Energy Efficient Lighting Opportunities

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Principal

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Today

- Potential
- Technologies
- Transforming the Market
- Voluntary Approaches
- Codes and Standards
- Best Practices

Why Energy Efficient Lighting?

- Easy to verify the energy savings
- Relatively easy to understand and install
- High energy savings potential
- Cost effective

The Potential

- CFL's
  - 4.7 billion eligible sockets in US, only 17% (11% residential) contain CFLs
- LED's by 2030
  - "Between 2010 and 2030, SSL could save 1,488 terawatt-hours representing a savings of $120 billion at today's energy prices"

Sources: US DOE *CFL Market Profile 2009*: *Energy Savings Potential of Solid-State Lighting in General Illumination Applications 2010 to 2030*

Technologies

- Mercury Vapor
- Metal Halide
- Incandescent
- Compact Fluorescent
- Linear General Service Fluorescent
- LED

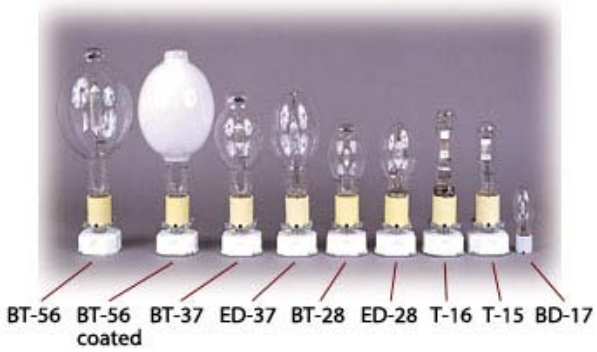
Mercury Vapor

- Lowest efficacy of High Intensity Discharge (HID) sources
- Last a very long time
- Very poor color rendering
- Least expensive of HID options
- The U.S. 2005 Energy Policy Act (EPAct) outlawed Mercury Vapor **ballasts** in 2008.
- Used for outdoor area lighting

Metal Halide Lamps

- More efficient than Mercury Vapor
- Provides white light
- High color rendering available
- Available as probe start or pulse start
- Typically used in outdoor area/sports lighting, and indoor warehouse and other high-bay lighting

Pulse Start Metal Halide



All types of MH: Photo Courtesy of Bulbman

- More Efficient than Probe Start
- The 2007 federal Energy Independence and Security Act (EISA) raised ballast efficiency requirements
  - Driving the use of **pulse-start systems**
- Less color shift
- Quicker start up
- Typically longer life
- Better lumen maintenance
- Better color rendering

Incandescent Lamps

clear

frosted

BR flood

- Least efficient light source
- Inexpensive
- Short lamp life
- Great color rendering – the source we use to compare all other warm sources
- “R” lamps were banned in the 90’s but law allowed manufacturers to slightly change the shape to “BR”

Incandescent

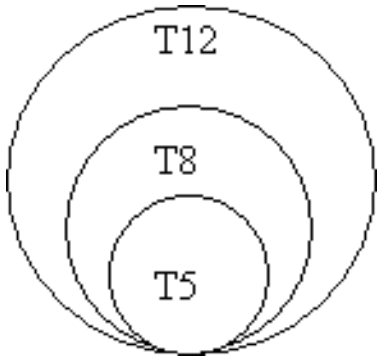
- EISA 2007 contains provisions for phasing in more efficient incandescent lamps for the typical 100W, 75W, 60W, 40W general service

Rated Lumens	Max Rated Wattage	Min Rated Lifetime	Effective Date
1490-2600	72	1,000 hrs	1/1/2012
1050-1489	53	1,000 hrs	1/1/2013
750-1049	43	1,000 hrs	1/1/2014
310-749	29	1,000 hrs	1/1/2014

Potential Replacements

GU24 socket replaces Edison Socket

General Service Fluorescent Lamps



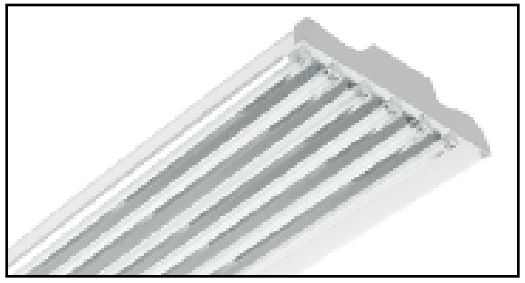


Photo Courtesy of Philips

- Phase in more energy efficient lamps and ballasts
- In theory, T12s will go out and must be replaced by more efficient technologies
- T8 are continually being fine tuned with ballast factor to create very efficient systems
- High Performance T8 lamps even better
- T5 lamps
  - High output available
  - Not necessarily more efficient than T8 or HPT8, look at system efficiency

General Service Fluorescent Lamps

Summary of DOE's 2012 Standards

Lamp	Correlated color temperature	Energy conservation standard (lumens/W)
4-ft. (T8-T12) medium bi-pin >25W	<4500K	89
	>4500K and <7,000K	88
2-ft. (T8-T12) U-shaped >25W	<4500K	84
	>4500K and <7,000K	81
8-ft. (T8-T12) Slimline >52W	<4500K	97
	>4500K and <7,000K	93
8-ft. (T8-T12) HO	<4500K	92
	>4500K and <7,000K	88
4-ft. (T5) miniature bi-pin standard output >26W	<4500K	86
	>4500K and <7,000K	81
4-ft. (T5) miniature bi-pin HO >49W	<4500K	76
	>4500K and <7,000K	72

LED – The New Lighting Frontier

- Government and industry working together to set standards for testing life, lumen depreciation, photometrics
- Education and Testing initiatives
  - DOE R&D
  - EPA/DOE ENERGY STAR
  - CALIPER
  - DOE and utility case studies

LED – Great Potential

- High efficiency - rival that of CFLs with potential to far exceed traditional sources
- Long Life 25,000+ hours (claims vary)
- Color can vary
- Do not behave like traditional light sources
- Quality is needed to maintain life and lumens
- Cost effective – traffic signals, exit signs, downlights, street lighting, freezers
- Consider operations and maintenance costs

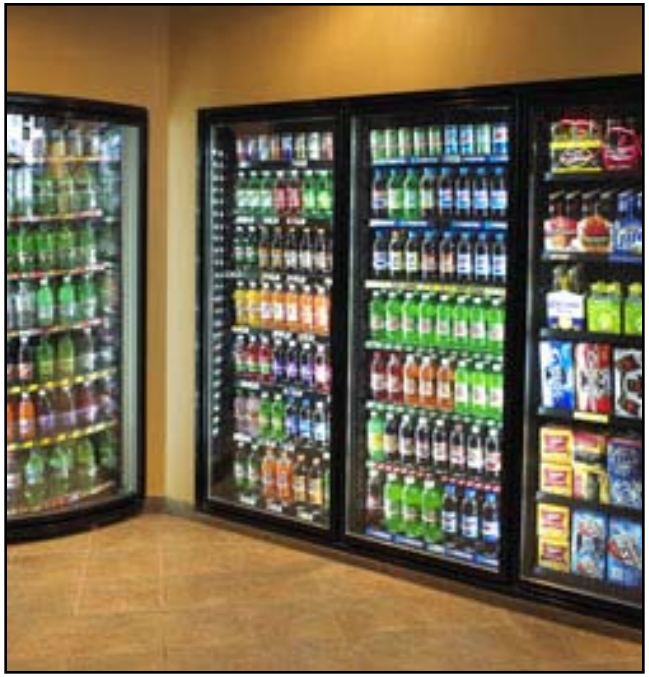
LED: Applications and Products

"Over a five-year period, the City of Los Angeles' Bureau of Street Lighting will replace 140,000 existing streetlight fixtures in the city with LED units."

Low Wattage Step Light

Photo – North Carolina – Progress Energy

LED: Applications and Products



Reach in Coolers and Freezers

Outdoor Signage

Under Cabinet and Over Cabinet Lighting

Down Lights (directional)

Flexible Cove Lighting

LED: Applications and Products

Evolving

Yet To Be Determined?

Controls

Wireless and Self Commissioning

Dimming

Occupancy Sensors

Vacancy Sensors

Fixture Mounted
Wall Mounted
Ceiling Mounted

Load Shedding
Ballasts

Transforming the Market

- Approaches
- Challenges
- Best Practices

Approaches

- **Voluntary**
  - Federal programs (ENERGY STAR)
  - Local and utility programs
- **Regulatory**
  - Technology/product regulation
  - Building code
- **Incentives**
  - Tax incentives
  - Product rebates
  - Energy savings (kWh) rebates

Voluntary Efforts

- **National ENERGY STAR® Program**
  - Work with manufacturers, distribution, retail markets
  - Consumer education
  - Third-party unbiased information
  - CFLs, Residential Light Fixtures, LEDs
- **Local Utility Programs**
  - Work directly with stores and installers
  - Direct install programs
  - Rebate and incentive programs
    - $ for energy efficient products
    - $ for kWh savings
  - Technical assistance

Legislation and Codes

- Federal Tax Deductions
- Federal Legislation: Incandescent, General Service Fluorescent Lamps, Ballasts, HID lighting
- State Energy Codes
  - ASHRAE/IES, IECC
  - California Title 24
- Local Codes – Outdoor Lighting

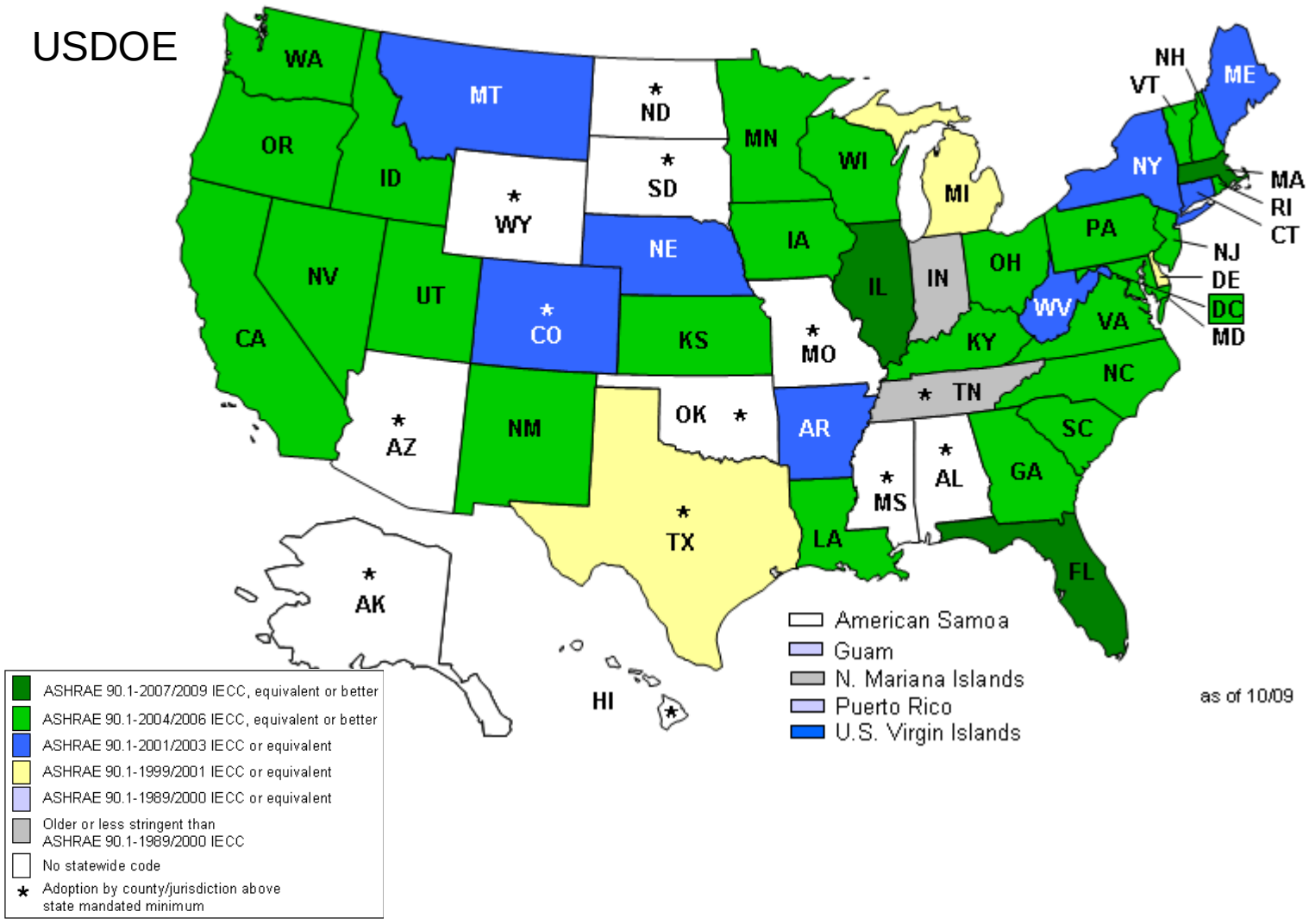
Energy Policy Act of 2005

- Federal Buildings to meet ASHRAE 90.1 2004
- States to meet ASHRAE
- Increased goals for energy efficiency at Federal Buildings
- Tax deduction for energy efficiency in all buildings based on W/sf compared to ASHRAE 90.1 2001(up to $0.60 per sf)

More to Come: ASHRAE and the U.S. Department of Energy (DOE): Increasing the energy efficiency of ANSI/ASHRAE/IESNA Standard 90.1-2010 by 30% over Standard 90.1-2004.

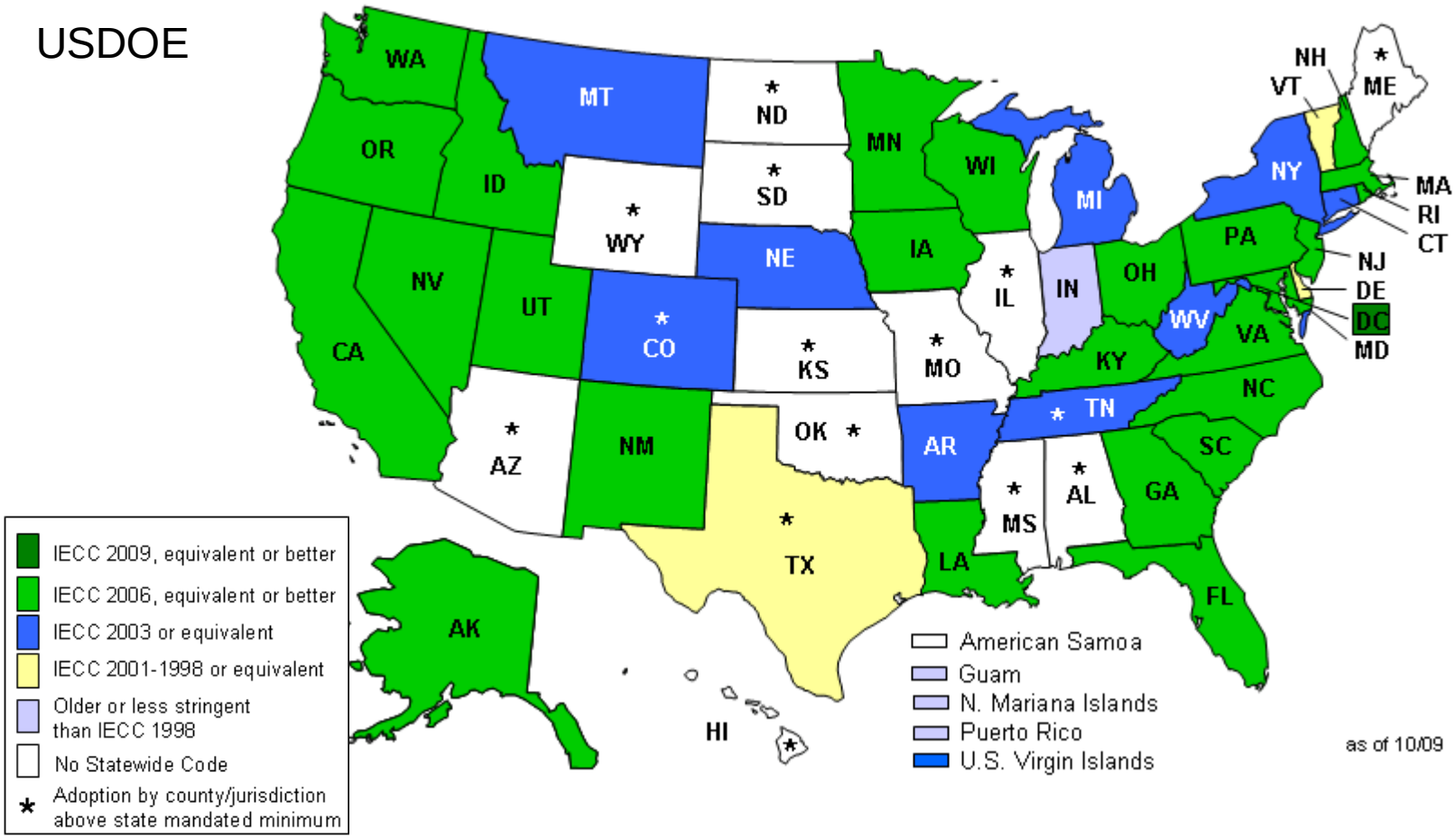
Energy Codes - Commercial

USDOE



US Energy Codes Residential

USDOE



EISA 2007

- Energy Independence and Security Act of 2007 (EISA 2007)
- Many of the energy policy provisions that congress had been trying to pass for years were included in this Act.

True or False?
The incandescent lamp will be phased out starting in 2010?

Market and Program Challenges

- **Disposal**
  - Need infrastructure, guidelines and some regulation
  - Prevent reselling of removed lamps and ballasts in domestic or foreign markets
- **Product Availability**
  - Help market adjust for increases in short or long term demand
- **Market Education**
  - Have to educate all market actors – manufacturers, distributors, installers, end-users

Best Practices

- Work with the market actors on codes, standards and programs
- Mix of local and national efforts
- Develop peer-to-peer relationships
- Bring market actors together; involve all sectors – manufacturing, distribution, retail, end-users, associations
- Start with smaller effort; build momentum

Summary

- Lighting is easy
- Voluntary and regulatory approach to market transformation
  - Rebates and market interaction
  - Energy codes
- Indentify the best applications
- Work with the market actors
- Ensure product availability and quality
- Opportunities to “leap-frog” (MV to LED)
- Outreach, outreach, outreach

Thank You

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