

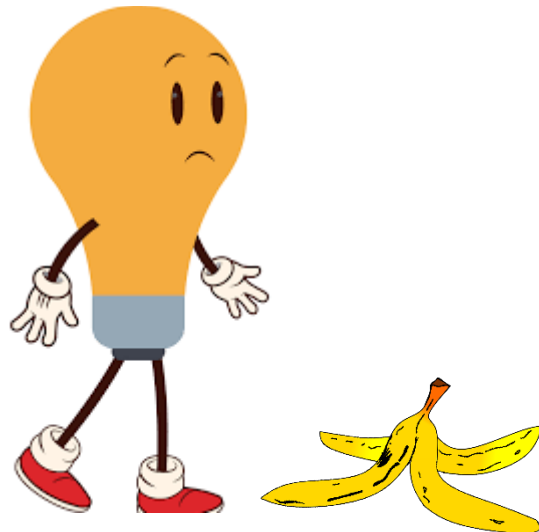
Promoting Energy Efficient Lighting Systems (PEELS)

Presented by

Armando Berdiel Chavez, LC, Meng.

Technology Development Supervisor

Spring 2020



l i g h t i n g d e s i g n l a b

Before we begin...

During the Webinar

- Attendees will be muted
- Please use the chat feature in the control panel to submit questions to LDL staff
- The presenter will pause to address questions every ~10 minutes
- Please participate in the online polls.

Following the Webinar

- Please take the short survey
- A recording and the slide deck will be posted on LDL's webpage
- Reach out to LightingDesignLab@seattle.gov with comments or questions.



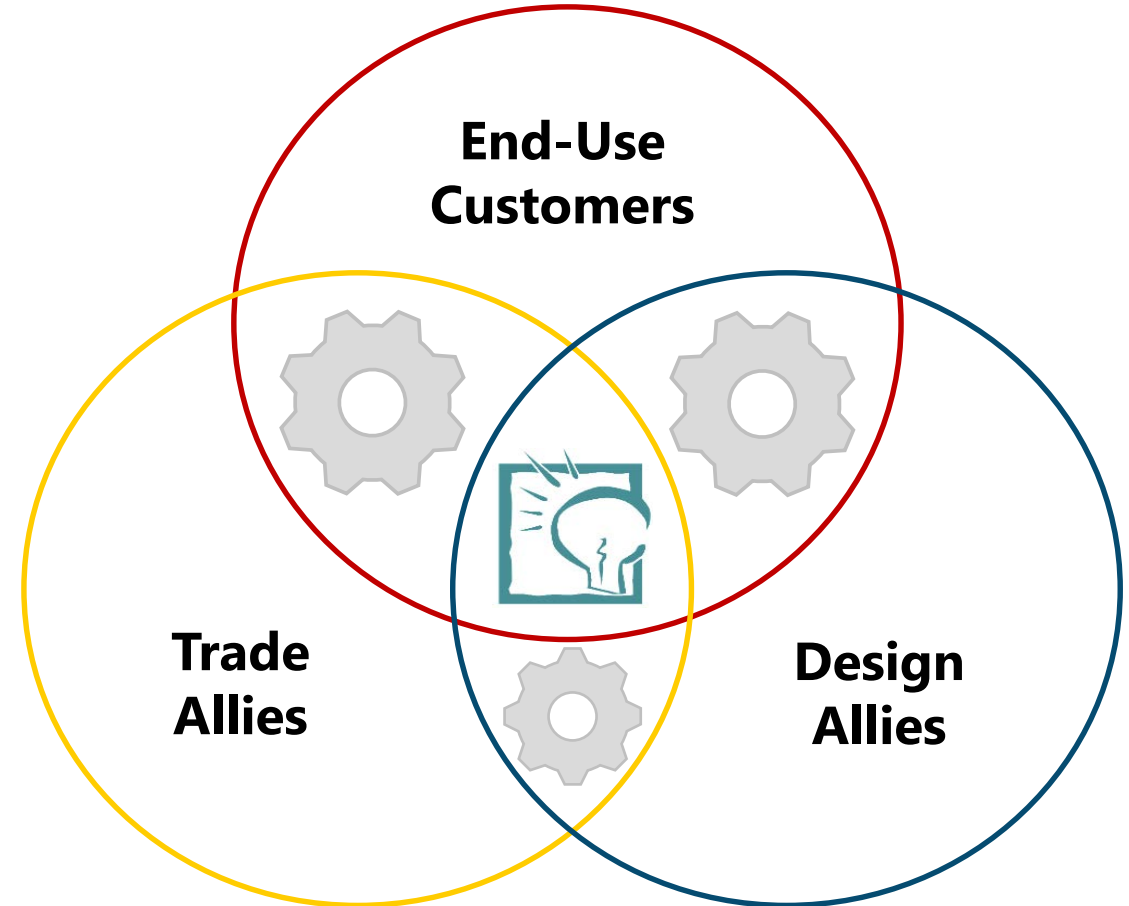
Powered by

Seattle City Light

Who We Work With



It takes a village...

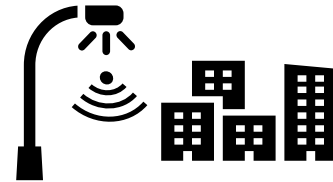


LDL's Four Core Service Areas

EDUCATION & TRAINING



TECHNOLOGY EVALUATION



TOOLS & RESOURCES



INFORMATION AGGREGATION



Instructor Background



Armando Berdiel Chavez, M.Eng., LC
Technical Development Supervisor



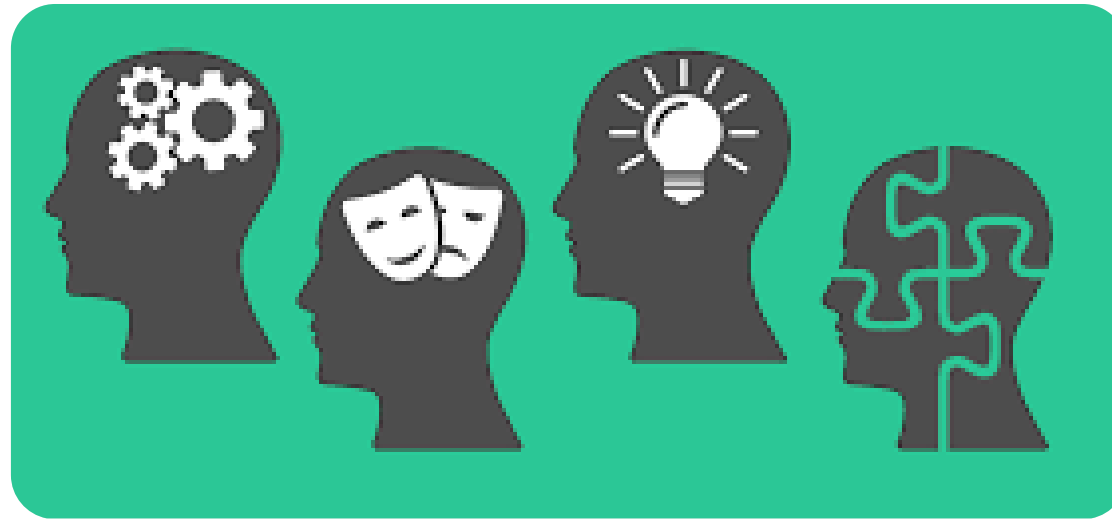
- Lehigh University, B.S.
 - Computer Science & Business
- Penn State University, Meng.
 - Engineering Management
- Lutron Electronics (PA)
 - Systems Support
 - Lead Project Coordinator
- Pearl Street LED Systems (NJ, NY)
 - Project Development Engineer



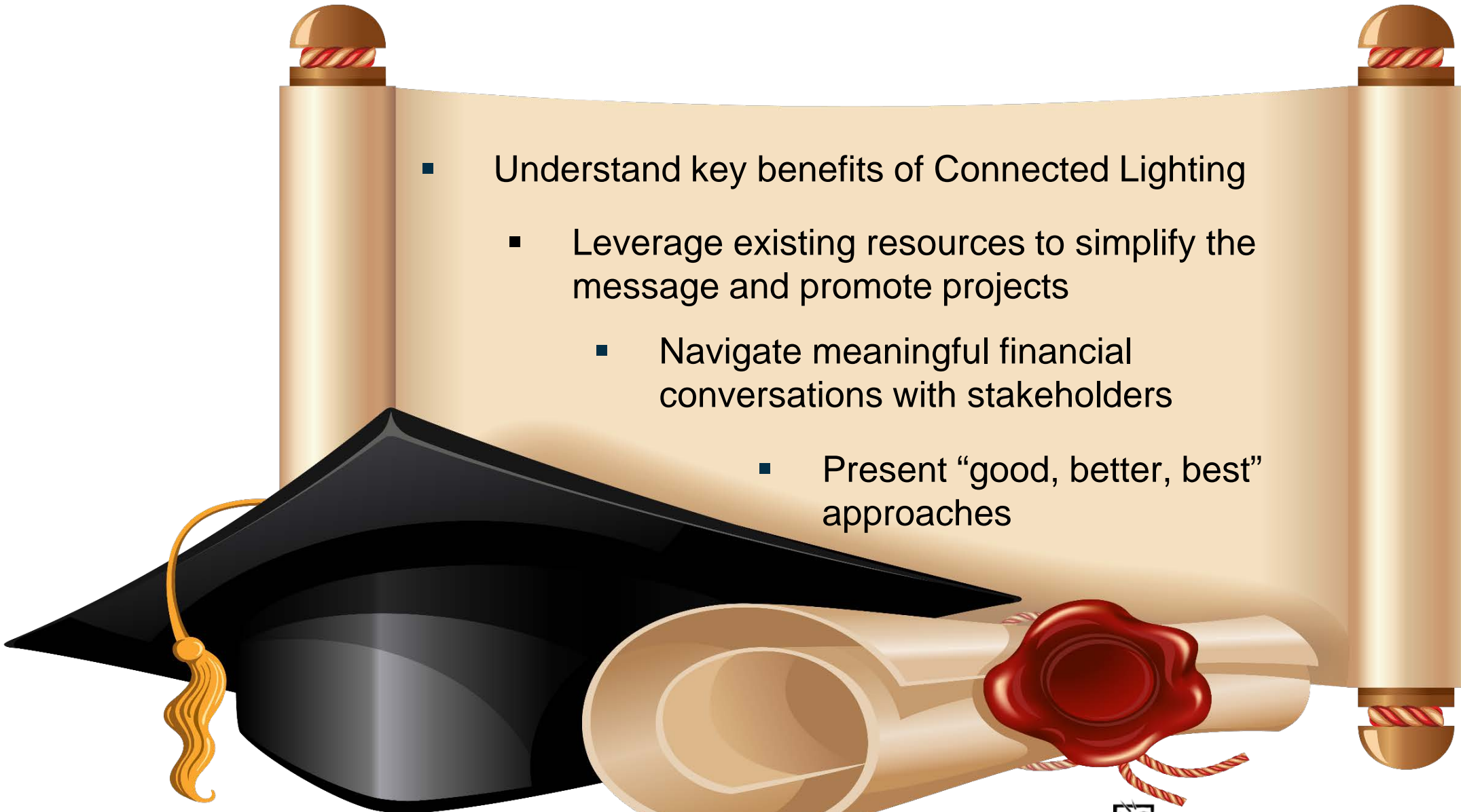
Time for a Quick Poll...

Enough about me...

Let's talk about you...



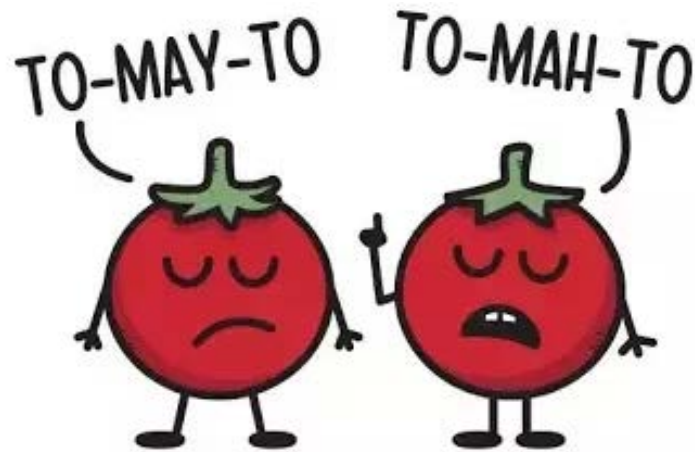
Learning Objectives

- 
- Understand key benefits of Connected Lighting
 - Leverage existing resources to simplify the message and promote projects
 - Navigate meaningful financial conversations with stakeholders
 - Present “good, better, best” approaches

What are We PEEing?



Some Terms, Acronyms, Definitions



Term	Definition
NLC / ALC / LC	Networked Lighting Controls
LLLC	Luminaire Level Lighting Controls
Connected Lighting	LED + NLC
NEB	Non-Energy Benefits
SBE / SB	Smart Building Ecosystem

NETWORKED LIGHTING CONTROLS SERIES



CONTROL TECH TERMS

This guide outlines key terms and concepts you **need** to know in order to communicate effectively with all project stakeholders.

LET'S GET ON THE SAME PAGE

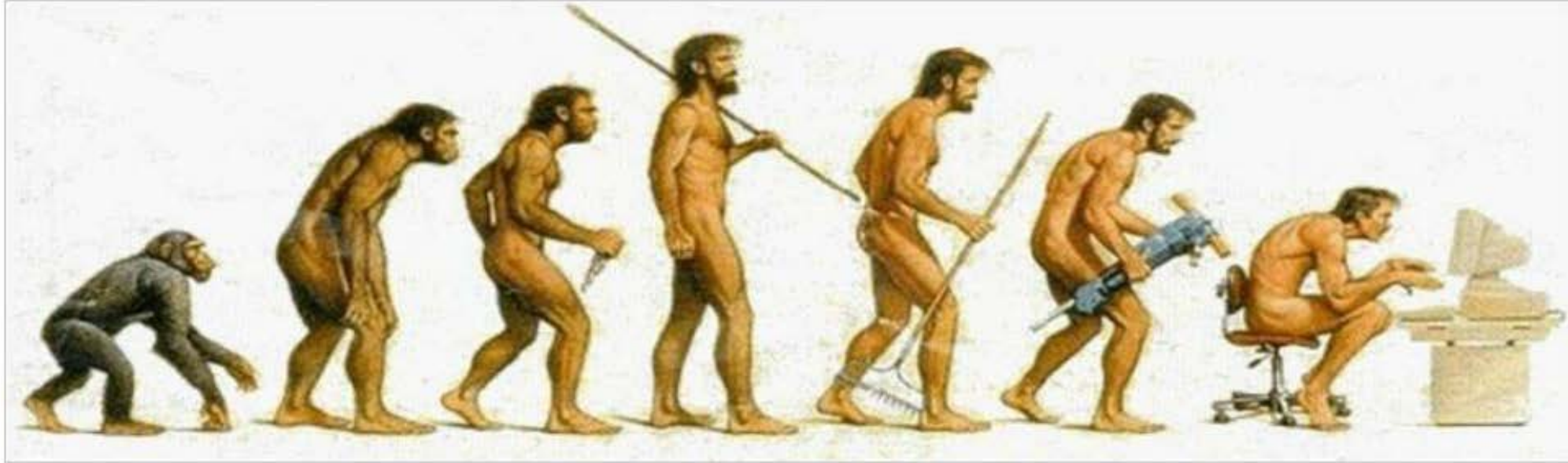
With the rapid pace of change in the lighting and controls industry, it is easy to confuse the ever-expanding list of new terms, technologies, and concepts being applied to networked lighting control solutions.

Part #1: Understanding System Components

Most Networked Lighting Control (NLC) Systems have basic components in common. Understanding the discrete components will help you better understand the pros and cons of different systems available on the market.

COMPONENT	WHAT DOES IT DO	HOW DOES IT DO IT	NOTES
Luminaire driver	Controls power to the luminaire and regulates dimming	Various control protocols; 0-10 volt, DALI, DMX	Not all LED fixtures come standard with dimming
Load controller	Sends commands and data from luminaire to NLC system	Wireless radio signal to Gateway	Load may be luminaires, receptacles, or motors
Gateway or hub	Communicates wirelessly with NLC components and other building systems	RF, cellular, ethernet server	May be wired in very large systems or POE
Central server	A more robust computing platform for NLC's and other whole building systems	Programmed through system computer software	Not required for all NLC, but will be needed to interface with other BMS
Configuration tool	Allows users to program functionality wirelessly throughout the NLC system	Programs load controllers and all system devices	Can be an App, a computer application or a mix of proprietary hardware and software
Wall station	Allows users to send signals to the system and relevant luminaires	By manually pushing a button or touchscreen	Wall stations were formally just known as "switches" or "dimmers"

(Vague) Theory of Lighting Project Evolution



Incandescent
lamps and
toggle
switches for
pennies

Use HID
for
exterior!

Use CFLs
and FL
Tubes for
Interiors!

Use those
sensor
switches to
save energy
and meet
code

LED is too
expensive

Induction
Lamps
are
Coming!!!

Mindful
LED+NLC
Design to
Maximize
Long Term
Gains

Let's Erase the “Saving-Centric” Mentality When Implementing Connected Lighting



What should the Connected Lighting Focus be?

①

Tenant
Comfort and
Building
Purpose

②

Codes &
Recommended
Practices

③

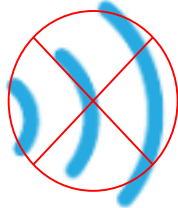
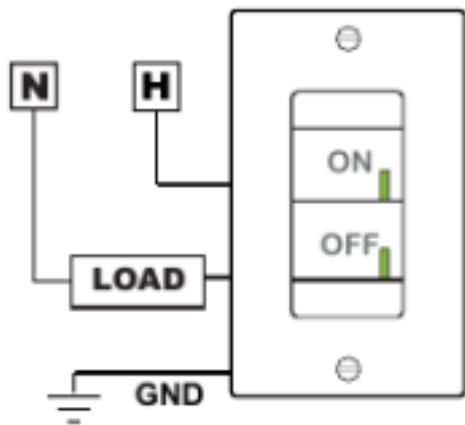
Revenue
Opportunities



The Odds Have Been Stacked Against NLC



Desired Timeout (Minutes)	Number of Flashes from Light/Motion Sensor
1 Minute	2 Flashes
5 Minutes	3 Flashes
15 Minutes	4 Flashes
30 Minutes	5 Flashes

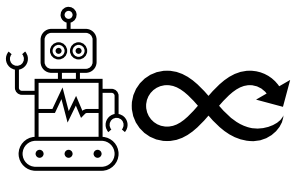


NLCs Today are Smoother and Leverage NEBs

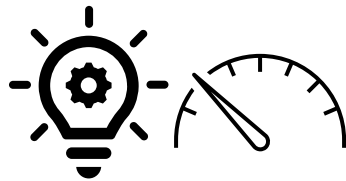
Even though there is still a long way to go...



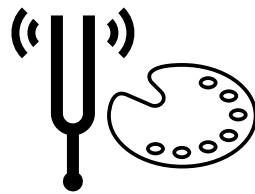
The Proliferation of *FEATURES*...



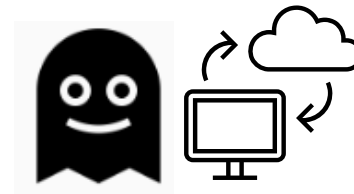
*Controls
Persistence*



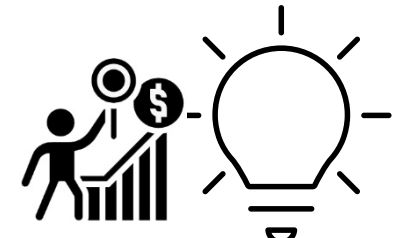
*Energy
monitoring*



Color tuning



Cyber security

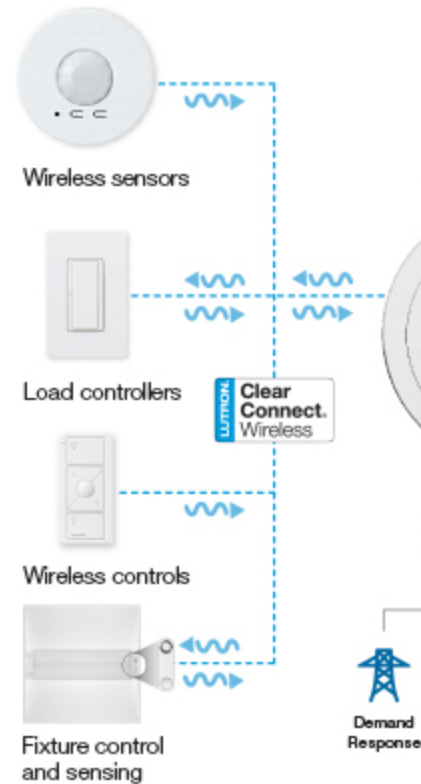


*Demand
Response*

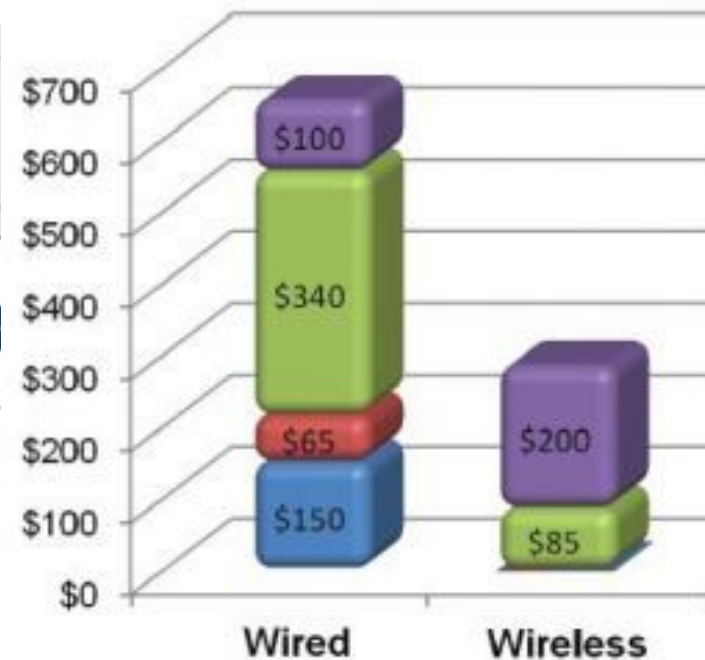
... and so many more

Networked Lighting Controls Today

- Distributed
- Wireless
- More Capable
- More Complex
- Less Complicated
- Less Costly
- Easier to Install / Commission
- Compatible
- Integrated



WIRED VS. WIRELESS COSTS



Where do Savings Come From?



- Converting to LEDs
 - Reduces Wattage
 - About 50%-75% reduction
- Adding NLC/LLLC Systems
 - Reduces Operating Hours
 - 8760 hours in a year
 - About 50%-75% reduction

What is a Kilowatt-Hour?

$$\text{Energy} = \text{Power} \cdot \text{Time}$$

$$\text{kWh} = \text{kW} \cdot \text{hr}$$

$$1 \text{ kW} = 1000 \text{ W}$$

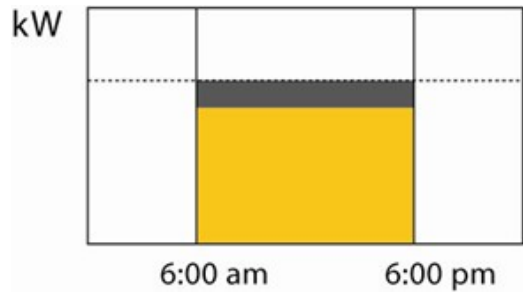
$$1 \text{ hr} = 3600 \text{ s}$$

Medium General Service Downtown Network (MDD)

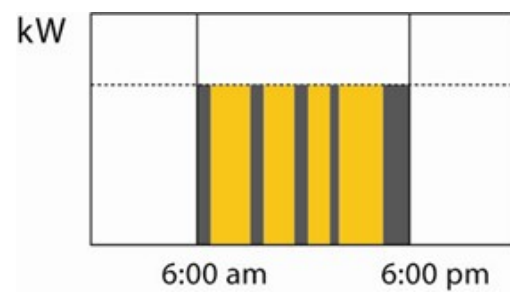
	Jan 2019	Nov 2019	Jan 2020
Per kWh	\$ 0.0925	\$ 0.0919	\$ 0.0987

Four Key Control Strategies – Crash Course

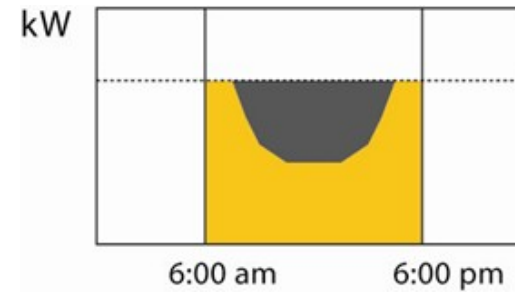
High End Trim or Task Tuning



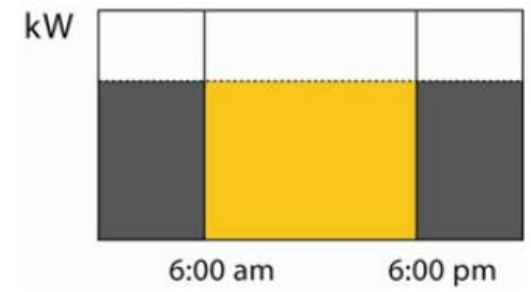
Occupancy & Vacancy



Daylight Harvesting

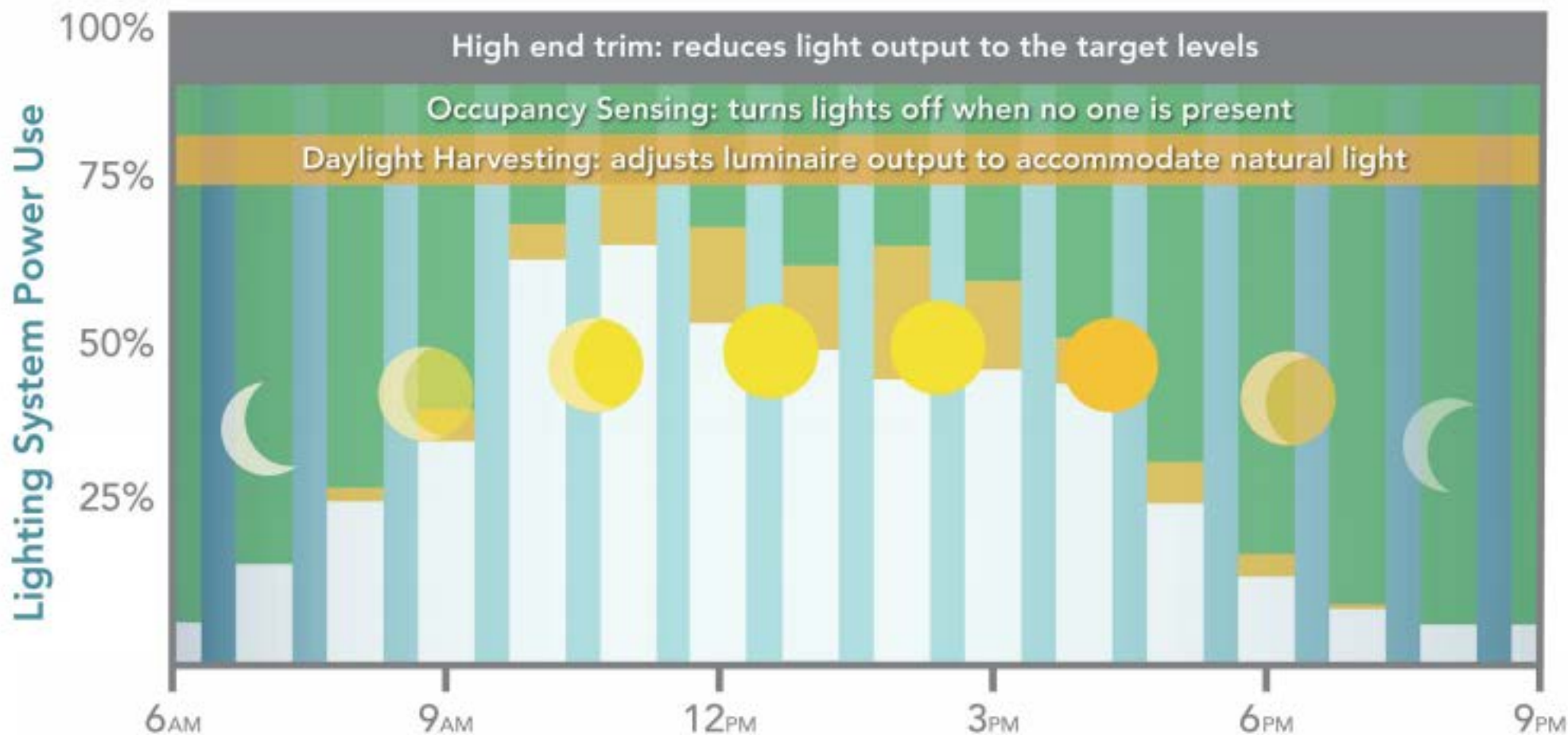


Scheduling

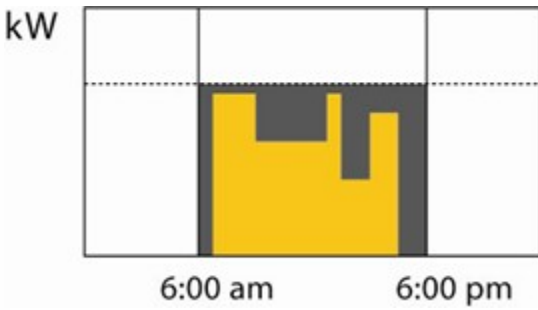


How These Control Methods Work Together

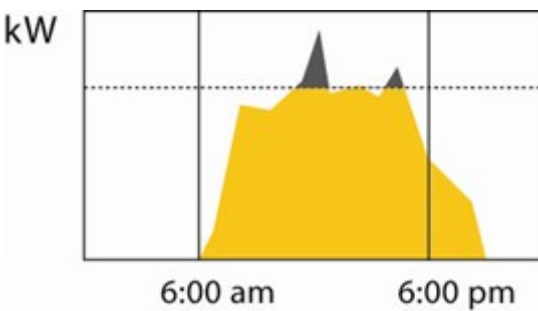
At the building level



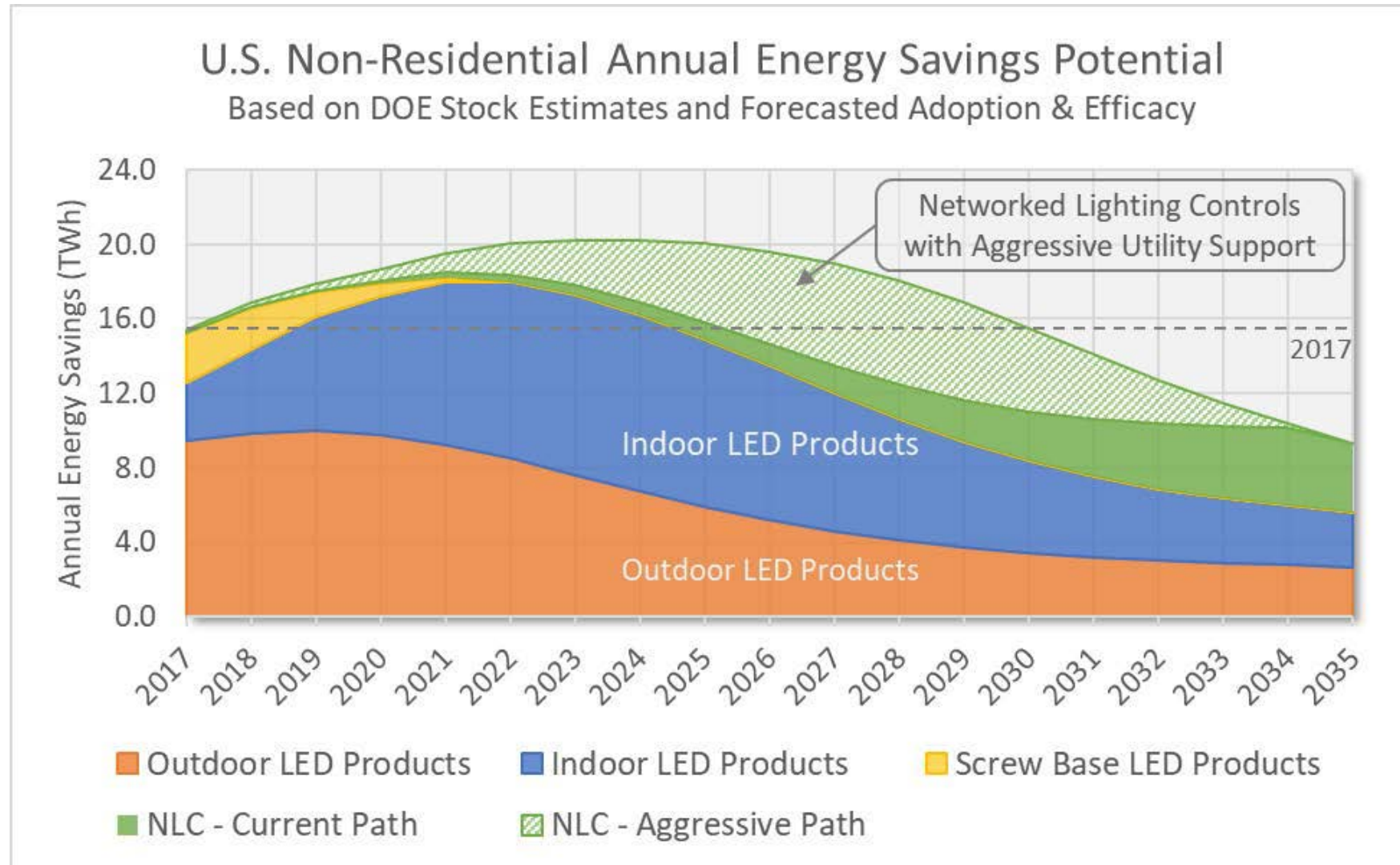
Personal Control



Demand Response



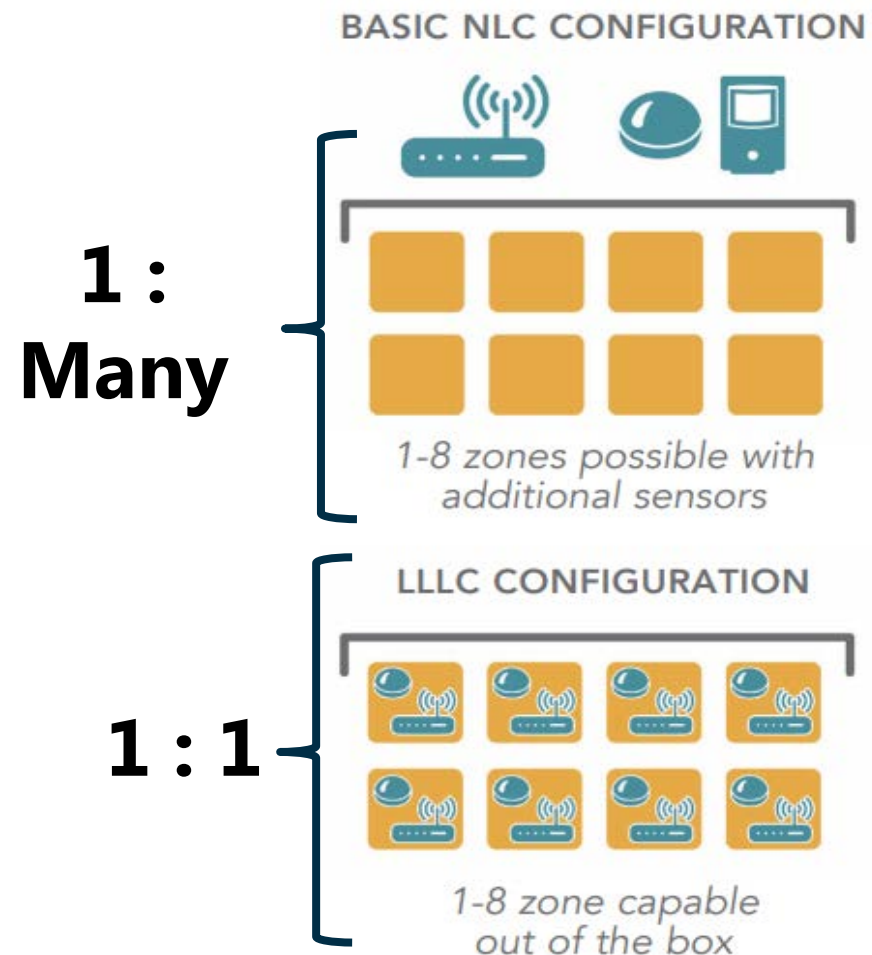
Energy Savings Strategies & Benefits Outlook



ENERGY SAVINGS POTENTIAL OF DLC COMMERCIAL LIGHTING
AND NETWORKED LIGHTING CONTROLS

Did You Know... NLC & LLLC

- Luminaire Level Lighting Control
 - Individually Addressable
 - Integrated occupancy and daylight sensors
 - Continuous dimming
 - Networkable
- Benefits
 - Less Components
 - Labor Savings
 - Simple Configuration
 - Future Expandability
 - Reconfigurable



BONUS: Automatically Meets Code

2018 Washington State Commercial Energy Code*

C405.2 Lighting controls. Lighting systems shall be provided with controls that comply with one of the following:

1. Lighting controls as specified in Sections C405.2.1 through C405.2.7.
2. ~~Luminaire level lighting controls (LLLC) and lighting controls~~ as specified in Sections C405.2.1, C405.2.3 and C405.2.5. The ~~LLLC luminaire~~ shall be independently configured to:
 - 2.1. Monitor occupant activity to brighten or dim lighting when occupied or unoccupied, respectively.
 - 2.2. Monitor ambient light, both electric and daylight, and brighten or dim artificial light to maintain desired light level.
 - 2.3. For each control strategy, configuration and re-configuration of performance parameters including: bright and dim set points, timeouts, dimming fade rates, sensor sensitivity adjustments, and wireless zoning configuration.

2: Individually Addressable

2.1: Occupancy, Vacancy, Dimming

2.2: Daylight Harvesting, Dimming

2.3: Networkable

*As per Gov. Inslee – To be Applied Nov 1st, 2020

LLLC Functionality Example

2)
4)

9:00am
7:00pm

Half Occupied
vacant Space

Lights brighter
Lights go off

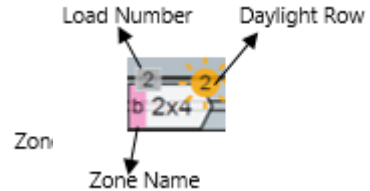
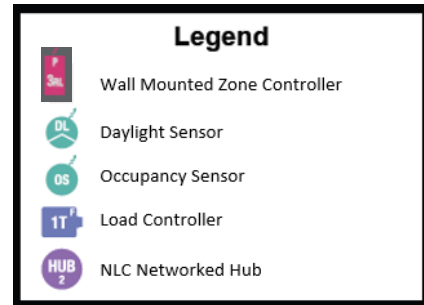
background
desks and/or

daylight level

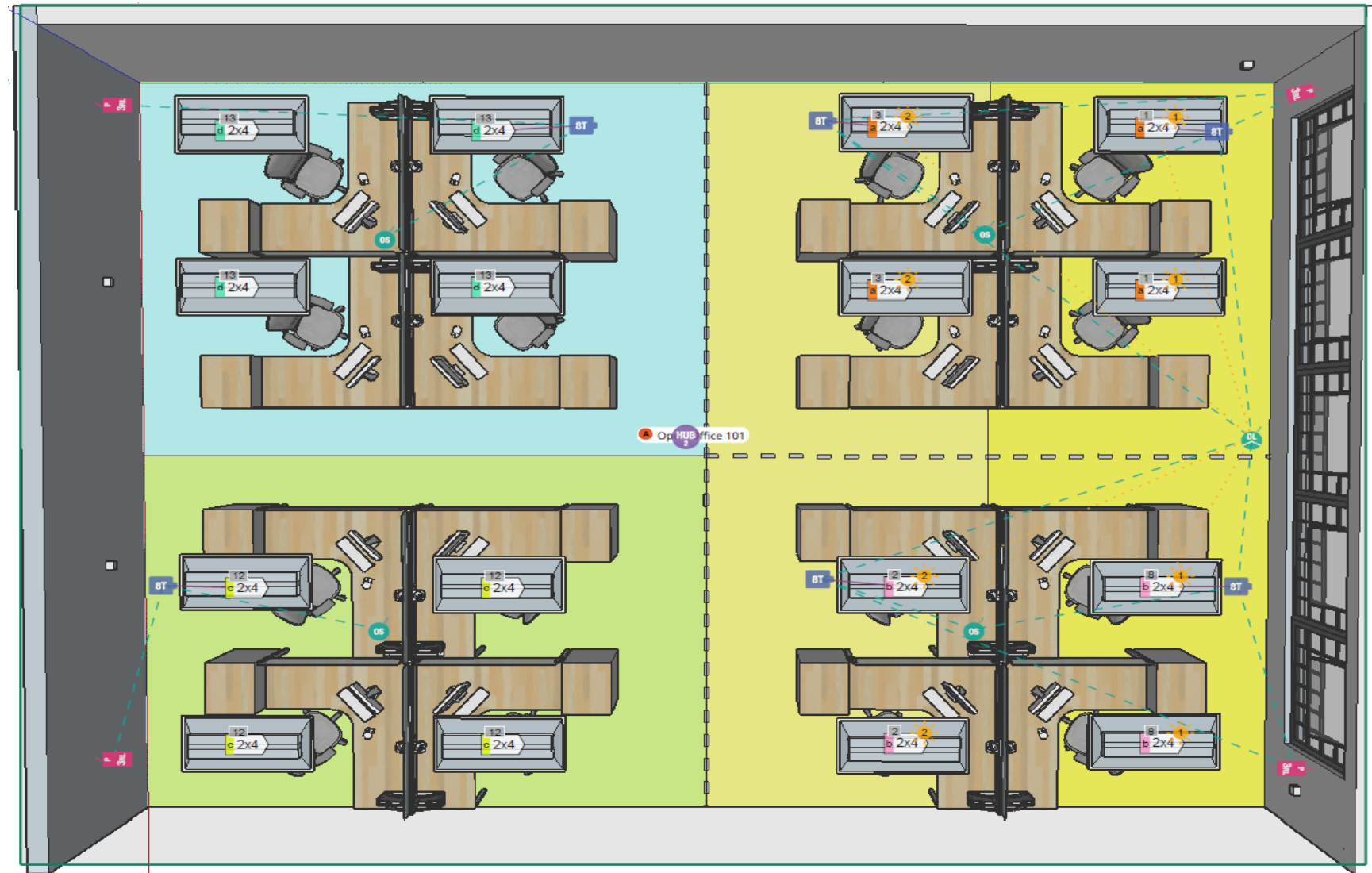
if occupied



NLC & LLLC Cost Analysis Case Study



Assumption:
Labor Rate:
\$100/hour



NLC & LLLC Case Study Cost Comparison

NLC (non-LLLC) Bill of Materials							
#	Part Number	Description	Quantity	Price	Install (Minutes)	Install \$	Material \$
1	PJ2-3BRL-GWH-L01	Wall Station	4	\$ 21.00	30	\$ 200.00	\$ 84.00
2	LRF2-DCRB-WH	Daylight Sensor	1	\$ 125.00	30	\$ 50.00	\$ 125.00
3	LRF2-OCR2B-P-WH	Occupancy Sensor	4	\$ 89.00	30	\$ 200.00	\$ 356.00
4	HJS-2-FM	Gateway/Hub	1	\$ 1,700.00	60	\$ 100.00	\$ 1,700.00
5	RMJS-8T-DV-B	0-10V Load Controller	6	\$ 152.00	60	\$ 600.00	\$ 912.00
6	CW-1-WH	Claro Wallplate	4	\$ 5.00	0	\$ -	\$ 20.00
7	PICO-WBX-ADAPT	Wallbox Adapter	4	\$ 8.00	0	\$ -	\$ 32.00
8	FIXTURES	Placeholder for Fixtures	16	\$ 200.00	30	\$ 800.00	\$ 3,200.00
						\$ (1,950.00)	\$ (6,429.00)

LLLC Bill of Materials							
#	Part Number	Description	Quantity	Price	Install (Minutes)	Install \$	Material \$
1	PJ2-3BRL-GWH-L01	Wall Station	4	\$ 21.00	30	\$ 200.00	\$ 84.00
2	HJS-2-FM	Gateway/Hub	1	\$ 1,700.00	60	\$ 100.00	\$ 1,700.00
3	CW-1-WH	Claro Wallplate	4	\$ 5.00	0	\$ -	\$ 20.00
4	PICO-WBX-ADAPT	Wallbox Adapter	4	\$ 8.00	0	\$ -	\$ 32.00
5	LLLC FIXTURES	Placeholder for LLLC Fixtures	16	\$ 270.00	30	\$ 800.00	\$ 4,320.00
						\$ (1,100.00)	\$ (6,156.00)

NLC & LLLC Case Study Cost Comparison

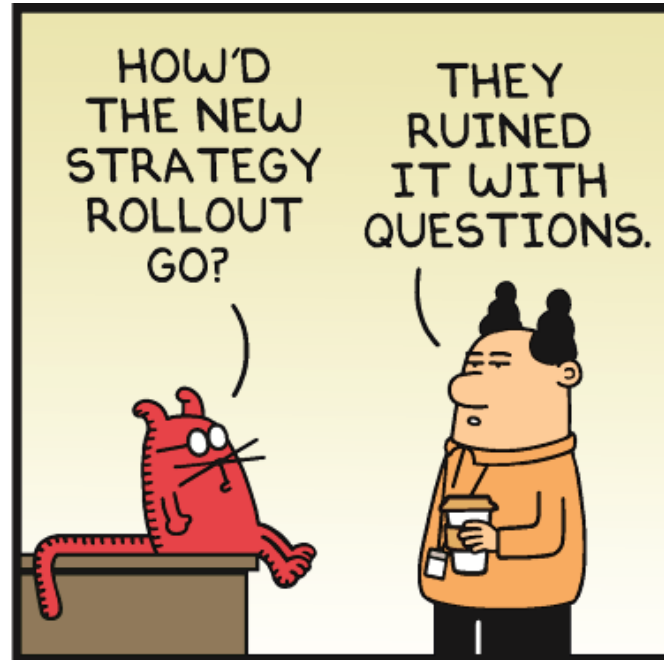
NLC (non-LLLC) Net Project Costs	
NLC Materials Cost	\$ (6,429.00)
Labor	\$ (1,950.00)
Room Commissioning	\$ (200.00)
Utility LLLC Incentive	\$ -
Utility Performance Incentive	\$ 500.00
Net Project Cost	\$ (8,079.00)

LLLC Net Project Costs	
LLLC Materials Cost	\$ (6,156.00)
Labor	\$ (1,100.00)
Room Commissioning	\$ (150.00)
Utility LLLC Incentive	\$ 800.00
Utility Performance Incentive	\$ 600.00
Net Project Cost	\$ (6,006.00)

What does the FIRST '1' in 1:1 or 1:Many stand for?

- Load Controllers
- Hubs/Gateways
- Wall Stations
- Day/Occ Sensors

Pause for Questions

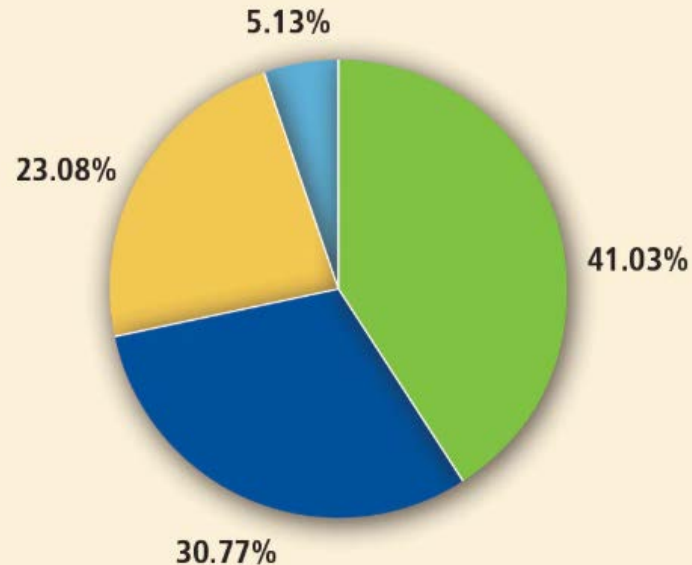


Energy Savings ... And?



Connected Lighting Prospectus for Buildings

NLC NEBs as Secondary Business Opportunity



Very likely
Somewhat likely
Possibly likely
Somewhat unlikely
Very unlikely, net responses 0%

LEDs Magazine SSL "State of the Industry" 2020 Survey

The 1-9-90 Rule

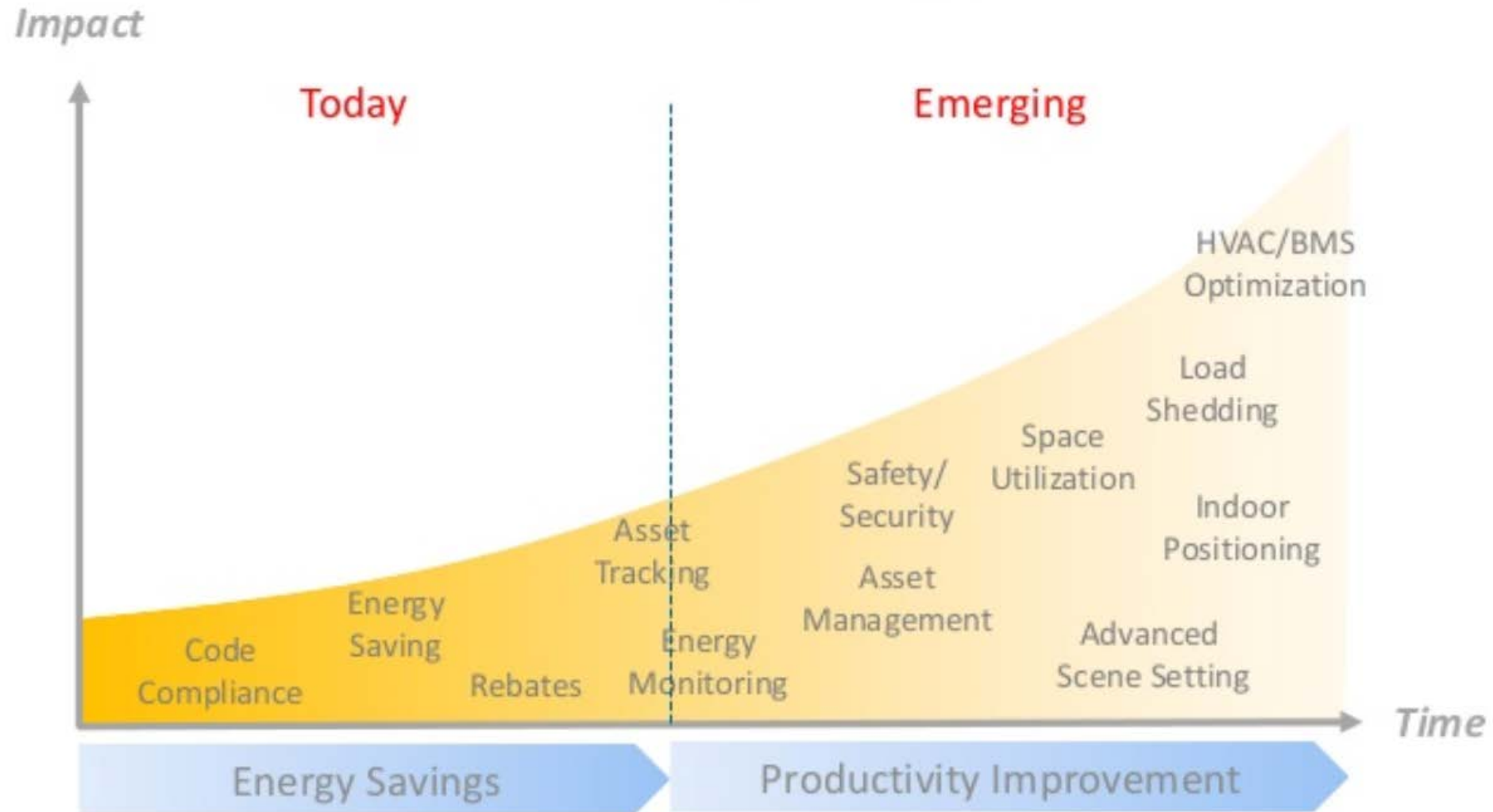
1% Energy & Resources

9%: Space & Layout

90%: Wellness & Productivity

+100%: Revenue & Opportunities

Leverage Non-Energy Benefits When Discussing Value



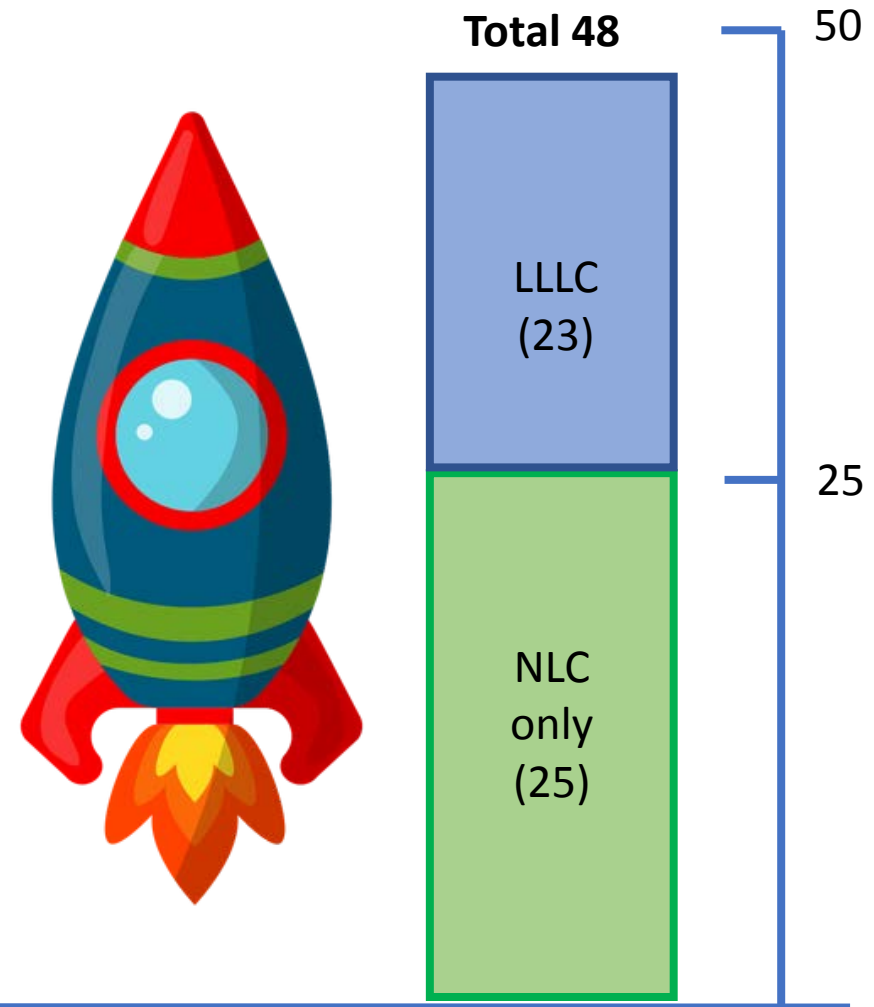
Current Market Trends & Dynamics

Market Proliferation*

- **48** systems currently on DLC NLC QPL
- **23** systems are LLLC

Just a Few System Features

- Controls Persistence (66%)
- Energy Monitoring (87%)
- Cyber Security (10%)
- Color Tuning (37%)
- Demand Response (64%)



**Total system count and features pulled from DLC's
Networked Lighting Controls QPL 5/27/20*

Smart Building Platforms are Increasing and Evolving

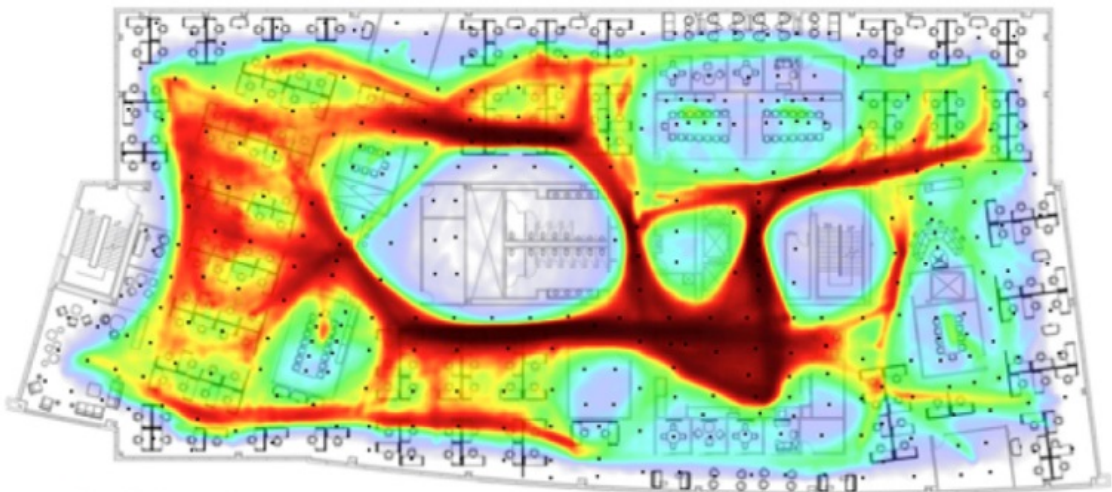


Space Utilization

- Cost of Empty Space?



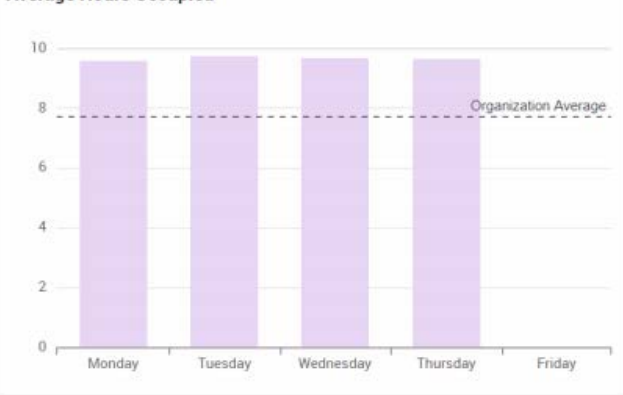
- Cost of Space Analysis



enlighted

Demo Building - Floor 3

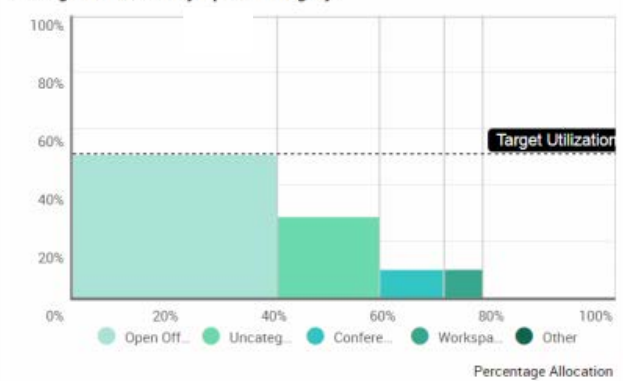
Average Hours Occupied



Utilization Over Time



Average Utilization By Space Category



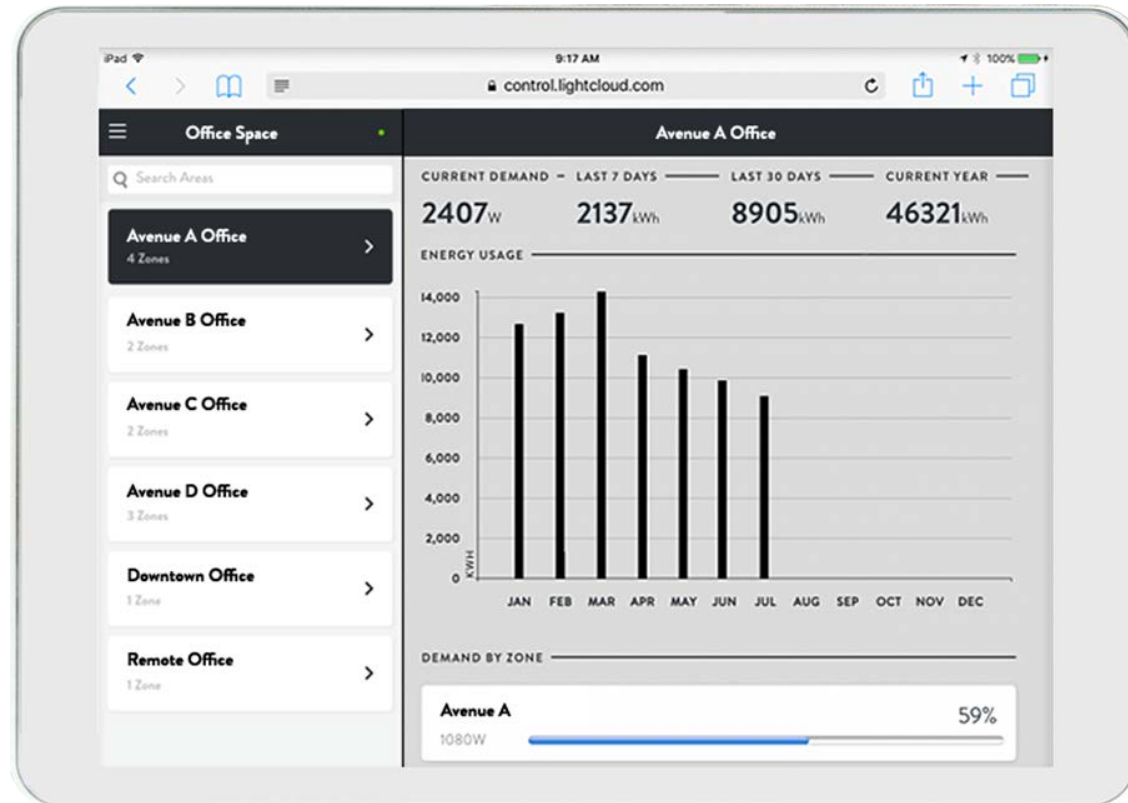
Utilization By Space Category

Space	Average / Portfolio Average	Peak / Portfolio Average
Amenities	13% / 51%	81% / 51%
Break Area	48% / 51%	80% / 51%
Conference Room	23% / 51%	58% / 51%
Corridor	54% / 51%	98% / 51%
Focus Booth	28% / 51%	70% / 51%
Food	67% / 51%	100% / 51%
Huddle-Area	2% / 51%	50% / 51%
Meeting	36% / 51%	75% / 51%
Meeting Room	31% / 51%	57% / 51%



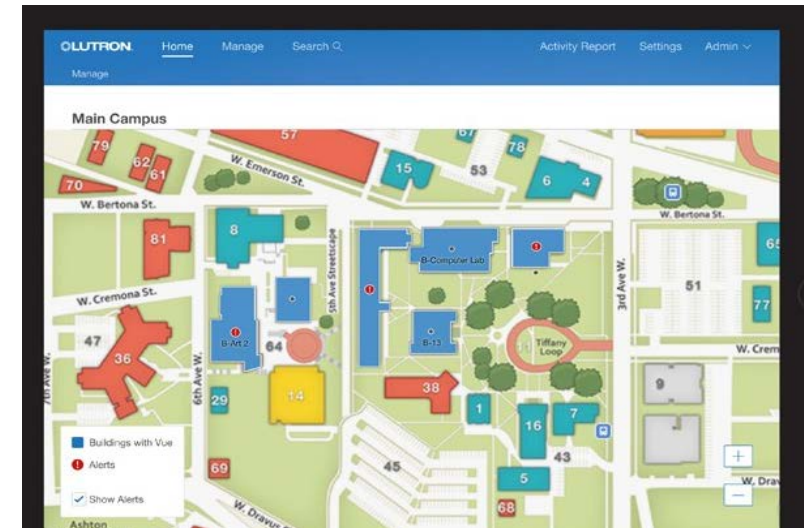
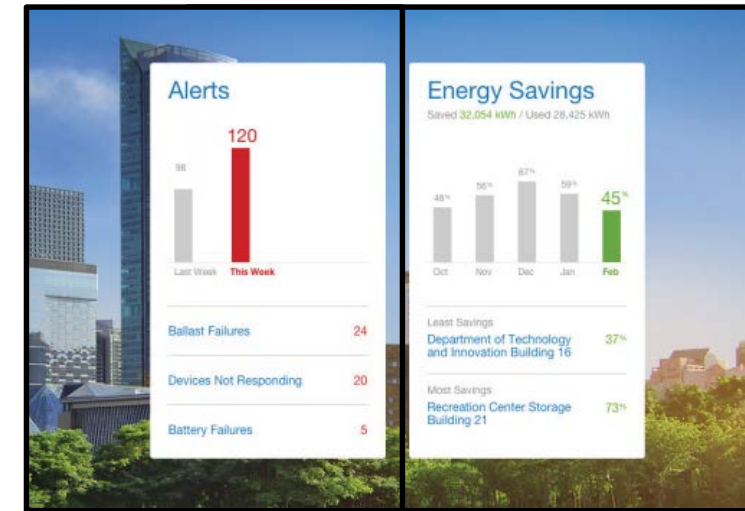
lighting design lab

NLC/LLLC Energy Monitoring, Control, & Diagnostics



RAB Lightcloud

Lutron Vive



Lutron Vive

Asset Tracking

VA Pittsburg Healthcare Case

Study Inventory management inefficiencies at hospitals



EINSTONE Track & Trace – Process Optimization and Efficiency Enhancements



- 1 The Asset Beacon is attached on a movable object and sends signal.
- 2 An EINSTONE Beacon, integrated in the lighting infrastructure, receives the signal from the Asset Beacon.
- 3 Data is transferred via a Bluetooth Low Energy mesh to a gateway.
- 4 The gateway sends data to the secured cloud.
- 5 The data is displayed for easy review in a dashboard, e.g. current location, temperature, state, heat maps, statistics and analytics of utilization.

**OSRAM
EINSTONE**
Beacon
Included

Indoor Positioning & Wayfinding

LEDs
MAGAZINE

Target gives the go-ahead on IoT lights at half its stores



LLLC

LLLC



Demand Response (Traditional Operation: Sneaker-net)



NLC/LLLC Automatic Demand Response

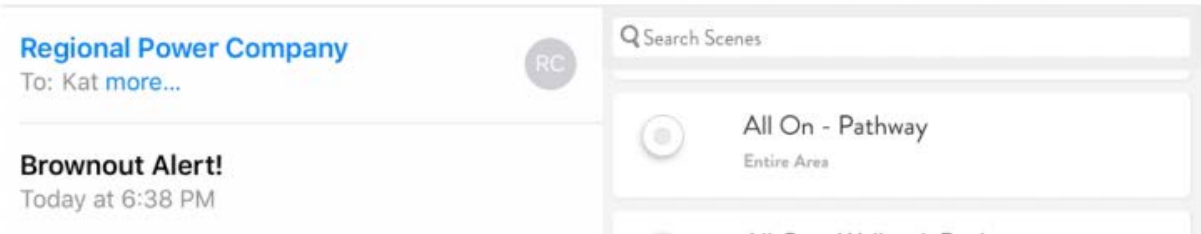
Lutron Vive



RAB LightCloud



When you receive a Demand Response alert from your utility, turn the Scene On.



Leviton Sector Distributed Lighting

Tunable White Lighting

- Specific color tuning adjusting the correlated color temperature / SPD
- Meant to affect mood or alertness.
- Circadian lighting.
- Simple preference?



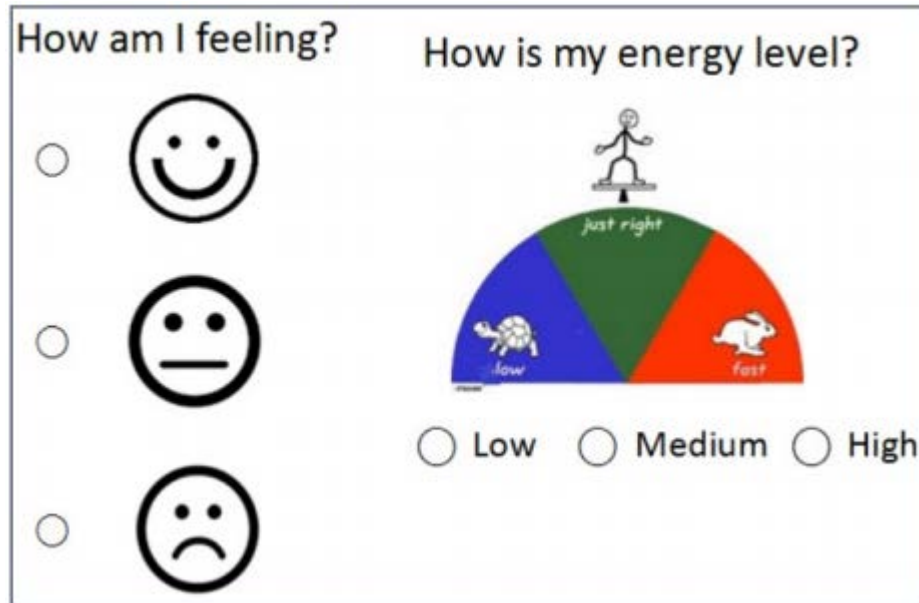
Tunable White in Classrooms – PNNL & DOE 2018-2019 Study

Study Conclusions

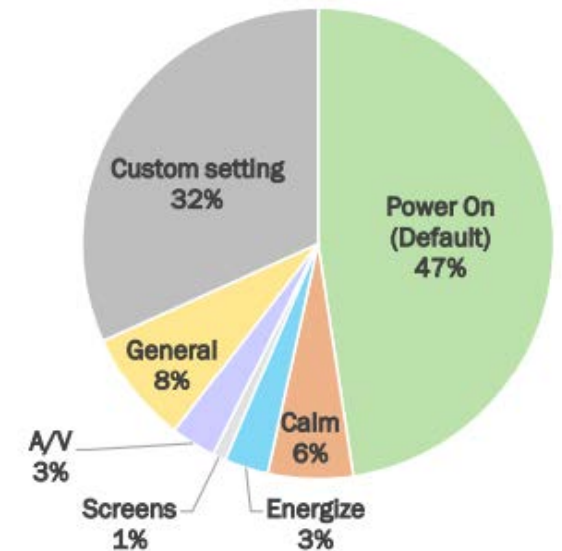
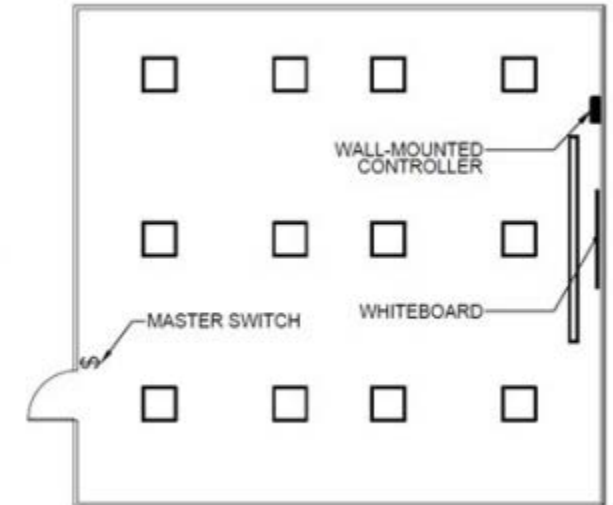
How am I feeling?

How is my energy level?

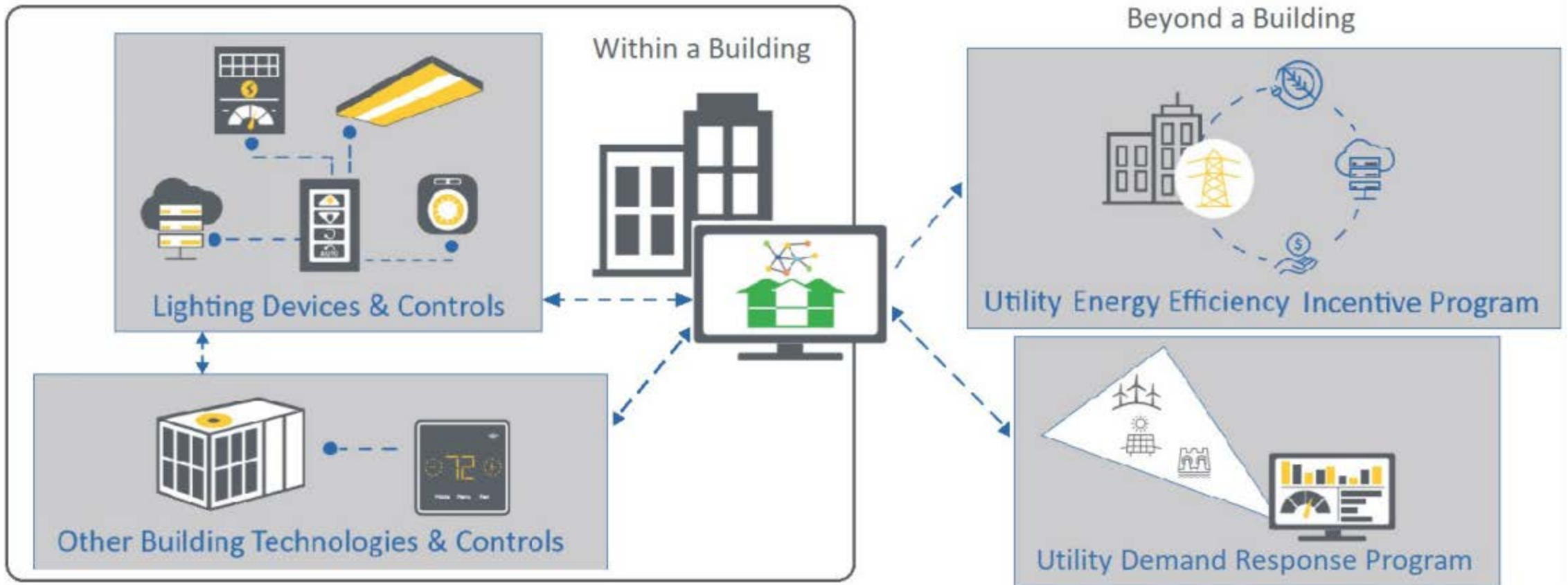
Low Medium High



- improved working conditions and learning environment for teachers and students



Infrastructure for the Technologies of Tomorrow



Courtesy of DLC: *Interoperability for Networked Lighting Controls* (May 19 2020)

Pause for Questions



What strategy[ies] should be most successful in promoting efficient lighting systems?

- Energy Savings
- Infrastructure for Connected Technologies
- Directly solving stakeholder problems
- Utility Dollar Injections

Barely Acceptable, Better, Best Approaches



Tunnel Mindset on Margins and Value

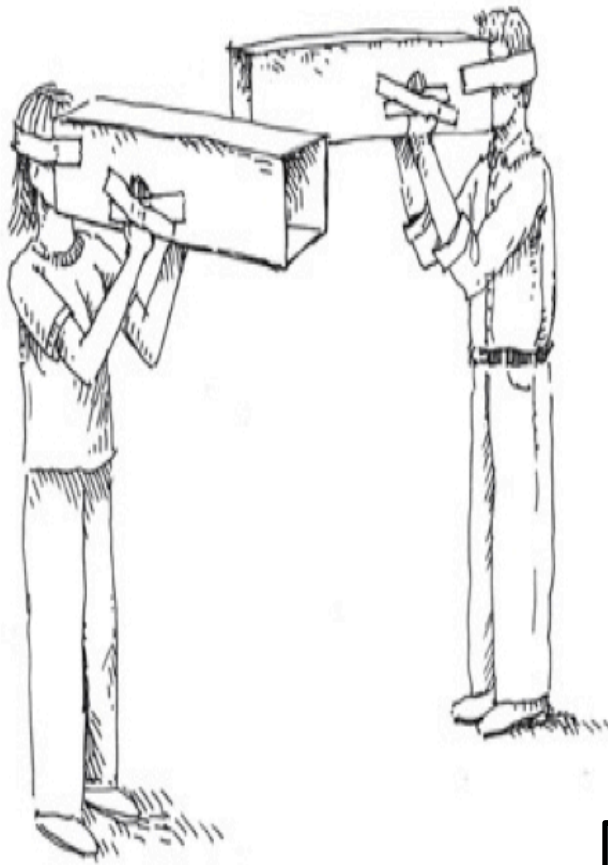
Can You Recognize The Tunnel Mindset?



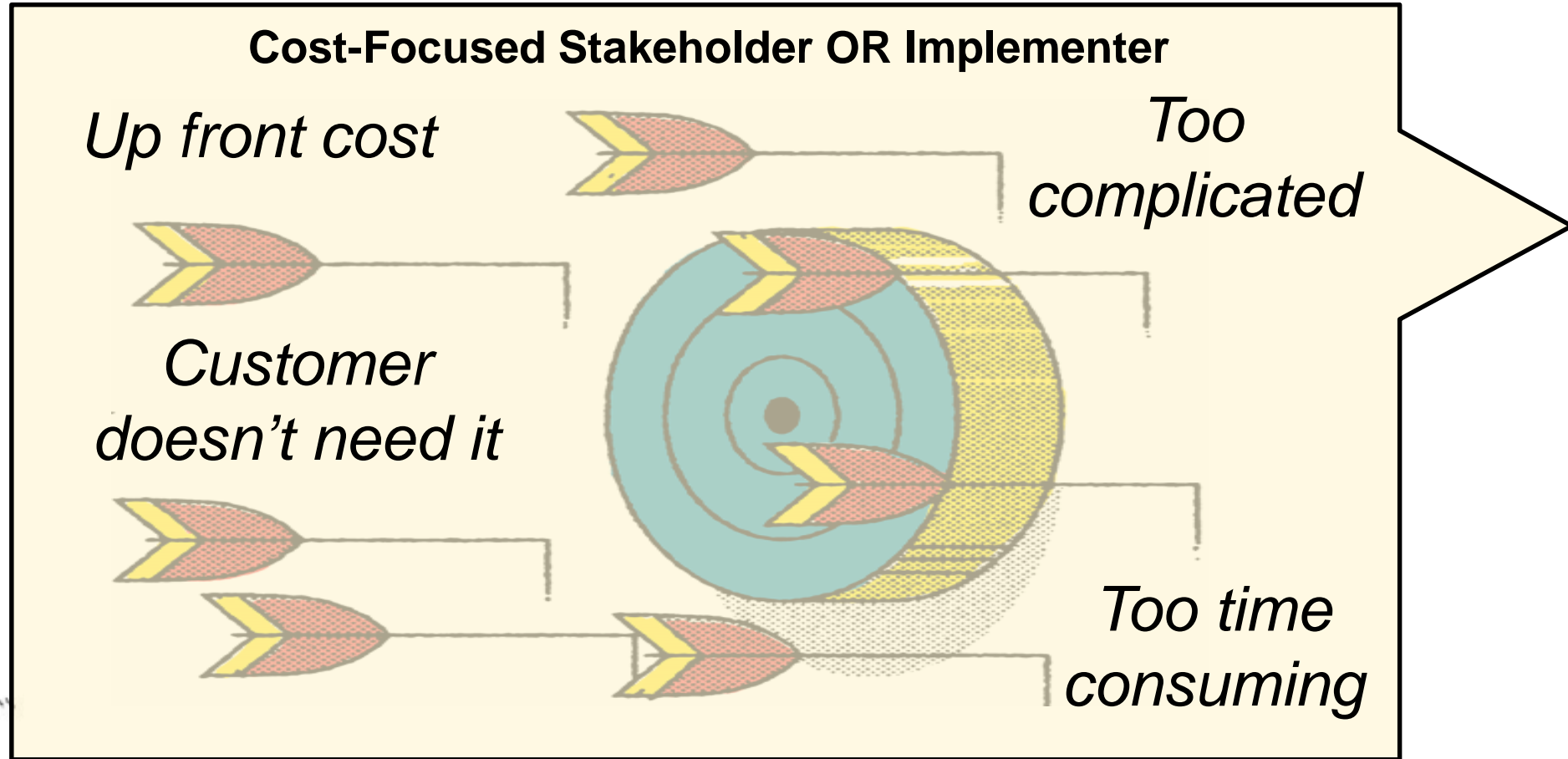
Narrow product portfolio
Competing solely on price
Simple and cheap = best



The Disconnect...



We block out the voices trying to give us new information









Design Ally:

I can't remember the last time I didn't spec an NLC product...

End-Use Customer:

I need integrated solutions...

“Good, Better, Best” Pathways

COMFORT				
	New Retrofit LED Lamp without Controls	New LED Fixture or Retrofit Kit without Controls	New LED Fixture or Retrofit Kit with Integrated Controls	
	Quality of Light	Good	Better	Best
	Smart Capabilities	On/Off	On/Off	On/Off, Dim, Occupancy, Daylight, Color Tuning
Life	 varies by lamp type			

“Good, Better, Best” Pathways



New Retrofit **LED Lamp**
without Controls



New **LED Fixture** or **Retrofit Kit**
without Controls



New LED Fixture or Retrofit Kit
with **Integrated Controls**

INCENTIVES AND SAVINGS

Utility Incentives <i>(contact your utility for more information)</i>	Limited	Better	Best
Energy Savings	Good	Better	Best
Total Cost of Ownership	Good	Better	Best

“Good, Better, Best” Pathways



New Retrofit **LED Lamp**
without Controls



New **LED Fixture** or **Retrofit Kit**
without Controls



New LED Fixture or Retrofit Kit
with **Integrated Controls**

COST

Equipment Cost	(\$ / \$ \$) <i>varies by lamp type</i>	(\$ \$ \$)	(\$ \$ \$)
Installation Cost	(\$)	(\$ \$)	(\$ \$ \$)
Maintenance Cost	(\$ / \$ \$) <i>varies by lamp type</i>	(\$)	(\$)

NEEA NLC/LLLC Retrofit Study

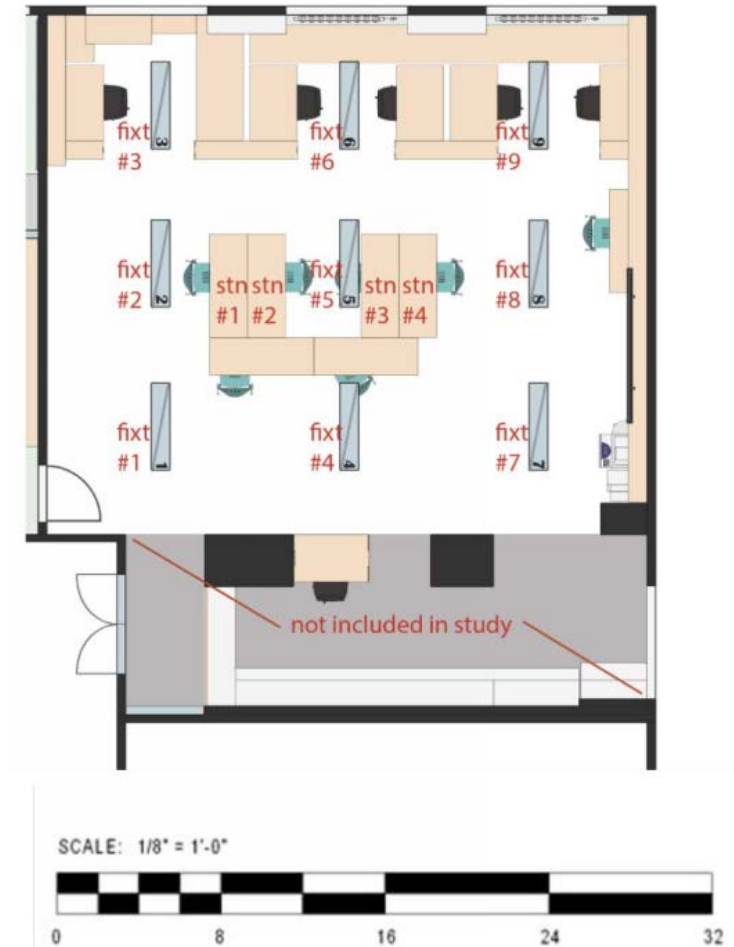


Luminaire Level Lighting Controls Replacement vs Redesign Comparison Study

September 3, 2020

REPORT #E20-315

Figure 1. Study space diagram



LLLC/NLC Retrofit Systems Cost Comparison

Table 12. Total Cost Comparison of All Retrofit Solutions

<i>System</i>	<i>Hardware total</i>	<i>Luminaire per unit</i>	<i>Labor</i>	<i>Design/ Specification</i>	<i>Total cost</i>	<i>Total cost/ft²</i>
<i>LLLC System #1</i>	\$4,181.00	\$380.00	\$1,045.00	\$252.76	\$5,383.76	\$6.04
<i>LLLC System #2</i>	\$4,204.77	\$410.00	\$1,536.15	\$379.14	\$6,120.06	\$6.87
<i>LLLC System #3</i>	\$4,455.43	\$490.00	\$1,163.75	\$1,011.04	\$6,630.22	\$7.44
<i>LLLC System #4</i>	\$4,015.96	\$403.00	\$760.00	\$631.90	\$5,407.86	\$6.07
<i>Redesign System #5</i>	\$8,347.07	\$389.00	\$1,654.90	\$5,655.80	\$15,657.77	\$17.57

LLLC/NLC Retrofit Systems Implementation Times

Table 3. Time Required for Install, Programming, and Commissioning

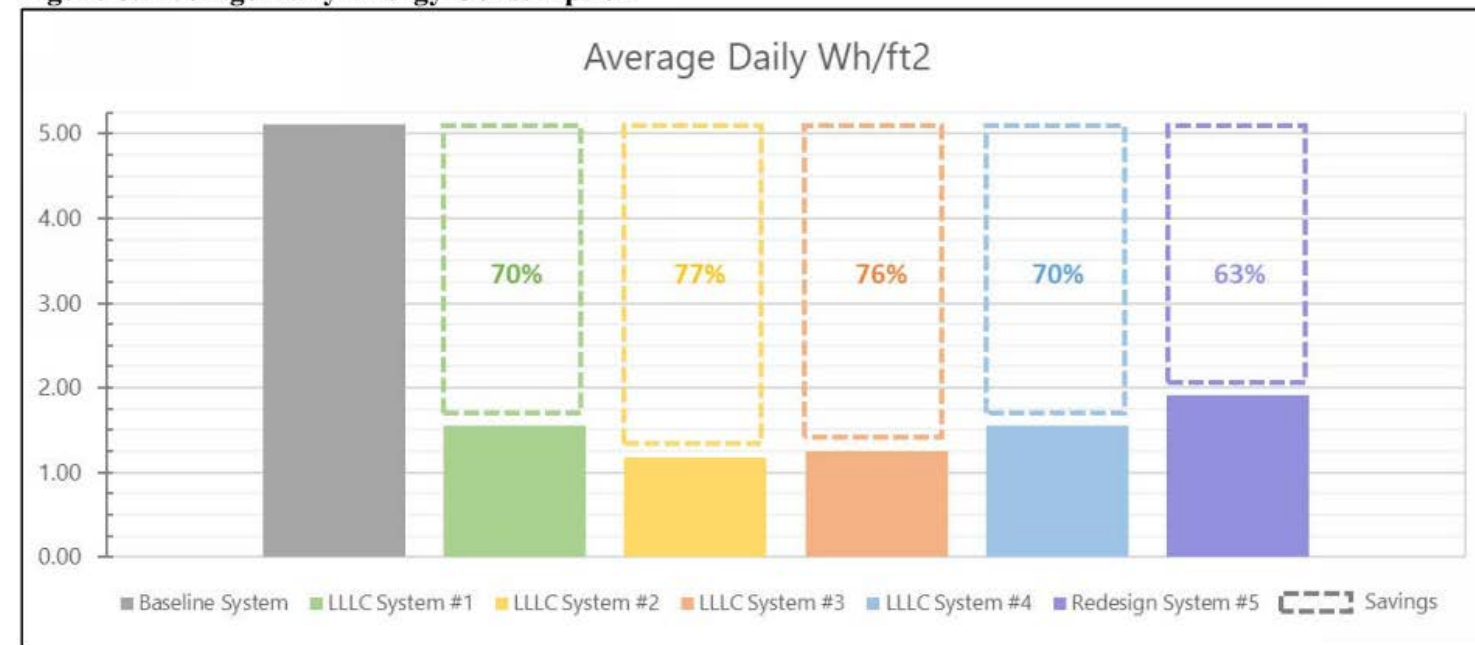
<i>System</i>	<i>Hardware install (HH:MM)</i>	<i>Programming (HH:MM)</i>	<i>Commissioning (HH:MM)</i>	<i>Total (HH:MM)</i>
<i>LLLC System #1</i>	05:15	00:45	03:00	09:00
<i>LLLC System #2</i>	05:50	02:45	04:30	13:05
<i>LLLC System #3</i>	05:40	00:35	04:30	10:45
<i>LLLC System #4</i>	03:30	00:30	02:30	06:30
<i>Redesign System #5</i>	07:05	02:35	06:00	15:40

LLLC/NLC Retrofit Systems Savings Breakdown

Table 5. Average Energy Consumption

	<i>Wh/ft²</i>									
	<i>Total</i>	<i>Lum. 1</i>	<i>Lum. 2</i>	<i>Lum. 3</i>	<i>Lum. 4</i>	<i>Lum. 5</i>	<i>Lum. 6</i>	<i>Lum. 7</i>	<i>Lum. 8</i>	<i>Lum. 9</i>
<i>Baseline</i>	5.11	0.57	0.58	0.57	0.45 ⁽¹⁾	0.59	0.58	0.59	0.59	0.59
<i>LLLC System #1</i>	1.54	0.23	0.18	0.08	0.25	0.15	0.12	0.25	0.23	0.05
<i>LLLC System #2</i>	1.18	0.15	0.24	0.07	0.26	0.19	0.04	0.07	0.10	0.04
<i>LLLC System #3</i>	1.25	0.22	0.19	0.06	0.18	0.13	0.04	0.24	0.14	0.05
<i>LLLC System #4</i>	1.55	0.43 ⁽²⁾	0.22	0.05	0.21	0.16	0.05	0.17	0.19	0.03
<i>Redesign System #5</i>	1.90	0.41	0.16	0.06	0.40	0.21	0.02	0.40	0.18	0.02

Figure 8. Average Daily Energy Consumption



Annual Estimated Savings & by Major Strategies

System	Fixture Zone *	Annual estimated lighting energy savings based on pre-tuning maximum energy consumption					
		Savings due to all controls measures		Savings due to daylight and occupancy		Savings due to high-end trim	
LLC System #1	Perimeter	74%	51%	74%	45%	0%	6%
	Middle	49%		37%		12%	
	Core	32%		25%		7%	
LLC System #2	Perimeter	85%	74%	75%	40%	10%	34%
	Middle	74%		23%		51%	
	Core	71%		31%		40%	
LLC System #3	Perimeter	80%	50%	80%	42%	0%	8%
	Middle	45%		31%		13%	
	Core	25%		15%		10%	
LLC System #4	Perimeter	86%	63%	71%	43%	15%	20%
	Middle	58%		35%		23%	
	Core	47%		26%		21%	
Redesign System #5	Perimeter	86%	67%	71%	32%	15%	35%
	Middle	73%		23%		50%	
	Core	47%		7%		40%	

Notes: Annual estimated lighting energy savings attributed to controls relative to pre-tuning maximum energy consumption of each fixture and system.

Never Forget... The Human Factor

4.5 Human factors comfort responses

- Highest satisfaction: LLLC systems being tuned to IES standards
- Overall brightness was found to be lower than expected (Trim)
- Light was more calming and helped focus than FL baseline
- Brighter task (desk) illuminance
- No major satisfaction difference between LLLC & NLC

Table 8. Study Participant Demographics and Sample Statistics

	<i>Total # subjects</i>	<i>Female/ male</i>	<i>Age</i>			<i>Vision correction</i>	<i>Total # 2-hr session</i>
			<i>18-30</i>	<i>31-45</i>	<i>46-55</i>	<i>Y/N</i>	
<i>Baseline</i>	8	4/4	7	0	1	5/3	22
<i>LLLC System #1</i>	16	8/8	13	3	0	6/10	34
<i>LLLC System #2</i>	12	7/5	8	4	0	5/7	28
<i>LLLC System #3</i>	10	7/3	7	3	0	4/6	34
<i>LLLC System #4</i>	15	8/7	11	3	1	6/9	36
<i>Redesign System #5</i>	15	9/6	14	0	1	4/11	29
<i>Total</i>	76	43/33	60	13	3	30/46	183

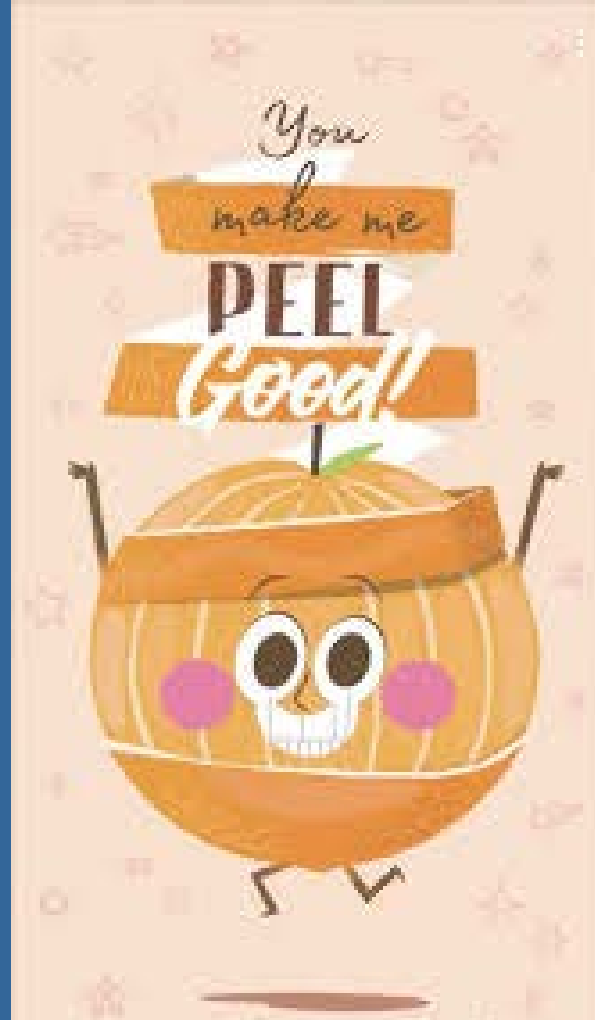
Pause for Questions



Which is NOT a TLED Limitation, Constraint, or Concern

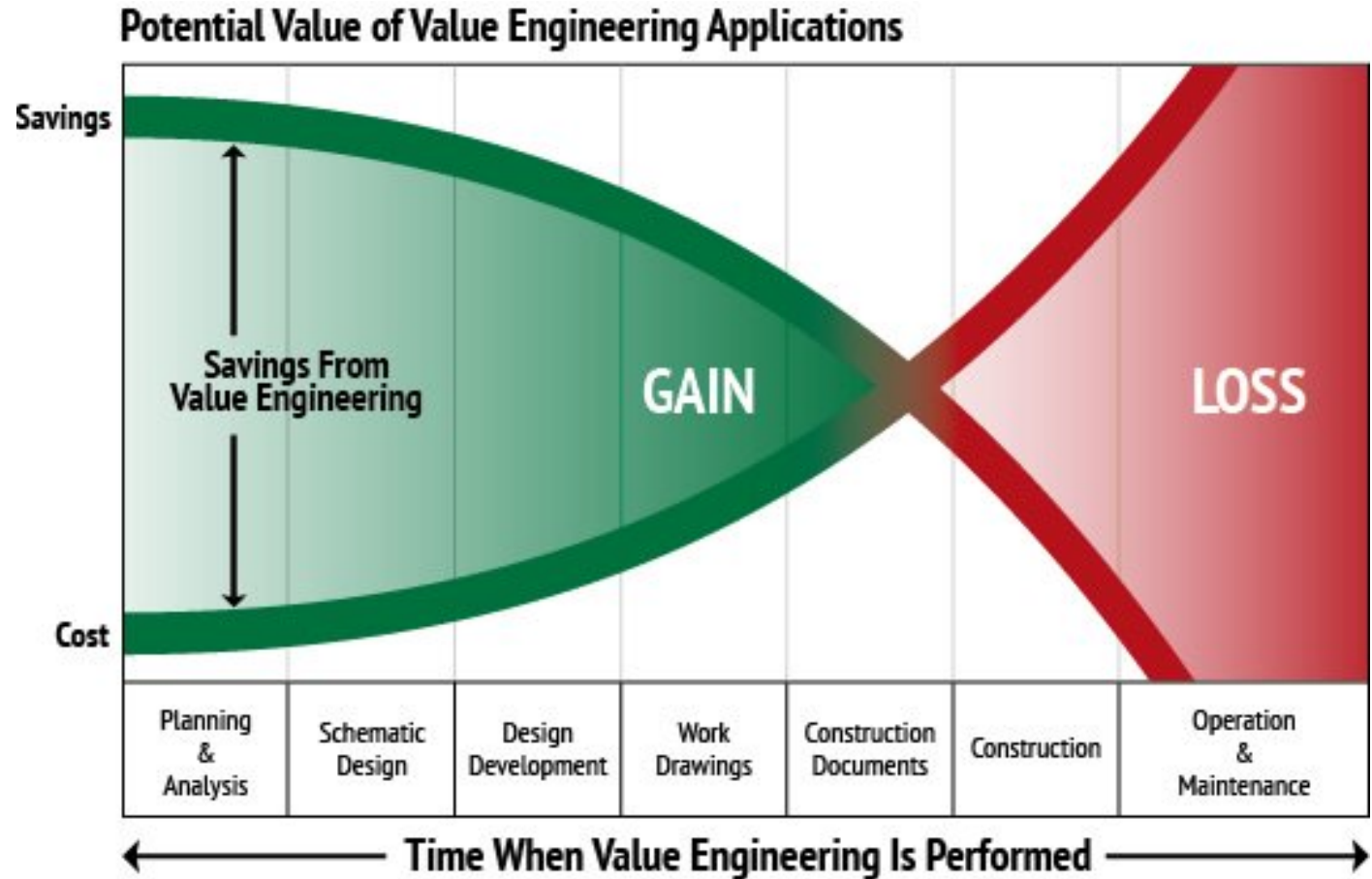
- Ballast/Driver compatibility concerns
- Light quality concerns
- Daylight zoning circuit concerns
- Wall Station confusion concerns
- System lifetime cost concerns

Delivering the RIGHT Project... Barriers... and Solutions

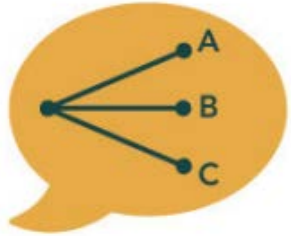


Not “Value” and not “Engineering”

- Removes hardware / features last minute to reduce cost
- Other Building contractors up-sell
 - EC typically down-sell
- True value engineering “adds” to up-front cost to reduce life-cycle cost



It's about the STAKEHOLDERS – not just the decision maker



Tenants

Living with
the system



Facility
Professionals

Leveraging
the system



Implementers

Implementing
the system

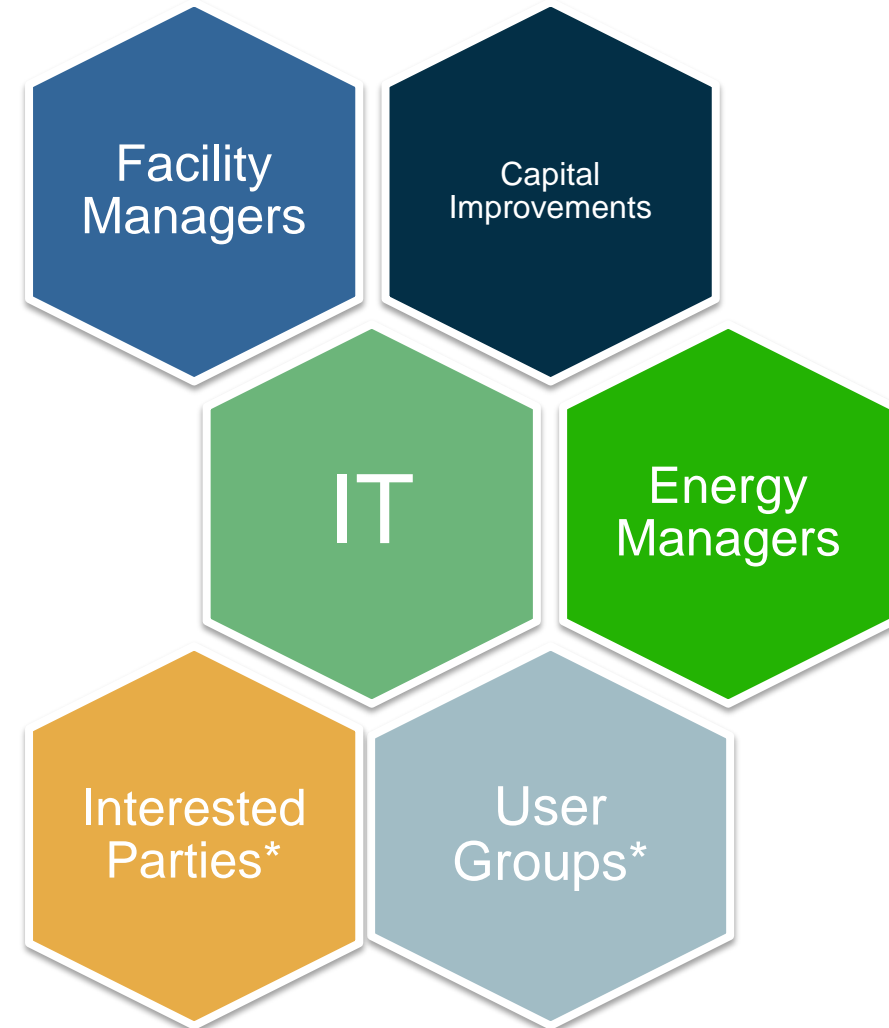


Owners

Invested in
the system

Decision Makers vs. Stakeholders

- Recommenders, Influencers, Gatekeepers
- They send key info upstream
- Understand level of involvement
- Get Buy In **EARLY**



Lunera Smart TLEDs Pilot at NYU

- 2017 Pilot at NYU
- Free gear from Lunera
 - Happy decision makers
- Each T8 needed IP address on Client's Network

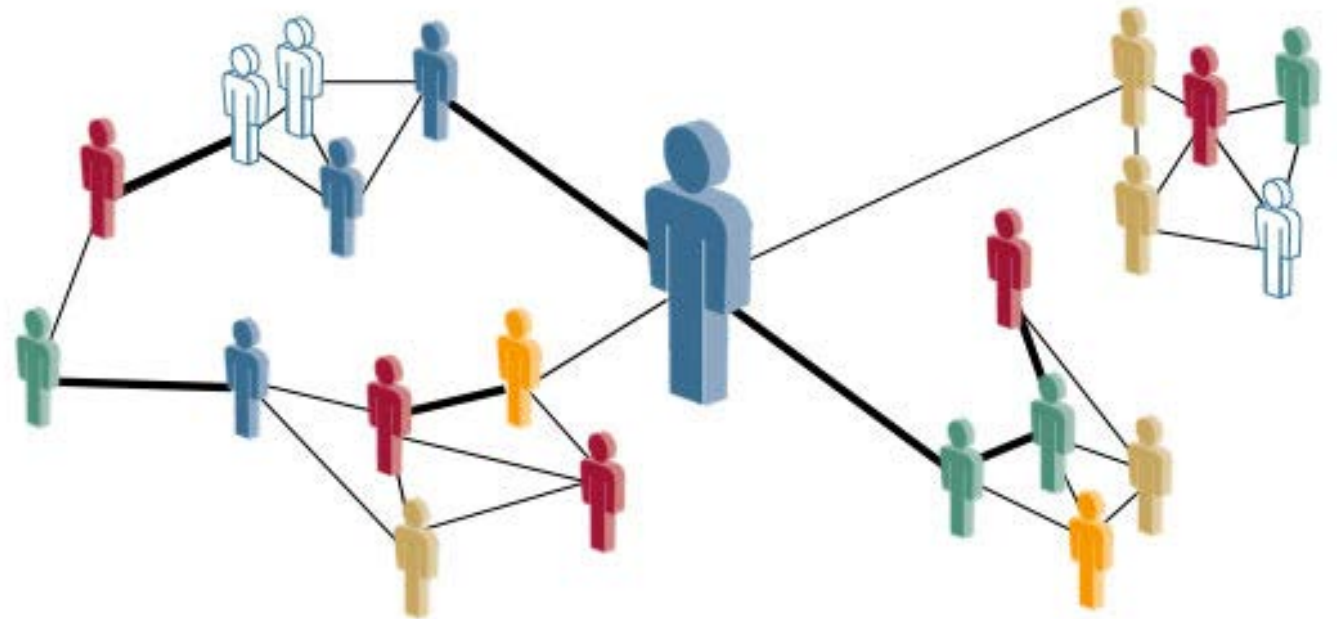
IT Dept:



Lunera Lighting

Map Out Decision Makers and Tiered Stakeholders

- Appropriate Topics to the Appropriate Stakeholder
- Create map of tasks and influencers.



Don't Force the Horse

- A Solution Looking for a Problem?
- What are the most pressing problems/opportunities for your [Insert Building Type Here]?



Tie-in with Stakeholder's Purpose & Goals



 **Seattle** Department of
Construction & Inspections



Foster Relationships
Through Education,
Awareness, and
Continuous
Improvement

Pause for Questions



Lighting Project Financials 101

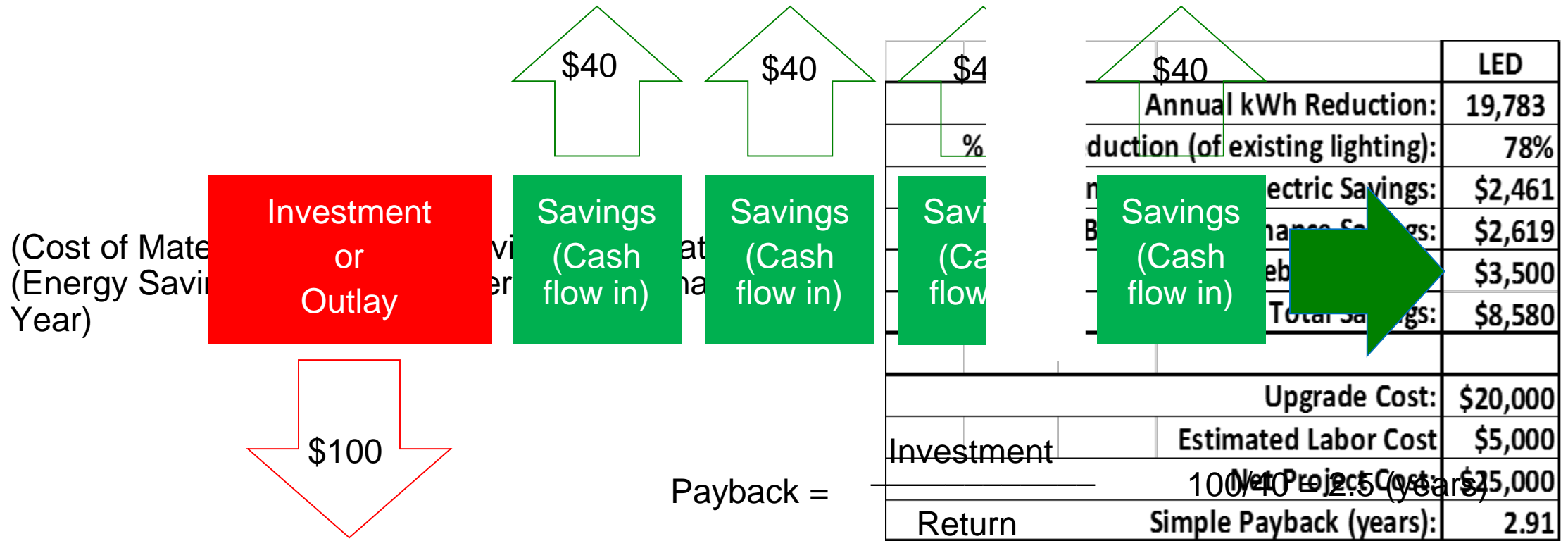


Discuss The Cost of Waiting

- Cost of Waiting - Urgency
 - Utility funding
 - Continue overspending on energy
 - Continue overspending on human capital
 - Equipment nearing EOL
- Listen to Stakeholder Objections
- Buy in from stakeholders



Simple Payback

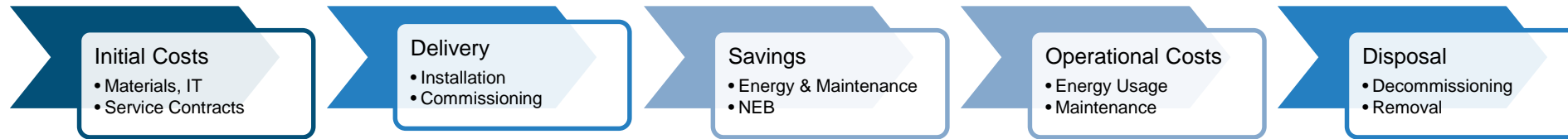


- Not a complex measure
- Initial financial talking point
- TLED projects usually have lower paybacks
- Real story is more complex

Simple Payback vs. Life Cycle Cost

Life Cycle Cost Analysis

System Life (i.e. 10 years)



To be expressed factoring Time
Value of Money

\$100 now = \$100 next year? ... Time Value of Money

- Compounding

- Sum + Interest is reinvested

- Rate: 10%

2019	2020	2021	2022
\$ 100.00	\$ 110.00	\$ 121.00	\$ 133.10

add add add
10% of \$100 10% of \$110 10% of \$121

- Discounting

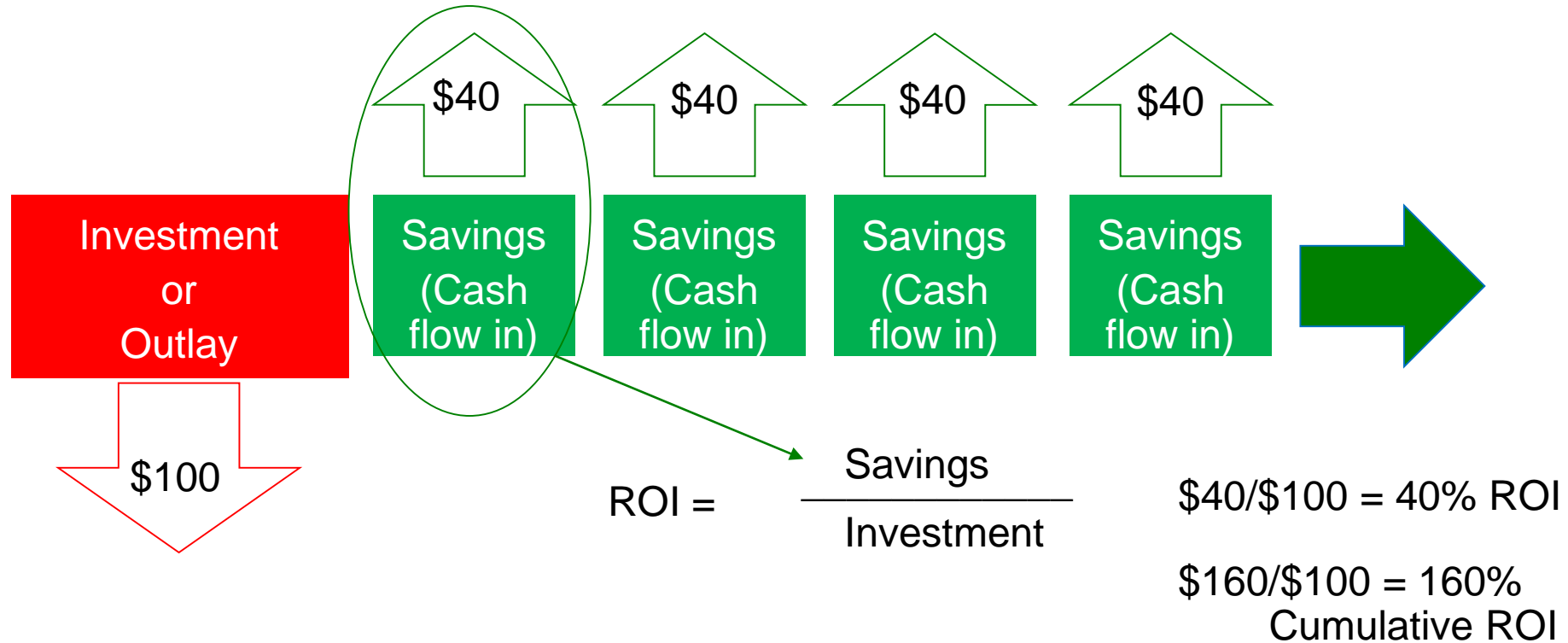
- Interest used in cash flow analysis
- Set by companies. Fluctuate
 - Weighted Average Cost of Capital (WACC)

- Focus:

- Returns on Investment measures
- Present Value
- Net Present Value



Return on Investment



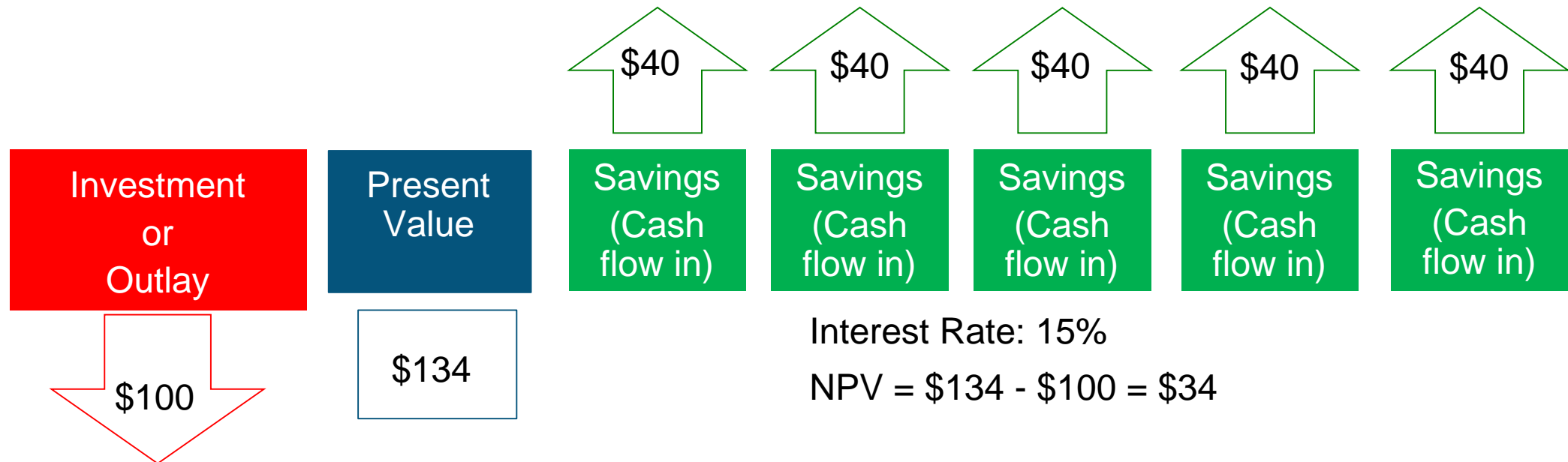
Tips on Thinking Present Value

- Present Value = today's equivalent of a future payment
- Discount Rate adjusts a future payment to its present value
- “Future payments are *discounted* to their Present Value”
- The higher the discount rate, the lower the present value
- The further the payment is in the future, the lower is present value



Net Present Value

- **Net Present value:** Present value of a cash flow, minus the initial investment or outlay
 - Commonly used to compare investments. Even if they don't have the same lifetime.



Simplified 10-Year Example

Discount Rate:	10%										
Date:	Today	End of Year	End of Year	End of Year	End of Year	End of Year	End of Year	End of Year	End of Year	End of Year	End of Year
	0	1	2	3	4	5	6	7	8	9	10
Cash Outflows											
Lighting System:	\$(65,400.00)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Rebate Incentives:	\$ 15,400.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Outflow:	\$(50,000.00)										
Cash Inflows											
Energy Savings:		\$10,000.00	\$10,300.00	\$10,609.00	\$10,927.00	\$11,255.00	\$11,593.00	\$11,941.00	\$12,299.00	\$12,668.00	\$13,048.00
Maintenance Savings:		\$ 5,000.00	\$ 5,150.00	\$ 5,305.00	\$ 5,464.00	\$ 5,628.00	\$ 5,796.00	\$ 5,970.00	\$ 6,149.00	\$ 6,334.00	\$ 6,524.00
Inflows:		\$15,000.00	\$15,450.00	\$15,914.00	\$16,391.00	\$16,883.00	\$17,389.00	\$17,911.00	\$18,448.00	\$19,002.00	\$19,572.00
Annual Cash Flows:	\$(50,000.00)	\$15,000.00	\$15,450.00	\$15,914.00	\$16,391.00	\$16,883.00	\$17,389.00	\$17,911.00	\$18,448.00	\$19,002.00	\$19,572.00
PV of Cash Flows:	(\$50,000.00)	\$13,636.36	\$12,768.60	\$11,956.42	\$11,195.27	\$10,483.01	\$9,815.64	\$9,191.18	\$8,606.13	\$8,058.70	\$7,545.85
	10-Year	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10
NPV:	\$53,257.17	(\$36,363.64)	(\$23,595.04)	(\$11,638.62)	(\$443.34)	\$10,039.67	\$19,855.31	\$29,046.48	\$37,652.61	\$45,711.31	\$53,257.17
Simple Payback:	3.19										
ROI:	34%										

One Page Proposal

- Components
 - Title and Subtitle
 - Target
 - Problem statement
 - Financial Summary
 - Payment Terms
 - Status
 - Action -> PO
 - Appendix



One Page Proposal

20% more Light with 40% Lower Energy Cost for the Parking Garage at 123 Project St.

Improving security, saving energy, lowering operating costs, and boosting the Energy Star score

Target: TO IMPROVE PARKING-AREA LIGHTING WITH ENERGY EFFICIENT, LONG-LASTING LED TECHNOLOGY

- To Address tenant safety concerns by increasing average lighting levels by 20% and moving to “whiter” light, enhancing visibility for both occupants and security camera.
- To reduce operating and maintenance costs for parking-area lighting by \$15,000 the first year (10-year NPV of over \$53,000).
- To capture \$15,400 in Energy Trust incentives, covering 24% of project costs
- To avoid a quarter-million pounds of CO2 emissions annually, boosting ENERGY STAR score to 70 from 68

Financial: Project first cost is estimated at \$50,000 after a utility incentive of \$15,400. A 10-year analysis yields a net present value of \$53,256 and a simple payback of 3.3 years.

Simple Payback	3.2 years
Net Present Value*	\$53,256
Return on Investment	34%

* NPV Assumes 10-year analysis term, 10% discount rate

Lighting as a Service = Netflix and Lit?



- No up-front capital costs
 - Equipment, Commissioning, Maintenance by Provider
 - Monthly Payment from Savings
- Energy Metering
- Contract with Provider and Implementer



Seattle City Light EEaS Pilot

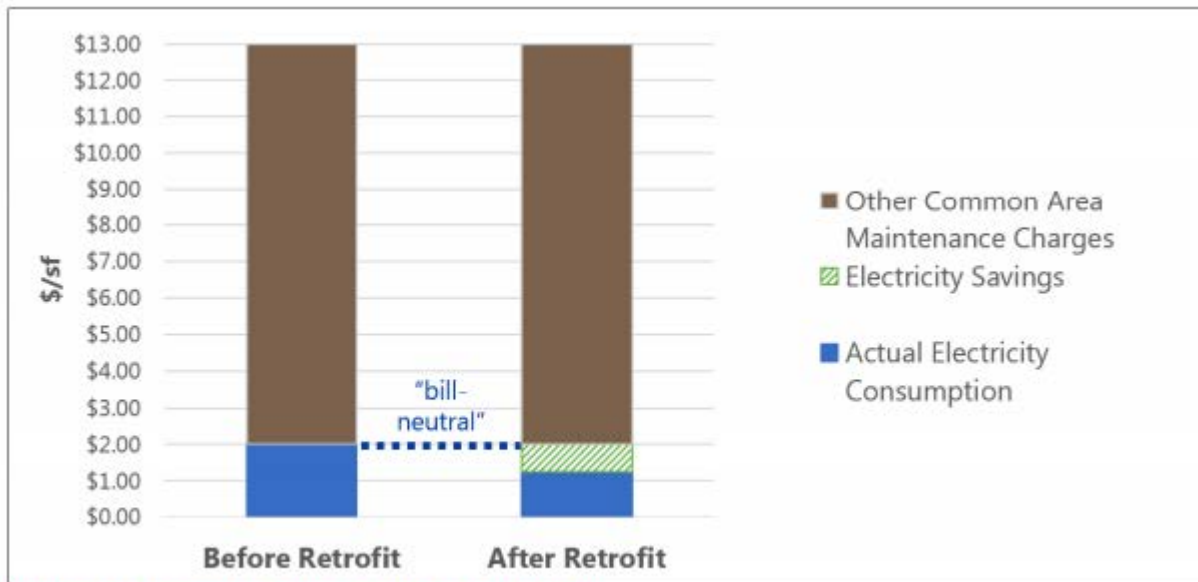


Figure 1. Example of Tenant Bill Neutrality

Energy Efficiency, News



Seattle City Light is piloting America's first Energy Efficiency-as-a-Service program

By [Jennifer Runyon](#) | 6.19.20

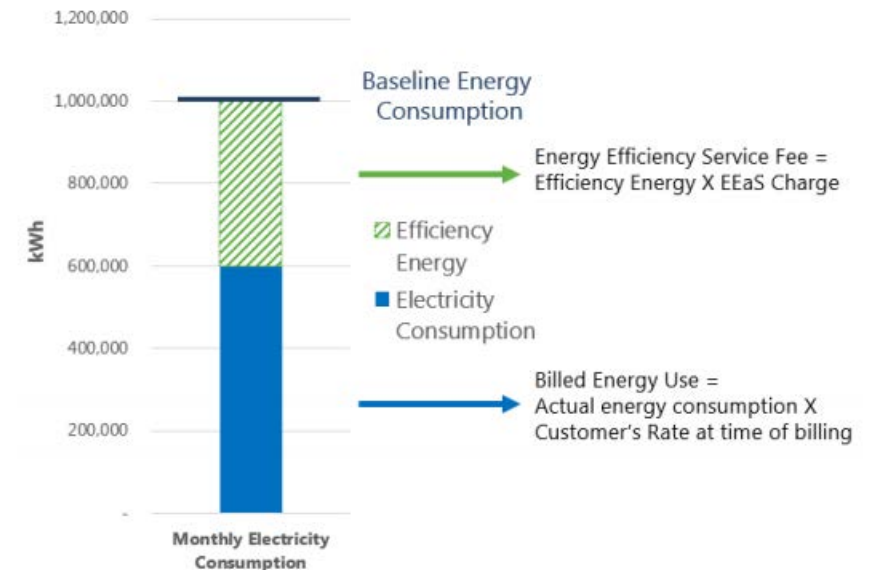


Figure 3. Basis of EEaS Seattle City Light Charges

Stakeholder Objection Counter Suggestion

- **"I don't have any budget for an upgrade"**
 - Consider existing cost for system and equipment maintenance
 - Discuss the cost of waiting
 - Demonstrate lifetime economics
 - Highlight NEBs to different stakeholders
 - Divide project into smaller phases
 - Project will set both an economic and technical infrastructure for additional value-add building projects
- **"I Just want the cheapest option"**
 - Provide at least 2 options: A cost-based option and a value-added benefit option for the building



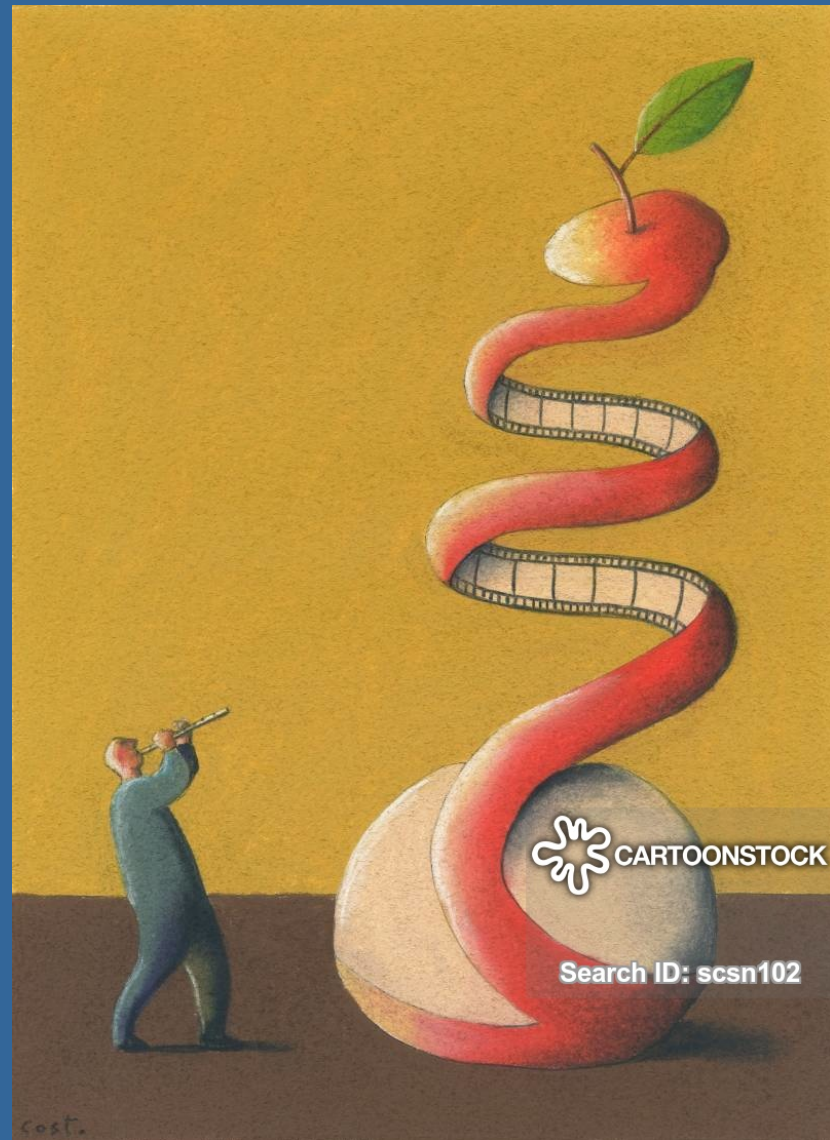
When should the Simple Payback calculation be Used over the Lifetime Calculation

- When you want the complete picture
- When you want to plan for the life of the system
- To get a quick snapshot of a project's financials
- Included in the project proposal

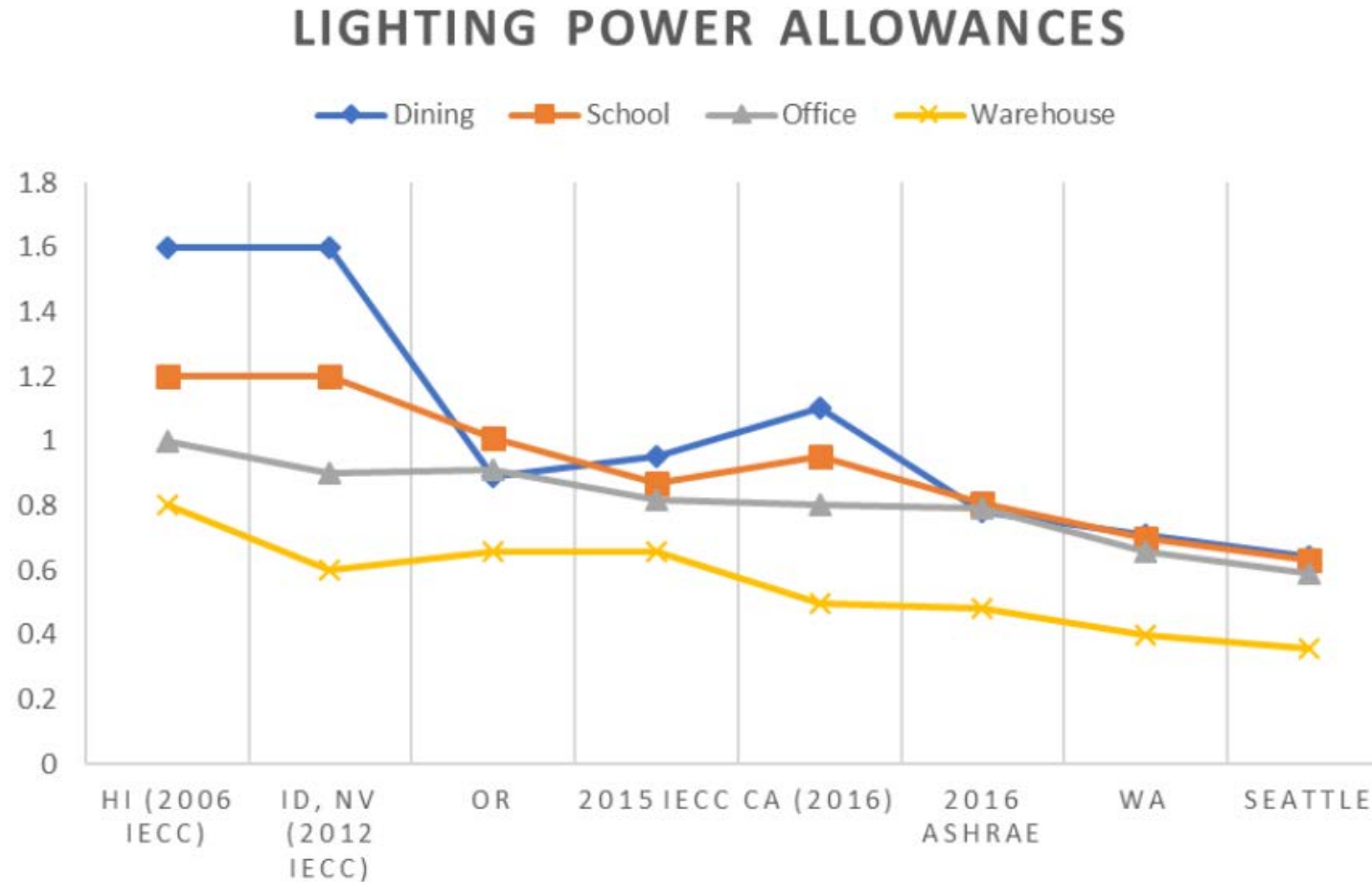
Pause for Questions



Tools and Teamwork to Make the Dream Work

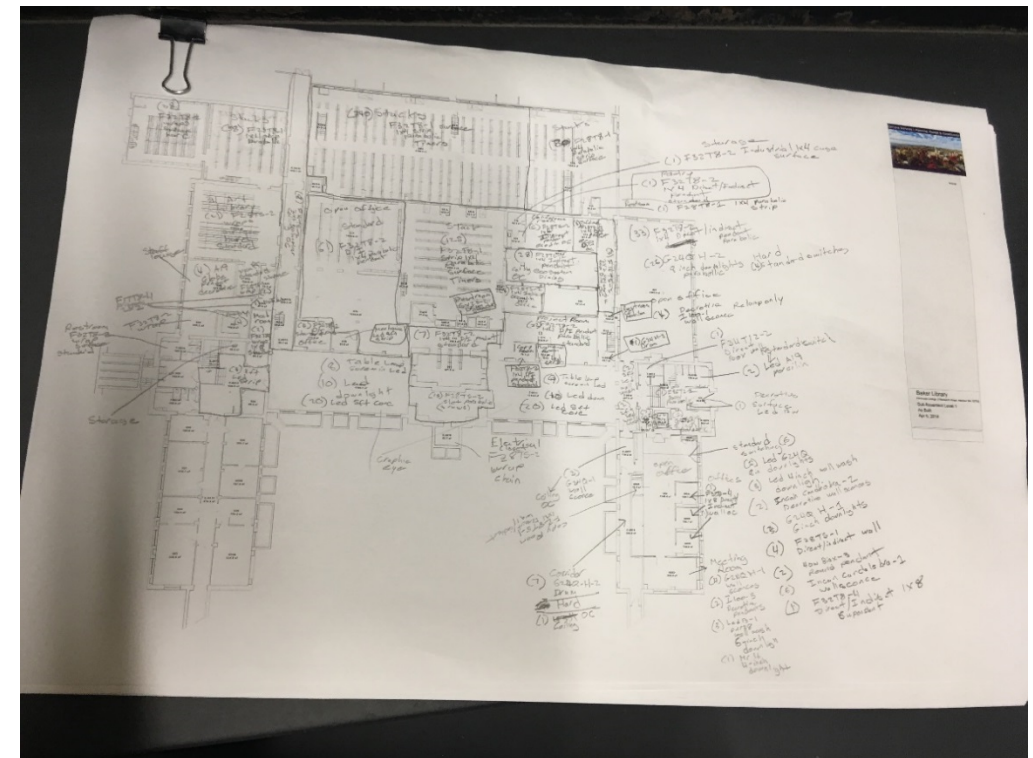
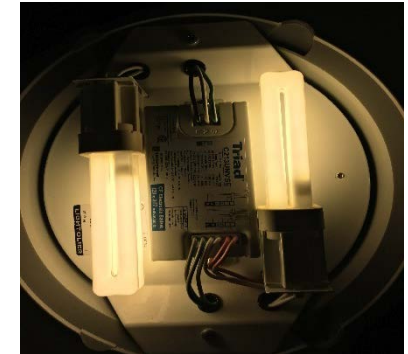


Codes & Regulations as Tool to Implement NLCs



Great Tool to Start These Talks: Lighting audit

- Attend LDL Audit & Retrofit Class ;)
- Benchmark Existing Conditions
- Estimate Energy, Labor, Rebate Savings
- Propose Multiple Solutions, Model kWh Savings
- Lead to Life Cycle Analysis and Non-Energy Benefits
- Tell a Story from Audit to Proposal



Interview: Healthcare Energy Manager

- Lighting Audit helped start conversation, decision
 - T12 in BOH!
 - Feedback from auditor
 - Help Decision Makers Prioritize
- SME familiar handling special space types
- Financials
 - Simple Payback > ROI, IRR
 - \$Labor > \$Hardware
 - Rebates!
- NEB
 - Ease of Maintenance, feedback
 - Facilities could reprogram
 - No need for software contract

Energy Management and Sustainability



Angela Mu

Energy Manager



Weill Cornell
Medicine

Why Utilities like City Light Care About Connected Lighting?

Cost Effective Energy Savings



Ensures optimal project savings for lifetime of EE upgrade

Elite Customer Service



Relationship with customers for continuous improvements

Gateway to Connected Stuff



Keeps utilities relevant and part of the solution

Program Design Considerations: Savings & Incentives

Example of prescriptive savings in City Light's lighting program

Space Use Type	Networked Lighting Controls	Luminaire Level Lighting Controls
Break Room	40%	50%
Classroom	25%	25%
Hallway	40%	50%
Lobby	40%	50%
The Loo	40%	50%
Warehouse	40%	50%

And so on and so forth...

Regional Technical Forums: Non-Residential Lighting Retrofits protocol

Dictionary

Search for a word



pro·vi·sion·al
/prəˈviːZHənəl/

1. Arranged or existing for the present, *possible to be changed later*

Simplify Approach:

- prescriptive savings
- prescriptive incentives



Right-Sized Incentive

- \$50-75 incentive bonus –
In addition to performance savings!



City Light NLC \$50/Fixture 2020 Requirements



- DLC NLC QPL System
- Programmed HET, Occupancy, Daylight Harvesting
- Min (2) Zones per 300sqft
- Pre-Install
 - SOO
 - Floor Plan
- Post-Install
 - As Builts
 - Site Visit



- TLEDs
- Fixtures under 20W
 - HET under 20W = prorated \$50 incentive



Seattle City Light

CUSTOMER ENERGY SOLUTIONS
PROGRAM REQUIREMENTS

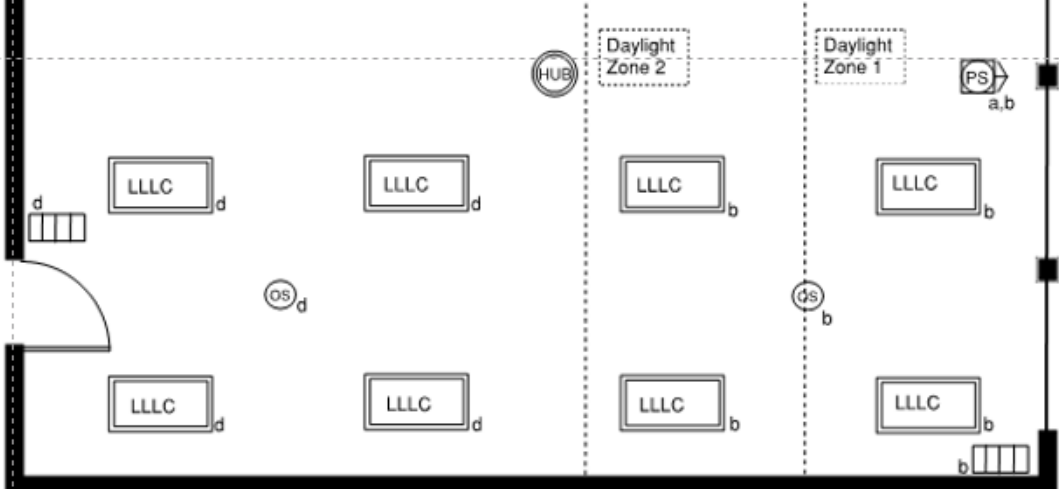


NLC Key Collaboration Tool: Sequence of Operations

The Sequence of Operations communicates intent

Area	Typical open office		
	Lights	Zones (a) - (d)	Fully dimmable lights controlled in this area
	Daylight Zones	Zones (a) - (b)	Daylight rows 1 and 2 will dim independently. Lights will automatically adjust to daylight maintaining recommended 30FC on task surfaces
	Manual Wall Control	Zones (a), (b), (c), (d)	For each independent zone, the user can select scenes on/off, 50%, and can raise/lower the zone

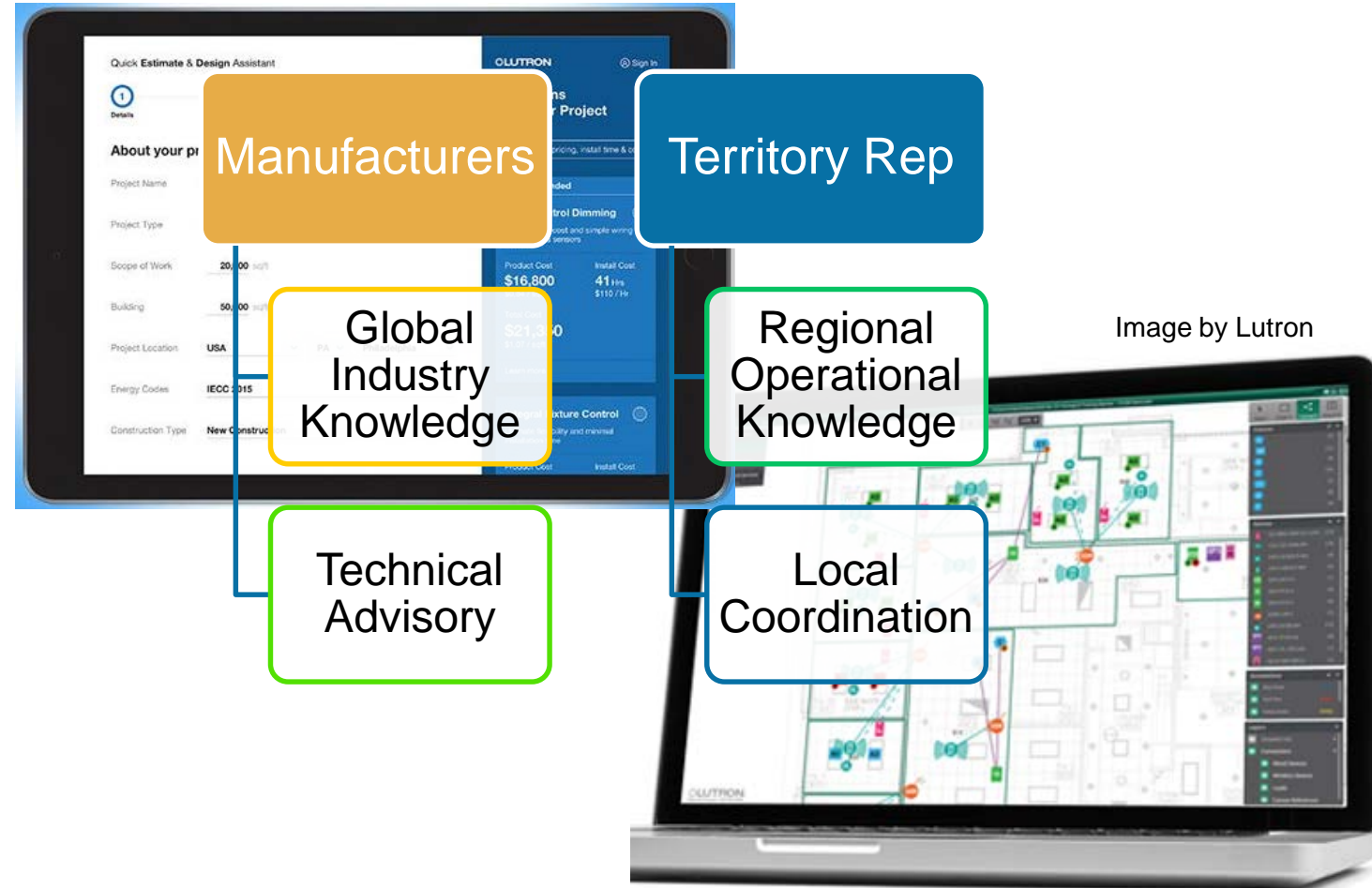
SPACE TYPE	CONTROL METHOD				
	HIGH END TRIM	DAYLIGHT SENSOR	MANUAL SWITCH	OCCUPANCY SENSOR	TIME CLOCK
Conference	X	X	X	X	
Equipment	X	X		X	
Office - open	X	X		X	X
Office - private	X	X	X	X	
Restrooms	X			X	



[Click to access LDL Sequence of Operations learning guide](#)

Leverage Partner's Procedural Efficiency

- Quoting tools
- Project Development tools
- One lines with Packaging
- Room Packaging
- Pre-Pairing
- Pre-Commissioning



PNW Regional Resources

Take a load off (literally). Join the Network.





1 & 2 Day NLC Workshops

for

EVERYBODY...

featuring

Hands-On Learning & Practical Application

LDL's Flagship Workshop

- Specifics of control methods
- Developing sequence of operations
- Specification writing & interpreting
- System design & set up
- And so much more!!!



NLC / LLLC Best Practice Guides and Video

NETWORKED LIGHTING CONTROLS SERIES



COMMUNICATING THE VALUE PROPOSITION

This guide will help simplify and clarify your value proposition by outlining distinct stakeholder groups and detailing what matters to them.

KNOW YOUR AUDIENCE – PLAN YOUR APPROACH

Networked lighting control systems offer plenty of benefits – but potential customers can feel overwhelmed or turn skeptical when they perceive too many promised benefits. Effectively communicating the value of NLC systems starts with knowing your audience – and planning your approach.

STEP 1: IDENTIFY YOUR STAKEHOLDERS

Yes, working with the key decision maker is paramount to making a project come together – but the key decision maker represents a cohort of stakeholders whose opinions matter.



STEP 2: SIMPLIFY YOUR MESSAGE

Instead of trying to convey all the potential system benefits to a general audience – examine the needs for each stakeholder group and use concise language to address their needs.



NETWORKED LIGHTING CONTROLS SERIES - COMMUNICATING THE VALUE PROPOSITION

Part #3: Networked Lighting Controls and Luminaire Level Lighting Controls, What's the Difference?

Now that you understand the basic components and concepts, we can take a closer look at the two primary ways these lighting systems operate in commercial buildings.

LLLC IS A TYPE OF NETWORKED LIGHTING CONTROLS SYSTEM

NLC and Luminaire Level Lighting Controls (LLLC) systems both deploy the same control strategies to ensure code compliance, tenant comfort, and sustained energy savings. Some products can be configured to operate in either mode.

The primary difference (and key concept) between these two approaches can be understood as a 1 to 1 vs. a 1 to many relationship.

NETWORKED LIGHTING CONTROLS

A Networked Lighting Controls (NLC) system is the combination of sensors, network interfaces, wall stations, and controllers that affect lighting changes to luminaires.

In a NLC system configuration there is a one to many relationship with one sensor controlling many luminaires.

BASIC NLC CONFIGURATION



LLLC CONFIGURATION



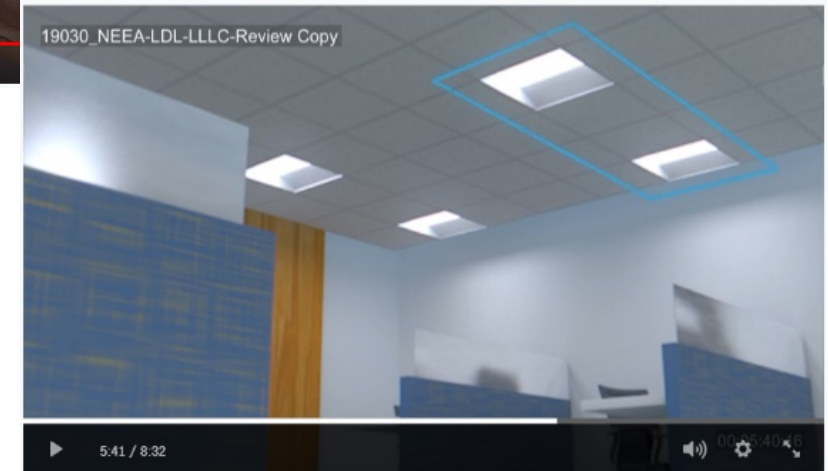
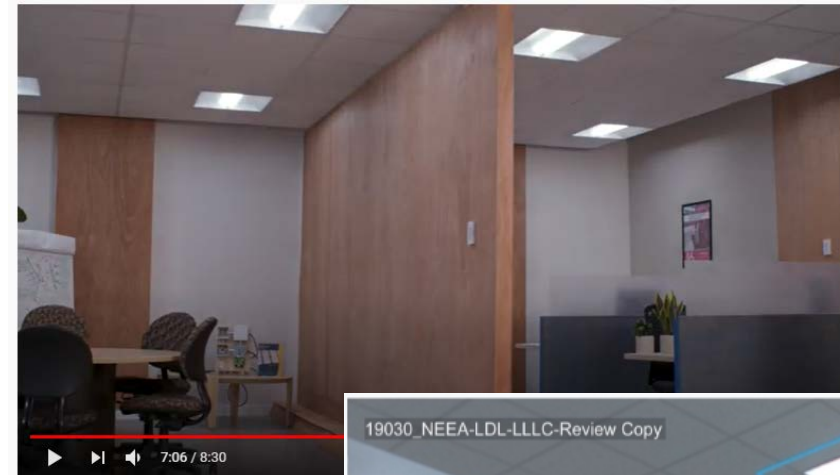
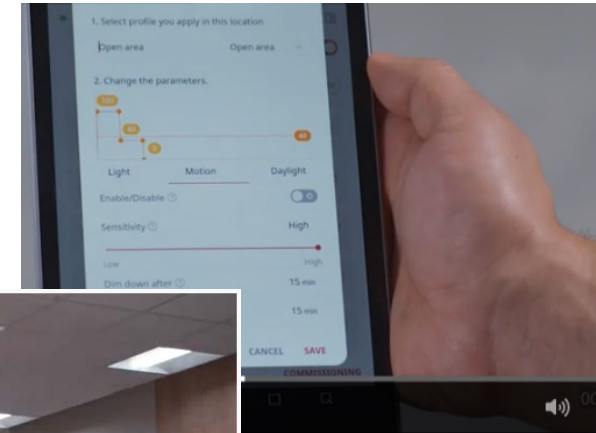
LUMINAIRE LEVEL LIGHTING CONTROLS

Increasingly, manufacturers are integrating NLC system components directly into luminaires. With LLLC, there is a one to one relationship with every light fixture being capable of being controlled directly. Each luminaire is its own control zone or may be grouped into zones with multiple luminaires – simplifying design, installation, and space reconfiguration.



NETWORKED LIGHTING CONTROLS SERIES - CONTROL TECH TERMS

3

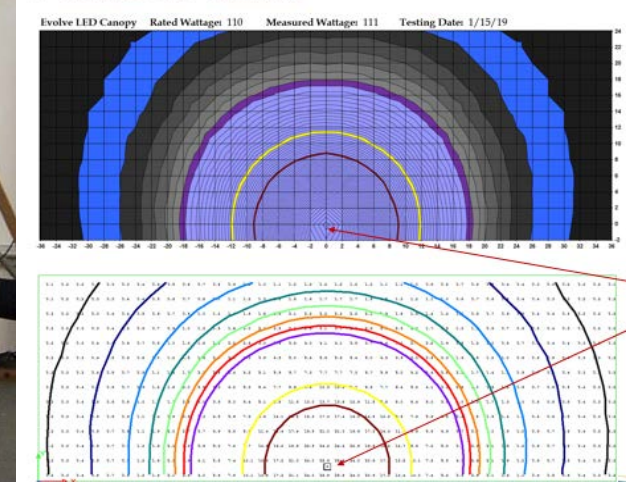


[Click to access the LDL networked lighting control learning guides](#)

Project Specific Consults and Mockups



Comparing the tested sample (top)
to the IES file (bottom)



Informing and Increasing Acceptance: The NLC User Experience

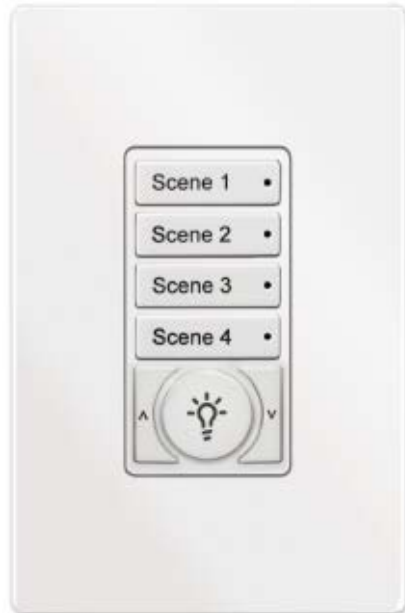


Image by Cooper

Ease of Use

Functionality

Operations



Image by Lutron



Facility Professionals

Pause for Questions



And now – a few words from LDL

Upcoming LDL Online Events

LDL Course	Delivery Date	Time
<u>What Went Wrong?</u>	Sept 22	10:00 - Noon
<u>Power Over Ethernet</u>	Oct 06	10:00 - Noon
<u>NLC for Healthcare Environments</u>	Oct 20	10:00 – Noon
<u>Fundamentals of NLC (Side A – Theory & Technology)</u>	Nov 03	10:00 - Noon
<u>Fundamentals of NLC (Side B – Practical Application)</u>	Nov 04	10:00 - Noon

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