CFLs 101

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2007 ENERGY STAR Lighting Partner Meeting

March 13, 2007

Motivation

- New partners, new people
- Outstanding questions
- Internal education
- Outreach to other organizations
- Presentation under development…

Overall Mission of the ENERGY STAR CFL Program

- In addition to setting efficiency levels and establishing consistent quality attributes, the ENERGY STAR CFL program seeks to encourage and educate the public to the benefits of replacing incandescent products with ENERGY STAR qualified CFLs.

- To continue to drive the market to offer the highest quality products – keep the integrity of the what the ENERGY STAR label stands for.

Agenda

1. CFL Overview
   - How they work, types, designs
2. Key Performance Characteristics
   - Describing efficiency, performance, light quality
3. CFL Testing Regimes
   - ENERGY STAR, PEARL, PNNL reflector testing
4. Informational Tools
   - Existing and under development
5. Questions!

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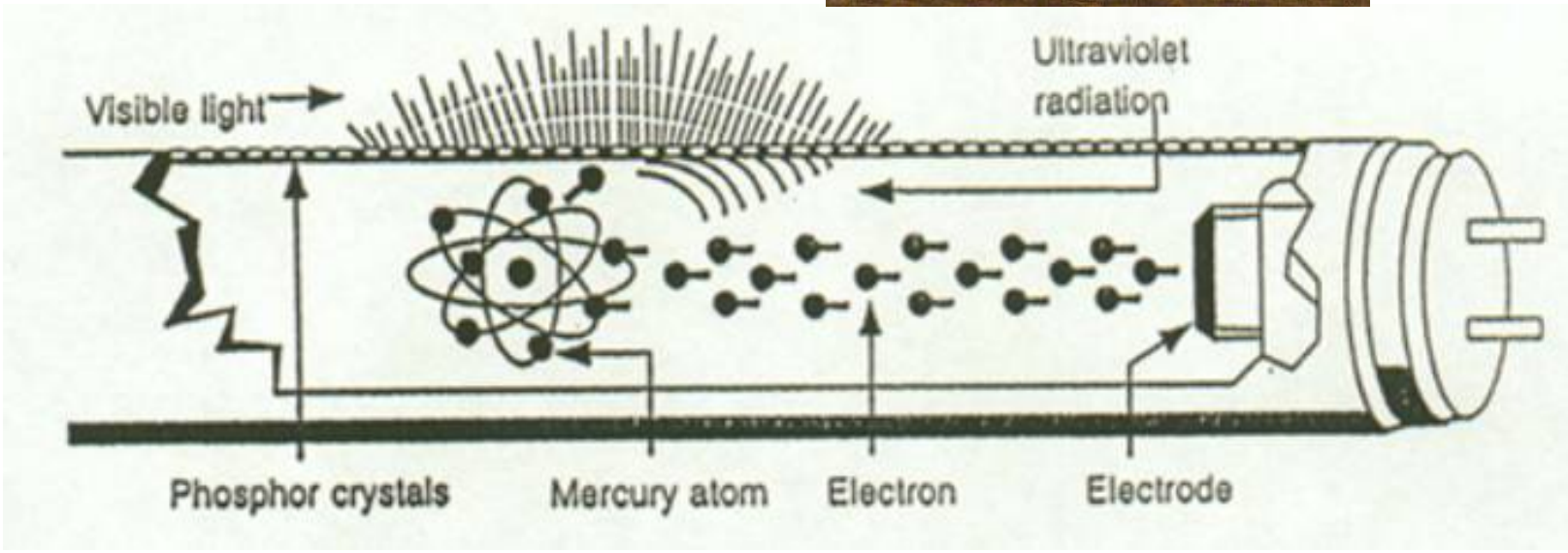
How do CFLs work?

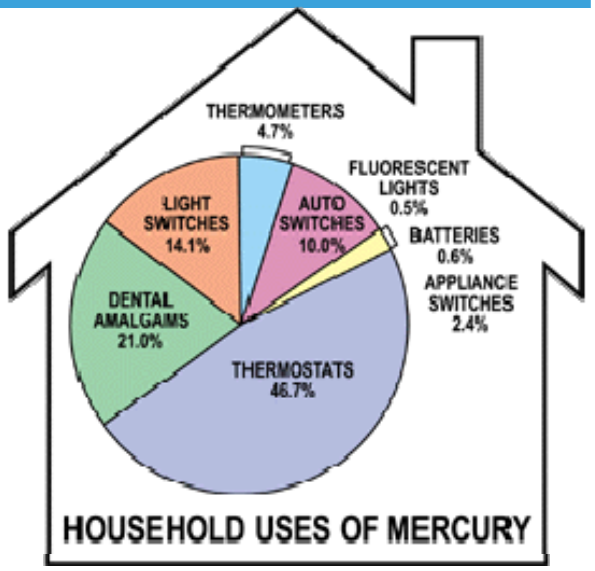
Two basic parts:

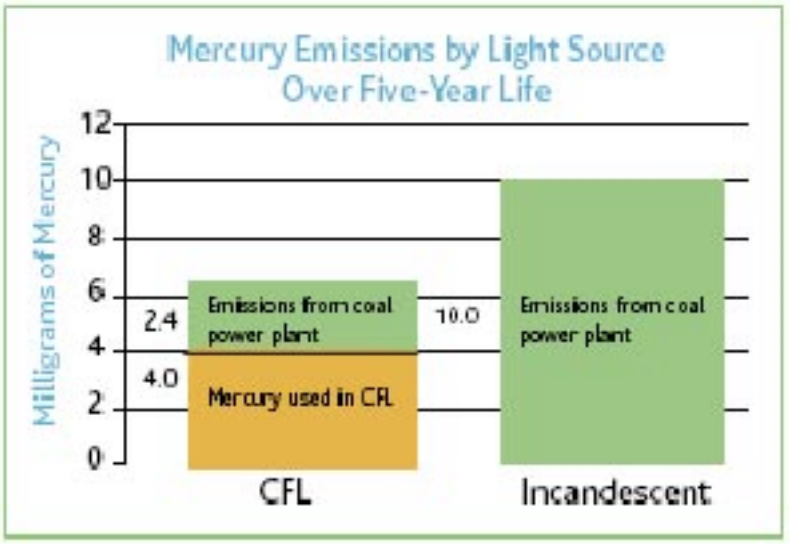
- Lamp
- Ballast



How do CFLs work?

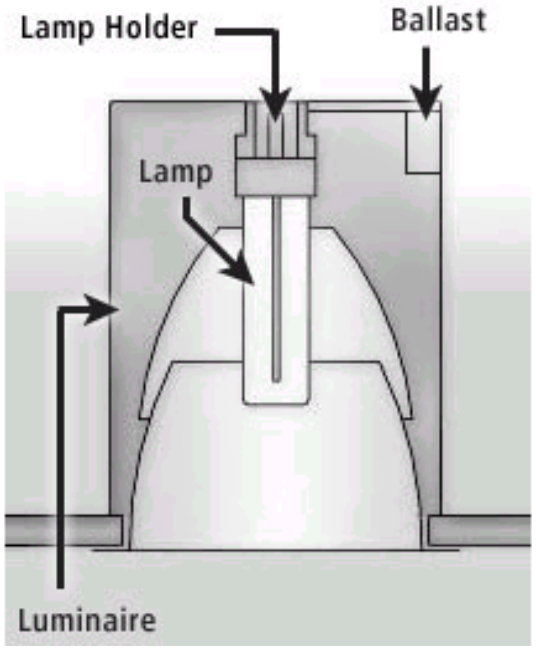
- Wait… did he say mercury?
- Relative to other household products, very little
- Result in net decrease of Hg entering environment
- More information on disposal available in next topical session (Conference Room A)

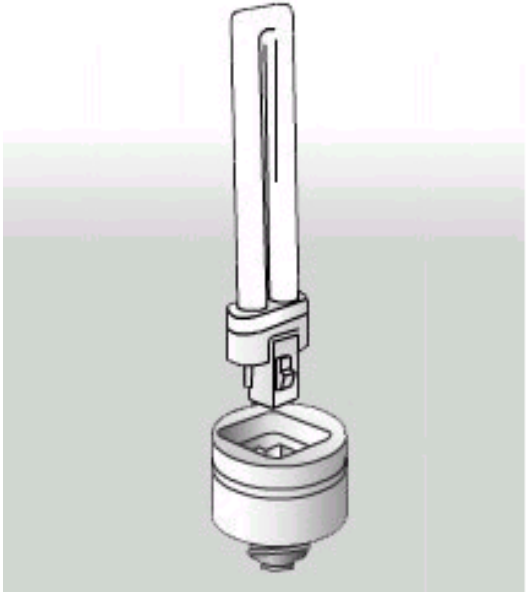


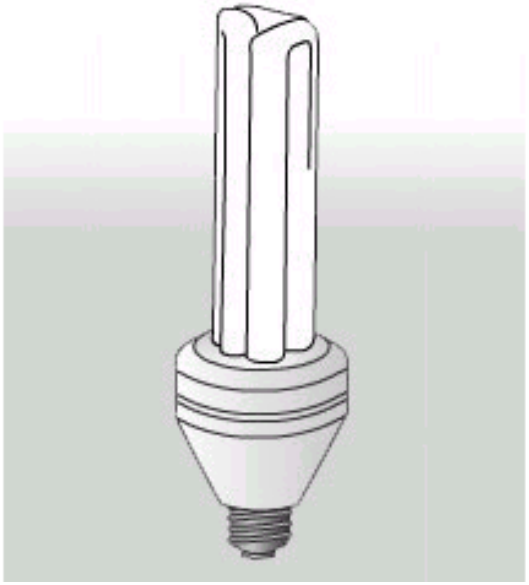


What designs and shapes do ENERGY STAR CFLs come in?

- Types
  - Dedicated, modular, **self-ballasted**







What designs and shapes do ENERGY STAR CFLs come in?

Spiral &
Mini-spirals

Reflectors:
R20, R30, R40
PAR38

Covered:
A-line, Globes,
Bullet, Candle

Twin, Triple,
Quad Tubes

What designs and shapes do ENERGY STAR CFLs come in?

GU-24

Candelabra

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CFL Metrics and Requirements

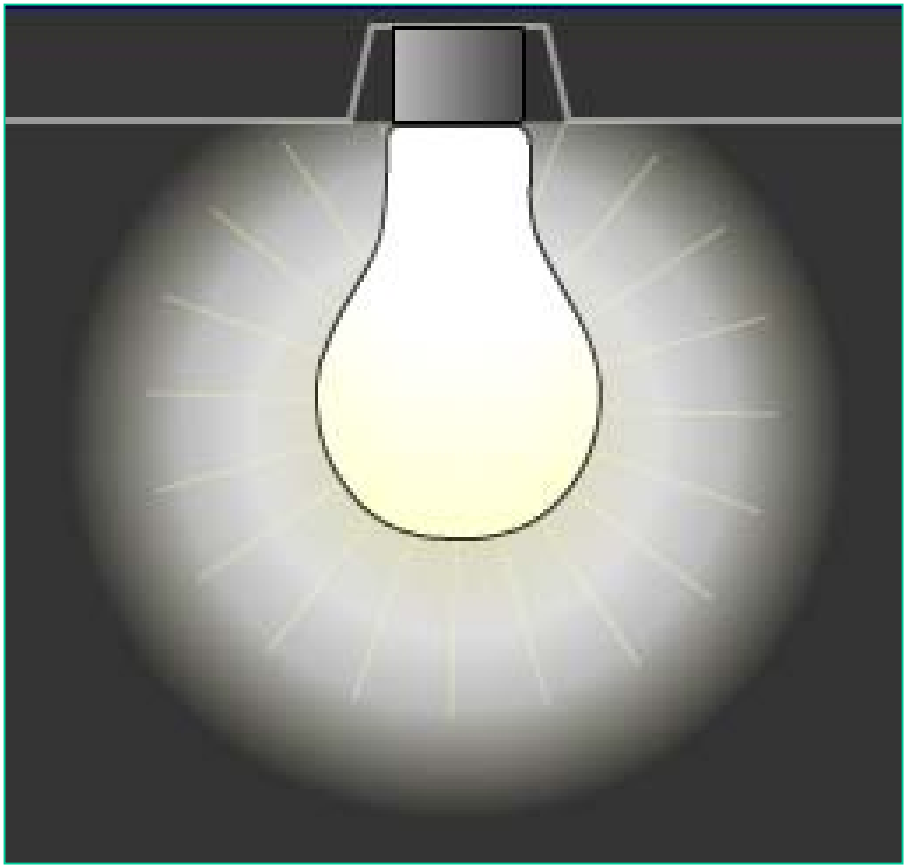
Numerous Metrics Characterize CFLs:

- Light Output
- Efficacy
- Lumen Maintenance
- Color Rendering
- Correlated Color Temperature
- Lifetime
- Starting Time
- Run-up time
- Etc.

CFL Metrics and Requirements
Light Output

Luminous Flux

- Total light output of a lamp **in all directions**
- Unit is the **lumen (lm)**; NOT the watt (W)



CFL Metrics and Requirements
Light Output

ENERGY STAR includes minimum light output requirements for CFLs intended to replace A-line incandescents in criteria

A-Shaped Incandescent bulb (Watts)	Typical Luminous Flux (Lumens)† † Lumens must be 100 hr, initial values for CFLs **Note:Excludes globes, reflectors, or decorative CFLs*
40	Minimum of 450
60	Minimum of 800
75	Minimum of 1,100
100	Minimum of 1,600
150	Minimum of 2,600

CFL Metrics and Requirements
Efficacy

Efficacy

- *IESNA Definition:* The quotient of the total luminous flux emitted by the total lamp power input. It is expressed in lumens per watt (lm/W)

Efficacy = Light Output (Lumens) / Input Power (Watts)

- ENERGY STAR efficacy requirements vary with:
  - Type/design (bare, covered, reflector)
  - Wattage

CFL Metrics and Requirements
Lumen Maintenance

Lumen maintenance

- The ability of to maintain light output over time
- For CFLs, measurements based on 100 hour baseline

ENERGY STAR CFL requirement:

- 90% Lumen maintenance at 1,000 hours of operation
- 80% Lumen maintenance after 40% of the rated lifetime (e.g. 3,200 hours for 8,000 hour rated life)

CFL Metrics and Requirements
Color Rendering

CRI = 90

CRI =70

CRI =50

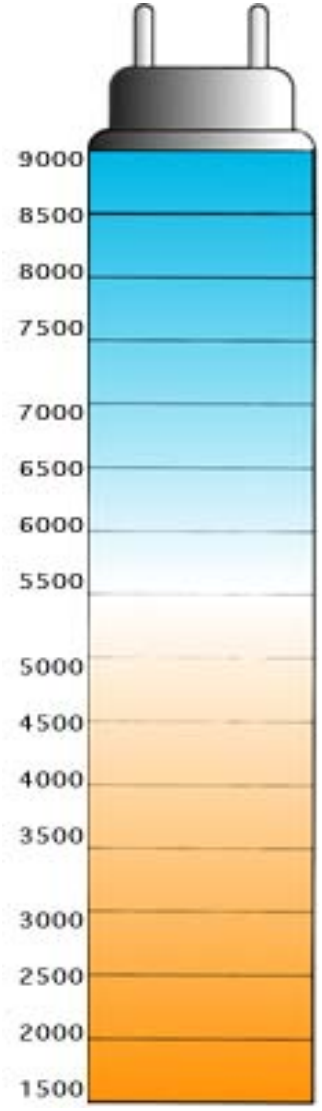
Color Rendering Index (CRI)

- Ability of the light source to show colors "realistically" (compared to incandescent)
- Ranges from 0 to 100 (Higher is better)
- CRI is a calculation; human eye can't discriminate fine differences in CRI
- Examples:
  - Metal halide = 60-70
  - Commercial Fluorescent Tube = 75
  - Incandescent = 100

ENERGY STAR CFL requirement:

- CRI greater than 80.0

CFL Metrics and Requirements
Correlated Color Temperature



Correlated Color Temperature (CCT):

- Indicates how **"cool"** or **"warm"** the light appears
- Measured in Kelvin (K)
  - Think of flames:

High temperature ⟶ ***"Cooler" light***

- Common lamp colors: 2700K, 3000K, 3500K, 4100K, 5000K
  - Lower Kelvin temperatures – **"warm"** white light
  - Higher Kelvin temperatures – **"cool"** white light

ENERGY STAR CFL requirement:

- CCT must falls between 2700-3000K, OR manufacturer must label exact Kelvin temperature.
- Under new criteria, only discreet CCTs will be allowed.

CFL Metrics and Requirements
Other Requirements

Starting Time:

- Time from switching on until lamp lights and remains lighted.
- ENERGY STAR Requirement: less than 1.00 seconds
- Can be achieved by several different starting technologies

Run-up Time:

- Time from switching on until lamp reaches full brightness
- ENERGY STAR Requirement: less than 3 minutes
- Amalgam mercury has slower run-up, but provides more robust tolerance to temperature extremes
- Revised criteria will reduce requirement for non-amalgams to less than 1 minute

CFL Metrics and Requirements
Other Requirements

- Lifetime
  - Defined to be the point at which 50% of the lamps have failed.
  - Average Rated Lifetime must be $\geq$ 6,000 hours.
  - Interim Life Test:
    - Two failures prior to 40% of rated life requires justification.
    - Three failures, product does not qualify.

- Warranty
  - Minimum 2 years residential use, 1 year commercial use

- Rapid Cycle Stress Test
  - At least 1 cycle for every 2 hours of rated lamp life

- Power Factor
  - > 0.50

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ENERGY STAR Qualification

- Manufacturers must have majority of tests done at a NVLAP-accredited laboratories.
- Labs test for all elements in ENERGY STAR criteria
  - Initial Qualification (all tests up to 40% of the rated life of product)
  - Full Qualification (completion of rated lifetime test)
- Initial test results and product packaging are sent directly to D&R for review and approval.
- Products with multiple lifetimes (e.g. 8,000 hours & 10,000 hours) - what gives?

Other Testing – PEARL

- **P**rogram for the **E**valuation and **A**nalysis of **R**esidential **L**ighting (PEARL)
- Finite number of products tested within one cycle
- Samples selected from multiple retail locations from across the county
- Failure in PEARL will disqualify product from ENERGY STAR.
- Under Criteria - Version 4.0, will be replaced by manufacturer-funded Third Party Testing program.

PEARL tests for:

- light output
- efficacy
- lumen maintenance
- interim life test
- rapid cycle stress test
- color rendering (CRI)
- CCT
- run-up time
- start time

Other Testing – PNNL Reflector Testing

- “Elevated Temperature Testing”
- This voluntary “competition” tests reflector CFLs in high-heat environment to simulate what they would experience in ICAT-rated downlight housing.
- Standard CFL testing done at 25 degrees C; high-heat environment causes decreased performance unless heat tolerance or management is built in
- Starting in Version 4.0, elevated temperature testing will be required for ENERGY STAR qualified reflector CFLs used in recessed can or downlights.

Testing Regime Summary

	ENERGY STAR	PEARL Testing	PNNL Testing for CFL Reflectors
Goal	Identify efficient, high quality CFLs	Quality Assurance	Verify performance
Eligibility	Open to all	Nominated Qualified products	Manufacturer participation
Source of Samples	Manufacturer supplied	Retail	Manufacturer supplied
Initial Qualification (up to 40% of rated life)	X	X	X+
Full Qualification (average lifetime)	X		X

CFL Metrics and Requirements
Packaging Requirements

- FTC Requirements
  - Light Output, Energy Used, Lifetime, Number of lamps in package, FTC Statement
- Model Number
- Warranty Fulfillment
- CCT
- Incandescent Equivalency and Lifetime Claims
- Starting Temperature
- Electromagnetic Interference
- Incompatibility with controls
- ENERGY STAR Logo Use

All packaging must be review and approved by D&R

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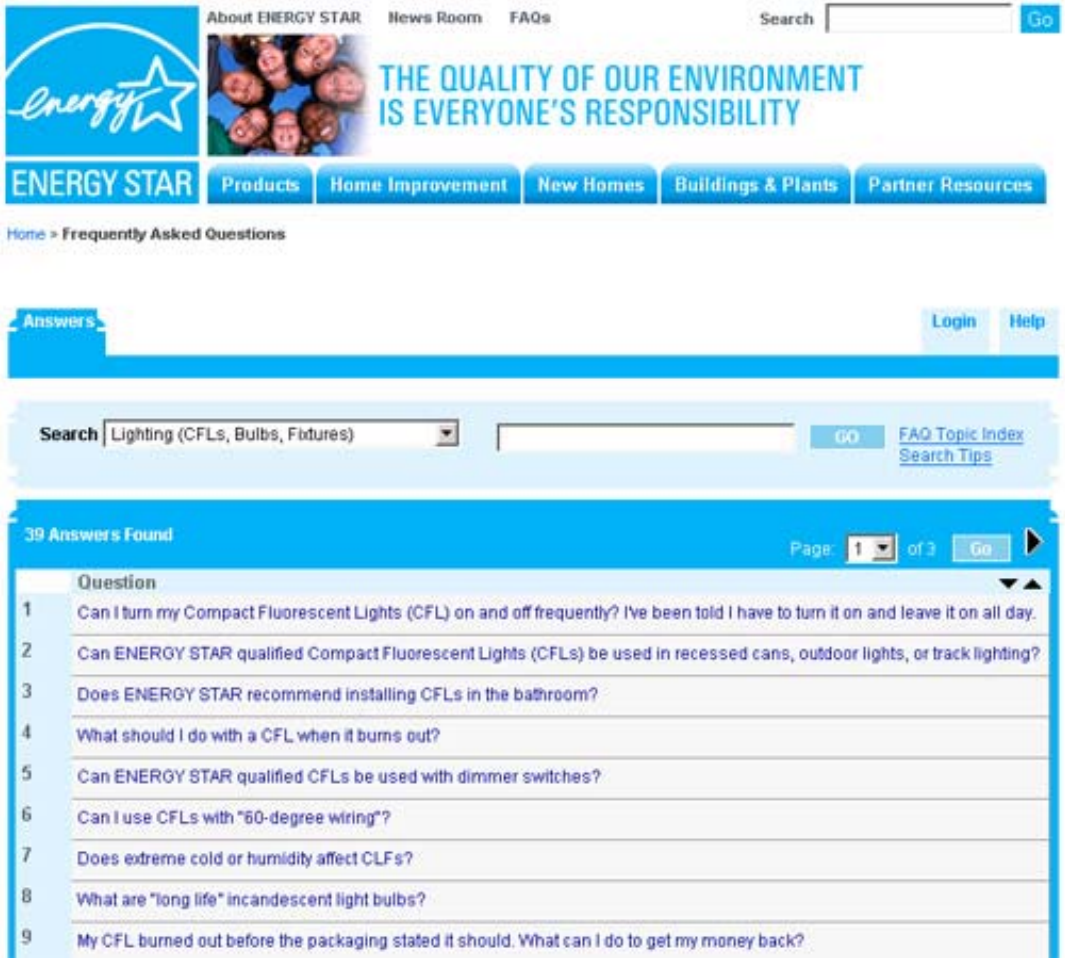
Online Tools – Existing

ENERGY STAR Frequently Asked Questions (FAQs)

- Equivalency
- Dimming capabilities
- Early Failures/Warranty
- Proper Installation
- Proper Disposal
- Understanding lumens



Online Tools – Current & Under Development

- Advanced Qualified CFL Products Search
- Product Fact Sheets
- Expanded CFL 101 presentation for Change A Light staff and partners
  - address many of the questions/concerns we hear through from partners and consumers.
- Partner Resources - Lighting Manufacturers & Retailers
  http://www.energystar.gov/index.cfm?c=manuf_res.pt_lighting
  - Surveys
  - Training Center
  - Logos
  - Technical Support Information (e.g. - GU24 Options Matrix)

Questions?