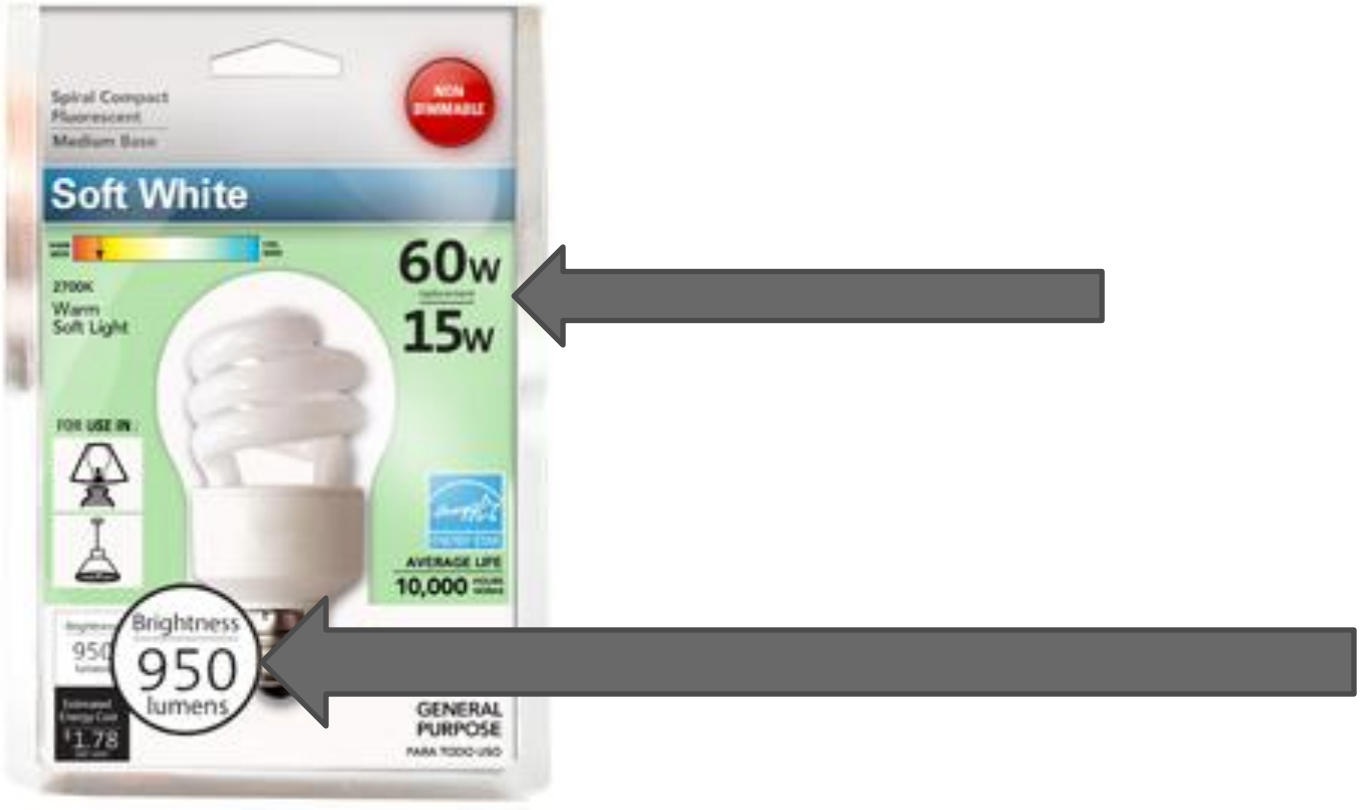
Light bulb labeling





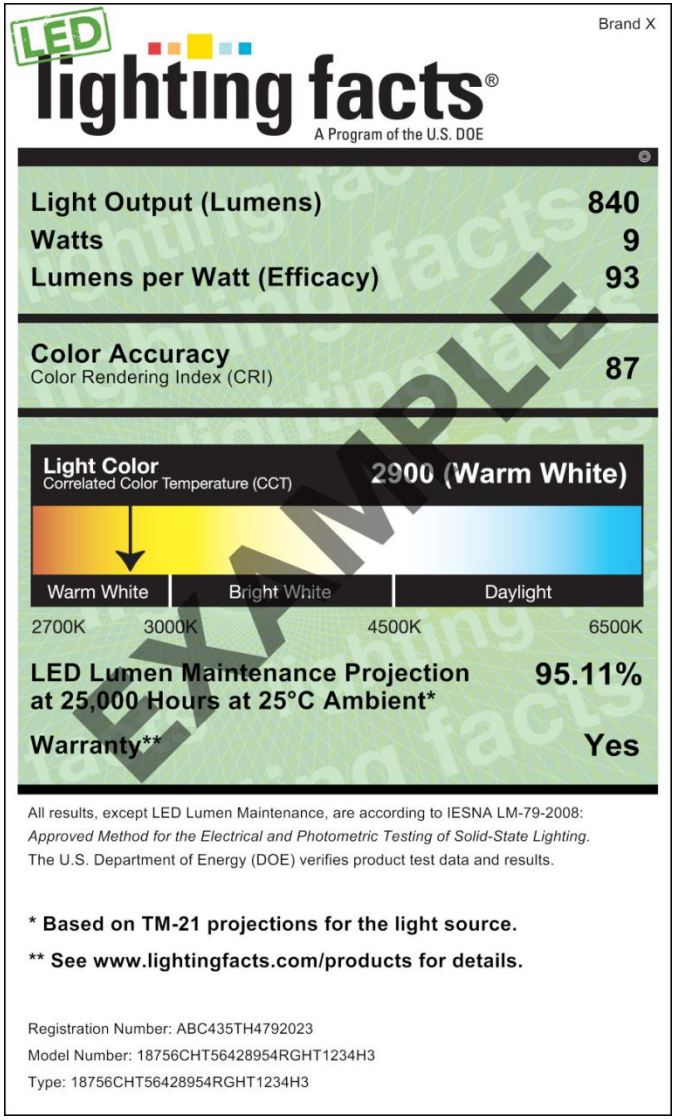


Bulb Packaging



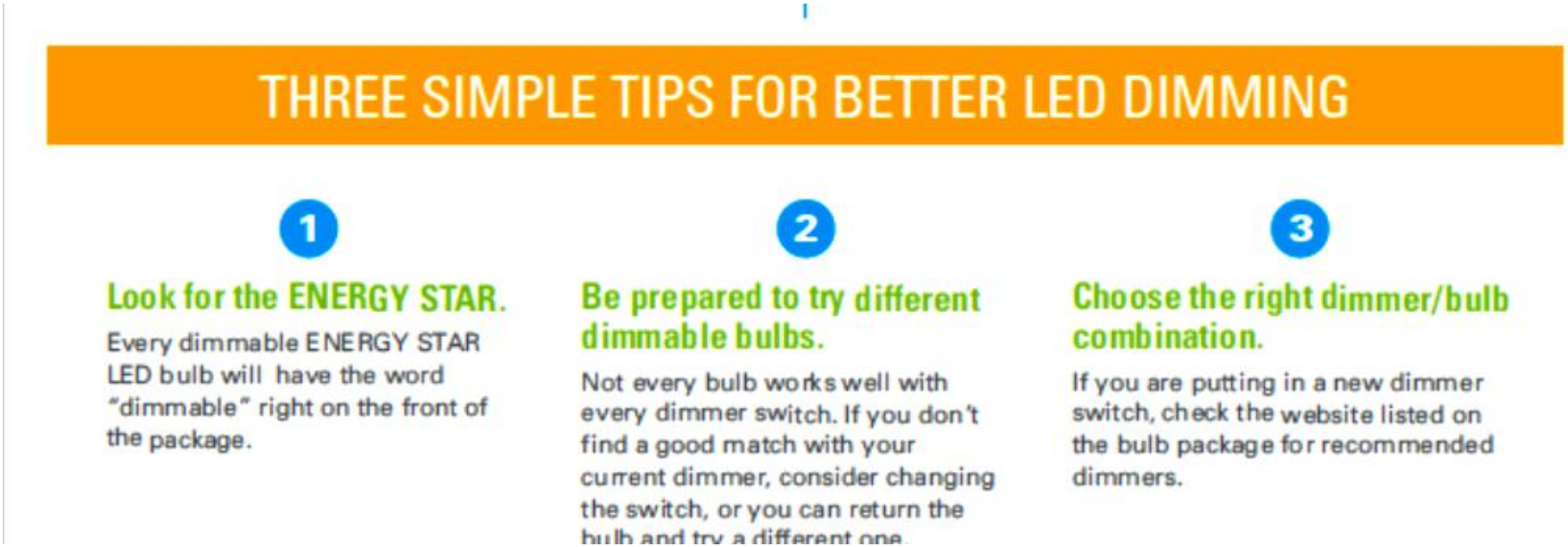
LED Light Fixture labeling DOE Program

- Standardized summary of verifiable product performance data, measured by industry standards (LM-79, LM-80, TM-21)
- Web-based product performance reporting initiative
  - www.lightingfacts.com
- Industry tool to help buyers
  - Resource to evaluate reported product performance against manufacturer claims
- Label and product list backed by verification of performance testing
- A voluntary and free program



www.energystar.gov/dimmable

www.energystar.gov/dimmable



If all light bulbs sold in the United States in 2017 were ENERGY STAR certified, the cost savings would grow to more than $4 billion each year and more than 50 billion pounds of annual greenhouse gas emissions would be prevented, equivalent to the emissions from over 5 million vehicles.

Taylor Jantz-Sell
ENERGY STAR Lighting Program Manager
Jantz-Sell.Taylor@epa.gov

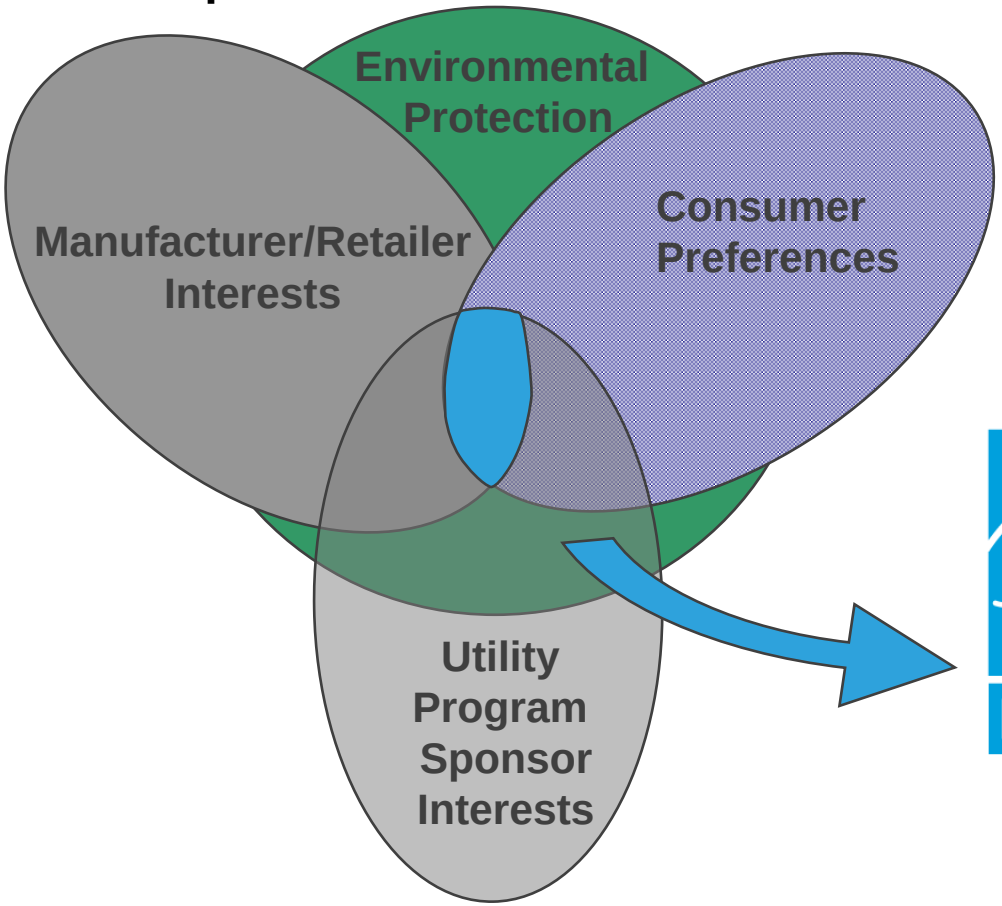
www.energystar.gov/lighting
www.energystar.gov/lightingresources

Extra slides

What is ENERGY STAR?

- Created by the U.S. Environmental Protection Agency in 1992 to reduce greenhouse gas emissions
- Voluntary product certification and labeling program
- Products that have earned the ENERGY STAR label meet strict energy efficiency & performance guidelines set by the US EPA with open and broad stakeholder engagement

Builds Upon Intersection of Interests



- Cost-effective
- No sacrifice in performance
- Gov't backed

Consumer is Key

ENERGY STAR Certification for Lighting Products

WAY More than just efficiency

- **Designed to ensure quality and performa consumers expect**:
  - Minimum warranty requirement
  - 6 different requirements for color to ensure quality up front & over time
  - Light output and distribution requirements
  - Size and shape requirements for light bulbs
  - Temperature testing to ensure products perform as expected after installation and higher temperature scenarios, e.g. recessed can, enclosed fixtures and more…

- ENERGY STAR third-party **certification and verification testing** help confirm **delivery on performance**

ENERGY STAR Lamps Requirements

- Lamp Classifications & dimensions
- Equivalency claim guidance according to light output or CBCP
- Efficacy
- Luminous Intensity Distribution
- Correlated Color Temp
- Color Rendering (CRI,R9,TM30 metrics)
- Color maintenance
- Color angular uniformity
- Lumen Maintenance
  - At ambient and elevated temperatures
- Elevated Light Output Ratio
- Electrical safety
- Power factor
- Frequency
- Start time
- Transient protection
- Standby power limits
- Packaging & lamp labeling
- Dimming (max/min light, flicker, noise)
- Connected: open access & energy use reporting
- Toxics
- Warranty

Test Methods –kidding not kidding

7 METHODS OF MEASUREMENT AND REFERENCE DOCUMENTS

Organization	Identifier	Description
ANSI	C78.376-2001	Specifications for the Chromaticity of Fluorescent Lamps
ANSI/NEMA/ ANSLG	C78.377-2011	Specifications for the Chromaticity of Solid State Lighting Products
ANSI	C78.5-2003	Specifications for Performance of Self-ballasted Compact Fluorescent Lamps
ANSI/ANSLG	C78.81-2010	Double-Capped Fluorescent Lamps—Dimensional and Electrical Characteristics
ANSI	C78.901-2014	Single-Based Fluorescent Lamps—Dimensional and Electrical Characteristics
ANSI/ANSLG	C81.61-2009	Specifications for Bases (Caps) for Electric Lamps
ANSI/ANSLG	C81.62-2009	Lampholders for Electric Lamps
ANSI	C82.11-2011	High-Frequency Fluorescent Lamp Ballasts
ANSI/ANSLG	C82.16-2015 (anticipated)	Light Emitting Diode Drivers—Methods of Measurement
ANSI	C82.2-2002	Method of Measurement of Fluorescent Lamp Ballasts
ANSI	C82.77-10:2014	Harmonic Emission Limits—Related Power Quality Requirements for Lighting Equipment
ANSI/IEEE	C62.41.1-2002	IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
ANSI/IEEE	C62.41.2-2002	IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits
ANSI/UL	153-2002	Standard for Safety of Portable Electric Luminaires
ANSI/UL	935-2009	Standard for Safety of Fluorescent-Lamp Ballasts
ANSI/UL	1310-2010	Standard for Safety of Class 2 Power Units
ANSI/UL	1574-2004	Standard for Safety of Track Lighting Systems
ANSI/UL	1598-2008	Standard for Safety of Luminaires
ANSI/UL	1598C	Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits
ANSI/UL	1598B-2010	Standard for Supplemental Requirements for Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires
ANSI/UL	1993-2009	Standard for Safety of Self-Ballasted Lamps and Lamp Adapters
ANSI/UL	2108-2004	Standard for Low-Voltage Lighting Systems
ANSI/UL	8750-2009	Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products
ASTM	E283-04	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
CIE	Pub. No. 13.3-1995	Method of Measuring and Specifying Color Rendering of Light Sources
CIE	Pub. No. 15:2004	Colorimetry
EU	Directive 2002/95/EC	Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment
FCC	CFR Title 47 Part 15	Radio Frequency Devices
FCC	CFR Title 47 Part 18	Industrial, Scientific, and Medical Equipment
IEC	60061-1 (2012)	Lamp Caps and Holders Together with Gauges for the Control of Interchangeability and Safety – Part 1: Lamp Caps
IEC	60081 Amend 4 Ed 5.0 (2010)	Double-capped Fluorescent Lamps - Performance Specifications
IEC	60901 (2011)	Single-capped Fluorescent Lamps - Performance Specifications
IEC	62301 ED 2.0 B:2011	Household electrical appliances - Measurement of standby power
IEC	61347-2-3-am2 ed1.0 b:2011	Amendment 2 - Lamp Control Gear - Part 2-3: Particular Requirements for A.C. Supplied Electronic Ballasts for Fluorescent Lamps
IEC	62321 Ed. 1.0	Electrotechnical Products - Determination Of Levels Of Six Regulated Substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers)
IEEE	PAR1789	IEEE Recommending Practices for Modulating Current in High Brightness LEDs for Mitigating Health Risks to Viewers
IES	LM-9-09	Electric and Photometric Measurements of Fluorescent Lamps
IES	LM-10-96 or LM-10-XX	Photometric Testing of Outdoor Fluorescent Luminaires (2015 update anticipated)
IES	LM-31-95	Photometric Testing of Roadway Luminaires Using Incandescent Filament and High Intensity Discharge (HID) Lamps
IES	LM-40-10	Life Testing of Fluorescent Lamps
IES	LM-41-14	Approved Method for Photometric Testing of Indoor Fluorescent Luminaries
IES	LM-46-04	Photometric Testing of Indoor Luminaires Using High Intensity Discharge or Incandescent Filament Lamps
IES	LM-49-12	Life Testing of Incandescent Filament Lamps
IES	LM-58-13	Method for Spectroradiometric Measurement Methods for Light Sources
IES	LM-65-14	Life Testing of Compact Fluorescent Lamps
IES	LM-66-14	Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps
IES	LM-79-08	Electrical and Photometric Measurements of Solid-State Lighting Products
IES	LM-80-08	Measuring Lumen Maintenance of LED Light Sources
IES	LM-82-12	Method for the Characterization of LED Light Engines and Integrated LED Lamps for Electrical and Photometric Properties as a Function of Temperature
IES	LM-84-14	Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires
IES	RP-16-10	Nomenclature and Definitions for Illuminating Engineering
IES	TM-21-11	Projecting Long Term Lumen Maintenance of LED Sources
IES	TM-28-14	Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaries
NEMA	LL 9-2009	Dimming of T8 Fluorescent Lighting Systems
NEMA	LSD 45-2009	Recommendations for Solid State Lighting Sub-Assembly Interfaces for Luminaires
NEMA	SSL 7A-2013	Phase Cut Dimming for Solid State Lighting: Basic Compatibility

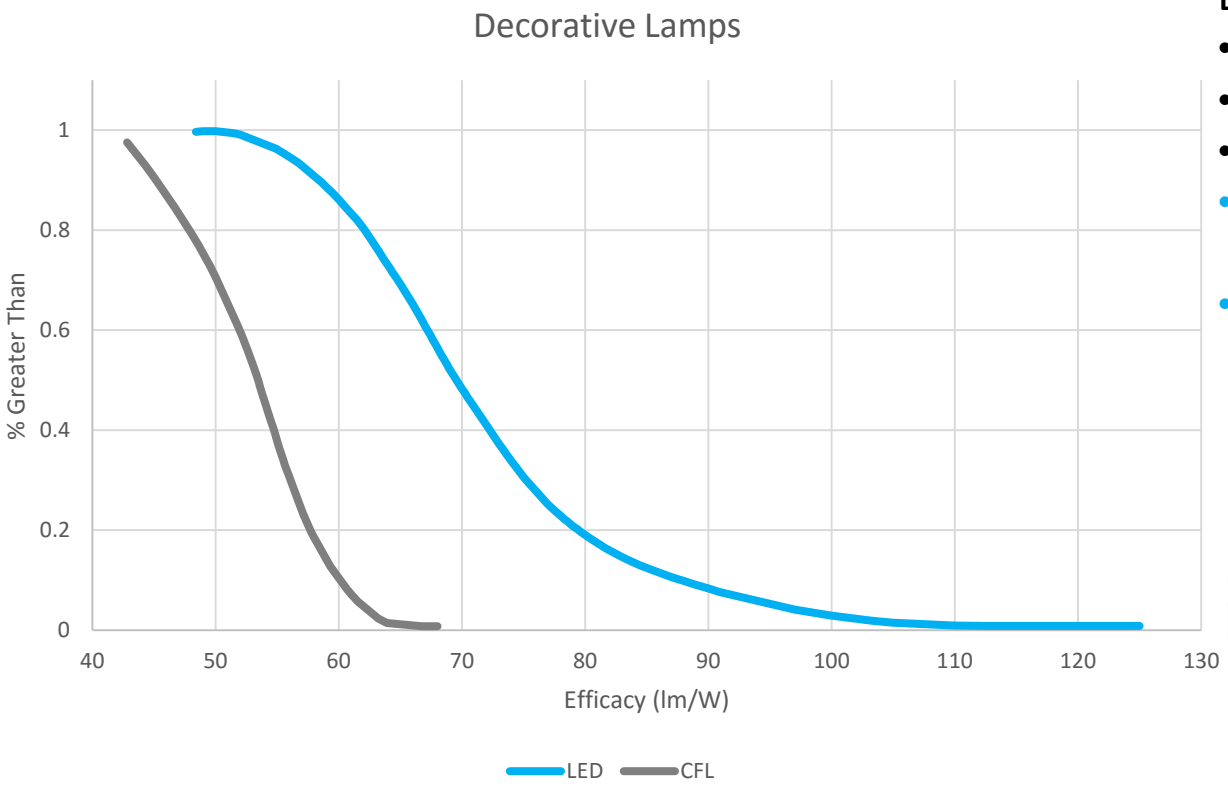
Residentially focused scope: Not all inclusive

ENERGY STAR Lighting

Energy saving replacements for the most common residential light bulbs and fixtures.

Eligible to Earn the ENERGY STAR	NOT Eligible to Earn the ENERGY STAR
General purpose CFL and LED lamps	Linear fluorescent lamps and their solid state retrofits
Accent lights (line-voltage and directional track lights)	High bay fixtures and recessed troffers
Down lights: recessed, pendant, surface-mounted, solid state retrofit kits	Outdoor street and area lighting: wall packs, garage, canopy lighting and wall packs
Wall sconces, chandeliers, bath vanities, ceiling and close-to-ceiling mount, floor and table lamps	Signage of any type, including EXIT signs and channel letter backlighting systems
Under cabinet or shelf-mounted task lighting	Linear fluorescent pendants
Ceiling and ventilation fans with lighting	Party or entertainment lighting
Portable desk task lights	Adapters or converters

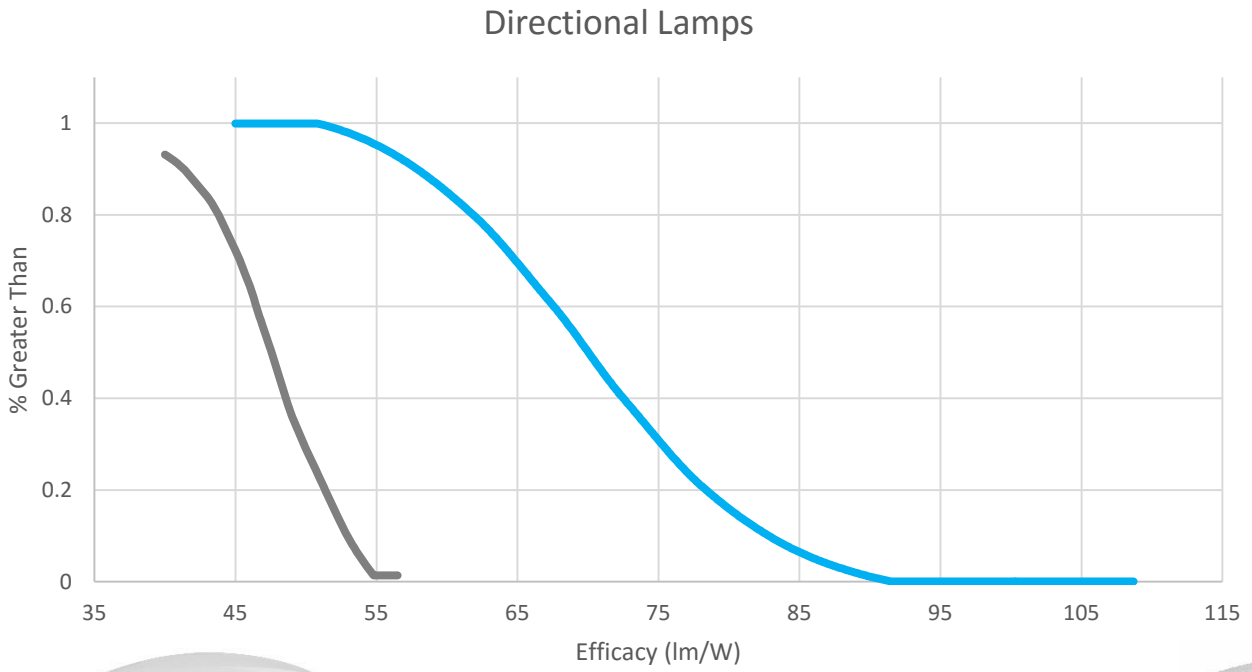
ENERGY STAR Decorative Bulbs



Decorative

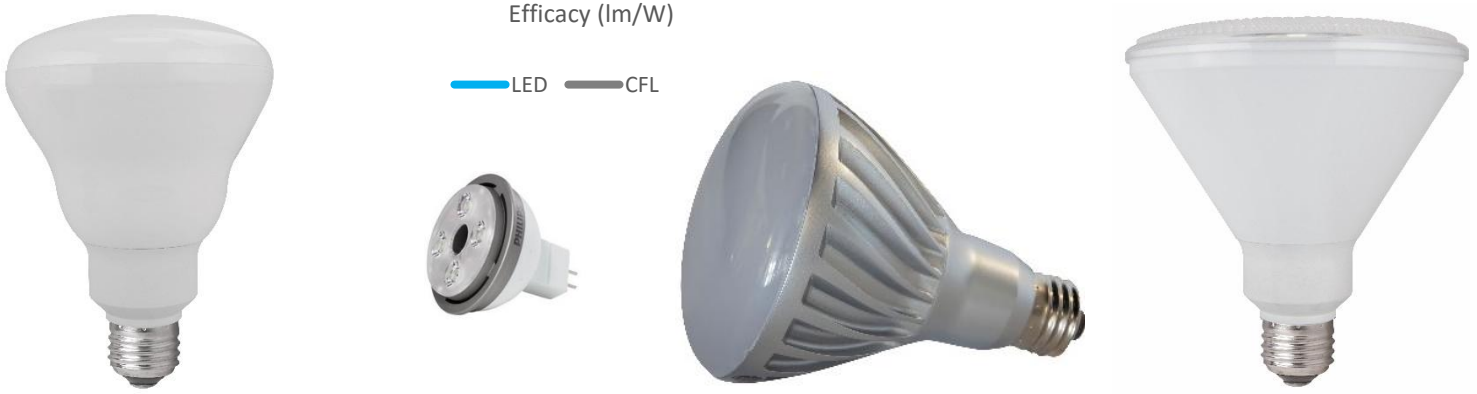
- **27% of sockets**
- Baseline Efficacy: 6-12 lm/w
- **No federal standard**
- Current ENERGY STAR min: 45, 50, 60 lm/w depending on W
- **2017 ENERGY STAR: 65 lm/w**

ENERGY STAR Directional Bulbs



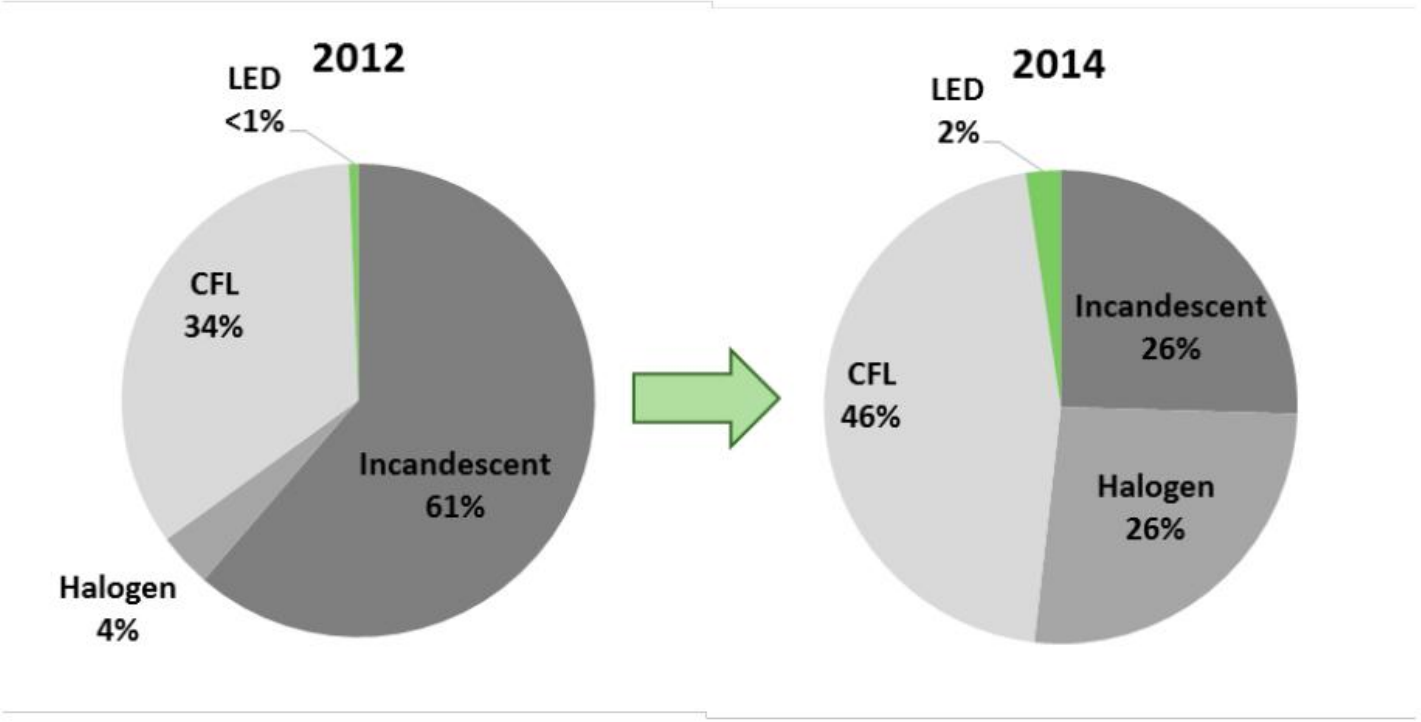
Directional

- Baseline Efficacy : 6 – 32lm/w
- Some federal standards exist
- Popular exemptions e.g. BR30
- 6% of sockets
- Current ENERGY STAR: 40 lm/w
- **2017 ENERGY STAR: 61 (90+CRI), 70 (80-90CRI) lm/w**



Progress: A-Type Lamps

- Total energy consumption of A-type lamps has decreased by roughly 10% to 756 tBtu since 2012.
- LED A-type market penetration in 2014 was 2.4%.



Source: U.S. Department of Energy, Adoption of Light-Emitting Diodes in Common Lighting Applications 2015

More than a billion light bulbs are sold each year in the U.S.

- **15% were ENERGY STAR certified**
  - ***Compact Fluorescent Lamps (CFL)***
    206,970 64% **(of CFL shipments)**
  - ***ENERGY STAR LED Lamps***
    79,058 75% **(of LED shipments)**