Efficiency Works™

Estes Park | Fort Collins | Longmont | Loveland

Lighting Controls

February 2020

Safety and reminders

- In case of emergency
  - Exits and assembly location
- Restrooms
- Food & beverages
- Questions during the presentation
  - Feel free to ask throughout

Nancy Clanton, PE, FIES, FIALD, LC, LEED Fellow

CEO of Clanton and Associates

Lighting design firm specializing in sustainable and regenerative design

- Serves on the solid-state lighting committee at the National Academy of Science
- Delegate to ISO 205 WG 7. USA Visual indoor environment design
- Received the 2018 Lifetime Achievement Award from Edison Report
- Member of the Wellbeing “Light” advisory group
- Two times winner of the, Presidential Award, IES
- International Clean Design Award and Woman Engineer Award, ACEC, 2014
- Served on the USGBC LEED Environmental Quality Technical Advisory Group
- Lighting group leader for Greening of the Whitehouse
- Led lighting workshops for the C40 Cities conference in Seoul

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Controls, Controls, and More Controls!

Nancy Clanton | Nancy@ClantonAssociates.com | Efficiency Works™

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Why Controls?

Basic Functions	
What	*How*
Produce the right amount of light…	Light output (intensity) Dimming
Where it is needed…	Zoning luminaires to controllers
and when it is needed!	Automatically reduce lighting when the space is unoccupied

lightingcontrolsassociation.org/2017/07/21/introduction-to-lighting-controls/

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Why Controls?

Advanced Functions	
What	*How*
Produce the right color of or shade of white light…	Separately dimming arrays of LEDs with different colors or white light correlated color temperatures (CCTs)
Allow remote programming and control…	Control systems with programming and lighting management capability
and tell you how your lights are performing.	Centralized intelligent control of systems with measuring and/or alarm/monitoring capability

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Why Controls?

1. Lighting responds to environment & schedule

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2. Users can adjust lighting for personal preference

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Why Controls?

1. Lighting responds to environment & schedule
2. Users can adjust lighting for personal preference
3. Extends the life of LED luminaires
   - Dimming reduces heat to LED by cutting power flow up to 120X per second
   - Dimming by 50% = 20X increase in lifespan!

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Why Controls?

1. Lighting responds to environment & schedule
2. Users can adjust lighting for personal preference
3. Extends the life of LED luminaires
4. Energy efficient
   - Lighting control produces 24-38% savings
   - Majority of state energy codes require controls for efficiency
   - LEDs + Controls = Min. Energy Costs.

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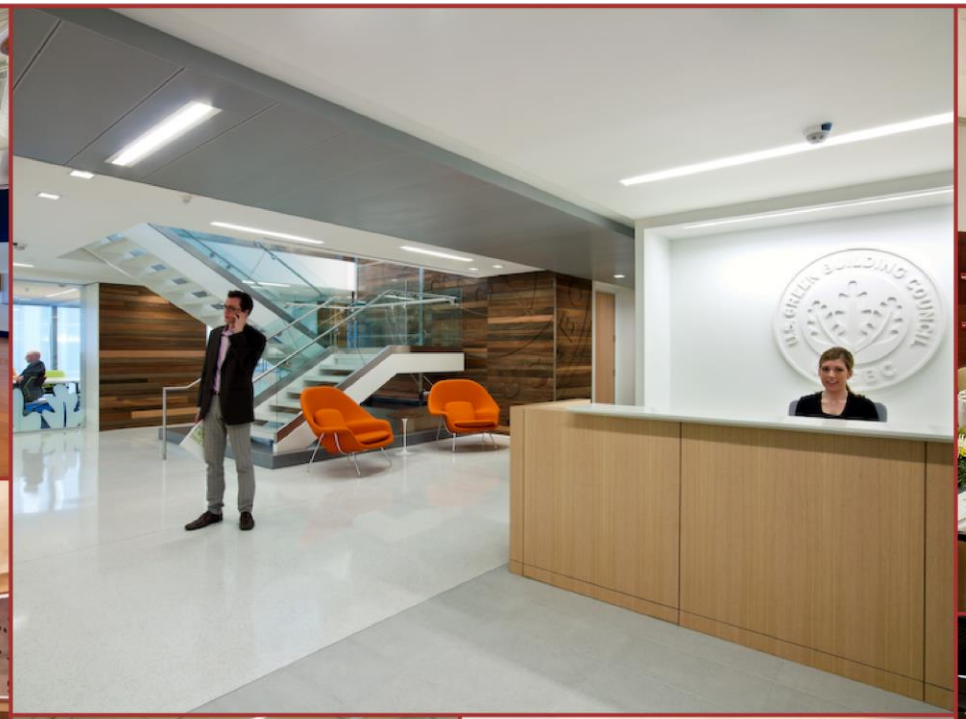
Why Controls?

1. Lighting responds to environment & schedule
2. Users can adjust lighting for personal preference
3. Extends the life of LED luminaires
4. Energy efficient
5. Efficiency Works rebates supports multi-level control implementation!
   - Luminaire replacement with controls get $0.25 or $0.50 per watt saved.
   - With planning, projects can still be paid fully from rebate.

What is the intent of the space?



Control Devices - Occupancy/Vacancy Sensors

Uses infrared light (shown) or ultrasonic sound to sense if an area is **occupied** and turns on/off lights

Control Devices - Occupancy/Vacancy Sensors

Uses infrared light (shown) or ultrasonic sound to sense if an area is **occupied** and turns **on/off** lights

Vacancy senors use infrared light or ultrasonic sound (shown) to sense if an area is **vacant** and **turns off** lights

Control Devices - Dual Band Occupancy/Vacancy

Use **both** infrared light and ultrasonic sound to control lights.

Control Devices - Open Loop Daylight Sensors

Detects daylight only. Typically installed facing a source of daylight.

Control Devices - Closed Loop Daylight Sensors

Detects daylight and electric lighting. Typically installed indoors and away from direct daylight.

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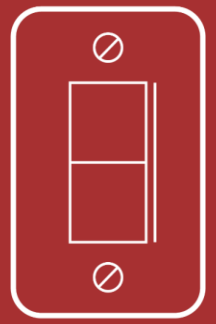

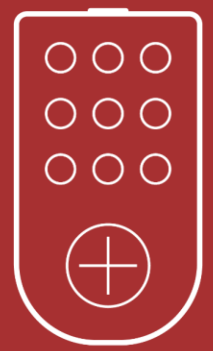

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Individual Controls - Not eligible for rebates

Individual Control Types:

- Switches
- Buttons
- Dimmers

- Apps

- Wireless Controllers

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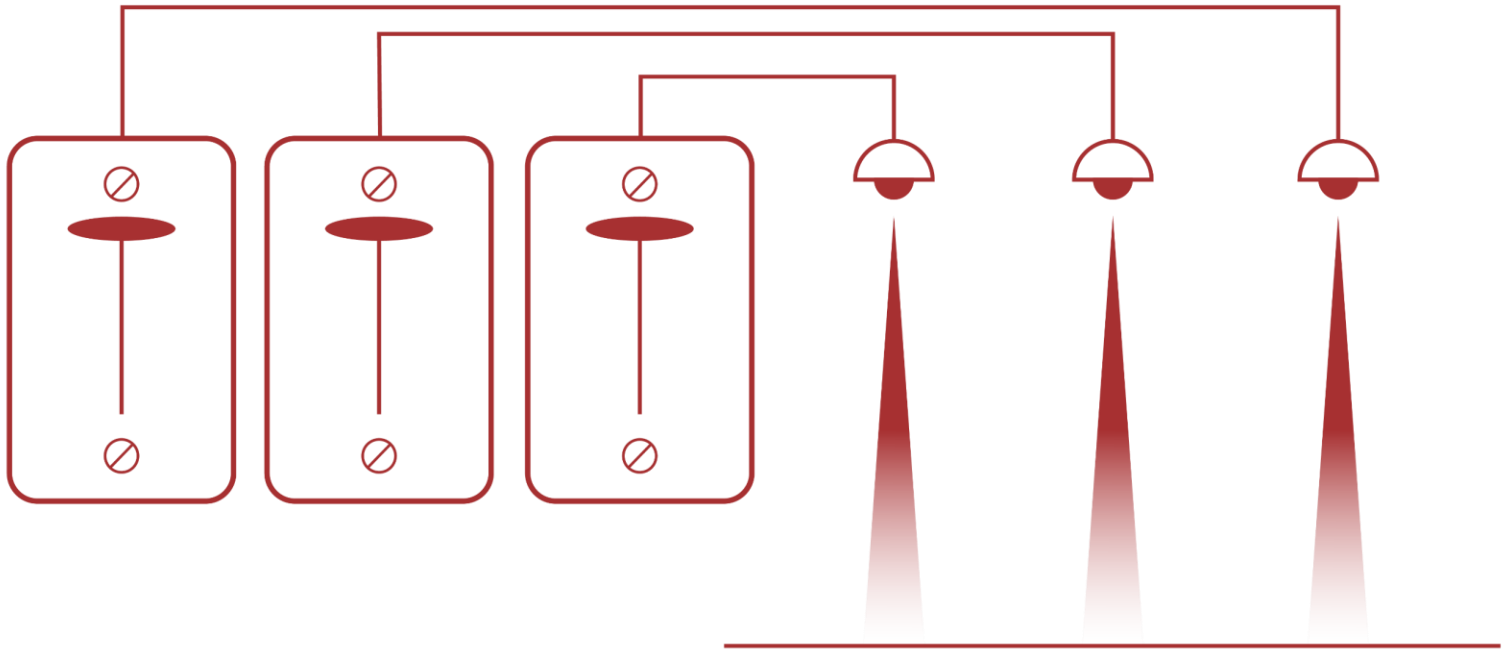
Dimmers - 0-10V



Pros:

- Inexpensive

Cons:

- Unidirectional Data
- Analogue

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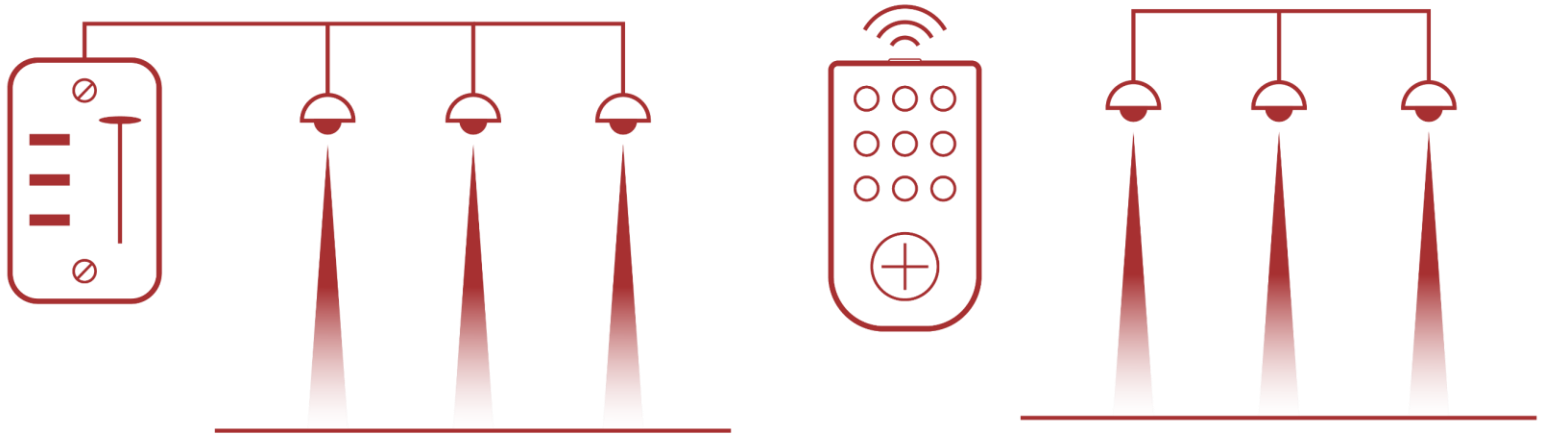
Dimmers - DALI

Digital Addressable Lighting Interface (DALI)



Pros:

- Digital
- Bidirectional data
- 64 connections

Cons:

- More Expensive
- LED Drivers must be DALI

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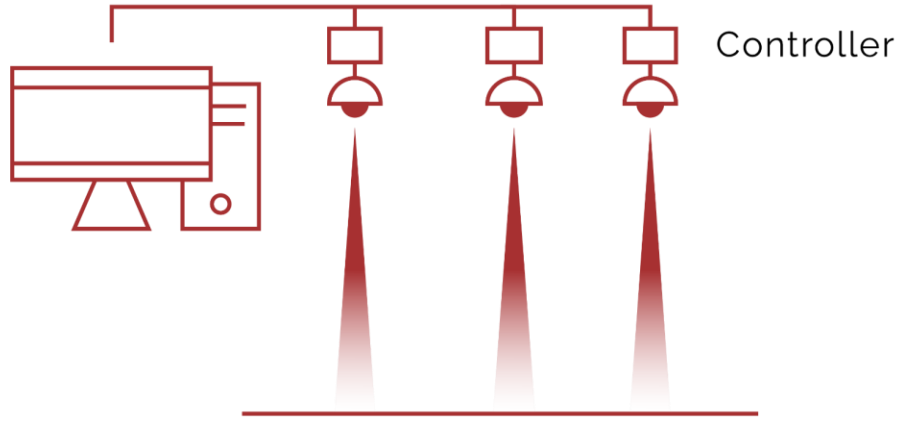
Dimmers - DMX

Digital Multiplexing - Typically used for color changing



Pros:

- Digital
- Bidirectional data
- 512 connections
- Allows color tuning

Cons:

- More expensive
- May require DMX LED Driver

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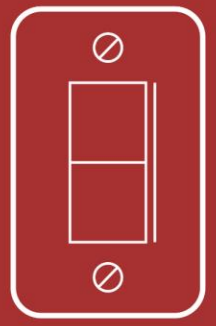
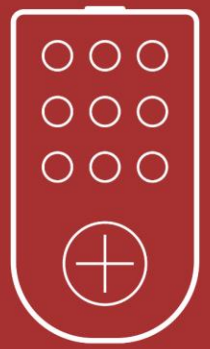
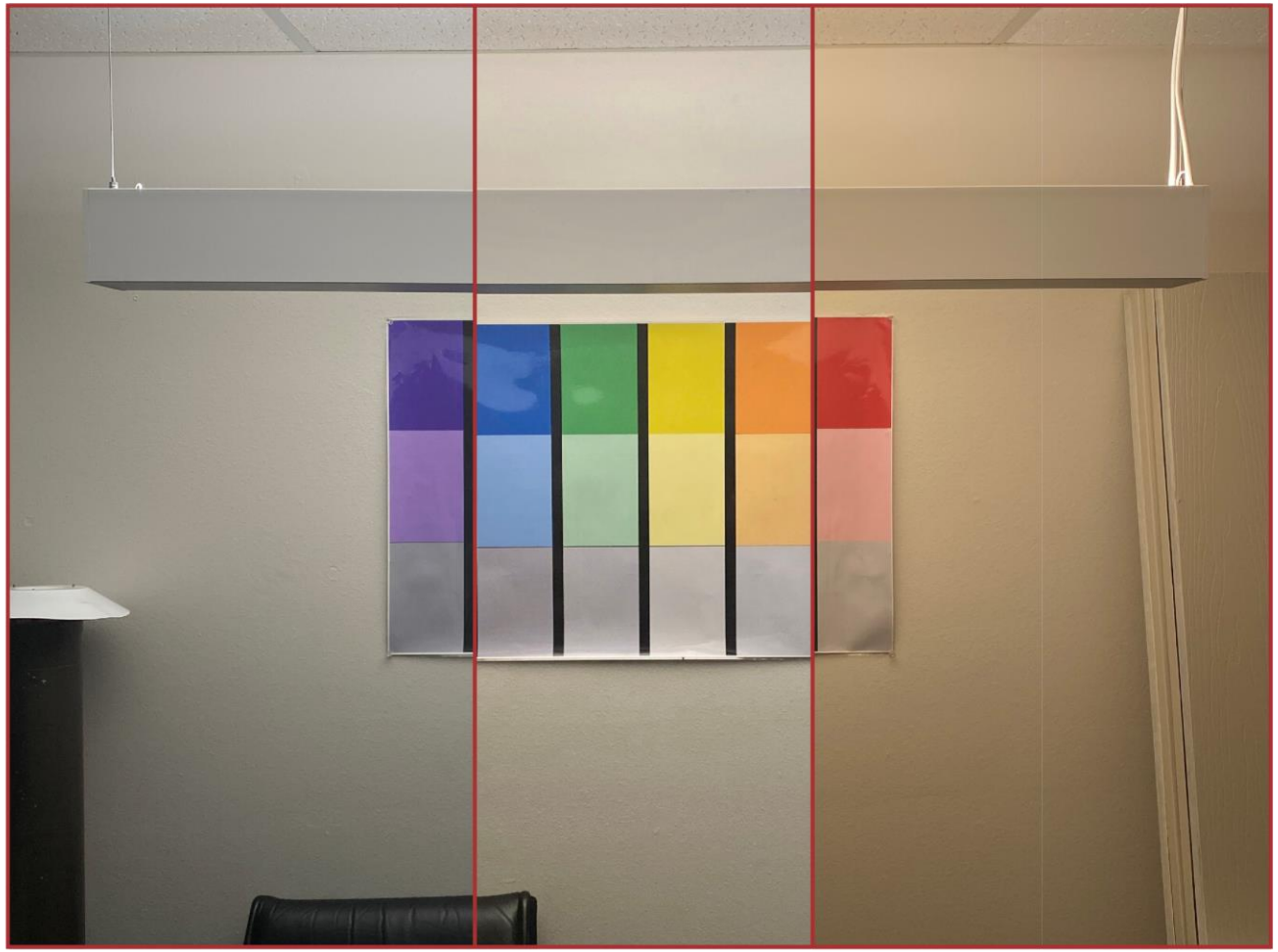




Color Tuning - Tunable white

Allows user to “tune” light from cool to warm.



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Color Tuning - Color Changing

Allows user to choose the color of their lighting.

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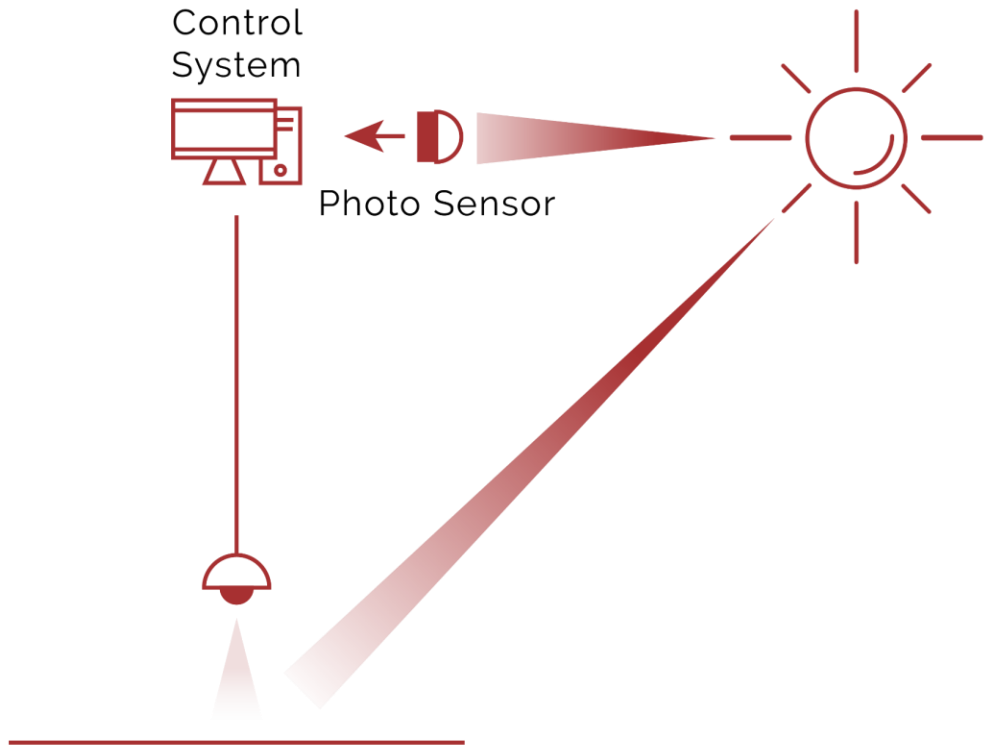
Multi-Level Controls -Daylight Harvesting

Open Loop

Dims light levels when daylight is available to light any given space. Eligible for rebates.



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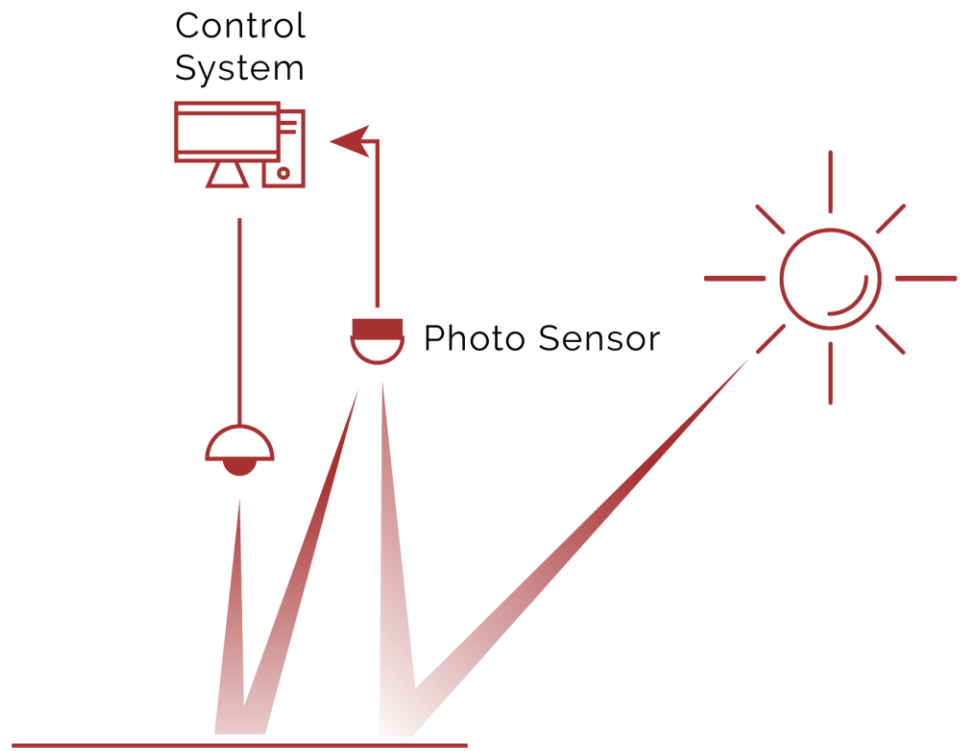
Multi-Level Controls -Daylight Harvesting

Closed Loop

Dims light levels when daylight is available to light any given space. Eligible for rebates.



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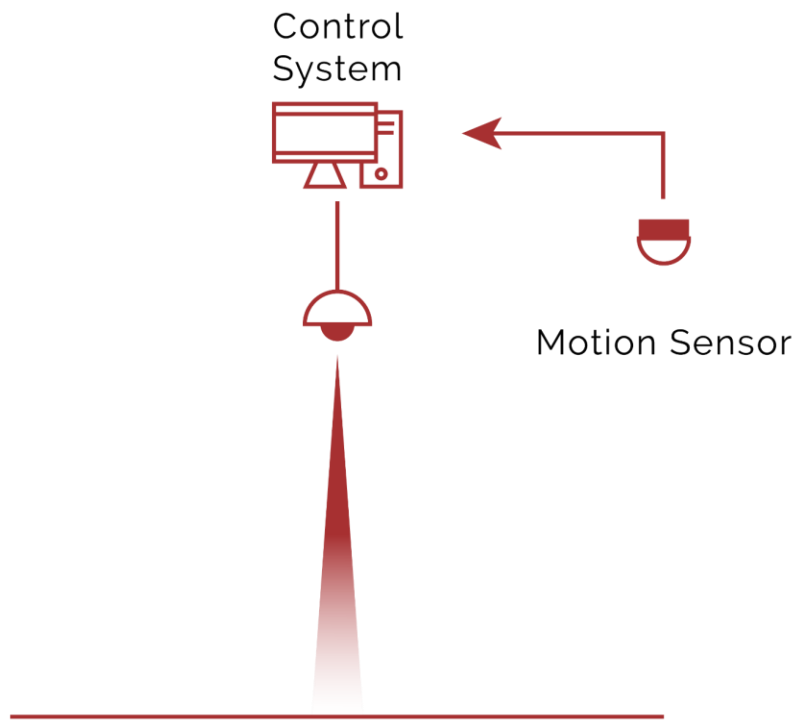
Multi-Level Controls - Occupancy

Utilizes motion detection to adjust lighting based on the occupancy of an area. Eligible for rebates.



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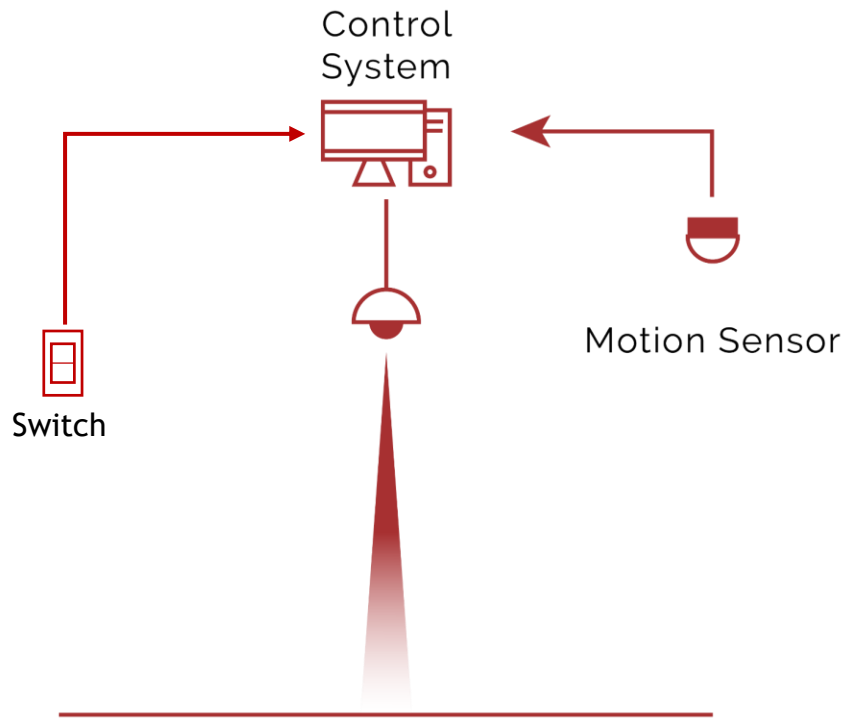
Multi-Level Controls - Vacancy

Utilizes motion detection to adjust lighting based on the occupancy of an area. Eligible for rebates.



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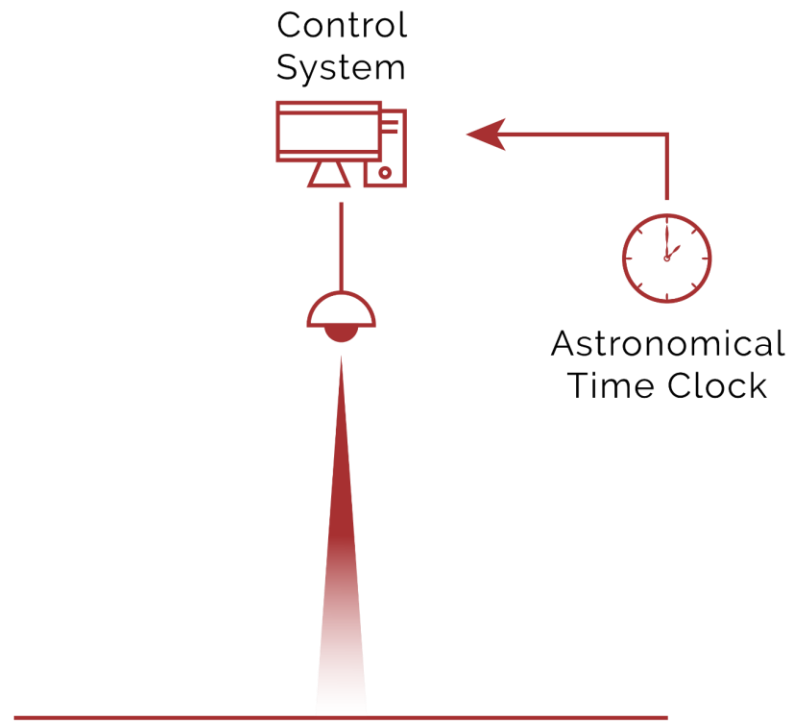
Multi-Level Controls - Time of Day

Provides pre-programmed changes in light levels based on the time of day and season. Eligible for rebates.



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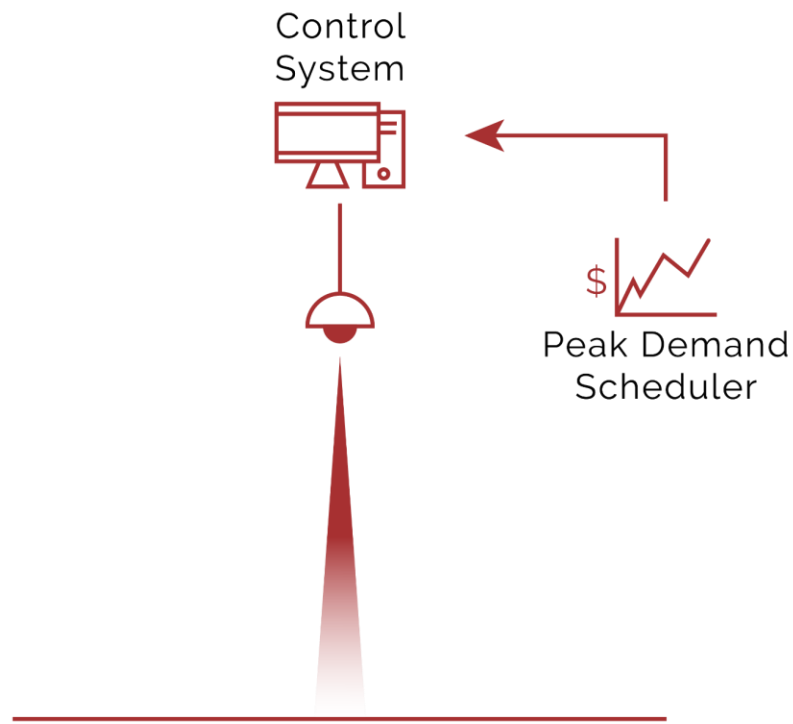
Multi-Level Controls - Peak Energy Demand

Automatically reduces lighting loads during peak electricity usage times. Eligible for re-bates.



Installation - Wired Control Systems

Pros:

More secure

Cons:

Higher Labor Installation

Installation - Wireless Control Systems

Pros:

Lower Labor Installation

Less Disruptive Installation

Better for Retrofits

Cons:

Less Secure

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How do Occupants Use Controls?

Occupants can dim/turn off lighting in personal spaces

Automatic controls are used when their is daylight or when occupants leave without turning off lights.

O&M can program pre-determined automatic settings!

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How do Occupants Use Controls?

Occupants can use GUIs to control and monitor lighting.

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Commissioning Controls - Process

Commissioning Process

Pre-design phase (Programming)	Owner project requirements
Design phase • Schematic design • Design development • Documentation	Basis of design Design submittal Reviews
Construction phase	Verify installation Performance testing
Occupancy & operations phase	End-user training systems manual

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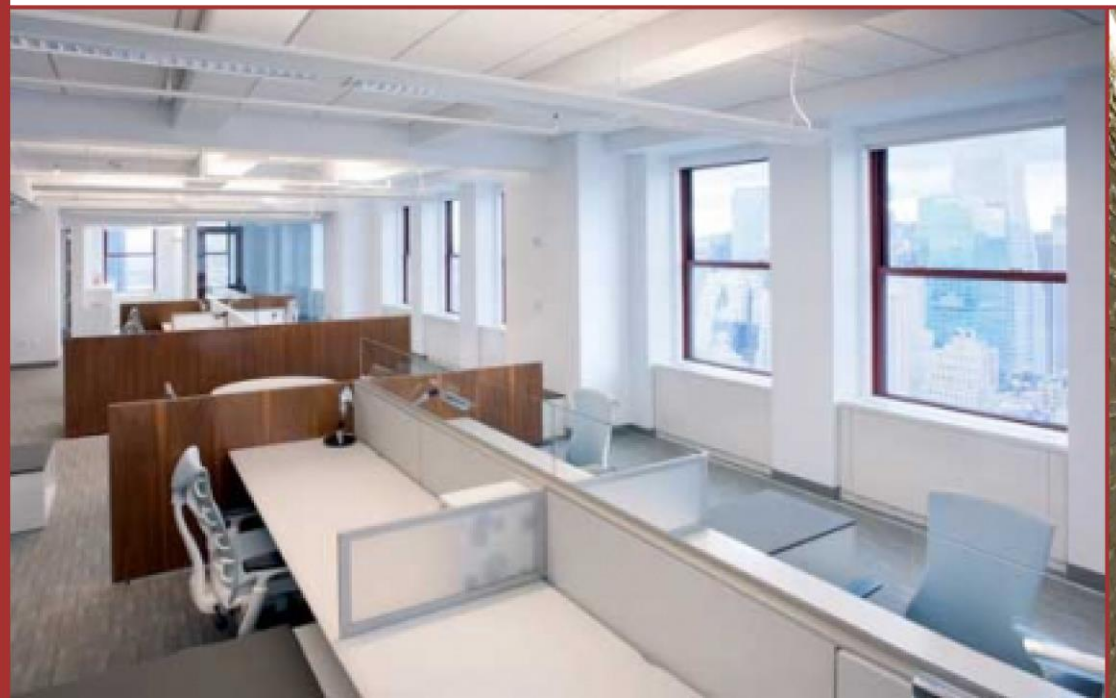
Commissioning Controls - Benefits

1. 13-16% energy savings and reduced operating costs



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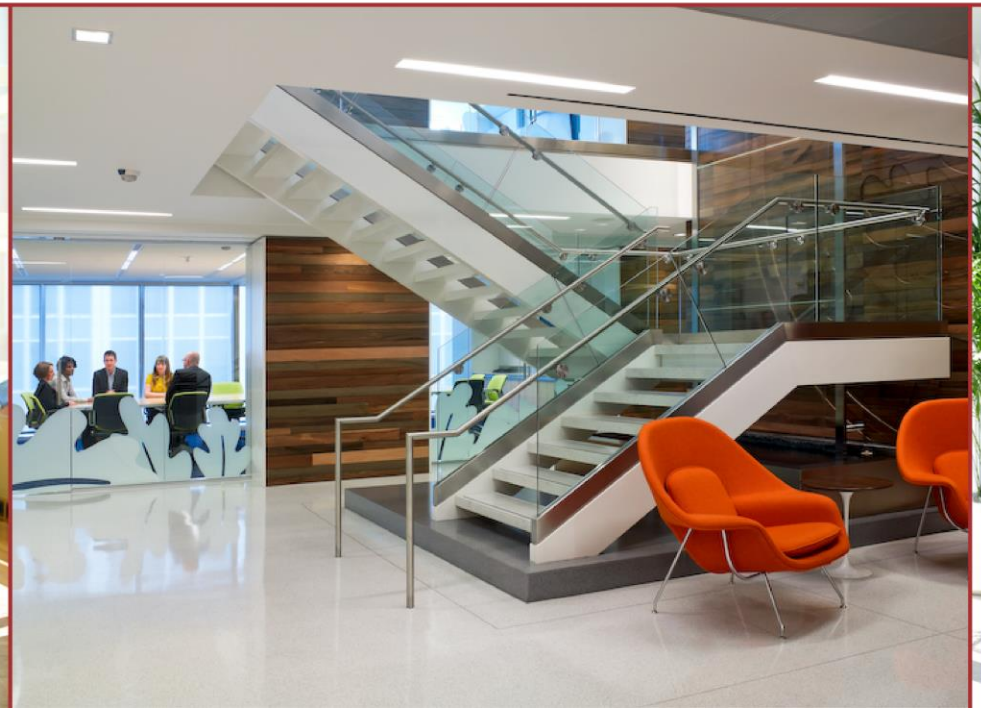
2. Enhanced property value and marketability



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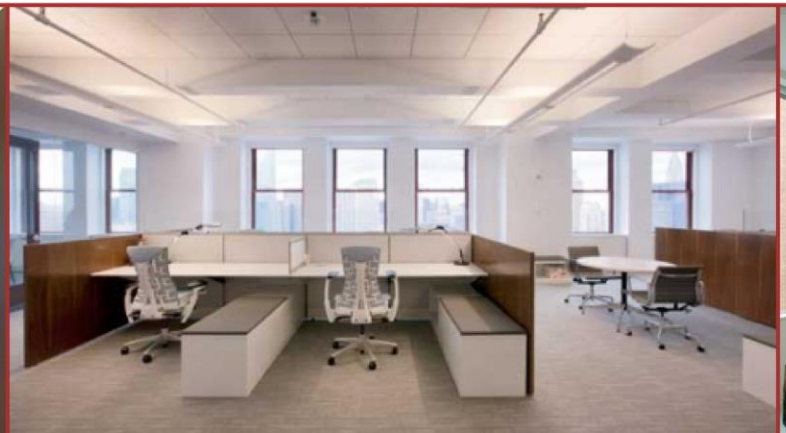
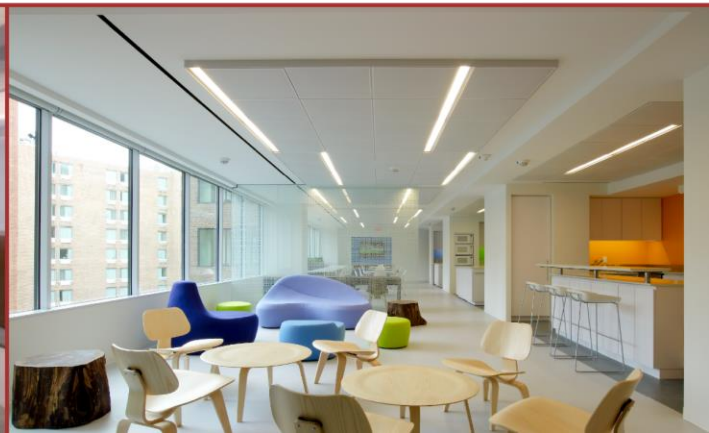

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Commissioning Controls - Benefits

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5. Confidence that building systems will work as intended

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Commissioning Controls - Benefits

1. 13-16% energy savings and reduced operating costs
2. Enhanced property value and marketability
3. Increased quality accountability by project team
4. Reduced risk
5. Confidence that building systems will work as intended
6. Greater user acceptance and satisfaction

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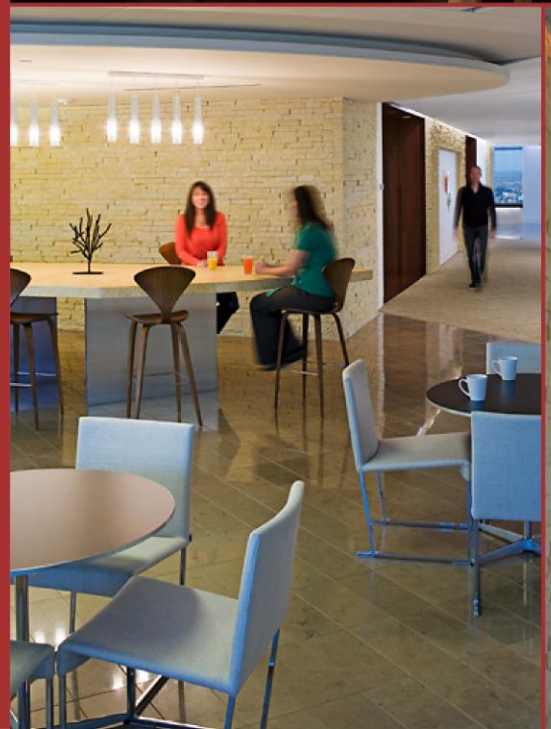
Commissioning Controls - Benefits



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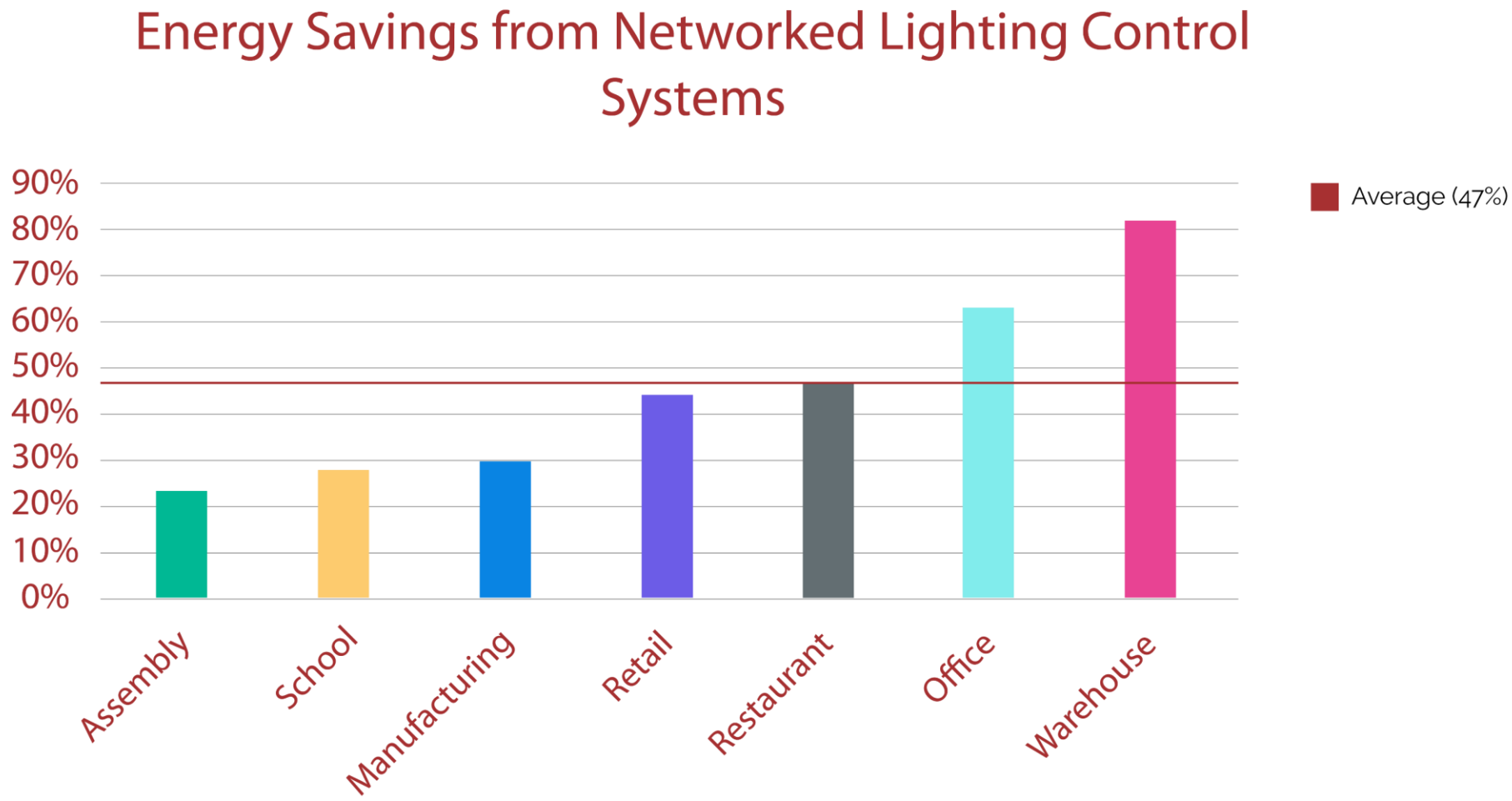
Multi-Level Controls Energy Savings



www.lightingcontrolsassociation.org/2017/11/22/dlc-estimates-energy-savings-from-networked-lighting-controls/

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When are Controls Successful?

1. Devices are properly “tuned” or calibrated
   - Sensors are shipped with factory-set settings
   - Optimizing settings increases user satisfaction

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When are Controls Successful?

1. Devices are properly “tuned” or calibrated

2. Automatic settings work and are easy to adjust

   - Self adaptive sensors analyze patterns and adjust automatically.
   - Consider setting lower lighting levels instead of turning off lights in open offices when unoccupied.

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When are Controls Successful?

1. Devices are properly “tuned” or calibrated
2. Automatic settings work and are easy to adjust
3. Controls save energy

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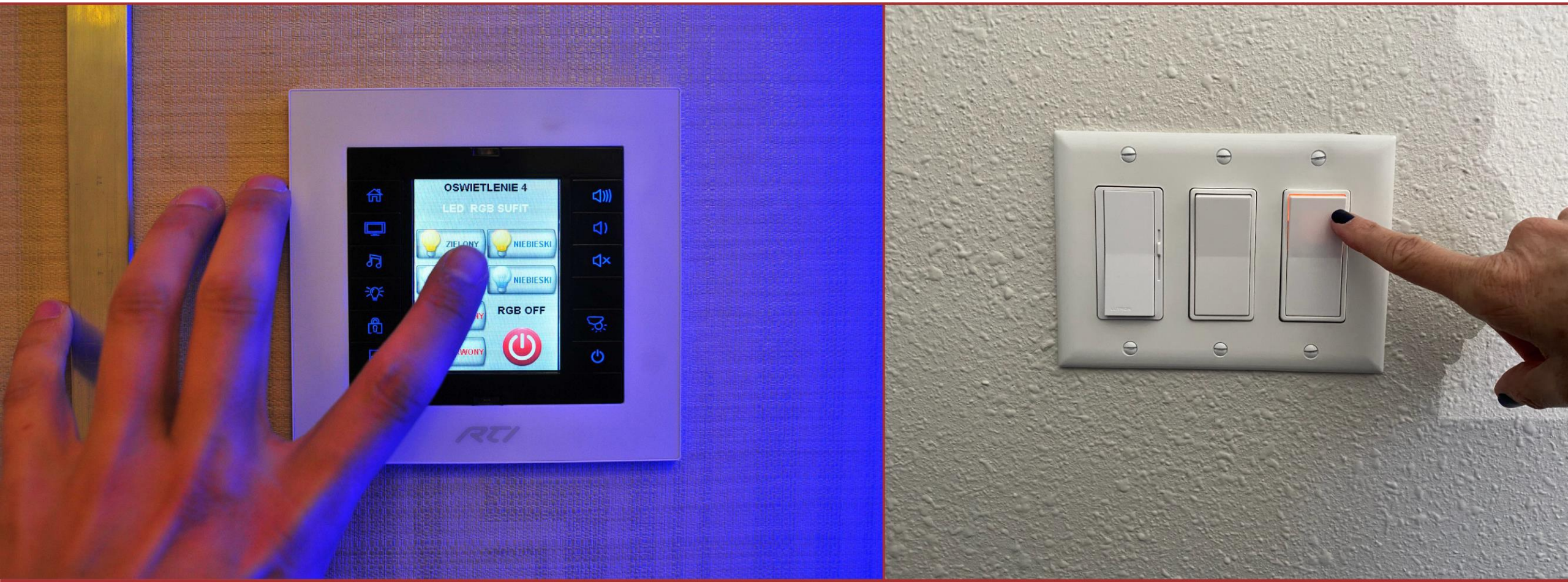
When are Controls Successful?

1. Devices are properly “tuned” or calibrated
2. Automatic settings work and are easy to adjust
3. Controls save energy
4. Occupants feel they have total control
   - Manual controls are most effective in occupied areas.

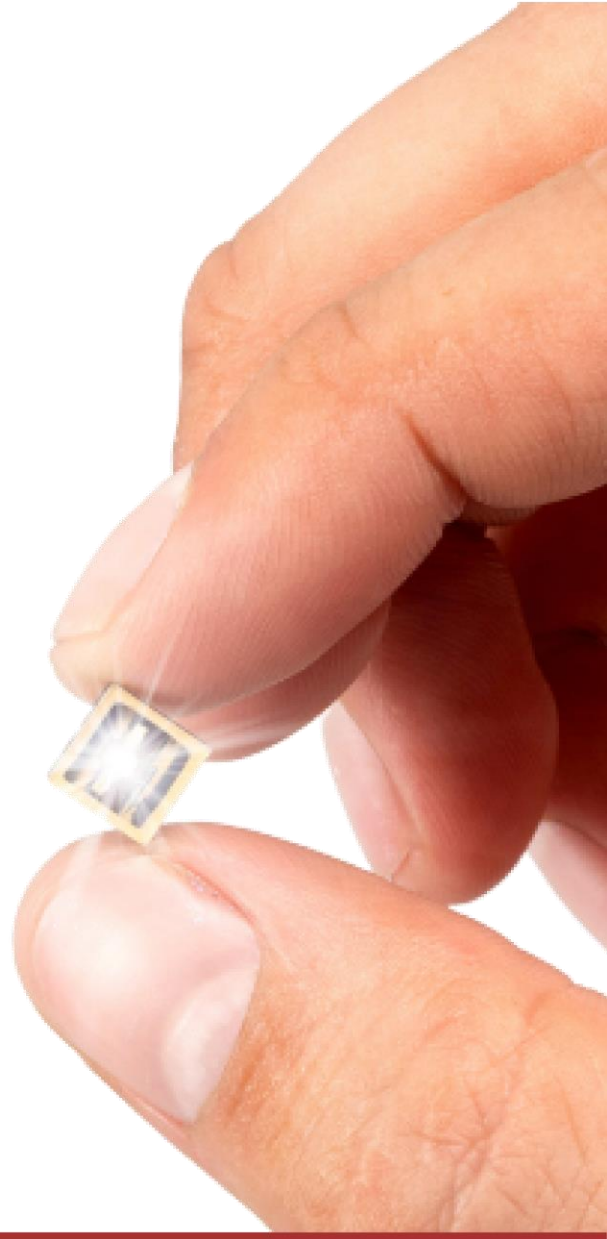
Controls are successful when occupants feel they have total control.



The Future

Laser lighting developers believe that laser diodes will replace LEDs as the light source of the future.

- Lasers could deliver 100 times the luminance of LEDs
- Occupy 1/10th the space
- Deliver 10X the range
- Transmit data (LiFi)



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Questions?

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LIGHTING DESIGN AND ENGINEERING

Let's Chat!

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