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Lighting for a Sustainable Future

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Acknowledgments

- ◆ The Illuminating Engineering Society of North America
 - The Energy Management Committee
 - ASHRAE Committee 90
- ◆ The International Dark Sky Association
- ◆ The California Energy Commission
 - Title 24 Building Energy Efficiency Standards
 - The PIER projects
- ◆ The Northwest Energy Efficiency Alliance
 - Better Bricks
- ◆ The California Lighting Technology Centers at UC Davis and Edison CTAC
- ◆ California Utilities
 - Sacramento Municipal Utility District
 - Pacific Gas & Electric
 - Southern California Edison
 - San Diego Gas and Electric
- ◆ The California Collaborative for High Performance Schools
- ◆ The Energy Center of Wisconsin
- ◆ The Consortium for Energy Efficiency
- ◆ The New Buildings Institute
 - The Advanced Lighting Guidelines
 - The Advanced Building Guidelines
- ◆ The Lighting Research Center
- ◆ US DOE

A Centennial Carol

The Ghost of IESNA Past

- ◆ A promising youth
- ◆ Challenges along the way
- ◆ But ultimately, a direction towards consumption and carelessness



A Centennial Carol

The Ghost of IESNA Present

- ◆ Our time to look at who and what we've become
- ◆ An opportunity to change



A Centennial Carol

The Ghost of IESNA Future

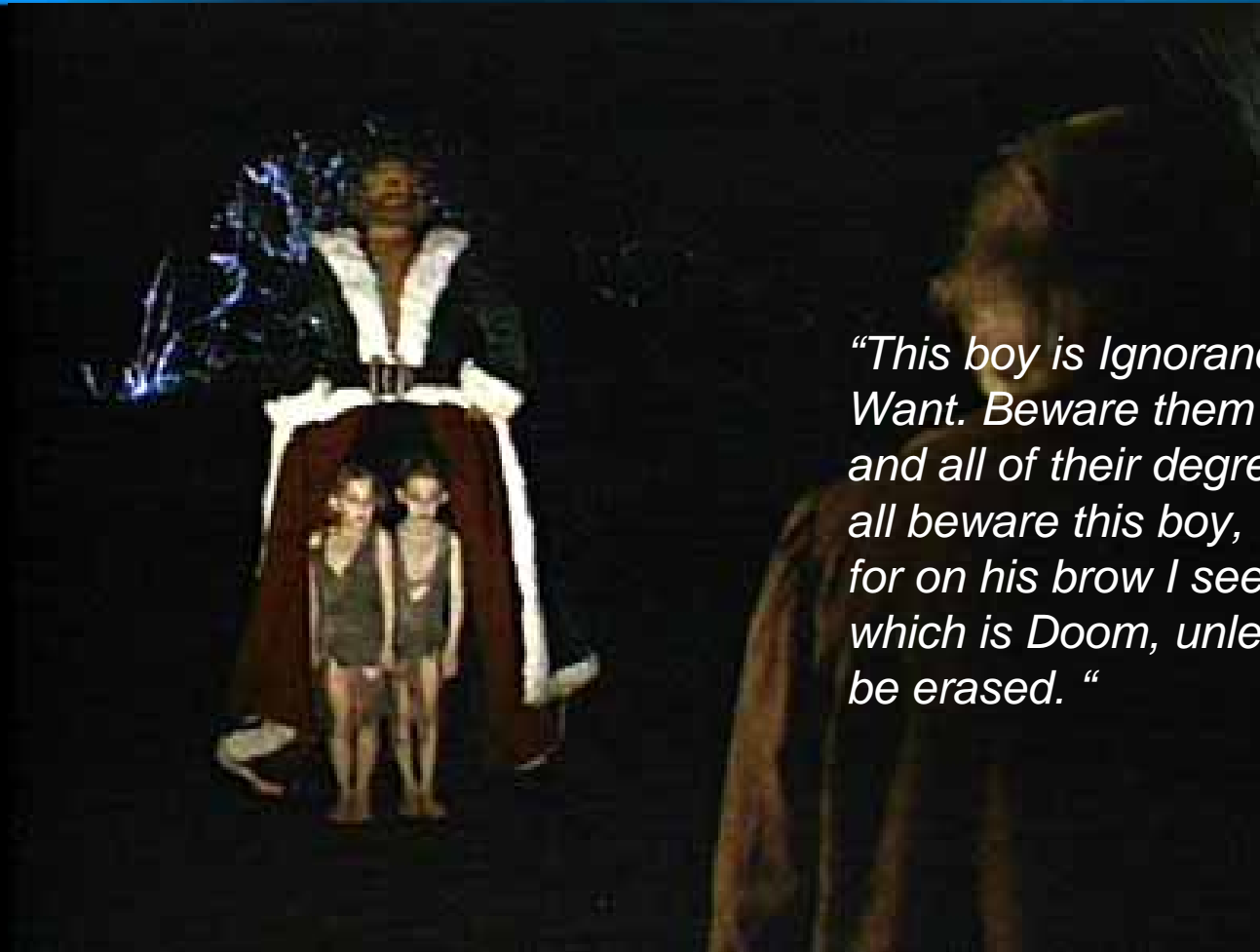
- ◆ A chance to see our possible futures
- ◆ Enabling us to make decisions to change the outcome



IESNA Past

- ◆ An age of discovery
- ◆ An age of wonder
- ◆ Necessary contributions to the functionality of the built environment
- ◆ Creative contributions to the enjoyment of life





“This boy is Ignorance. This girl is Want. Beware them both, and all of their degree, but most of all beware this boy, for on his brow I see that written which is Doom, unless the writing be erased.”

Without blaming ourselves too much, we've been careless about the negative impacts of lighting, driven often by the demands of society and commerce.

IESNA Present

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The options

1. Stay the course.
2. Foresee the future and change the course.



The Course of Sustainability

Can this course become the foundation of future IESNA philosophy, standards development, design guides, technical memoranda, Recommended Practices, and the Handbook?

How much must we change?

What must we learn?

How quickly must we act?



Key Ways in Which We Must Change Soon

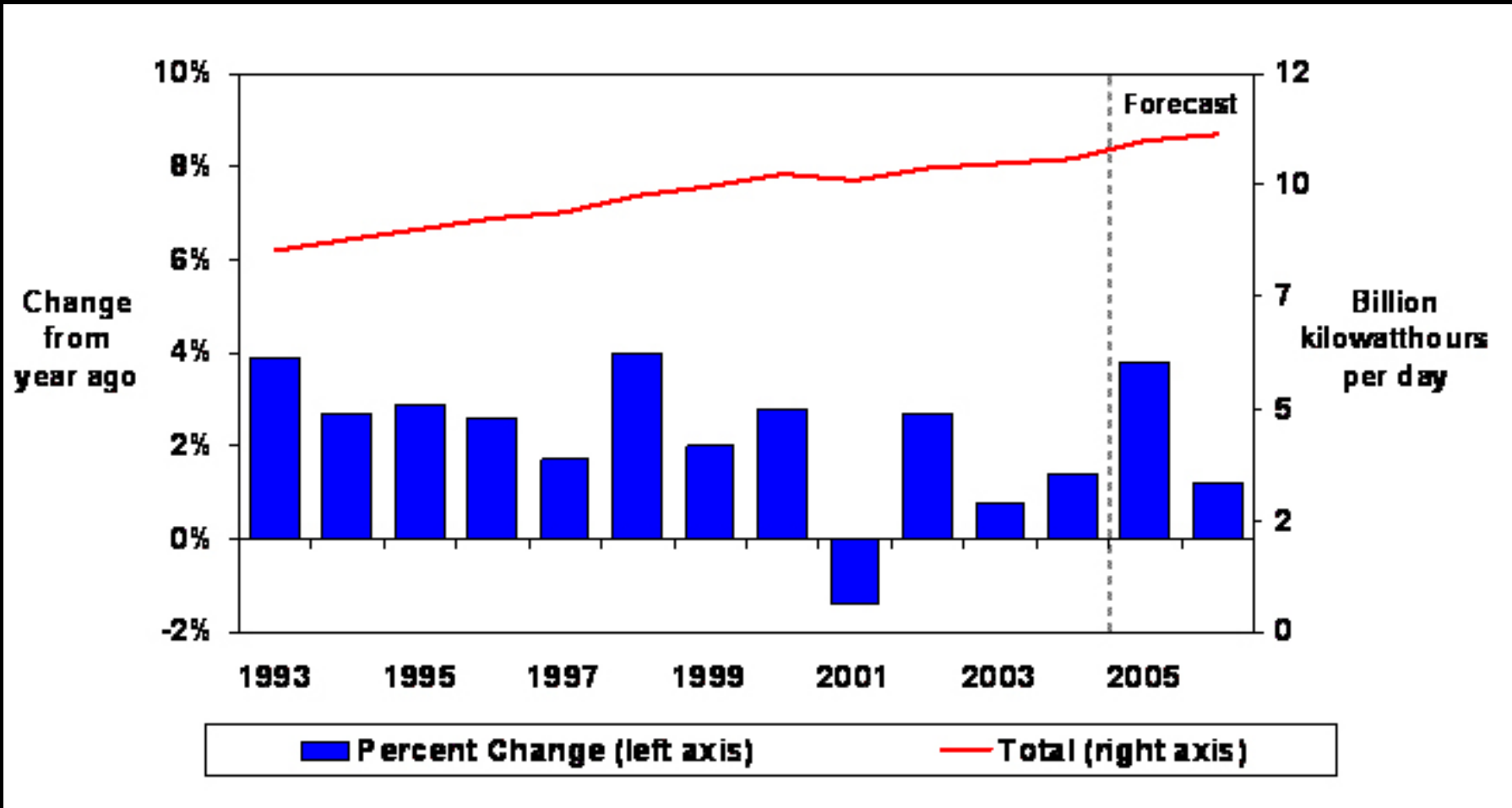
- ✦ Significantly reduce our use of energy
- ✦ Dramatically improve how we use materials and other resources to provide the world with light
- ✦ Learn much more about the relationship of light to living organisms
- ✦ Overcome a century of carelessness and return the night sky
- ✦ Develop, promulgate and maintain all new standards, especially relative to energy efficiency and sustainable building.

Sustainability = Energy

- ✦ Lighting consumes about 25% of all electric energy use in the US
 - 70% of all electric generating capacity comes from fossil fuel sources
 - Directly affects greenhouse gases
 - Directly affects airborne pollutants
 - 20% of electric capacity comes from nuclear
 - 10% comes from hydro and renewables
 - Diverts power from other uses
- ✦ Lighting contributes significantly to peak demand and blackout issues

Reducing Energy Use

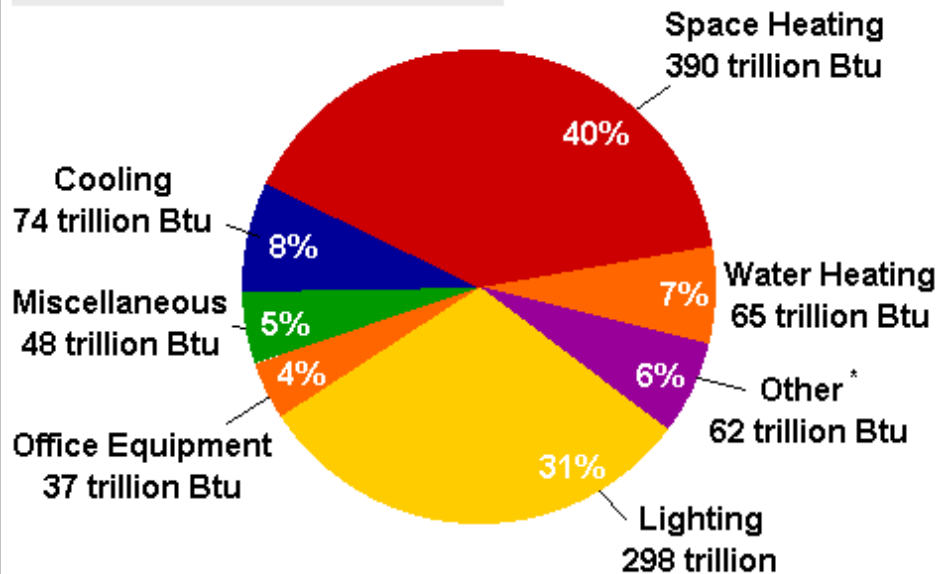
Currently, electric energy use is growing at a rate of 2-3% per year (DOE, 2005)



Reducing Energy Use

Lighting is one the largest consumers of electric energy (DOE, 2000)

SITE ENERGY USE IN RETAIL AND SERVICE BUILDINGS
972 trillion Btu

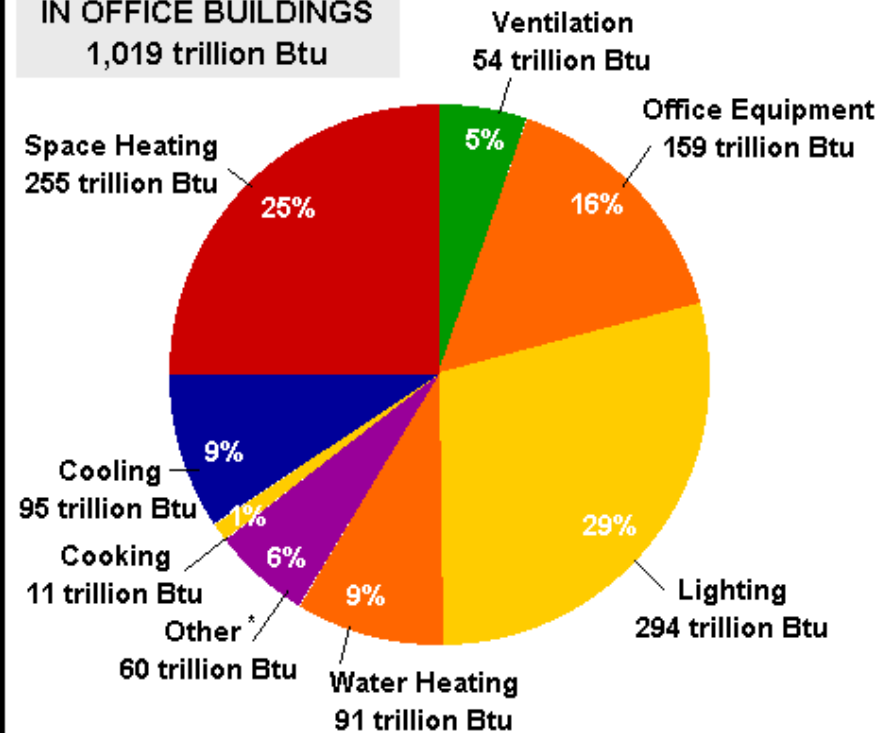


* Other includes ventilation (31 trillion Btu), cooking (20 trillion Btu), and refrigeration (11 trillion Btu).

Note: Due to rounding, individual figures may not sum to totals.

Source: Energy Information Administration, 1995 Commercial Buildings Energy Consumption Survey.

SITE ENERGY USE IN OFFICE BUILDINGS
1,019 trillion Btu

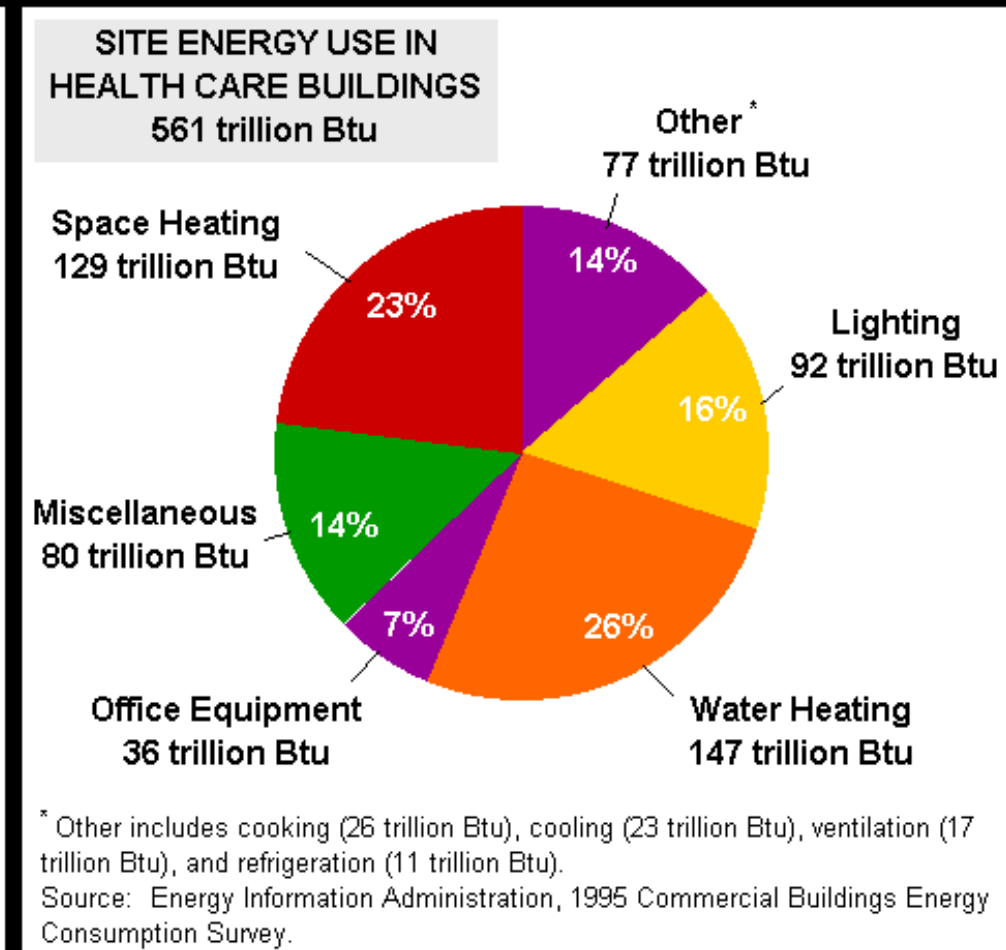
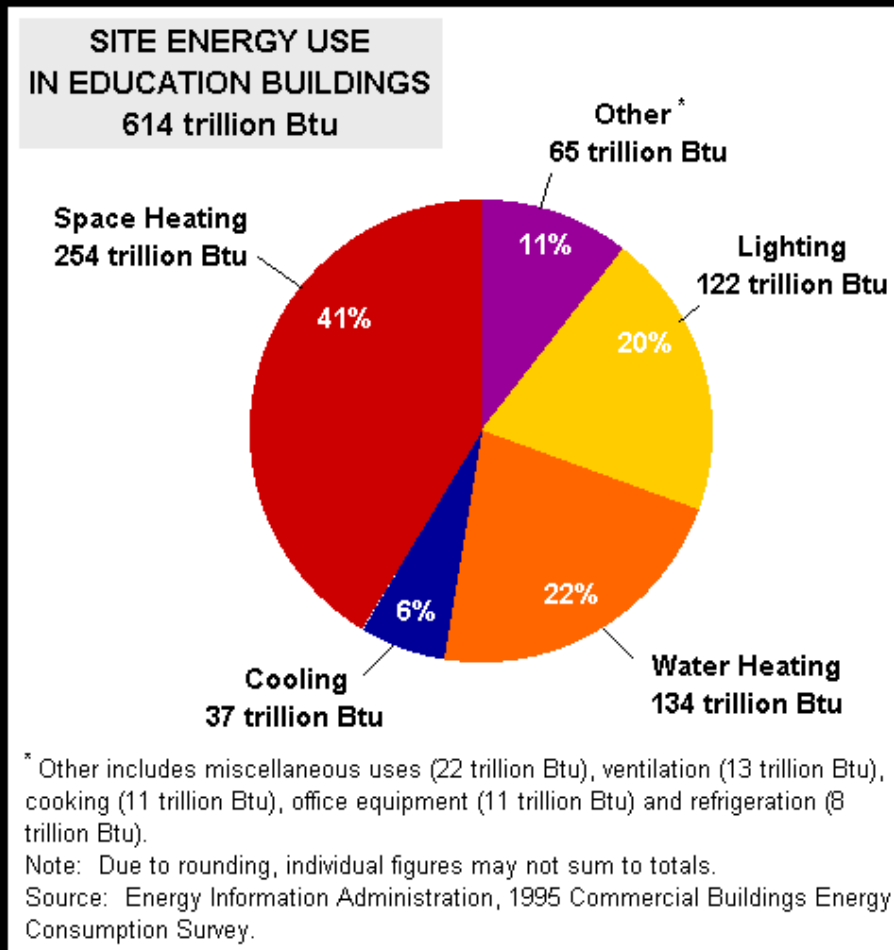


* Other includes miscellaneous uses (55 trillion Btu) and refrigeration (5 trillion Btu).

Source: Energy Information Administration, 1995 Commercial Buildings Energy Consumption Survey.

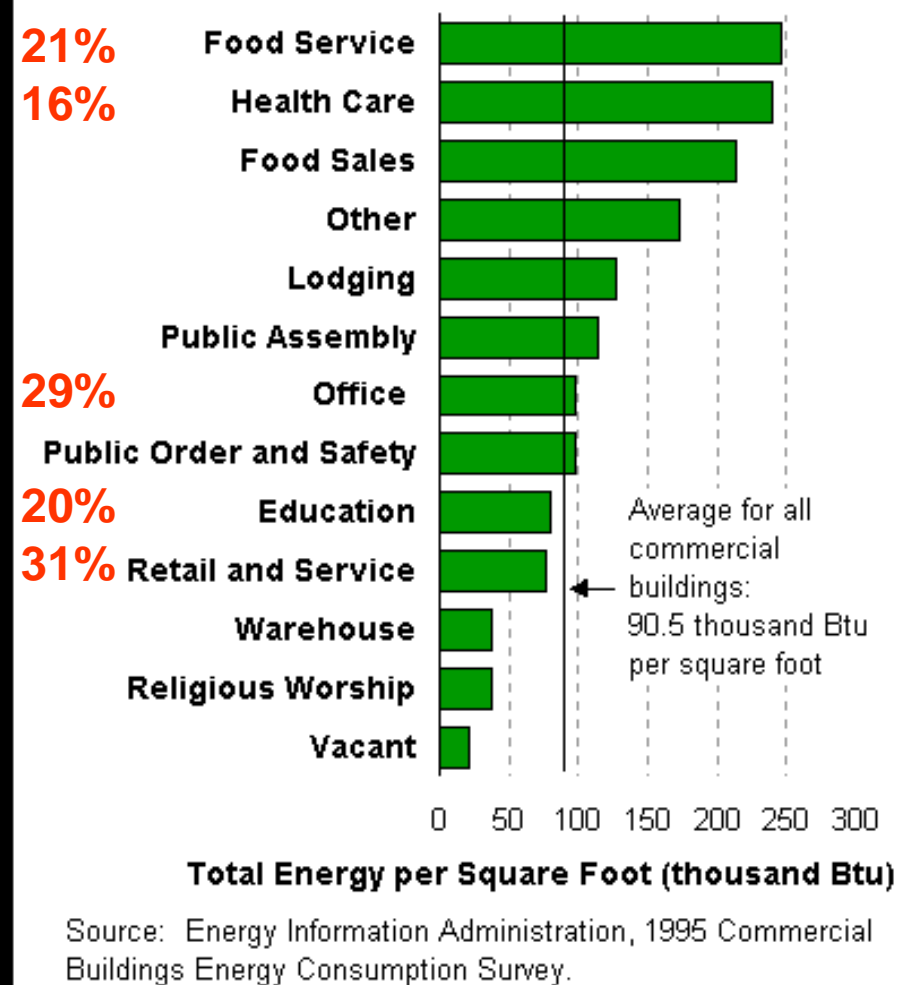
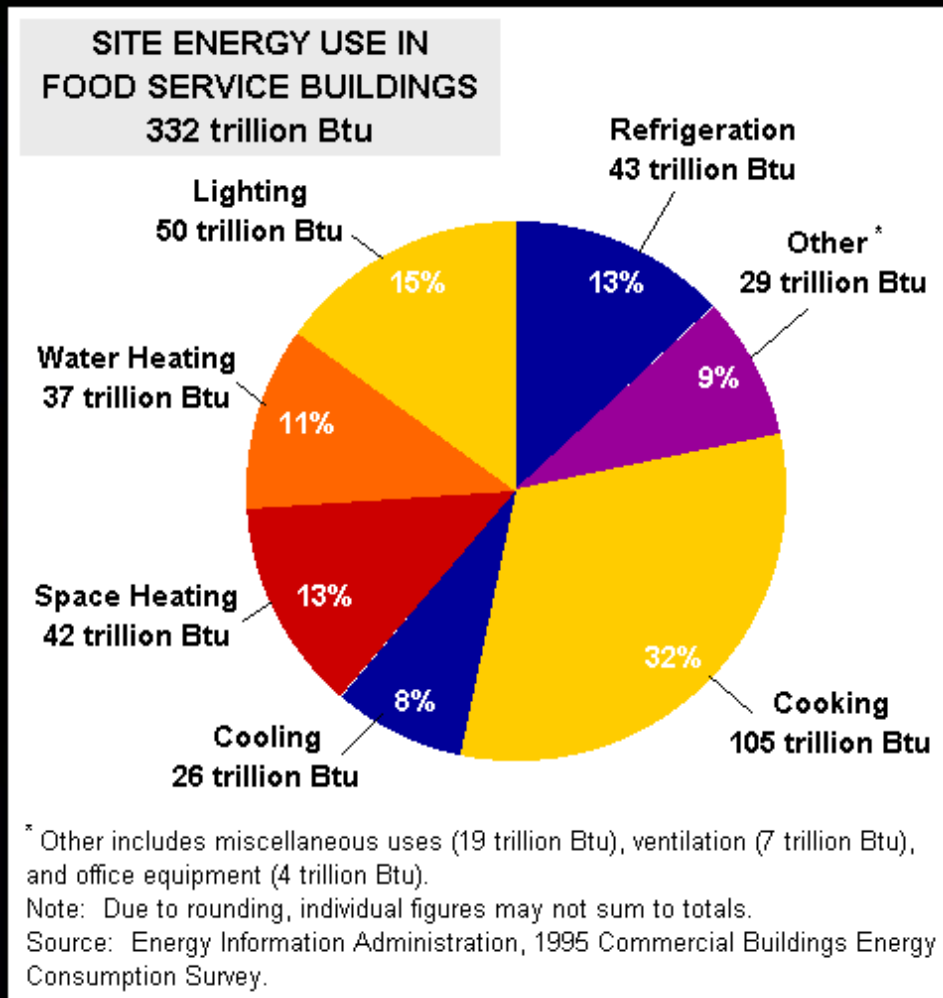
Reducing Energy Use

Lighting is one the largest consumers of electric energy (DOE, 2000)



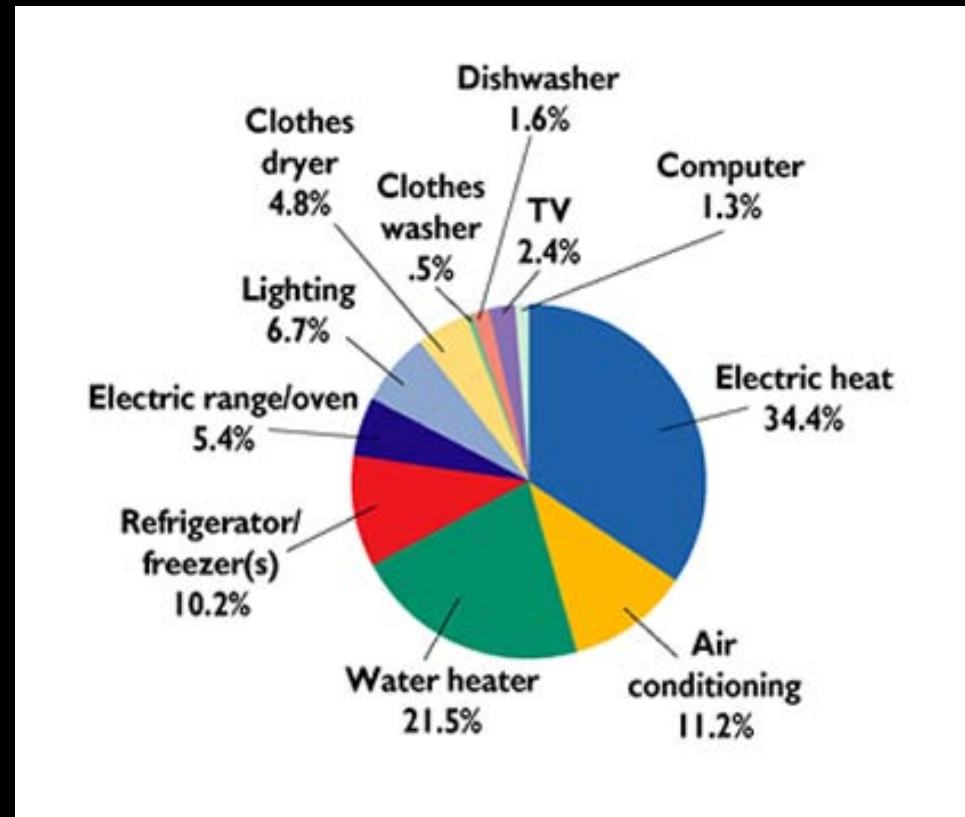
Reducing Energy Use

Lighting is one the largest consumers of electric energy (DOE, 2000)



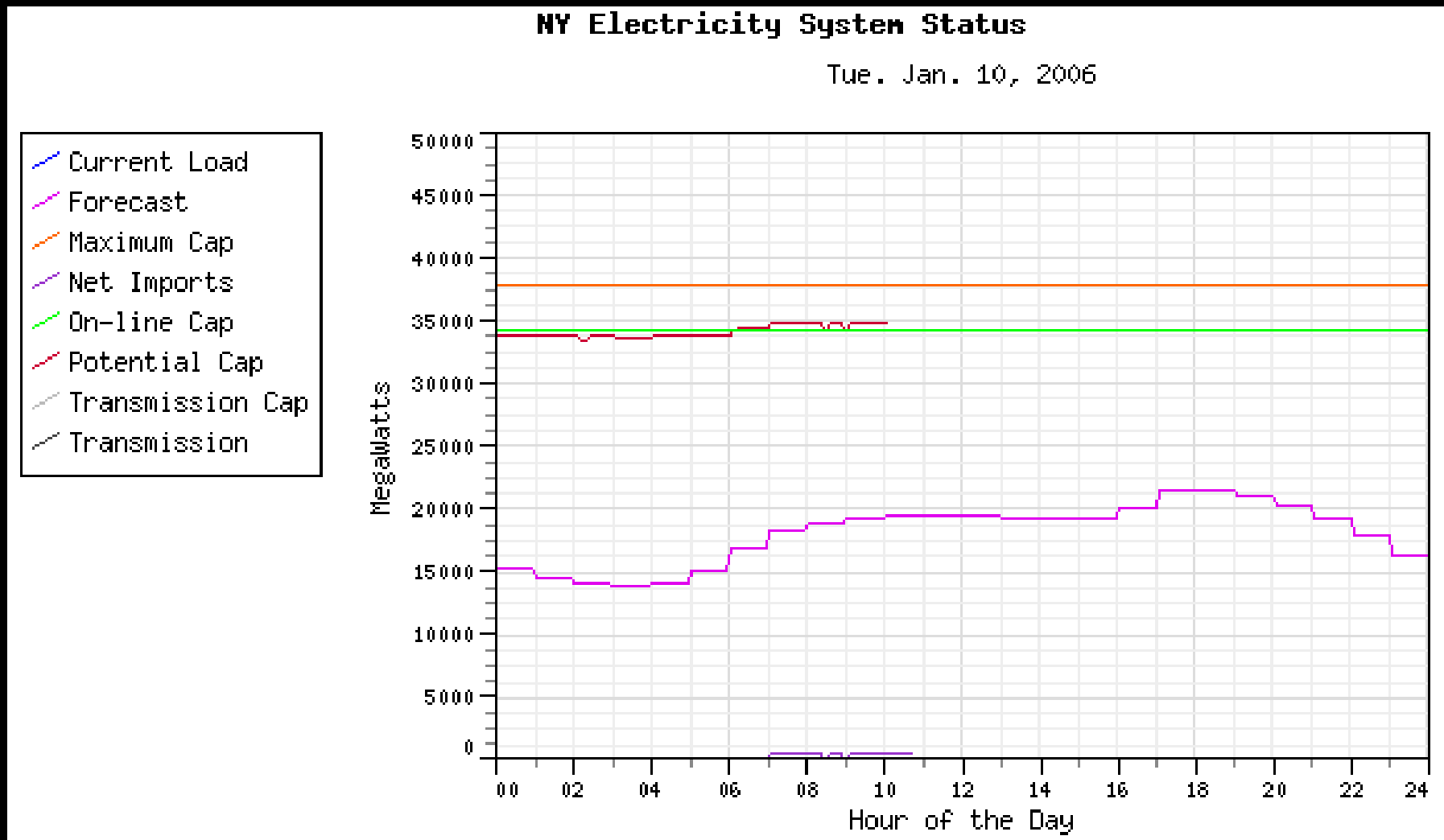
Reducing Energy Use

Residential Lighting Energy Use is Modest (California PIER, 2003)



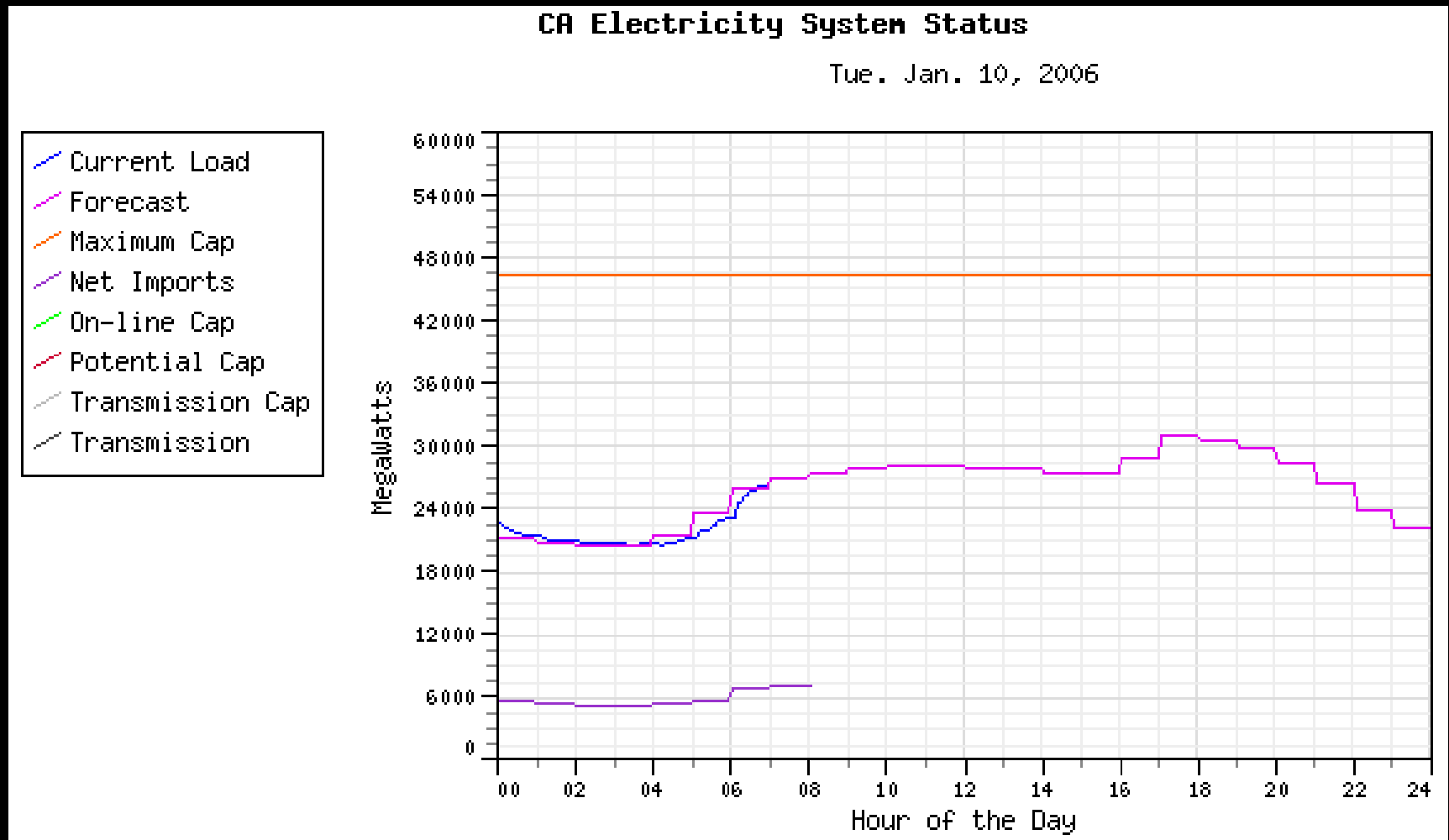
Demand is the Issue

When the peak exceeds the cap, blackouts take place



Demand is the Issue

Capacity can be added late and fast, but with a significant cost financially and environmentally



Lighting's Issues

- ✦ A significant reduction in average lighting power density has occurred since 1973 in most sectors
 - Office LPD has decreased from 4 w/sf in 1973 to 1 w/sf in 2005
 - Electric lighting percentage has dropped in most other sectors as well
 - However, the net change of the daily demand curve has not been dramatically altered
- ✦ Electric lighting in all sectors tends to increase use coincident with demand

Sustainable Opportunities

1. Take major steps to develop daylighting as a **preferable** light source.
2. Help accelerate the development and use of advanced integrated controls.
3. Work to comprehensively reduce lighting power use.
4. Develop and teach new methods for better use of energy.
5. Cease to reward blatant energy wasting applications.



Sustainability = Using Fewer and Better Materials

Materials of tomorrow

- ◆ “Cradle to cradle” thinking
 - Recycle
 - Restore and renovate
 - Retrofit
- ◆ Good Materials
 - Low inherent energy
 - Easy recycled
 - Minimal environmental drawbacks
- ◆ Bad Materials
 - Single cycle then trash
 - High inherent energy
 - Toxic

Lighting's Issues

- ✦ Heavy dependence on oil-based materials
 - Acrylic
 - Thermoplastics
- ✦ Mercury containing lamps
- ✦ PCB containing ballasts
- ✦ Electronics containing a variety of pollutants
 - Lead
 - Mercury
- ✦ Considerable by-products
 - Spent lamps
 - Short life luminaires

Sustainable Opportunities

1. Develop an energy efficient, non toxic, pollution free lighting technology and use it.
2. Carefully choose materials for products. Enhance and encourage those renewable or recyclable.
3. Minimize amount of lighting.
 - Reduce trash and non recycleables

Sustainability = Photobiology

Recent research findings suggest numerous lighting-related photobiological issues

Human Benefits

- Health attributable to Circadian rhythms
 - Shift work
 - SAD
 - Senior health
- Productivity attributable to lighting and daylighting
 - Heschong Mahone Group PIER findings
 - Light Right business productivity findings
- Clinical Uses
- ✦ Impacts on other Living Creatures
 - Positive impacts (agriculture)
 - Negative impacts (sea turtles)

Lighting's Issues

- ✦ Until the 1980's, almost no applications-oriented research.
- ✦ Rise of inaccurate, misleading and/or fraudulent lighting businesses
 - “full spectrum” lighting
- ✦ Building designs that fail to harvest healthy potential
 - Inadequate daylighting
 - Lack of views

Sustainable Opportunities

- ◆ Tie recommendations of lighting practices to photobiological benefits as they are recognized.
- ◆ Continue and fund photobiological research
- ◆ Dramatically increase the reliance upon daylighting for interior illumination



Sustainability = The Night Sky

Outdoor Lighting is a Necessity of Life



Towers and Icons



Building entrances



Streets and roads

Principal Problem: Obtrusive Light

Principal Sources of Public Complaint

- ◆ Car dealers
- ◆ Gas stations
- ◆ Sports lighting
- ◆ Wallpacks
- ◆ Floodlights



Principal Problem: Sky Glow



Los Angeles, 1908



Los Angeles, 1988

Lighting's Issues

- ✦ Uncontrollable growth
- ✦ American-style design based largely on commercial interest or risk management
 - Conspicuity
 - Safety
 - Security
- ✦ Lack of research
- ✦ Lack of care
 - Conflicts within IESNA

Sustainable Opportunities

- ✦ Halt the trends
 - Develop total lighting or energy limits and codes
 - Develop model ordinances
 - Maintain dark sky issues as part of sustainable awards like LEED
- ✦ Develop new basic research
 - Advanced dynamic visibility metrics like ETAL
- ✦ Develop new practices
 - Adaptation and environmentally based standards
 - When not to light

Sustainability is an elusive and qualitative concept. We need codes and standards to ensure that everyday practices are reasonably sustainable.

- Achieve practical goals
- Cost effective
- Have impact

Codes and Standards to Ensure Sustainability

Sustainability is generally a “less is more” approach. Many qualities of sustainability run contrary to modern standards and expectations.



Principal Codes and Standards Affecting Lighting

Energy Codes

- ASHRAE/IESNA 90.1
- IECC
- California Title 24

Lighting Codes and Ordinances

- Model Lighting Ordinance and individual ordinances

Sustainability Standards

- LEED

Energy Code Issues

- Fail to address energy/focus on power
- Continuing need to have lower values
- The process of code maintenance is questionable and not receiving appropriate scrutiny
- Generally lax enforcement
- Preference for a simple one-size-fits-all code but need for a complex tailored code
- Blatant code violations published in journals
- Lighting design awards given to non-code compliant projects
- Inability to accommodate justifiable over-the-top projects

MLO Issues

- Virgin territory
- History of poorly conceived and/or designed outdoor lighting
- History of neglect of the outdoor environment
- History of bad, locally written ordinances
- Need to prevent obtrusive light
- Need to stop wasted upward light
- Complicated by inadequate standards, limited research, and potential for significant stranded investments

Sustainability Issues

- 80 years of neglect in daylighting
- The evolution of daylighting into fashion
- Lack of IESNA involvement allowed USGBC to develop poor standards involving lighting
 - LEED-NC Dark Sky SS8 credit
 - LEED-EB Mercury Limit Prerequisite
 - LEED-NC and CI Daylighting and view Credits
 - LEED-NC, EB and CI controls credits
- Recognize LEED-AP but not LC
- The broad idea that IESNA standards are too generous

1. Invest more time and money in participating in all sustainable standards programs
 - ◆ Official participation in LEED
 - ◆ Official participation in IECC
 - ◆ Stronger research and support for 90.1
 - ◆ Renewed support for Title 24
 - ◆ Full support of the IDA/IESNA MLO task group
2. Renewed activity and importance placed on
 - ◆ Daylighting
 - ◆ Time-based energy management
 - ◆ Broad environmental considerations

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