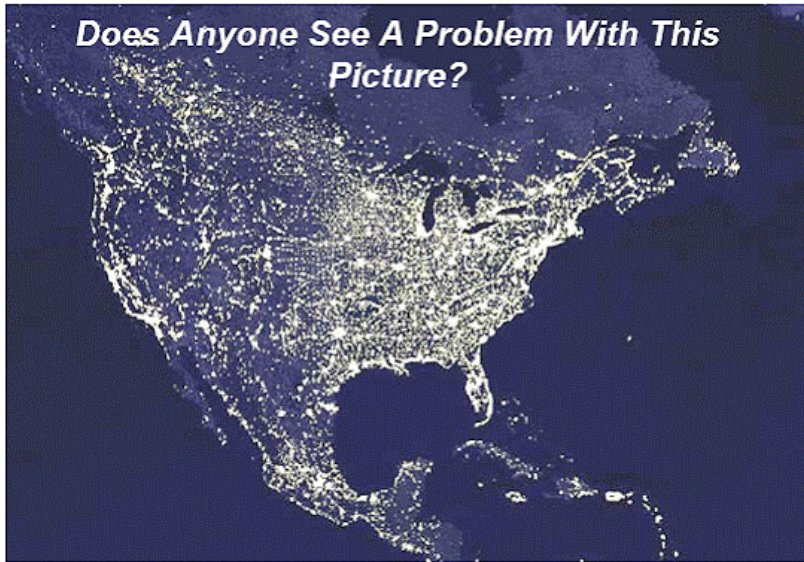


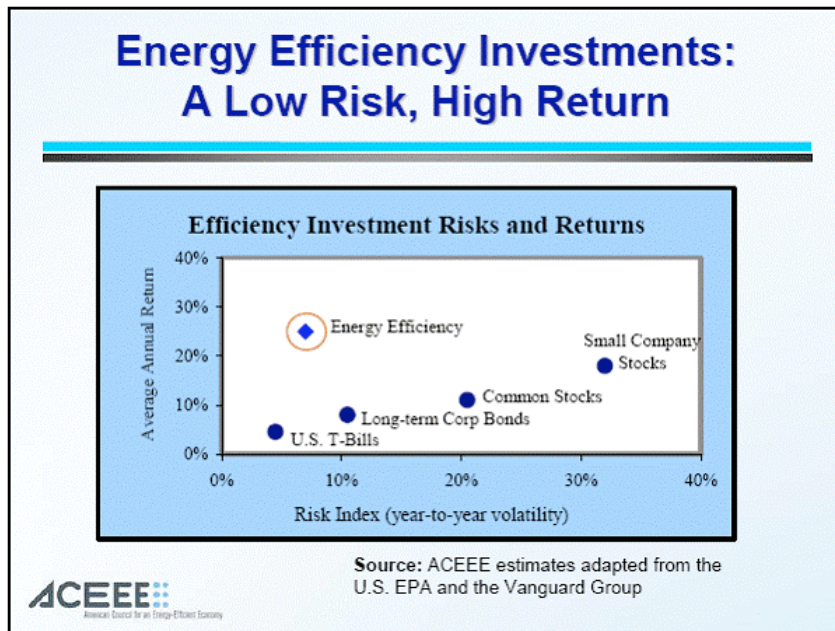


Lighting Design & Redesign for Energy Efficiency  
Certified Lighting Efficiency Professional  
[steve.heising@sunwavelighting.net](mailto:steve.heising@sunwavelighting.net)  
Steve Heising, MBA, CLEP 303-581-9296



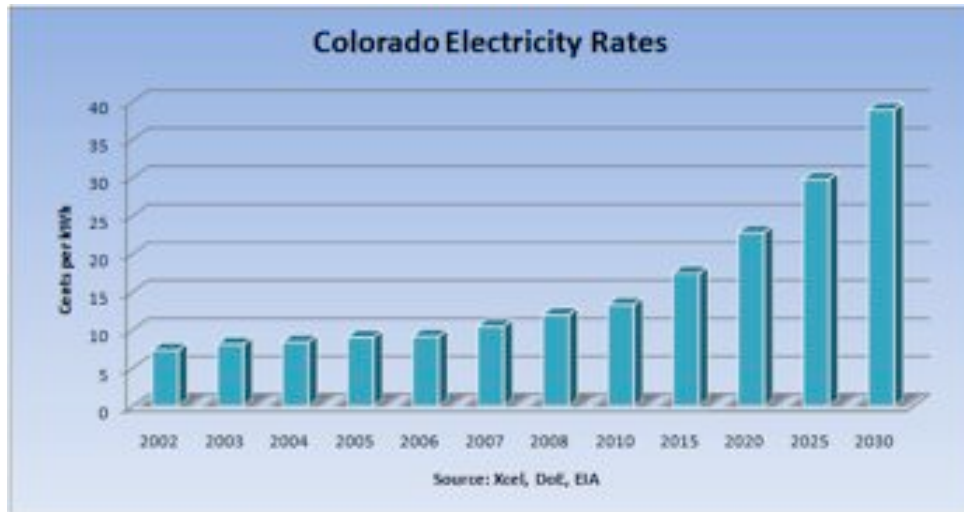
# Lighting Efficiently

LOW RISK HIGH RETURN. Fruit on the Ground.

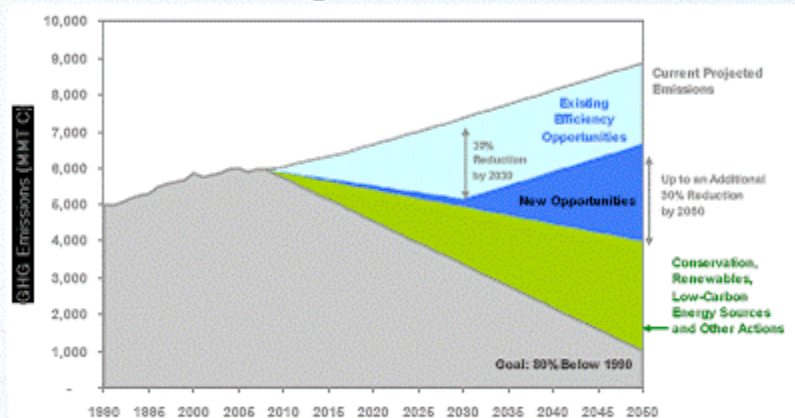


# Electricity Costs Are Going Up

- By 2020 were going to be paying 22cents a kWh. Much of CA and NY pay that now.

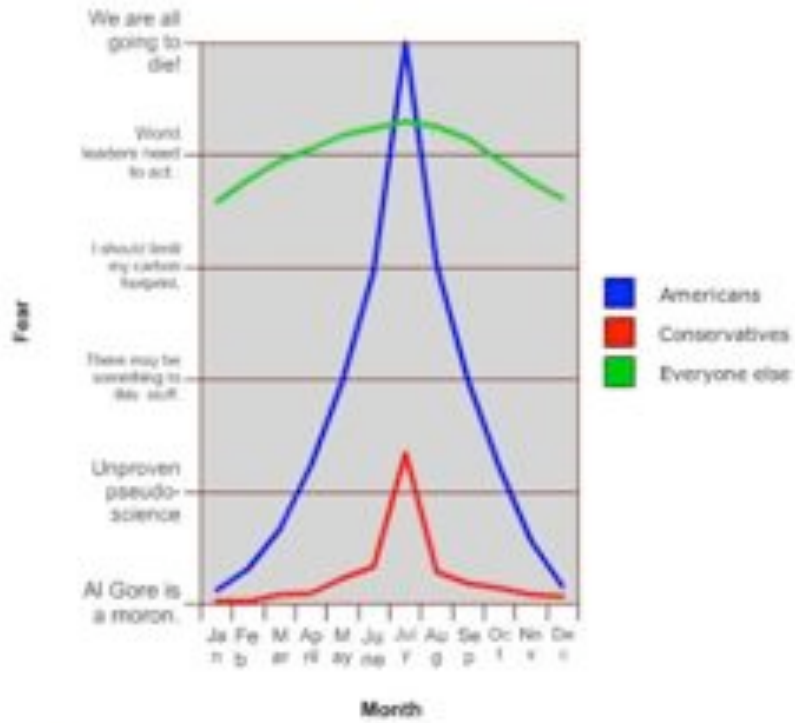


## Role of Efficiency in Addressing Climate Change in the U.S.



Note: This graph is stylized and is not exact.

### Popular Thoughts about Global Climate Change

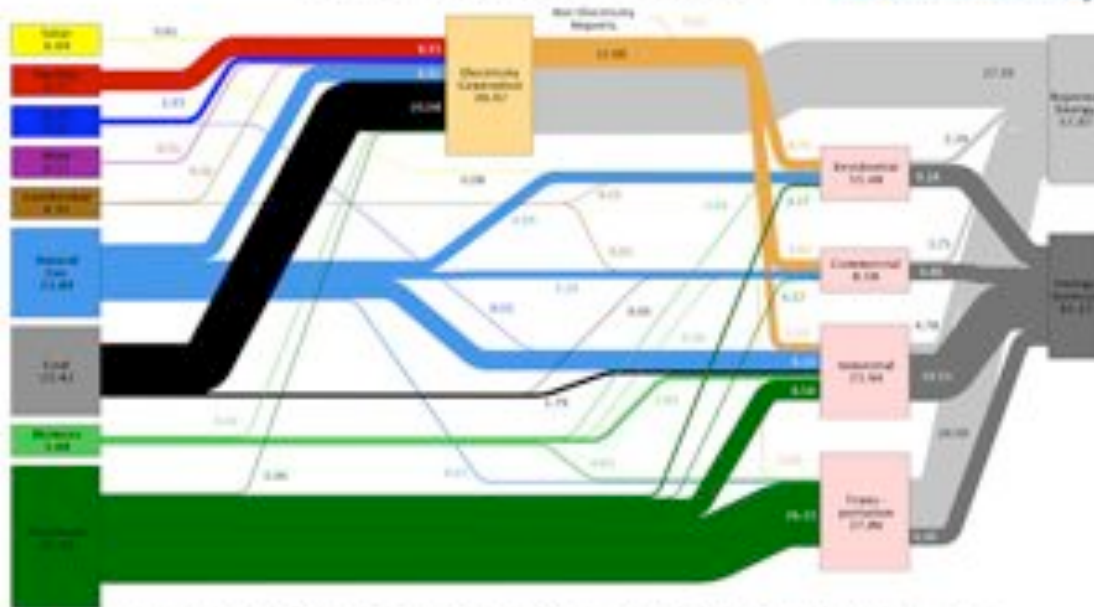


GraphJam.com

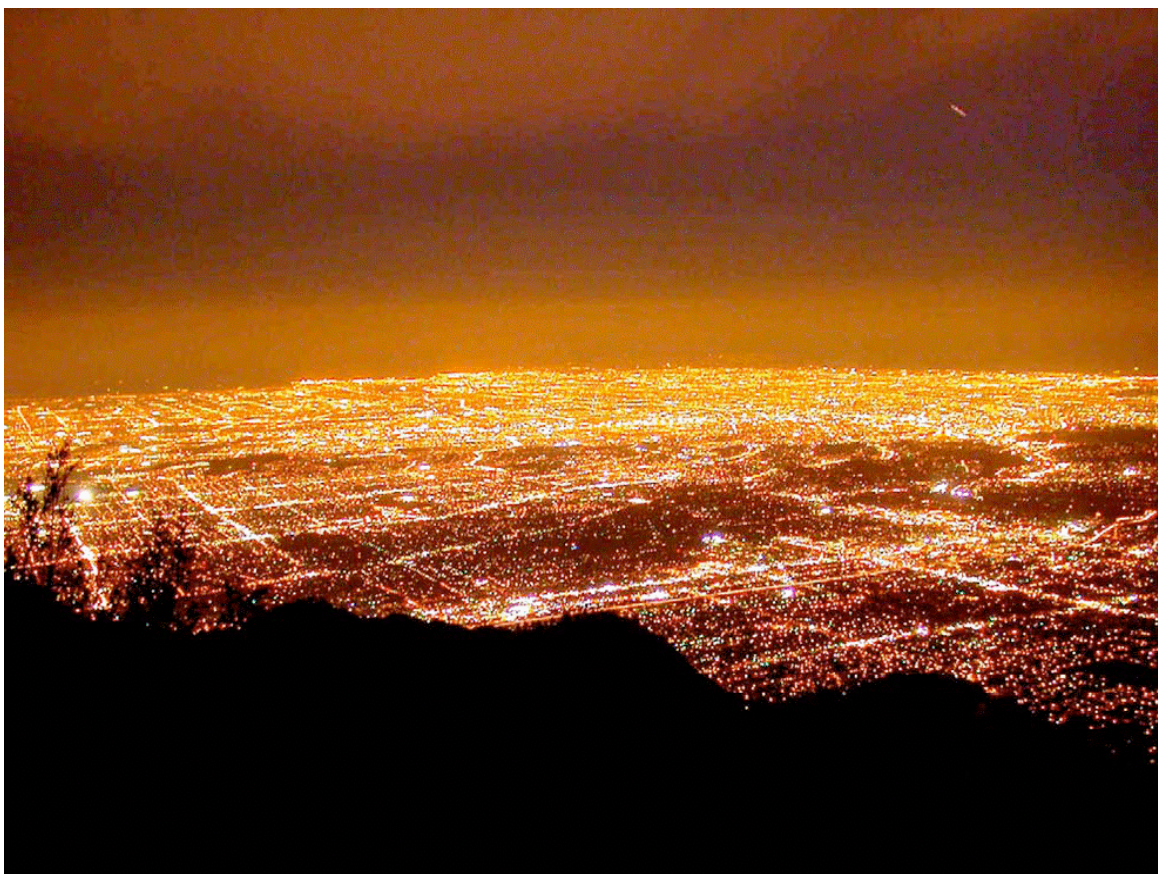
When Will it be Ice Free ?



Estimated U.S. Energy Use in 2008: ~99.2 Quads



Source: EIA, 2009. Data is based on EIA's 2008 Annual Energy Review. Data is presented as a composition of 100 units, which does not equal 100 due to rounding. The Lawrence Livermore National Laboratory is a U.S. Department of Energy office. The work was performed by Lawrence Livermore National Laboratory under contract number DE-AC02-04OR21400 for the U.S. Department of Energy. The Lawrence Livermore National Laboratory is a U.S. Department of Energy office. The work was performed by Lawrence Livermore National Laboratory under contract number DE-AC02-04OR21400 for the U.S. Department of Energy. The Lawrence Livermore National Laboratory is a U.S. Department of Energy office. The work was performed by Lawrence Livermore National Laboratory under contract number DE-AC02-04OR21400 for the U.S. Department of Energy.



## Energy Efficiency

Bottom Line Opportunities for Metro Denver Companies  
June 2006



Metro Denver  
Economic Development Corporation

www.metrodenver.org

Figure 1  
Colorado Energy Consumption by Sector

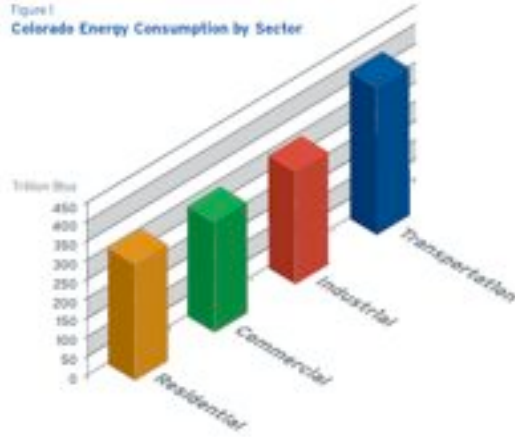
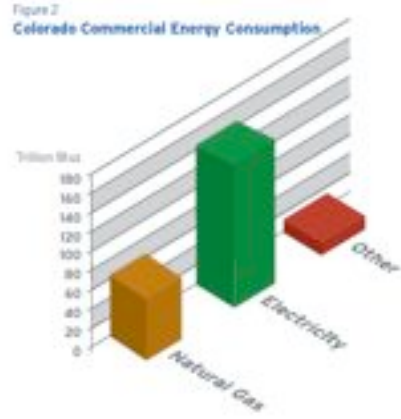


Figure 2  
Colorado Commercial Energy Consumption



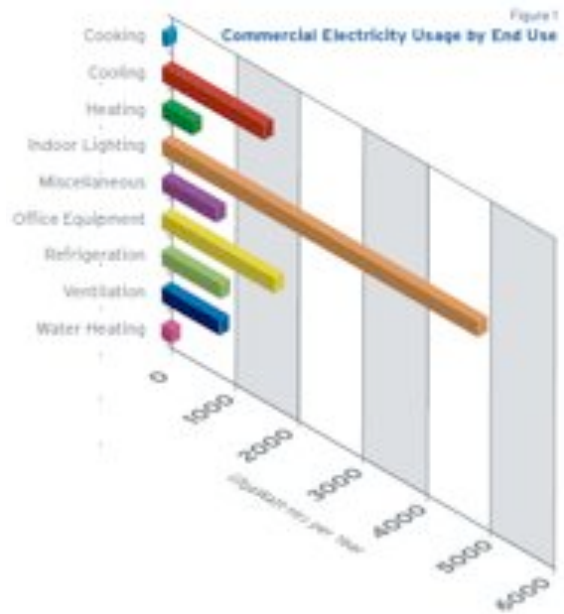
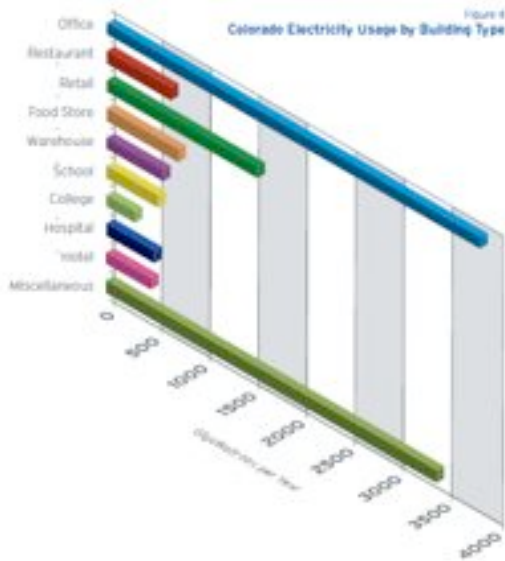
## Energy Efficiency

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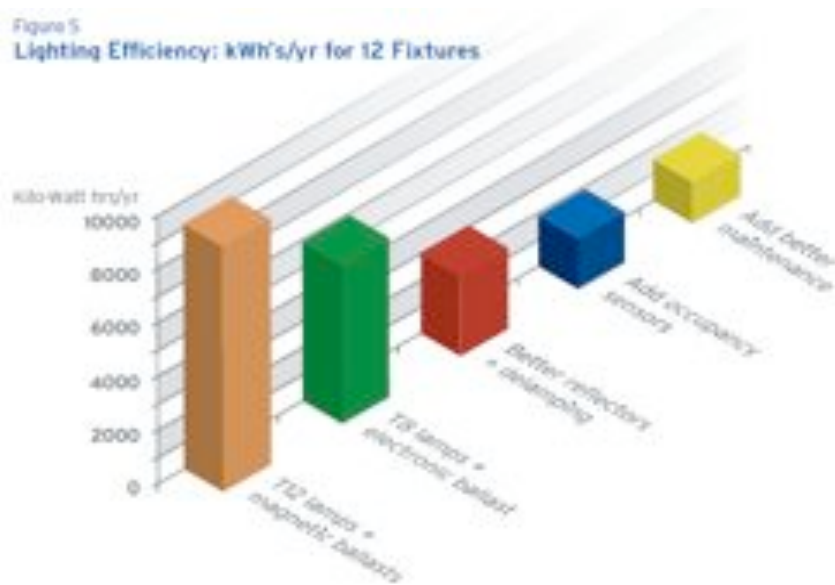


## Energy Efficiency

Bottom Line Opportunities for Metro Denver Companies  
June 2006



Figure 5  
Lighting Efficiency: kWh's/yr for 12 Fixtures



## What Color Light is the Right Color Light?

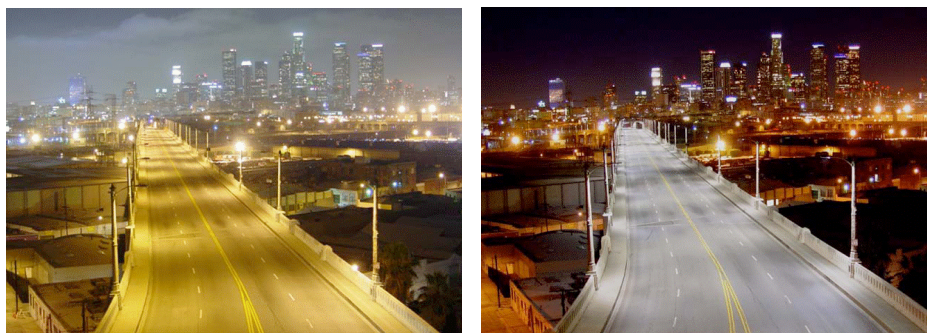


## What Color is that LED?



Color shift is a big issue with LED's. MSI LEDs are warranted for 5 years against color shift. Is your LED?

## LPS vs LED? Which Light is Right at Night?

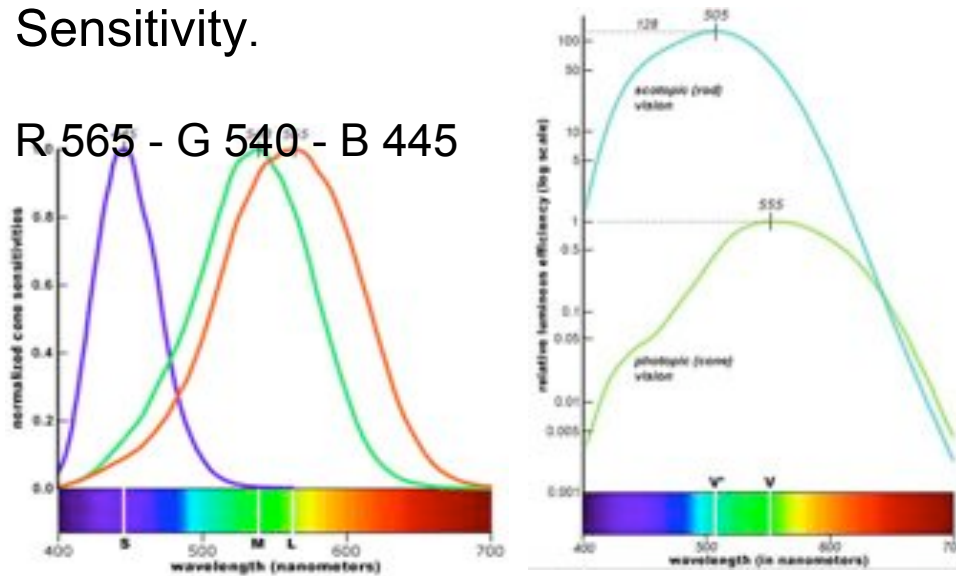


If lumens were all that is important, we would all use low pressure sodium lights.

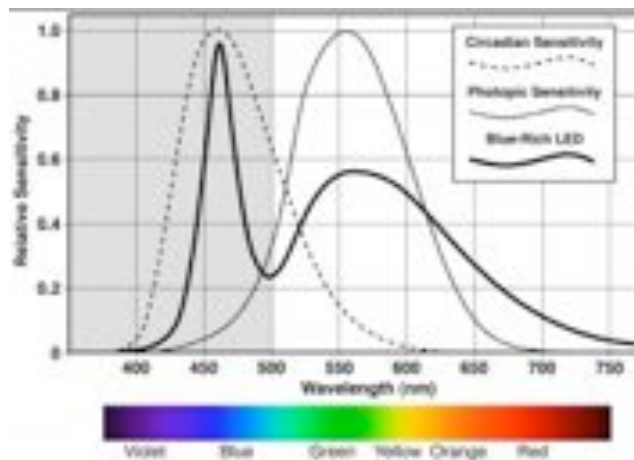
So how can a lighting system be sustainable if it does not account for energy and the effects on all three human visual systems?

The Human Eye has Photopic 555 Nm (Cones) and Scotopic 505 Nm (Rods) Sensitivity.

R 565 - G 540 - B 445



There is More Going on than Simply Lumens and Foot Candles on the Work Surface.



The eye has Photopic 555nm, Scotopic 505nm, and Cirtopic 460nm receptors. Lumens and footcandles addresses only one visual system. Note that all three systems are most sensitive to different wavelengths.

# Energy Efficiency Pyramid



# The New FTC Lighting Facts Label

Lighting Facts		Per Bulb
Brightness	820 lumens	
Estimated Yearly Energy Cost	\$7.23	
Based on 3 hrs/day, 11¢/kWh Cost depends on rates and use		
Life	1.4 years	
Based on 3 hrs/day		
Light Appearance	Warm ————— Cool 2700 K	
Energy Used	60 watts	

Lighting Facts		Per Bulb
Brightness	870 lumens	
Estimated Yearly Energy Cost	\$1.57	
Based on 3 hrs/day, 11¢/kWh Cost depends on rates and use		
Life	5.5 years	
Based on 3 hrs/day		
Light Appearance	Warm ————— Cool 2700 K	
Energy Used	13 watts	
<b>Contains Mercury</b>		
For more on clean up and safe disposal, visit <a href="http://epa.gov/cfl">epa.gov/cfl</a> .		

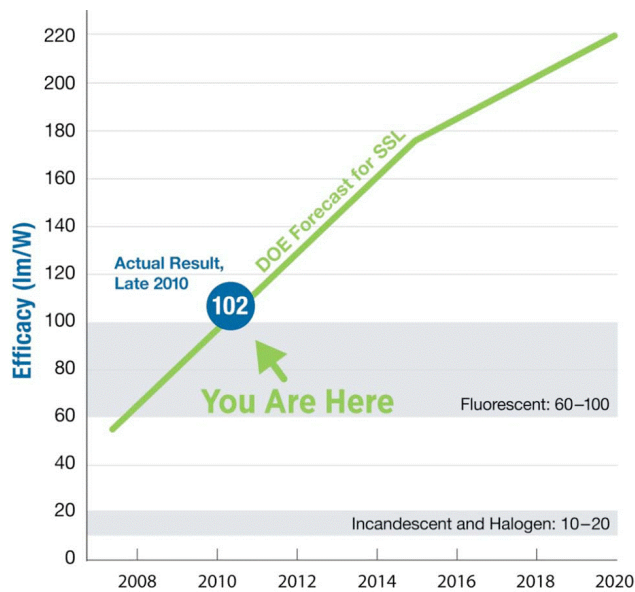


New Back Label for Bulbs Containing Mercury

# Is Not to be Confused With the New DOE Lighting Facts Label



## Is the future of Lighting LEDs?



Source: DOE SSL R&D Multi-Year Program Plan



Meet the Array LED Lamp Line.  
[Learn More](#)



**SAVE ENERGY**  
• Only uses 11 Watts  
• Replaces 75W

**SACRIFICE NOTHING**  
• 90 CRI  
• 2700K

**Cree LRP-38™**  
The PAR-38 replacement.



INTRODUCING THE **IPAR-38™**  
WITH **POWERBAND™** TECHNOLOGY

**\$35 XCEL ENERGY REBATE**



## LED's Made Right Here in Boulder, Colorado USA

### Albeo Technologies

100 system lumens per watt.

Made in Boulder

See what the future is going to look like at Natural Grocers in Longmont.

The Future is so Bright you Got to Have Shades.

Would you like it less bright.? Me too...

Highbay Demo 240 Watts.



# Self Powered Wireless Controls No Batteries - No Wires



**WIRED VS. WIRELESS COSTS**



- Parts
- Re-Paint
- Labor
- Drywall Patching

## Implement Basic Efficiency First

Use High Lumen 32 watt lamps and CEE Listed Ballasts for Longest Life and Most End of Life Lumens per watt.

## Then Add Controls. Occ Sensors - DLH

Account for Diminishing Returns, You can't do better than off.

## Remember the KISS Rule Applies ...

Particularly WRT Lighting Controls

## Lifecycle Cost Assessment - Navigant Consulting

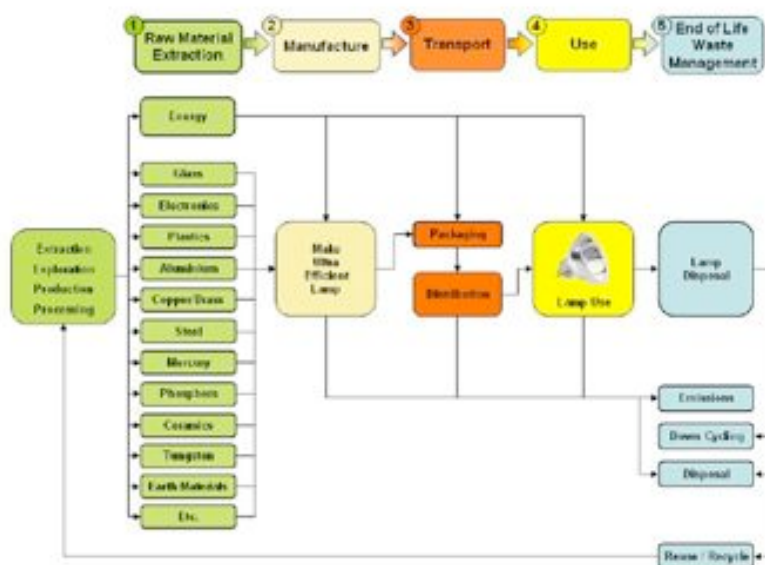


Figure 1.2 Life Cycle Assessment Flow Diagram for a Generic Lamp

## Lifecycle Cost Assessment - Navigant Consulting

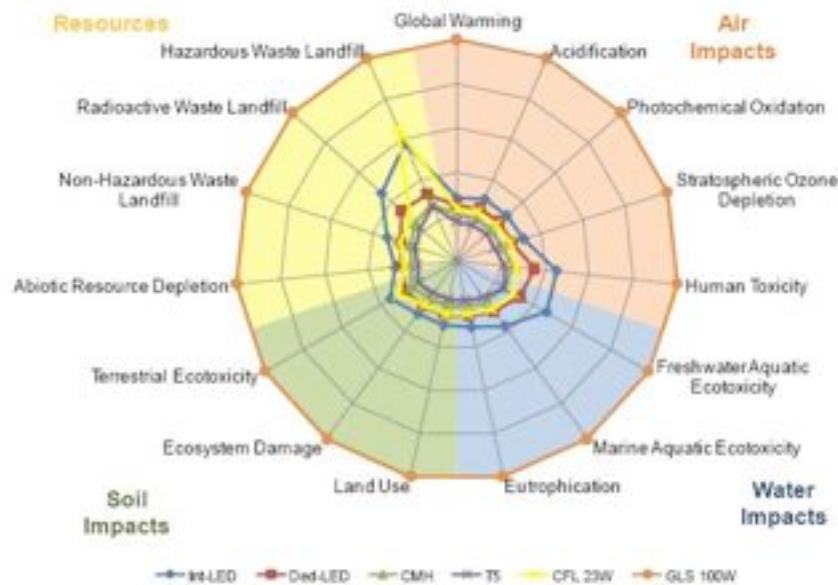


Figure ES.1 Relative Life-Cycle Assessment Impacts of the Lamps Analyzed

## What is it about Daylight?

- Daylight is thought to increase sales 40%, test scores 10 15 % and generally improve productivity. Heschong Mahone Group.
- Marianna Figeroa et. al. LRC 2010 finds that daylight affects circadian rhythms. Also significant is that electric light can do the same thing for those that do not have windows. However, just because your kids school has enough light to read, this does not mean you have enough light to set your kids biological clocks. Teenagers staying up later and later had clocks were found to be 1/2 to 1 hour slow. Bright daylight or simulated daylight especially early in the day was found to move clocks earlier. This potentially explains how daylighting improves test scores... Kids are awake!
- Are your kids hard to wake up in the morning?

## Thank you to BGBG – Questions?

- **Albeo technologies** Industrial Strength Solid State Lighting
  - LED's made right here in Boulder, Colorado USA)
- **Axis Technology.** Daylight harvesting ballast system.
  - Each ballast has an integrated photocell
  - Headquartered in Omaha Nebraska moving production back from China.
- **Easylite** Frequency Modulated Dimming
  - Low voltage controls including wireless.
  - Headquartered here in Boulder
- **Orion Energy Systems** GE lamps ballasts
- **Switch Genie** “Brains in the Ballast” You can't do better than off
  - Now made in Minneapolis, Minnesota.
  - Simple SPST wall switch to existing building automation system.
- **Luxim – LEP Light Emitting Plasma.**
- **www,.SunwaveLighting.NET**
  - Vendor Neutral Lighting Systems Integrator.
  - CLEP from AEE, Xcel Trade Advisory Board - BGBG.
  - Spectrally Enhanced Lighting
  - Retrofits Rebates Results!

Last one to leave . . .  
Please turn out the lights.

