



# ENERGY STAR Qualified CFLs

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# Agenda



## 1. Overview of ENERGY STAR

- What is ENERGY STAR? Why is it important?

## 2. ENERGY STAR Criteria for CFLs

- Describing efficiency, performance, light quality
- Qualification Process, Federal Standard, etc.

## 3. Tools

- You may find useful...

## 4. Questions!

# What is ENERGY STAR?



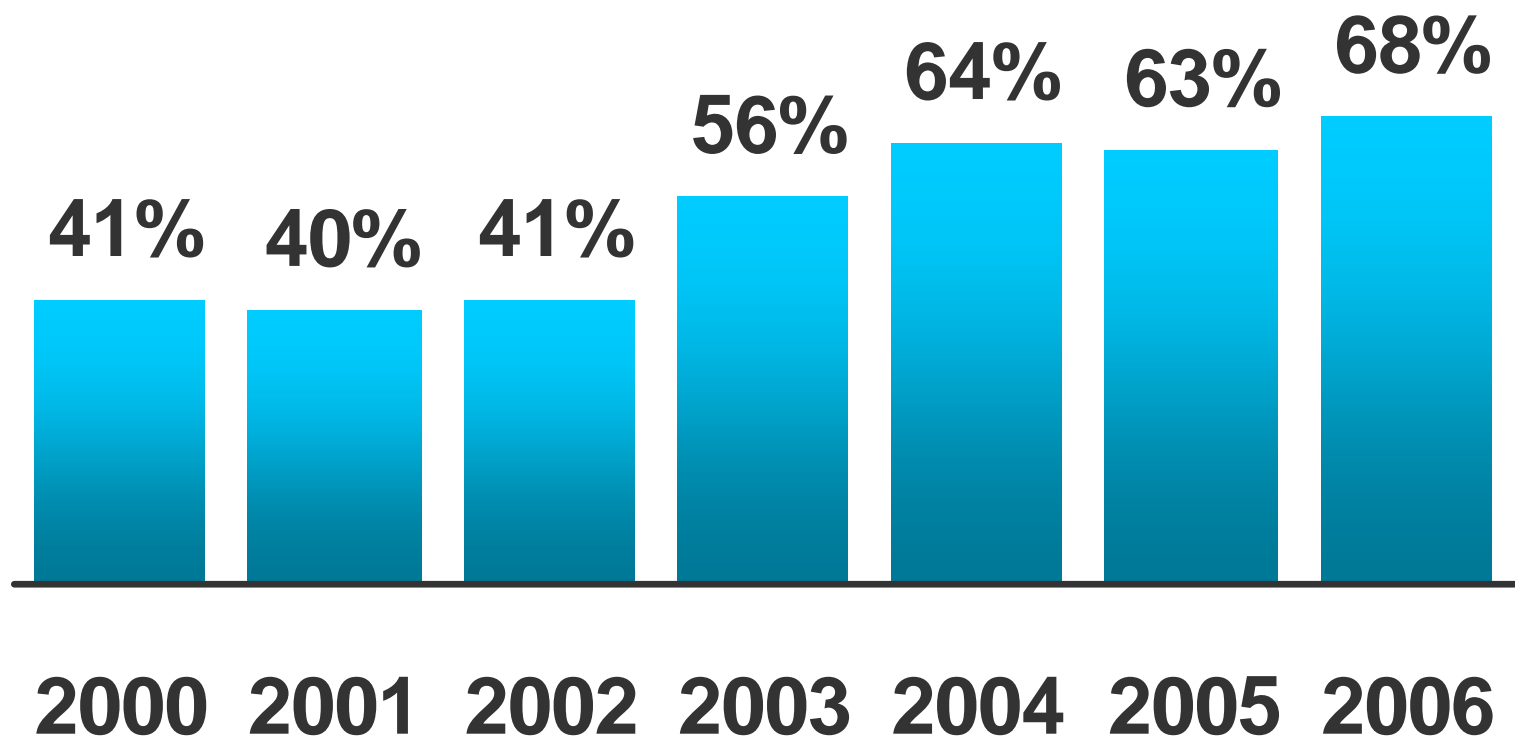
- Symbol of Energy Efficiency
  - Products
  - Buildings
  - Practices
- Voluntary Partnership
- Managed jointly by U.S. DOE and U.S. EPA



# Consumer Recognition of ENERGY STAR

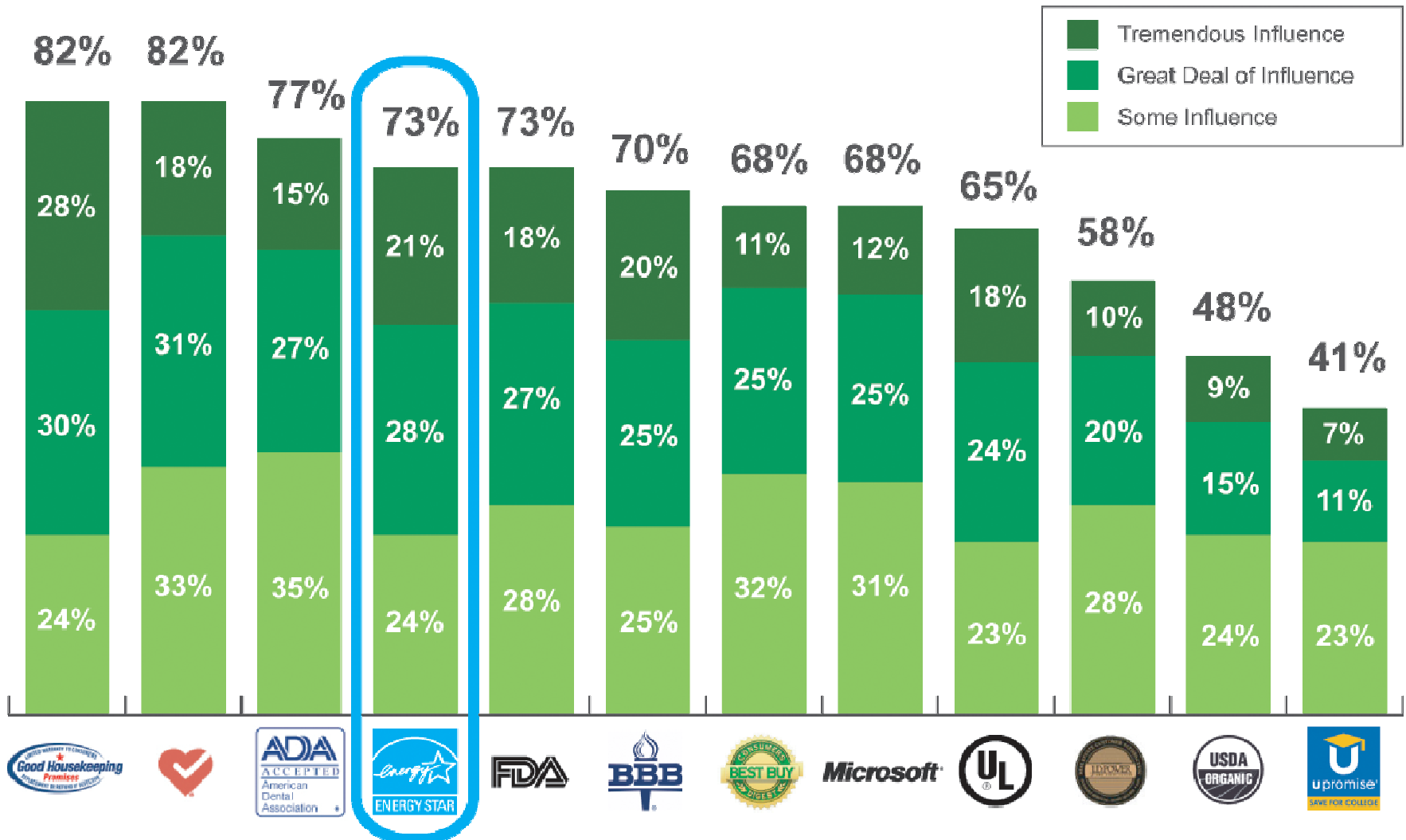


## Aided Recognition of ENERGY STAR Label



Source: Consortium for Energy Efficiency Household Surveys (2001-2006). Standard errors vary between 1.5% and 2.2%.

# ENERGY STAR Influences Purchasing Decisions



# Why is ENERGY STAR Necessary?



- To provide clear guidance about which every day products are energy efficient – ENERGY STAR makes it simple.
  - E.g. Refrigerators
- To provide clear guidance about which *inherently* efficient products perform to acceptable standards of quality.
  - E.g. Compact Fluorescent Light Bulbs

# ENERGY STAR Guiding Principles



- ✓ Significant energy savings
- ✓ No impact on product performance
- ✓ Cost effective
- ✓ Several technology options can qualify
- ✓ Energy consumption can be quantified
- ✓ Label differentiates products and is visible to purchasers

[www.energystar.gov/productdevelopment](http://www.energystar.gov/productdevelopment)

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# History and Status

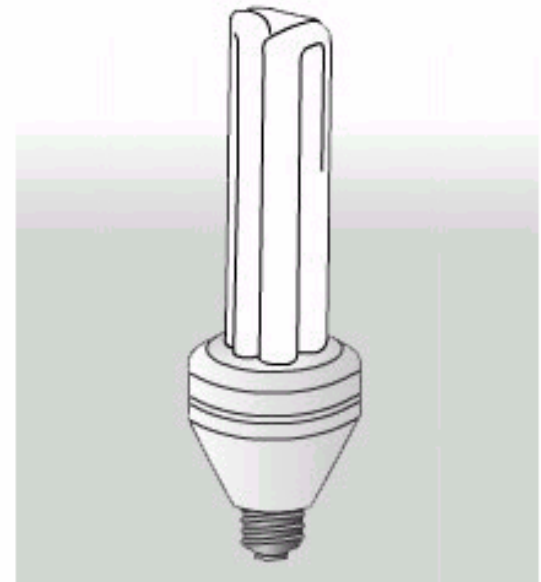
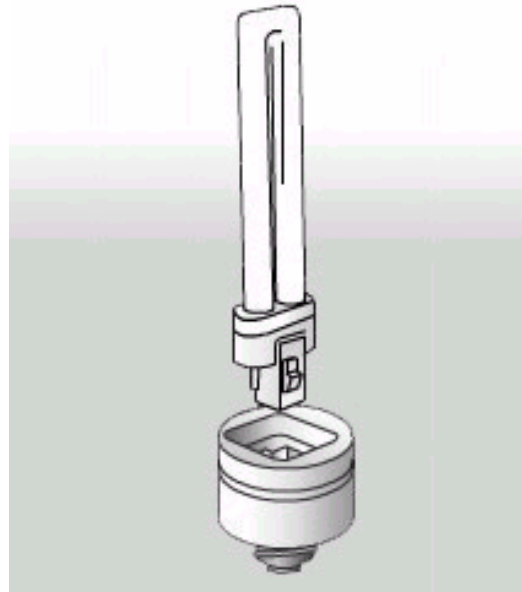
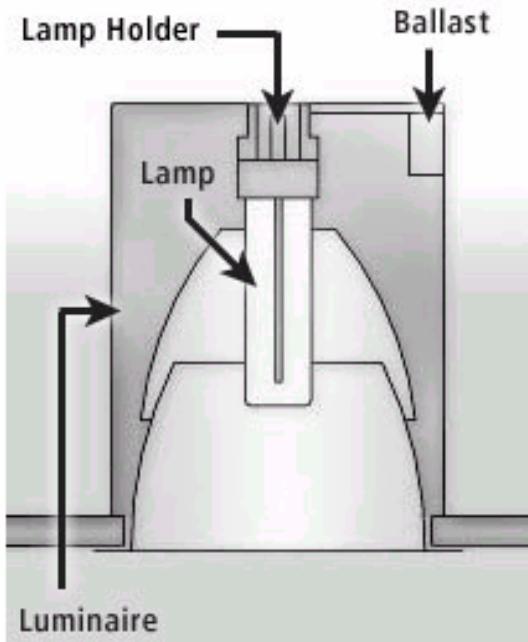


- First ENERGY STAR Criteria for CFLs took effect in 1999
- Currently operating under version 3.0 (2003)
- Criteria currently under revision to version 4.0
- Anticipated release of final 4.0 criteria this month
- Criteria takes effect 270 days after release of final criteria (EPA Act 2005)
- [www.energystar.gov/productdevelopment](http://www.energystar.gov/productdevelopment) > Revisions to Existing Specifications > CFL Criteria

# What types of CFLs does the ENERGY STAR Criteria Cover?



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



# What types of CFLs does the ENERGY STAR Criteria Cover?



Medium Screw Base

*Currently covered under  
ENERGY STAR*



GU-24

*Covered in the Residential Light  
Fixtures Criteria*



Candelabra

*Will be included into ENERGY STAR  
in 2008*

# 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



# 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

## *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)

$$\text{Efficacy} = \text{Light Output (Lumens)} / \text{Input Power (Watts)}$$

- 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

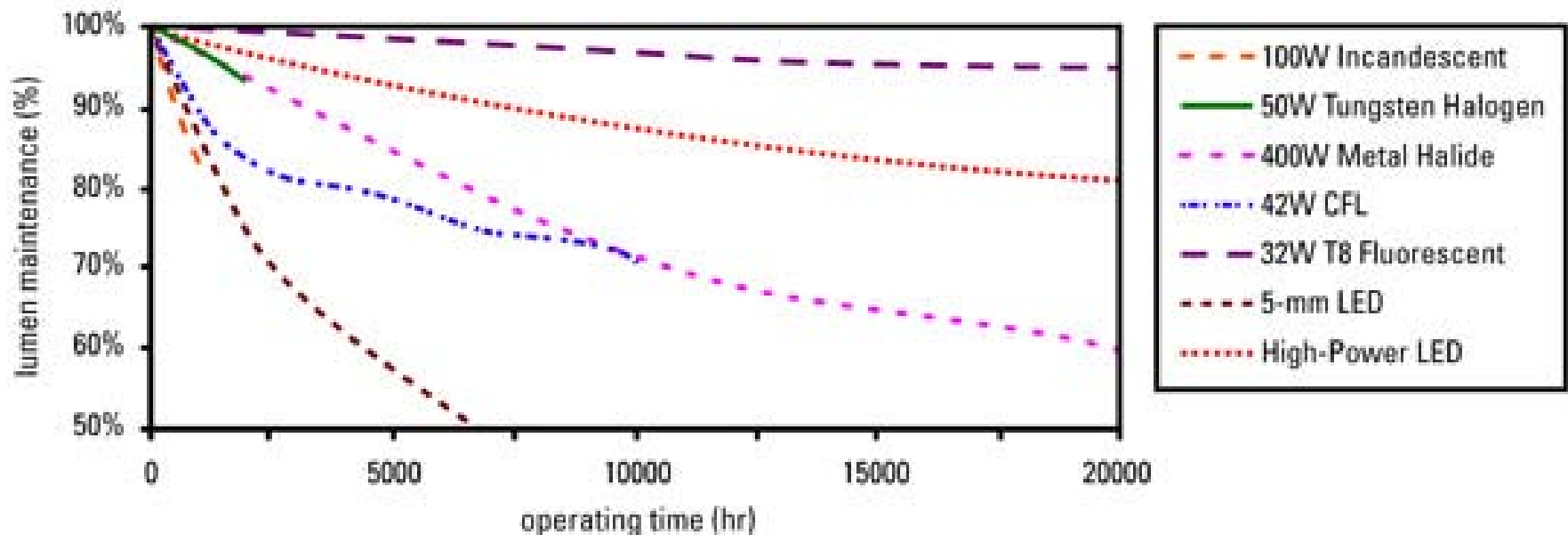
### ENERGY STAR CFL requirement:

- 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)

# Lumen Depreciation



## 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.



# CFL Metrics and Requirements

## *Color Rendering*



### 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



CRI = 90



CRI = 70



CRI = 50

- Examples:

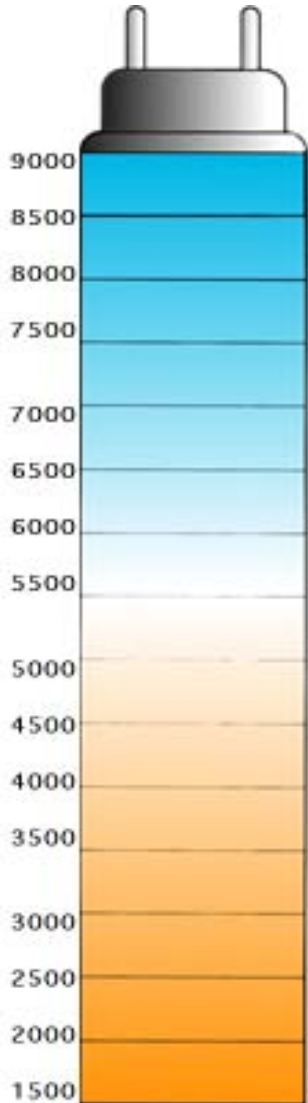
- Metal halide = 60–70
- Commercial Fluorescent Tube = 75
- Incandescent = 100

### 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, 3500K, 6500K
  - Lower kelvin temperatures – “warm” white light
  - Higher kelvin temperatures – “cool” white light

## ENERGY STAR CFL requirement:

- 3.0: CCT must fall between 2700–3000K, OR manufacturer must label exact Kelvin temperature.
- 4.0: Only 2700K, 3000K, 3500K, 4100K, 5000K, and 6500K will be allowed. Test data must fall within tolerance limits.

# CFL Metrics and Requirements

## *Starting and Run-Up*



### 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 80% of full brightness
- ENERGY STAR 3.0 Requirement: less than 3 minutes
- Amalgam mercury has slower run-up, but provides more robust tolerance to temperature extremes, controlled dosing.
- Revised 4.0 criteria will reduce requirement for non-amalgams to less than 1 minute

# CFL Metrics and Requirements

## *Other Requirements*



- **Lifetime**
  - Version 3.0: Average Rated Lifetime must be  $\geq 6,000$  hours.
  - Version 4.0: 8,000 hours for bare products 1 year after taking effect; else 6,000
  - 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**
  - $> 0.50$

# CFL Metrics and Requirements

## *Packaging Requirements*



- FTC Requirements
  - Light Output, Energy Used, Lifetime, FTC Statement
- Model Number
- Warranty Information
- Color Temperature
- Incandescent Equivalency Claims
- Lifetime Claims
- Starting Temperature
- Electromagnetic Interference
- Incompatibility with controls
- ENERGY STAR Logo Use

All packaging must be review and approved

# New Requirements for 4.0



## High-Heat Testing

- Traditional test procedures poorly simulated environment in ICAT recessed cans
- DOE, with Pacific Northwest National Lab and NEMA developed high-heat testing procedures for lumen output, lumen depreciation, and lifetime
- Will apply to reflector products

## Third-Party Testing and Verification

- Off-the-shelf QA testing program to ensure quality

## Mercury

- Source reductions and labeling requirements

# 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)
- Test results and product packaging are submitted prior to qualification.
- Products with multiple lifetimes (e.g. 8,000 hours & 10,000 hours)

# How does ENERGY STAR differ from the Federal Standard?



The Federal standard for CFLs was based on the ENERGY STAR criteria for CFLs – **Version 2.0.**

Efficacy Requirements for the Federal standard and the current Version 3.0 are the same.

- This is due to no changes for the efficacy requirements

For Version 4.0, efficacy requirements will increase for the following CFL types:

- Bare (fixed light output)
- Bare (dimmable or multi-level) NEW category
- Covered
  
- CFL Reflector efficacy will stay the same



# How does ENERGY STAR differ from the Federal Standard?



The following requirements are included within the ENERGY STAR criteria, but not within the Federal Standard:

- Correlated Color Temperature (CCT)
- Color Rendering Index (CRI)
- Start Time
- Run-up Time
- Power Factor
- Electromagnetic & Radio Frequency Interference
- Transient Protection
- Warranty
- Packaging Requirements

Since the Federal standard does not include the key performance parameters – CCT, CRI, start time, run-up time, and power factor – the quality of the products that meet just the Federal standard will be much lower than those that can meet the ENERGY STAR criteria for CFLs – Version 3.0 or 4.0.

# Why are ENERGY STAR qualified CFLs superior to non-qualified models?



- Qualified CFLs' performance parameters are verifiable; non-qualified CFLs are not
- Qualified CFLs are required to be tested at a NVLAP-accredited laboratory (through NIST)
  - Initial Lumen Output
  - Lumen Maintenance
  - Start-up time
  - Run-up time
  - Color
  - Also subject to off-the-shelf (PEARL) testing
- Qualified CFLs have packaging review

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# ENERGY STAR Quantity Quotes



Connecting large-quantity buyers with suppliers of energy-efficient products

- Light bulbs (CFLs)
- Light fixtures
- Clothes washers
- Dehumidifiers
- Dishwashers
- Refrigerators
- Room AC

Register at [energystar.gov/QuantityQuotes](https://energystar.gov/QuantityQuotes)

# ENERGY STAR Quantity Quotes



Here's how it works:

1. Purchaser submits a purchase request to suppliers through the Web site
2. Interested suppliers respond to the purchaser through the Web site
3. Purchaser follows up with suppliers and chooses one to negotiate a contract with

Register at [energystar.gov/QuantityQuotes](https://energystar.gov/QuantityQuotes)

# ENERGY STAR Quantity Quotes



## Benefits:

- Save time
- Save money
- Get the right product
- Keep your contact information private

Register at [energystar.gov/QuantityQuotes](https://energystar.gov/QuantityQuotes)

# Questions?



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[www.energystar.gov](http://www.energystar.gov)  
[www.energystar.gov/cfls](http://www.energystar.gov/cfls)