Lighting Technology Panel

Federal Utility Partnership Working Group
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Doug Avery
Southern California Edison

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National Energy Conservation Mandates

- There are Federal and State Mandates to reduce energy consumption
  - California Investor Owned Electric Utilities are ordered to save around 3 Billion kWh's each year from 2007-2113
  - Federal buildings ordered to reduce electrical energy consumption 35% by 2012

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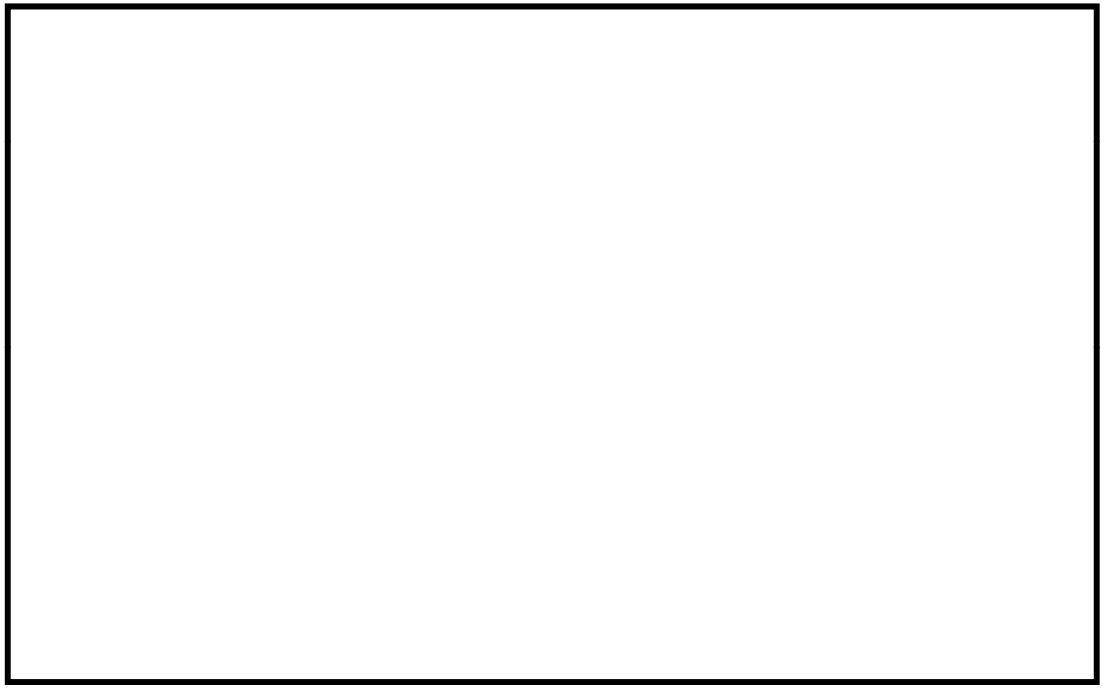
Energy Consumption

Lighting accounts for 42.7% of energy consumption



Data Courtesy of SDG&E

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Energy Consumption

More than ¾ of the lighting load is non-residential.

Data Courtesy of SDG&E

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What Needs to Happen is:

Old Lighting System

1.1 w/sqft

Advanced Lighting System

.5 w/sqft

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What are the hurdles?

- Lack of contractor experience
  - Over-bid projects
  - Unfamiliar technology
  - Call-backs and customer complaints

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System not installed properly

- Not commissioned or calibrated
- Defeated because of problems
- Considered "bad" technology

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Installation Instructions don't work

- Manufacturers instructions are overly complicated
- Installation literature hard to read and follow

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Why Controls?

- Widgets alone will not achieve efficiency or demand response requirements
- System Integration
  - All connected load
  - Communication & interconnectivity

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The Lighting Systems Approach:

- Energy Efficiency
  - Tuning
  - Daylight harvesting
  - Scheduling
  - Occupancy
- Demand Response
  - Real Time Pricing
  - Utility Demand Response

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Office of the Future Consortium

- Utility Sponsors
  - Southern California Edison
  - Sacramento Municipal Utility District
  - Seattle City Light
  - Pacific Gas & Electric
  - Sempra Utilities
  - ConEdison
  - National Grid
  - NSTAR
  - BC Hydro
- Pacific NW National Lab through US DOE
- New Buildings Institute

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Design Trends

- ✓ 70:30 split of open to private offices
- ✓ cubes 20% smaller since 2000
- ✓ team spaces
- ✓ lower walls
- ✓ unassigned work space

NREL Research Support Facility Rendering

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Lighting System Approach

- Better design with advanced technologies, fixture design and layered controls
- Modest reduction in lighting power density
- 30% lighting energy savings

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Lighting Technology Panel
Lighting the Office of the Future

James R Benya, PE, FIES, FIALD, LC
BENYA LIGHTING DESIGN

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The Offices of the Past

- Lighting power density 1.5-2.5 w/sf
- Large zone controls
- Most retrofitted with T-8 lamps and electronic ballasts
- Some retrofitted with compact fluorescent screw based lamps or other new technologies

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Project #1

- Greater LA area, 9' ceiling
- Existing 1960's era 1x4 troffers
- Delamped and retrofitted with T-8 and reflector
- North and south facing windows
- Large floor plate
- Undercabinet fluorescent lights
- All lights turned on by the "energy management system" from 5:30AM to 6:00PM
- Extra cost for operating lights after 6 or on weekends

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Project #1 Study

- Light levels >50 footcandles throughout
- Overhead lighting 1.5 W/sf + .4 W/sf HVAC
- Task lighting .5 W/sf + .15 W/sf HVAC
- Total approx. 6 kWh/sf/year + 2 kWh/sf/year HVAC (>50% on peak)
- 25% typical open office desk occupancy
- 75% typical private office occupancy
- Security issues limit daylighting

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Project #1 Issues

- Landlord reluctant to altering their "system"
- Asbestos containment above ceiling prevents suspending heavy lighting equipment
- Building nearing end of life
- Ceiling tiles re-useable but not ideal
- Furniture system has task lights with T-12 lamps

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Project #1 Solutions

- Workstation mounted uplights
- Ceiling hung lightweight task lights
- Replace lens troffers in offices and hallway
- State of the art control system

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Project #1 Results

Existing Conditions

- 2 W/sf including task lights
- 6 kWh/sf/yr
- 50-60 footcandles everywhere
- No controls other than one switch for 7500 sf

New Design

- 0.92 W/sf including task lights
- 2.2 kWh/sf/yr
- 50-60 footcandles on task/15-25 ambient
- State of the Art controls throughout include dimming ballasts with individual workstations and demand response and daylighting

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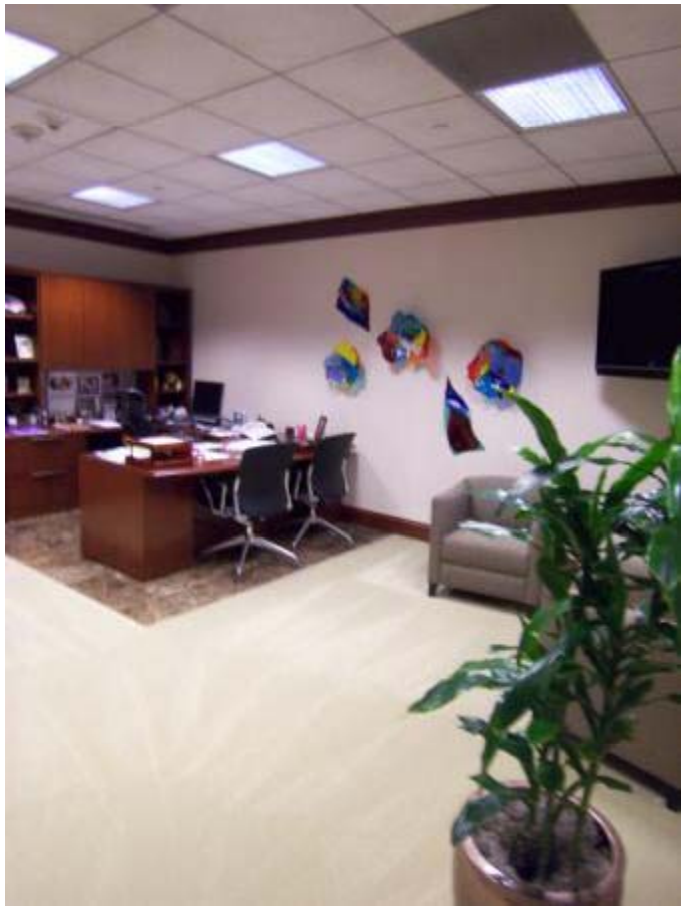
Project #2

- Greater LA area, 9' ceiling
- Existing paracube 2x2 troffers
- T-8 U-lamps
- Incandescent art lights and decorative lighting
- East and west facing windows
- Large floor plate
- Undercabinet fluorescent lights
- Common areas on "energy management system"
- Motion sensors for private offices



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Project #2 Study

- Light levels ~25 footcandles throughout
- Overhead lighting 1.05 W/sf + .3 W/sf HVAC
- Task and art lighting .8 W/sf + .2 W/sf HVAC
- Total approx. 8 kWh/sf/year + 2.5 kWh/sf/year HVAC (>50% on peak)
- >90% typical open office desk occupancy
- 50% typical private office occupancy
- Older building, single pane glazing with film on windows,|'evelor blinds

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Project #2 Issues

- Aesthetics very important
- Beige colored ceiling <60% reflectance needs to be addressed
- Space rebuilt in 1999
- MR16 art lights poorly designed and located
- Niches and task lights not good
- Central video meeting room

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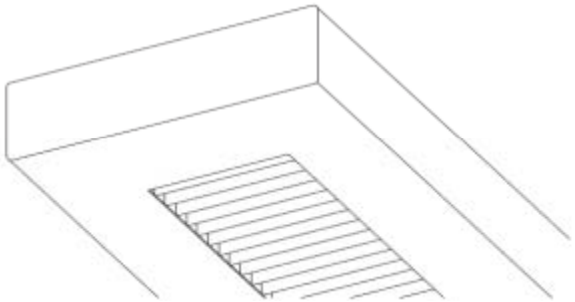
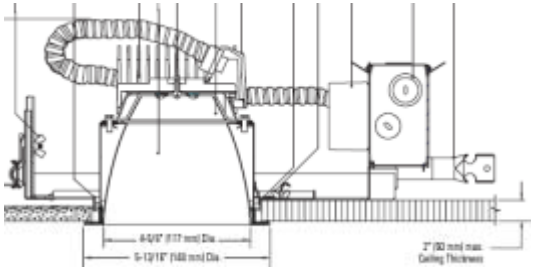
Project #2 Solutions

- Pendant lights over desks
- LED Downlights
- LED Art accent lights
- Pendant indirect lights for conference room
- State of the art control system





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Project #2 Results

Existing Conditions

- Title 24: 1.84 w/sf
- 8 kWh/sf/yr
- Only 25-30 footcandles everywhere
- Private offices have motion sensors and 2 switches
- Video room has a dimming system
- All other lighting on EMS on/off

New Design

- Title 24: 0.64 w/sf
- 3 kWh/sf/yr
- 50-60 footcandles on task/15-25 ambient
- State of the Art controls throughout include dimming ballasts with individual workstations and demand response and daylighting

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Summary

- There are a wide variety of project types and issues
- Some are easily solved with a simple retrofit
- Some require considerable lighting design expertise
- All can save lots of energy and give outstanding results

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ANY QUESTIONS?

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