RAP | Energy solutions for a changing world

Lighting Efficiency Standards: An Update and Review of Current Issues

November 1, 2011 @ 1:00 p.m.

Moderator: **Chris Neme**, Energy Futures Group

Instructors: **Glenn Reed**, Energy Futures Group

Gabe Arnold, PE, LC, Optimal Energy

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http://www.surveymonkey.com/s/725TRCT

CHALLENGES AND OPPORTUNITIES FOR RESIDENTIAL LIGHTING PROGRAMS: *IESA, HALOGENs, CFLs, AND LEDs*

Regulatory Assistance Project Webinar

November 1, 2011

ENERGY FUTURES GROUP

Glenn Reed, Energy Futures Group

Acknowledgements

- Northeast Energy Efficiency Partnerships (NEEP) Residential Lighting Strategy (RLS) Project Team

  - Linda Malik, NEEP
  - Glenn Reed, Energy Futures Group
  - Gabe Arnold, Optimal Energy
  - Stephen Bickel, D&R International
  - Chris Calwell, Ecos Consulting

Residential Webinar Overview

- EISA Lamp Standards
- Technology Choices Under EISA
- EISA Impacts on Efficiency Programs
- Remaining Lighting Potential
- Consumer Education and Marketing
- Conclusions

EISA Lamp Standards

Energy Independence and Security Act of 2007 (EISA) Particulars

- Applies to the manufacturing and import (not the sales) of general service incandescent lamps (GSIL)

General service incandescent lamp means a standard incandescent or halogen type lamp that is intended for general service applications; has a medium screw base; has a lumen range of not less than 310 lumens and not more than 2,600 lumens; and is capable of being operated at a voltage range at least partially within 110 and 130 volts

EISA Particulars (cont.)

- Two tiers of standards
  - 2012-2014 phase in
  - 2020
- Tier 1 standards (2012-2019) create unique lumens per watts for every wattage of lamp covered
- The 2020 requirement (45 lumens/watt) may rise depending on what DOE decides in 2014.

EISA Particulars (cont.)

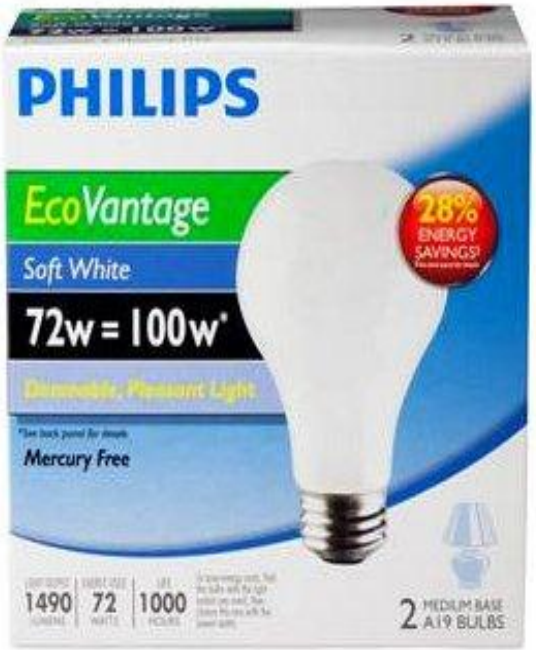
- Separate, lower standards for modified spectrum lamps
- 22 exemptions: vibration resistant, reflector, appliance, three-way, etc.
  - DOE monitoring sales of five lamp types
- Tier 1 standards (2012-2019) create unique lumens per watts for every wattage of lamp covered

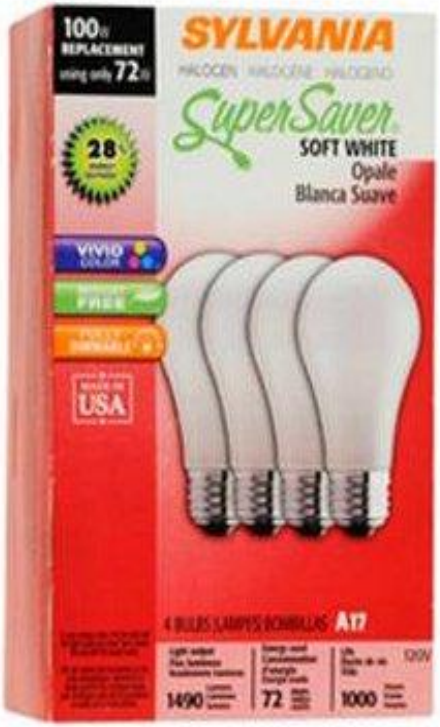
EISA GISL Requirements

EISA Effective Dates	Typical Incandescent Replaced	Typical Incandescent Lumen Output	Typical Incandescent Efficacy	EISA Replacement	EISA Lumen Ranges	EISA Minimum Efficacy Ranges
1/1/2012	**100 W**	1600	17 lm/W	**72 W**	1490-2600	21 – 36 lm/W
1/1/2013	**75 W**	1150	16 lm/W	**53 W**	1050-1489	20 – 28 lm/W
1/1/2014	**60 W**	800	14 lm/W	**43 W**	750-1049	17 – 24 lm/W
1/1/2014	**40 W**	450	12 lm/W	**29 W**	310-749	11 – 26 lm/W

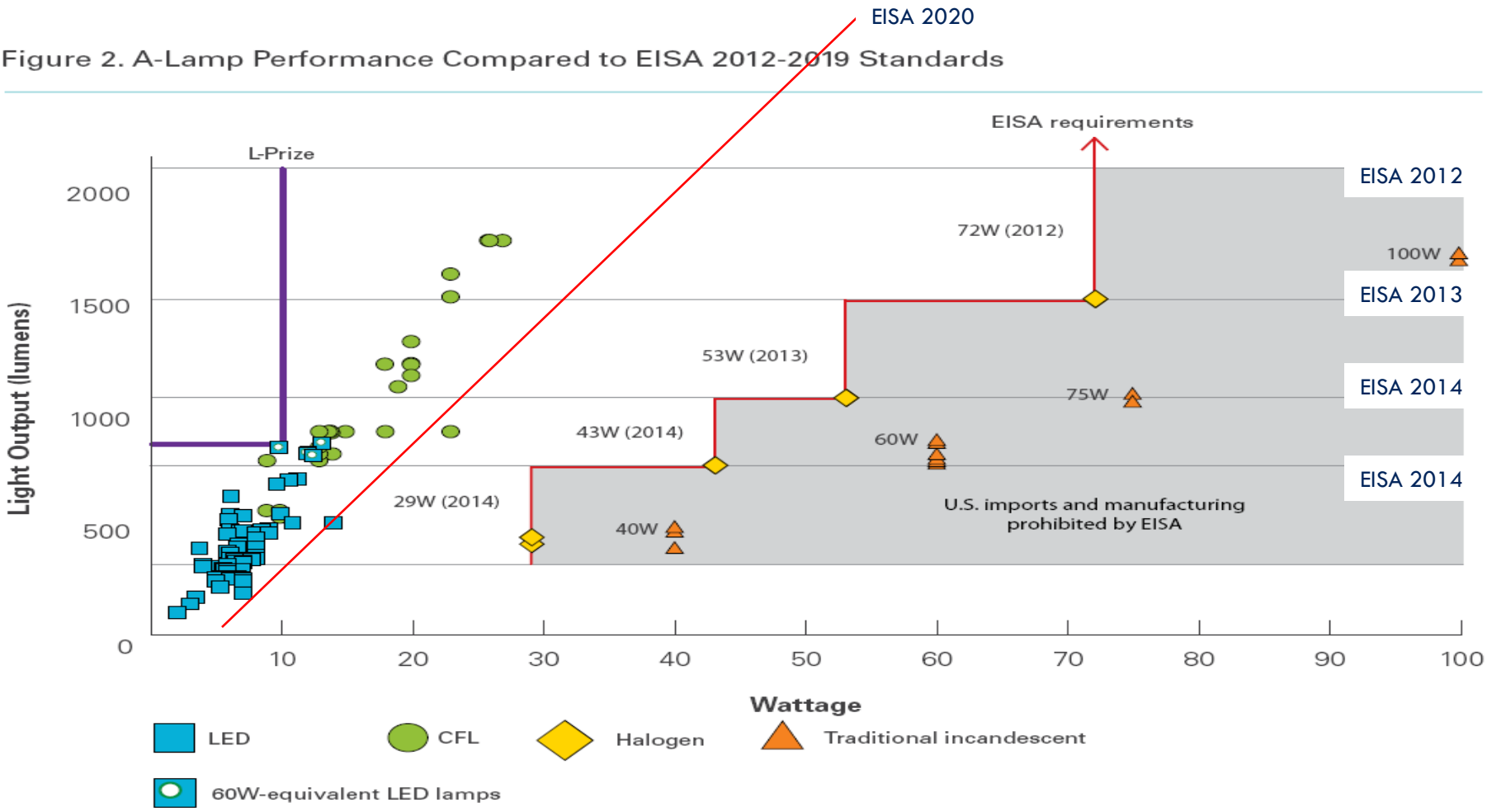
- Sets minimum performance standards for General Service Lamps
- Technology Neutral
- EISA does NOT ban incandescent lighting
- Requires manufacturers to reduce wattage, but allows them to greatly reduce *lumens* as well.

100 W Equivalent Halogens Just Meet EISA requirements





EISA in Context



Source: DOE Lighting Facts Program. *Product Snapshot: LED Replacement Lamps, April 2011.* Prepared by D&R International.

Technology Choices Under EISA

EISA Compliant Products

Current EISA Compliant Lighting Choices for 100W Incandescent

Halogen Incandescent (minimally compliant)
72 Watts
1490 Lumens
1,000 hr
21 Lumens/Watt
$1.50

Advanced Halogen Incandescent
70W
1,600 Lumens
3,000 hr
22.9 Lumens/Watt
$5

Incandescent
100 Watt
1,600 Lumens
750 hr
16.0 Lumens/Watt
$0.50

LED
12 Watts
800 Lumens*
25,000 hrs
66.7 Lumens/Watt
$40

CFL Dimmable
26 Watts
1,700 Lumens
10,000 hr
65.4 Lumens/Watt
$10

CFL
26 Watts
1,700 Lumens
12,000 hr
65.4 Lumens/Watt
$3

Current ENERGY STAR LED Products replace up to 60W, 75 &100W replacements in 2012/2013

Minimally Compliant Halogen Incandescent

Halogen Incandescent (minimally compliant)
72 Watts
1490 Lumens
1,000 hr
20.7 Lumens/Watt
$1.50

Things to know

- Inexpensive, but least efficient, shortest life option for consumers
- Saves ~28%, but ~15% less light
- Lower lumens may cause confusion and/or “bin-jumping”
- Price projected to drop to $0.70 in 2012
- Example: Philips Ecovantage, Sylvania Super Saver

Example of Consumer Confusion

*AT LEAST 25% ENERGY SAVINGS**
"See back panel for details"

Back panel says: "*When compared to an incandescent lamp rated at 1200 lumens.*" But 1200 lumens is more typical for 75 W lamps, so the savings (75 W – 72 W) are closer to 4%, not 25%.

Advanced Halogen Incandescent

Advanced Halogen Incandescent (IR Halogen)

70W
1,600 Lumens
3,000 hr
22.9 Lumens/Watt
$5

Things to know

- More expensive than minimally compliant halogens
- Saves 30%, 5% less light
- “Halogen Infrared” Technology
- Will consumers pay more? Will market develop?
- Example: Philips Halogena Energy Saver GLS

Advanced Halogen Incandescent (cont.)

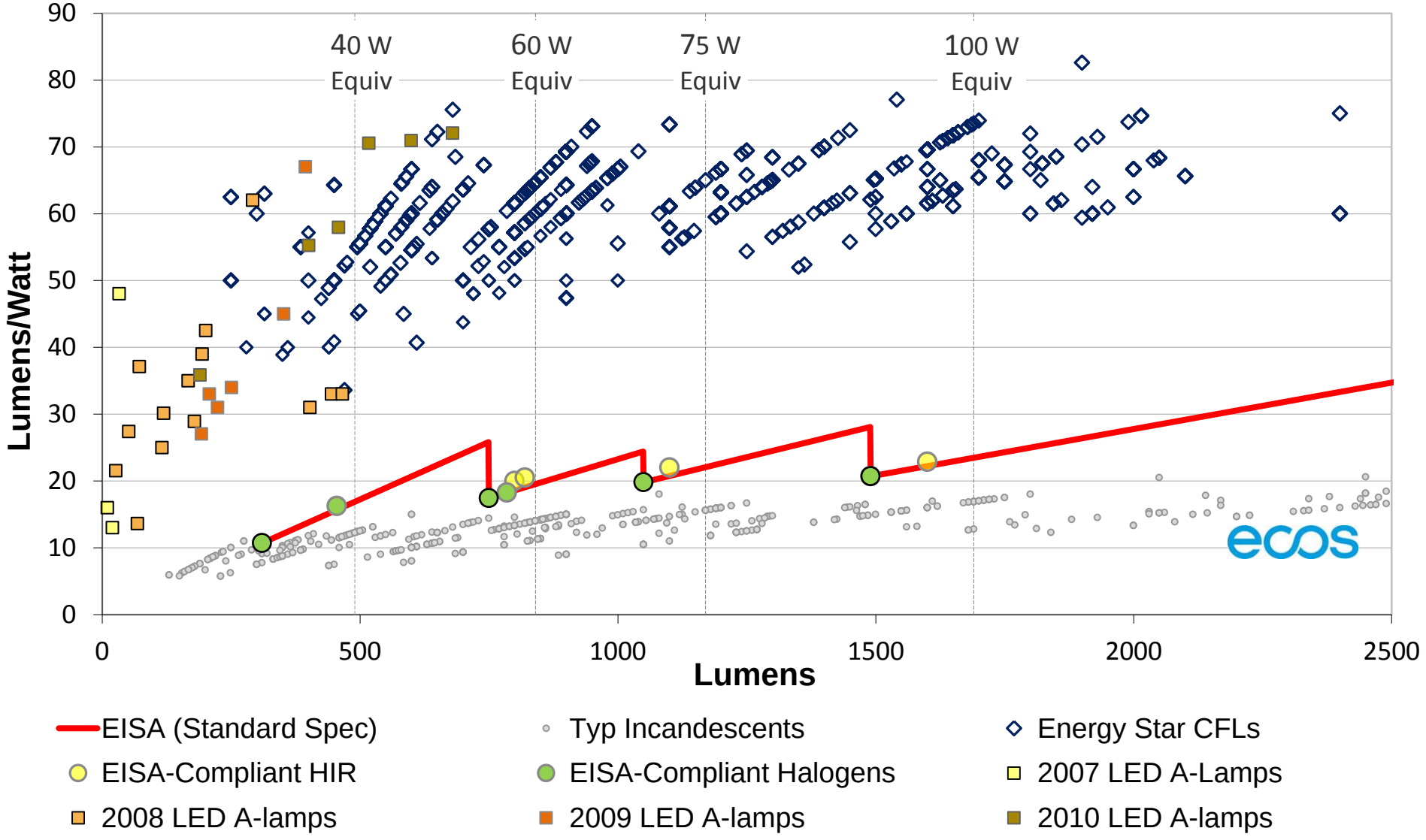
Advanced Halogen Incandescent (IR Halogen)

70W
1,600 Lumens
3,000 hr
22.9 Lumens/Watt
$5

Things to know

- Even more efficient halogens can be produced
- Can improve efficacy by two-three fold
- 2x halogens expected to be available next year
  - Possible efficiency program opportunity given lack of 100W equivalent LEDs in 2012

Currently Available Technologies in Comparison to EISA Requirements



CFLs

CFL Dimmable
26 Watts
1,700 Lumens
10,000 hr
65.4 Lumens/Watt
$10

CFL
26 Watts
1,700 Lumens
12,000 hr
65.4
Lumens/Watt
$3

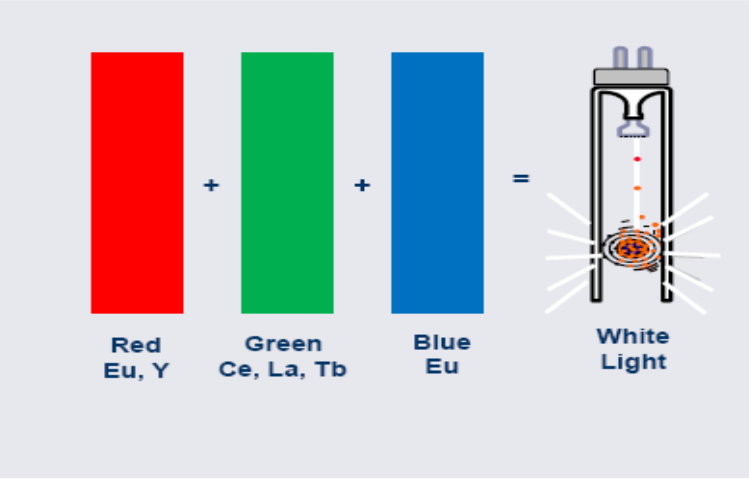
Things to know

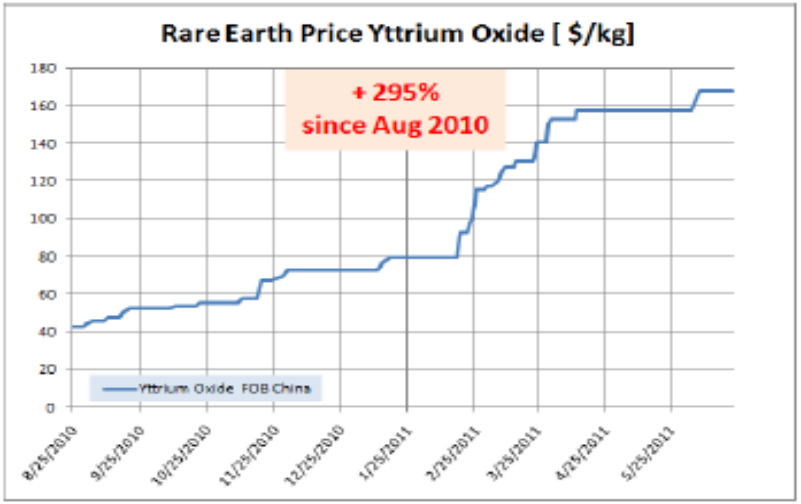
- Performance Issues and Mercury continue to challenge consumer acceptance
  - Dimming performance and cost for “specialty” CFLs
  - Color
  - Warm-up
  - Product quality
- Costs have risen/likely to rise due to shortage of rare earth oxides used in CFL phosphors

CFL Prices Rising Due to China Export Quotas

- Rare Earth Oxides are used in fluorescent lamp phosphors
- China enacted strict new export quotas on Rare Earth Oxides beginning in 2010
- CFL prices up ~25% so far
- Potentially 3-5 years until new sources come online?

- ***CFLs remain very cost-effective, even with increases***





LEDs

LED
12 Watts
800 Lumens*
25,000 hrs
66.7 Lumens/Watt
$40

Things to know

- Current products can replace up to 75W
- 100W replacement in 2012
- Poor quality products may harm consumer uptake
- Use and promote ENERGY STAR to differentiate quality products
- Limited ENERGY STAR qualified A-lamps; most are directional lamps, i.e., reflectors

*Current ENERGY STAR LED Products replace up to 60W, 75 &100W replacements in 2012/2013

LEDs (cont.)

LED
12 Watts
800 Lumens*
25,000 hrs
66.7 Lumens/Watt
$40

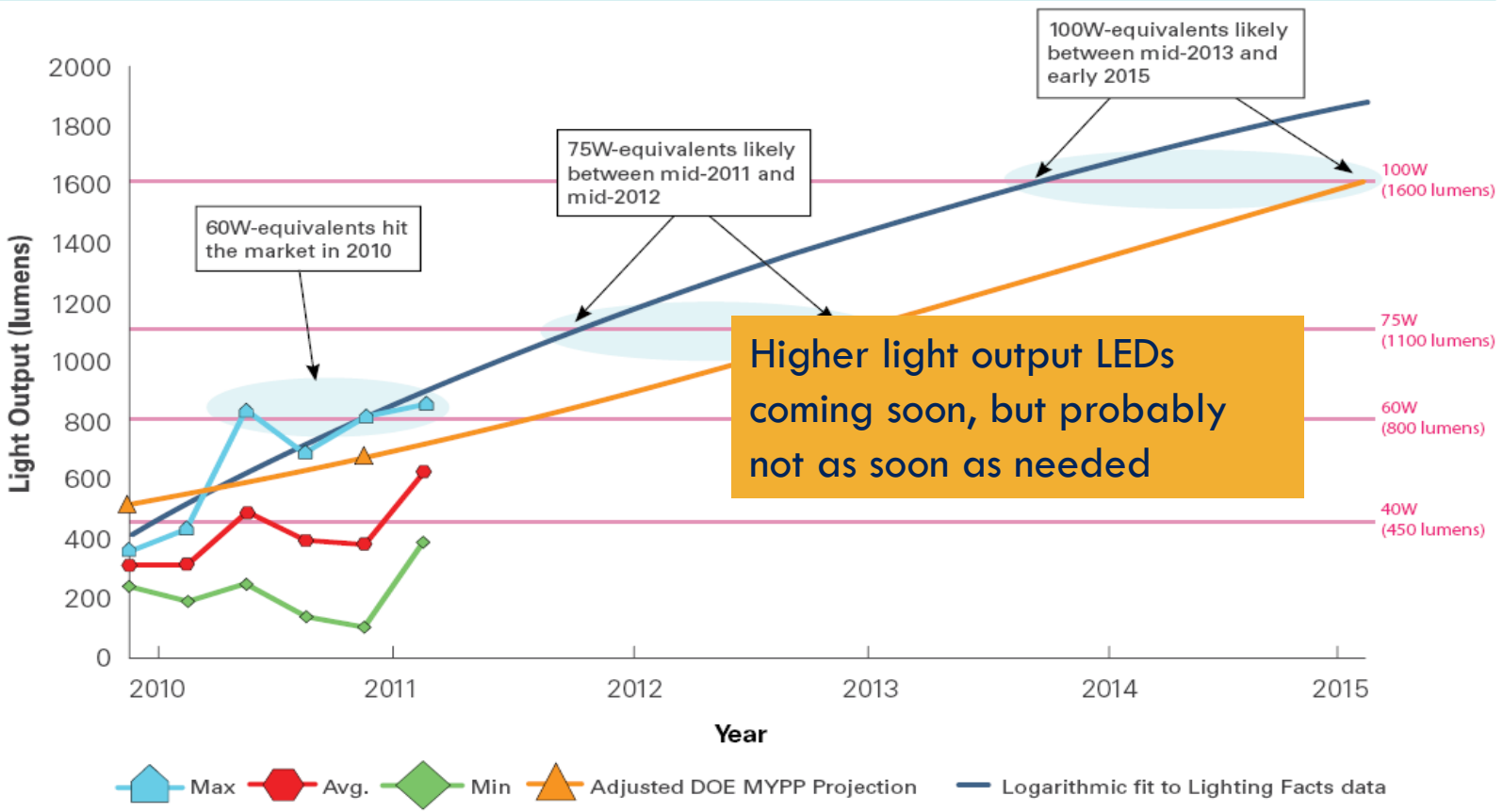
Things to know

- Price to drop to $10-15 by 2015?
- Sales have been increasing exponentially – many retailers selling out inventory w/o assistance of rebates
- Huge industry investment in manufacturing will dramatically increase product flow

LEDs May Play a Limited Role in PA Programs for Several Years

lighting facts
A Program of the U.S. DOE

Figure 4. LED A-Lamp Performance Trends and Projections



DOE Lighting Facts Program. *Product Snapshot: LED Replacement Lamps, April 2011.* Prepared by D&R International.

EISA and Technology Choice Summary

- Many choices exist for consumers when EISA takes effect
  - Halogen Incandescent, CFL, LED
  - Some low cost, some high cost
- Minimally-compliant, lower lumen products are a concern
- LEDs are coming, but expensive and not quite ready for 100 watt replacements
- Few ENERGY STAR qualified A-lamps available
- Consumers will need to learn to shop based on lumens
- Education is critical in this transition

EISA Impacts on Efficient Lighting Programs

How do the EISA Standards Impact Efficient Lighting Savings?

- Increasing baseline from Standard Incandescent to Halogen Incandescent → Lower savings per CFL/LED

How much lower?

- We do not expect an immediate shift to the EISA minimum wattages as the baseline due to:
  - Some consumer hoarding
  - Manufacturer and retail stockpiling
  - Many exempt bulb types: vibration resistant, 3-way, etc.
  - Consumer confusion and “Bin-Jumping” due to phased standards and lower lumen halogens
  - But likely to see EISA impacts on lower lumen bins before they are covered by EISA

Projected CFL Baseline Wattages

Rated Lumen Ranges	Pre-EISA Baseline Wattage	New 2012 Baseline Wattage	New 2013 Baseline Wattage	New 2014 Baseline Wattage	EISA Target Wattage
1490-2600	100 watts	88-93 watts	78-83 watts	74-78 watts	72 watts
1050-1489	75 watts	70-74 watts	63-66 watts	56-59 watts	53 watts
750-1049	60 watts	57-60 watts	53-57 watts	47-50 watts	43 watts
310-749	40 watts	38-40 watts	36-38 watts	32-34 watts	29 watts

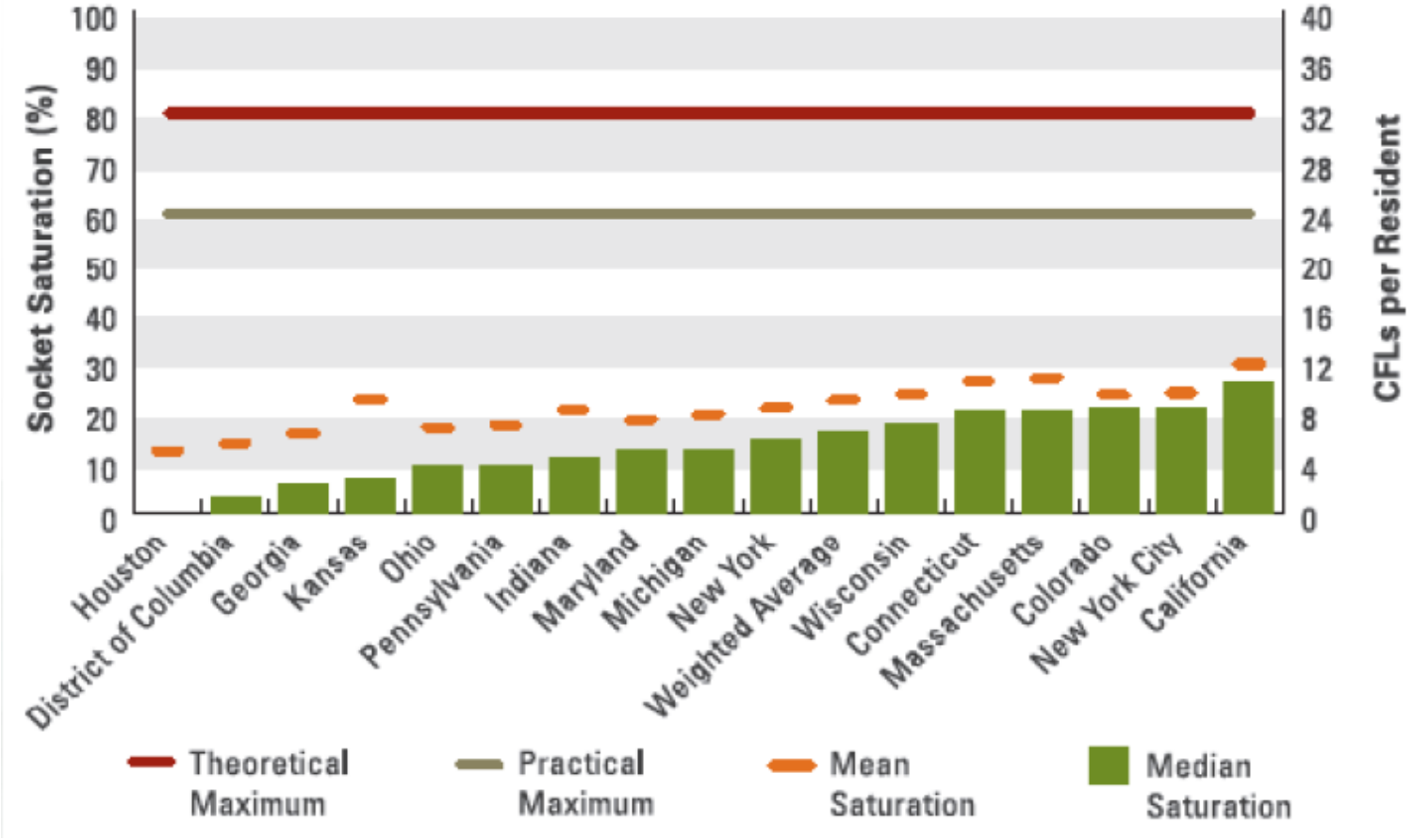
Source: Forthcoming EPA White Paper: The Road Ahead: Maximizing Light Bulb Efficiency Savings in a Changing Marketplace, and Forthcoming NEEP Residential Lighting Strategy Report
Both documents in peer review and expected November/December 2011

Estimated Gross EISA Lamp Savings

100 Watt (1600 lumen) Equivalent
Gross watts

	Pre-EISA	EISA Target
Baseline	**100**	**72**
Standard CFL	26	26
Delta	***74***	***46***
LED	23	23
Delta	***77***	***49***

Are There still Efficient Lighting Opportunities? Yes, CFL socket saturation remains relatively low



Source: CFL Market Profile 2010, DOE

However, Free-rider & NTGR Factors Tend to Reduce CFL NET savings

2011/2012 CFL NTGR Planning Values	Standard	Specialty	Hard to Reach	School Fundraiser
Connecticut	81%	81%		
Massachusetts	25%	80%	50%	50%
Rhode Island	50%	80%	100%	
Vermont	50%	118%	118%	

Approaches to Limiting CFL Free-ridership

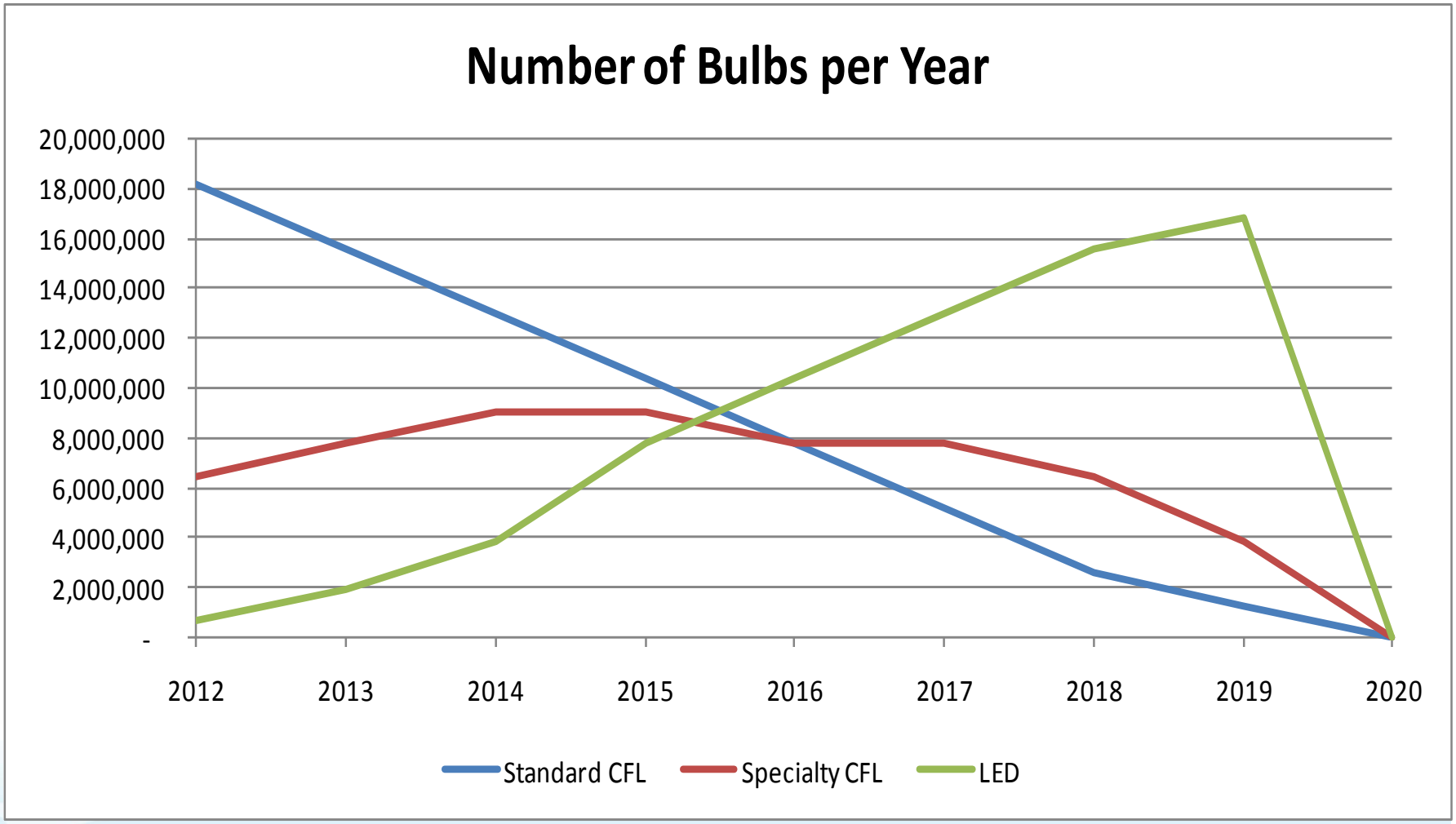
- Increased focus on specialty lamps and “hard-to-reach” customers/markets
- Market share and market lift program models
  - Attempts to restrict program incentives to incremental increase in product sales
  - Typically requires more complete provision of sales data by retailer and/or manufacturer
  - Usually need to negotiate baseline sales upfront
    - Prior regulatory approval needed?

Remaining Lighting Potential

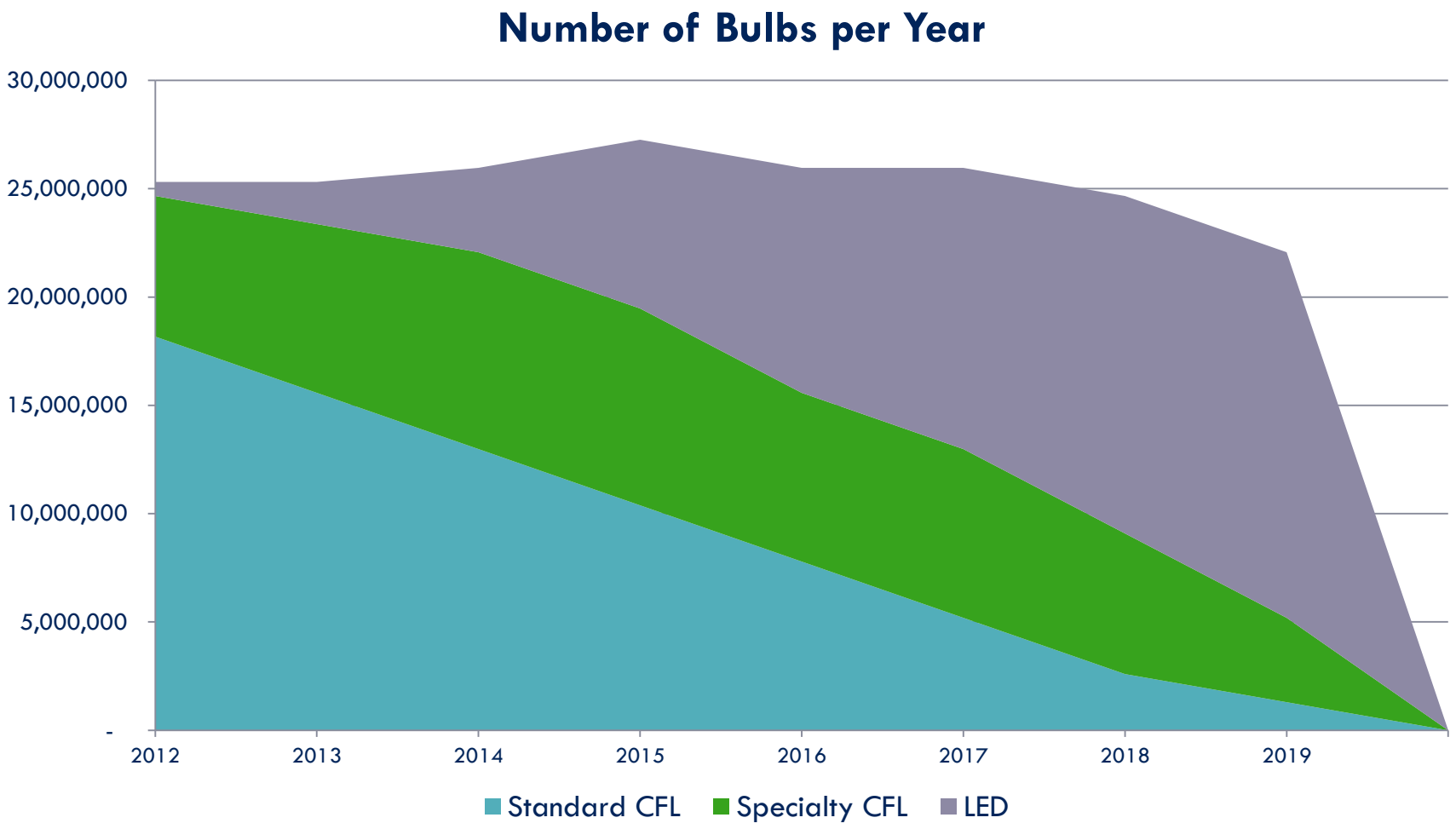
Remaining Lighting Potential in the Northeast

- Results from draft NEEP Residential Lighting Strategy (RLS) analysis
  - Final report due out in November
- Seven state region: New England and New York
- Moderately aggressive implementation
  - 1.7-2.1 units/household per year from 2012-2019
- Post-2020 lifetime savings significantly reduced by 2020 EISA standard

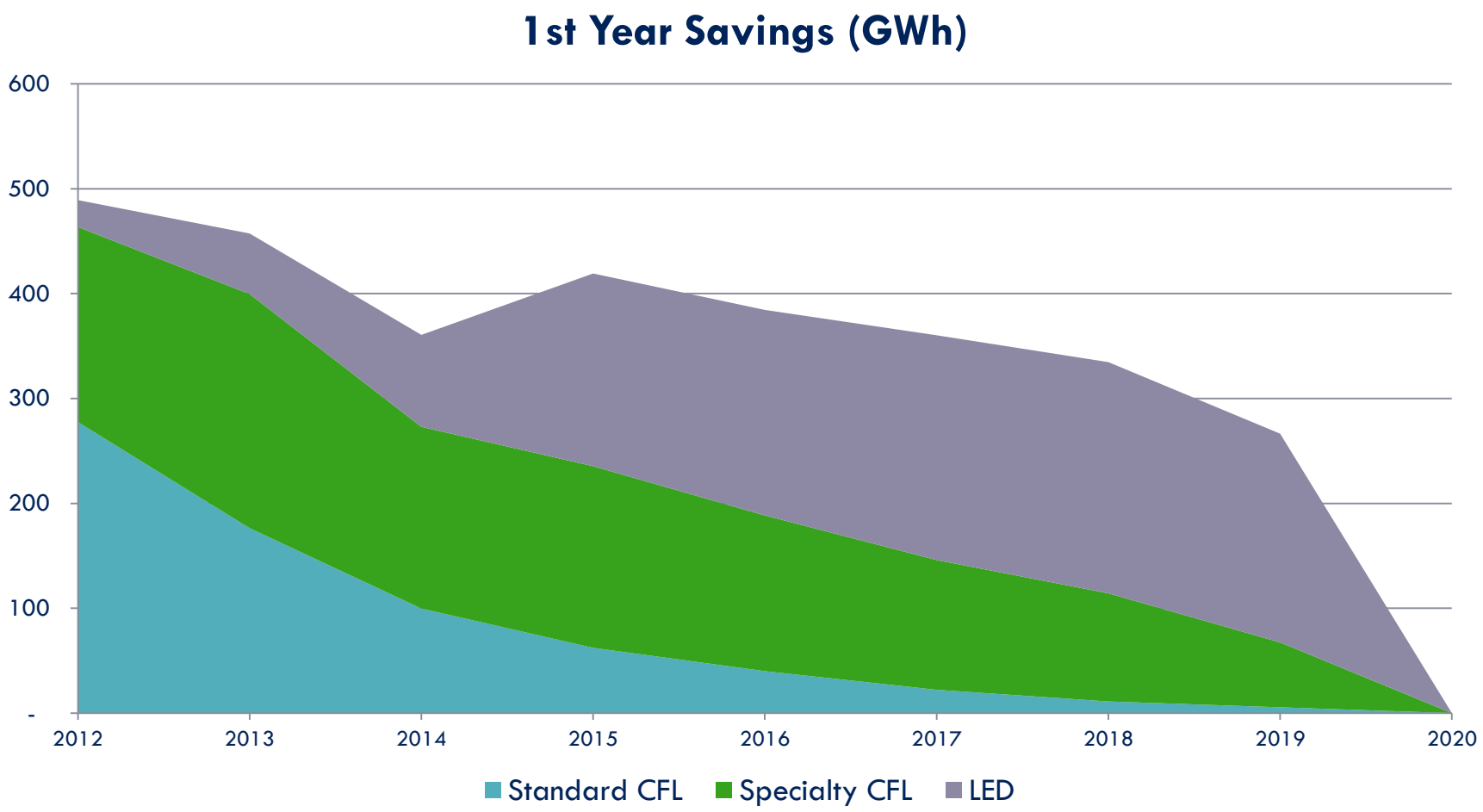
Decreasing Reliance on Standard CFLs



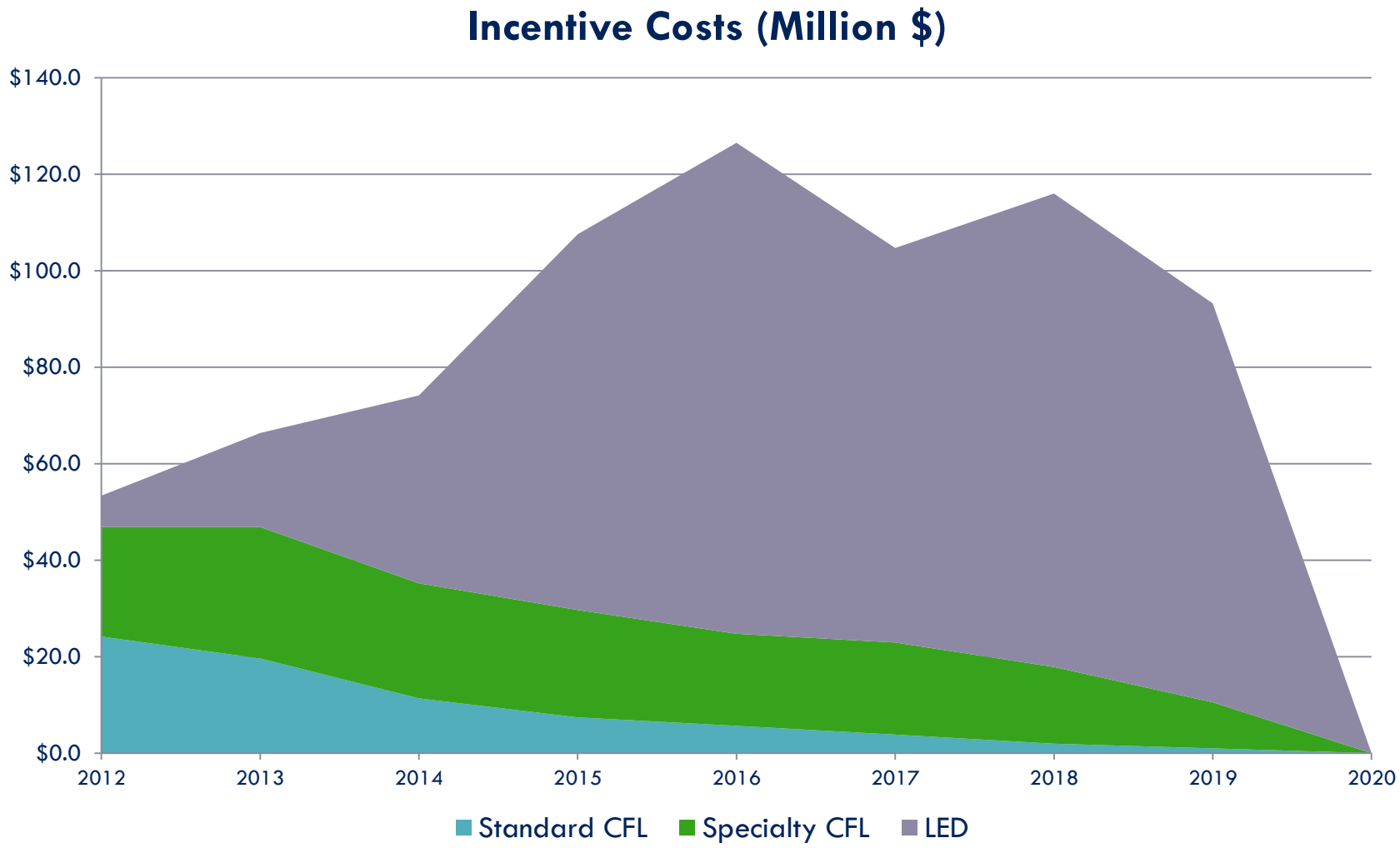
And Increasing Reliance on LEDs



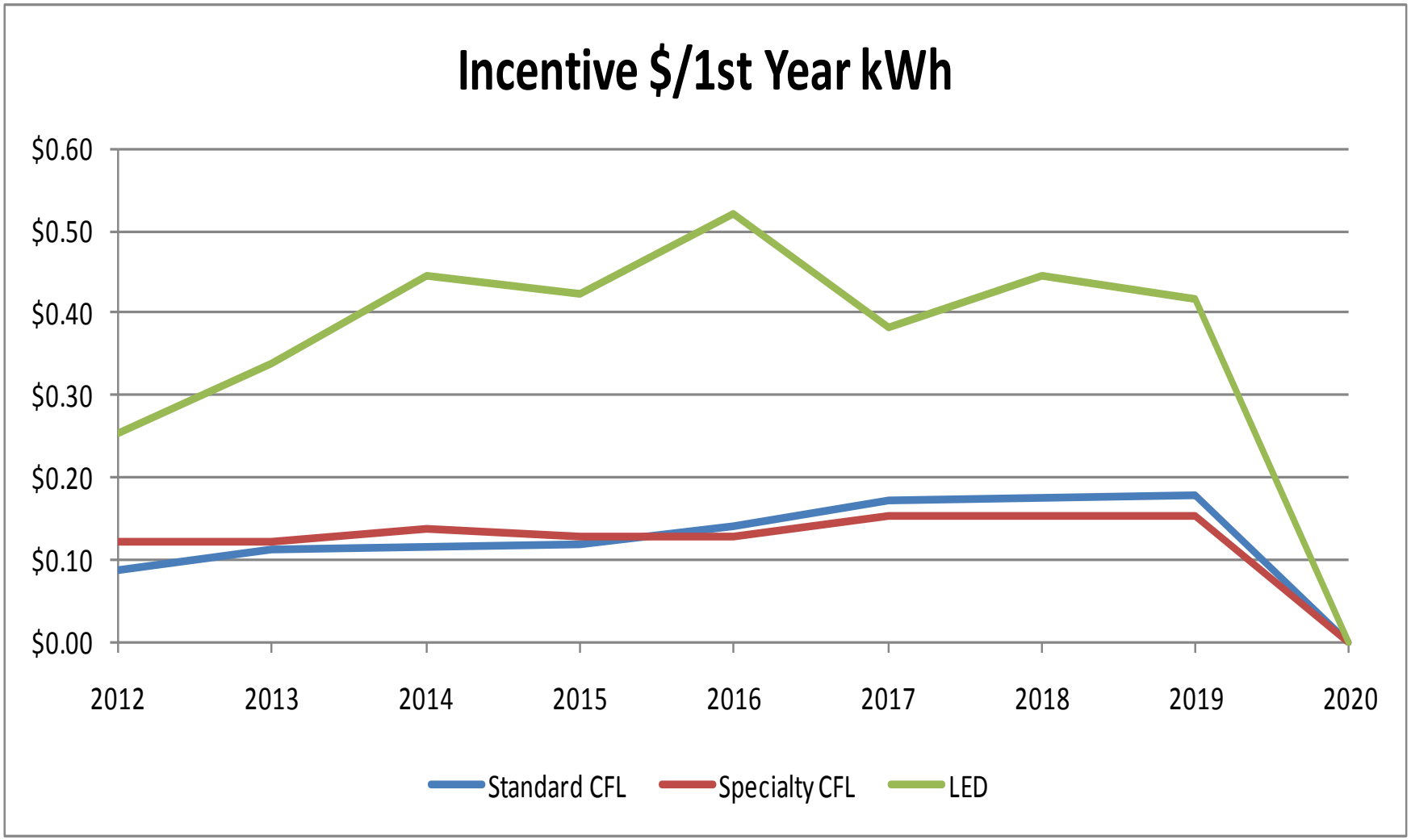
There Still Will be Significant Lighting Savings



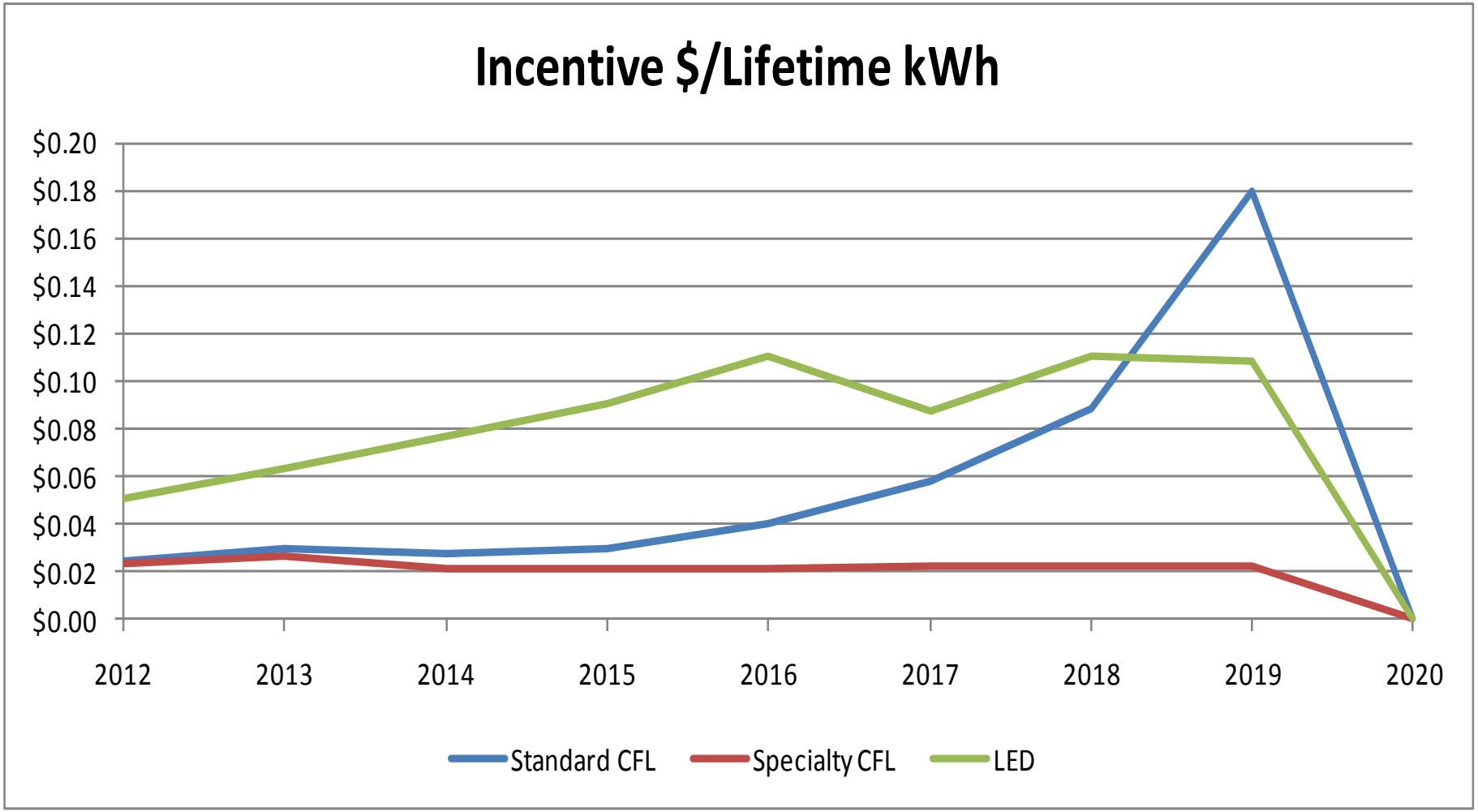
LED Incentives Will Require Larger Budget Commitments



Regional Savings Opportunity: Estimated Cost of Energy Savings



Regional Savings Opportunity: Estimated Cost of Net Energy Savings



Reasons for Increased Costs of Lighting Savings

- Higher LED and specialty CFL incentives
- Decreasing reliance on “cheap” standard CFLs
- Decreasing net savings/lamp in future years
  - Declining NTG ratios
  - Lower gross savings: increased baseline efficiencies
- 2020 EISA significantly reduces lifetime savings

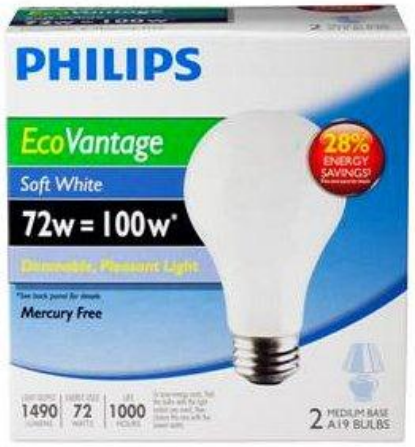
Consumer Education and Marketing

Education Will be Needed to Help Consumers Choose Bulbs Based on Lumens, not Watts

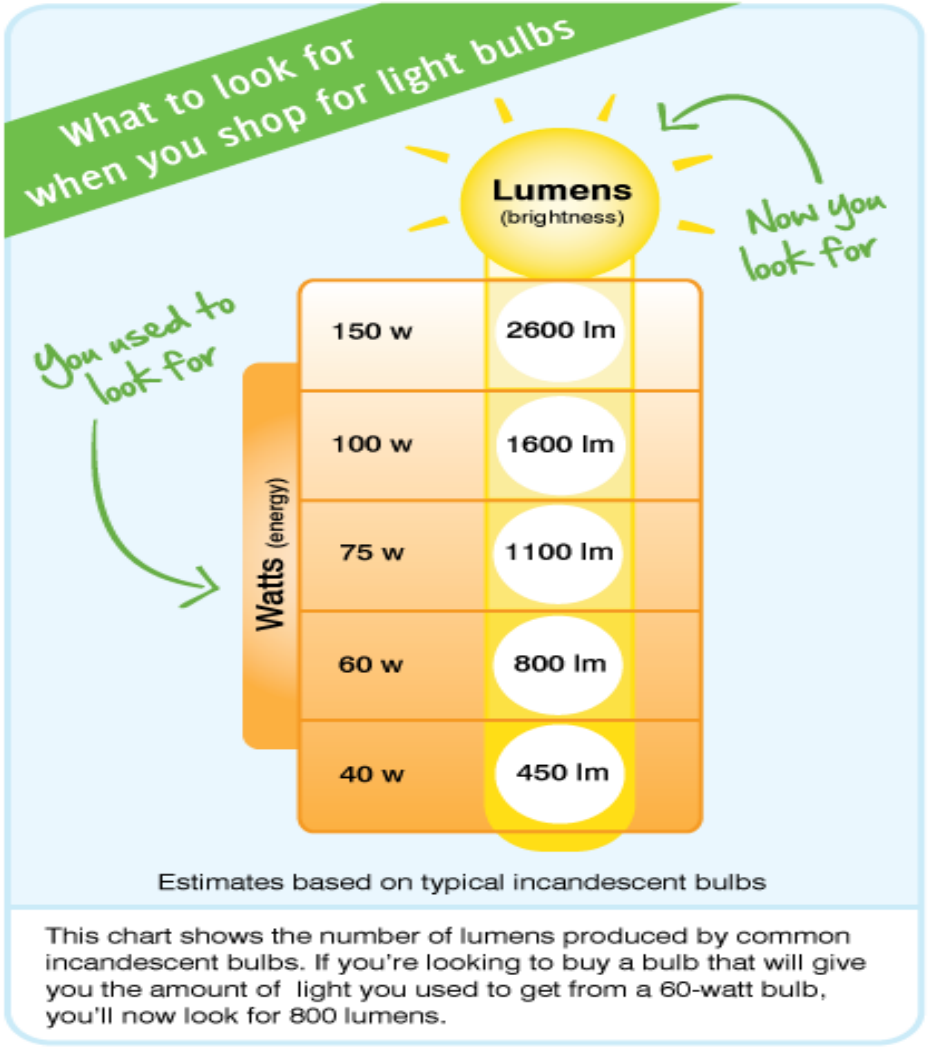
Consumer is trying to replace:				
Watts	Lumens	Technology		
60	800	Incandescent		
Options in store (~2014):				
Watts	Lumens	Technology	Savings	Result
8	800	LED	52 W	Maximum achievable savings
13	800	CFL	47 W	Much more savings than required by EISA, same amount of light.
43	800	IR Halogen	17 W	This is what EISA intended. Same light output, lower wattage.
53	1100	Halogen	7 W	Less savings than intended, more light than is needed.
53 ↓ **72**	600 ↓ 800	Modified Spectrum Halogen	7 ↓ -12 W	Less savings than intended, not enough light. Customer may upgrade to brighter bulb, using more energy

Programs and Education Needed to Guide Consumers to Efficient Choice

- Without programs and education, post EISA consumers may shift purchases to halogen incandescent
  - Perceptions that halogen incandescent is an efficient choice
  - Higher CFL prices, poor economy may drive purchases to lowest priced option



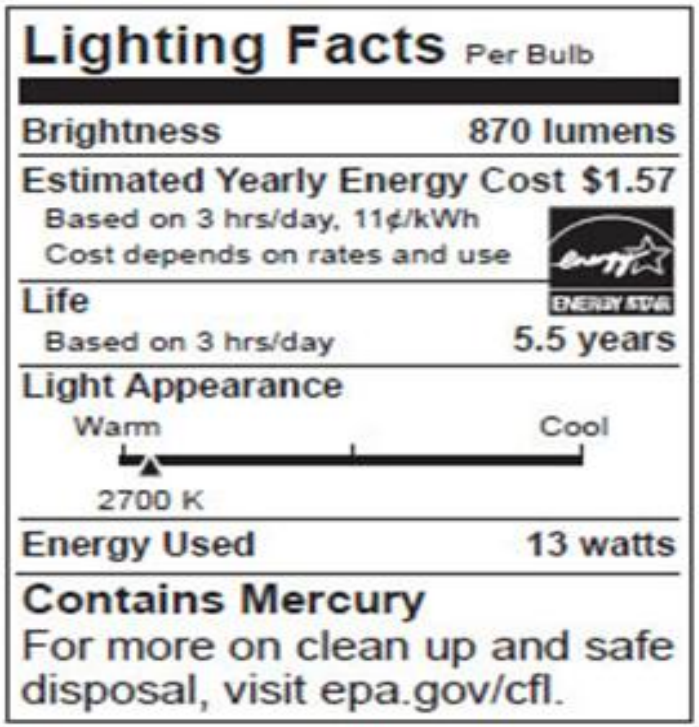
What Education is Needed?



- Consumers must learn to shop based on Lumens
- CFLs and LEDs are the energy efficient options

National Efforts to Educate Consumers

- FTC Lighting Facts Label required as of 1/1/12



lumens = brightness
watts = energy

New Back Label for Bulbs Containing Mercury

Educational Websites

- LUMEN Coalition (Lighting Understanding for a More Efficient Nation)
  - www.lumennow.org
- FTC Educational Website
  - www.ftc.gov/lightbulbs
- DOE Educational Website
  - www.energysavers.gov/lighting

Energy Efficiency Program Role in Educating

- Leverage existing tools and resources
- Work with retail partners – smaller retailers will need more help
- Consider educational marketing campaigns
  - Educate on upcoming changes to lighting
  - Guide customers to more efficient CFL and LED choices

Industry Efforts to Educate Consumers

- NEMA – The 5 Ls of Lighting
  - www.lightbulboptions.org
- Large retailers/manufacturers (Home Depot, Lowes, Ikea, GE, etc.) already working to educate consumers
  - Dedicated websites, youtube videos
  - Light Bulb displays organized by lumens
  - Educational Signage
  - Example Lowes/GE video: http://www.youtube.com/watch?v=OQDqB4uCt9Y

Conclusions

Conclusions: EISA Impacts

- EISA halogens – not CFLs - will continue to be the baseline for next few (?) year
- Significant savings still from CFLs
- Even with lower savings due to EISA, declining NTG, and higher cost due to rare earth quotas, CFLs are very cost-effective
- Using federal standard may overstate baseline initially and understate CFL savings

Conclusions: Emergence of LEDs

- LEDs are entering the market rapidly
- Increased sales and shelf space
- Higher lumen products (wattage equivalents)
- But very few ENERGY STAR A-lamps
- Decreasing costs, but still expensive
- And still a lot of poorly performing products

Conclusions: Program Considerations

- Most successful lighting program strategies will be:
  - Multi-year,
  - Flexible:
  - market responsive
  - Consumer education

Q&A

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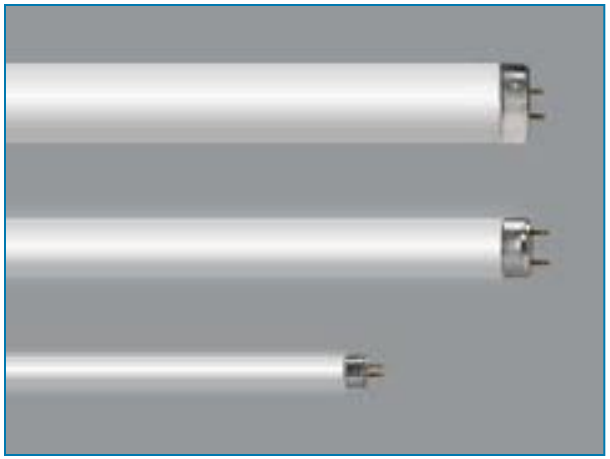
Optimal ENERGY Integrated Energy Resources

Understanding the Impact of Recent GSFL (T12/T8/T5) Federal Lighting Standard on the Lighting Market and Commercial Energy Efficiency Programs



Gabe Arnold, PE, LC

Prepared for:
Regulatory Assistance Project
November 1, 2011

Federal Efficiency Standards

- Enabled by Federal Legislation that create scheduled “DOE Rulemakings”

- Lighting
- Appliances
- Electronics
- HVAC
- Transformers
- Electric Pumps/Motors
- Commercial Kitchen Equipment
- Etc.

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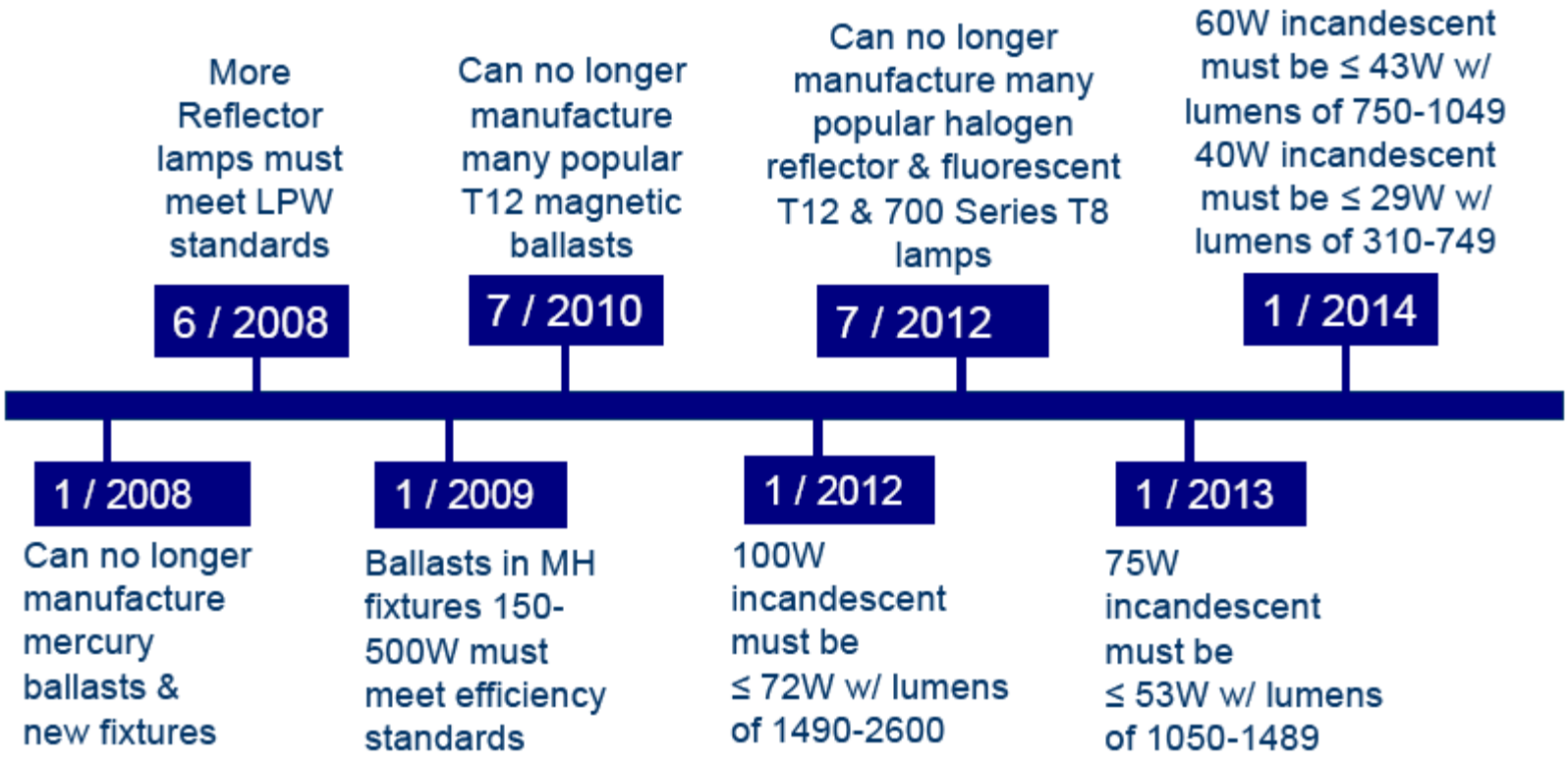
Product Covered	Initial Legislation	Last Standard Issued	Effective Date	Issued By	Updated DOE Standard Due	Potential Effective Date	States With Standard
Ceiling Fans and Ceiling Fan Light Kits	EPACT 2005	2005	2007	Congress	2013	2016	
Compact Fluorescent Lamps	EPACT 2005	2005	2006	Congress	2013	2016	
Fluorescent Lamp Ballasts	NAECA 1988 1988	2000	2005	DOE	2011	2014	
General Service Lamps: Incandescents plus CFLs, GSLED, GSOLED	None	2007	2012	Congress	2017	2020	NV, CA,
HID Lamps	EPACT 1992	None	None	N/A	2014	2017	
Illuminated Exit Signs	EPACT 2005	2005	2006	Congress	2013	2016	
Incandescent Reflector Lamps	EPACT 1992	2009	2012	DOE	2014	2017	VT, DC, WA, MA, OR, MD, NY, CT
Incandescent Reflector Lamps (includes certain BR and Other Exempted IRLs)	EPACT 1992	None	None	N/A	2011	2013	
Linear Tube Fluorescent Lamps	EPACT 2005	2009	2012	DOE	2014	2017	
Mercury Vapor Lamp Ballasts	EPACT 2005	2005	2008	Congress	None	None	
Metal Halide Lamp Fixtures	EISA 2007	2007	2009	Congress	2011	2015	CA
Portable Light Fixtures	None						CA
Torchiere Lighting Fixtures	EPACT 2005	2005	2006	Congress	2013	2016	
Traffic Signals	EPACT 2005	2005	2006	Congress	2013	2016	

Source: Appliance Standards Awareness Project

Optimal ENERGY

Timeline of Lighting Standards



Source: OSRAM Sylvania

Optimal ENERGY

What standard are we discussing today?

- GSFL (General Service Fluorescent Lamp) Standard

Product Covered	Initial Legislation	Last Standard Issued	Effective Date	Issued By	Updated DOE Standard Due	Potential Effective Date	States With Standard
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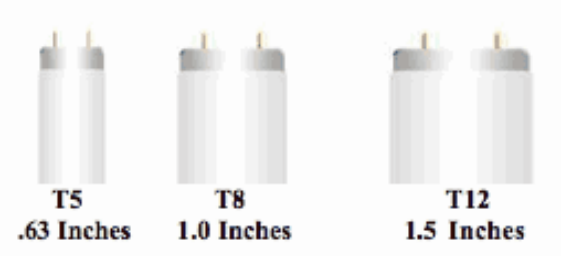
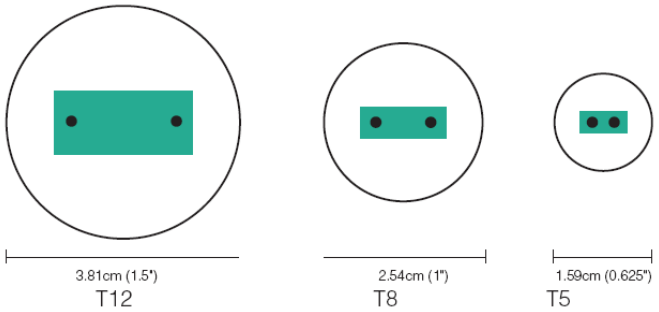
Mercury Vapor Lamp Ballasts	EPACT 2005	2005	2008	Congress	None	None	
Metal Halide Lamp Fixtures	EISA 2007	2007	2009	Congress	2011	2015	CA

GSFL Standard

- Sets new federal efficiency levels on T12/T8/T5 Fluorescent Lamps

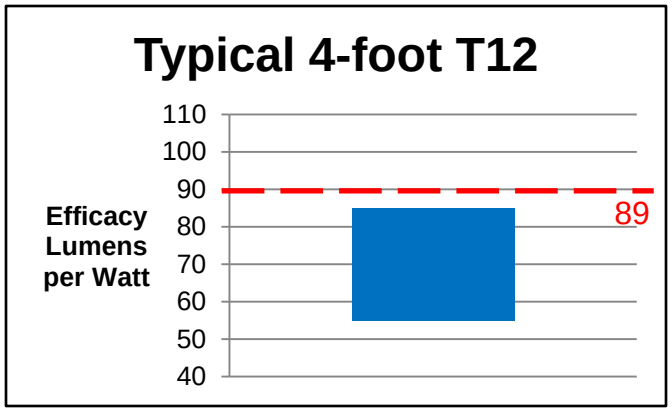


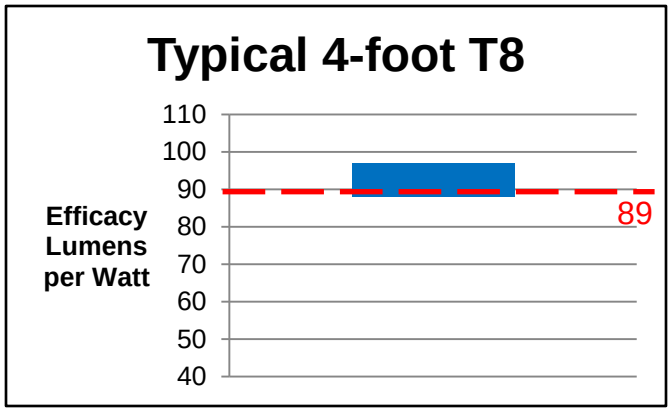


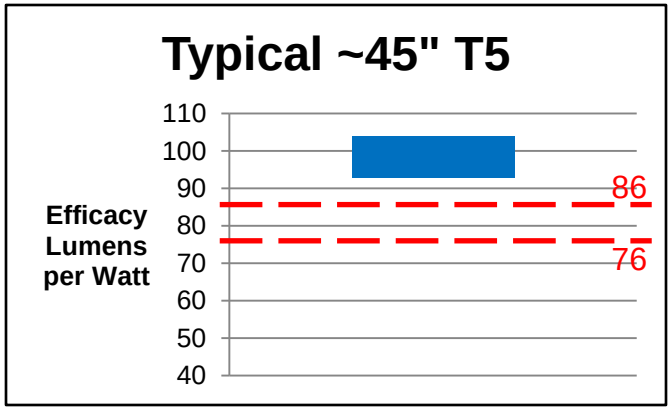
- Standard will go into effect July 2012 for *<u>manufacturing</u>* of lamps. Existing lamp stock can be sold without restriction.

Optimal ENERGY

Relative Efficacy of T12/T8/T5 Compared to Standard







Notes to Graphs

- Graphs show 'typical' lamps only, not all lamp types shown
- T5s rated at different temp. than T8, causes "play" on numbers
- Do not compare T5 and T8/T12 efficacy

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Requirements of the Standard

Lamp Type	Correlated Color Temperature	New Minimum Efficacy lm/W
4-Foot (T8-T12) ≥ 25W	≤ 4500K	89
	> 4500K and ≤ 7000K	88
2-Foot (T8-T12) U-Shaped ≥ 25W	≤ 4500K	84
	> 4500K and ≤ 7000K	81
8-Foot (T8-T12) ≥ 52W	≤ 4500K	97
	> 4500K and ≤ 7000K	93
8-Foot (T8-T12) High Output	≤ 4500K	92
	> 4500K and ≤ 7000K	88
4-Foot (T5) ≥ 26W	≤ 4500K	86
	> 4500K and ≤ 7000K	81
4-Foot (T5) High Output ≥ 49W	≤ 4500K	76
	> 4500K and ≤ 7000K	72

What Products are Eliminated?

Lamp Type	Impact
4’ T12 and U-bent T12	All eliminated*
4’ T8 and U-bent T8	All “700” series eliminated All “800” series, HPT8, and RW lamps unaffected
4’ T5 and T5HO	All unaffected
8’ T12 and T12HO	All 75W and “700” series 60W T12 eliminated “800” series 60W T12 lamps unaffected All T12HO eliminated*
8’ T8 and T8HO	Mostly unaffected

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* Exemptions to the Standard

- Fluorescent lamps designed to promote plant growth
- Fluorescent lamps designed for cold temperature applications
- Colored fluorescent lamps
- Impact-resistance fluorescent lamps
- Reflectorized or aperture lamps
- Fluorescent lamps designed for use in reprographic equipment
- UV lamps
- Lamps with a Color Rendering Index of 87 or greater

Initial Reaction from Regulators and Programs was Similar to Reaction on EISA

- No need for programs to promote T12 upgrades after standard takes effect
- Efficient technology (T8) becomes baseline
- Where will new savings come from?

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Examples of Regulator and Evaluator Response

- Wisconsin regulators/evaluators: no more T12 baseline after 2010

- Efficiency Vermont regulators/evaluators: rapidly decreasing NTG; no more T12 baseline after 2011

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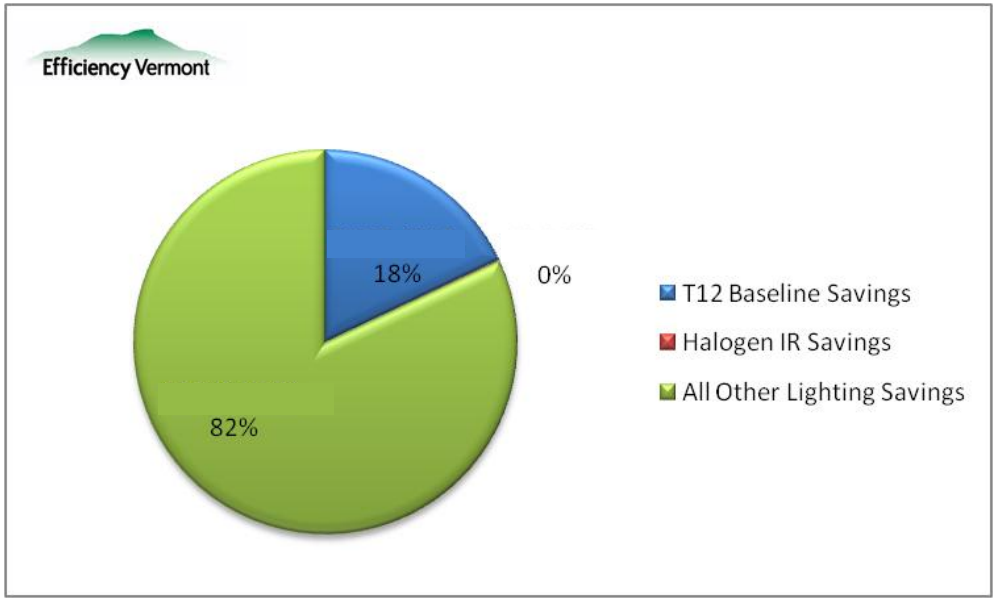
Energy Efficiency Program Impact

- Impact depends somewhat on size, goals, and maturity of program
- T12s are low-hanging fruit

Example:

Efficiency Vermont Business Retrofit Program 2008



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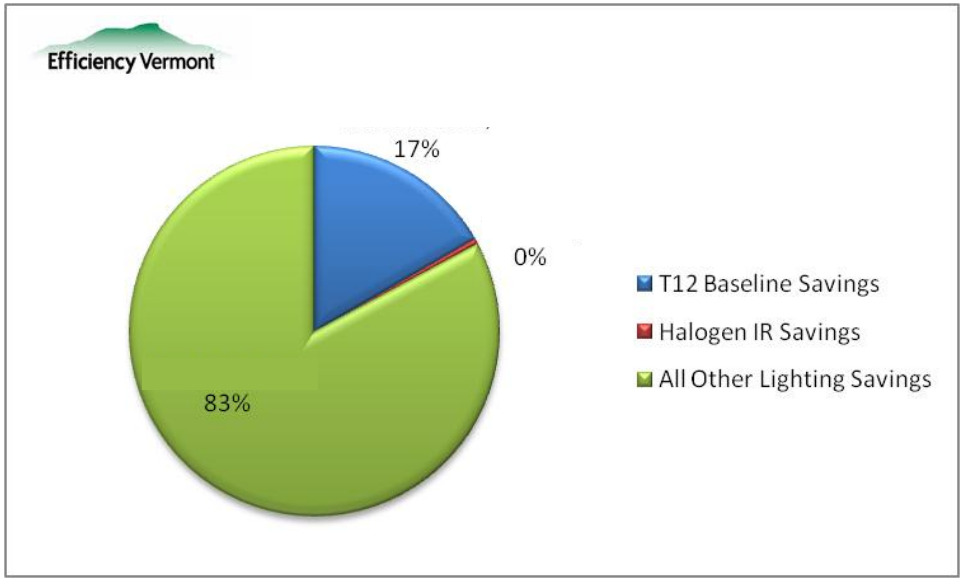
Energy Efficiency Program Impact

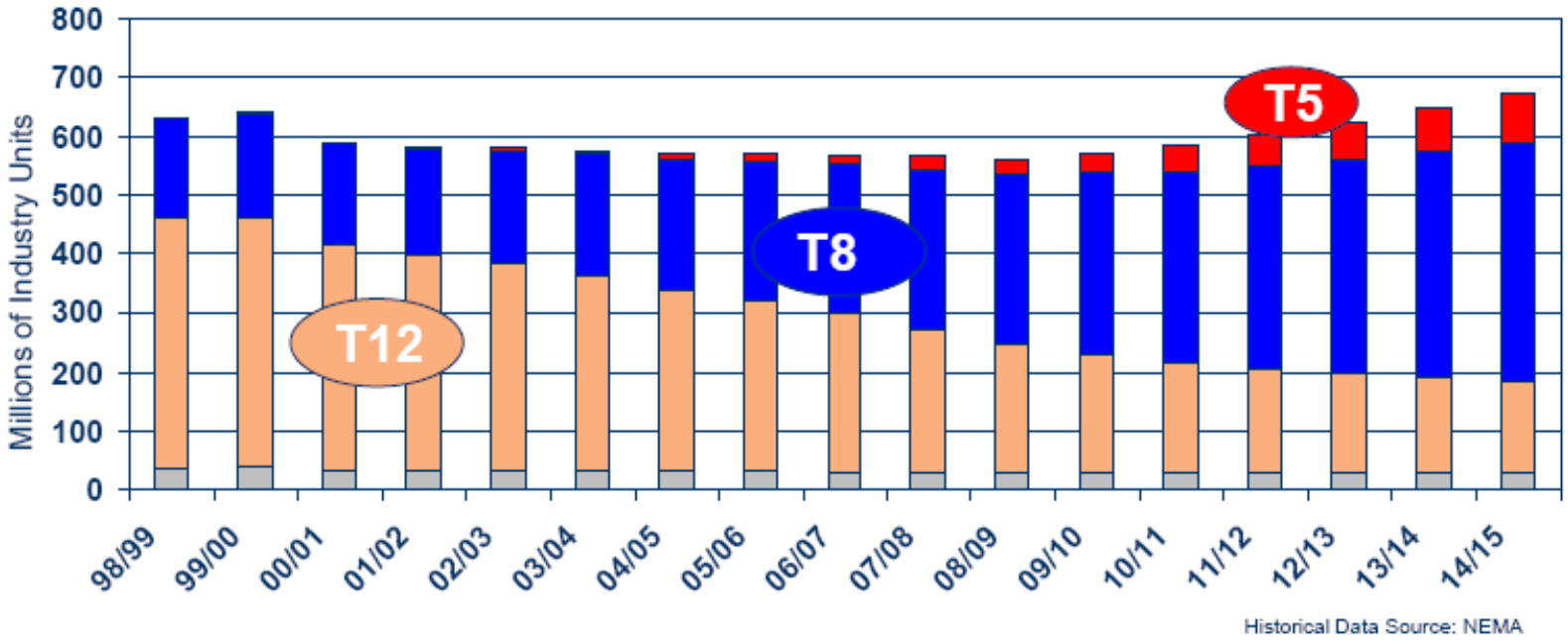
Example:

Efficiency Vermont Business Direct Install Program 2008



How many T12s still exist in the market?

- T12s still account for ~30% of sales



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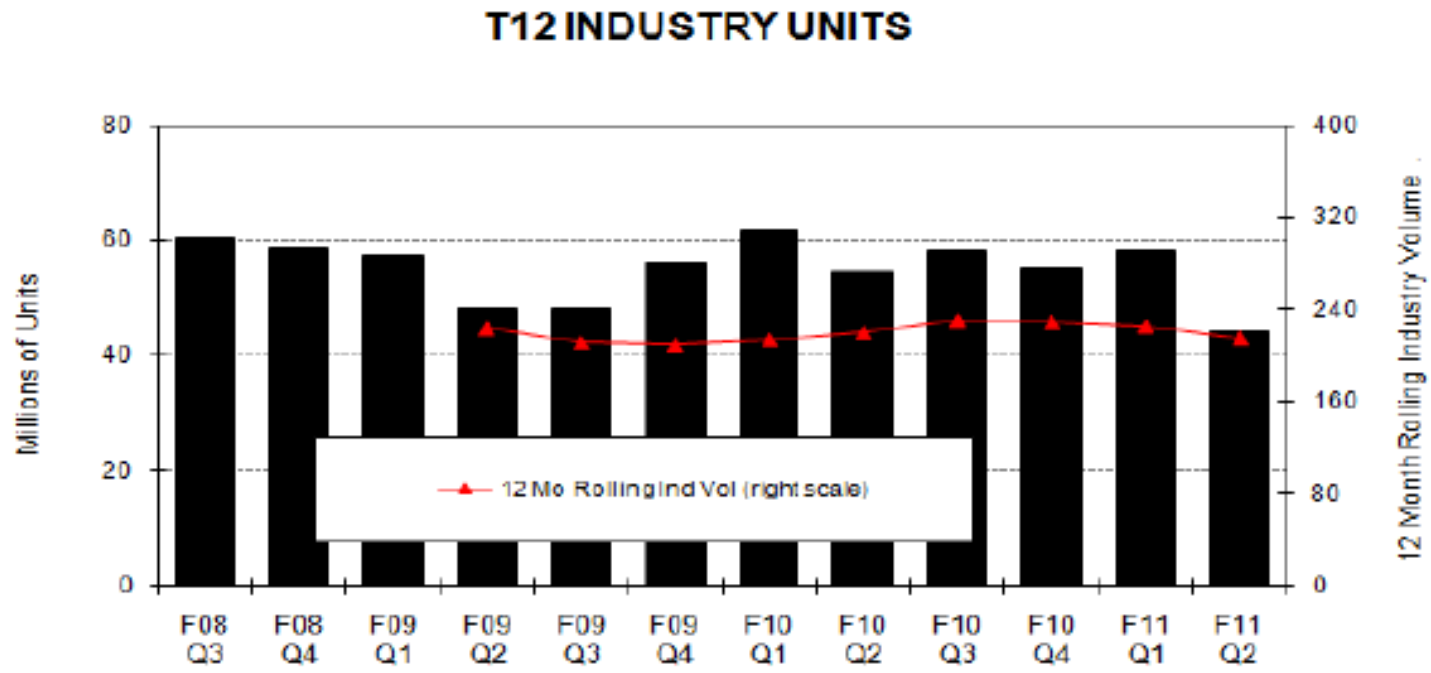
~220M T12 Lamps Sold per Year (equates to estimated 750M installed base)

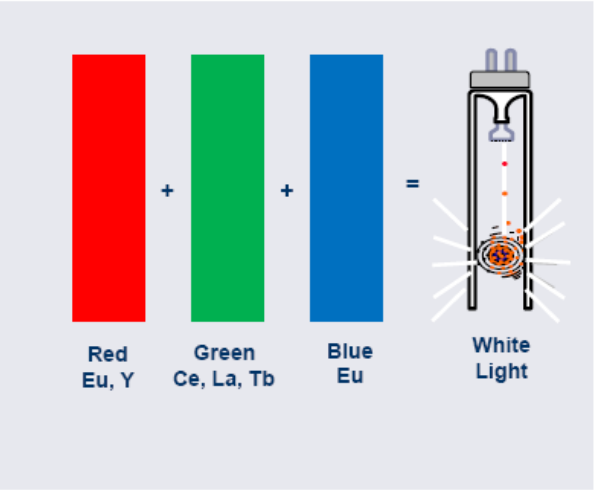


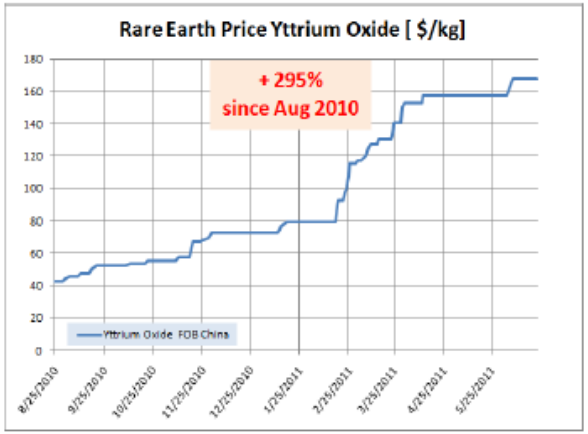
	F11 Q2
Industry Units	44M
Rolling Industry Volume	216M

Data Source: NEMA

Other Factors: Prices Rising due to Rare Earth Export Quotas

- Rare Earth Oxides are used in fluorescent lamp phosphors
- China enacted strict new export quotas on Rare Earth Oxides beginning in 2010
- Prices up 25 – 100% so far
- Disproportionately affects most efficient T8 and T5 lamps.





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…but Rare Earth Impact on C&I programs is Actually Very Small

- Relamp/Reballast Cost: $50 - $150
- New Fixture Cost: $100 - $300
- Increase in Lamp Cost due to Rare Earth: $2 per lamp

- Effect: Increases cost of measure by ~1 to 5%

Important Questions to Ask

- How likely is it that a facility using T12 lamps will (be forced) to upgrade to T8 or another system once standard takes effect?
- How much manufacturer or retailer stockpiling will occur?
- How prevalent will the exempt products be?
- How much hoarding will occur?

Recent Program Responses to Regulators

- Do not account for T12 baseline shift in current or 2012 program savings
- Determine how to account for standard in 2013 once more is known about stockpiling, prevalence of exempt lamps, etc

- Basis: Exempt Lamps, Rare Earth Phosphors, Installed Base Lamp Life

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Recent Program Responses to Regulators

Efficiency Vermont

- Currently renegotiating previous agreement with Regulators
- Proposal for baseline shift to occur in 2015, 2 years after standard effective date

- Basis: Exempt Lamps, Rare Earth Phosphors, Installed Base Lamp Life

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Recent Program Responses to Regulators

- Flipped argument on head: Standard effective date would be 2017, not 2012, if it weren't for program involvement in priming market to higher efficiency T8 and HPT8
- Program can claim market transformation savings for standard itself from 2012 to 2017*

- Location of Report: http://energytrust.org/library/reports/110908_CommLighting__MarketTransformation.pdf

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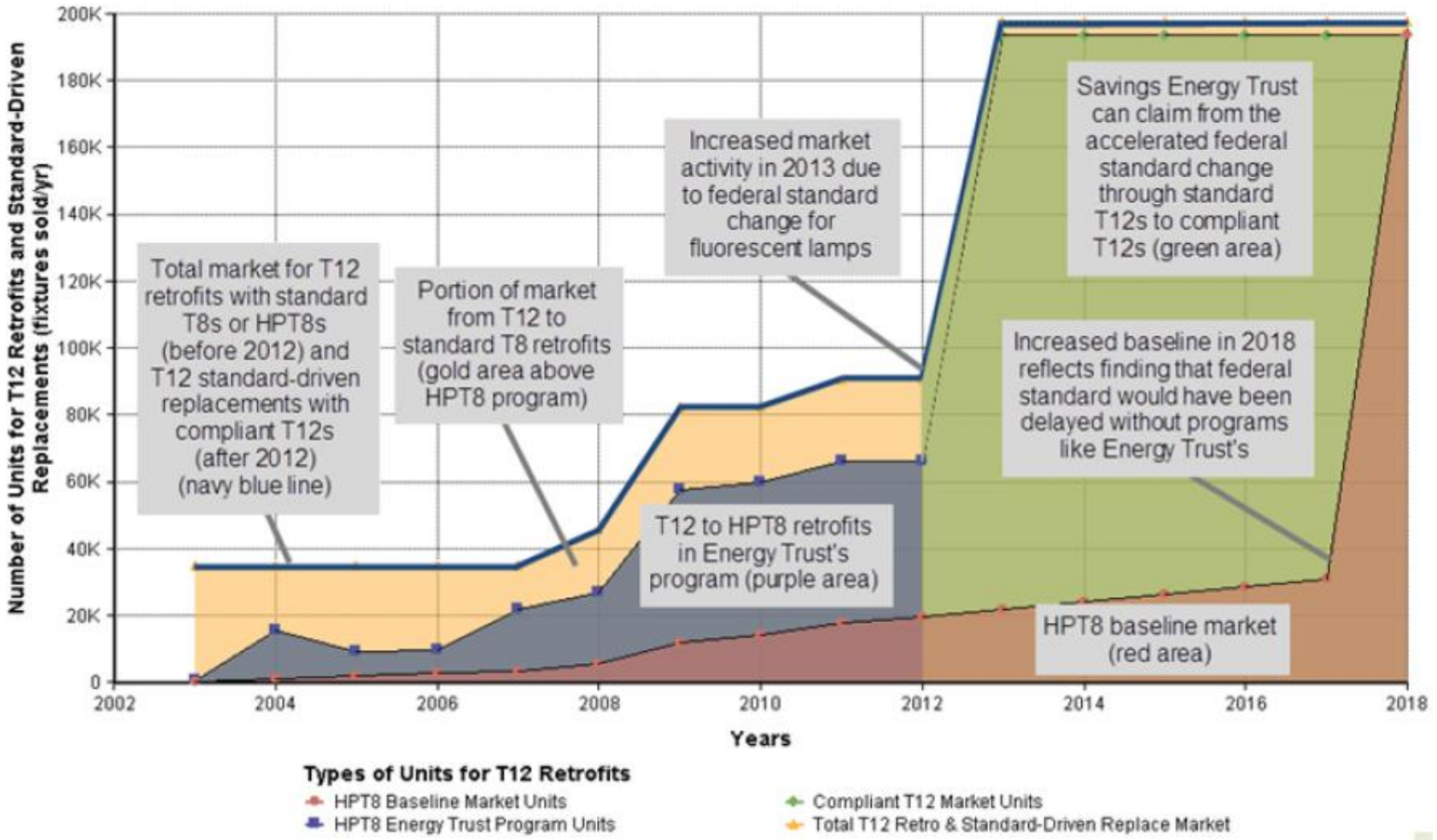
Oregon Energy Trust Market Transformation Credit



Source: OSRAM Sylvania

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Why the Oregon Report is Important

- Sets precedent for claiming local program savings due to federal standards – can this approach be used with other technologies and standards and in other places?

- Provides methodology to claim market transformation credit

*Report has been received thus far with significant skepticism

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Even so, it's a question of "when", not "if"

- Eventually existing stock will run out and businesses will be faced with costly exempt replacement lamps or upgrade to something better
- T8 will ultimately become baseline
- Impending standard on ballasts may raise baseline further by eliminating standard T8 ballasts
- New opportunities for savings must be pursued

Post-standard Lighting Opportunities

- The future is bright
- LED, LED, LED
- Controls, Controls
- Design and System Opportunities

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Post-standard Lighting Opportunities

- Even with Standard T8 baseline, there are still cost-effective opportunities to upgrade

3-lamp
Standard T12
122 Watts

3-lamp
Standard T8
87 Watts

2-lamp High
Performance T8
w/ Fixture Kit
49 Watts

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Post-standard Lighting Opportunities

- LEDs will offer even more savings but cost not quite there yet

3-lamp
Standard T8
87 Watts

2-lamp High
Performance T8
w/ Fixture Kit
49 Watts

Current best-
in-class LED
36 Watts

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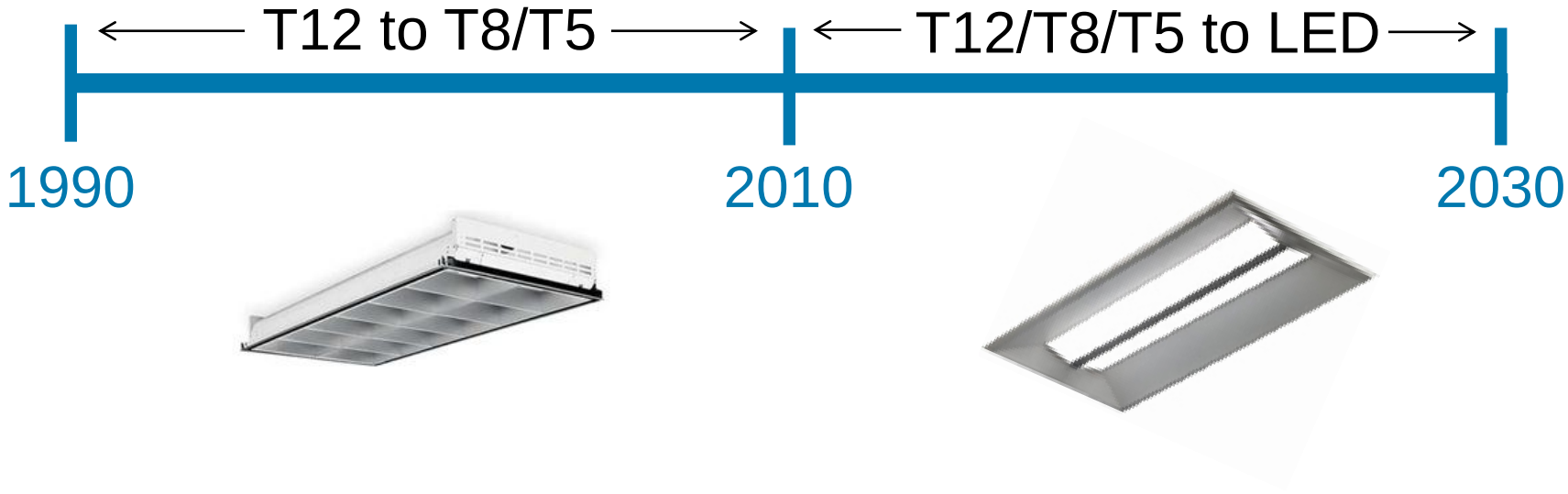
LEDs Usher in the Next Wave of Retrofits

- We will retrofit the same facilities we have retrofit over the last 20 years – again



LEDs will also open New Opportunities

- Retail Track and Spot Lighting
- Efficiency Programs have had limited success in this application
- Existing EE Technologies lacked features required to compete with Halogen:
  - High CRI
  - Beam Control
  - Dimmable
  - Instant-On
  - Cost-effective
  - Easy Retrofit

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LEDs will also open New Opportunities

- LED Street and Parking Lot Lighting
- Efficiency Programs have largely ignored this opportunity before LED

<u>Why?</u>

- Existing HID technologies already considered efficient
- “Design” Opportunities not well understood or pursued

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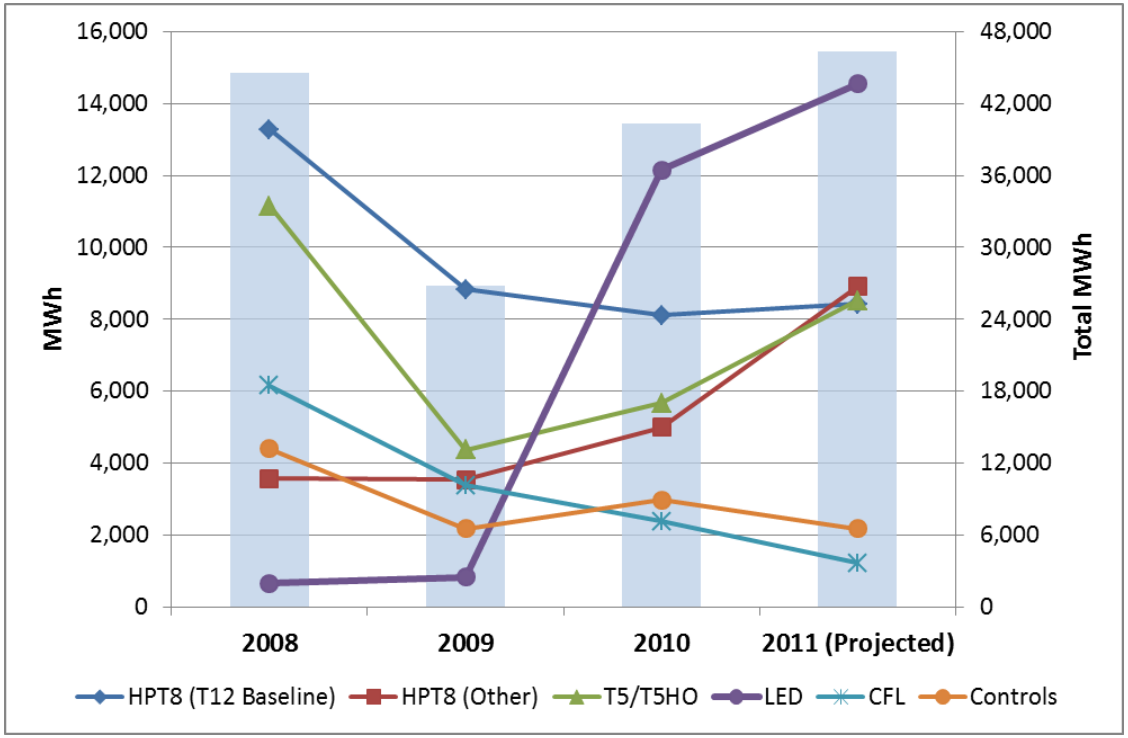
LED Opportunity Already Showing Large Results with some Programs

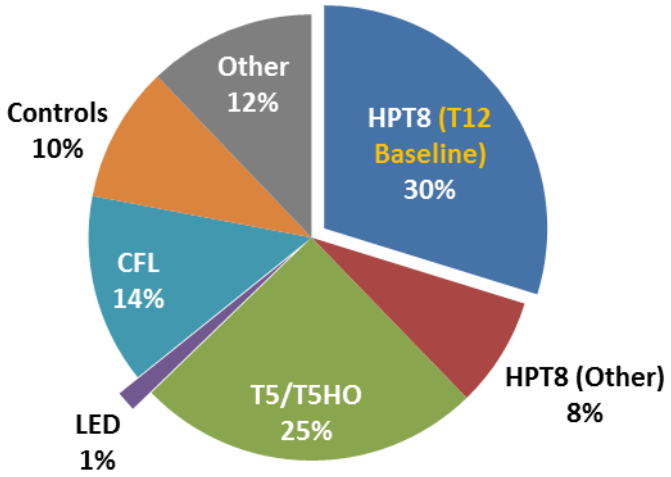
- LED now largest contributor to C&I Lighting Savings for Efficiency Vermont



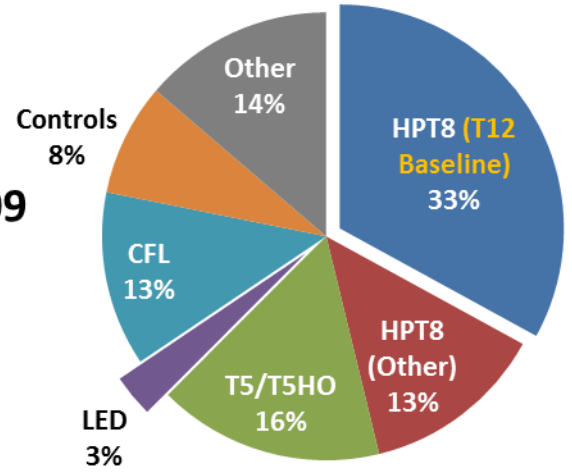
Source: Dan Mellinger, Efficiency Vermont

Efficiency Vermont C&I Lighting Savings

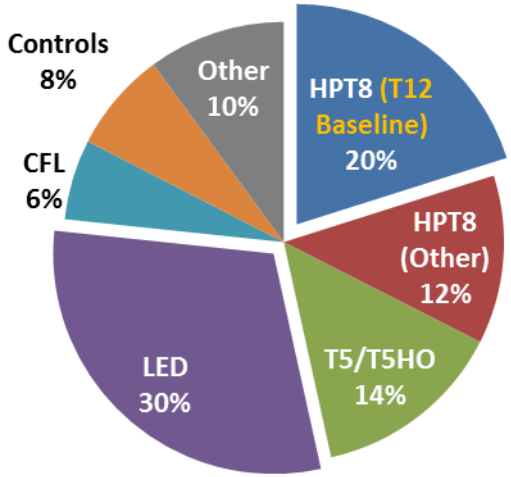
2008



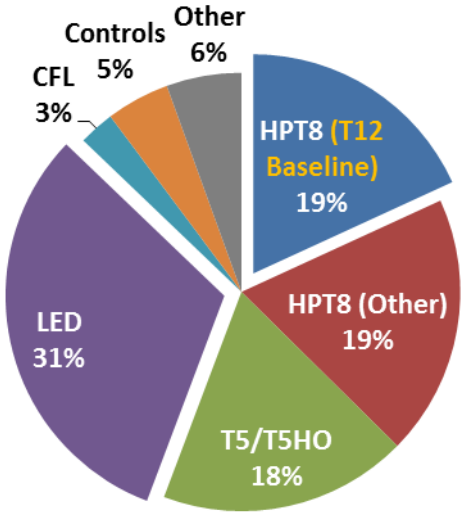
2009



2010



2011 Projected



Source: Dan Mellinger, Efficiency Vermont

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Summary

- Federal Standard will take time to have it's intended effect due to exempt and stockpiled lamps
- Tremendous cost-effective C&I lighting opportunity remains
- Some savings may cost more due to current cost of LEDs – but still much less than cost of supply and worth pursuing

Optimal ENERGY Integrated Energy Resources

Thank you

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