Architecture Net Zero 2010 - Why Wait?

James R Benya PE FIES FIALD LC
BENYA LIGHTING DESIGN
Professor of Environmental Design
California Lighting Technology Center
UC Davis
Editor at Large, Architectural Lighting Magazine
(Soon to be a blogger!)

Defining "Net Zero"

- Net Zero Electricity
- Net Zero Energy
- Net Zero Carbon Footprint
- Off Grid

Net Zero Electricity

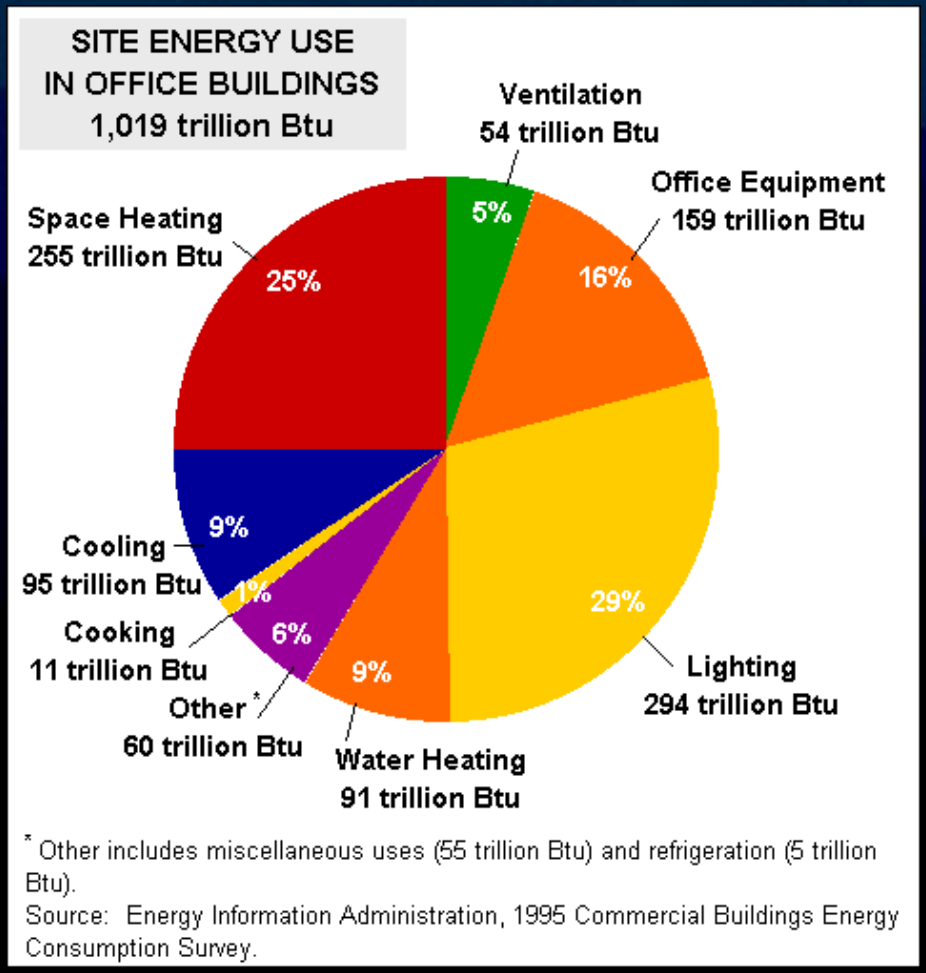
The Chartwell School, Seaside CA

- LEED Platinum
- Practical Costs

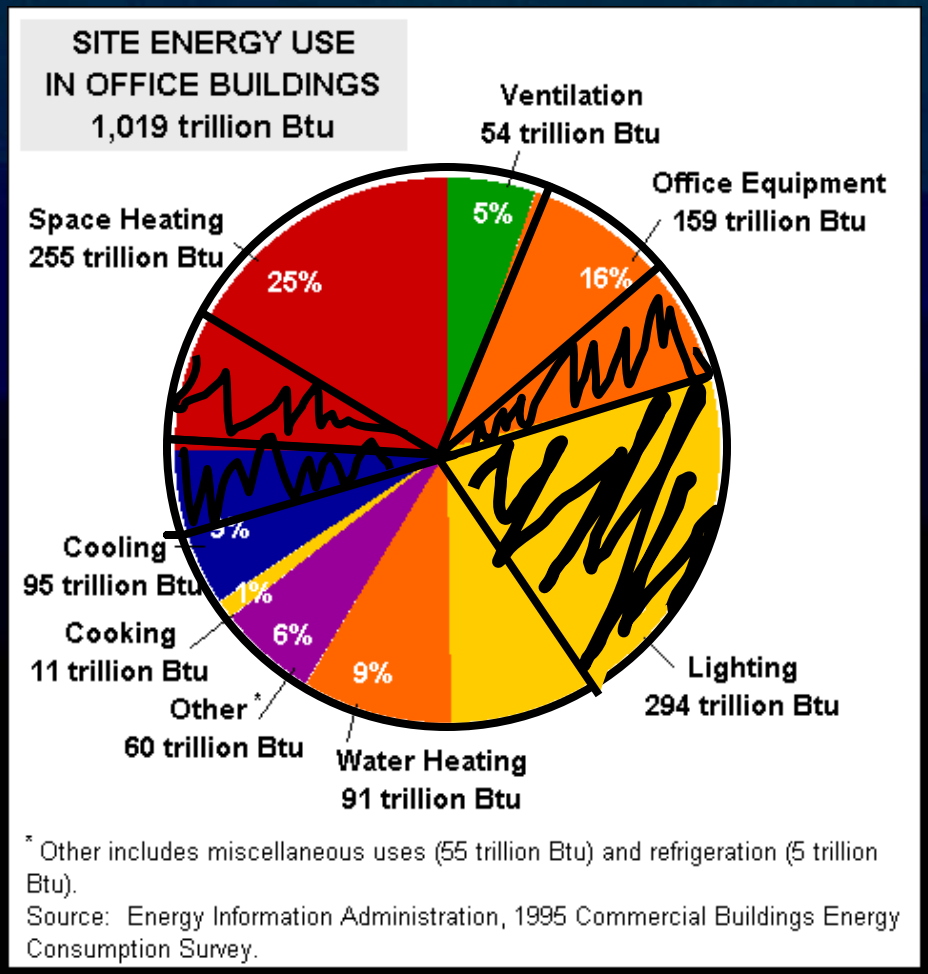
Concepts Behind Net Zero

- True Net Zero does not need the grid
- Cogeneration
  - Uses the maximum possible energy from depletable resources
  - Not remotely close to the concept
- Practical Net Zero
  - Building energy demand profile does not match non-depletable source profile
  - Excess thermal energy can be stored but excess electric energy is better off returned to the grid as a “bank”
  - Bank “account” is depleted periodically

Office Building Energy Use



Office Building Energy Use



Simple, readily available opportunities

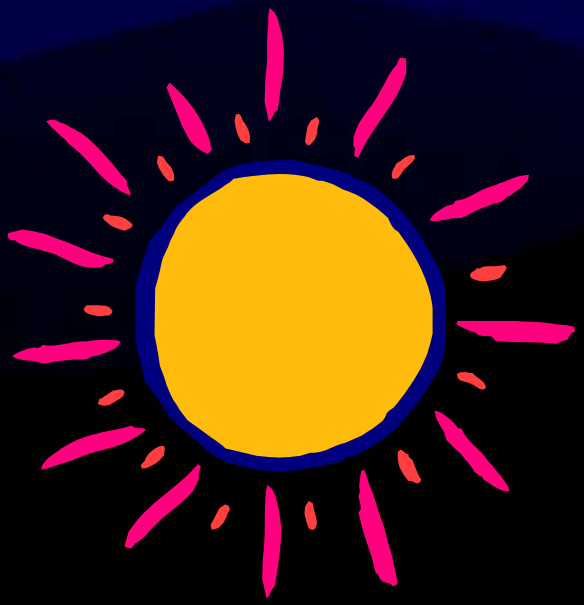
- Lighting
- Lighting related cooling
- Cooling due to bad daylighting
- Office Equipment
- Better/smarter insulation

First Use ***Nega***watts

- Once known as “passive solar” and “conservation”
- Not politically popular
  - Don’t sell
  - Don’t consume resources
  - Not owned by oil interests

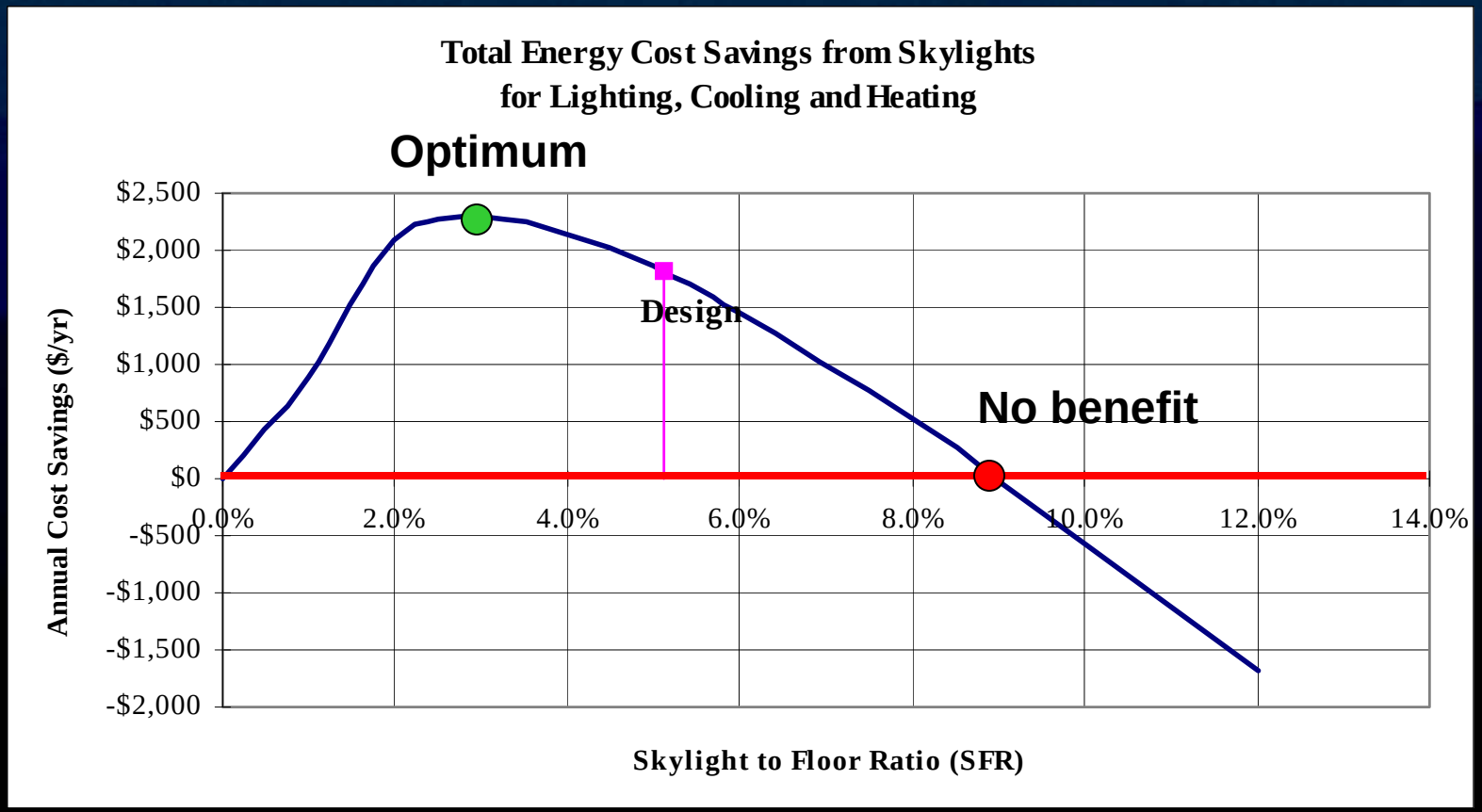
Old Energy Proverb

Negawatts cost less than Megawatts



Free if you know how to use it…..

Step 1: Provide Significantly Better Daylighting



Savings from Good Daylighting

- Up to 100% of lighting demand
- The cooling associated with lighting demand
- Excessive cooling due to sub-optimal daylighting
- Cooling energy coincident with other peaks

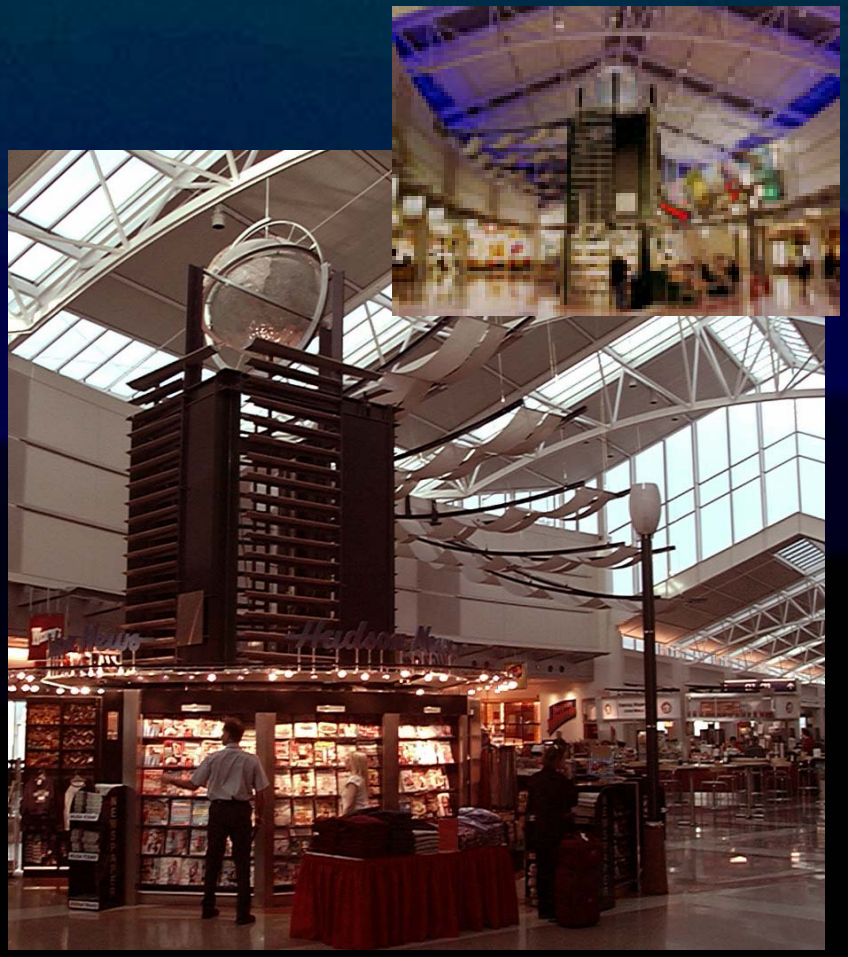
Critical to Good Daylighting

- Proper massing
- Proper orientation
- Proper shading
- Take advantage of topography, landscape and other natural elements
- The passive solar guys had something going…

Step 2: Better Electric Lighting

- High efficiency lighting equipment
- Smart Lights – ability to control through digital lighting infrastructure
- Natural ambient design technique – in daylighted spaces, avoid trying to produce daytime light levels with electric light
- Low ambient design
- Integrated control that assures daylight harvesting

Technique: Natural Ambient



- Takes advantage of the day-night cycle
- High light levels by day (but not too high)
- Low light levels by night (but not too low)
- Lights OFF by day – let the lighting follow nature

New Technique: Natural Ambient

Carl Greve Jewelry (GBD Architects)

University of Oregon Lillis Business Center (SRG Partnership)

New Technique: Natural Ambient

- Design a competent daylighting system
- Where needed provide very specific task lighting
- Turn all other interior lights off by day
- Raise the ambient briefly at sunrise and sunset to help manage the change
- Maintain a low light level at night

Top Lighting Technologies

- Super T8
- T5
- Compact fluorescent
- LED

Step 3: Drop IT Power

2007 oPod Survey of California Offices

- Lighting 1.1 w/sf
- Computers 0.7 w/sf
- Monitors 0.4 w/sf
- Printers and misc Varies, at least 0.2 w/sf

The lighting load is exceeded by the IT load.

Offices vary…but some things are constant

Printer row, Irvine. No trees are saved here!

Account executive. Computer, task light, LCD screen, a bunch of vampire loads, and the occasional laser printer

Simple IT Changes

- Use laptops or thin clients
  - Standard office computer 60-120 watts
  - Laptop 15-50 watts
  - Thin client 10-20 watts
- Use LCD screens (save about 30-40 watts each)
- Minimize wall-warts
- Employ IT energy management software

Step 4: Control Plug Loads

Plug Loads Discovered

• Portable space heaters (10%)	1500w
• Hot/cold water dispenser	500 w
• Personal refrigerator (2%)	120 w
• Personal fan (5%)	25 w

Step 5: Mechanical and Envelope Solutions

Passive Systems such as

- Passive solar techniques
- White roof
- Better insulation
- Natural ventilation

Active Systems such as

- Hot water collectors
- Heat pumps (ground or water source)
- Dark sky systems
- Storage systems

Step 6: Load Shedding Controls

- A system to shed loads to force a better demand profile or simply prevent use at bad times
- A system to shed load in response to grid demand and/or time of use costs

Step 7: Add non-depletable source

Ordinary Efficient Building		Super Efficient Building	
• Lights	1.1 w/sf	• Lights	0.2 w/sf
• Computers	1.1 w/sf	• Computers	0.5 w/sf
• HVAC (cooling)	1.0 w/sf	• HVAC (cooling)	.5 w/sf
• Plug load other	.5 w/sf	• Plug load other	.25 w/sf
• Non-process	.5 w/sf	• Non-process	.25 w/sf
DEMAND	4.2 w/sf	DEMAND	1.7 w/sf

Today: A Close to Net Zero Building*

Envelope

- North facing triple glazed façade
- Central north facing clerestory skylight
- South facing windows with light shelf
- Skylights throughout

Mechanical

- Water source or ground source heat pump
- Natural ventilation
- Green roof with PV array
- Good insulation

*Net zero carbon on a fairly normal budget

A Net Zero Building*

Lighting

- General lighting 0.3 w/sf
- Task lighting 0.45 w/sf
- Digital dimming and controls for all systems
- Daylighting designed for >90% effectiveness

Plug Loads

- Demand response and management controls
- Workstation sensors
- >95% conversion to laptops without desktop monitor
- All LCD monitors on other computers

*Net zero carbon on a fairly normal budget

Other Keys to Success

- Totally integrated design team
- Daylighting is part of schematic design
- Owner, architect, engineers and consultants are all part of schematic design
- Early definition of goals
- Early identification of incentives and rules
- Use LEED later not now

Architecture Net Zero 2010 - Why Wait?

For posting of this program check the www.benyalighting.com website