



Bringing Efficiency to LightSM

Lighting Controls Summit

Welcome to San Ramon!

Hosted by:



*Pacific Gas and
Electric Company*

Bringing Efficiency to Light.



Non-profit
organization



Creates
performance
specifications



Provides
tools,
information,
& expertise



Accelerates
adoption of
efficient
commercial
lighting

Solid-State Lighting (SSL)

Drive efficiency by distinguishing quality, high-performance LED products for the commercial sector.



Networked Lighting Controls (NLC)

Support energy efficiency administrators, and industry, with the broad scale adoption of NLCs.

Welcome



*Pacific Gas and
Electric Company*[®]

Networked Lighting Controls



NLC QPL



Energy
Data
Report



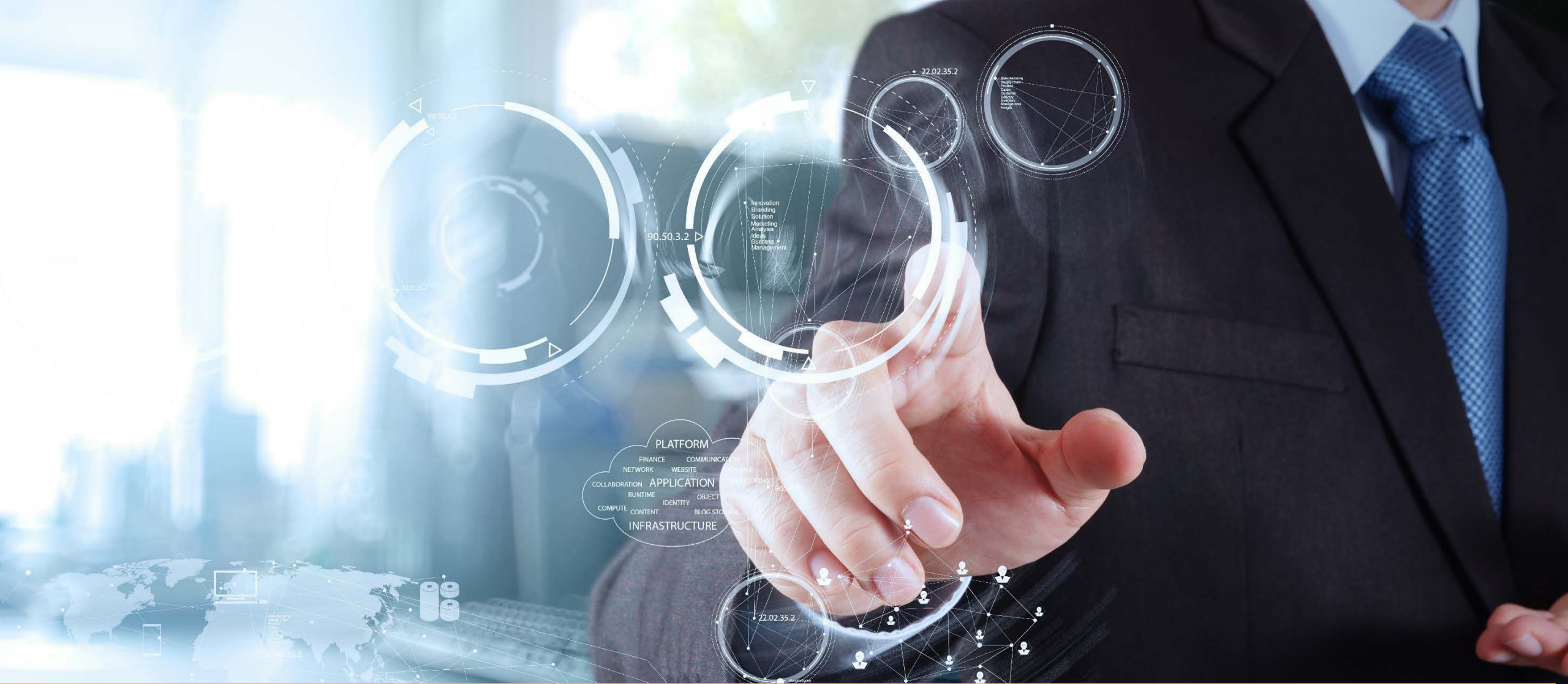
Training
Curriculum



Savings
Calculator

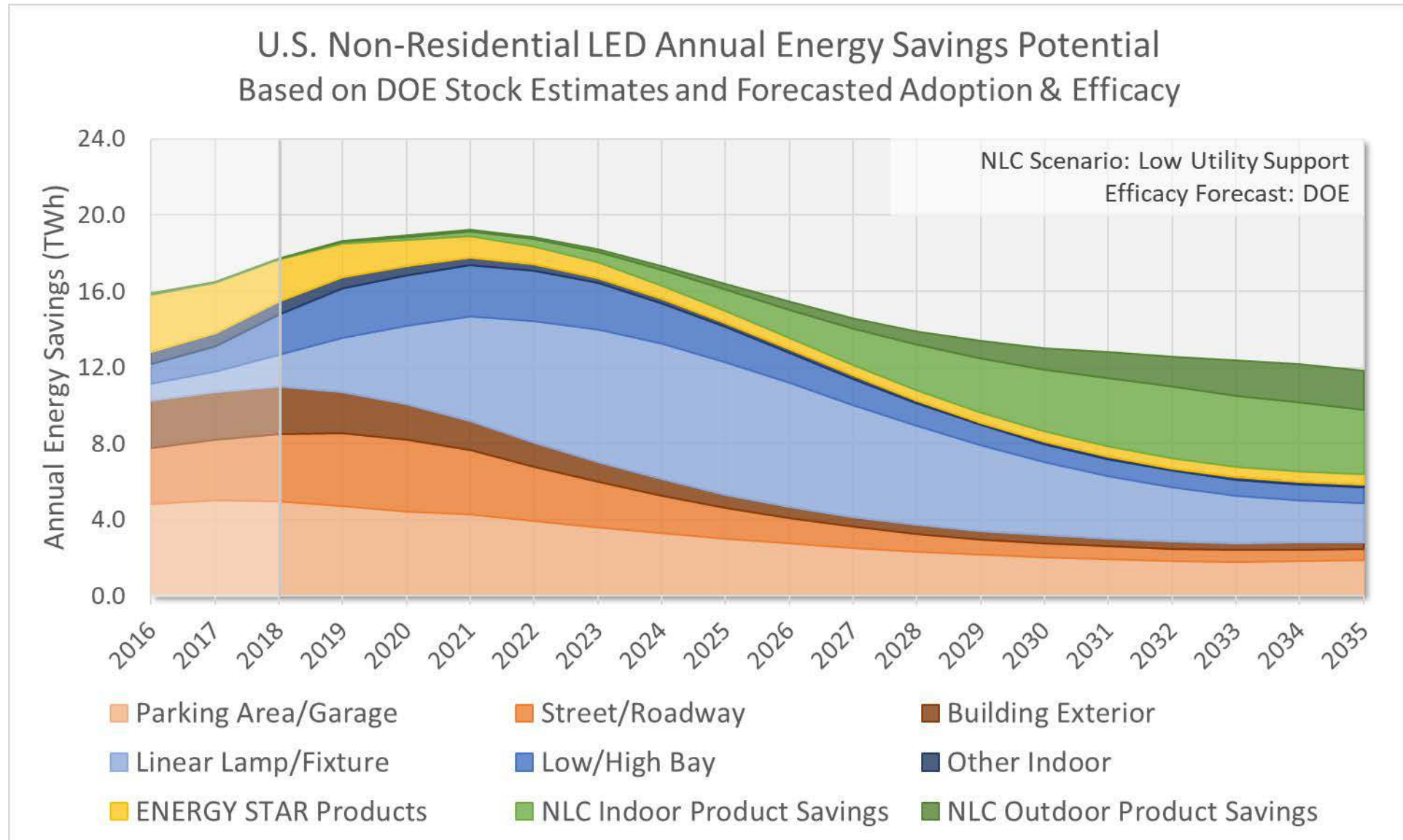


Efficiency
Program
Incentives

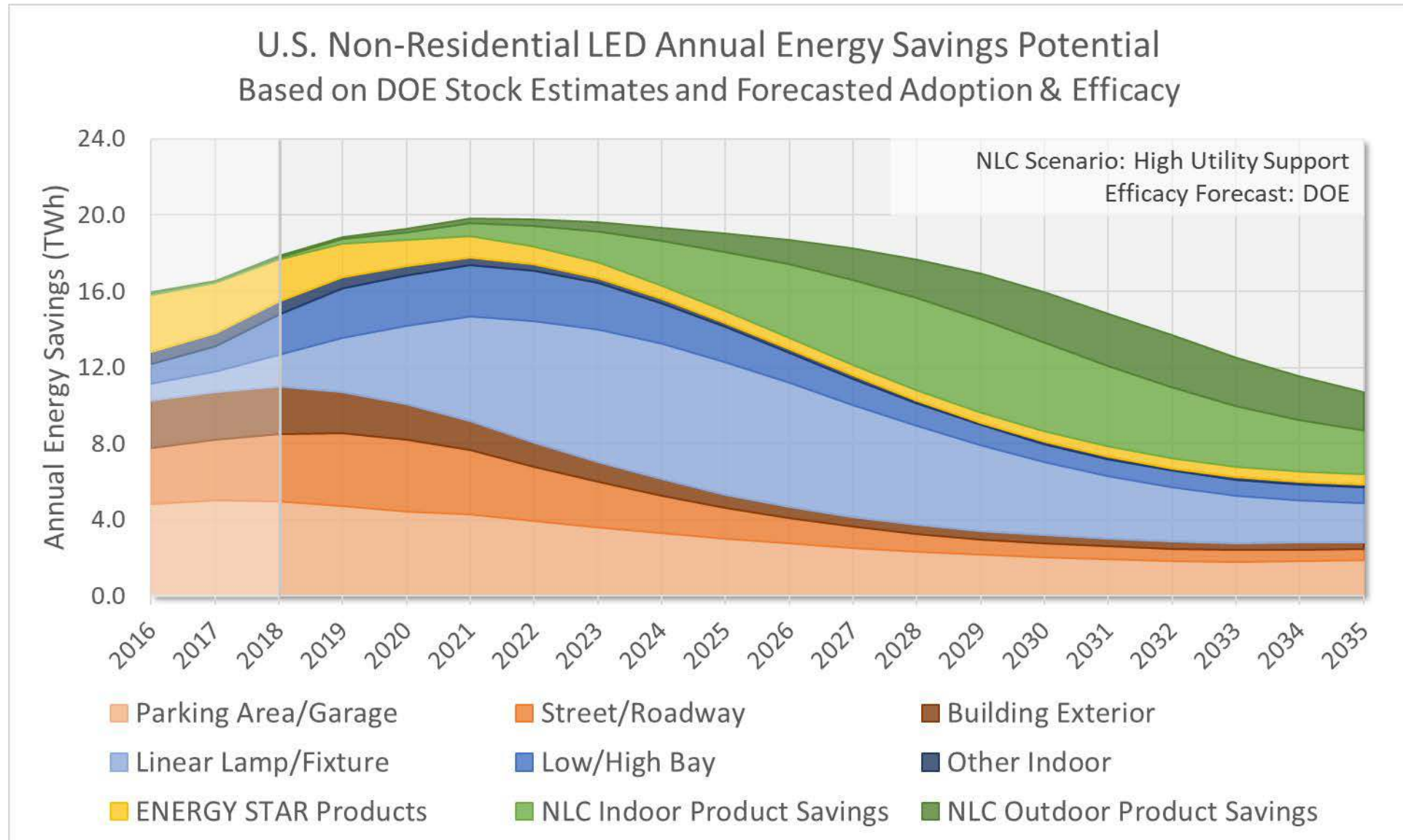


Full Scale Adoption of Networked Lighting Controls

LED and NLC Savings Potential – Current Path

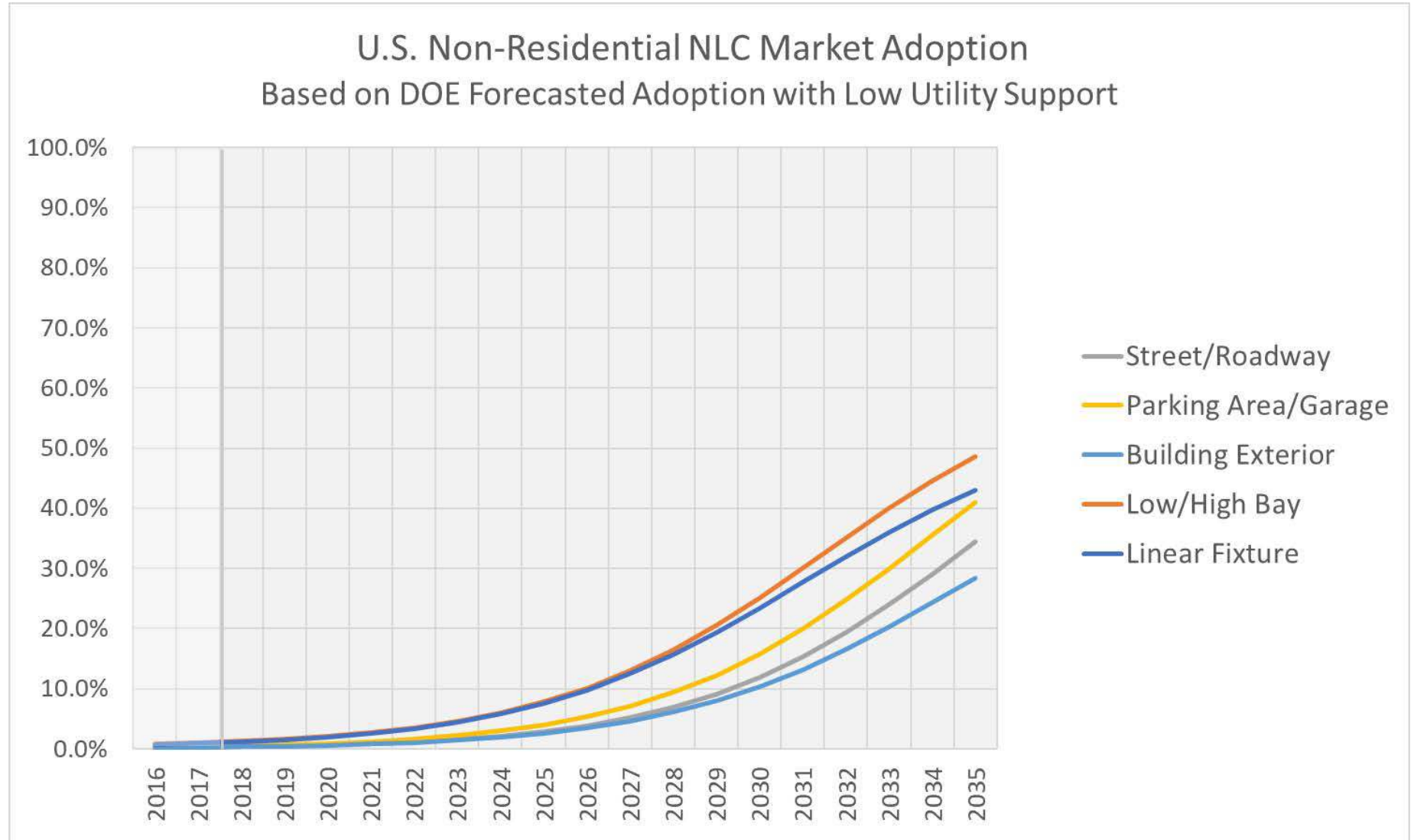


LED and NLC Savings Potential – NLC High Utility Support



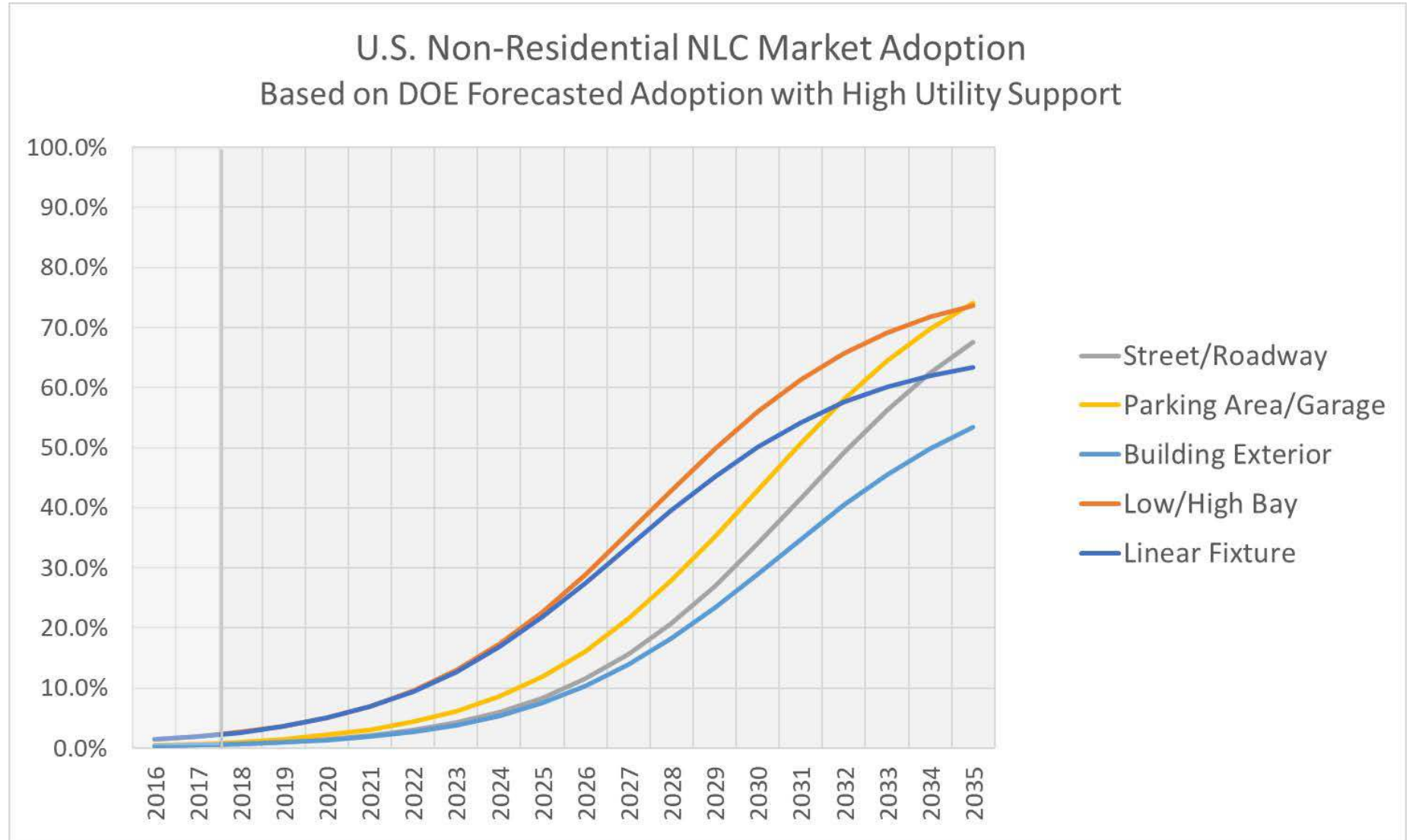
NLC Adoption Forecast – Current Path

- Chart shows adoption for networked lighting controls assuming low levels of utility support
- Very little adoption is expected to persist for many years to come under this scenario



NLC Adoption Forecast – NLC High Utility Support

- Chart shows adoption for networked lighting controls assuming high levels of utility support
- Rapid growth phase occurs 5 years earlier compared to current path
- Interior product categories reach rapid growth by 2022; exterior by 2025



Data Sources and Assumptions

Resource	Date Published	Analysis Use	Assumptions
DOE U.S. Lighting Market Characterization (LMC)	Nov 2017	<ul style="list-style-type: none"> National inventories (tables 4.1 and 4.27) LED installed stock and penetration % Baseline hours and watts (tables 4.5, 4.7, 4.29, 4.30) LED hours and watts (prior to efficacy adjustments) 	<ul style="list-style-type: none"> 1% annual growth was assumed for all product categories 2 lamps per fixture for linear fluorescent 4 lamps per fixture for fluorescent high bay
DOE Energy Savings Forecast of Solid-State Lighting in General Illumination Applications (ESF)	Sept 2016	<ul style="list-style-type: none"> LED adoption forecast (Navigant) NLC adoption forecast (Navigant) LED efficacy forecast (table D-4) 	<ul style="list-style-type: none"> The DOE assumed a higher % savings for NLC (68% for office buildings) than the DLC study reports. This analysis uses the DLC figure (47%) initially, but increases the savings linearly up to the DOE 2035 goal of 80% (indoor) and 60% (outdoor). These higher control reductions may be possible through improvements in technology, programming, installation, and artificial intelligence.

* SSL/NLC Projection Models by D. Mellinger, Energy Futures Group



Meeting Objectives

1. Brainstorm ways to develop more, and more effective, NLC efficiency programs
2. Collect and discuss lighting industry input on DLC's Networked Lighting Controls Specification and QPL
3. Identify possible solutions and next steps to address key industry challenges and opportunities
4. Identify ways we can work together to accelerate adoption

Morning Agenda: Utility Networked Lighting Controls Programs

- Hear Results from Recent DLC Study on NLC Programs
- Examples from different controls programs in place
- Scaling up Education: focus on training for NLCs
- Brainstorm Sessions- collaborate with peers on how to build more and better NLC rebate/incentive programs



Afternoon Agenda: NLC V3.0 Technical Requirements Update

- Energy Monitoring
- NLC System Security
- Afternoon session will include presentations, live polling, and Q&A periods



Meeting Ground Rules

- One speaker at a time
- Raise hand to speak – a mic will be provided to you
- Share your unique perspective
- Participate 100%
- Try to avoid rabbit-holes and off-topic tangents
- Emphasis of meeting is gathering input
- Most importantly: keep it positive and have fun!

Panel Discussion: Utility Networked Lighting Controls Program Design

Speakers



**Chris
Wolgamott**
NEEA



**Kyle
Kichura**
Franklin Energy



**Fritzi
Pieper**
DLC



**Damon
Bosetti**
DLC



Northwest NLC Incentive Programs

Chris Wolgamott
Senior Product Manager
NEEA





TOGETHER We Are Transforming the Northwest



Bonneville Power Administration

- “Kicker” Incentive for each fixture
- Simple/Easy
- Rolls out in March 2018
- Only for Retro fit jobs, no new construction incentives for NLC
- Training role out

Measure Series C: LED General Indoor / Outdoor

The General Indoor / Outdoor category includes a variety of fixtures typically installed under 15' including recessed troffers, surface mounted wraps, vapor tight, and a wide assortment of other general service lamps fixtures. Measure Series C excludes exterior applications such as parking lots, wall packs, roadways, etc. For these applications Measure Series E: LED Exterior shall be used.

Measure	Watt Baseline	Required Wattage Reduction	Incentive per standard fixture
C1-40%	≤100	≥40%	\$20
C1-40% w/Networked Cont	≤100	≥40%	\$60
C1-50%	≤100	≥50%	\$30
C1-50% w/Networked Cont	≤100	≥50%	\$70
C1-60%	≤100	≥60%	\$40
C1-60% w/Networked Cont	≤100	≥60%	\$80
C1-70%	≤100	≥70%	\$50
C1-70% w/Networked Cont	≤100	≥70%	\$90
C2-40%	101-200	≥40%	\$40
C2-40% w/Networked Cont	101-200	≥40%	\$80
C2-50%	101-200	≥50%	\$60
C2-50% w/Networked Cont	101-200	≥50%	\$100
C2-60%	101-200	≥60%	\$80
C2-60% w/Networked Cont	101-200	≥60%	\$120
C2-70%	101-200	≥70%	\$100
C2-70% w/Networked Cont	101-200	≥70%	\$140
C3-40%	≥201	≥40%	\$70
C3-40% w/Networked Cont	≥201	≥40%	\$130
C3-50%	≥201	≥50%	\$100
C3-50% w/Networked Cont	≥201	≥50%	\$160
C3-60%	≥201	≥60%	\$120
C3-60% w/Networked Cont	≥201	≥60%	\$180
C3-70%	≥201	≥70%	\$140
C3-70% w/Networked Cont	≥201	≥70%	\$200

Notes:

- Standard Fixtures are not required to be listed on the DLC Qualified Products List
- Fixtures with Networked Controls must be listed on the DLC Networked Lighting Controls Qualified Products List and the model / product number must be included in the *Notes Section* of the lighting calculator.

Measure Series D: LED High Bay

Measure Series D is intended for interior LED High Bay fixtures.

Measure	Watt Baseline	Required Wattage Reduction	Incentive per fixture
D1-40%	140-299	≥40%	\$80
D1-40% w/ Networked Cont	140-299	≥40%	\$140
D1-60%	140-299	≥60%	\$140
D1-60% w/ Networked Cont	140-299	≥60%	\$200
D1-70%	140-299	≥70%	\$200
D1-70% w/ Networked Cont	140-299	≥70%	\$260
D2-40%	300-399	≥40%	\$100
D2-40% w/ Networked Cont	300-399	≥40%	\$160
D2-60%	300-399	≥60%	\$180
D2-60% w/ Networked Cont	300-399	≥60%	\$240
D2-70%	300-399	≥70%	\$300
D2-70% w/ Networked Cont	300-399	≥70%	\$360
D3-40%	400-499	≥40%	\$140
D3-40% w/ Networked Cont	400-499	≥40%	\$200
D3-60%	400-499	≥60%	\$240
D3-60% w/ Networked Cont	400-499	≥60%	\$300
D3-70%	400-499	≥70%	\$360
D3-70% w/ Networked Cont	400-499	≥70%	\$420
D4-40%	≥500	≥40%	\$250
D4-40% w/ Networked Cont	≥500	≥40%	\$350
D4-60%	≥500	≥60%	\$400
D4-60% w/ Networked Cont	≥500	≥60%	\$500
D4-70%	≥500	≥70%	\$500
D4-70% w/ Networked Cont	≥500	≥70%	\$600

Notes:

- LED Screw-in products replacing HID are not eligible for the High Bay category and must be entered in Measure Series F: HID Replacement Screw-in.
- Standard Fixtures are not required to be listed on the DLC Qualified Products List
- High Bay Fixtures with Networked Control must be listed on the DLC's Networked Lighting Controls qualified products list and the model / product number must be included in the Notes Section of the lighting calculator.

Puget Sound Energy

- “Kicker” Incentive for each fixture
- Simple/Easy
- Started in January 2018
- Includes both Retro-fit and New Construction
- Only for LLLC (Luminaire Level Lighting controls)
- Training program in place



Puget Sound Energy

Program	Incentive applies to...	Incentive value	Incentive maximum
Business Lighting	<u>TLED Lamps² and their installation</u>	<u>\$2 per TLED² lamp regardless of type or length in any new or existing light fixture-</u>	70 percent of total project cost
	<u>Fixtures³ and their installation</u>	<u>\$0.15 per kilowatt-hour (kWh) of projected annual energy savings¹</u>	
	<u>Interior LLLC³ fixtures and their installation</u>	<u>\$50 bonus in addition to the \$.15 per kilowatt-hour (kWh) of projected fixture annual energy savings¹</u>	
Street Lighting	Equipment and installation	\$0.15 per kilowatt-hour (kWh) of projected annual energy savings ¹	70 percent of total project cost

¹ Incentives are subject to PSE cost-effectiveness standards.

² TLED Lamps replacing T12, T8 or T5 fluorescent lamps in existing or new fixtures (this includes all "Plug and Play", "Ballast ByPass" and "External Driver" TLEDs).

³ LLC fixture bonus is limited to interior fixtures. Each fixture must include both an integral occupancy and daylight sensor, and must have wireless networking capabilities with embedded lighting control logic. The system shall also have the capability to allow the user to turn the lights off.

Energy Trust of Oregon

- “Kicker” Incentive for each fixture
- Simple/Easy
- Just started (less than a week ago)
- Only for new construction incentives for LLC only
- Training role out

Energy Trust of Oregon

Commissioning Incentive

- \$3,000 per project
- Can be completed by lighting installation contractor

Evaluation Incentive

- \$2,500
- Paid at completion of 8 month evaluation



Energy Trust of Oregon

Early Design Incentive

- \$1,000 per project
- Early design meeting with owner and lighting designer

Installation Incentive

- \$70/fixture
- Also eligible for incentives for LPD reductions through the Lighting Calculator



Questions?



Chris Wolgamott
Senior Product Manager
NEEA
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DLC Controls Summit 2018

Kyle Kichura, LC

Lighting Channel Manager



focus on energysm

Partnering with Wisconsin utilities

Who/What is Focus on Energy?

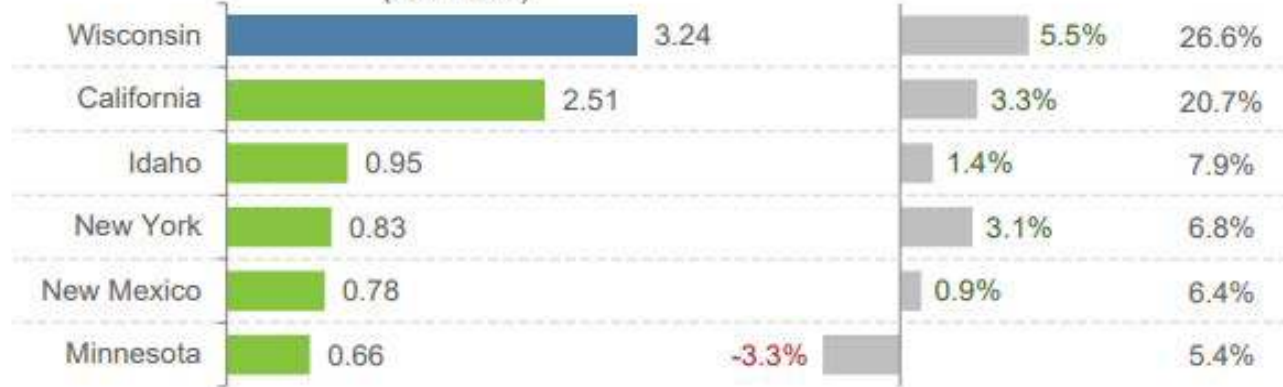
- Focus on Energy is Wisconsin utilities' statewide program for energy efficiency and renewable energy
- Partnered with 108 utilities across Wisconsin to offer utility customers (business & residential) opportunities to save energy & money
- Overseen by the Public Service Commission of Wisconsin



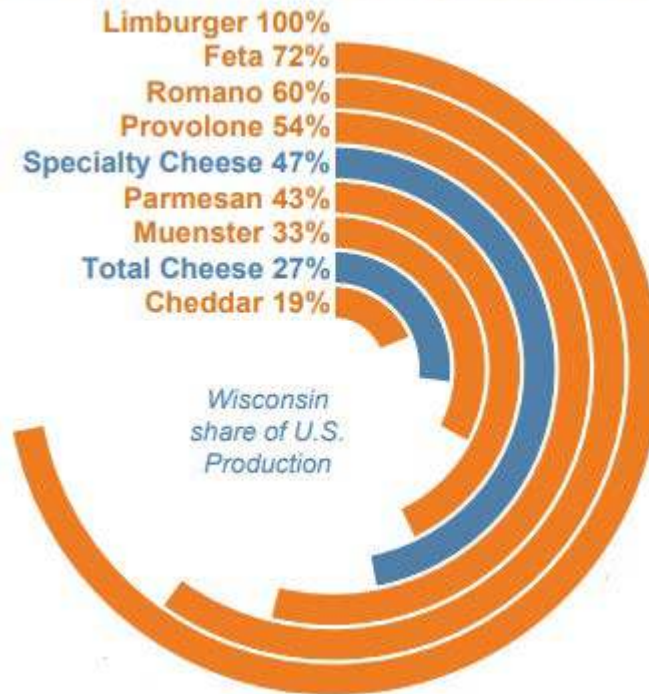
2016 Cheese Stats

Cheese Production – Top 6 States

(billion lbs.)



Wisconsin leads the U.S. in production of:



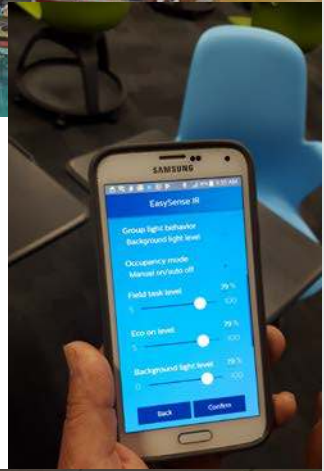
4th in the World
 If Wisconsin were a country, it would rank 4th in the world in cheese production, behind the rest of the U.S., Germany and France

NLC Incentive Offering

- \$/ft² Incentive Design
 - \$0.25/ft² (designed space) – lower lumen fixtures/higher fixture density applications
 - \$0.125/ft² (designed space) – high lumen fixtures/low fixture density applications
 - 50% incentive paid upon project completion, 50% upon controls system commissioning
- Energy Monitoring Bonus (optional)
 - \$0.05/ft² (designed space) for projects utilizing energy monitoring systems and sharing usage data with Focus on Energy
 - Paid upon receipt of met parameters
- Control incentives are in addition to fixture offerings if coupled with a fixture upgrade
- Pre-approval is required

NLC Incentive Offering 2017

- Started Off As Pilot In 2017
 - 14 unique space types
 - 3 system mfgs / 4 system types
 - 831,063 sq. ft.
 - \$146,526.50 in base incentives paid
 - \$25,719.50 in energy monitoring bonuses paid
- Estimated Savings
 - 166.21 1st year kW
 - 873,014 1st year kWh (\$0.197/kWh)
 - 13,968,218 LC kWh (\$0.012/kWh)
 - 47,662 LC MMBtu (\$3.61/MMBtu)



NLC Incentive Offering 2018



INTERIOR CONTROLS



Requirements:

- Control systems must be DesignLights Consortium™ TRT V2.0 listed
- All projects must receive pre-approval with a reservation code. Please call 800.762.7077 before you start your project.

Pre-approval documentation must include:

- Documentation of controlled space(s) proposed
- Proposed equipment specifications
- Sections 1-6 completed on Incentive Application



BUSINESS INCENTIVES				
Measure Description	Code	Incentive	Unit	NC
Low lumen output fixtures/high fixture density applications (i.e. troffers, downlights, etc.)	L3965	\$0.25	Square Foot	YES
High lumen output fixtures/low fixture density applications (i.e. high bay)	L3966	\$0.125	Square Foot	YES
Energy Monitoring Bonus*	L4101	\$0.05	Square Foot	YES
NC = New Construction Eligible?				

*Bonus offering is for NLC systems utilizing an energy monitoring capability. Customers must be willing to share data with Focus on Energy. Additional requirements may apply.

Design Considerations

- Participation Ease (External)
 - \$/ft² incentive delivery resonated well with the market
 - Trade Ally interviews
 - MEEA member AEP Ohio had switched to \$/ft²
 - Quick incentive estimates/budgeting
 - Tie to DLC QPL
 - Easy to communicate eligible systems
 - Guaranteed system capabilities
 - Less internal system review needed, leads to quick pre-approval
- Program Calculation Ease (Internal)
 - Validate square footage with drawings
 - Deem calculations where we could (savings factor, HOU)
 - Staff/Implementer training
 - Future planning

Successes

- \$/ft² Incentive Design
 - Distributor commented that it allowed them to open up conversations they were not having before
 - Manufacturer's Rep commented that they finally had something they could use
- Space Type Variety
- Manufacturer and Manufacturer Representative Engagement
 - Training support
 - Promotion
- Positive Customer Feedback



Challenges

- Internal Pilot Challenges
 - Limited pilot funding, marketing “Achilles Heel”
 - Launch/offering timeline vs. sales cycle
- More Manufacturer and Manufacturer Representative Engagement
 - Keep training momentum going
 - Not all engaged at this point
- Lack of Market Knowledge
 - Previous system experiences
 - Options presented
- System Costs
 - Relatively expensive in some cases
 - Market expects high level of savings/benefit confidence
 - Metrics that speak to that (i.e. \$/ft²)
- Incremental Costs
 - Way for manufacturers and utilities to work together?



Future Considerations

- Keep Simplifying Incentive Models/Metrics
- Take More Hybrid Calculation Approach
 - Middle ground between custom and prescriptive
 - Claim deeper savings
 - Incorporate NEBs
- Require Installer Training?
 - Help guarantee controls strategies in place
 - Customer satisfaction, persistence
- Tiered Structure Between Room Level and Portfolio Level Systems
- Training, Training, Training

Questions?



NLC Program Design Study

Fritzi Pieper

Program Design Study



DLC Priority: Supporting
Development of New
Utility NLC Programs

Project Scope

 Interviews

 Develop Key Findings/ Themes

Develop Strategic Recommendations for Programs

Findings varied by Audience



13 Key Findings



Industry
Training



NLC
Promotion



Standardization



EM&V



Incentive
Design



Industry Training

1. Training is essential at all levels
 - Foundational
 - Product Specific
 - Sales
 - Utility program
2. Keeping Pace with Technology
3. Installers are reluctant to promote NLCs
4. Commissioning Challenges



Promoting NLCs in Programs

5. Need for dedicated promotional offerings

- Promoting existence of NLC programs is Insufficient
- Website Promotion for NLCs Needs Improvement
- Program Outreach for NLCs Requires Focus

6. Nomenclature Matters

- Networked lighting controls VS Connected lighting VS LLLCs VS Advanced Lighting Controls
- Terminology is used interchangeably but referring to simple and complex features



Standardization

7. Need for standardization to streamline data collection

Standardization involves two aspects:

- 1) Defining properties of various types of control technologies.
- 2) Providing a common means of fulfilling program validation requirements.



EM&V Efforts

8. Utility NLC incentive levels are too low to impact current 1st cost of NLCs

- Need for more energy savings data
- Need for research to determine monetary value of future DR and peak load capacity NLCs could bring about

9. Need for accurate valuation of Non-Energy Benefits (NEBs)



Incentive Design

Utilities with dedicated NLC offerings are having more success but programs vary in complexity and predictability

10. Cost effectiveness challenge

11. Custom Programs Dominate

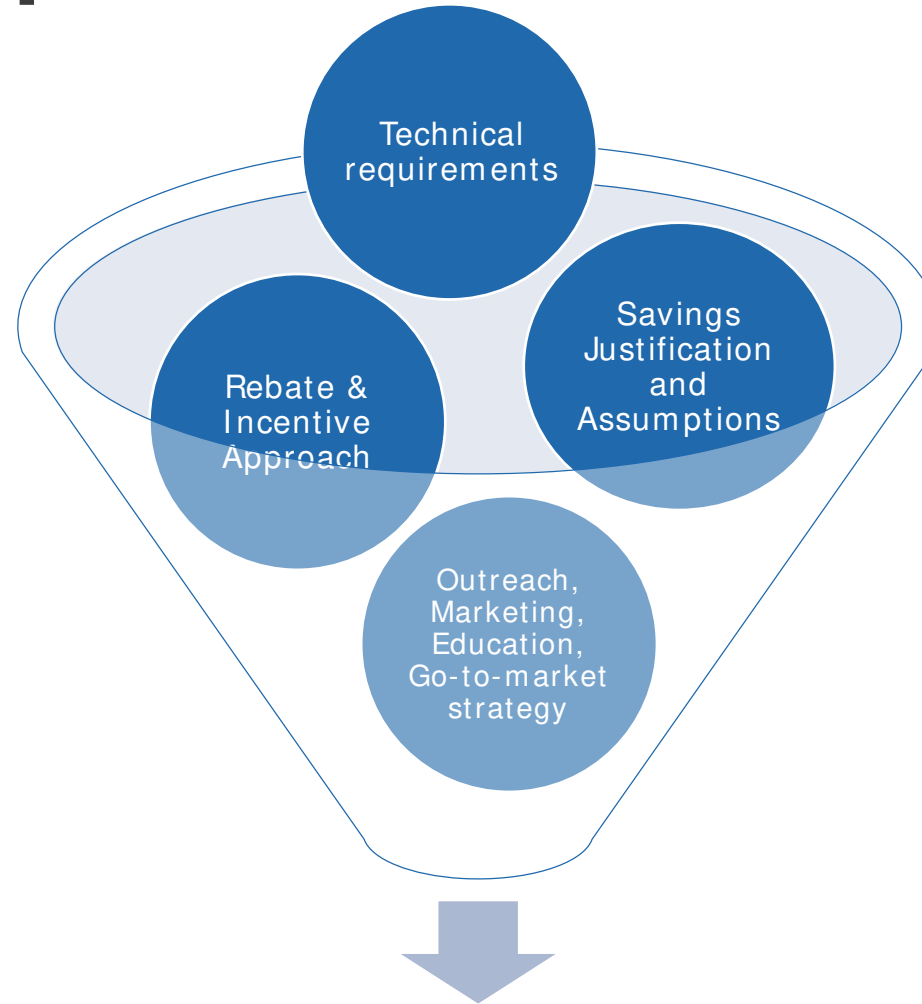
- Custom savings calculations, custom requirements

12. Customers and Trade Allies Prefer Prescriptive Programs

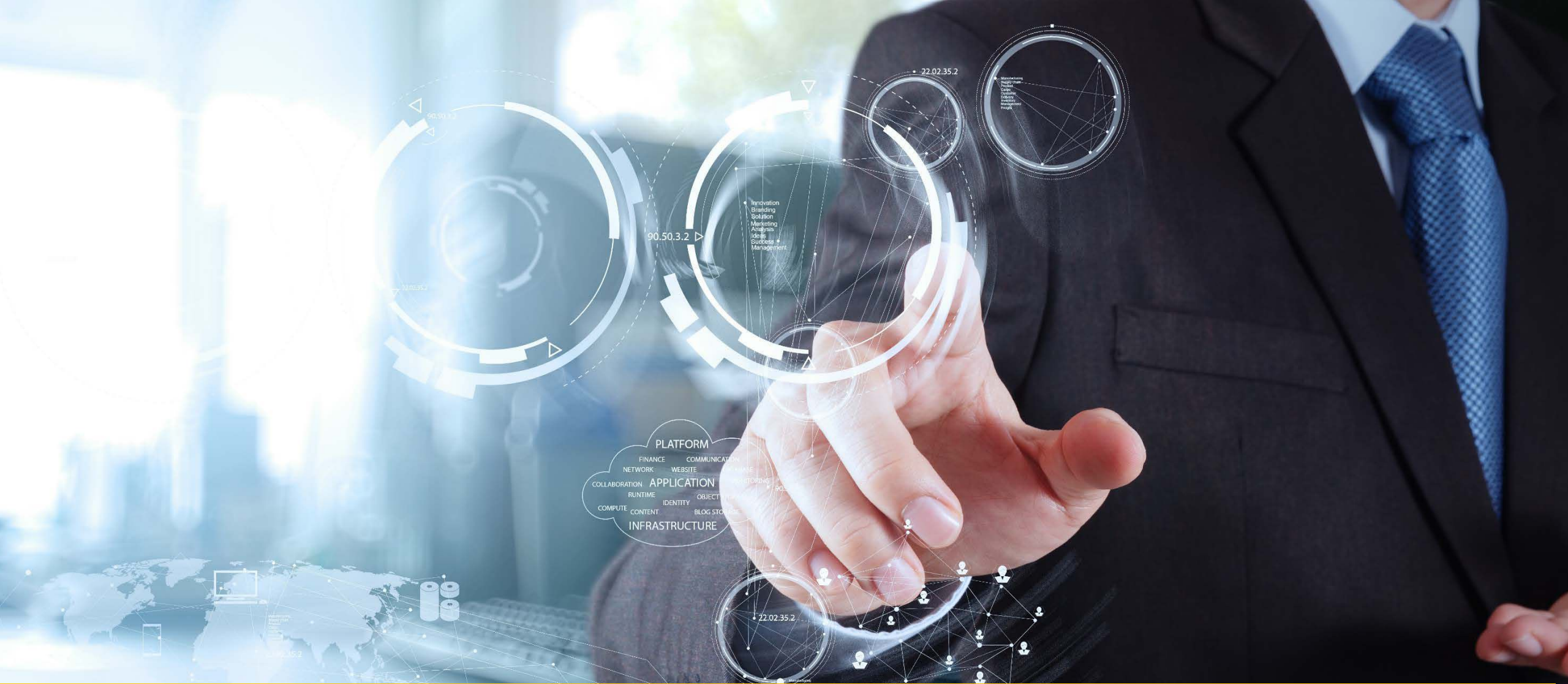
- Established rebate for assumed savings estimates

13. Simple Retrofit Disincentive

What's Next?



New NLC Programs



Full Scale Adoption of Networked Lighting Controls

The State of NLC Training

Damon Bosetti

What's The Need?

- How do we increase NLC adoption in small-medium C&I buildings, especially for retrofits?
- The trades ecosystem is the trusted voice advising these decisions.
- Complement existing training, like LCA and CAL/NALCTP
- 2017Q2-now: ~ 250 students
- now-2019: ~ 350 students





What Have We Learned?

- Mixing practical and theory works well
- You get what you pay for!
- Scaling-up in-person has some hard math
- How to get around hardware limitations?
 - 300 pounds of equipment, in 4 cases
 - Student contact time limits depth of exploration

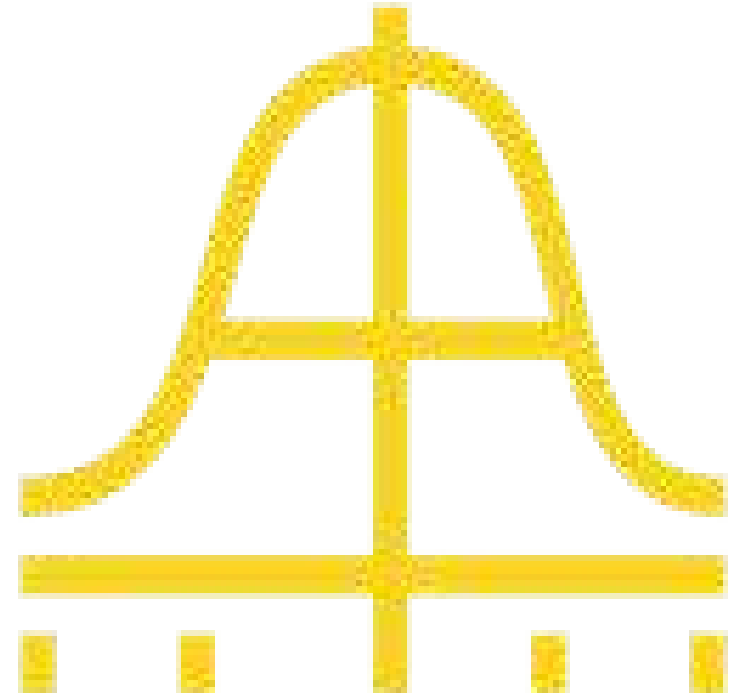
Scale Training, Scale Impact

- We're continuing in-person classes to keep testing, but we'll be closing in on an online version of this class, this summer.
- Vastly increased reach
- Cover more topics



How Do We Ensure Coverage?

- Who are we trying to reach, and how will we find them?
- Carrots? Sticks?
- Messaging variation?



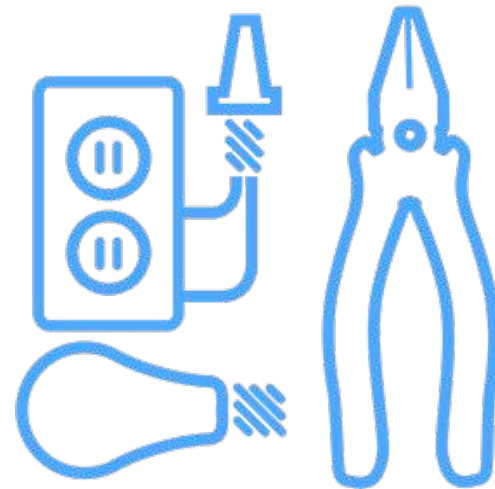
Who Delivers It?

- Who's the one delivering the training?
 - Utility?
 - Manufacturer?
 - State licensing agencies?
- Is delivery split from development and maintenance of the training?



What Gets Trained?

- Broad-brush system parameters?
- System economics?
- Sales techniques?



Small Group Brainstorms

Small Group Brainstorms

- Attendees selected their preferred topics in advance
- Each topic is assigned a color
- Sit at table that matches the color on your badge
- Each table brainstorms their topic for 30 min



Facilitators

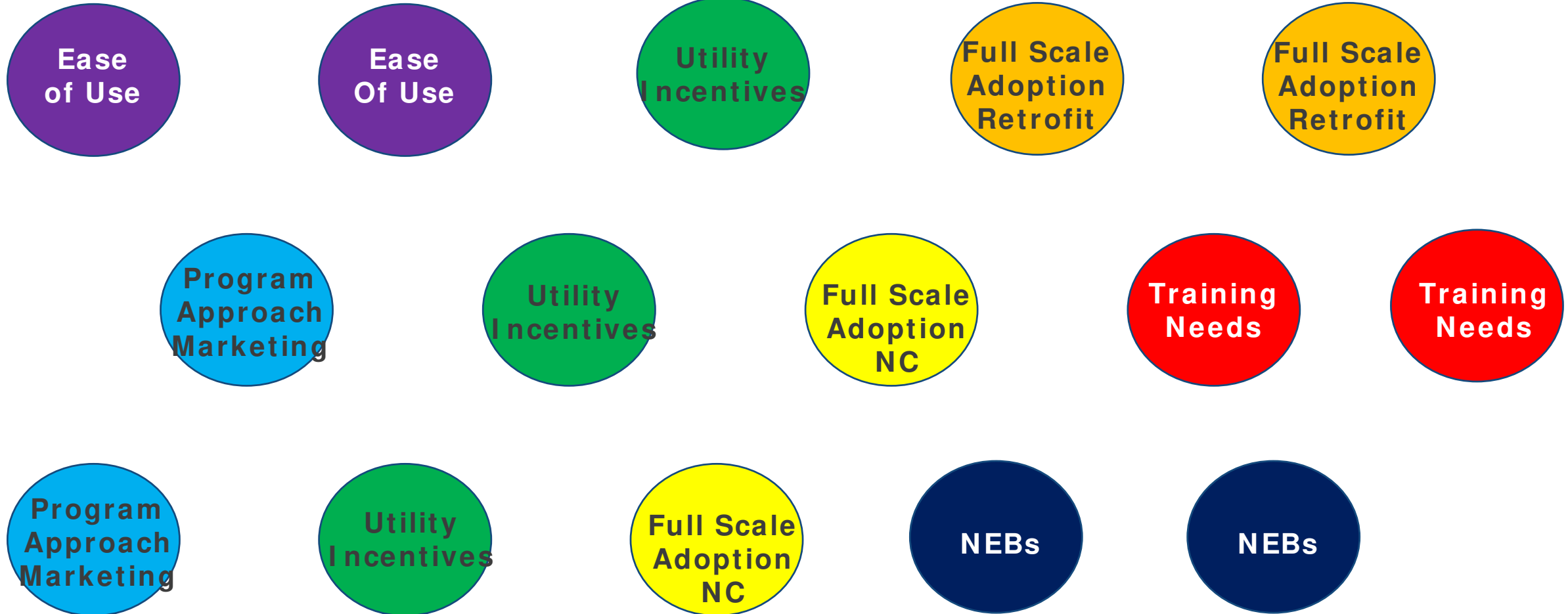
- One at each table
- Collects your input into PowerPoint Template
- Following the brainstorming, presents your top ideas/takeaways/findings to full audience



Topic List

- Preparing for Full Scale Adoption – New Construction
- Preparing for Full Scale Adoption – Retrofit
- Utility Incentives
- Program Approach and Marketing
- Ease of Use
- Training Needs
- NEBs

Tables and Topics



Preparing for Full Scale Adoption - New Construction

Background

- A utility needs to increase their lighting program savings to meet their efficiency program goals.
- Analysis shows that participants are not installing controls – a significant lost savings opportunity. If the controls are installed, the utility can achieve their savings goals.
- To address, the utility plans to require NLCs to be installed on all projects beginning in 2019 in order to access any lighting rebates.
- Consider from a New Construction Program Perspective

Assignment

Brainstorm as a group and record 3 bullets in response to each of the following questions:

- How does the utility prepare for this change? What are the 3 most important things they need to do to be successful with this change?
- What are the market characteristics needed to be successful? This may include characteristics such as education of the supply chain, availability/stocking, average payback, etc.
- What are the technology characteristics needed to be successful? This may include characteristics such as technology performance, simplicity, standardization, scalability, schematic, etc.

Preparing for Full Scale Adoption - Retrofit

Background

- A utility needs to increase their lighting program savings to meet their efficiency program goals.
- Analysis shows that participants are not installing controls – a significant lost savings opportunity. If the controls are installed, the utility can achieve their savings goals.
- To address, the utility plans to require NLCs to be installed on all projects beginning in 2019 in order to access any lighting rebates.
- Consider from a Retrofit Program Perspective

Assignment

Brainstorm as a group and record 3 bullets in response to each of the following questions:

- How does the utility prepare for this change? What are the 3 most important things they need to do to be successful with this change?
- What are the market characteristics needed to be successful? This may include characteristics such as education of the supply chain, availability/stocking, average payback, etc.
- What are the technology characteristics needed to be successful? This may include characteristics such as technology performance, simplicity, standardization, scalability, schematic, etc.

Program Ease of Use

Background

- Utilico is looking to design an easy-to-participate program for Networked Lighting Controls
- Utilico must strike a balance between ease of use and being able to accurately predict or measure energy savings.
- Custom programs reduce utility risk, but can be more costly, complex, unpredictable for participants.
- Prescriptive programs are more simple and predictable, but use broad assumptions for energy savings and may have other trade-offs.

Assignment

Answer the following questions to assist Utilico in designing their program

- How can you make this program easier for participants to engage in? What are 3 characteristics of an easy-to-participate program?
- Which aspects of the custom models pose the greatest barriers to participation, and why?
- What is needed to adopt a more easy-to-participate program? (ex: more data, standardization across systems, etc.)

Program Approach and Marketing

Background

- Efficiency programs, serving as brand-neutral advocates, are invaluable in supporting the education, awareness, and credibility of emerging technology such as NLC.
- NLC adoption is hindered by limited awareness of its benefits, and of available rebates and incentives. Different types of NLC systems (simple vs. comprehensive) are appropriate for different types of customers.
- Some vertical markets, such as commercial office space, campuses, retail, warehouse, and healthcare may benefit from customized promotions.

Assignment

Answer the following questions:

- Is it better to have a single program offering for all customers or should it be tailored by vertical market?
- Which verticals would provide the greatest benefit of a customized program and marketing approach?
- What elements should a customized approach include?
 - Customized literature by vertical?
 - Customized rebates/incentives by vertical?
 - Case studies by vertical?
 - NEBs promotion by vertical?
 - Etc.

Utility Incentives

Background

Utilities would like to increase their incentives for networked lighting controls but are concerned about the cost-effectiveness and risk of not realizing the savings they predict.

How do they justify higher incentives and mitigate risk?

Assignment

Brainstorm as a group and record 3 bullets in response to each of the following questions. Please be as detailed as possible.

- What are 3 convincing arguments that can be made, or analysis that can be done, to convince senior level management and/or regulators to offer higher than normal incentives for networked lighting controls?
- What are 3 strategies the utility can use to mitigate risk and help ensure they realize high levels of savings for the high levels of incentives they offer?

Training Needs

Background

- Perceived and real difficulty of installing and commissioning networked lighting controls increases installation costs and creates disincentives to promote them to customers.
- DLC and member utilities have been developing training with the goal to de-mystify NLCs and increase their use, especially in the small C&I spaces that legacy controls have largely bypassed
- How do we get the market well-trained and informed – at scale – on this technology?

Assignment

Brainstorm as a group and record a brief answer for each of the following questions:

- What kind of training is needed?
 - Foundational or Product-specific? A mixture?
 - Single sessions or a series?
 - Code-based or feature-based?
- When DLC's NLC training goes online, what might an in-person system specific supplement look like?
- What incentives should there be for receiving this training? CEU/ licensure? Requirement for incentive participation? General marketing competitiveness?

Non-Energy Benefits

Background

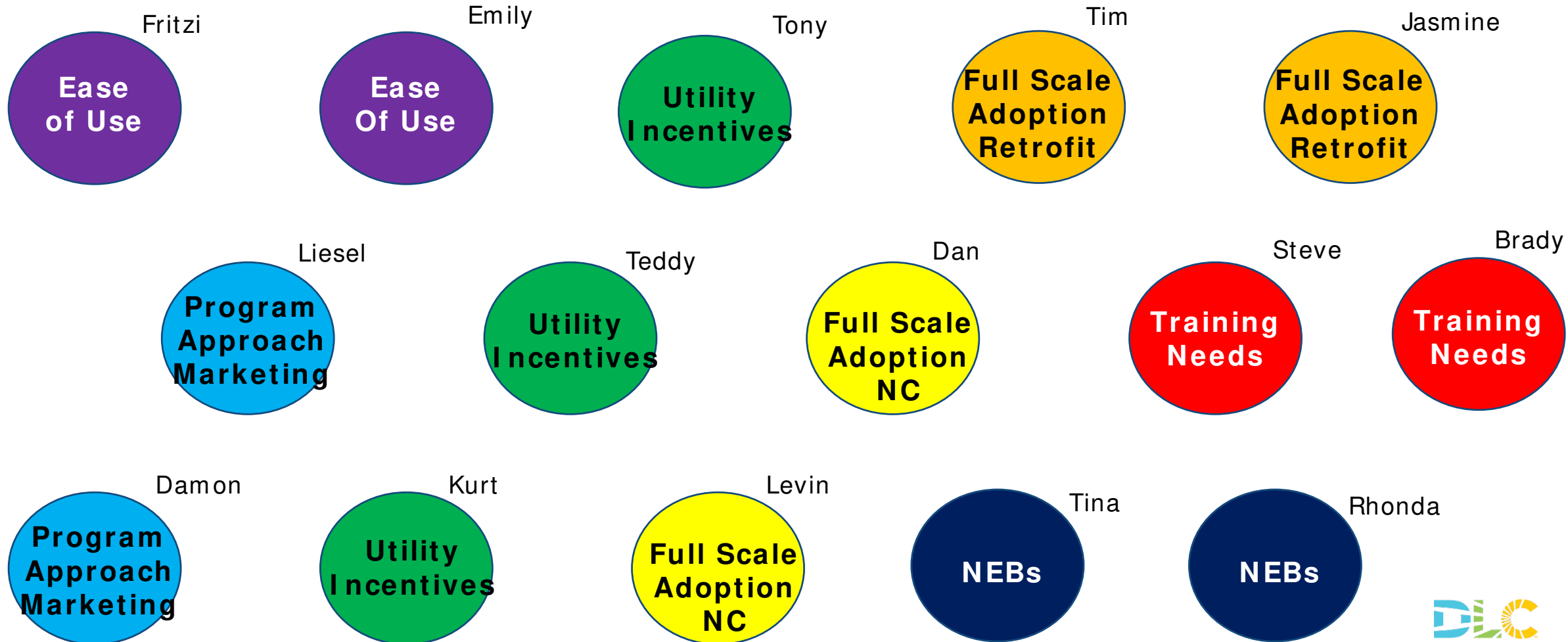
- Non-Energy Benefits (NEBs) benefits beyond energy savings
- When value of NEBs can be clearly communicated or quantified, they can be leveraged to increase sales and adoption
- In some cases, quantified NEBs can be incorporated into utility cost-effectiveness calculations enabling them to offer higher incentives or rebates.

Assignment

Brainstorm as a group and record a brief answer for each of the following questions:

- Which 3 NEBs provide the greatest potential for promotion and quantification? By utilities? By manufacturers?
- Which benefits need common terminology to reduce market confusion?
- What help do manufacturers need, can they cooperate, what collaborations are needed to support/promote this better?

Topics and Facilitators



Small Group Brainstorm Results

Program Ease of Use

Background

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- Utilico must strike a balance between ease of use and being able to accurately predict or measure energy savings.
- Custom programs reduce utility risk, but can be more costly, complex, unpredictable for participants.
- Prescriptive programs are more simple and predictable, but use broad assumptions for energy savings and may have other trade-offs.

Assignment

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- How can you make this program easier for participants to engage in? What are 3 characteristics of an easy-to-participate program?
- Which aspects of the custom models pose the greatest barriers to participation, and why?
- What is needed to adopt a more easy-to-participate program? (ex: more data, standardization across systems, etc.)

What are 3 characteristics of an easy-to-participate program?

- Prescriptive, mid-stream or up-stream programs with predictable incentive levels. However, savings assumptions are more conservative.
- Having a utility portfolio that provides an incentive for everyone, Small-Medium Business and Large Commercial.
- Receiving incentive up front (ideally by SKU, not sqf).
- Using Normalized Meter Energy Conception (NMEC) approach – looking at meter data/ progression analysis could help utilities make better savings assumptions.

Which aspects of the custom models pose the greatest barriers to participation, and why?



- Reluctance of customers and contractors to participate due to previous bad experience with controls or due to lack of understanding of the technology. Contractors lack training
- Complicated structure scares away customers and causes increased administrative cost for utilities to handhold participants through the process of complex custom incentive programs.
- Custom programs are not necessarily cost effective for utilities. Lack of access to data to assess savings leads to lack of granularity in current savings assessments
- Lack of certainty up-front leads to customers not going after rebates for new construction. For retrofit projects, customers also need certainty of savings and incentives. If incentives don't come through, customers may face increased cost and may not participate in the future.
- Uncertainty of commissioning can lead to unsatisfied customers.

What is needed to adopt a more easy-to-participate program?

- Utility could pay for energy studies to gather larger data set through pilots to get better savings estimates. All pilots from across the country could be compiled into a mega study.
- A plan or guidance for how to commission systems is needed.
- Require proposal from manufacturers that includes clear description of sequence of operations, what-if scenarios, 1-800 number, etc. to provide contractors and end-users with as much up-front information as possible.
- Provide education for customers and installers with clear measurable goal such as a certification that utilities could require for incentive programs.
- Provide an incentive upfront and a kicker or bonus after some time.
- DLC could standardize data collection and reporting (need before and after).

Program Ease of Use

3 Most Important Ideas/ Findings/ Takeaways from the Group:

1. Prescriptive, mid-stream or up-stream
 - Receive money before customer has to pay (ideally by SKU, not by sq ft)
 - Incentive up-front + kicker at end (hybrid)
2. Tighten window of uncertainty with templates and default settings
 - Mandate as part of NLC spec
3. DLC to standardize data collection and reporting
 - Need before and after

What are 3 characteristics of an easy-to-participate program?

- Has to be understandable to everyone, not just the utility program
 - The example was given of a turbo tax like program with binary questions that shows what you qualify for online and carries you through the process through qualification by answering yes or no questions about what applied to you. This would be easy for owner to submit, etc.
- Must be accurate- the utility can't afford inaccuracy in the savings.
 - The program must meet overarching set of goals for the entire selection. The accuracy of savings for the incentives must be high level to report to the commissioners, the entire program will be penalized if the savings are inaccurate.
- Equal access for small and large customers, the program should allow for customers with fewer resources to have access to the same information
 - Often, smaller customers don't know about programs because contractors don't approach them due to the smaller payoff

What are 3 characteristics of an easy-to-participate program? (continued)

- Includes training-Part of the online portal, however there does not need to be a huge training focus beyond the initial introduction to the program if the program is not changing radically over time.
- The program must be lucrative to everyone
 - The value must be significantly high for all stakeholders, doesn't necessarily mean high incentives, but the savings need to be high for utilities, incentives high enough for end users/manufacturers- the program must be worth participating in

Which aspects of the custom models pose the greatest barriers to participation, and why?



- M&V (measurement and verification)- why is it not scalable or cost effective? Because you don't get your money until a year later. It's a pain logistically, unless the product does it itself, which is not usually the case. In addition, the data must be logged through 4 seasons, summer doesn't provide heat value. At minimum, programs require measurement and verification for two shoulder months (in the spring and autumn)
- Does self monitoring help with baseline? With NC the baseline is code. With retrofits, the baseline depends on what is being changed.
- Can make assumptions with lighting, claiming hours of operation but its still a pain with delay

- For a custom program, have to validate the to 90 percentile range because it is custom. It's easier with prescriptive, custom costs everyone more money
- Modified M&V programs (hybrid models) alleviate the barrier of the M&V
 - These programs take conservative view of the savings, pay up front for the first 70%, hybrid model, have to do M&V for the course of the year to get up to 25% greater than 100% - like a bonus. Puts owness on the building to perform. Downside of them not saving the 70% but it's a conservative look so is generally safe.

What is needed to adopt a more easy-to-participate program?

- Unlikely to get away from custom on some of the products. Prescriptive for small business plug and play, custom for complex larger products that tie to HVAC and plug load, etc.
- Small up front costs helps customers see value
- Don't pay for dumb fixtures anymore- results in relegating that building to be dumb for 15-20 years
- Shared savings- less upfront cost for utility as the savings is proven, front loading for the utility. Utility would rather deal with up front vs custom or modified, then they don't have to follow up

- Not manufacturer specific, must be agnostic get yourself away from manufacturer and specific types of technology for material costs payback, create a percentage based approach
- Percentages are more of a custom path and can be more difficult than fixed dollar to control paths. However, custom paths can be good, for example the hybrid approach. Over the year, proves persistence of savings that you're claiming for 15 years, need to continue for 15 years at current depreciation value.

Program Ease of Use

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- Three characteristics of an easy to use utility program are
 - understandability/accessibility to all participants
 - accuracy
 - the program is lucrative/ has value realized for all participants
- M&V poses a large barrier to custom programs- solutions include hybrid models
- A way to make programs easier include using prescriptive programs for less complex, plug and play controls used in smaller projects and custom or hybrid paths for larger, more complex projects that connect with HVAC and other systems. Move towards requiring controls for incentives.

Preparing for Full Scale Adoption - New Construction

Background

- A utility needs to increase their lighting program savings to meet their efficiency program goals.
- Analysis shows that participants are not installing controls – a significant lost savings opportunity. If the controls are installed, the utility can achieve their savings goals.
- To address, the utility plans to require NLCs to be installed on all projects beginning in 2019 in order to access any lighting rebates.
- Consider from a New Construction Program Perspective

Assignment

Brainstorm as a group and record 3 bullets in response to each of the following questions:

- How does the utility prepare for this change? What are the 3 most important things they need to do to be successful with this change?
- What are the market characteristics needed to be successful? This may include characteristics such as education of the supply chain, availability/stocking, average payback, etc.
- What are the technology characteristics needed to be successful? This may include characteristics such as technology performance, simplicity, standardization, scalability, schematic, etc.



What are the 3 most important things the utility needs to do to be successful with this change?

1. Efficiency programs must quantify expected energy savings beforehand, and then measure and verify (M&V) the results after installation. When performance is not well known, 100% of all projects need M&V. When performance is very predictable, still M&V is needed on a sample of 5% or 10% of projects. So: data is essential.
2. Get at least 50% of trade allies (installation contractors) onboard with the new tech
3. Plug and play tech, to support # 2

What are the market characteristics needed to be successful?



- Get an early adopter trade ally as advocate for the program.
- Have at least half of trade allies, using NLC. Keep it simple for a contractor. 1 page info about the program, no more.
- Make the NLC system simple to buy with the rebate. For instance, the contractor gets \$50 discount at the distributor's counter—rebate applied at Point of Sale. The only paperwork for contractor is a piece of paper to sign at the counter
- Need education. Utility can sponsor—training is a “prudent” use of money accepted by regulators.

What are the technology characteristics needed to be successful?



- Easy monitoring. For instance, a box with no programming. Just plug it in, and see a green light if it's working red light if not. The simple case would be 1-way communication of energy data from the site to the utility—the utility has no control, just received data. You buy the box now for \$50. After sending data for a year, you get a \$75 refund.
- How will utilities process the data? Utilities with smart meters may already have capacity to process data. Others may need a 3rd party service
 - A standard data format is needed. Could send data various ways—cellular, email ,however.
- Main questions for data: Did the usage pattern change over time? What is the baseline, since there is no pre-installation data? For New Construction, compare to segmented data, showing typical energy usage for various building types that barely meet code. For instance, Georgia Power runs regression patterns, from M&V pre-post they have done on many projects, to estimate a code baseline for each type of building. Ideally, multiple utilities would contribute to an aggregated database, to say that building of this type, in this climate zone, with this building code, uses this amount of energy.
- need plug and play tech, for POS rebate.
 - This would be simpler without manual setup of networking. Just smart fixtures, no zoning..

Preparing for Full Scale Adoption - New Construction

3 Most Important Ideas/ Findings/ Takeaways from the Group:

1. Ideal: Point of Sale, fixed rebate.
2. Utility needs confirmation of savings. 100% of projects early, gradually reduce to 10% or 5%, but always necessary.
 1. For each project (or some, with extra rebate), send data to utility, to confirm savings.
 2. Comm box with cellular output to utility, and wireless communication with wireless luminaires
 3. Need a standard data format
 4. Can utility process data? (Some already have 99% smart meters)
3. Plug and Play is essential. Zoning makes it complicated. Consider starting with per-fixture controls that are not networked / flexibly zoned.



What are the 3 most important things the utility needs to do to be successful with this change?

- Educating engineers/arch that lighting controls are not just a panel in the back of the house
- Educating designers, electricians, and utility engineers what is required for incentives; they need to know up front
 - IALD and other trade organizations
- Utilities need ways to estimate savings that is not based on size for prescriptive offerings
- Bundling with other programs (e.g. Demand Response)

What are the market characteristics needed to be successful?



- Inform upstream actors (in construction plan) that NLC is a requirement
- Luminaires leave the factory with standardized controls so utilities know what savings they can expect
 - Some guaranteed savings would allow utilities to treat lighting and controls as a system

What are the technology characteristics needed to be successful?



- Standardized reporting format
- Accuracy (2%) in metered energy use
 - Need to be careful what the accuracy metric is
 - Accuracy goes up, cost goes up
 - What does it cost for accuracy, and what is the utility willing to pay?
- ANSI standard not getting enough participation
 - Utilities need to get involved, express their needs
 - Specific standards for application (parking, office)

Preparing for Full Scale Adoption - New Construction (Dan)

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- Bundle NLC with other energy efficiency strategies/programs
 - E.g. Automatic Demand Response
- Luminaires (LLLC) shipped from factory with standard control strategies; may allow utilities to look at **SSL+ NLC as a system**
- Agreement between regulators, utilities, orgs setting standards of **meter measurement accuracy** requirements/feasibility

Non-Energy Benefits

Background

- Non-Energy Benefits (NEBs) benefits beyond energy savings
- When value of NEBs can be clearly communicated or quantified, they can be leveraged to increase sales and adoption
- In some cases, quantified NEBs can be incorporated into utility cost-effectiveness calculations enabling them to offer higher incentives or rebates.

Assignment

Brainstorm as a group and record a brief answer for each of the following questions:

- Which 3 NEBs provide the greatest potential for promotion and quantification?
- Which benefits need common terminology to reduce market confusion?
- What help do manufacturers need, can they cooperate, what collaborations are needed to support/promote this better?

Which 3 NEBs provide the greatest potential for promotion and quantification? By utilities? By manufacturers?



1. HVAC Integration
2. Package Remote Diagnostic & Maintenance together
3. Circadian (but revised to encompass broader related opportunities/features IE. Task tuning)



Which NEBs need common terminology to reduce market confusion?

Start with actually replacing “NEB” with alternative terminology (NEB is not accurate and does not describe the true scope of sub categories).

--Such as “user satisfaction”

- Not common terminology but rather ..standardize Calculators
- Not common terminology but rather ..standardize Databases



What help do manufacturers need, can they cooperate, what collaborations are needed to support/ promote this better?

More and better case studies that ...

- Relate NEB, or user satisfaction technologies or features back into energy design discussions.
- Relate NEB, or user satisfaction technologies or features back into user energy savings quantifications.

(Must be substantive).

Non-Energy Benefits

3 Most Important Takeaways from the Group:

1. Rebrand “NEB” itself and better refine/ identify sub-categories
 - Some have varied types benefits
 - Some also include energy savings
 - Consider how multiple benefits can be quantified separately on the data side
2. “More” and “better” science based, technical reference data
 - Empirical case studies
 - Cross industry research

Both goals developed in support of balancing out the design and sales discussion on the front end with outcomes that can be incentivized well.

Which 3 NEBs provide the greatest potential for promotion and quantification? By utilities? By manufacturers?



- Recommend prioritizing NEBs by market segment
 - Healthcare and education (circadian)
 - Industrial (safety),
 - office (comfort, space utilization),
 - retail (asset tracking)
- General recommendations on end user NEBs:
 1. Decreased Maintenance and Optimization costs - all
 - Remote diagnostics
 2. Personal/Location Safety – all (safety is key issue for utilities and convey safety messages regularly)
 3. Security (cyber) – differentiator among manufacturers



Which NEBs need common terminology to reduce market confusion?

- **NEBs** – lets define the Non Energy Benefit

Some terms considered to be NEBs should be reconsidered and defined (examples):

- People Tracking (sounds creepy)
- Occupant Optimization can this be characterized as Space Utilization
- Circadian Controls versus Human Centric lighting – human centric can be too many things
- Increasing Productivity versus mood and personalization



What help do manufacturers need, can they cooperate, what collaborations are needed to support/ promote this better?

- Manufacturers understand the priority for the end user
 - Communicate those priorities to utility/program managers
- Knowing which states can even approach NEBs
 1. Regulatory environments vary in acceptance of NEBs for cost benefit analysis
 2. Which NEBs are actionable in program design
- Set up working group to lay out the terms, regulatory areas, market segmentation of NEBs for clarity and industry alignment

Non-Energy Benefits

3 Most Important Ideas/ Findings/ Takeaways from the Group:

1. Identify the NEBs most likely to have metrics associated
2. Prioritize those NEBs in the DLC NLC spec in Reported versus Required capabilities
3. Working group, anyone?

Preparing for Full Scale Adoption - Retrofit

Background

- A utility needs to increase their lighting program savings to meet their efficiency program goals.
- Analysis shows that participants are not installing controls – a significant lost savings opportunity. If the controls are installed, the utility can achieve their savings goals.
- To address, the utility plans to require NLCs to be installed on all projects beginning in 2019 in order to access any lighting rebates.
- Consider from a Retrofit Program Perspective

Assignment

Brainstorm as a group and record 3 bullets in response to each of the following questions:

- How does the utility prepare for this change? What are the 3 most important things they need to do to be successful with this change?
- What are the market characteristics needed to be successful? This may include characteristics such as education of the supply chain, availability/stocking, average payback, etc.
- What are the technology characteristics needed to be successful? This may include characteristics such as technology performance, simplicity, standardization, scalability, schematic, etc.



What are the 3 most important things the utility needs to do to be successful with this change?

- Highly incentivize projects early on in the program
 - Will accelerate the adoption of NLCs
 - Enables program to collect data early on
 - Publicizing early wins will increase program awareness
- Training, training, training
 - Identify appropriate members of the value chain to perform this training
 - Without proper education early adoption will be limited
- Simplify the incentives
 - Easy to understand incentives likely to accelerate adoption
 - Incentives should align with project costs to ensure short ROI

What are the market characteristics needed to be successful?



- Product availability
 - Diverse selection of different products critical
 - Technology must be easy to understand for installers and end users
- Return on investment is critical
 - If payback does not make sense projects wont move forward
 - Highly incentivize early to accelerate
- Collaboration within the entire value chain
 - Will reduce confusion in the marketplace



What are the technology characteristics needed to be successful?

- Systems need to be simple to install, configure, and use
- Accurate validations need to be in place to confirm that systems are performing as expected
- Products need to have some standardization
 - Without a common platform adoption may be limited

Preparing for Full Scale Adoption - Retrofit

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- Return on Investment
 - If the ROI is too far out, program will not gain traction
 - Highly incentivize early on
 - Provides an opportunity to collect data
- Training, training, training
 - Need to explore best methods to train high volumes of people effectively
 - Identify the appropriate members of the value chain to perform this training
- Simplicity of NLC systems
 - Need to get to the point where NLCs are like cell phones. Regardless of manufacturer and platform the technology is easy adapted to
 - Simplicity in the systems will help accelerate adoption



What are the 3 most important things the utility needs to do to be successful with this change?

- **Comprehensive:** A more holistic approach to the whole system.
- **Greater incentives that match percentage-wise some older rebate programs(covering the incremental cost from traditional controls to NLCs:**
 - Larger rebate incentives, possibly incentives that are for below code (for states that don't allow rebates for going to code and have stricter requirements (i.e. California Title 24 Part 6)).
 - Incentivize to lighting contractor as an option over account holder. (similar to East Bay Energy Watch in California)
 - Open to rebating non-LLC
- **Capturing savings is a must:** Not enough to install, utilities need to have confidence that controls will be used consistently. Possibly incorporate with DR program, Tying the pathways of utility rebate with future possible DR revenue
 - This may exclude systems that don't have direct DR capability.
- **Education:** Contractors and sales reps on rebate resources. Educate Sales Reps of existing businesses to feel comfortable explaining NLCs and their benefits

What are the market characteristics needed to be successful?



- New revenue branch
- Open to more mid-stream rebate programs
- Consider, revenue of software, for storage data, support, monitoring
- Rebate for controls going beyond code.
- Easier specification for retrofit
- Market being educated on rebate programs
- Consistency with LLC types. Supply more accessible. If an NLC-component fails early then replacing that part means an order, not just “a run to the hardware store”.

What are the technology characteristics needed to be successful?



- Still open to accepting non-NLC projects
- Adaptive legacy support.
- Fully backward compatible, especially with 0-10V systems. No need for all to become digital systems
- Simple adaptations
- Developed written and recognized standard
- Integration with any non-retrofitted areas of building

Preparing for Full Scale Adoption - Retrofit

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- 1 A more holistic approach for light system approach. Possible incorporation with DR lighting program and incentivizes beyond code.
- 2 Education to Contractors and Market to be able streamlined to easily inform customers about obtaining rebates.
- 3 Retrofit customers need to be ensured that NLC will be fully backwards compatible with existing technology and useable for years in the future.

Utility Incentives

Background

Utilities would like to increase their incentives for networked lighting controls but are concerned about the cost-effectiveness and risk of not realizing the savings they predict.

How do they justify higher incentives and mitigate risk?

Assignment

Brainstorm as a group and record 3 bullets in response to each of the following questions. Please be as detailed as possible.

- What are 3 convincing arguments that can be made, or analysis that can be done, to convince senior level management and/or regulators to offer higher than normal incentives for networked lighting controls?
- What are 3 strategies the utility can use to mitigate risk and help ensure they realize high levels of savings for the high levels of incentives they offer?

What are 3 convincing arguments to analysis to convince management or regulators to offer higher than normal incentives for NLCs?



- Three key factors are squeezing programs:
 - rising baselines, increased goals and TRMs that reduce hours of operation beyond what is actually occurring reduce the savings opportunity.
 - NLCs create an opportunity to address those risks by providing deeper savings and monitoring to actually document hours of operation.
- Restructure savings programs so there is a higher priority on controls. Designs should maximize the behavior that encourages NLCs.
- By combining controls and lighting would minimize evaluation risk, it creates a better customer lifecycle cost and combining them would improve project economics and savings.

What are 3 strategies the utility can use to mitigate risk and help ensure they realize high levels of savings for the high levels of incentives they offer?



- Because energy savings vary so widely by project, the biggest risk for utilities to a poor evaluation from a few single sites.
 - Develop a standard sequence of operations (occupancy sensing, task tuning, timeouts, etc, is it ready to support start-up), which will improve standardization of installation and start-up.
 - Use monitoring data to develop and preponderance of evidence, so that projects portfolios aren't judged by a small sample size. This could involve a standardized reporting method and evaluation approach such as IPMVP Option B.
- Using energy monitoring, utilities can offer retro-commissioning services for projects that do not meet expectations to reduce the risk from evaluation

Utility Incentives

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- 1 – Monitoring really can help reduce risk
- 2 – standardization is key
- 3 – Prioritize controls in your portfolio structure

What are 3 convincing arguments or analysis to convince management or regulators to offer higher than normal incentives for NLCs?



- Arguments for higher incentives for NLCs
 - Program redesign to make it more systematic (custom)
 - Integrate the lighting & NLC into one system and incent the whole system (don't treat the components as separate elements)
 - Design new programs based upon entire systems (NLC and beyond – e.g. BMS, etc) enlarge the pool of energy benefits as a means of enlarging the incentive funding
 - Programs are custom but 'The New Custom' accessible, verifiable, and always the most generous
 - Develop dedicated marketing programs & related collateral specific for NLCs
 - Address the regulatory and inter-utility barriers/constraints that limit/cap project incentives
 - Leverage information technology to reduce overhead costs of program administration.
 - Require energy data for NLC incented projects to provide verification of realized additional energy savings
 - Build incentives based upon long-term/lifecycle energy savings and operating expenses
 - Total costs over the expected or economic life of the system
- Analysis that can be done for higher incentives for NLCs
 - What is the market cost for NLCs integrated into lighting systems?
 - The DLC study focused on the delta of increased energy savings.
 - What is the delta for the increased installed cost (materials & labor)

What are 3 strategies the utility can use to mitigate risk and help ensure they realize high levels of savings for the high levels of incentives they offer?



- Strategies that utilities can use to mitigate risk
 - Require energy data for all NLC projects
 - Delayed/withheld incentives paid based upon realized energy savings
 - % of incentives withheld and paid out periodically based upon measured & verified energy savings
 - Increase the pool of qualified NLC professionals (sales > design > engineer > install > program > commission > use)
 - Training & designation/certification programs for every role in the channels
 - New Construction & Retrofit channels differ and training programs developed for each.

Utility Incentives

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- 1 Arguments for higher incentives for NLCs
 - Program redesign to make it more systematic (custom)
 - Based upon entire systems (NLC and beyond – e.g. BMS, etc)
 - enlarge the pool of energy benefits \approx >incentive funding
 - ‘The New Custom’ accessible, verifiable, & always the most generous
 - Address the regulatory and inter-utility barriers/constraints that limit/cap project incentives
 - Require energy data for NLC incented projects to provide verification of realized additional energy savings
 - Build incentives based upon long-term/lifecycle energy savings
- 2 Analysis that can be done for higher incentives for NLCs
 - What is the market cost for NLCs integrated into lighting systems?
 - The DLC study focused on the delta of increased energy savings. What is the delta for the increased installed cost (materials & labor)?
- 3 Means of mitigating risk
 - Require energy data
 - Delayed/withheld incentives paid based upon realized energy savings
 - Increase the pool of qualified NLC professionals (sale > design > engineer > install > program > commission > use)

What are 3 convincing arguments of analysis to convince management or regulators to offer higher than normal incentives for NLCs?



- Provide Testimonials (co-branded with utilities) from customers with successful NLC systems.
- Promote the value and capability of NLC to provide Comprehensiveness – can control more (plug load, pumps & motors, etc.) – X% of savings is not lighting anymore. Investment in NLC interoperability can add to other connected building system efficiencies.
- Initiate pilot programs to show interoperability capability.
- Use third-party validation of NLC project data to illustrate potential for reducing complexity and implementation costs of programs.

What are 3 strategies the utility can use to mitigate risk and help ensure they realize high levels of savings for the high levels of incentives they offer?



Reduce time and cost by energy monitoring – can verify persistence for those programs with lifetime goals. Require M&V as part of the program requirements.

Recommend post-install recommissioning opportunity for deeper customer engagement and deeper savings.

Validate savings projections w/data loggers, to allow credible use of manufacturer project savings data. Have DLC require a third-party verification to be on the QPL.

Utility Incentives

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- Need to allow future risk mitigation by encouraging training.
 - Proper training will clarify market capabilities and costs
 - Coordination of industry approach to training will facilitate adoption
- Need to invest in pilots that show comprehensiveness.
 - NLC can augment efficiency of other connected building systems
- Need third party validation of savings projections.
 - Will allow use of manufacturer data to compliment pilot studies

Program Approach and Marketing

Background

- Efficiency programs, serving as brand-neutral advocates, are invaluable in supporting the education, awareness, and credibility of emerging technology such as NLC.
- NLC adoption is hindered by limited awareness of its benefits, and of available rebates and incentives. Different types of NLC systems (simple vs. comprehensive) are appropriate for different types of customers.
- Some vertical markets, such as commercial office space, campuses, retail, warehouse, and healthcare may benefit from customized promotions.

Assignment

Answer the following questions:

- Is it better to have a single program offering for all customers or should it be tailored by vertical market?
- Which verticals would provide the greatest benefit of a customized program and marketing approach?
- What elements should a customized approach include?
 - Customized literature by vertical?
 - Customized rebates/incentives by vertical?
 - Case studies by vertical?
 - NEBs promotion by vertical?
 - Etc.

Is it better to have a single program offering for all customers or should it be tailored by vertical market?

- Both – single broad offer for all, but targeted offers for some markets
- Depend on utility resources, and need to balance incentives
- Use based on power density, several verticals could work (segment by use: industrial vs office)
 - Incentives could be different, but not too deep into multiple different markets/offers
- Hours of use are more important than power density when LPDs are plummeting
 - Need to be cost effective, (designing to .4 w/ft² in Title24)
 - Perception is that we won't see big delta in savings between with or without NLC
 - Need to offer other benefits, beyond energy benefits
 - Designer/arch/client sells to end user
 - Needs to be required by end user or contractors will come in with least cost option
- Need to know right system for application
- This is Market education rather than “marketing”

Which verticals would provide the greatest benefit of a customized program and marketing approach?

- Broad program highest rate (smud)
- Office – small to midsize especially (transition during fit out)
 - Property management companies, competitive advantage
- Warehouse space types
- University campus
- Possibly healthcare, but challenges in intricacies of design
- Price tag turns customers off, how to pay for that? Incentives help go beyond code
- Human centric – timing and customizability (need standardization)
 - Healthcare and education

What elements should a customized approach include?

- Incentive adders are easiest model to use (but risk not getting savings)
- Higher incentive rate based on kwh/sq ft
- Need research on systems, proven models
- Need data on case studies, show impact and benefits, customizability
 - Paybacks, evidence
- Lighting cost models, energy models, showing impacts of controls, metering before project
- Case studies on installation success – for facility managers
- Ability to modulate, customize system
- Human centric effects benefits
- Mandates or motivated by reducing carbon footprint
- Target benefit by user interest-Financial vs non energy
 - University may be more interested in non-energy benefits
 - Corporate may be mostly bottom line – attract retain employees, optimize space
 - Tenant space may find green and energy benefits will give competitive advantage

Program Approach and Marketing

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- 1 Single broad offer with targeted offers for some markets that have very different hours of use and end user needs (warehouse, office, university, healthcare) but not too many different offers
- 2 Need to include verified successful installations, tailored for given market (not always energy benefit)
 - Corporate: financial analysis, employee recruitment retention, space optimization
 - University: financial, non-energy benefits
 - Mid size office: tenant fit out opportunity to be more competitive
- 3 Additional selling point: Connection to Internet of things through the NLC system separated/isolated from building IT system

Program Approach and Marketing

Background

- Efficiency programs, serving as brand-neutral advocates, are invaluable in supporting the education, awareness, and credibility of emerging technology such as NLC.
- NLC adoption is hindered by limited awareness of its benefits, and of available rebates and incentives. Different types of NLC systems (simple vs. comprehensive) are appropriate for different types of customers.
- Some vertical markets, such as commercial office space, campuses, retail, warehouse, and healthcare may benefit from customized promotions.

Assignment

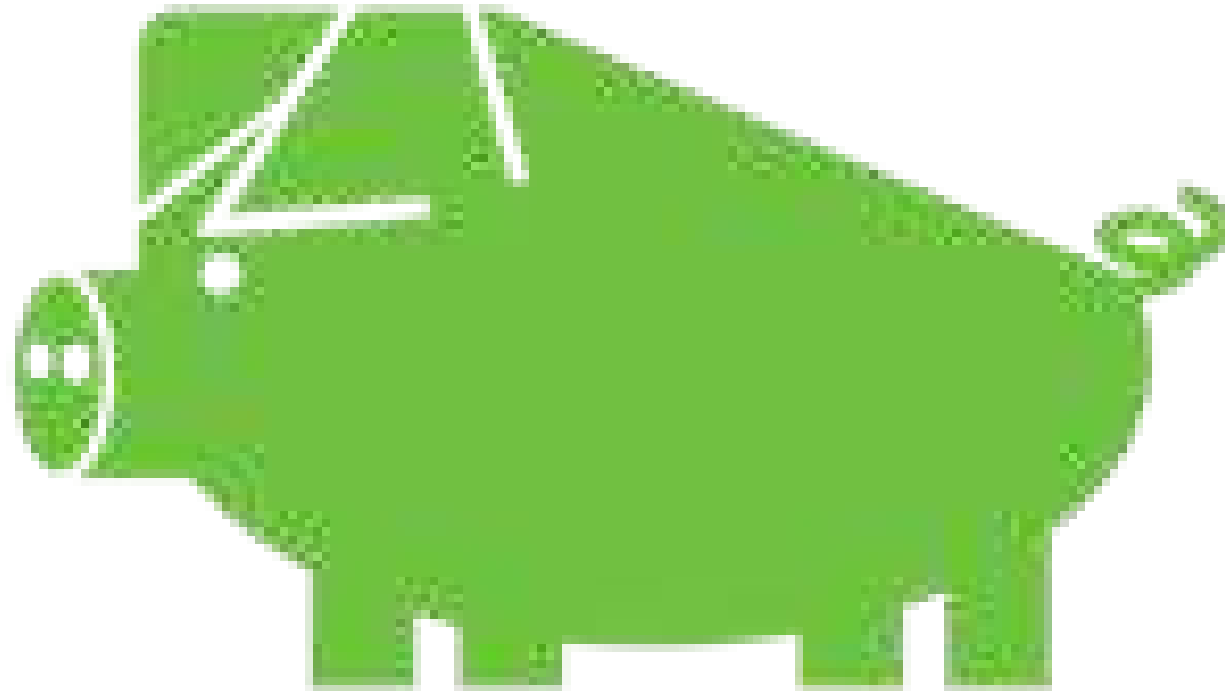
Answer the following questions:

- Is it better to have a single program offering for all customers or should it be tailored by vertical market?
- Which verticals would provide the greatest benefit of a customized program and marketing approach?
- What elements should a customized approach include?
 - Customized literature by vertical?
 - Customized rebates/incentives by vertical?
 - Case studies by vertical?
 - NEBs promotion by vertical?
 - Etc.

Is it better to have a single program offering for all customers or should it be tailored by vertical market?

- Start broad: think billboards and mailers with a generic message that's applicable to everyone.
- Then segment by building size. This correlates decently to fixture types and power classes. Slightly more specific marketing messages.
- Then segment by vertical. This give you LPD and ability to use controls. Manufacturing and warehouses are both 35' highbay, with very different lighting power fingerprints. Vertical-specific marketing messages, sensitive to different fiscal cycles, ownership patterns.

Which verticals would provide the greatest benefit of a customized program and marketing approach?



What elements should a customized approach include?



Item	Do we need it?
Customized literature by vertical?	Yes
Customized rebates/incentives by vertical?	Yes
Case studies by vertical?	Yes
NEBs promotion by vertical?	Yes, with caveats

Program Approach and Marketing

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- Prep the market with a broad, universal message
- When customers begin to knock on the door, have more specific messages ready for them.
- With the complexity of the delivery chain, is there a role for upstream rebates with NLCs to prime the pump?

Training Needs

Background

- Perceived and real difficulty of installing and commissioning networked lighting controls increases installation costs and creates disincentives to promote them to customers.
- DLC and member utilities have been developing training with the goal to de-mystify NLCs and increase their use, especially in the small C&I spaces that legacy controls have largely bypassed
- How do we get the market well-trained and informed – at scale – on this technology?

Assignment

Brainstorm as a group and record a brief answer for each of the following questions:

- What kind of training is needed?
 - Foundational or Product-specific? A mixture?
 - Single sessions or a series?
 - Code-based or feature-based?
- When DLC's NLC training goes online, what might an in-person system specific supplement look like?
- What incentives should there be for receiving this training? CEU/licensure? Requirement for incentive participation? General marketing competitiveness?



What kind of Training is Needed?

- Some product-specific training is definitely worthwhile.
- Foundational training is necessary.
- Some minimum system-specific training (but taught by independent trainer).
- Then manufacturers can help by providing system-specific training. Worthwhile to have some framework for the type of training they might offer?



Who needs the Training?

- Installers
- Utility EE “salespeople”
- Distributors

When DLC's Training goes Online, what might an in-person system-specific supplement look like?



- Foundational material from an on-line class should be repeated at the in-person class (to reinforce the basics).
- Application workshop – how to select a system for a specific project
- Hands-on training led by independent trainer?
- Hands-on training with (hopefully) multiple vendors?
- Mini-trade show with multiple vendors?

What incentives should there be for receiving this training?

- Specifier incentive (a la Efficiency Vermont's RELIGHT program)
- Installer incentive
- Work with IBEW (or other groups) to make this part of their training curriculum?

Training Needs

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- 1 – Beneficial to have different areas of focus in different types of training classes/offerings (on-line?)
- 2 – Promote the availability of training classes and other educational offerings!!!
- 3 – TRAIN THE TRAINERS!!

Training Needs

3 Most Important Ideas/ Findings/ Takeaways from the Group:

- Solid foundational online training with refreshers as technology changes
- Supplemental in person training is crucial
 - Application specific and product specific
- “Interoperability of language”: If we’re not using the same vernacular, that kills the whole NLC process.
- Everyone needs to be touched by *some* training (regardless of incentives available to that group)



What kind of Training is Needed?

- Foundational online training first and then move to product specific afterwards, likely multiple times
- Different level/depth of training for different user groups
 - For example: high level/broad for utilities, and product specific for installers
- Differentiate retrofit vs. new construction
 - Might be entirely different solutions, and doing a single training can muddle the issue.
 - Often different codes apply
- “Two-way training” so that the expected outcomes can be balanced by what the manufacturers can deliver.
 - Speed dating in Vermont! An event to match manufacturers and contractors/designers.
 - Single event made it easier for contractors to make it instead of hosting new manufacturers week after week.
- How-to videos for installing systems
 - Contractors can reference as needed (in the field or at their desk as a refresher)

When DLC's Training goes Online, what might an in-person system-specific supplement look like?



- Primarily for contractors
 - Physically having their hands on the product is the most important
 - Builds familiarity before they're in front of a customer
 - Helps relate to a product demo that they might have seen prior/online
 - Common applications in the field - show different scenarios so it can be directly applied into projects
 - Being able to relate and reinforce how different NLC features look between systems (understanding of common language is important)
- Have in person trainers give contact info for local reps who contractors can follow up with afterwards to troubleshoot, etc.

What incentives should there be for receiving this training?

- Preferred provider groups can allow for more incentives to go to highly trained contractors/vendors
 - Can limit certain incentives to ONLY this group of preferred provider group
 - Can be based off of existing training framework that utility employs (which allows introduction of new training programs)
- “Premium” concept based on people rather than product
- Certified network based on systems where people are constantly updating with changing technology
- General market competitiveness is not enough. Marketing for “qualified” groups is not enough.
 - Money talks! Sometimes people will specify SSL products with NLCs because they know it’ll get a higher rebate, even if it doesn’t go directly to them (eg. to a trained designer)



Who needs the training?

- Whoever is implementing at the end of the process
- Anyone in supply chain
 - Designers
 - Contractors
 - Suppliers
 - Sales at manufacturers
- Utility staff
 - Engineers who are talking on the phone with customers
 - Account managers selling the customers

NLC V3.0 Specification

Feedback and Discussion

Speakers



**Levin
Nock**
DLC



**Jeremy
Yon**
*Current,
Powered by GE*



**Peter
Schwartz**
*Lawrence
Berkeley
National
Laboratory*



**Ken
Modeste**
UL

Networked Controls Revision Cycle

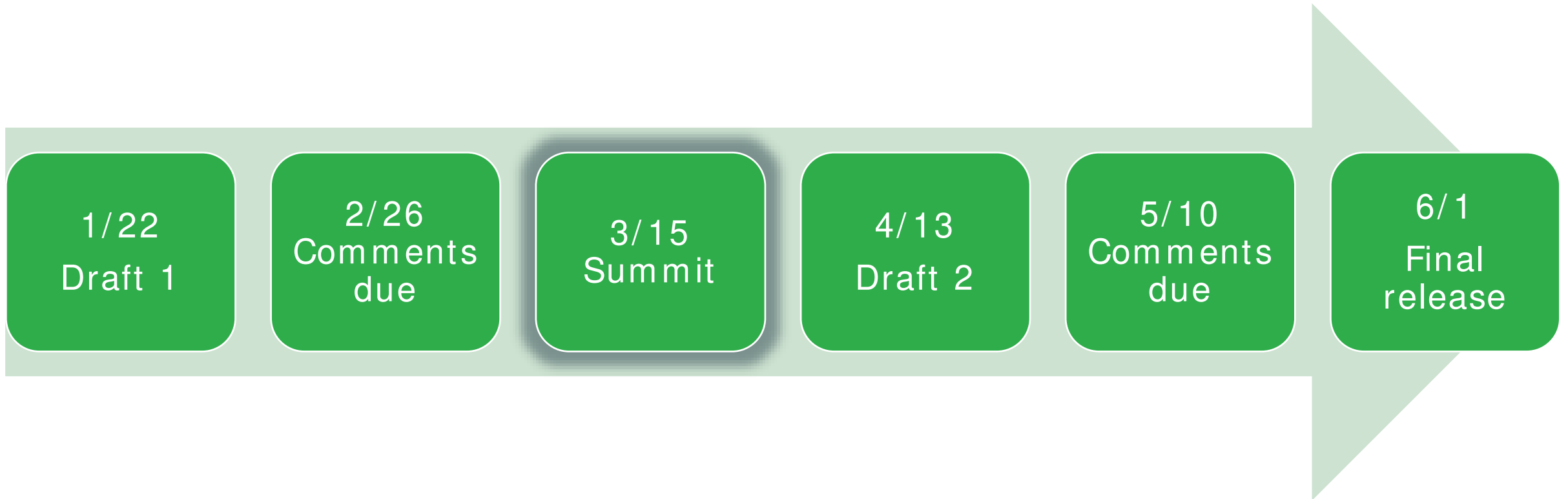
Technical Requirement
Revised Annually every June 1

Revision process begins every
January to allow time for
stakeholder input

One Year Grace Period:
re-apply under last year's version.

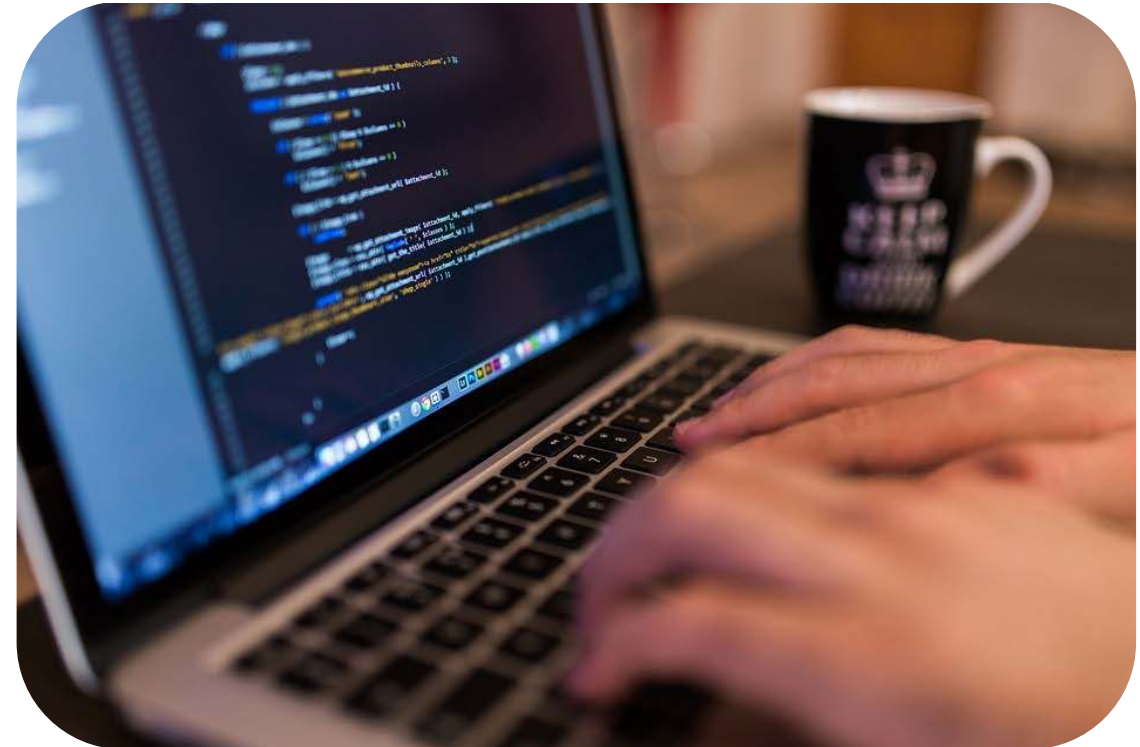


Timeline for V3.0 Controls Spec



Comment Summary

- 86 comments from:
 - 12 Manufacturers
 - 1 Trade Association
 - 1 Lab
 - Thoughtful, generally positive tone



Session Logistics



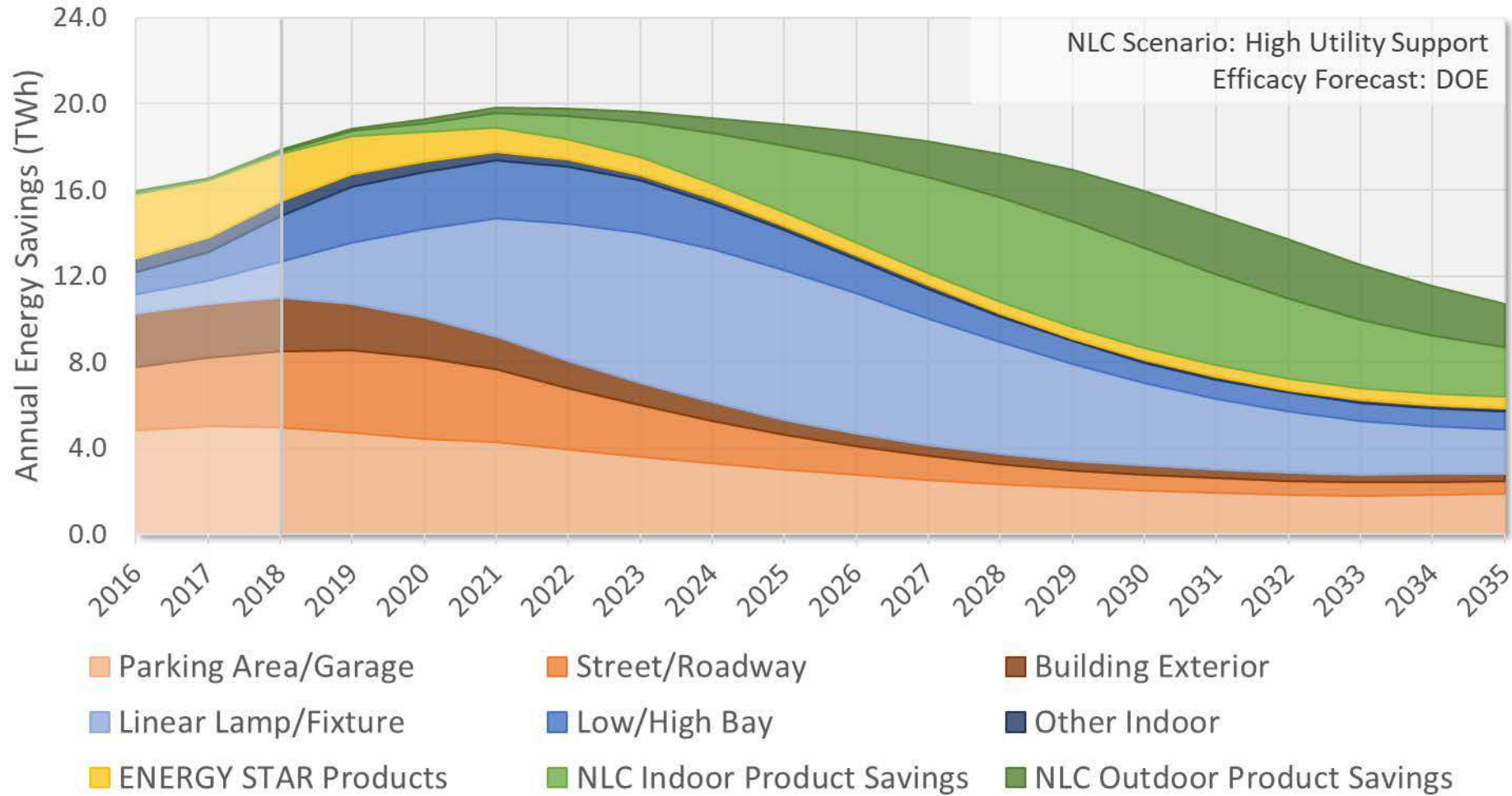
3 Sessions

- Energy Monitoring: Opportunity
- Cybersecurity: Risk
(Break)
- Misc.

- Panel to open each session
- Open discussion
- Live polling

Energy Monitoring

U.S. Non-Residential LED Annual Energy Savings Potential Based on DOE Stock Estimates and Forecasted Adoption & Efficacy



Projected first-year energy savings

Energy Monitoring: 3 Approaches

- 1. Direct Measurement** – Lighting system measures energy use with integrated meters in devices and/or circuit level controllers
- 2. Calculated** – Lighting system calculates energy use from dimming signal and factory-programmed wattage
- 3. Calculated with Manual Input** – Lighting system calculates energy use from dimming signal and fixture wattage input into system by installer or commissioning agent



Energy Monitoring: First Draft Proposal

June 2018 V3

- The Energy Monitoring capability is **Reported**, not Required.
- This optional capability can only be claimed if **Direct Energy Measurement** is used. Calculated methodologies will not be accepted.

June 2019 V4

- The Energy Monitoring capability is **Required**. In order to qualify, a system must be capable of Energy Monitoring.



Stakeholder Comment Summary

Standards

DLC should not disallow “calculated” methods. Some “calculated” systems might theoretically be able to achieve an accuracy standard. Rather DLC should require an accuracy standard, and not specify the means to achieve it.

Granularity of Measurement

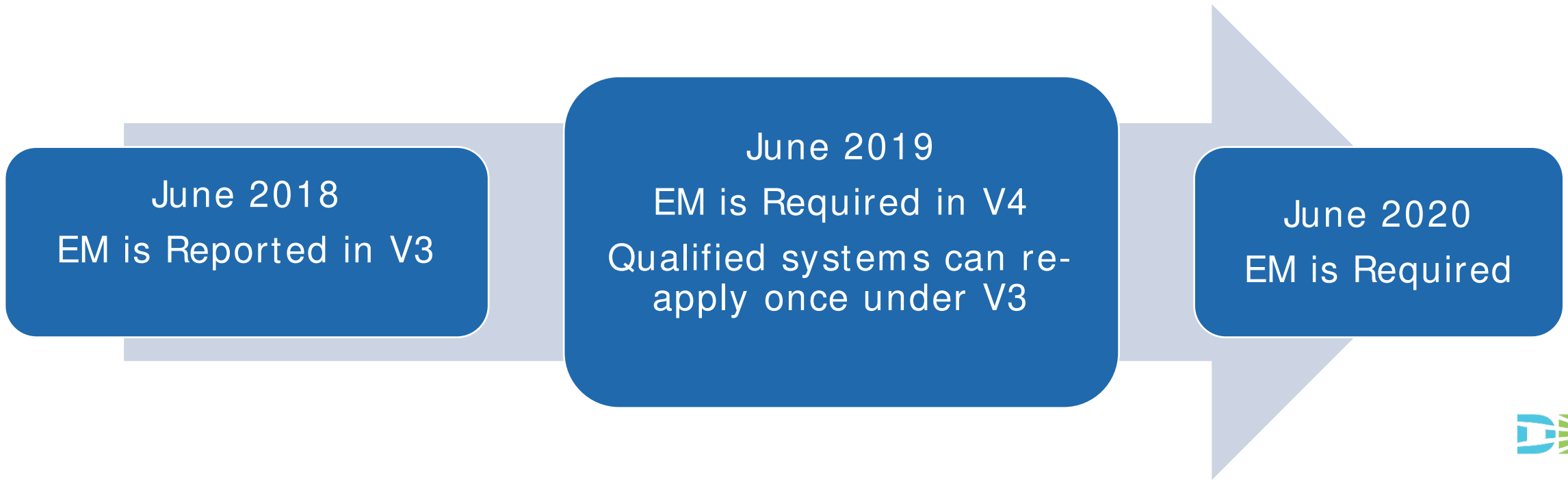
Confirm that circuit-level metering is an option and fixture level is not required.

Timing

2019 is too soon to require Energy Monitoring and no longer allow “calculated” methods. 2020 may be acceptable.

Clarifications

- Circuit level metering is acceptable. DLC will revise definition.
- Grace Period Policy: The 1-year grace period enables a qualified system to re-apply in 2019 under V3, to remain qualified until June 2020, 2 years from now.



Energy Monitoring: Revised Proposal

June 2018 V3

- The Energy Monitoring type is **Reported**, whether “Direct Measurement”, or “Calculated”.

June 2019 V4

- Energy Monitoring Capability is **Required** & must comply with forthcoming ANSI accuracy standard.
- If ANSI standard is not available yet, then calculated methodologies will not be accepted. Manufacturers will self-report accuracy of direct measurement methods.
- Option to reapply under V3 with 1-year grace period.

June 2020 V5

- Energy Monitoring Capability is **Required**



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Energy Measurement: Updates on the Puzzle Solution

15 March 2018 - San Ramon, CA

Jeremy Yon - jeremy.yon@ge.com



Energy Measurement: WHY?

- Building Management
- Evaluation and Verification
 - Regulatory
 - Financial
- System Management
 - Electric Grid
 - System Efficiency Initiative (Alliance to Save Energy)
 - www.ase.org/SEI

71 Special Note in Draft 1 on Energy Monitoring

72 With this draft, the DLC proposes a phased approach for energy monitoring that includes
73 proposed requirements for V3.0 that will be implemented on June 1, 2018 and proposed
74 requirements for V4.0 that will be implemented on June 1, 2019. The DLC seeks
75 comment on both the V3.0 proposal and the overall phased approach.

76 Under the current V2.0 Requirements, Energy Monitoring capability is reported, and not
77 required.

78 In V3.0, to be released June 1, 2018, this capability will continue to be reported.

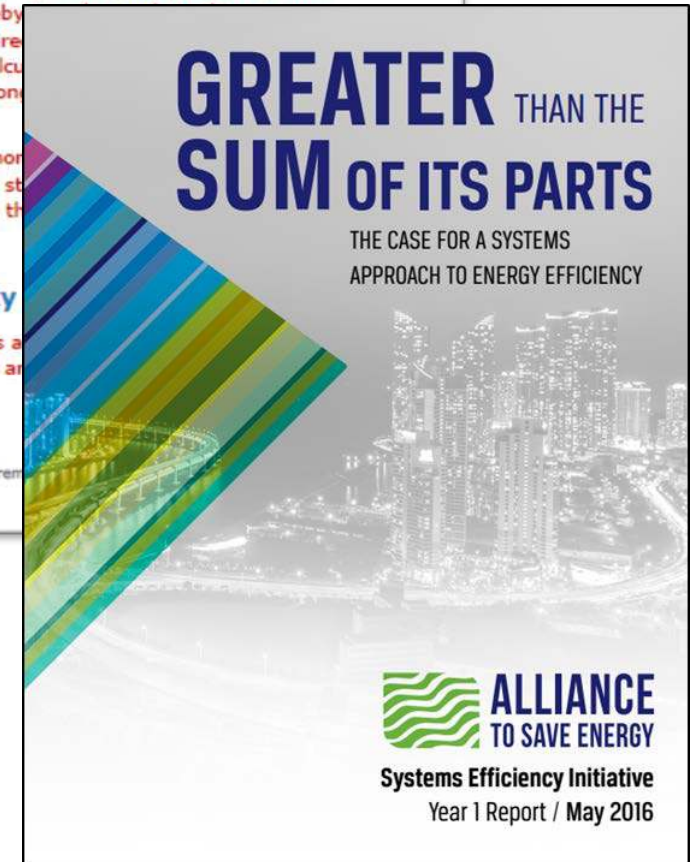
79 However, the DLC is proposing a change whereby
80 monitoring capability, a system must include direct
81 only measure on/off or dimming status, and calculate
82 nominal or manually-entered wattage, will no longer
83 monitoring capability.

84 In V4.0, to be released June 1, 2019, energy monitoring
85 capability. If one or more appropriate industry standards
86 those standards will be referenced. Otherwise, the
87 definition of the capability.

88 Special Note in Draft 1 on Security


89 Similar to energy monitoring, the DLC proposes a
90 DLC seeks comment on both the V3.0 proposal and

 DRAFT Networked Lighting Control V3.0 Technical Requirements
Distributed via email January 22, 2018



GREATER THAN THE
SUM OF ITS PARTS

THE CASE FOR A SYSTEMS
APPROACH TO ENERGY EFFICIENCY

 **ALLIANCE**
TO SAVE ENERGY

Systems Efficiency Initiative
Year 1 Report / May 2016

Energy Measurement: Four-Part Puzzle

ANSI C136 (Roadway/Area)
ANSI C12 (Revenue)

Testing
Method

Use Case
Research

ANSI C137

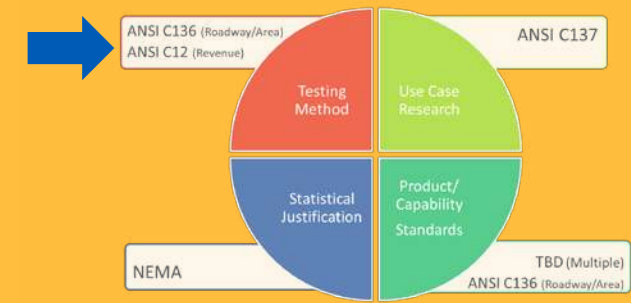
Statistical
Justification

Product/
Capability
Standards

TBD (Multiple)
ANSI C136 (Roadway/Area)



Part One: Testing Method

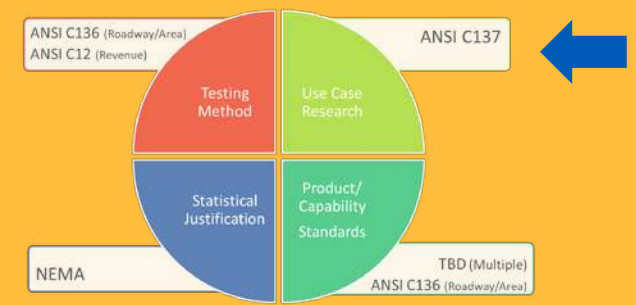


Draft-ANSI C136.50 – For Roadway and Area Lighting Equipment –
Revenue Grade Energy Measurement within a Locking type Control Device

Draft-ANSI C136.52 – For Roadway and Area Lighting Equipment –
LED Drivers with integral Revenue Grade Energy Measurement Means

- 30 Member Organizations NEMA acts as Secretariat
- Expected 2019 (Roadway & Area)
- Test Conditions
- Accuracy Tests
 - Watts & impacts of parameter changes
- Operational Performance Verification
- External Influences Performance Verification

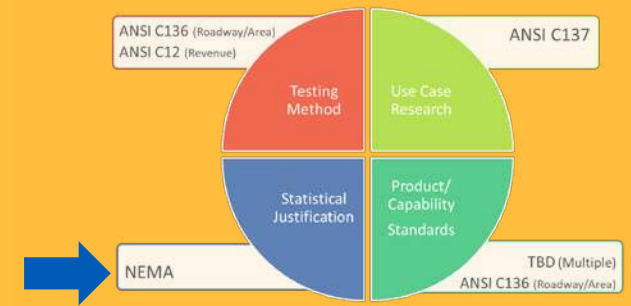
Part Two: Use Case Research



ANSI C137 Ad-Hoc Committee: Energy Prediction and Measurement

- 34 Member Organizations
- NEMA acts as Secretariat
- Identified Targeted Use Cases
 - Performance contracting
 - Utility EE programs
 - System Energy Management
 - Distributed Performance
 - System Performance
 - Codes/Standards/Certifications
- Progress: Surveys completed and being reported to Committee this Month
 - Energy Solutions under contract to the DLC
 - 2 Surveys on Performance Contracting
 - 6 Surveys on Energy Performance Verification
 - 1 Survey on System Energy Management
- Next Steps:
 - Creating a proposed Use-Case definition and identifying the most appropriate Standardization vehicle

Part Three: Statistical Justification

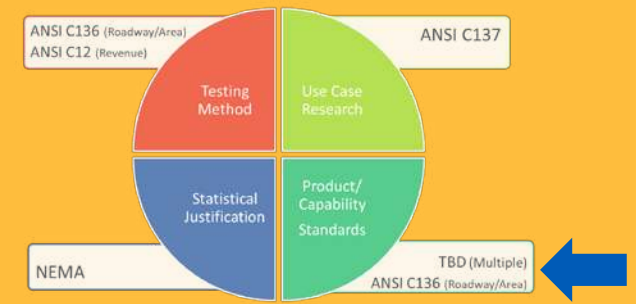


NEMA Lighting Systems Division: Lighting Controls Section: Evaluation Grade Classification AD HOC



- 7 Members
- Administered by NEMA
- Completing initial framework for publication or transference
- Collaborating with evaluation experts
- Expected Late 2018
- Documenting strengths and limitations of existing industry references
- Researching stakeholder sensitivities to Accuracy and Precision of distributed data
- Documenting statistical proofs of comparability and guidelines
- Working toward a list of requirements to enable equivalency of different data sampling

Part Four: Product/Capability Standards



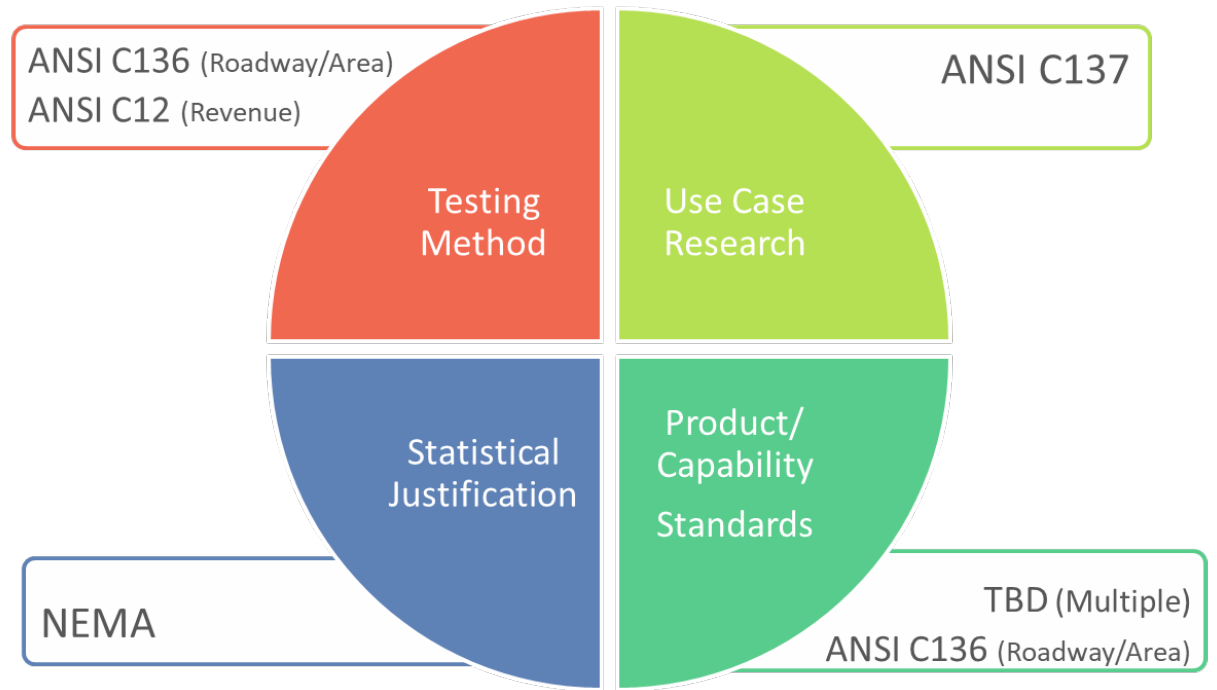
APPLICATION/USE CASE SPECIFIC

- Define Reporting Parameters
 - Define Accuracy/Precision
 - Define Acceptance Criteria
-
- Roadway and Area Lighting Equipment
 - Draft-ANSI C136.48 – Networked Lighting Controllers (NLC)
 - Locking-type socket controller
 - Expected Q4 2018 (Roadway & Area)
 - Other Use Cases– TBD
 - Indoor Commercial Distributed systems {{xxxx standard}}

Takeaways

- Many experts working in parallel coming up with the puzzle pieces
 - Minimizing overlap!
 - Always room for more expertise
 - Time is needed for good execution
- Execution requirements will be tailored to application/use case
- Engagement with various “consumer-approver” critical for adoption
- Outcome target is a range of scalable system solutions

- **ANSI committees** are open to all interested parties and are particularly in need of those in the underrepresented categories of ‘End User’ and ‘General Interest’.



Questions/thoughts:

Jeremy Yon

jeremy.yon@ge.com

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Advanced Lighting Controls in New & Existing Buildings – Energy Monitoring & Reporting

Peter Schwartz, Principal Investigator, LBNL



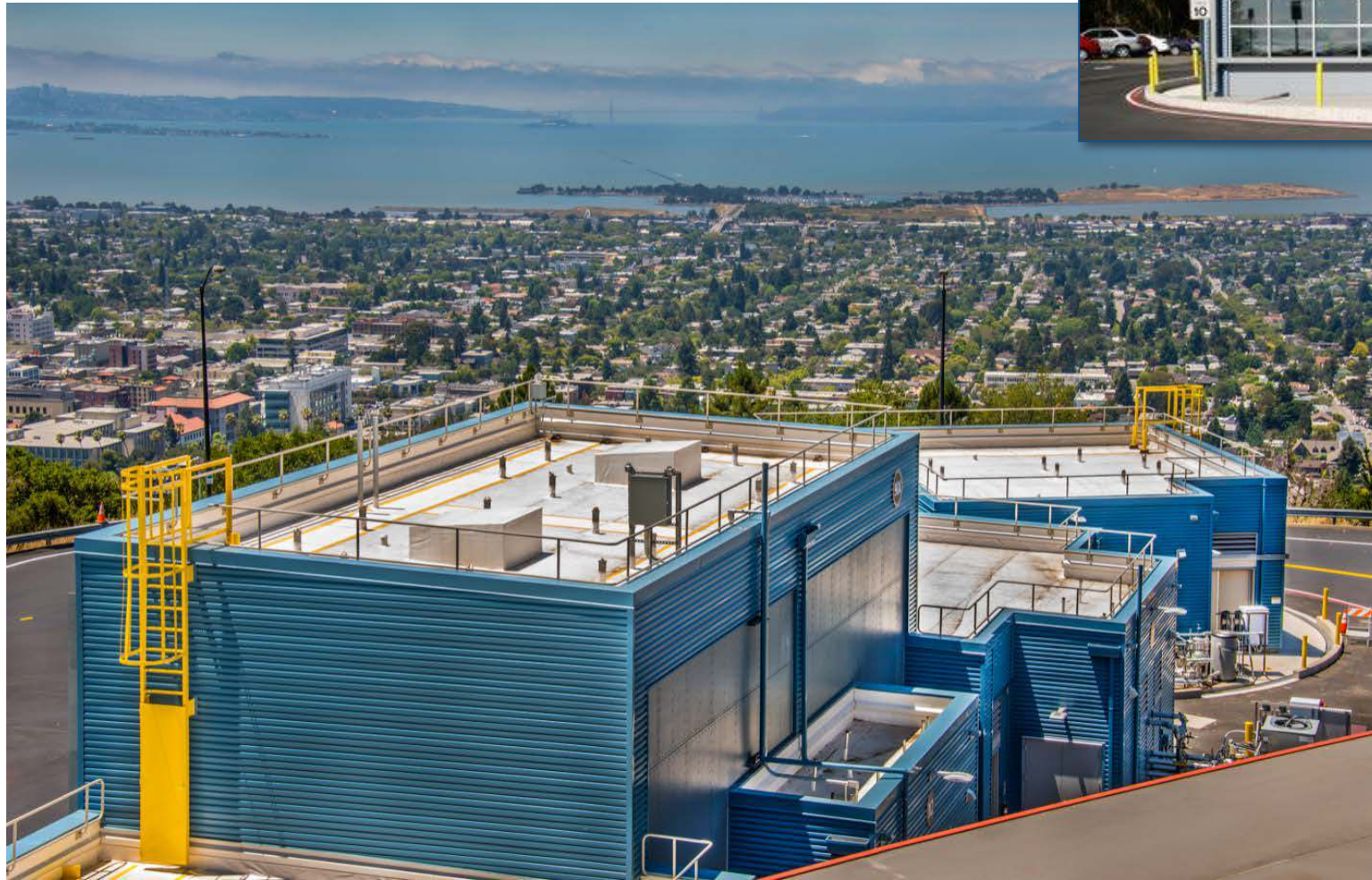
Agenda

Present an overview of LBNL research results, detailing the difference in accuracy between **calculated vs. metered** energy

- Methodology
- Results
- Summary of Issues

Methodology

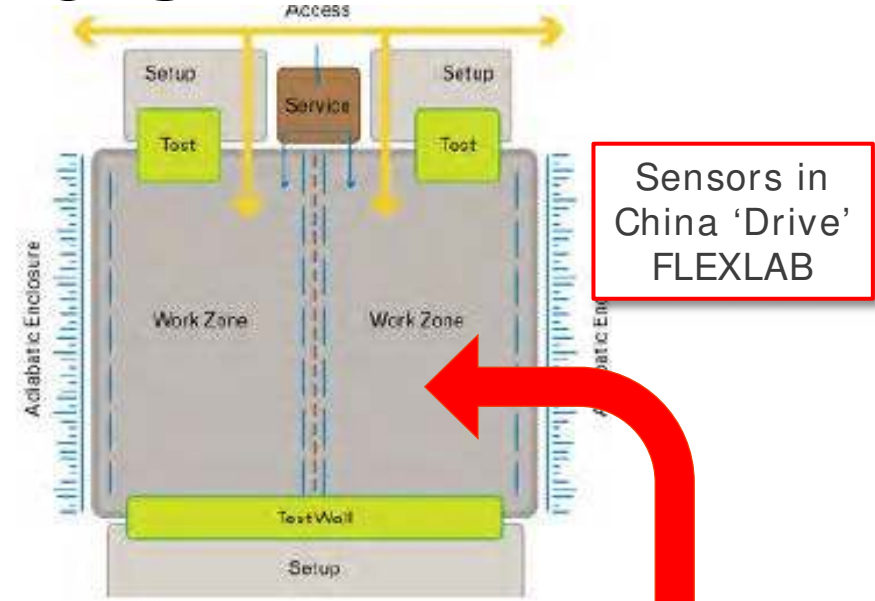
FLEXLAB



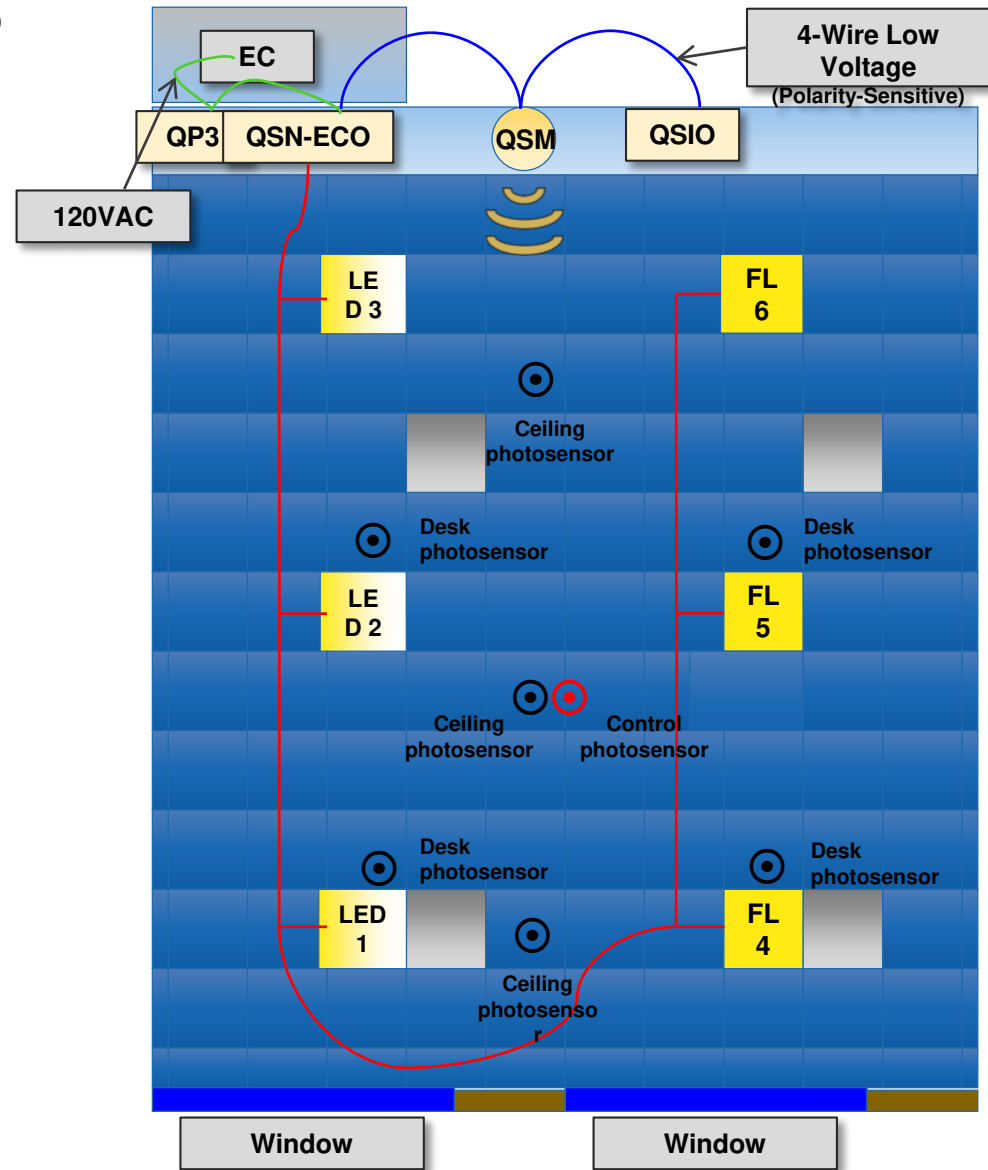
LBL's FLEXLAB facility.
Experiment utilized one of two rotational test cells in photo.

Advanced Lighting Controls

- 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



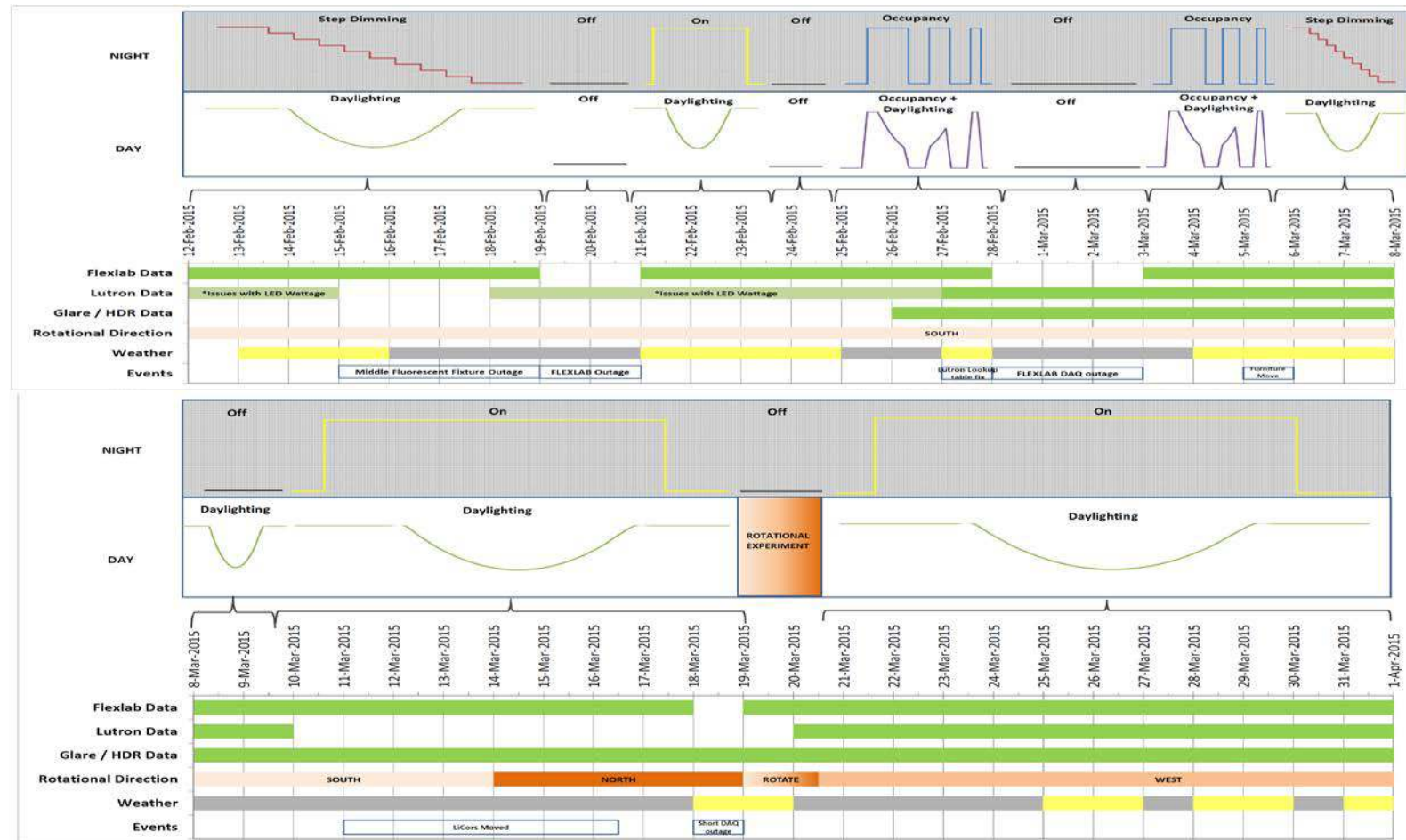
FLEXLAB Test Cells



Advanced Lighting Controls

Schematic FLEXLAB Experiment Overview

- Top schematic summarized testing between 2/12/15 & 3/8/15, while bottom schematic summarizes testing between 3/8/15 & 4/1/15.

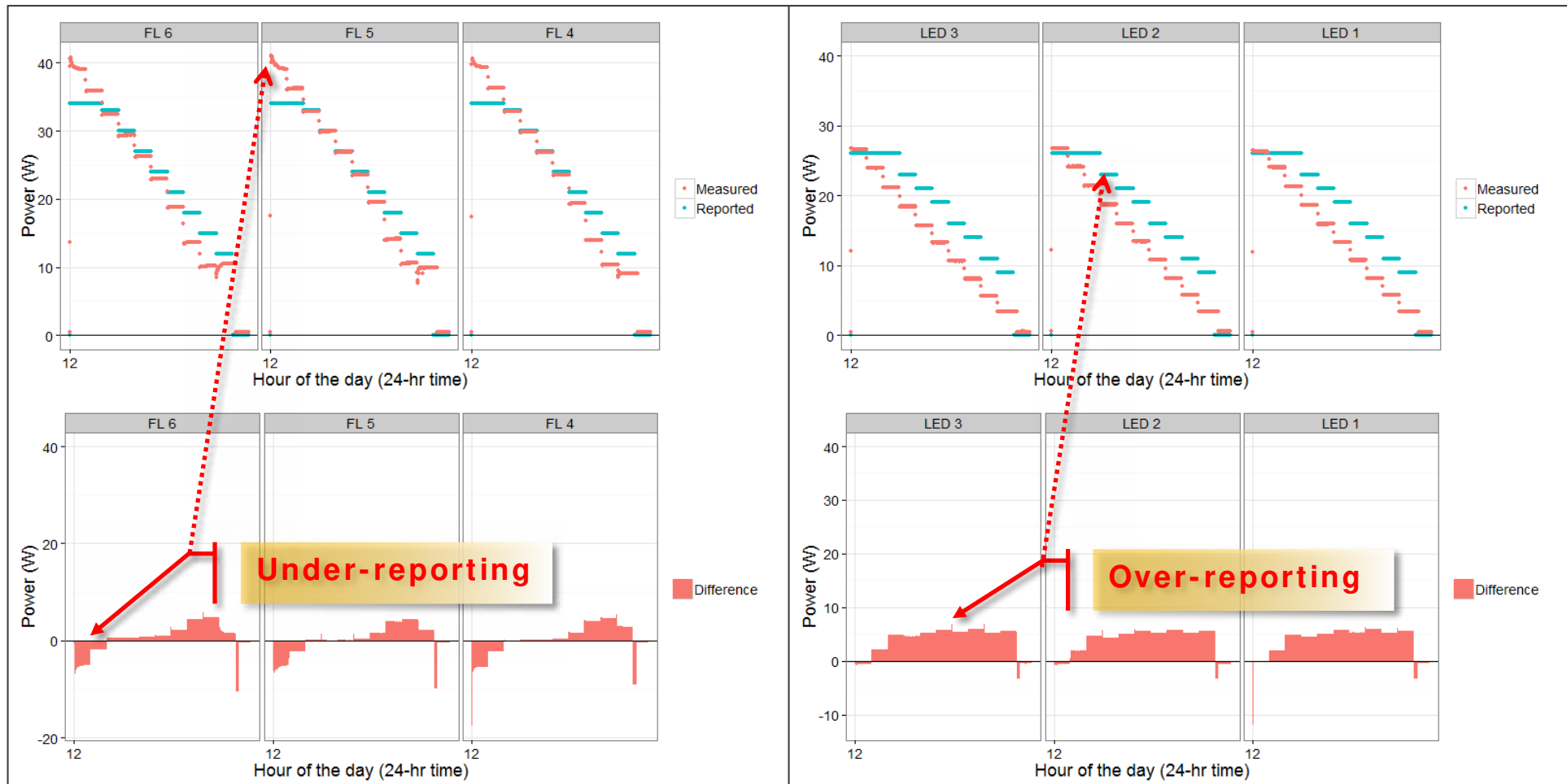


Results

Advanced Lighting Controls

Controls Scenarios: Step-Dimming

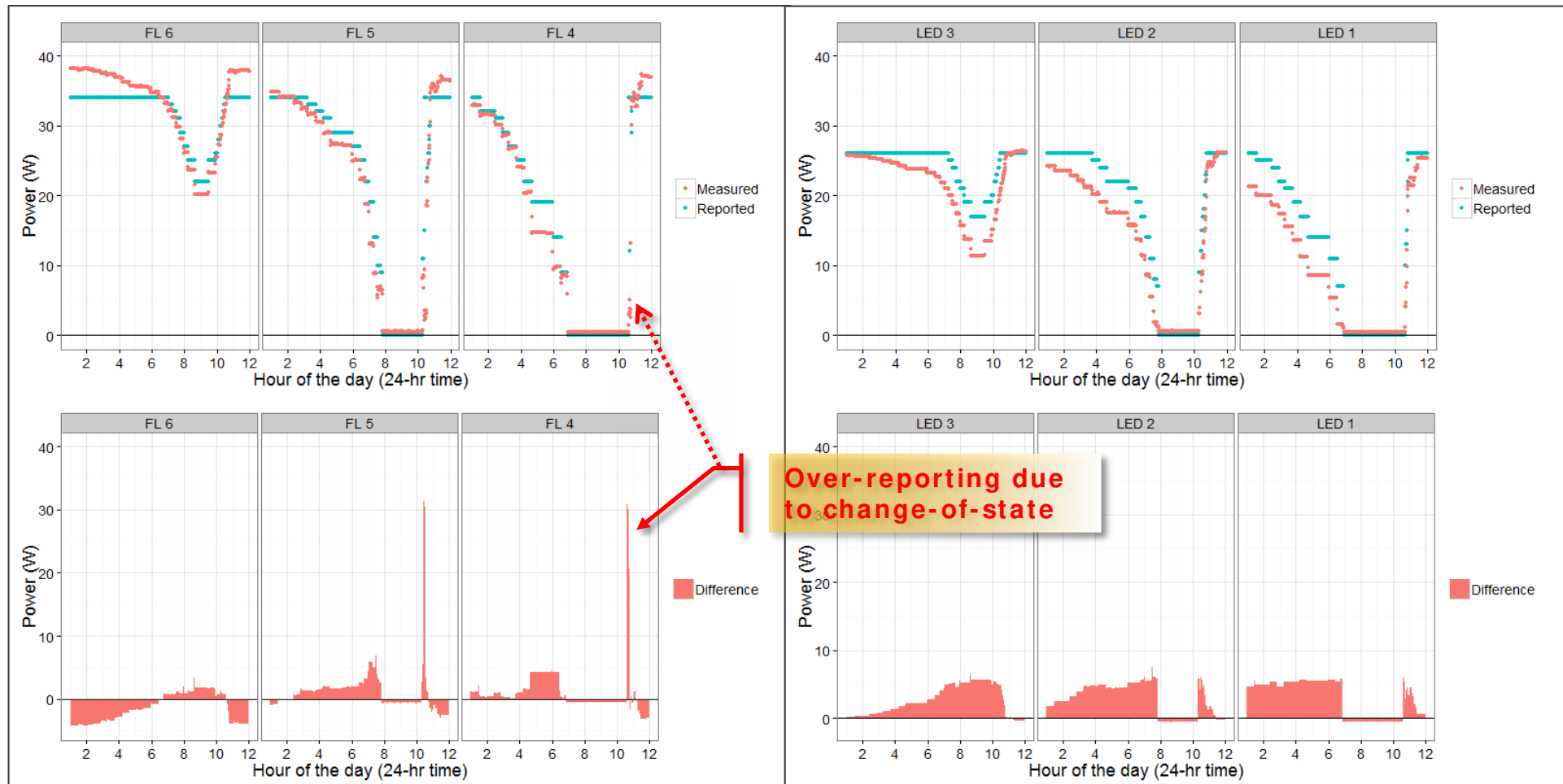
- Reported vs. measured power values for fluorescent (left) & LED fixtures (right) during stepped dimming; lower plot shows difference



Advanced Lighting Controls

Controls Scenarios: Daylight Harvesting

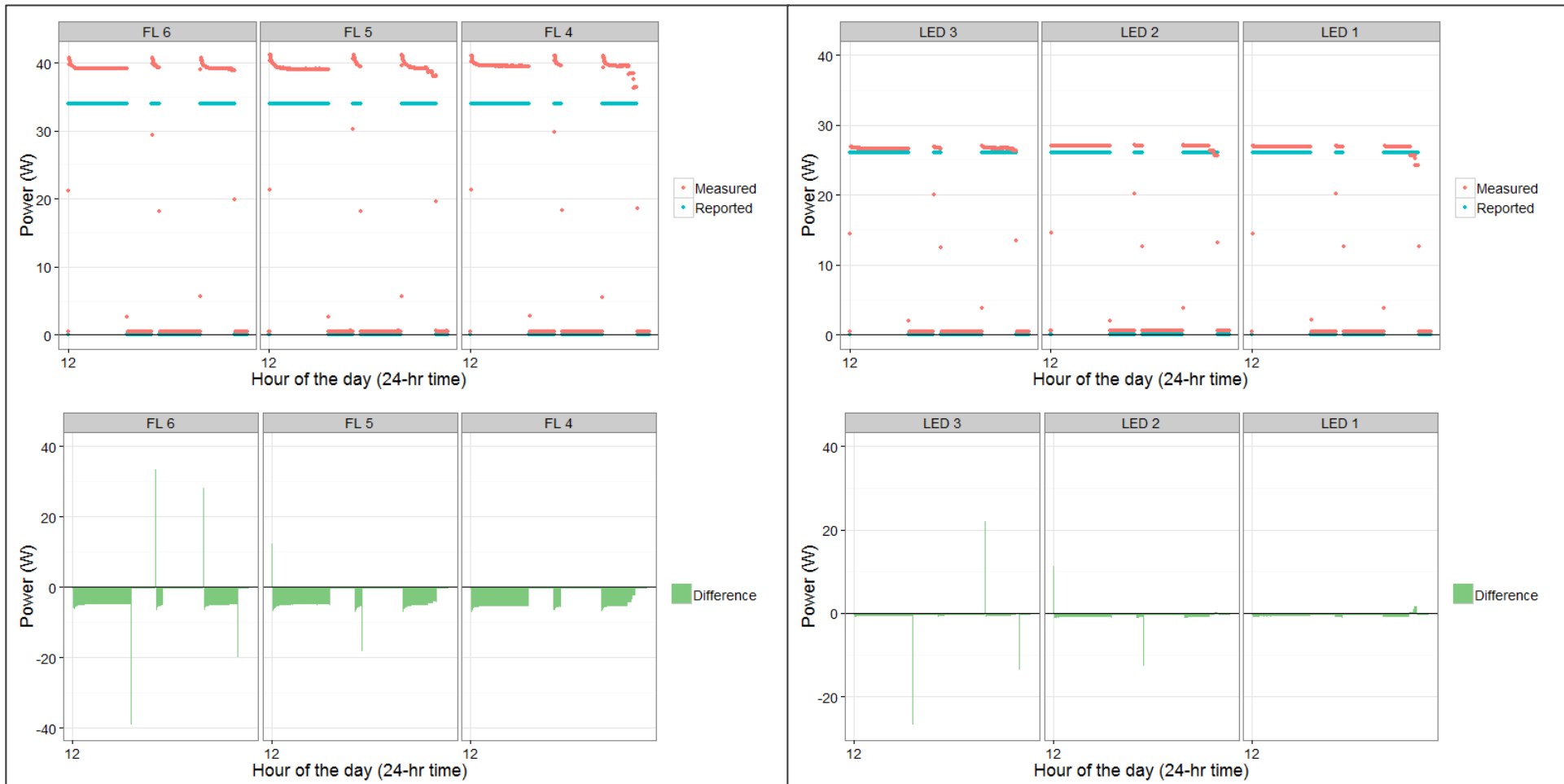
- Reported vs. measured power values for fluorescent (left) & LED fixtures (right) during daylight harvesting; lower plot shows difference



Advanced Lighting Controls

Controls Scenarios: Occupancy Sensor

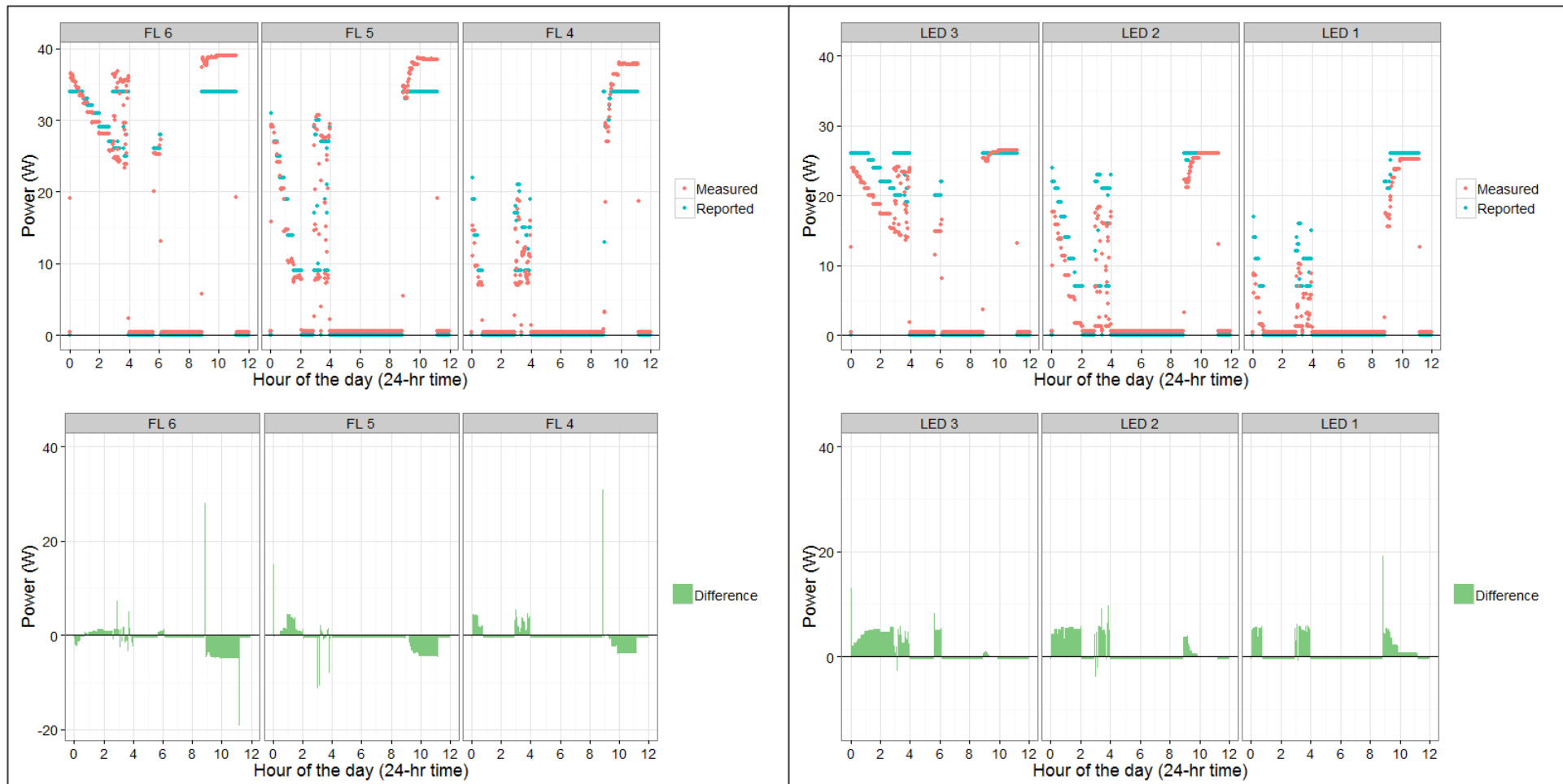
- Reported vs. measured power values for fluorescent (left) & LED fixtures (right) during occupancy sensing; lower plot shows difference



Controls Scenarios

Occupancy Sensor & Daylight Harvesting

- Reported vs. measured power values for fluorescent (left) & LED fixtures (right) during occupancy sensing & daylight harvesting; lower plot shows difference



Advanced Lighting Controls

Baseline Power Measurements

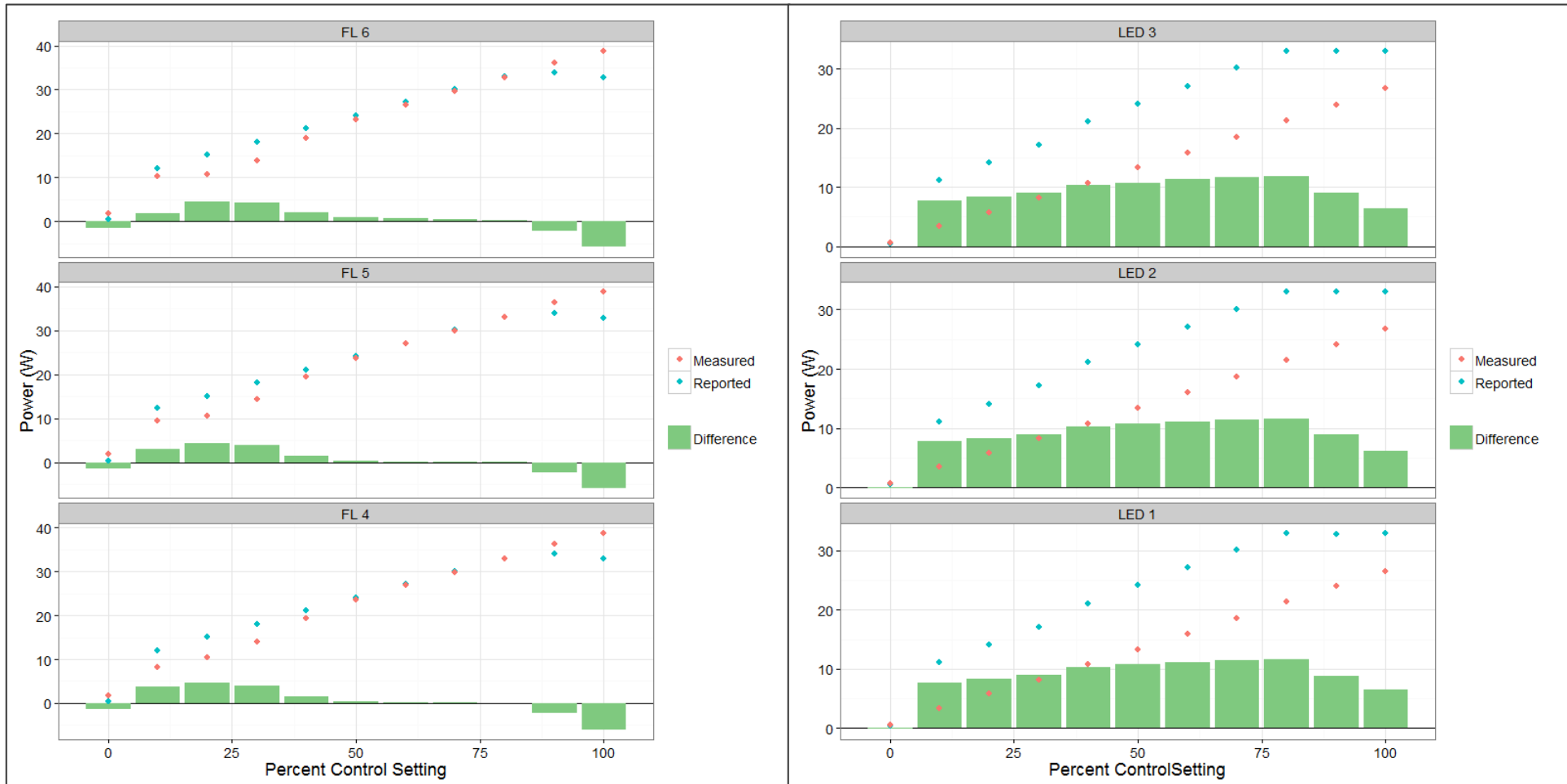
- Baseline reported & measured FLEXLAB luminaires' power averaged for 10 days running at full power for 12 hours/day, & % difference between measured & reported values

Luminaire	Mean Reported Watts	Mean Measured Watts	Difference between reported & measured
FL 6	34.0	39.1	-13%
FL 5	34.0	37.7	-10%
FL 4	34.0	38.4	-11%
LED 3	26.0	26.5	-2%
LED 2	26.0	26.4	-2%
LED 1	26.0	25.7	1%

Advanced Lighting Controls

Step Dimming

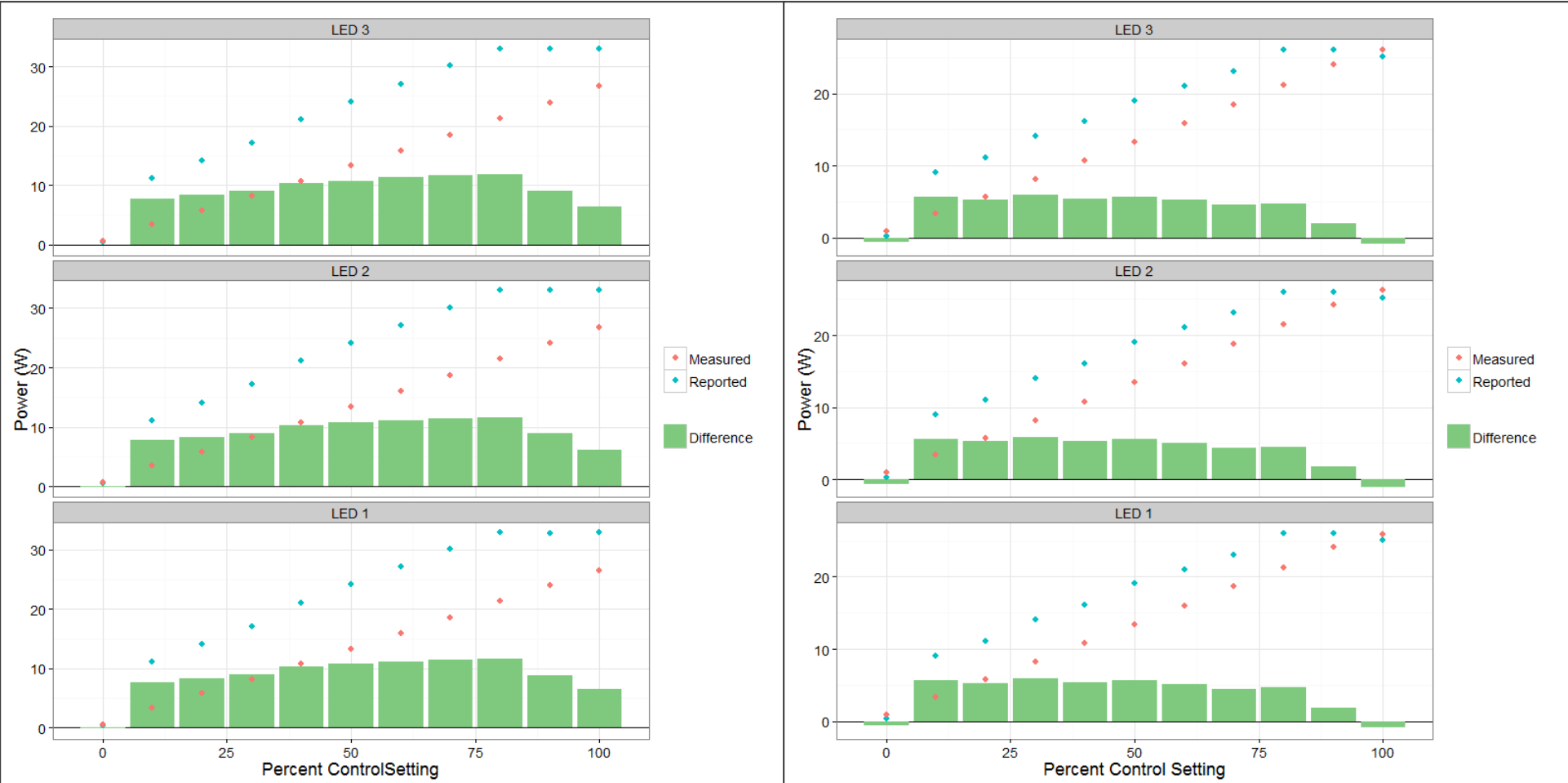
- Reported & measured FLEXLAB luminaires' power, & difference between measured & reported values



Advanced Lighting Controls

Step Dimming—LED Calibration

- Reported & measured (FLEXLAB) power for LED luminaires; after reported power correction these have



Advanced Lighting Controls

Daylight Harvesting

- Daylight harvesting reported & measured mean power & % difference between measured & reported values, for all luminaires:

Luminaire	Mean Reported Watts	Mean Measured Watts	Difference between reported & measured
FL 6	32.6	33.6	-3%
FL 5	24.4	23.5	4%
FL 4	20.5	17.9	15%
LED 3	24.9	21.9	14%
LED 2	19.4	15.6	24%
LED 1	15.5	11.1	39%

Advanced Lighting Controls

Occupancy Sensing

- Occupancy sensing reported & measured mean power & % difference between measured & reported values, for all luminaires:

Luminaire	Mean Reported Watts	Mean Measured Watts	Difference between reported & measured
FL 6	17.3	20.2	-14%
FL 5	17.2	20.3	-15%
FL 4	17.2	20.4	-15%
LED 3	13.2	13.8	-4%
LED 2	13.2	14.0	-6%
LED 1	13.2	13.8	-5%

Advanced Lighting Controls

Occupancy Sensing plus Daylight Harvesting

- Occupancy sensing plus daylight harvesting, reported & measured mean power & % difference between measured & reported values, for all luminaires:

Luminaire	Mean Reported Watts	Mean Measured Watts	Difference between reported & measured
FL 6	18.0	18.6	-3%
FL 5	8.9	9.4	-5%
FL 4	6.0	6.3	-5%
LED 3	13.8	12.0	16%
LED 2	6.8	5.9	16%
LED 1	4.6	4.0	14%

Advanced Lighting Controls – Energy Savings from Different Controls Strategies

- Average FLEXLAB-reported power, under all luminaires' control strategies:

Luminaire	Baseline (W)	Daylight Harvesting (W)	Savings	Occupancy Only (W)	Savings	Occupancy plus Daylight Harvesting (W)	Savings
FL 6	39.1	33.6	14%	20.2	48%	18.6	52%
FL 5	37.7	23.5	38%	20.3	46%	9.4	75%
FL 4	38.4	17.9	53%	20.4	47%	6.3	84%
All FL	115.2	74.9	35%	60.8	47%	34.3	70%
LED 3	26.5	21.9	17%	13.8	48%	12.0	55%
LED 2	26.4	15.6	41%	14.0	47%	5.9	78%
LED 1	25.7	11.1	57%	13.8	46%	4.0	84%
ALL LED	78.7	48.7	38%	41.6	47%	21.9	72%

Advanced Lighting Controls – Energy Savings from Different Controls Strategies

- Average power as reported by **lighting control system**, under all control strategies, for all luminaires:

Luminaire	Baseline (W)	Daylight Harvesting (W)	Savings	Occupancy Only (W)	Savings	Occupancy plus Daylight Harvesting (W)	Savings
FL 6	34	32.6	4%	17.3	49%	18	47%
FL 5	34	24.4	28%	17.2	49%	8.9	74%
FL 4	34	20.5	40%	17.2	49%	6	82%
All FL	102	77.5	24%	51.7	49%	32.9	68%
LED 3	26	24.9	4%	13.2	49%	13.8	47%
LED 2	26	19.4	25%	13.2	49%	6.8	74%
LED 1	26	15.5	40%	13.2	49%	4.6	82%
ALL LED	78	59.8	23%	39.6	49%	25.2	68%

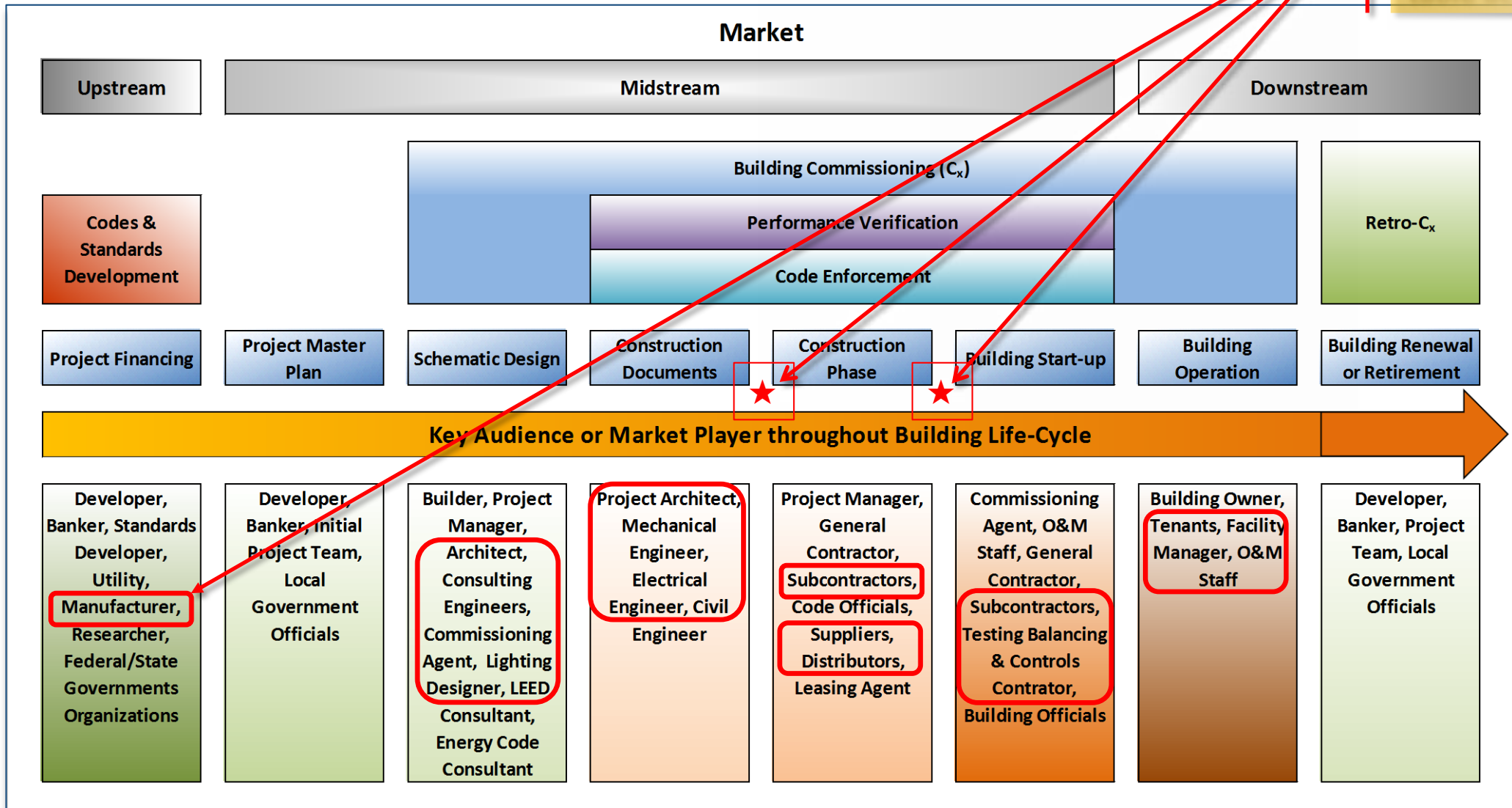
Summary of Issues

Summary of Issues

- Energy monitoring using Advanced Lighting Controls that employ fixture-lamp-ballast lookup tables dictate energy reporting accuracy
- Default tables are typically highly inaccurate
- At the boundaries (Full-on/ Full-off), controls either over- or under-report energy levels
- No one pays contractors or controls manufacturers/commissioning agents to update resident lookup tables to what is ultimately installed in the field
- Lamps & ballasts change over time due to replacement upon burnout or during tenant improvements or renovations
- Controls manufacturers can provide more accurate reporting if provided accurate fixture-lamp-ballast operational data for various control strategies – **Rarely happens!**

Issues: Market Discontinuity Areas

Key players impacting look-up table accuracy



Advanced Lighting Controls

Verifying Deep EE Savings – Data Value

Increasingly sophisticated and “connected” lighting controls systems are starting to address the dilemma of how to estimate energy use & savings down to the individual luminaire level & estimate how much energy the system is saving from each control strategy (e.g., daylight harvesting, occupancy sensing, etc.) to **establish the foundation to move towards verifiable “outcome-based” code compliance.**

- This type of data has been missing until recently & may have value in a variety of ways:
 - Building managers can see exactly how much energy their systems are using & explore strategies for achieving deeper savings.
 - Lighting controls manufactures can better market their systems by showing potential customers verified savings reports for similar customers’ applications.
 - EE program designers may be more interested in promoting lighting controls systems investments when the risks associated with variable and/or unverified savings are mitigated.
 - Regulators with an interest in reducing overall building energy use (rather than simply reducing lighting power density) can use this data for compliance verification for next generation “outcome-based” codes.

Advanced Lighting Controls

Verifying Deep EE Savings – Energy Reporting

- **No existing standards or test procedures** that describe how lighting controls systems should measure, estimate, record or report energy use or attribute energy savings.
- Numerous factors may lead to inaccuracies in collecting these data, including:
 - Poorly calibrated power meters
 - Inaccurate look-up tables
 - Inaccurate savings attribution algorithms
 - Insufficiently programmed ‘change-of-state’ levels & time steps

This project directly addresses this issue by measuring lighting system performance over a broad range of conditions & controls settings, & then comparing reported luminaire-level energy use to measured energy use. While the test described in this report presents the reported-versus-measured results for a specific lighting system, the methodologies developed can be applied more broadly to lighting controls systems generally. Ultimately these methods may lead to test procedures and codes for lighting controls systems that ensure accurate and uniform energy use reporting.

Advanced Lighting Controls

Verifying Deep EE Savings

- LBNL has for the first time directly addressed this issue by:
 - Measuring lighting system performance over a broad range of conditions & controls settings in a highly controlled FLEXLAB environment
 - Comparing reported luminaire-level energy use to measured energy use

While the test described in this report presents the reported-versus-measured results for a specific lighting system, the methodologies developed can be applied more broadly to lighting controls systems generally. Ultimately these methods may lead to test procedures and codes for lighting controls systems that ensure accurate and uniform energy use reporting.

Contact Information

- Peter M. Schwartz, LBNL
- pmschwartz@lbl.gov
- + 1(510) 486-6926



**LBNL FLEXLAB
Facility**

Energy Monitoring: Revised Proposal

June 2018 V3

- The Energy Monitoring type is **Reported**, whether “Direct Measurement”, or “Calculated”.

June 2019 V4

- Energy Monitoring Capability is **Required** & must comply with forthcoming ANSI accuracy standard.
- If ANSI standard is not available yet, then calculated methodologies will not be accepted. Manufacturers will self-report accuracy of direct measurement methods.
- Option to reapply under V3 with 1-year grace period.

June 2020 V5

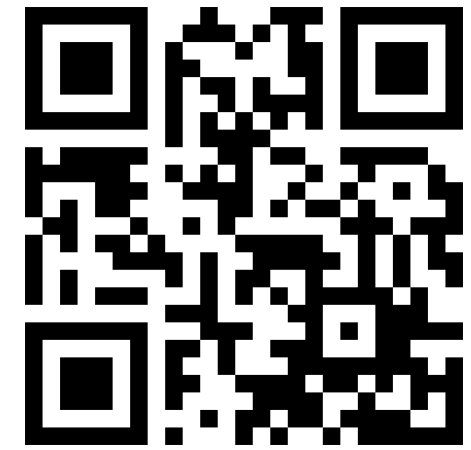
- Energy Monitoring Capability is **Required**



Live Poll: Energy Monitoring Question 1

Do you approve of the general
direction of DLC's Revised Proposal?

- a. Strongly support
- b. Support
- c. Neutral
- d. Object
- e. Strongly object

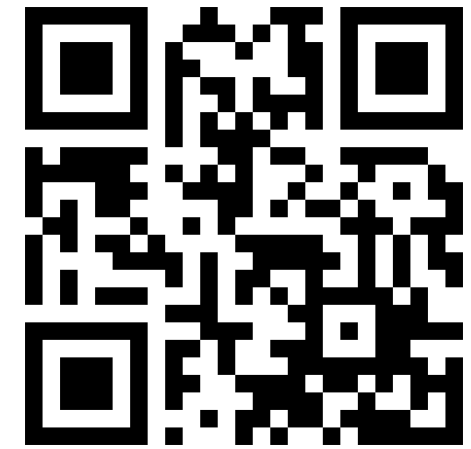
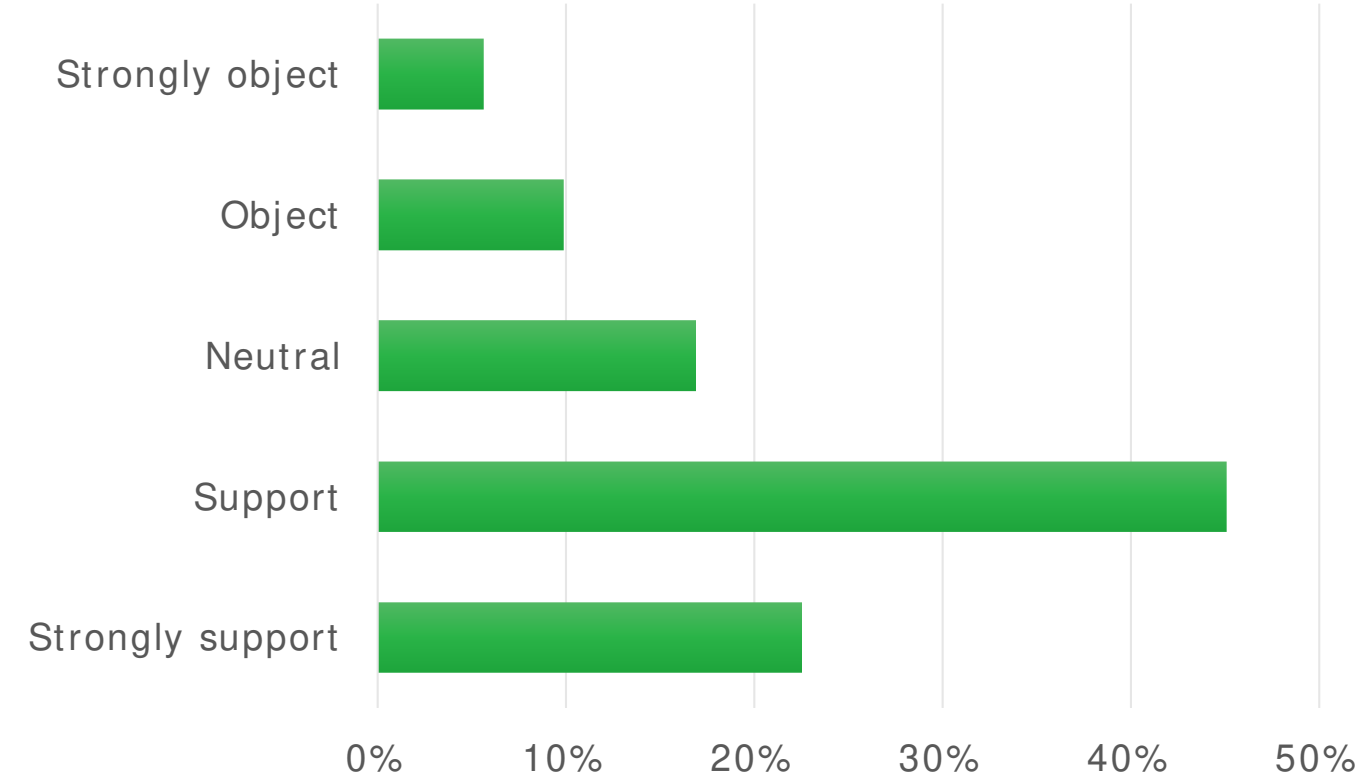


<http://etc.ch/NctR>



Energy Monitoring: Question 1

Do you approve of the general direction of DLC's Revised Proposal?



<http://etc.ch/NctR>



Energy Monitoring: Question 2

How is DLC's timing?

- a. Much too fast
- b. A bit fast
- c. Acceptable
- d. A bit slow
- e. Much too slow

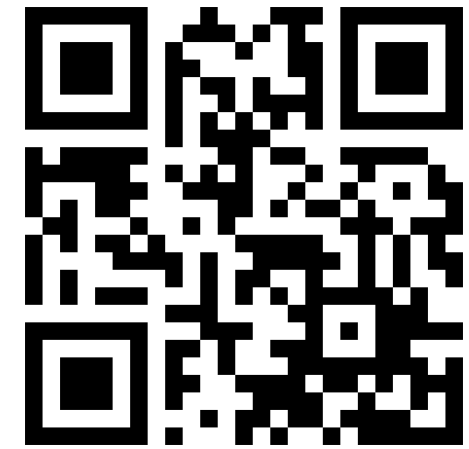


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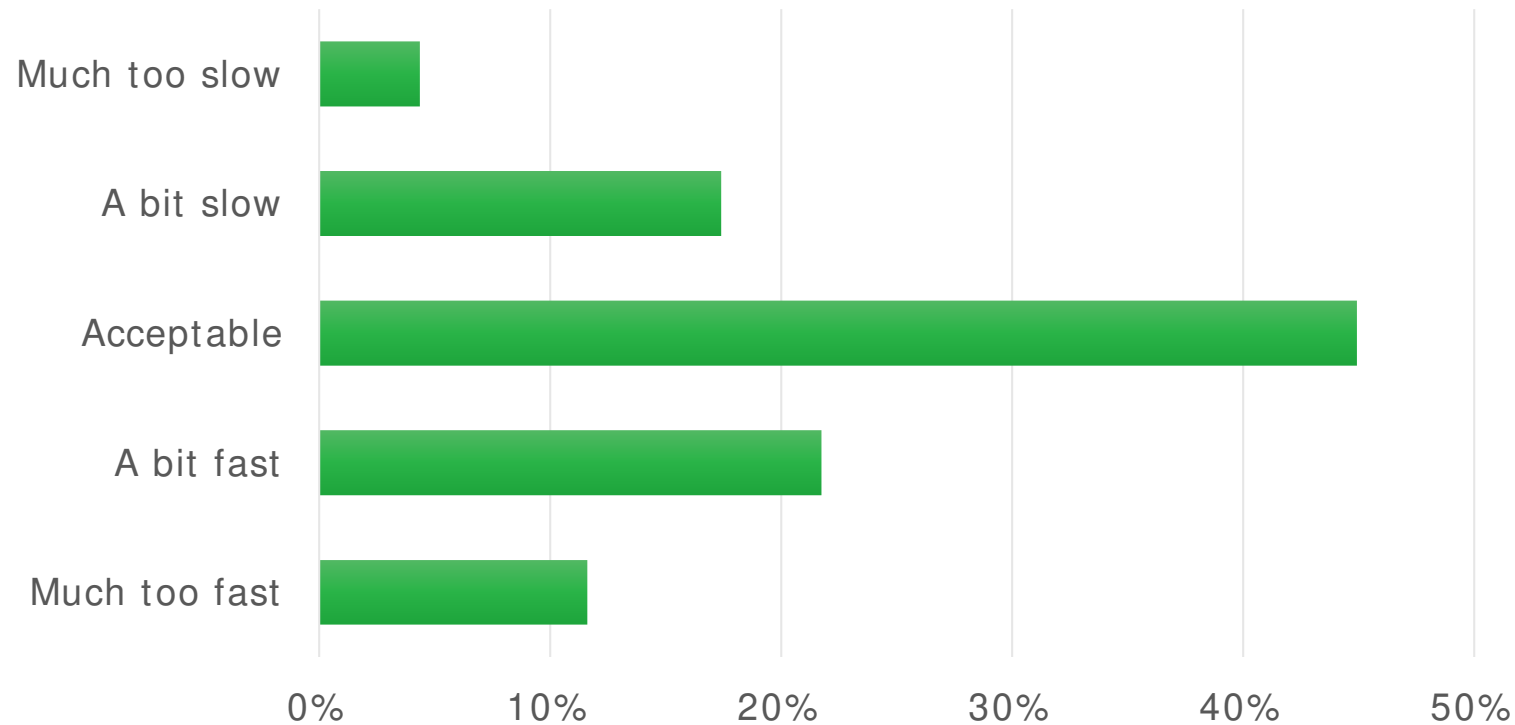


Energy Monitoring: Question 2

How is DLC's timing?



<http://etc.ch/NctR>



Cybersecurity

What's so important about cybersecurity?



Cybersecurity: First Draft Proposal

June 2018 V3

Cybersecurity is reported for components that comply with ANSI UL 2900-1:2017

June 2019 V4

Compliance with ANSI UL 2900-1:2017 is required, or with other standards as available.



Cybersecurity: Comment Summary

- Consider alternatives to UL 2900-1.
 - Concerns about IP in submitting to UL
 - Other standards exist that should be considered (NERC-CIP, NIST SP800-82, ISO 27000, IEC 62433 etc.)
 - There should be other providers besides UL
 - Current UL-2900-1 if applied in full to all components is very expensive
- Clarify requirements regarding endpoints, internet-connection vs. freestanding, components vs. whole systems
- 2019 is too soon, but 2020 might be acceptable

Clarifications

- DLC is looking for equipment level tests and standards that can address cybersecurity aspects of devices
- DLC may also consider cybersecurity standards and certifications that can be applied to the manufacturer or vendor
- Cybersecurity practices implemented at customer installation sites by the customer and/or installer are important – but outside DLC's purview

Cybersecurity: Overview of Standards

Standard	Applies to	Compliance audit available?	Relevant to report on QPL?
NERC-CIP	Large utilities	Only for utilities by regulators	No
IEC 62443	Industrial control systems	Only for automated factories (\$\$\$)	No
NIST SP800-82	Industrial control systems	No	No
NIST Cybersecurity Framework	IT best practices	Yes but nonstandard	?
ISO/IEC 27,001	IT best practices	Yes	Yes
ANSI UL 2900	Products	Yes	Yes

JOINT CANADA-UNITED STATES NATIONAL STANDARD ANSI/CAN/UL 2900-1:2017

Software Cybersecurity for Network-Connectable Products, Part 1: General Requirements

With the growth of IIoT in the Lighting space, there is a need for cybersecurity testing of

- **Components**
- **Products**
- **Systems**

to mitigate the risk of cyber incidents in operational networks.

While many specifications and guidance documents provide information on secure product development principles,

there is still a need to test and measure the security posture of products using comprehensive testing criteria and an important certification management process throughout the life of a component.

What should the security testing include and what are important attributes to measure and evaluate?

What are supply chain considerations?

How do you maintain certified status in the age of lighting system vulnerabilities?

Testing and Certifying Products and Systems



How to Measure Security

Component Security

- Device Security
- Device Configuration
- Device Implementation

Evaluate Service Suppliers

- Supply Chain Logistics
- Service Suppliers Competency
- Service Suppliers Security Risks

Implementation

- Security Practices
- Risk Assessment
- Monitoring

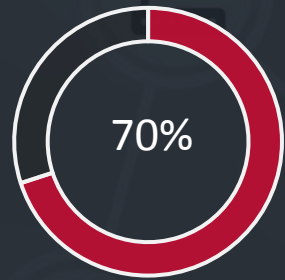
System Security

- Implemented Security Controls
- Site Policies
- Site Continuous Assessment and Monitoring

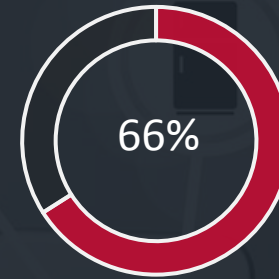
Vendor

- Security Practices
- Secure Development Cycle
- Suppliers Security Risks

The IoT Cyber Threat



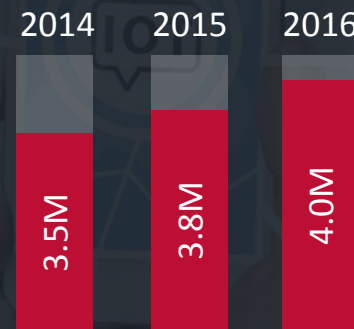
70% of IoT devices are vulnerable to attack (Source: HP)



By 2018, 66% of networks will have experienced an IoT security breach (Source: IDC Research)

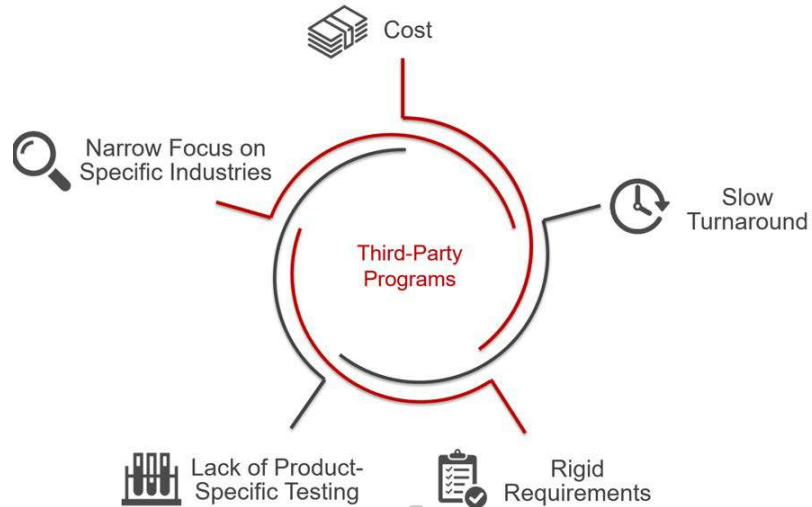


28% to 47% of organizations have experienced IoT-related breaches (Source: Forrester/CISCO)



In 2016, the average consolidated total cost of a data breach was \$4M USD (Source: 2016 Ponemon Study)

STANDARDS LANDSCAPE



Security Standards and Guidance Documents

- **ANSI/CAN/UL 2900-1**
- FISMA
- HIPAA
- PCI
- IEC 80001
- ISO/IEC TR 15443
- ISO/IEC 15408
- DHS C³ VP & CRR
- SANS 20 CSC
- ISO/IEC 27000 Series
- SAE AS5553 & 6174
- Cyber Essentials (UK)
- Top 35 Mitigation Strategies (AU)
- ISO/IEC DIS 20243 / O-TTPS
- NIST Cybersecurity Framework & SP 800-53r4 Security Controls
- ITU-T CYBEX 1500 Series



With so many standards, specifications and guidance documents, manufacturers are asking WHICH ONE IS RIGHT FOR ME

Standards

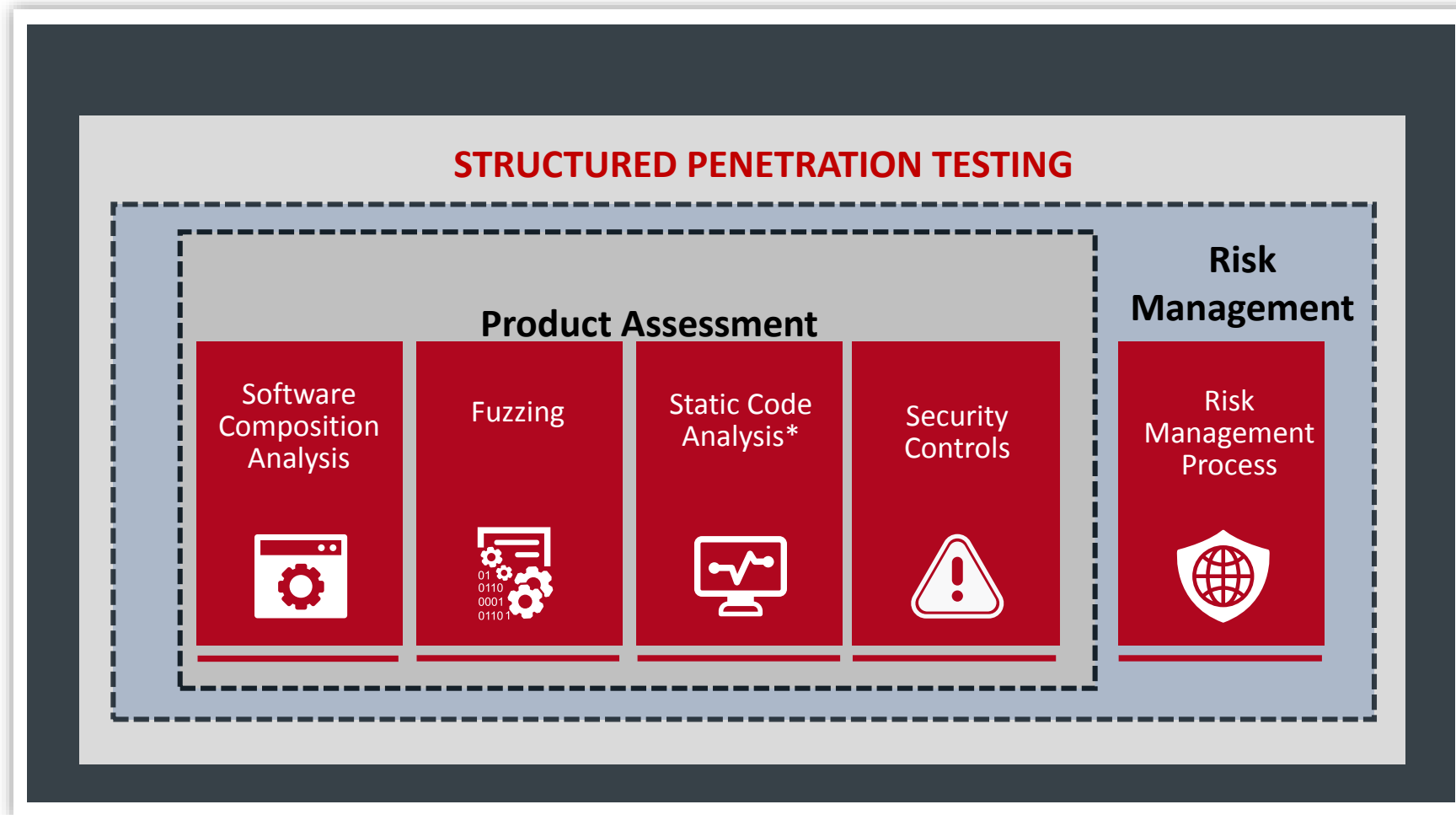
Standards	Vendor Organization Assessment and Audit	Regulatory	Product, Device and System Testing
NIST SP 800-53	General guidance audit standard for facilities	Used in some federal facilities for guidance.	There is no product testing or certification programs associated
NIST SP 800-82	General guidance for industrial control systems and cybersecurity		As a guidance document, there is no specifications for testing
NERC CIP		consists of 9 standards and 45 requirements covering the security of electronic perimeters and the protection of critical cyber assets as well as personnel and training, security management and disaster recovery planning.	
ANSI C137.2	General guidance standard for parking lot lighting systems purchase and installation		
IEC 62443	Primary target is industrial control systems with Organization Assessment standards		Primary target is industrial control systems and asset owners and procurement requirements





Testable Criteria
Repeatable and Reproducible

Content of ANSI/CAN/UL 2900-1



***Access to Code IS NOT REQUIRED. The vendor performs their code analysis and provides the results to UL**



What any Laboratory can do

NETWORK-CONNECTABLE PRODUCTS & SYSTEMS



YOUR NETWORK
CONNECTABLE PRODUCT
AND/OR SYSTEM

Submit product or system
for discrete testing
(One or more individual tests)

Submit product or system
for certification testing
(All tests)

ANSI/CAN/UL Services

RISK MANAGEMENT

- Known Vulnerabilities
- Fuzz Testing
- Code & Binary Analysis
- Access Control & Authentication
- Cryptography
- Remote Communication
- Software Updates
- Structured Penetration Testing

TRAINING SERVICES

ADVISORY SERVICES

REVIEW SERVICES

YOUR REPORT AND/OR
CERTIFICATION

Test
Report



Certificate



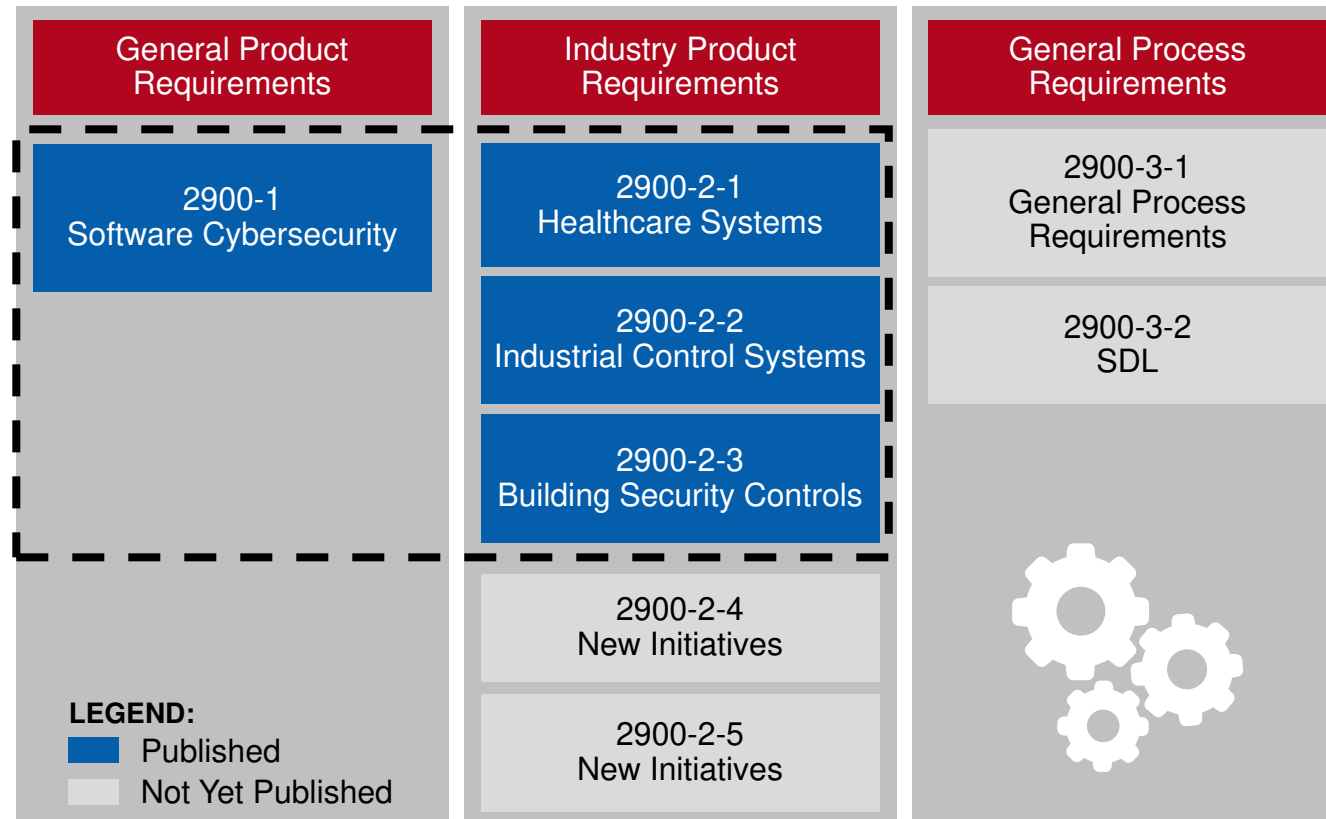
KEY TAKEAWAYS:

✓ RISK MITIGATION

✓ INNOVATION

✓ COMPETITIVE ADVANTAGE

ANSI/CAN/UL 2900 Standards



Options to move forward

Option 1

Use the ANSI/CAN/UL 2900-1 standard

Option 2

Create a ANSI/CAN/ 2900-2-X standard for lighting based on the 2900-1 standard

ANSI/CAN/UL 2900 Standards

General Product Requirements

ANSI/CAN/UL 2900-1
Software Cybersecurity

Industry Product Requirements

ANSI/CAN/UL 2900-2-1
Healthcare Systems

2900-2-2
Industrial Control Systems

2900-2-3
Building Security Controls

ANSI/CAN/UL 2900-2-X
Lighting

General Process Requirements

ANSI/CAN/UL 2900-3-1
General Process
Requirements

ANSI/CAN/UL 2900-3-2
SDL



If a different lighting standard is needed

UL takes the ANSI/CAN/UL 2900-1 standard as a starting point

- Form an Industry Advisory Group(IAG) based on industry vendors, experts and asset owners
- IAG meets and provides guidance on what requirements are needed
 - Time to test
 - Complexity of Requirements
 - Cost of standard testing
 - ETC..
 - 3-6 month window
 - **A DRAFT IS CREATED BY THE IAG BASED ON 2900-1 REMOVING AND ADDING REQUIREMENTS**
- UL works with IAG to develop and publish changes as a 2900-2-X that references UL 2900-1 and includes additions and deletions
- UL publishes 2900-2-X and works through the ANSI process (6-9 month window)



Q&A

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Cybersecurity: Revised Proposal



June 2018 V3

Cybersecurity is reported for components (UL 2900-1:2017; etc.?) & for manufacturers (ISO 27001-1, NIST Cybersecurity Framework; etc.?).

June 2019 V4

With market research and stakeholder input, identify a set of cybersecurity standards that includes UL 2900-1. Only products that comply with one of those standards may declare the **optional** cybersecurity capability.

June 2020 V5

Cybersecurity is **Required**. Products must comply with at least one standard identified in V4 (or reapply under V4 with the 1-year grace period).

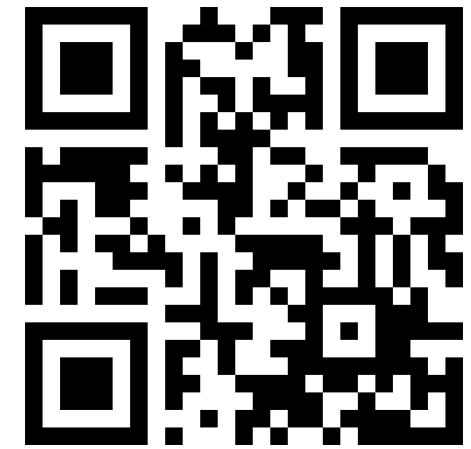
June 2021 V6

Cybersecurity is **Required**.

Cybersecurity: Question 1

Do you approve of the general direction of DLC's Revised Proposal?

- a. Strongly support
- b. Support
- c. Neutral
- d. Object
- e. Strongly object

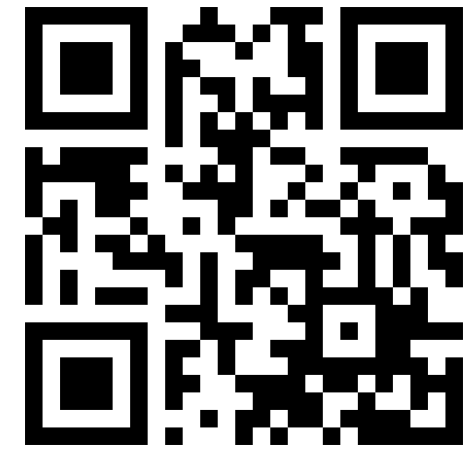


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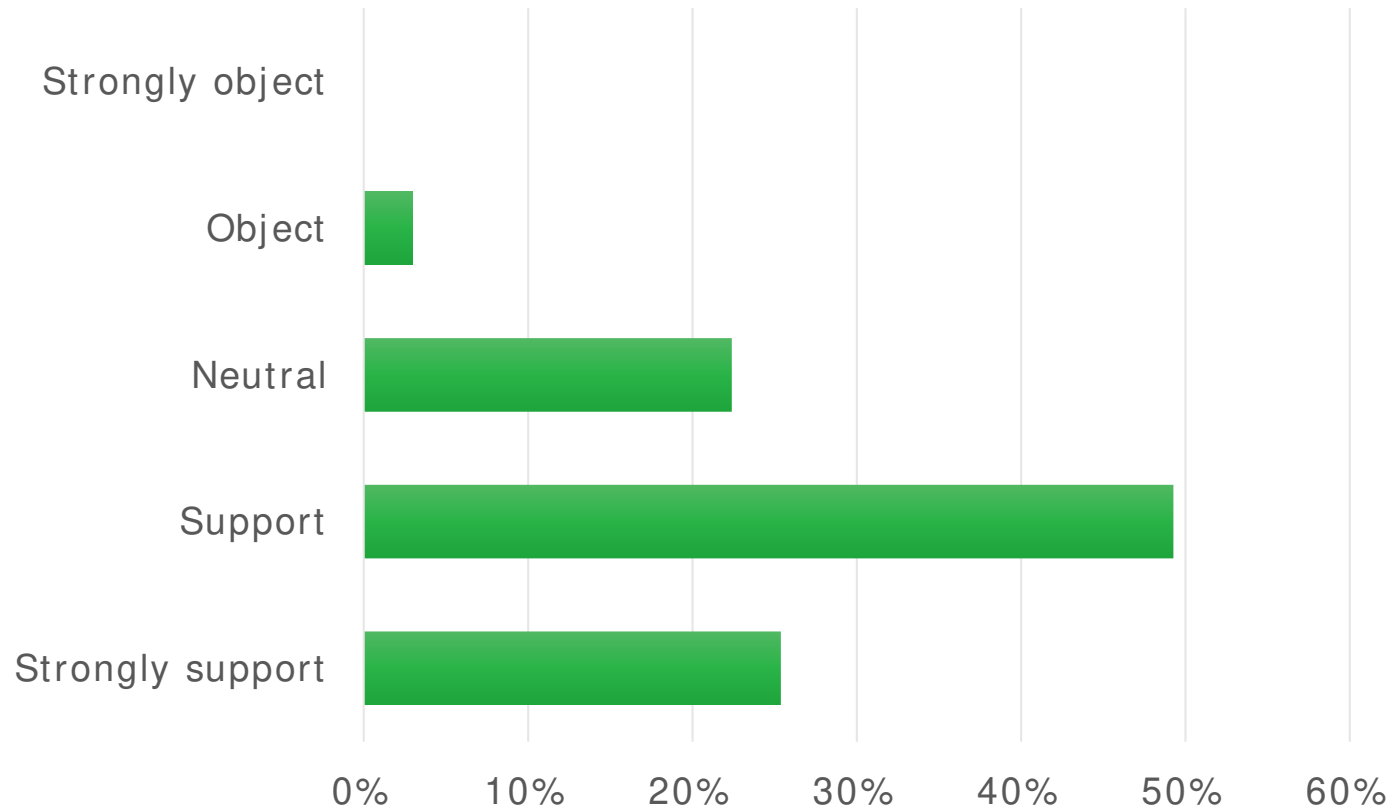


Cybersecurity: Question 1

Do you approve of the general direction of DLC's Revised Proposal?



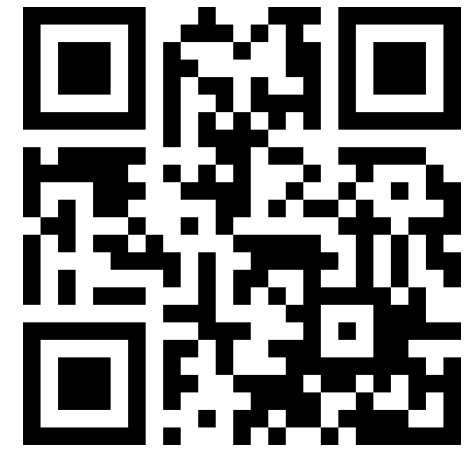
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Cybersecurity: Question 2

How is DLC's timing?

- a. Much too fast
- b. A bit fast
- c. Acceptable
- d. A bit slow
- e. Much too slow



<http://etc.ch/NctR>

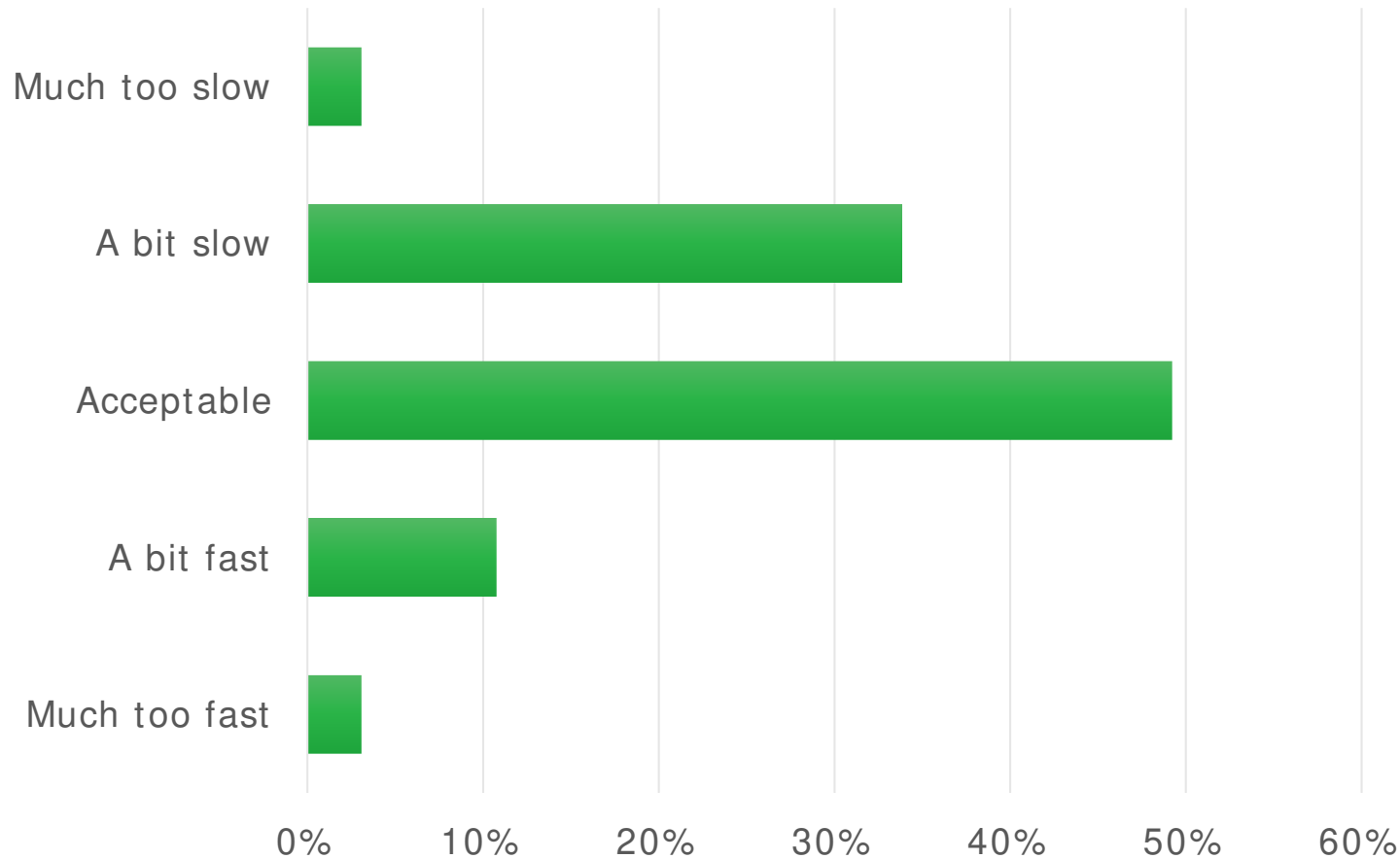


Cybersecurity: Question 2

How is DLC's timing?



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Other Proposed Changes in V3.0 Technical Requirements

Agenda p.1: Quick Report Out

Topic	Plan
Presentations	Reuse for reapplications
Scene Control	New reported capability
Emergency Lighting	Revise the definition
Zoning	Revise the name
DC / PoE	Accept, timed with SSL 9/2018
Interoperability	No major changes until V4
Building Code	Add disclaimer: follow code
Report More Sensors	Revise application details

Agenda p.2: Discussion Topics

Topic	Discussion
Phased Approach to Major Changes	What's Next?
Publicly Available Information	Require for 22 capabilities (not 500+ detailed answers)

Topic: Presentations

What we proposed

Proposed Change in NLC Technical Requirements	Explanation by DLC
Presentations	For re-applications without major product updates, accept a recording of the presentation from last year.

Comments

Unanimous support



Topic: Scene Control

What we proposed

Proposed Change in NLC Technical Requirements	Explanation by DLC
Scenes	Add Scene Control as a reported capability

Comments

General support.

One concern that some Outdoor applications do not use scene control.



Topic: Emergency Lighting

What we proposed

Proposed Change in NLC Technical Requirements	Explanation by DLC
Clarify description	Shorten, and replace "Interact" with "Connect", to more accurately describe the physical connections shown in a wiring diagram.

Comments

General support.

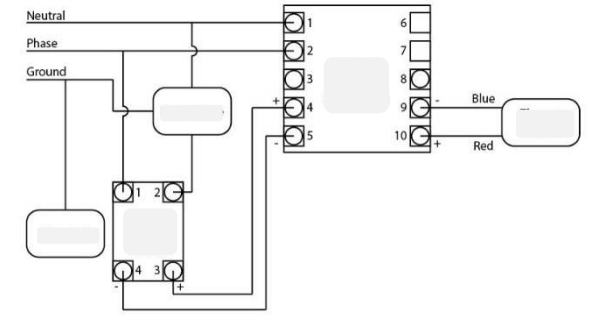
Emphasize “physically” connected

Topic: Emergency Lighting

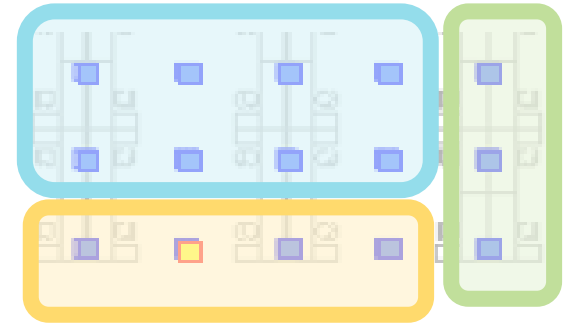
Response

”Publicly available documentation illustrating how a system’s luminaires **physically connect** with an emergency power source.

The QPL will provide the URL(s) for online documentation provided by manufacturers for system designers to refer to. This documentation will identify wiring diagrams, required components, and/or application guides needed to understand design considerations for integrating the system into an emergency lighting system.”



Topic: Zoning



Change proposed by reviewer

- Rename the “Zoning” capability, to emphasize that flexibility is required.

Explanation

- The purpose of this requirement is to support flexible rezoning without rewiring. Hardwired zoning does not qualify.

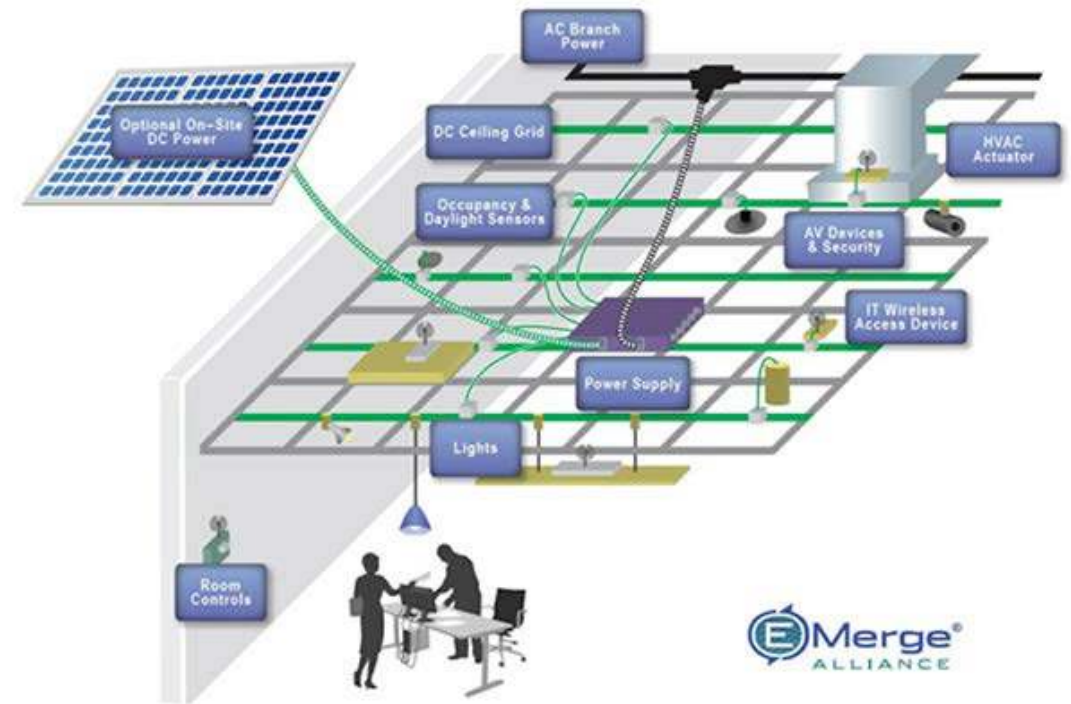
Current Definition (1st of 3 paragraphs)

- “The capability to group luminaires and form unique lighting control zones for a control strategy **via software-defined means**, and not via physical configuration of mechanical or electrical installation details (e.g. wiring).”

Topic: Accept DC/ PoE Control Systems (Direct Current & Power over Ethernet)

Comment Summary

- Unanimous support for DLC to cover this product category
- A question about DC voltage classes as defined in UL 1310, to be addressed in SSL policy



Topic: DC/ PoE

Next Steps

- DLC will accept SSL applications beginning in September 2019
- DLC will accept and begin processing Control applications beginning in June 2019
- To avoid confusion with rebate/incentive programs, DLC will not publicly qualify and list DC/PoE Control Systems until the corresponding SSL application process is available in September.



Topic: Interoperability



Background

DLC made a comment in the Draft 1 webinar that we were working on interoperability requirements that may be proposed in Draft 2

Comments Received:

DLC should not incorporate significant new requirements in Draft 2 if they were not in Draft 1

Response

- Changes for interoperability, if any, will be minor adjustments to the Application and QPL, to focus on multiple-choice answers that are most relevant to interoperability
- Any significant new requirements for Interoperability would be proposed for V4 in 2019.



Topic: Building Code

Comment

How does DLC's requirement relate to building code?

Response

Add a paragraph: "This Technical Requirement describes a system's capabilities, but does not describe how these capabilities can be used to meet various building code requirements. The local building code should be followed when configuring a NLC system."

Topic: Report more sensors

Changed proposed by reviewer:

Optional reporting fields for more sensors

- Fixture-level closed-loop
- Tunable white or full color
- Environmental sensing (humidity, CO2, IAQ, RF sniffer, etc)

Response

- No change in Technical Requirement
- Consider modifying Application and QPL

Discussion Topic: Phased Approach to Major Changes

Comments

Commenters appreciated the multi-year phased approach to Security and Energy Monitoring, allowing for time to make adjustments to products and roadmaps.

Discussion

DLC will consider a phased approach to future interoperability requirements. In what other topic areas might a phased approach make sense?



June 2019 V4

June 2020 V5

June 2021 V6

Publicly Available Information: First Draft

Proposed Change

- In order for an applicant to claim a capability, a reference to that capability must be available in public documentation.

Goals

- To assist specifiers in product selection
- To encourage qualified products that are well documented
- To address major market barriers: confusion and unfamiliarity

Publicly Available Information: Comments

Comment Summary

- Some details are only available to customers in contract documentation
- Propose “available directly to customer, or made available upon request of a customer”
- Require description and/or operational instructions, beyond merely the name of the capability
- 500+ answers are too many for public references
- Remove “some exceptions”. Transparency is needed for interoperability

Publicly Available Information: **Clarification**

20 topics, not 500

Required Interior Capabilities

Networking of Luminaires & Devices
Occupancy Sensing
Daylight Harvesting/Photocell Control
High-End Trim
Zoning
Luminaire and Device Addressability
~~Continuous Dimming~~

Reported Interior Capabilities

Control Persistence
Scheduling
Energy Monitoring
Device Monitoring / Remote Diagnostics
Type of User Interface
Luminaire Level Lighting Control
(LLLC, integrated)
Personal Control
Load Shedding (DR)
Plug Load Control
External Systems Integration
(e.g. BMS, EMS, HVAC, Lighting, API)
Emergency Lighting
Security
Color Changing / Tuning
~~Start Up and Configuration Party~~
Scene Control

Publicly Available Information: Revised Proposal

For a manufacturer to claim a capability and be listed as having it on the QPL, (except for “Continuous Dimming”, and “Startup and Configuration Party”), a description and/or instructions for the capability must be in a public-facing document such as a brochure, specification sheet, instruction manual, or video clip. “Public-facing” documentation is a finished product available to the customer or made available upon request by a customer. It should not be a document produced for the sole purpose of obtaining DLC qualification without further use for customers. DLC reserves the right to accept, reject, or require changes to documentation to satisfy this requirement.

Publicly Available Info: Question

Do you approve of the general direction of DLC's Revised Proposal?

- a. Strongly support
- b. Support
- c. Neutral
- d. Object
- e. Strongly object

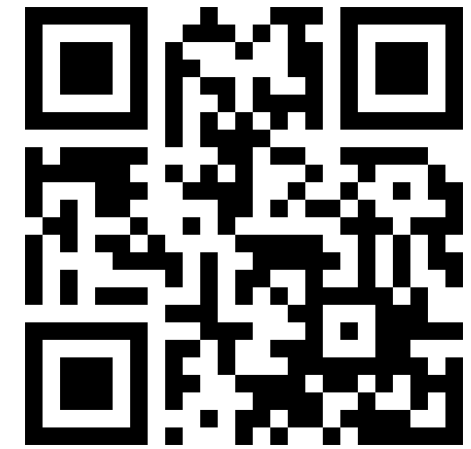


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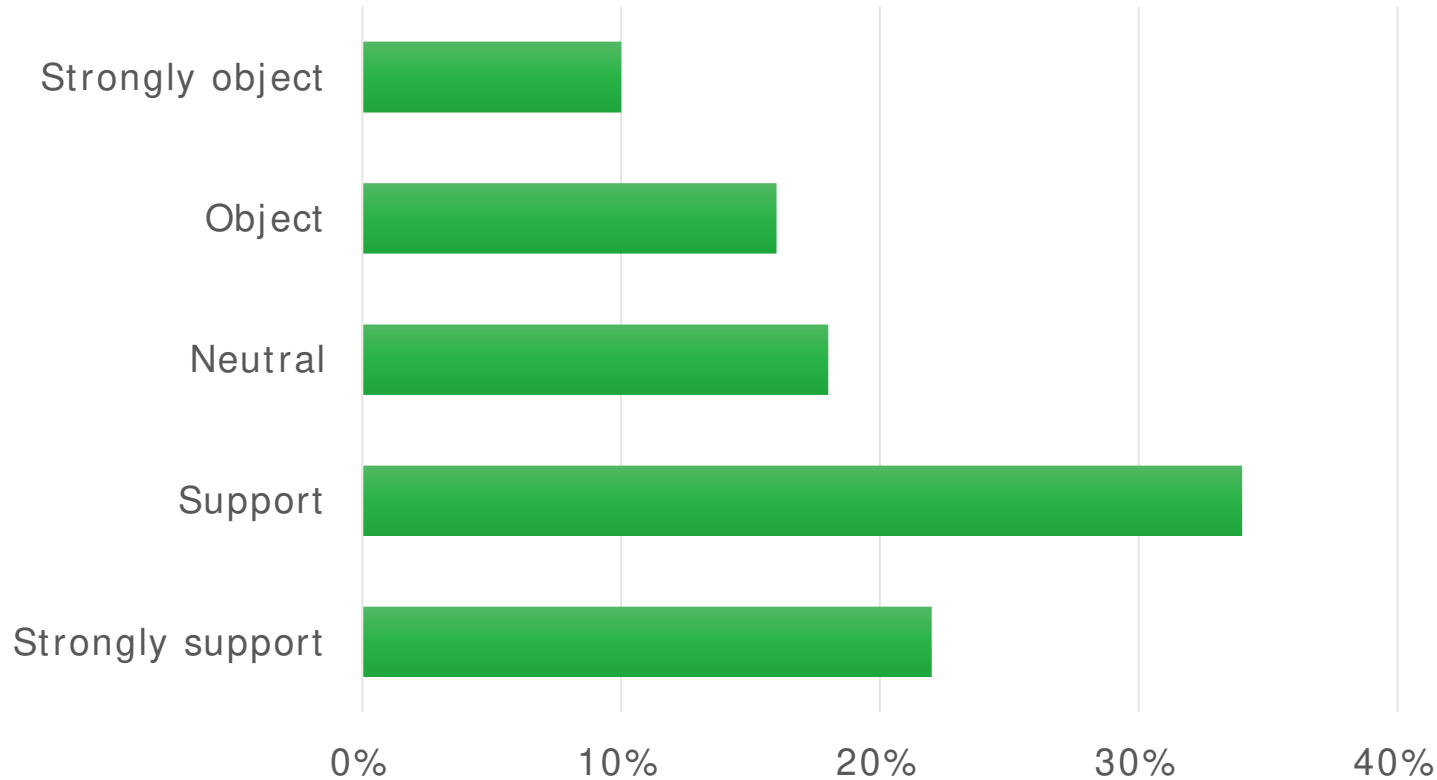


Publicly Available Info: Question

Do you approve of the general direction of DLC's Revised Proposal?



<http://etc.ch/NctR>



Next Steps and Other Updates

Next Steps

- Today's presentation will be posted to the DLC website
- Findings/Ideas/Takeaways from morning brainstorming will be used to develop resources to support energy efficiency administrators
- Draft 2 of NLC V3.0 Spec will be issued April 13
- Standardization Efforts for Energy Monitoring and Security...



Other NLC V3.0 Spec + QPL Updates

- Streamline re-application process coming this June
- Develop and refine policies for families of NLC products and private label products
 - Documentation requirements, fee structure, application process, QPL designation
- Change from Excel-based QPL to Online QPL in late 2018





DLC

**STAKEHOLDER
MEETING 2018**

July 9 - 11
Boston, MA

A nighttime photograph of a city skyline reflected in water. The buildings are brightly lit, and their lights are reflected in the calm water below. The sky is dark, and the overall scene is vibrant and colorful.

Visit the DLC's Hometown!



Day	Agenda
-----	--------

Day 1 – morning	In-person Member meeting
------------------------	--------------------------

Day 1 – afternoon	Pre-conference workshops & CEU courses Opening Reception
--------------------------	---

Day 2	Full day conference Panels Breakout sessions Structured Networking Off-site Reception
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Day 3	Full day conference Panels Discussion Sessions Breakout Sessions Structured Networking
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Panels

- The Future of Lighting
- Outdoor Lighting
- DLC SSL V5.0
- Data Standardization
- Horticultural Lighting

Discussion- and Breakout sessions

- Application Level Efficacy
- Glare Metrics
- Horticultural Metrics
- Interoperability
- SSL 5.0 *Control* Requirements
- And more!

Details

Conference Hotel: **Boston Park Plaza Hotel**

Make your hotel reservations [online!](#)

Register Today!

<https://www.regonline.com?eventID=2223698&rTYPeID=1186245>





Bringing Efficiency to LightSM

Thank you!

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Electric Company*[®]