CALIFORNIA LIGHTING TECHNOLOGY CENTER

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Adaptive (a.k.a. Smart) Lighting (& Daylighting) Controls

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RESEARCH **INNOVATION** **PARTNERSHIP**

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The Fundamental Lighting Design Strategy

Provide

Right Light → *Right Spectral Power Distribution*

Where → *Right Candle Power Distribution*

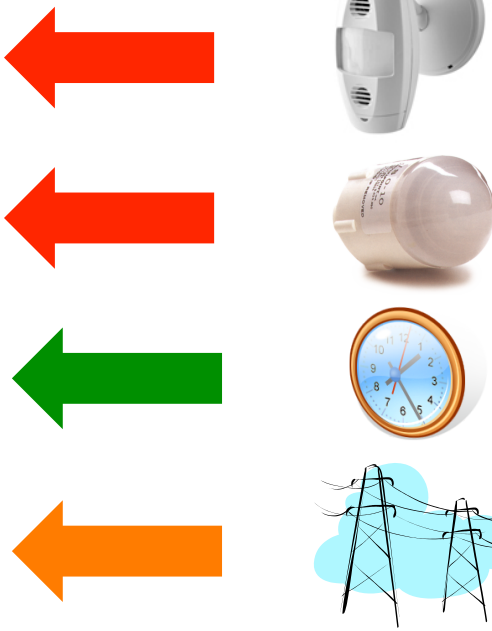
& When → *Right Operation Through Time*

Needed

Key Lighting Control Strategies

- High-end Tuning
- Occupancy/Vacancy!
- Daylight Harvesting!
- Scheduling
- Demand Response!
- Personal Control

Automated Controls



What Is Happening

Easy

What To Do

Adaptive Lighting & Daylighting Systems

- **Automatically adjust their light output…**
  - Candle Power Distribution (SPD) - *total flux & spatial distribution*
  - Spectral Power Distribution (SPD) - *color spectrum – CCT, CRI*
- **…based on environmental conditions**
  - Occupancy / Vacancy
  - Daylight
  - DR Signals
  - …
- **…to optimize space & building performance**
  - Comfort
  - Energy Savings
  - Peak Demand Reduction
  - …

CLTC Adaptive Lighting Control Strategy

During Occupancy
Focus on Comfort

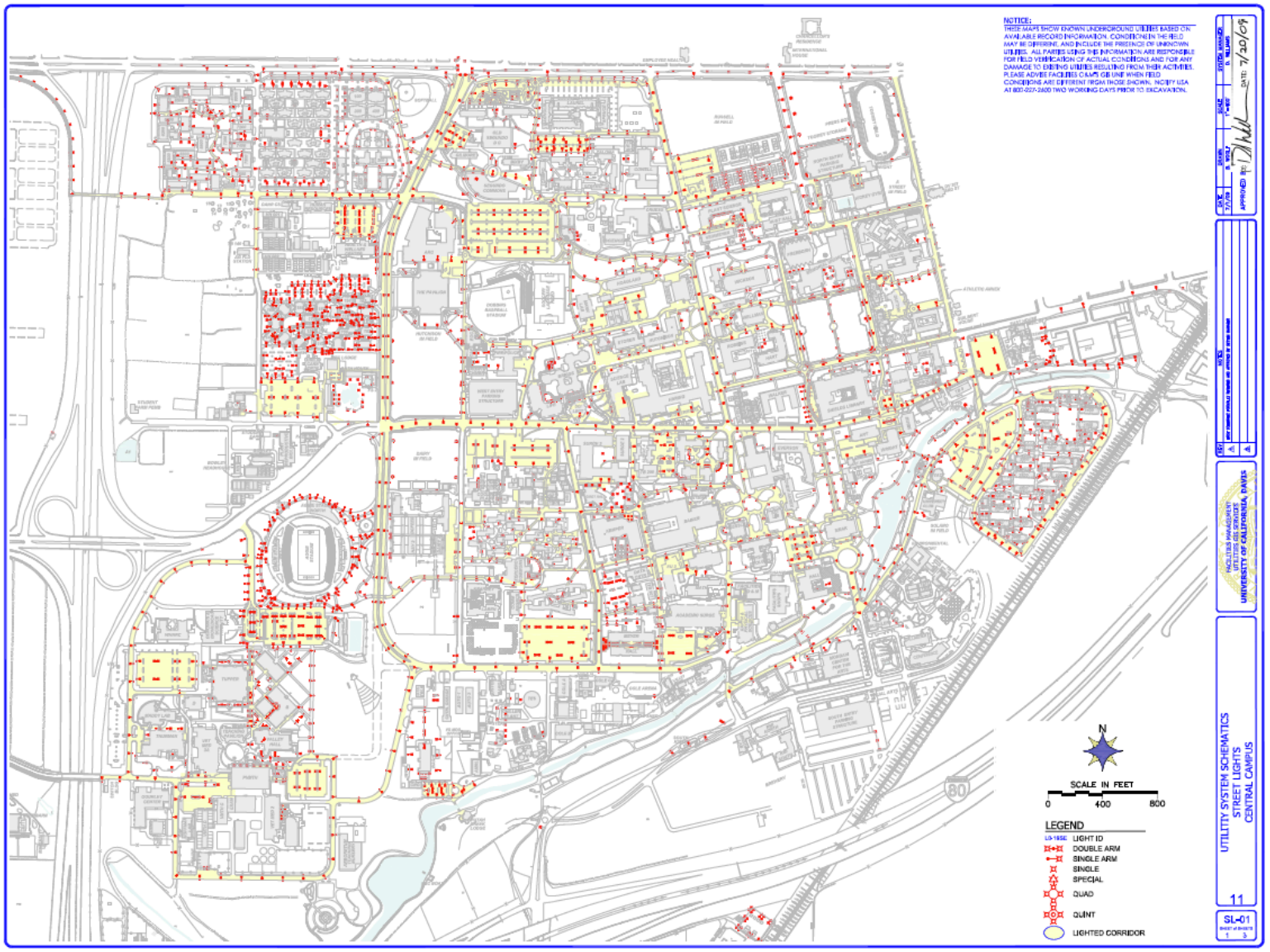
During Vacancy
Focus on Energy Efficiency

Adaptive Outdoor Lighting – Circa 2005

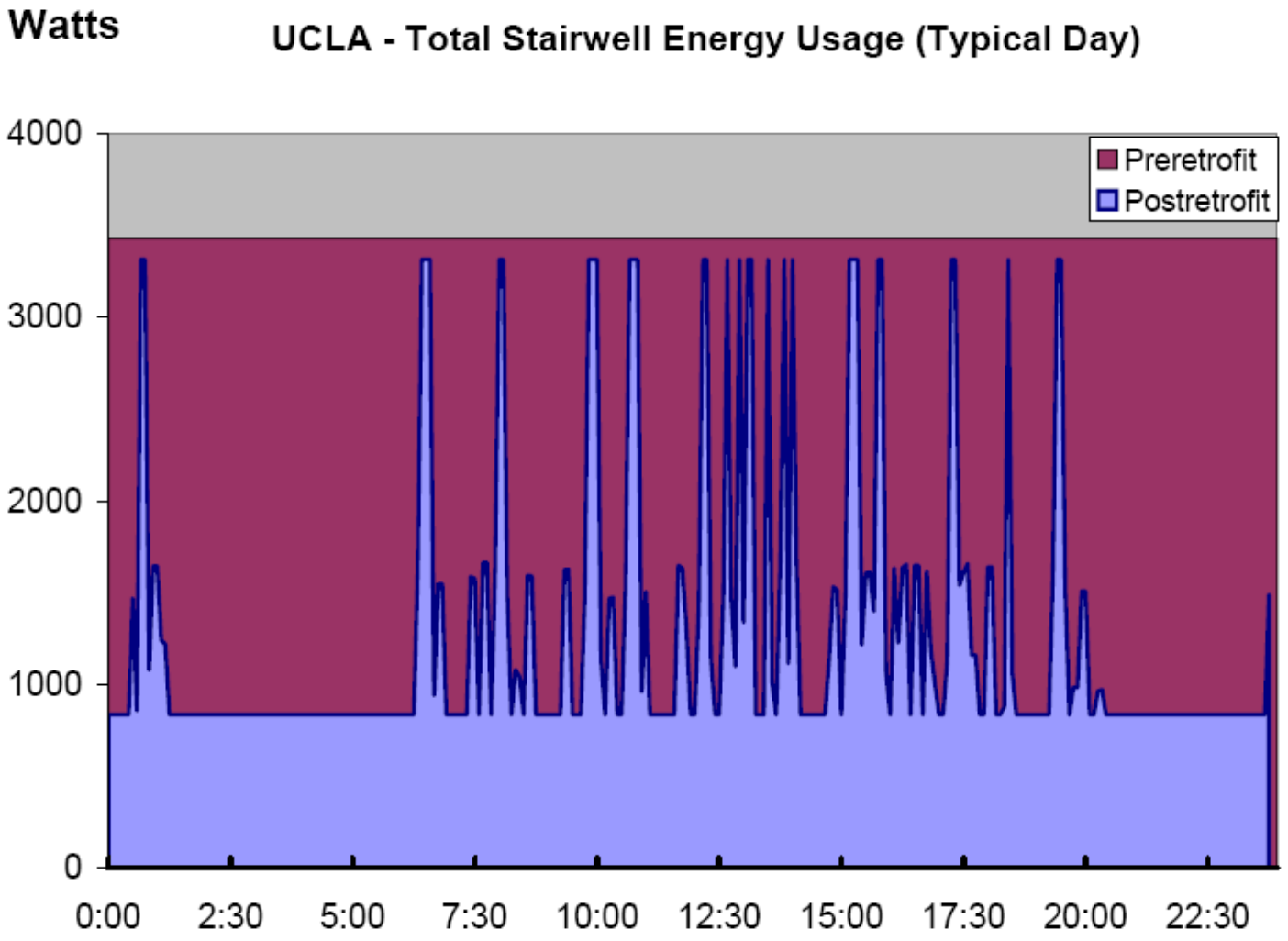
- Amber LED (2W) & CFL Light Sources
- Photo sensor: both light sources off during daytime
- Occupancy sensor: LED during vacancy and CFL during occupancy

UC Davis Campus Today

~1,600 Networked Occupancy-Based Bi-Level Outdoor Luminaires

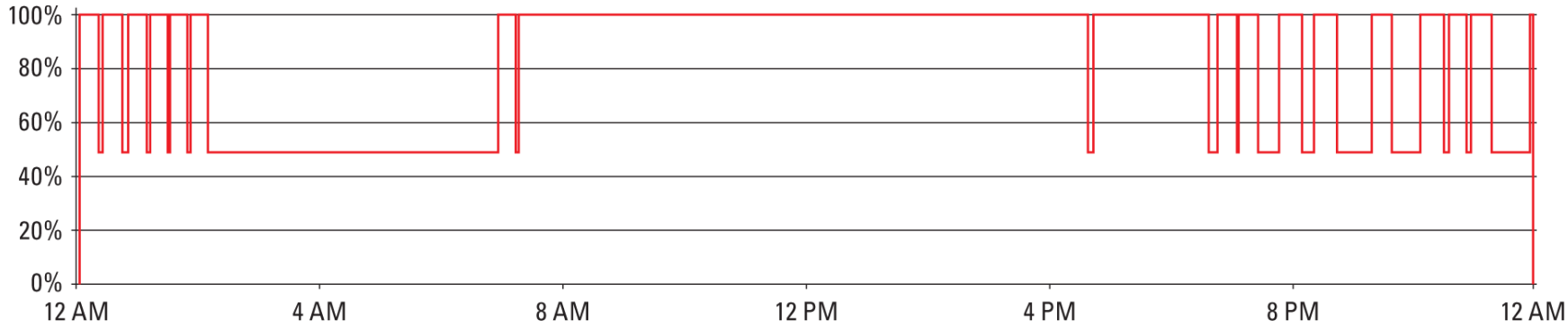


Stairwell Occupancy-Based Bi-Level Controls



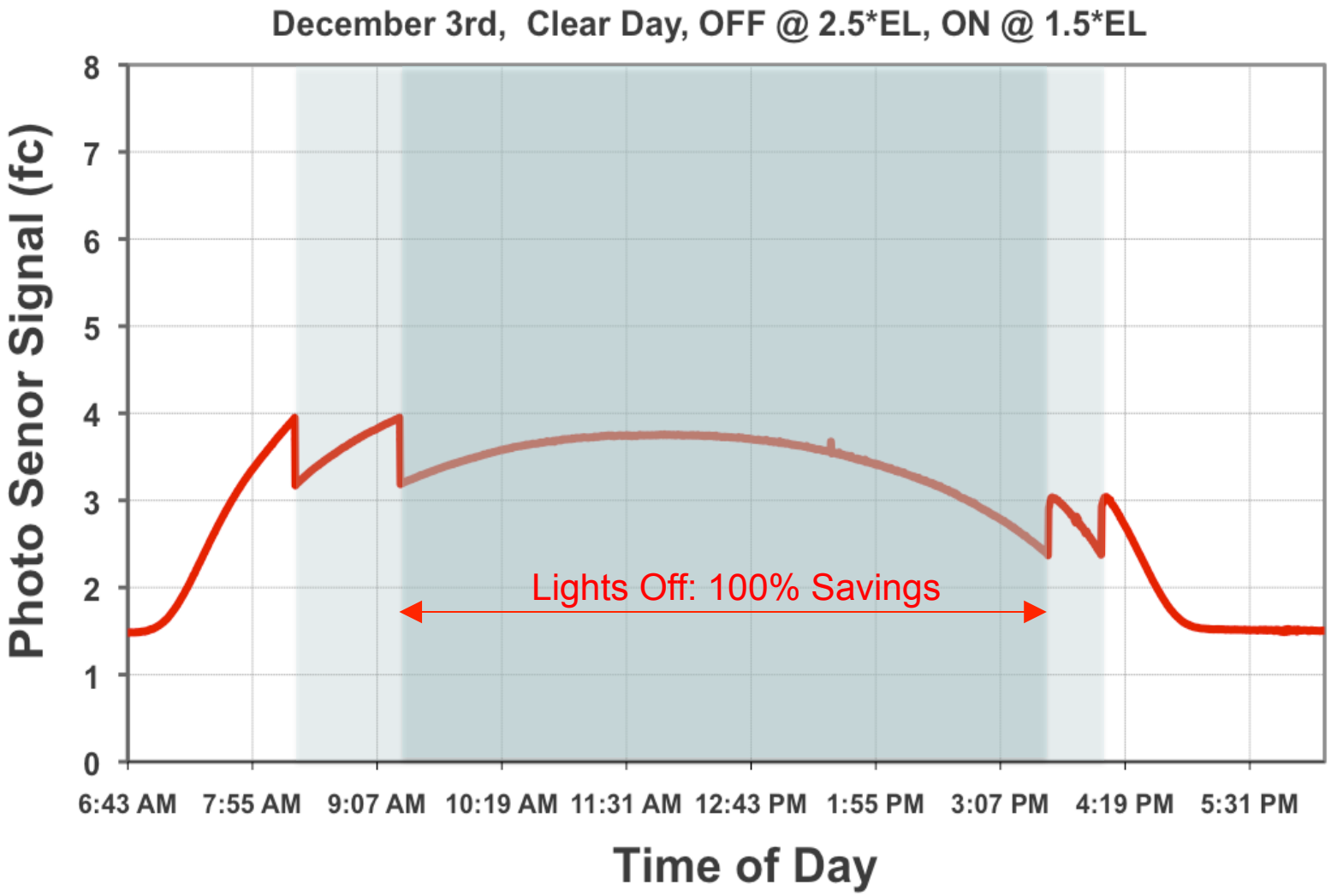
Corridor Occupancy-Based Bi-level Control
Bainer Hall, UC Davis

Weekday

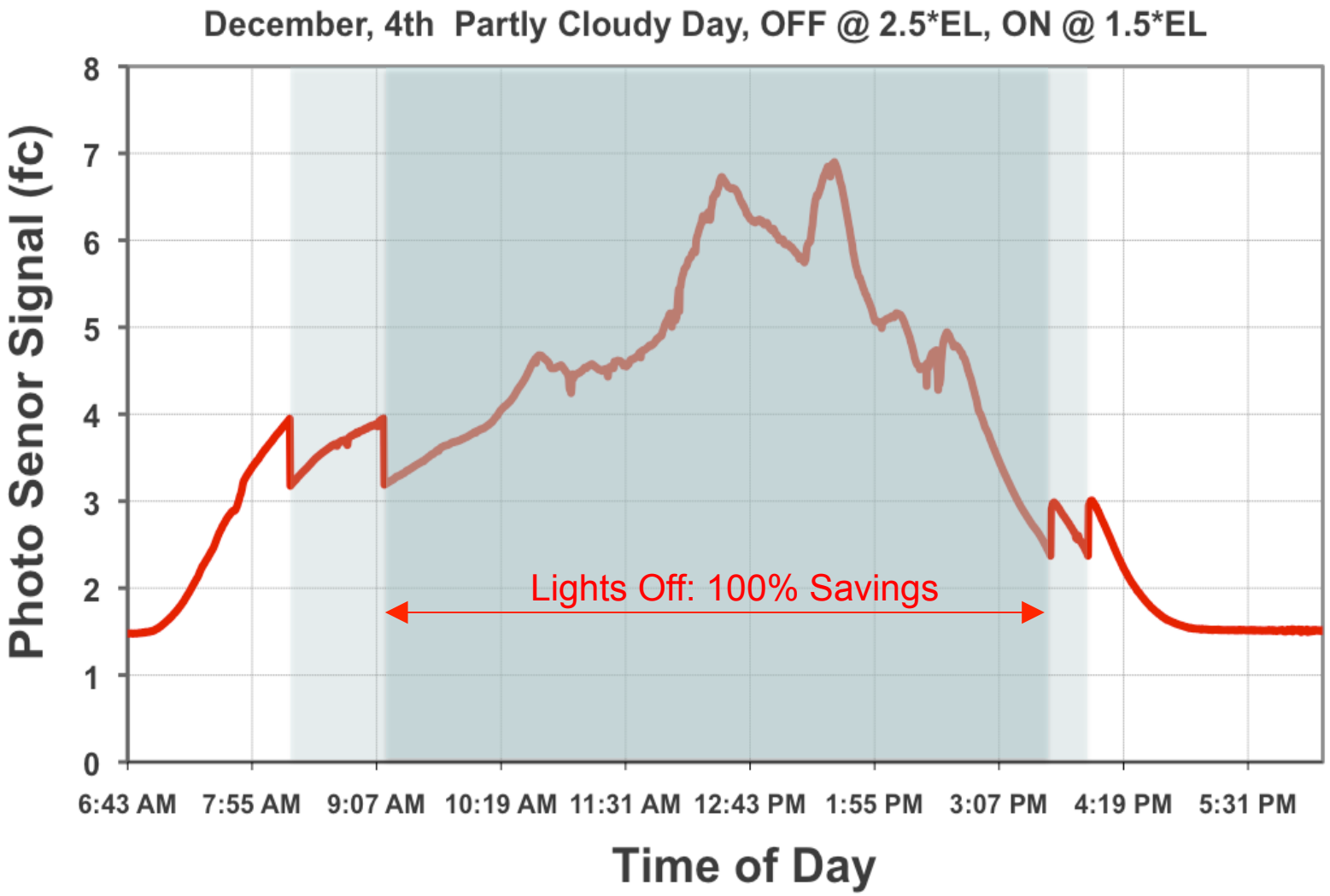


Weekend

Bi-Level Switching for Daylight Harvesting

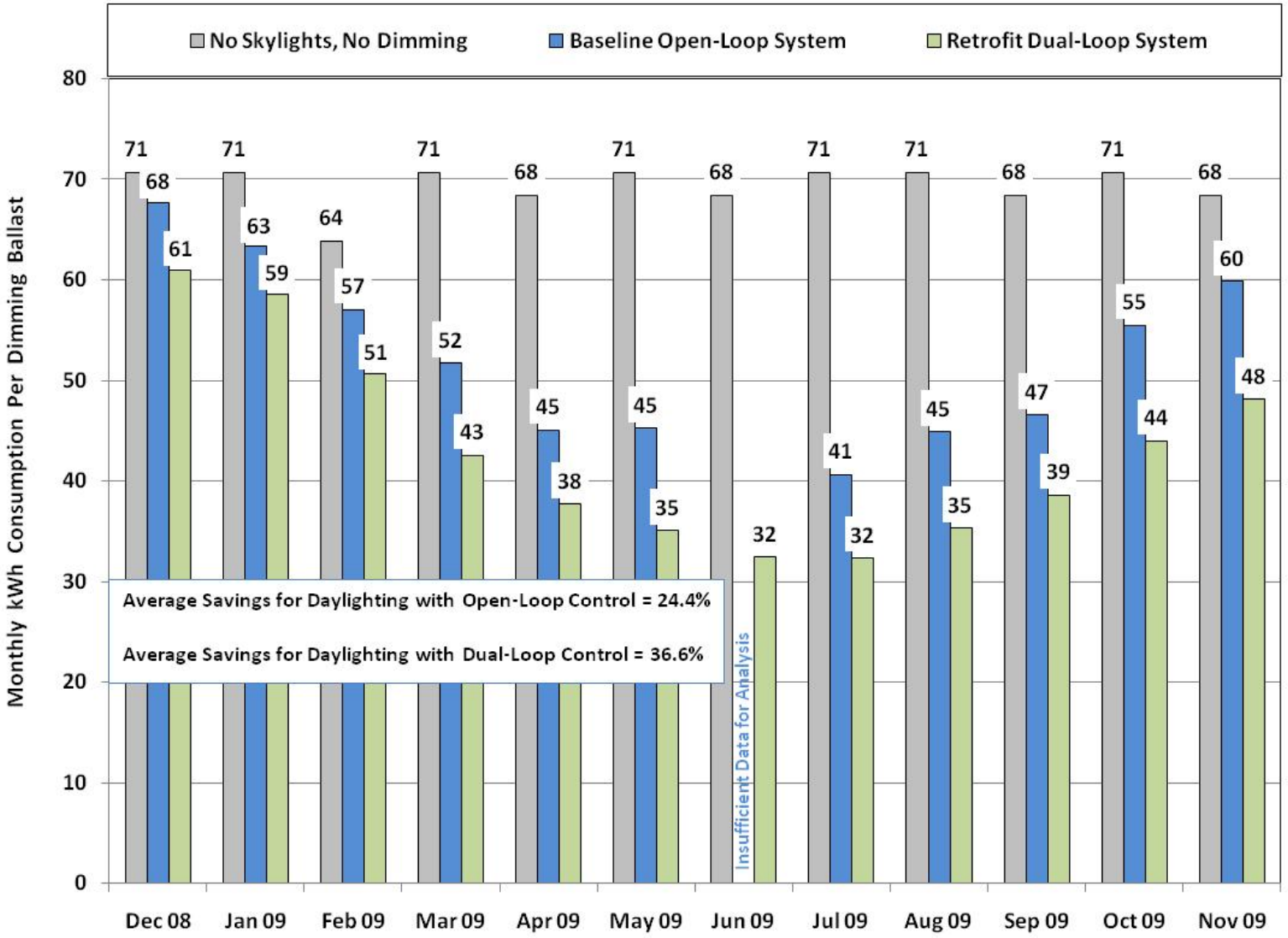


Bi-Level Switching for Window Daylight Harvesting



Dimming for Skylight Daylight Harvesting

24/7 Operation



Digital Controls Have Changed The Game!

- **Analog Controls**
  - **Design** controls strategy
  - **Install** controls components
  - **Commission** control systems **based on strategy**
- **Digital Controls & Communications**
  - **Install** controls components – **sensors!**
  - **Design** & implement control strategies
  - **Commission** control systems **based on monitored performance**

Smart Luminaires, Windows & Skylights

- Integrated sensors (occupancy, light, temperature, …)
- Integrated communications (DR & sensor-based controls)
- Smart Luminaires
  - Automatic adjustment of electric light CPD & SPD
  - Based on Occupancy, Daylight, DR & Manual(!) signals
- Smart Windows & Skylights
  - Automatic Adjustment of Daylight CPD SPD & Ventilation
  - Based on Occupancy, Electric Lighting, HVAC & Manual(!) signals

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Thank You!

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