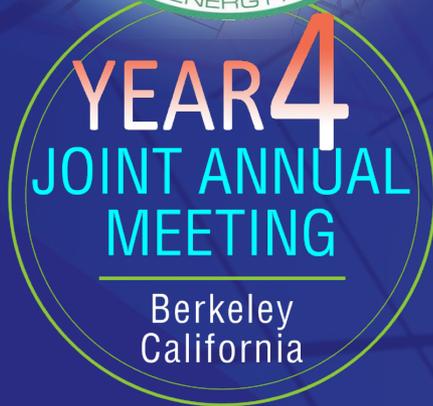


# BUILDINGS ENERGY EFFICIENCY CONSORTIUM

U.S. - CHINA CLEAN ENERGY RESEARCH CENTER (CERC-BEE)



## 2B. Lighting Controls Demonstration Partnership China – U.S.

### Advanced Lighting Controls in New and Existing Buildings

LBNL ■ CABR ■ Lutron

Presented By

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Electronics, Lighting and Networks Group  
Building Technology and Urban Systems Department  
Lawrence Berkeley National Laboratory  
25 August 2014

# Advanced Lighting Controls in New & Existing Buildings

## Outline

- Project Purpose & Objective
- Progress & Accomplishments - Year 4 Milestones, Target Outcomes
- Key Year 4 Technical Achievement
- Schedule of completion for remaining (unmodified) Year 4 Milestones & Target Outcomes, percentage of cumulative unspent DOE funds
- Issues/risks & abatement plans
- Concept proposal for project continuation—CERC – BEE 2.0

# Advanced Lighting Controls

## Purpose, Progress & Accomplishments

- **Purpose & Objective – Identify:**
  - Best performing controls strategies & most cost-effective approaches
  - Opportunities for code improvements relative to lighting controls
- **Progress & accomplishments on Year 4 Milestones, Target Outcomes**
  - Lutron installation complete & commissioned at CABR field test site in Beijing
  - Experimental plans for FLEXLAB test were refined
- **Key Year 4 Technical Achievement**

# Advanced Lighting Controls in New and Existing Buildings

<b>Item</b>	<b>Description</b>
<b>Full Project Name</b>	Advanced Lighting Controls in New and Existing Buildings
<b>Reporting Period</b>	Q2/Q3 2014
<b>U.S. Research Team</b>	LBNL: Peter Schwartz, Francis Rubinstein, Erik Page
<b>U.S. Industry Partners</b>	Lutron Electronics: Robert Nachtrieb
<b>China Research Team</b>	National Low-Carbon Lighting Research Center: Huang Yuehui
<b>China Industry Partners</b>	Lutron Electronics: Matt Blakeley

# Advanced Lighting Controls in New and Existing Buildings

## Timeline:

Start date: FY13

Planned end date: FY15

## Key Milestones:

1. Q3 FY14: Lab Experiment in FLEXLAB
2. Q1 FY15: Field Test at CABR building (Beijing)
3. Q4 FY15: Final report

## Target Market/Audience:

Market = commercial buildings under 100ksf

Audience = new/existing service providers, owners and managers of small commercial buildings and portfolios.



## Budget:

Total DOE \$ to date \$145k

Total future DOE \$: FY 15 funding TBD

Cost share: \$100k (Lutron)

# Advanced Lighting Controls in New and Existing Buildings

Item	Description
<b>Full Project Name</b>	Advanced Lighting Controls in New and Existing Buildings
<b>U.S. Technical Next Steps</b>	We continue to develop detailed experimental plan FLEXLAB experiment & anticipate receiving sample controls equipment from Lutron. LBNL will conduct equipment benchtop testing to enable quicker FLEXLAB installation when it is available.
<b>Notable U.S. Non-Technical Progress, Achievements</b>	LBNL has hired a Program Manager to manage this project, who will start July 21.

# Advanced Lighting Controls in New and Existing Buildings

Item	Description
<b>Quarterly Milestones &amp; Deliverables</b> (Notable U.S. Technical Progress, Achievements, Findings)	<b>Milestones:</b> <ul style="list-style-type: none"><li>▪ <i>Installation of lighting controls systems in FLEXLAB - June 2014</i></li></ul> <p>Milestone not yet completed as we are:</p> <ul style="list-style-type: none"><li>▪ <i>Still refining the experimental design</i></li><li>▪ <i>Awaiting arrival of Lutron lighting controls systems</i></li><li>▪ <i>Waiting for FLEXLAB to be fully operational</i></li></ul> <p>This milestone is now anticipated for October 2014</p> <b>Deliverables:</b> <ul style="list-style-type: none"><li>▪ <i>Experimental plan for evaluating lighting controls system in FLEXLAB – April 2014</i></li></ul> <p>In <b>Q1</b>, completed experimental plan conceptual design at FLEXLAB &amp; field test at CARB (Beijing).</p> <p>In <b>Q2</b>, in discussions between LBNL &amp; Lutron, we continued to refine experimental plan but it is not yet finalized—Anticipate September 2014 completion.</p>

# Advanced Lighting Controls Progress & Accomplishments

## 2014 Target Outcomes

## 2014 Progress

1. Demonstrated control system launch in U.S. & China markets by end of 2014

This target outcome is no longer relevant; system installed in CABR & tested in FLEXLAB is an existing (not newly developed) LUTRON product

2. Clear road map & progress to establishing codes in 2014

Limited Progress in Q2 2014

3. Economic value proposition including field data and modeling against the real cost to demonstrate technology's viability in market/application

Refined experimental design this quarter explicitly addresses this target

4. Code language & engagement plan for U.S. & China partners to have next generation code adopted & implemented

Limited Progress in Q2 2014

5. FY2014 goal: Tool for analyzing lighting data collected by manufacturer's control system

Experimental design refined this quarter explicitly addresses this target

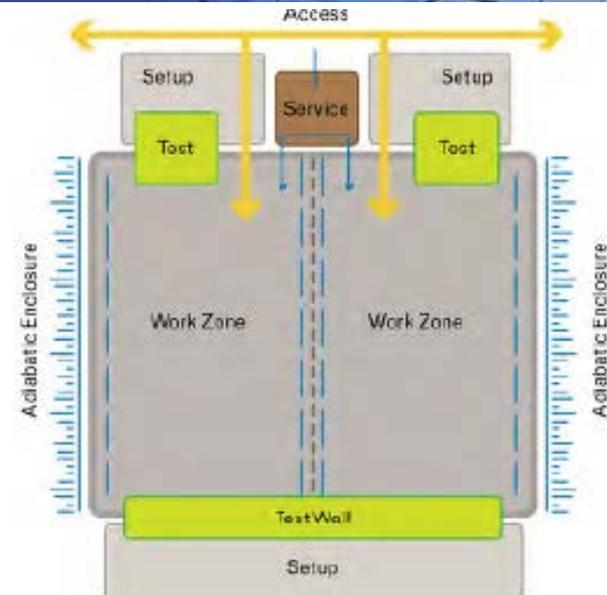
6. Stretch goal (FY15): Embed analysis into developed code language to verify compliance

Limited Progress in Q2 2014

# Advanced Lighting Controls Progress & Accomplishments

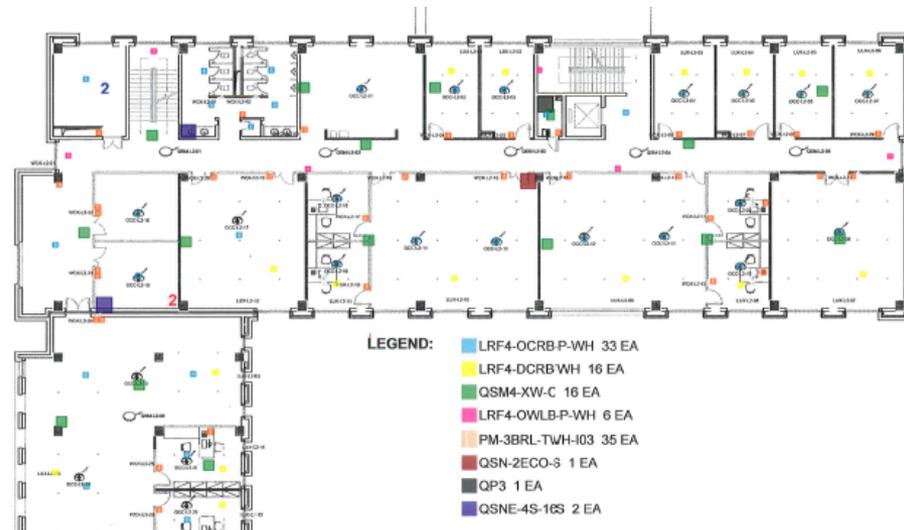
- **FLEXLAB Test**

- Monitor Energy Savings & Performance of various lighting controls strategies is controlled, highly monitored environment



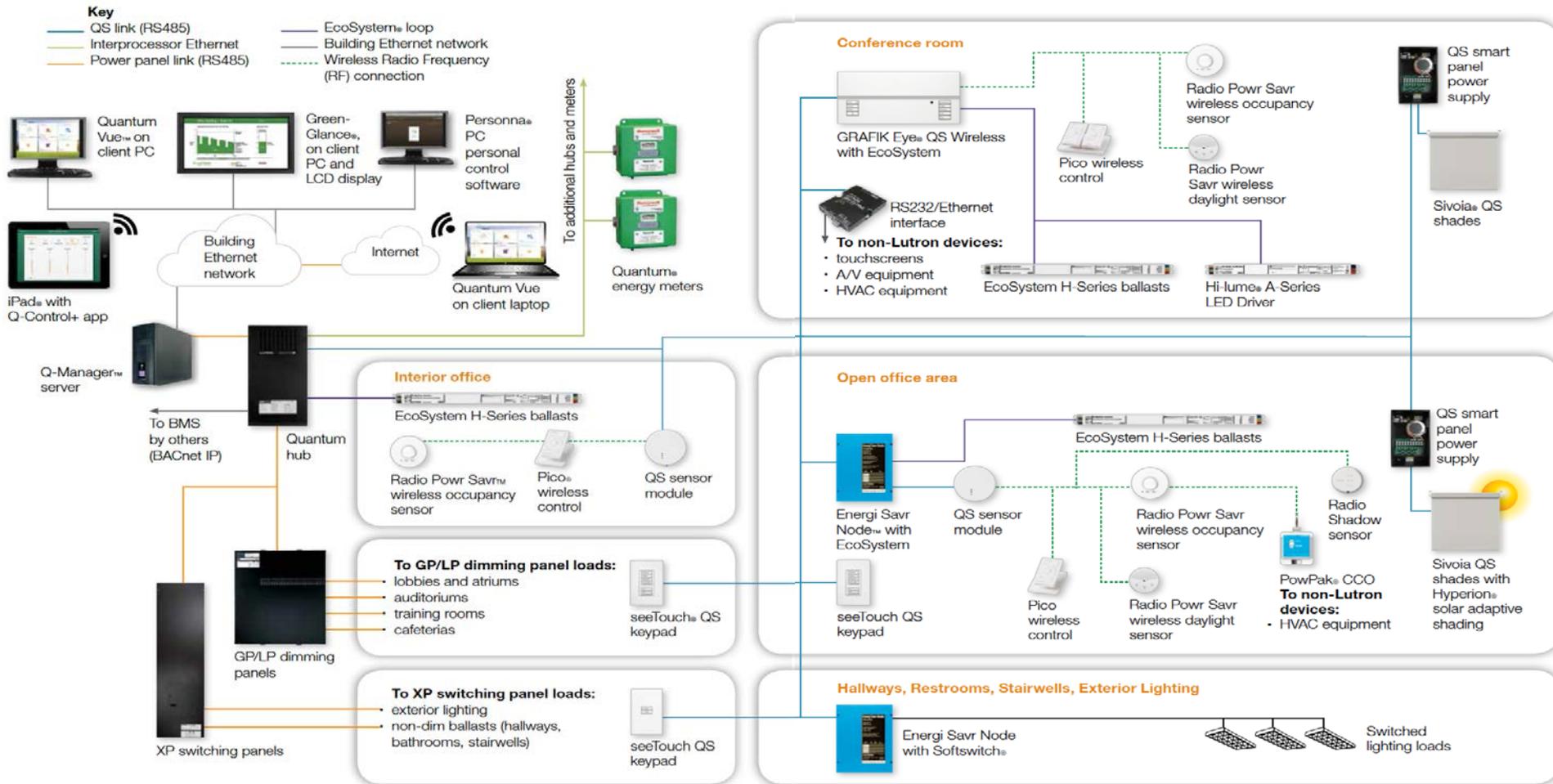
- **CARB Field Test**

- Explore some of same controlled strategies in a Chinese office environment

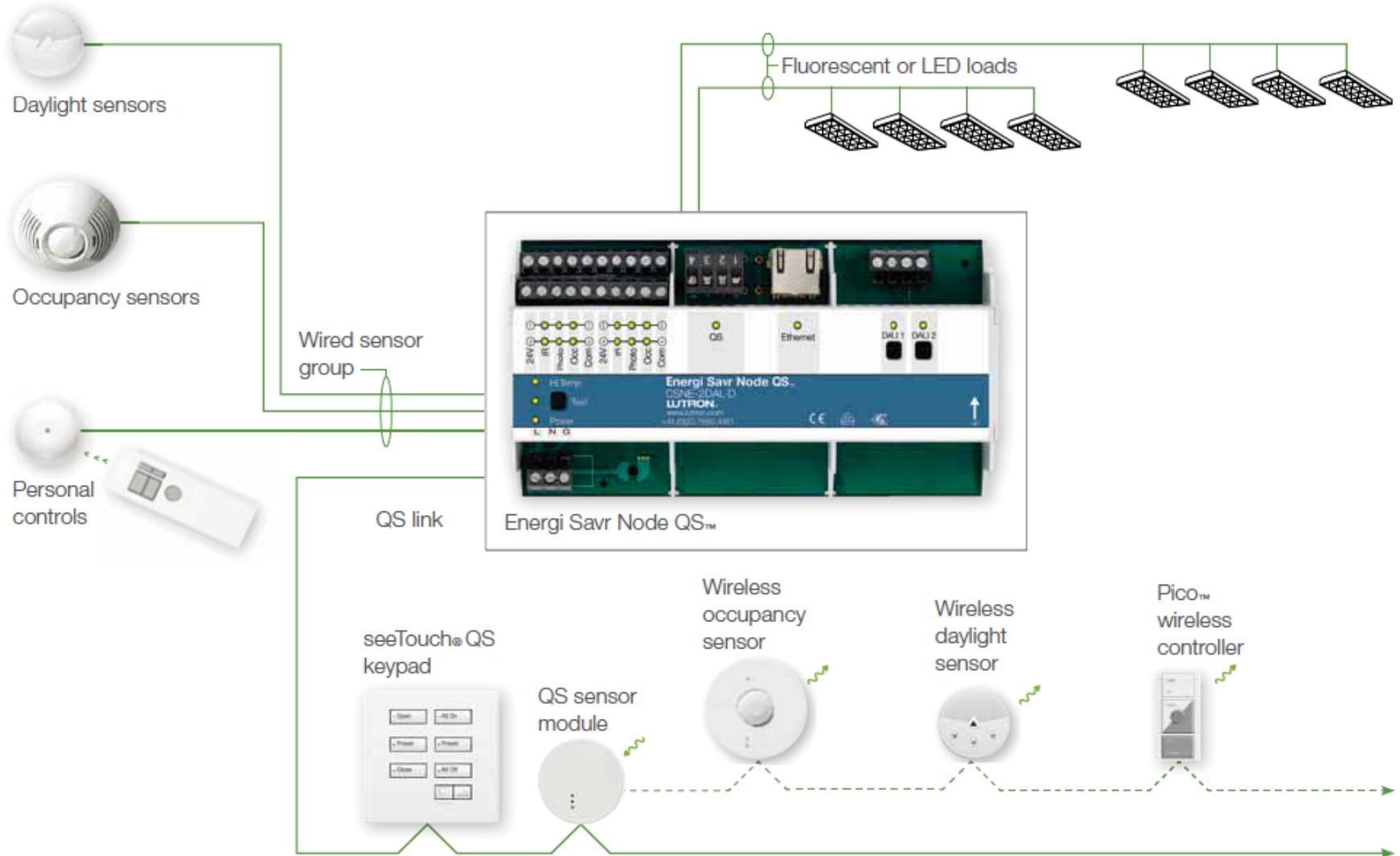




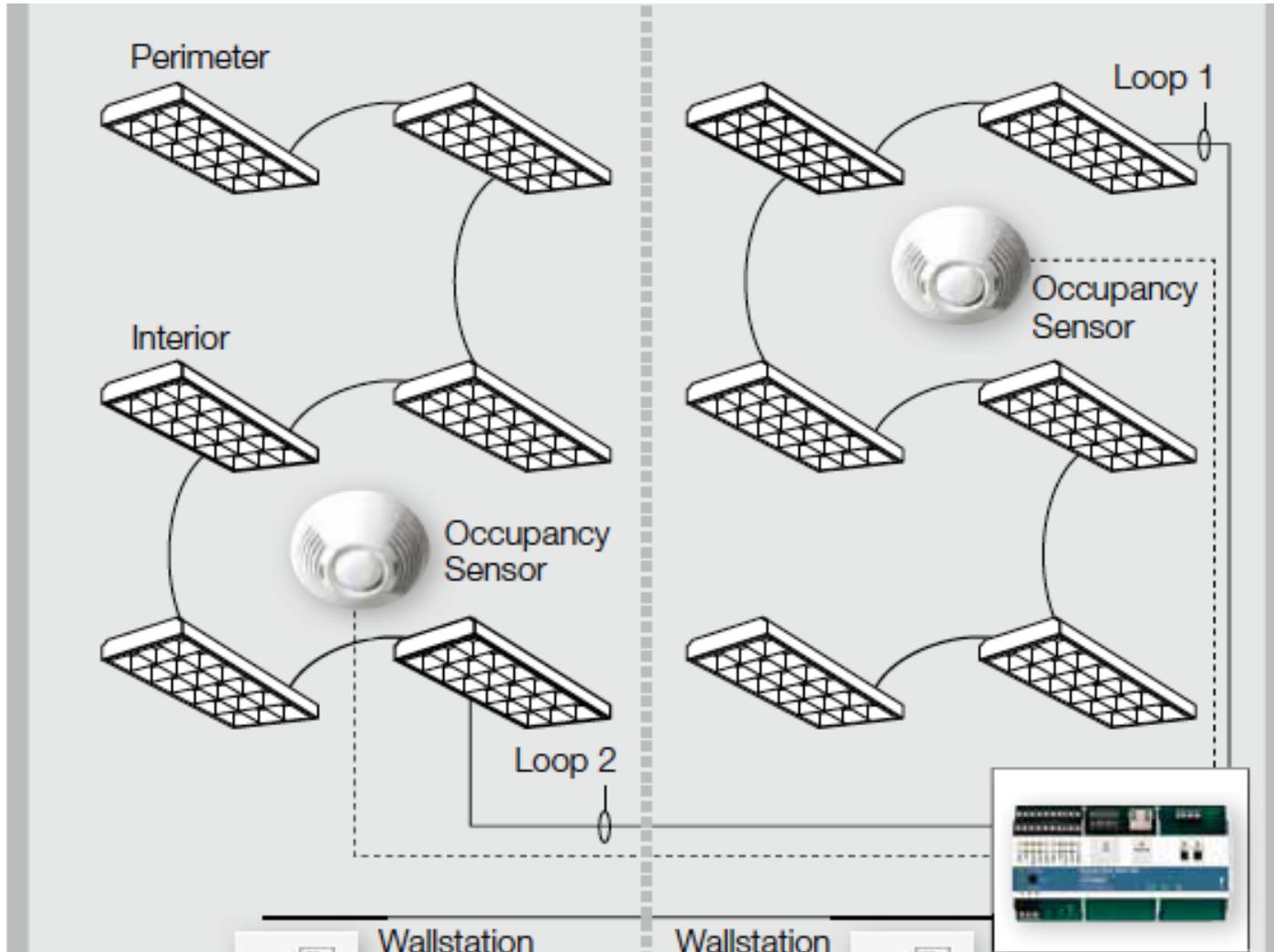
# Lighting Controls Architecture



# Controls Schematic



# Controls Schematic



# FLEXLAB



# FLEXLAB Test Cells



# FLEXLAB Test Cells



# Advanced Lighting Controls

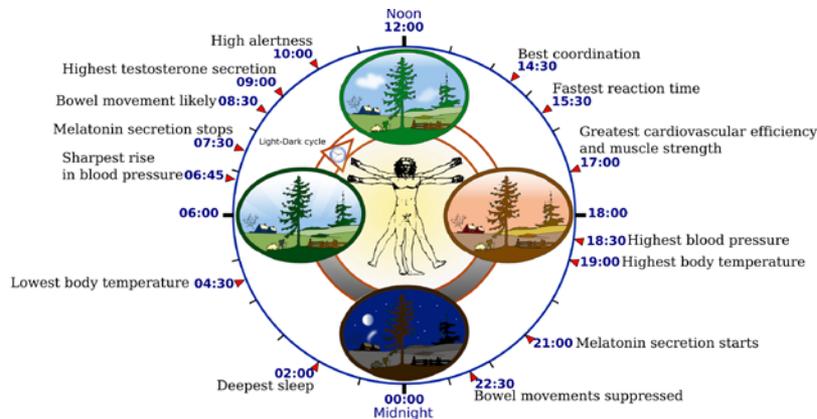
## Potential CERC 2.0 Concepts

- Leverage advanced lighting controls systems' dense sensor networks & data acquisition to establish:
  - Occupant behavioral patterns
  - Energy performance for different building types, location, etc.
  - **Goal:** help “**crack building's DNA & genetic code**” to better understand a building's 'parentage' & therefore, predict its performance when replicated
  - Employ advanced, intelligent networked lighting control systems as distributed grid resources to provide:
    - **Demand response (DR)**
    - **Ancillary services** (voltage & frequency regulation)

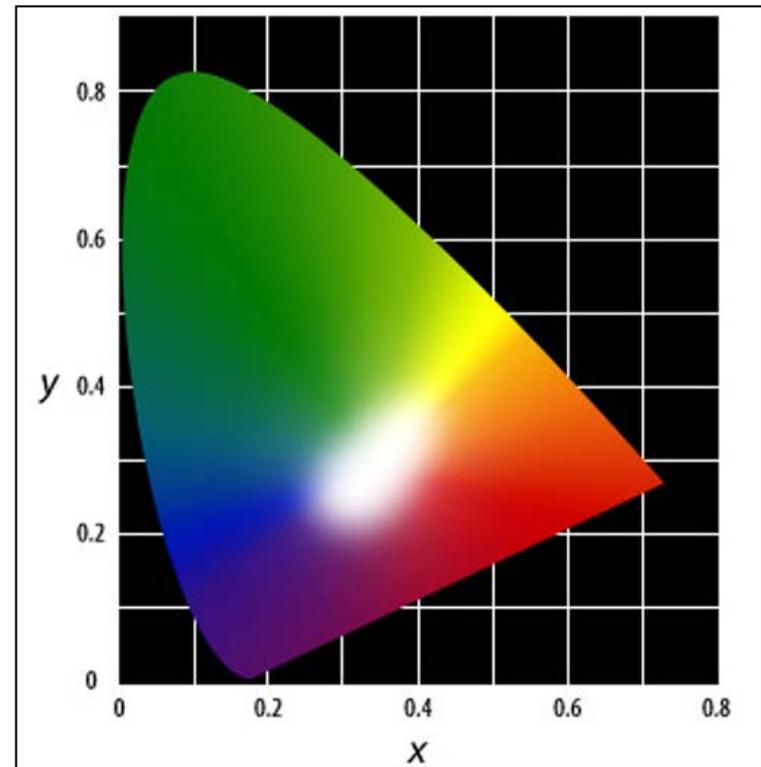
# Advanced Lighting Controls

## Potential CERC 2.0 Concepts

- Hybrid DC-wired, solar PV-storage-LED lighting systems with enhanced controls systems
  - Employ CCT LED luminaires to explore potential to shift spectrum to optimize human comfort & productivity while minimizing energy consumption
  - Strategies based on:
    - Glare reduction
    - Occupant task requirements
    - DR load shed
    - Circadian cycle—nighttime eye adaption



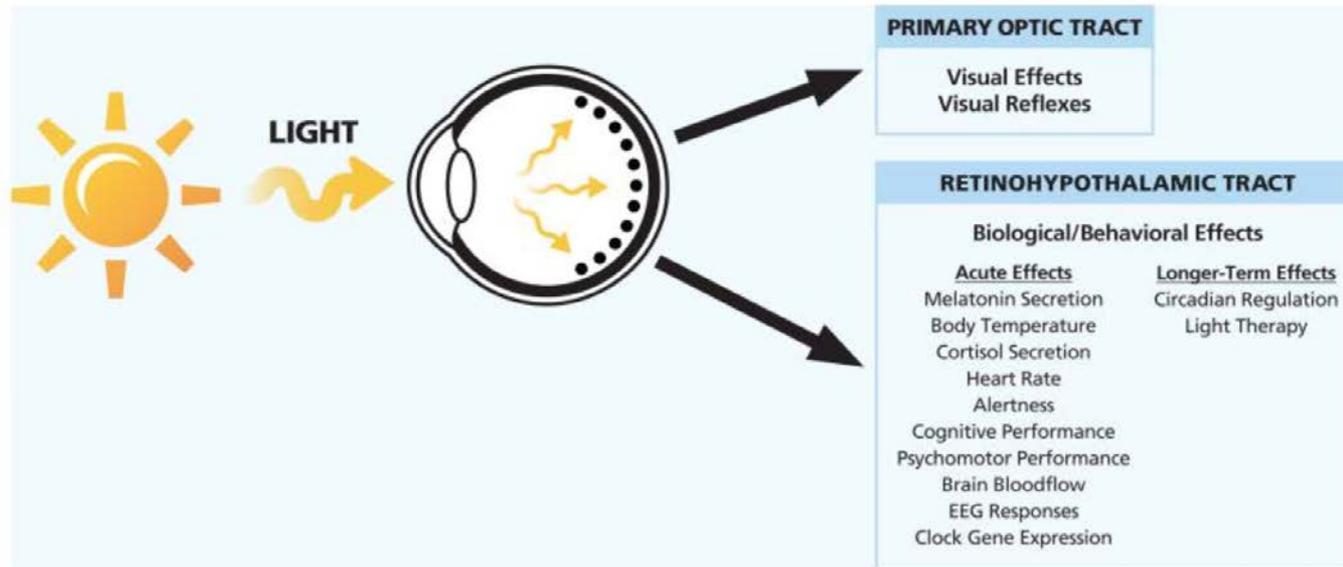
Source: [http://en.wikipedia.org/wiki/Circadian\\_rhythm#mediaviewer/File:Biological\\_clock\\_human.svg](http://en.wikipedia.org/wiki/Circadian_rhythm#mediaviewer/File:Biological_clock_human.svg)



# Advanced Lighting Controls

## Potential CERC 2.0 Concepts

- Solar PV-storage-LED street & exterior lighting systems with enhanced controls systems



Source: Benjamin Warfield and George Brainard/Thomas Jefferson University. Adapted by Matthew Ray/EHP.