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Luminaire Level Lighting Controls: Market Progress Evaluation Report #2

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Acronyms

BPA	Bonneville Power Administration
DLC	DesignLights Consortium
IECC	International Energy Conservation Code
LLLC	Luminaire-level lighting controls
MPER	Market Progress Evaluation Report
MPI	Market progress indicator
MT	Market transformation
NEEA	Northwest Energy Efficiency Alliance
NLC	Networked lighting controls
QPL	Qualified product list
ROI	Return on Investment

Executive Summary

This study is the second market progress evaluation report (MPER) for NEEA's Luminaire-Level Lighting Controls (LLLC) Initiative, building on the first MPER completed in 2021.

LLLC Initiative Background

The NEEA LLLC Initiative is designed to overcome barriers in the commercial lighting market to the adoption of LLLC, so they become standard technology for commercial lighting projects. LLLC are a type of networked lighting control (NLC) system in which each individual light fixture has a built-in sensor and controller so the luminaires can communicate wirelessly and transmit data and be flexibly programmed and re-programmed in any grouping needed.

From 2016 to early 2019, NEEA pursued foundational program development activities to begin to overcome key barriers laid out in the LLLC Logic Model: first cost, lack of skilled trade allies, product readiness, and lack of market understanding of the value proposition. These foundational activities included supporting the development of a detailed product specification, conducting research to support the development of utility incentive programs, conducting marketing and media outreach, training installers and designers/specifiers, and influencing code development to include LLLC as an optional code compliance path (with the long-term goal of LLLC being a code requirement).

The LLLC program gained approval in early 2019 to move into market development. This has consisted of continuing the foundational activities, while also working with manufacturers and their sales channels to increase LLLC promotion in their region, working with trade and industry associations to educate their members, partnering with early adopter specifiers to influence others, and developing case studies to highlight the value proposition of LLLC.

MPER Objectives and Research Activities

The main goal of an MPER is to understand how an initiative is progressing towards its outcomes by measuring market progress indicators (MPIs). Outcomes and MPIs are developed by NEEA teams before programmatic activity begins in order to predict how the market should change based on the planned interventions. In other words, the outcomes share key changes that the program is hoping to achieve, while the MPIs are sources of evidence that can be effectively measured to help gauge progress towards these outcomes.

While the aim of this second MPER for the LLLC Initiative was to track the program's progress towards predicted outcomes, the Cadmus Group also assessed the clarity and alignment of the program's planned activities with overcoming market barriers and driving market changes. Finally, this study also leveraged the data collection opportunities to address two additional research objectives identified by the program team that support programmatic planning for the coming year. In short, the four core research objectives included:

- Tracking the LLLC Initiative MPIs to compare progress over time on several short- and near-term outcomes.

- Reviewing updates to the LLLC market transformation theory, program logic model, and market progress indicators (MPIs) since MPER 1 to assess their clarity and alignment in conveying the program's strategy and planned activities to overcome market barriers and drive market changes that will increase LLLC adoption and NEEA's proposed approach for evaluating LLLC market progress.
- Conducting limited additional research on market changes related to the lighting controls market more broadly.
- Identifying what leads decision-makers to purchase LLLC (versus other NLC), as well as what features they value after the product is installed (if they also happen to be end-use customers) to gain a better understanding of barriers and opportunities for LLLC in the market. [1]

To address these objectives, the Cadmus Group conducted the research activities described in Table 1.

Table 1. Research Activities for NEEA LLLC Initiative MPER 2

Task	Target Group	Completes
Document review	N/A	N/A
Stakeholder interviews	Interviews with NEEA program staff, NEEA implementation contractor staff, and staff from NEEA's funding utilities	7
Supply-chain market actor interviews	Interviews with controls manufacturers, manufacturer representatives, and distributors	12
Installer survey	Surveys of Northwest commercial lighting and controls installation companies	30
Designer/specifier survey	Surveys of Northwest commercial lighting designer/specifier companies	27
Decision-maker Surveys	Decision-makers and end-use customers who installed lighting controls	8

As shown in Table 2, the program has realized several of the short-term (one to two years) outcomes and is making progress on medium-term (three to five years) outcomes. In the areas of utility, manufacturer, influential industry organization, and code-related engagement (MPIs 1, 2, 3A, 6, and 7), NEEA has shown continued progress and achieved several of the MPIs. For all other MPIs, NEEA has made progress or held the indicator constant, showing the continued development of the market.

[1] Throughout this report, the term *end-use customer* generally refers to the organization that owns, manages, or occupies the space where the control system is installed and is primarily used to differentiate that organization's perspective from that of supply chain market actors. The term does not refer to specific individuals. Likewise, the term *decision-makers* refers to the individuals within an organization who are responsible for their lighting decisions. The Cadmus team uses the term *decision-makers* in the remainder of the report.

Table 2. 2022 Estimated Value for LLLC MPIs Assessed in MPER 2

Expected LLLC Program Outcome (Logic Model)	LLLC Program MPI	MPI 2021 Estimated Value	MPI 2022 Estimated Value
Outcome I (short term) 1. Utilities support LLLC through programs with incentives	**1A.** Utilities establish LLLC incentive programs	10 programs[a] (of 12 possible)	11 programs (of 12 possible)
Outcome II (short term) 1. DesignLights Consortium (DLC) maintains a Qualified Products List (QPL) 2. Specification continues to advance	**2A.** DLC regularly reviews the LLLC QPL	Achieved	Achieved – no changes
	2B. DLC regularly reviews LLLC specification and updates	Achieved	Achieved – no changes
Outcome III (short term) 1. Manufacturers formalize and provide LLLC training 2. Lighting Design Lab provides LLLC training 3 NEEA's NXT Level training includes LLLC	**3A.** Manufacturers with LLLC products on the DLC QPL offer LLLC training to at least one type of supply-side market actor	All manufacturers interviewed had LLLC trainings with at least one supply-side market actor (n=7)	All manufacturers interviewed had LLLC trainings with at least one supply-side market actor (n=4)
	3B. The percentage of lighting installation companies with at least one installer trained in LLLC	32%[c] (n=66)	71% (n=32)
	3D. The percentage of lighting installation companies with the capability to bid on a project that involves LLLC installation	66% (n=145)	71% (n=33)
	3E. Percentage of companies with at least one LLLC-trained installer in each state[b]	Not assessed in MPER 1	ID (n=20): 57% MT (n=8): 46% OR (n=23): 69% WA (n=24): 73%
Outcome IV (short term) 1. Increase in supply-chain awareness among trade allies and lighting designers	**4A.** The percentage of lighting installation companies and the companies with lighting designers/specifiers who are aware of LLLC	Installation companies: 78% (n=179) Designer/ specifier companies: 68% (n=86)	Installation companies: 78% (n=33) Designer/ specifier companies: 82% (n=31)
Outcome V (short term) 1. Lighting designers and specifiers recommend LLLC solutions	**5A.** The percentage of companies with lighting designers/specifiers who have recommended LLLC to a decision-maker for at least one project	44% (n=75)	63% (n=27)
	5B. The percentage of companies with designers/specifiers who say they have written LLLC into at least one project plan	35% (n=78)	61% (n=27)
Outcome VI (short term) Manufacturers increase the	**6A.** Manufacturers say compared to the previous year,	Not assessed in MPER 1	4 of 4 manufacturers

Expected LLLC Program Outcome (Logic Model)	LLLC Program MPI	MPI 2021 Estimated Value	MPI 2022 Estimated Value
number of product types with embedded controls.	for at least one of these fixture types – low-bay, high-bay, recessed can, & retrofit kits – they have increased the number of products available with embedded controls		
	6B. Sales reps say there are sufficient types and styles of fixtures with embedded controls to meet their customers' needs	Not assessed in MPER 1	6 of 7 manufacturer's representatives
Outcome VII (short term) 1. LLLC is an optional path in Washington code, and LLLC is referenced in the 2018 International Energy Conservation Code (IECC)	**7A.** LLLC is an Optional Compliance Path in Washington code	Achieved	Achieved – no changes
	7B. LLLC is referenced in the 2018 IECC	Achieved	Achieved – no changes
Outcome IX (medium term) 1. LLLC is accepted as the easiest-to-install lighting controls solution	**9A.** The percentage of installation companies that report having installed at least one LLLC system (i.e., "experienced installation firms")	61% (n=159)	63% (n=32)
	9B. The percentage of experienced installation companies that say LLLC systems are easier to install than other NLC systems	43% (n=59)	74% (n=21)
Outcome XI (medium term) Increase in decision-maker selection of LLLC systems	**11B**. Year-over-year improvement in satisfaction level reported by customer-side decisionmakers who have purchased LLLC	Not assessed in MPER 1	6 of 8 respondents

[a] In MPER 1, Cadmus erroneously excluded two utilities from this list, bringing the revised total to 10 utilities.

[b] While the sample size at the total region level is sufficient for analysis, it is smaller at the state level. Thus, state-level differences are directional (i.e., not statistically significant).

[c] In the MPER 1, we had a narrower definition of 'trained' that did not account for market actors with a different business plan (i.e., to sub-contract out some of the work in some cases, or to specialize in some aspects of their role). For the MPER 2, we decided to do broaden the definition to more accurately reflect the functional business practices of these market actors, which resulted in a re-analysis of the MPER 1 data as well in order to have a comparison. This is why the results do not match with the MPER 1 report.

Conclusions and Recommendations

As shown in Table 3, Cadmus formed conclusions about the LLLC market and initiative based on extensive qualitative and quantitative research and developed recommendations to support ongoing market transformation.

The Topic column links to the appropriate subsection in the *Conclusions and Recommendations* section, where supporting findings for conclusions and additional details on recommendations are included.

Table 3. Summary of Conclusions and Recommendations

Topic	Conclusion	Recommendation
RO #1: Assess Program Foundation	Conclusion 1: NEEA's program modifications have kept pace with LLLC market changes and continue to advance LLLC market share.	Recommendation 1: Continue to have close coordination with upstream market actors so that market-facing materials, trainings, and other related documentation are updated when market changes occur.
RO #2: Track Market Progress	Conclusion 2: NEEA's efforts to advance LLLC have resulted in progress in several aspects of the LLLC market. Conclusion 3: Ability to install LLLC among market actors remained strong.	Recommendation 2: Continue existing program activities until the NEEA's specified criteria for market transformation (i.e., achievement of MPIs) are met.
RO #3: Lighting Controls Market Research	Conclusion 4: While awareness and perceptions of LLLC products have improved, market actor confidence and current market conditions still impede market uptake. Conclusion 5: Continue to focus on benefits beyond energy/cost savings will be important to grow LLLC market share.	Recommendation 3: Ensure that market actors have easy access to resources helping them understand the value proposition of LLLC and how it differs for different types of customers. In these resources, ensure that both detailed energy savings and benefits beyond energy/cost savings are clearly articulated. Continue to regularly publish updates to these resources and encourage upstream market actors to distribute materials to downstream market actors.
RO #4: LLLC Decision-Making Factors	Conclusion 6: Motivators for choosing a specific lighting technology reflect the varied and specialized use cases that can be applicable for LLLC. Conclusion 7: A varied set of LLLC system features likely led to positive installation and usage experiences.	Recommendation 4: Work with upstream market actors to ensure that installers and designers/specifiers have the appropriate understanding of the LLLC value proposition for different customer segments and are prepared to tailor their sales pitch to a customer's unique needs.

1. Introduction

The NEEA Luminaire-Level Lighting Controls (LLLC) Initiative is designed to overcome barriers to the adoption of LLLC in the commercial lighting market so they become standard technology for commercial lighting projects. LLLC are a type of networked lighting control (NLC) system in which each individual light fixture has its own built-in sensor and controller, enabling the luminaires to communicate wirelessly and transmit data and be flexibly programmed and re-programmed in any grouping needed. By comparison, in other NLC systems, the sensor and controller are external to the fixtures. One sensor and controller—typically mounted in the ceiling—will control a group of fixtures, usually wirelessly.

From 2016 to early 2019, NEEA focused on foundational program development activities. NEEA developed a Market Transformation (MT) Theory and LLLC Logic Model that laid out barriers to LLLC adoption, LLLC market opportunities, and a path to market transformation. Barriers consisted of first cost, lack of skilled trade allies, product readiness, and lack of market understanding of the value proposition. Opportunities consisted of rapid market adoption of solid-state lighting and on NEEA's perception, based on long-standing experience in the codes arena, that LLLC can be successfully incorporated into codes.

During these years, Northwest Energy Efficiency Alliance (NEEA) pursued foundational program development activities to begin addressing barriers and leveraging opportunities. These included working with the DesignLights Consortium (DLC) to create a specification for LLLC features and operation, conducting outreach with manufacturers to influence the development of qualifying products and conducting LLLC energy savings and incremental cost studies. More direct market interventions, which are ongoing, include influencing the incorporation of LLLC into building energy codes, sharing information about LLLC with utilities as they develop incentive programs for LLLC to mitigate first cost, and providing training to lighting professionals through efforts co-sponsored with NEEA's funding utilities to address the lack of skilled supply-chain market actors.

In early 2019, the program received approval from NEEA's director-level staff and funding utilities to move into the market development phase. In addition to continuing the activities described above, the program team hired contractors for field implementation and marketing. Implementation has focused on leveraging previously established relationships with manufacturers and establishing direct working relationships with local manufacturer sales channels of LLLC to support them in championing LLLC in the Northwest. Additionally, the implementation team has trained local manufacturer representatives and distributors in effective messaging and sales techniques for LLLC and has partnered with these manufacturer representatives and distributors to educate designers and specifiers. The implementation team also supports utility-hosted training for installers, designers, and specifiers, and delivers additional education through local and national professional and trade associations. Marketing activities to further raise awareness and acceptance of LLLC include the placement of articles in industry publications, spotlighting influential early adopter customers and market actors, holding webinars, and collaborating on informational and educational events with professional and trade associations for installers, designers, specifiers, and end-use customers such as building operators.

The LLLC program is also working with a third-party contractor to collect anonymized regional LLLC sales data from manufacturers that have agreed to share data with NEEA. NEEA is also receiving information about the number of LLLC units installed and incentivized in the Northwest reported through utility programs in an annual survey.

Based on the program outcomes described in the LLLC Logic Model, NEEA identified a number of market progress indicators (MPIs) for tracking program progress. This study is the second of several LLLC market progress evaluation reports (MPER) that will track the LLLC MPIs and provide continuing market research to refine NEEA's outreach and intervention activities. This study is referenced as MPER 2, whereas the initial measurement year is referenced as MPER 1.

2. Methodology

The MPER 2 has four core research objectives:

- Review updates to the LLLC market transformation theory, program logic model, and MPIs since MPER 1 to assess their clarity and alignment in conveying the program's strategy and planned activities to overcome market barriers and drive market changes that will increase LLLC adoption and NEEA's proposed approach for evaluating LLLC market progress.
- Track the LLLC Initiative MPIs to assess progress over time on several short- and near-term outcomes.
- Conduct limited additional research on market changes related to the lighting controls market more broadly.
- Identify what leads end-use customer decision-makers to purchase LLLC (versus other NLC), as well as what features they value after the product is installed to gain a better understanding of barriers and opportunities for LLLC in the market.

To inform MPER 2, the Cadmus team conducted several primary and secondary research tasks and designed each to address a specific subset of research questions related to the core research objectives. This section provides additional detail on the methods and purpose for each task listed in Table 4.

Table 4. Research Activities for NEEA LLLC Initiative MPER 2

Task	Research Objectives Addressed	Target Group	Completes
Document review	1	N/A	N/A
Stakeholder interviews	1, 2, 3	Interviews with 3 NEEA program staff (conducted as a single interview), 1 NEEA implementation contractor staff person, and 5 staff from NEEA's funding utilities	7
Supply-chain market actor Interviews	2, 3, 4	Interviews with 4 controls manufacturers, 7 manufacturer representatives, and 1 distributor	12
Installer survey	2, 3	Surveys of Northwest commercial lighting and controls installers	30
Designer/specifier survey	2, 3	Surveys of Northwest commercial lighting and controls designer/specifiers	27
Decision-maker survey	2, 4	Decision-makers at customers that installed lighting controls	8

A full explanation of the methodology for each task is included in *Appendix A. Detailed Methodology*.

3. Detailed Findings

This section presents the detailed findings from Cadmus' research, organized by research objective. Results are synthesized across tasks in the *Conclusions* section that follows. Several tasks informed each research objective, as noted below.

3.1. RO #1: Assess Program Foundation

As the first step in this evaluation, Cadmus reviewed program documentation that was updated since MPER 1 and interviewed NEEA program staff, implementation contractor staff, and staff from NEEA's partner utilities to understand changes to program design.

Program Foundation Remained Solid

In reviewing NEEA's LLLC program documentation, Cadmus found that NEEA made minor updates to two documents since MPER 1. The first updated document was the Logic Model, where NEEA added new opportunities, a new mid-term outcome, new outputs, new activities, and adjusted short-term outcomes. Likewise, the updated LLLC Program Plan included extra regional coordination and the use of LLLC as a solution for whole-building requirements. All other documents from MPER 1 were consistent (except for some minor revisions) and still reflect the program theory and remain viable. Additionally, Cadmus reviewed one document for the first time, the LLLC Product Plan, which clearly organizes all product knowledge so program teams can make informed decisions about activities and market interventions.

NEEA staff reported that the pandemic caused disruption for in-person LLLC trainings, but that in-person trainings have now resumed. Since MPER 1, NEEA created portable demonstration boards, which could be demonstrated at trade conventions and similar events to better support training efforts.

Cadmus found that the program documentation accurately reflects the program theory and was updated appropriately following the learnings from MPER 1. To understand more about these changes, we incorporated the Logic Model, Program Plan, and Product Plan revisions into the stakeholder interviews.

LLLC is Advancing in the Market

During the interviews, NEEA staff reported that LLLC is advancing in the market. They stated that while some misunderstandings around LLLC persist from market actors, overall awareness has increased dramatically for LLLC specifically (beyond NLC in general) and data collection efforts have improved. They reported that LLLC is mentioned at events from different market actors and the general conversation has shifted from *what is LLLC* to *why LLLC is useful*? The program implementer, Cadeo Group, corroborated this sentiment, noting that in 2022 there was a shift from setting up the LLLC market to getting value out of previously established relationships. This involved working with manufacturer partnerships and delivering educational resources and trainings through organizational partners, such as trade associations and professional organizations.

NEEA staff reported that the LLLC program focused on a few key areas in 2022. One was deepening the message and improving communication about the value proposition for LLLC to utilities. NEEA understood that there are limits "to how far simply talking about LLLC is going to get," so they created and use product-specific demo boards at trade shows. They also collaborated with key manufacturer partners on a series of videos, as well as publishing early-adopter case studies and interviews based on the MPER 1 results in 2022 and early 2023.

NEEA staff reported that sales data quality and quantity have improved over time. NEEA partnered with Encentiv Energy to collect data on the LLLC market. If LLLC manufacturers agreed to share data with NEEA, Encentiv Energy processed, anonymized, and aggregated the data before delivering it to NEEA. Staff estimated that their partnership with Encentiv may cover 40% to 50% of the market.

NEEA staff believed utilities have prioritized LLLC. However, NEEA staff also noted that utilities are focused on near-term resource acquisition and have a full portfolio of measures, of which LLLC are a single offering. So, while NEEA and utilities have shared goals around LLLC, NEEA staff noted that they needed to identify how LLLC fit in with a utility's larger needs.

Utility respondents also shared ideas for how NEEA might improve their efforts in the LLLC market, including some that are already incorporated in program activities and plans. For example, one respondent shared that "contractors prefer one- to two-hour meetings or trainings, to half- or full-day meetings. Quick, dense, and informative trainings are going to be more attractive to them." NEEA is acting in alignment with that recommendation, having developed and implemented a suite of training materials and programs that include short, intensive online sessions lasting 7-10 minutes, to longer in-person meetings running the gamut of 1 to 2 hours, to half days, to multiple days.

Another respondent shared that NEEA should "keep working top-down" with manufacturers, in order to support distributor trainings, as "distributors have no training on the product, since they don't stock it, it's challenging to get them to spend time on this". While there is a perception that no distributors are trained, NEEA has partnered with manufacturers and their local representatives to train key distributors in the region.

A third respondent shared that "NEEA should find ways to help out these [smaller], more well-established utilities. If the utility implemented an LED program years ago and now everything is LED, how should they be marketing LLLC and NLC in a way that makes sense?" Several case studies and videos are available to utilities online through the BetterBricks website, in addition to the utility marketing toolkit, which may address this request. Program activities and resources are also regularly communicated with utility program managers at Integrated Systems Coordinating Committee (ISCC) meetings.

Finally, we asked about additional training topics that NEEA could incorporate into future trainings. While some utility respondents were content with the current suite of topics, others mentioned that better inclusion of circadian rhythm applications would be useful for hospital and recovery facilities. While NEEA currently provides supplementary information on circadian rhythm for this market segment, it is not shared more broadly across trainings currently. Distributors, installers, and decision-makers may

be unaware how the color of lighting (shifting from yellow tones during the day to blue tones at night) could support a healthy circadian rhythm for patients and medical personnel, alike, and other people who may need to work overnight shifts.

3.2. RO #2: Track Market Progress

The main goal of this study is to understand how the LLLC program may be achieving its outcomes through the detailed tracking of market progress indicators. Cadmus used several research activities to estimate each of the MPIs listed in Table 5. This table presents the estimated 2022 values for the MPIs and the values from 2021, which are discussed in more detail following the table.

Research Challenges

Cadmus encountered several challenges during MPER 2 that impacted its ability to generalize these data to the full Northwest LLLC market:

- **Survey Response Rates**: Cadmus encountered low survey response rates among both market actors (installers and designers/specifiers) and decision-makers. While these have always been challenging groups to survey, the response rates for these surveys were lower than prior efforts and reflected the post-pandemic survey response experience that Cadmus has seen across different industries and regions. On the market actor side, installers and designers/specifiers have a high project load and a shortage of workers in the industry, leading to a lower likelihood that they will respond to survey requests.[2]
- **Survey Sample Quality**: The market actor survey sample contained a higher-than-expected level of disconnected numbers or designated contacts that had retired, leading to a smaller set of contacts available to answer the survey. Additionally, we have found it increasingly difficult to reach respondents on landlines, which made up the majority of sample phone numbers. In the decision-maker survey sample, Cadmus primarily used CoStar to collect available contacts, supplemented by a small amount of utility program data. The CoStar data contained property manager and owner information, but these were typically corporate landline phone numbers with no name attached, which made it difficult to reach the needed contact. Also, the contact data did not have email addresses, which help to gather willing contacts quickly. Finally, the CoStar data did not have information on whether the organizations recently completed a lighting upgrade, leading to the need to cold call all available records. While Cadmus pursued other data sources that included email addresses and more detailed data, a dataset of the same scale as CoStar was unavailable.

This resulted in the final confidence and precision (see Table A-3 in *Appendix A. Detailed Methodology*) not meeting the targets for the installer and designer/specifier survey. For the above reasons, Cadmus advises using caution to avoid over interpreting the MPER 2 MPI estimates. Some MPIs, including MPIs 1A, 3A, 3D, and 4A, appear close to 100% already, which in some cases might prompt a decision to discontinue the measurement of these MPIs in subsequent MPERs. However, because of the issues

[2] Border States. Last modified January 4, 2022. "The State of the Electrician Shortage in 2022: New Data on the Impact of COVID-19." solutions.borderstates.com/the-electrician-shortage

described above, Cadmus recommends conducting at least one additional year of MPI tracking for other MPIs not listed as "Achieved" as additional data points for comparison.

Table 5.Estimated Values for MPIs Assessed in MPER 2

Expected LLLC Program Outcome (Logic Model)	LLLC Program MPI	MPI 2021 Estimated Value	MPI 2022 Estimated Value
Outcome I (short term) 1. Utilities support LLLC through programs with incentives	**1A.** Utilities establish LLLC incentive programs	10 programs[a] (of 12 possible)	11 programs (of 12 possible)
Outcome II (short term) 1. DesignLights Consortium (DLC) maintains a Qualified Products List (QPL) 2. Specification continues to advance	**2A.** DLC regularly reviews the LLLC QPL	Achieved	Achieved – no changes
	2B. DLC regularly reviews LLLC specification and updates	Achieved	Achieved – no changes
Outcome III (short term) 1. Manufacturers formalize and provide LLLC training 2. Lighting Design Lab provides LLLC training 3 NEEA's NXT Level training includes LLLC	**3A.** Manufacturers with LLLC products on the DLC QPL offer LLLC training to at least one type of supply-side market actor	All manufacturers interviewed had LLLC trainings with at least one supply-side market actor (n=7)	All manufacturers interviewed had LLLC trainings with at least one supply-side market actor (n=4)
	3B. The percentage of lighting installation companies with at least one installer trained in LLLC	32%[c] (n=66)	71% (n=32)
	3D. The percentage of lighting installation companies with the capability to bid on a project that involves LLLC installation	66% (n=145)	71% (n=33)
	3E. Percentage of companies with at least one LLLC-trained installer in each state[b]	Not assessed in MPER 1	ID (n=20): 57% MT (n=8): 46% OR (n=23): 69% WA (n=24): 73%
Outcome IV (short term) 1. Increase in supply-chain awareness among trade allies and lighting designers	**4A.** The percentage of lighting installation companies and the companies with lighting designers/specifiers who are aware of LLLC	Installation companies: 78% (n=179) Designer/ specifier companies: 68% (n=86)	Installation companies: 78% (n=33) Designer/ specifier companies: 82% (n=31)
Outcome V (short term) 1. Lighting designers and specifiers recommend LLLC solutions	**5A.** The percentage of companies with lighting designers/specifiers who have recommended LLLC to a decision-maker for at least one project	44% (n=75)	63% (n=27)
	5B. The percentage of companies with designers/specifiers who say	35% (n=78)	61% (n=27)

Expected LLLC Program Outcome (Logic Model)	LLLC Program MPI	MPI 2021 Estimated Value	MPI 2022 Estimated Value
	they have written LLLC into at least one project plan		
Outcome VI (short term) Manufacturers increase the number of product types with embedded controls.	**6A.** Manufacturers say compared to the previous year, for at least one of these fixture types – low-bay, high-bay, recessed can, & retrofit kits – they have increased the number of products available with embedded controls	Not assessed in MPER 1	4 of 4 manufacturers
	6B. Sales reps say there are sufficient types and styles of fixtures with embedded controls to meet their customers' needs	Not assessed in MPER 1	6 of 7 manufacturer's representatives
Outcome VII (short term) 1. LLLC is an optional path in Washington code, and LLLC is referenced in the 2018 International Energy Conservation Code (IECC)	**7A.** LLLC is an Optional Compliance Path in Washington code	Achieved	Achieved – no changes
	7B. LLLC is referenced in the 2018 IECC	Achieved	Achieved – no changes
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[b] While the sample size at the total region level is sufficient for analysis, it is smaller at the state level. Thus, state-level differences are directional (i.e., not statistically significant).
[c] In the MPER 1, we had a narrower definition of 'trained' that did not account for market actors with a different business plan (i.e., to sub-contract out some of the work in some cases, or to specialize in some aspects of their role). For the MPER 2, we decided to do broaden the definition to more accurately reflect the functional business practices of these market actors, which resulted in a re-analysis of the MPER 1 data as well in order to have a comparison. This is why the results do not match with the MPER 1 report.

MPI 1A: Almost all Northwest Utilities Offered Incentives for LLLC in 2022

Cadmus verified the number of utility incentive programs in the Northwest region by reviewing the compiled list of LLLC incentives available through the BetterBricks website (accessed Spring, 2023), reviewing the list of NEEA partners available on neea.org (accessed Spring, 2023), and by gaining more context through interviews with NEEA staff members and utility program managers.

According to BetterBricks and interviews with the NEEA program team, eleven out of twelve alliance partners have incorporated LLLC incentives into their programs: BPA (which serves 148 entities), Energy Trust of Oregon (which runs the NLC incentives for Portland General Electric, NW Natural, and Cascade Natural Gas Corporation)), Idaho Power, Pacific Power, Puget Sound Energy, Seattle City Light, Avista Utilities, Snohomish County Public Utility District, Clark Public Utilities, Chelan County PUD, and Tacoma Power (see Table 8). This is up by one program since the last MPER, with the addition of the Energy Trust of Oregon. Table 6 provides additional detail on each active incentive program.

Table 6. Active Incentive Programs for NLC (including LLLC) by Organization

Organization [a]	Unit Eligibility	Rebate Amount	Project Eligibility
Bonneville Power Administration (148 separate entities can access these incentives for their customers)	NLC, including LLLC	Dollar per kilowatt-hour calculated through the Lighting Calculator); additional $60 to $2000 per fixture for non-specialty (i.e., general indoor/outdoor) fixtures; $140 to $600 per hi-bay fixtures installed with NLC, depending on wattage reduction	Nonresidential retrofit projects
Clark Public Utilities	NLC, including LLLC	(Uses BPA calculator and rebates described above.)	Nonresidential retrofit projects
Chelan County PUD	NLC, including LLLC	(Uses their own calculator, which incorporates the BPA incentives described above.)	Nonresidential retrofit projects
Idaho Power	NLC, including LLLC	$15 to $30 per sensor, or $25 to $35 for LED fixtures with multiple control strategies	Nonresidential retrofit projects
Pacific Power	NLC, including LLLC	$0.12 to $0.38 per kilowatt-hour saved;	Nonresidential retrofit projects; LLLC must have at least one control strategy enabled; other NLC must have at least two control strategies enabled.
	NLC, including LLLC	$0.40 to $1.00 per watt controlled	Nonresidential new construction
Puget Sound Energy	NLC, including LLLC	$0.45 per kilowatt-hour saved (all NLC); LLLC receive an additional $50 or $75 bonus per fixture	Nonresidential and multifamily retrofit projects; multifamily projects must be in common areas; new construction; higher LLLC fixture bonus is limited to daylighted spaces
Seattle City Light	NLC, including LLLC on the QPL	$0.15 per kilowatt-hour saved, NLC projects get an additional $150 bonus per fixture and LLLC projects get an additional $75 bonus per fixture	Nonresidential retrofit projects; multiple strategies must be enabled
Avista Utilities	LLLC fixtures must be DLC-qualified	LLLC incentive of $150 per interior fixture and $85 for exterior	Nonresidential interior lighting retrofit projects; other NLC must not have had occupancy sensor previously; LLLC must replace fixtures that did not have a control
Snohomish County Public Utility District	NLC, including LLLC	Incentives based on the type of control installed, wattage, and hours of use. $11 to $171 per fixture for LLLC; $9 to $137 per fixture for other NLC	Nonresidential retrofit projects; requires a description of the proposed controls strategy

Organization [a]	Unit Eligibility	Rebate Amount	Project Eligibility
Tacoma Power	Efficient lighting measures, including advanced lighting controls [b]	General business: $0.17 per kilowatt-hour saved; maximum 60% of installed cost Small business: $0.19 per kilowatt-hour saved; maximum 100% of installed cost	Offered through Save with Lighting
Energy Trust of Oregon	LLLC lighting and control systems	Interior LED: $60-$100 per fixture with LLLC controls; Exterior LED: $65-$425 per fixture with LLLC controls; High-bay/Low-bay LED: $175-$355 per fixture with LLLC controls; $0.20 per annual kWh saved	Each measure must be reviewed and prequalified by Energy Trust

[a] The report is available by clicking on the name of the organization.

[b] Cadmus could not find a definition for advanced lighting controls on Tacoma Power's website.

MPI 2A and 2B: The DLC Continues to Support LLLC

Cadmus reviewed the DLC's website for information regarding the LLLC Qualified Products List (QPL) and interviewed a representative from the DLC in the first MPER to corroborate Cadmus concluded that the DLC is regularly reviewing and updating the LLLC QPL, categorizing LLLC on various attributes, and updating the technical specifications, leading to both MPI 2A and 2B being listed as "Achieved."

MPI 3A: All Interviewed Manufacturers Offered LLLC Training

Table 7 shows the status of MPI 3A, which is consistent in both 2021 and 2022.

Table 7. Details of MPI 3A

LLLC Program MPI	2021 Estimate	2022 Estimate
3A. Manufacturers with LLLC products on the DLC QPL offer LLLC training to at least one type of supply-side market actor	All manufacturers interviewed had LLLC trainings with at least one supply-side market actor (n=7)	All manufacturers interviewed had LLLC trainings with at least one supply-side market actor (n=4)

Like in the previous MPER, all manufacturers we interviewed offered LLLC trainings to at least one supply-side market actor. All four of the manufacturers interviewed[3] offered trainings on LLLC systems. The trainings targeted manufacturing partners, including contractors, manufacturer's representatives, the branded system community, system partners, and wholesale distributors (all one mention). Three of the four manufacturers said they did not make any changes to the target audience of their trainings in the past year. One manufacturer stated that in the past year, they shifted towards increased emphasis on LLLC trainings. When asked how long their trainings have been running for, responses ranged from 18 months to as long as five years.

[3] All four of these manufacturers were part of the completed interview sample in MPER 1.

MPI 3B – The Percentage of LLLC Trained Lighting Professionals Grew by Over a Third

For MPI 3B, the survey questions assessed the percentage of lighting installation companies with at least one trained LLLC installer, which Cadmus defined as having received training in at least one out of four key topics: the best type of building spaces for LLLC, the benefits and capabilities of LLLC relative to other types of control systems, how to install LLLC, and how to program LLLC.

Though MPI 3B specifically monitors installation companies, the survey also asked designer/specifiers about LLLC training. Cadmus defined trained for a designer/specifier as having received training in at least one of three subjects: the best type of building spaces for LLLC, the benefits and capabilities of LLLC relative to other control systems, and how to connect LLLC through wireless protocols, such as Wi-Fi or DALI.

Of the survey respondents, 71% of installers said their company had at least one trained LLLC installer while 59% of designers/specifiers said their company had at least one trained designer/specifier. Both of these were substantially higher than in 2021. Table 8 shows the percentage of companies with staff trained in LLLC.

Table 8. Percentage of Companies with Trained Staff

Stratum	2021	2022	Change
Companies with Installers	32% (n=66)	71% (n=33)	39% increase
Companies with Designer/Specifiers (Not included in MPI)	25% (n=42)	59% (n=31)	34% increase

Source: Installer and Designer/Specifier survey, QC4 (installers). "For each of the following, please indicate if any staff at your company, including yourself, have been trained on this subject: the best types of buildings and spaces for LLLC, the benefits and capabilities of LLLC relative to other types of control systems, how to install LLLC, to program LLLC, install other types of networked controls, program other types of networked controls?" And QD3 (designer/specifiers): "Please indicate if you or other lighting professionals at your company have been trained on the following subjects: best types of buildings and spaces for LLLC, the benefits and capabilities of LLLC relative to other types of controls systems, the requirements for connecting through wireless protocols such as Wi-Fi or Dali?"

MPI 3D – The Majority of Installation Companies can Install LLLC

MPI 3D monitors the percentage of lighting installation companies with the capability to bid on a project that involves LLLC. Cadmus considered respondents to be capable of bidding on an LLLC project if they were capable of installing an LLLC system.

As shown in Table 9, installation companies reported relatively consistent levels of installation capabilities from 2021 to 2022.

Table 9. Installation Company Bidding Capability for LLLC Projects

Year	n	Installation Capabilities
2021	145	66%
2022	33	71%

Source: Installer and Designer/Specifier survey, QC5: "Without hiring subcontractors, would you say that your company is currently capable of installing an LLLC system, installing and programming an LLLC system, or neither?"

MPI 3E – LLLC-Trained Installers are Distributed across the Northwest Region

MPI 3E measures the distribution of lighting installation companies with at least one trained[4] LLLC installer across the four states of the Northwest region. An installation company may operate in several states, especially when their offices are located near state borders.

Table 10 shows results across states and associated sample sizes. Each of the four states are served by multiple LLLC installation companies. As anticipated, based on the higher population density and code requirements of Oregon and Washington, the share of installation companies with training is higher in those states than in Idaho and Montana.

Table 10. Percentage of Companies with Trained Staff, by State

State	n	2022	
		Trained	No Training
Idaho	20	57%	43%
Montana	8	46%	54%
Oregon	23	69%	31%
Washington	24	73%	27%

Source: Installer and Designer/Specifier survey, QC4 (installers): "For each of the following, please indicate if any staff at your company, including yourself, have been trained on this subject: the best types of buildings and spaces for LLLC, the benefits and capabilities of LLLC relative to other types of control systems, how to install LLLC, to program LLLC, install other types of networked controls, program other types of networked controls?"

MPI 4A – Awareness of LLLC Remained High in 2022

MPI 4A monitors the percentage of installers and designers/specifiers who are aware of LLLC. To evaluate MPI 4A, Cadmus used survey questions about awareness that incorporated the definition of the technology:

- QB6: "Are you aware of a type of networked lighting control system in which each fixture is programmable and has its own built-in sensor, allowing for flexible grouping and granular fixture control? These are known as luminaire-level lighting control systems, or LLLC."

[4] "Trained" is defined previously on page 24 as installers who have received training on at least one of the following topics: 1) the best type of building spaces for LLLC, 2) the benefits and capabilities of LLLC relative to other types of control systems, 3) how to install LLLC, and 4) how to program LLLC.

- QB7: "Are you aware of another type of networked control system, in which one sensor—typically mounted in the ceiling—controls a group of programmable fixtures, usually wirelessly?"

The majority of installers and designers/specifiers were aware of LLLC, at 78% for installers in both 2021 and 2022. Designers/specifiers were slightly less aware in 2021, with 68% being familiar with LLLC, but this increased to 82% in 2022. Table 11 shows the percentages of awareness for both of these groups.

Table 11. Awareness of LLLC

Stratum	2021		2022	
	n	Percent Aware	n	Percent Aware
Installers	179	78%	33	78%
Designer/Specifiers	86	68%	31	82%

Source: Installer and Designer/Specifier survey, QB6: "Are you aware of a type of networked lighting control system in which each fixture is programmable and has its own built-in sensor, allowing flexible grouping and granular fixture control? These are known as Luminaire-level Lighting Control systems, or LLLC."

MPIs 5A and 5B – Designers/Specifiers were More Likely to Recommend and Include LLLC in Projects than in 2021

MPI 5A tracks the percentage of designers/specifiers who have recommended LLLC to a project decision-maker for at least one project. MPI 5B tracks the percentage of designers/specifiers who have written LLLC into project plans.

As shown in Table 12, designers/specifiers were more likely to have recommended LLLC in 2022 than in 2021, an increase of 20%.

Table 12. Designers/Specifiers Recommending LLLC

Year	n	Percentage
2021	75	44%
2022	27	63%

Source: Installer and Designer/Specifier survey, QD6: "How many times would you estimate your company has included a recommendation for LLLC in a project?"

As with MPI 5A, respondents were more likely to have written LLLC into a project plan in 2022 than 2021 (Table 13).

Table 13. Designers/Specifiers Writing LLLC into Project Plans

Year	n	Percentage
2021	78	35%
2022	27	61%

Source: Installer and Designer/Specifier survey, QD8: "Approximately how many times would you estimate your company has written LLLC into a project plan?"

MPI 6A and 6B – The Number of LLLC Products on the Market have Increased

All four of the manufacturers interviewed reported seeing an increasing number of luminaires with embedded sensors and controls, so all four have increased the number of products they manufacture with embedded sensors and controls in accordance with the trend. Offices and warehouses were cited by two respondents as places where these embedded sensors and controls are gaining in popularity. Manufacturers said that compared to the previous year they have increased the number of products available with embedded controls for essentially all product types.

All seven manufacturer's representatives corroborated what manufacturers reported – there are an increasing number of products with embedded sensors and controls on the market. Manufacturer's representatives cited 2x2s and 2x4s (3 responses), linear direct/indirect (2 responses), corridor lighting (2 responses), pole lighting for outdoor (2 responses), stairwell lighting (2 responses), and high bay lighting (1 response) as product areas with increased popularity for embedded features.

Six of the seven manufacturer's representatives interviewed felt that there are sufficient types and styles of fixtures with embedded controls to meet their customers' needs. The sole dissenting respondent said that the number of fixtures offered with embedded controls is increasing, however the number of new LLLC products that are becoming available on the market has not increased as fast as expected. They speculated that part of this lag was probably due to the chip shortage and supply chain problems. They said that they've seen some of the products that manufacturers planned to release get put on hold so that they could focus on using the parts that were available to produce as many of their existing products as possible.

MPI 7A and 7B – LLLC Continues to be an Optional Pathway in the WA Code and Referenced in 2018 IECC

As noted in MPER 1, LLLC was listed as an optional compliance pathway for the WA code and LLLC is referenced in the 2018 IECC. This continues to be the case in MPER 2, so these MPI estimates have not changed.

MPI 9A – The Number of Installation Companies with LLLC Experience Remained Steady

MPI 9A monitors the number of installation companies that have installed at least one LLLC system.

As shown in Table 14, 63% of installation companies have installed at least one LLLC system, relatively consistent with the estimate from 2021.

Table 14. Installation Companies That Have Installed at Least One System

Year	n	Percent
2021	159	61%
2022	32	63%

Source: Installer and Designer/Specifier survey, QC7: "How many LLLC systems has your company installed, not including work done by subcontractors? Your best estimate is fine."

MPI 9B – Installers were More Likely to say that LLLC was Easier to Install than Other NLC

MPI 9B monitors the percentage of experienced installation companies (those that have installed at least one LLLC and other NLC system) that say LLLC systems are easier to install than other NLC systems. Cadmus evaluated the *easiest to install* system as the one that required less time and labor to install.

In 2022, a higher percentage of respondents said LLLC requires less time and labor than other NLC, a reversal from 2021 (Table 15).

Table 15. Experienced Installers Who Say LLLC Requires Less Time and Labor to Install than Other NLC

Year	n	LLLC Less Time/Labor
2021	59	43%
2022	21	74%

Source: Installer and Designer/Specifier survey, QC12: "Based on your experience, which type of system is likely to require less time and labor to install and program – an LLLC system, or another type of networked controls system?"

MPI 11B – End-Use Customers were Generally Satisfied with their LLLC Systems

Since the installation, most respondents said the lighting control system has worked very well (six of eight respondents), noting that they have not had any issues with their system. This observation follows the trend found in MPER 1, where end-use customers were more likely to report positive than negative experiences resulting from their controls projects. The remaining two respondents explained the issues they faced:

- One respondent said they experienced issues with the installation and controlling their lights. They stated that the issue was addressed by reaching out to the manufacturer representative. this respondent noted that they typically address issues through the manufacturer's representative, although they state that the manufacturer's representatives are not always knowledgeable on how to resolve issues.
- Another respondent stated that they had issues with relays coming off the walls and the card system relay terminals creating etching problems. This issue was resolved by the manufacturer supplying heavier-duty relays. This respondent rated their overall experience with installation and system performance average.

3.3. RO #3: Lighting Controls Market Research

Beyond the MPI tracking, Cadmus used the research activities to collect information on additional lighting controls topics of interest. Specifically, this included LLLC awareness and market actor capabilities, LLLC system features and applications, the outlook of the market, as well as barriers and opportunities.

Most Respondents we Interviewed were Aware of LLLC

NEEA staff reported high awareness for LLLC among different market actors; anecdotally, staff at a recent lighting industry conference said that "every presentation had LLLC, as opposed to NLC in the prior years." NEEA staff also reported that across all market actors, interest had increased, while end-use customers remained the group that needed more attention, as also noted in the interviews during MPER 1. Overall, NEEA staff reported that market awareness of LLLC had increased to the point where NEEA has been able to shift some messaging from *what is LLLC* to *why LLLC is useful* to clients.

About three quarters of respondents felt confident about selling LLLC

The survey asked installers and designer/specifiers about their confidence in their ability to sell both LLLC and other NLC. As shown in Table 16, installers reported a slightly higher confidence in selling other NLC than LLLC. While the difference between LLLC and other NLC in *very confident* ratings is not significant (p=0.1087), the difference for the *not too confident* rating is.

Table 16. Confidence in Selling Lighting Controls

Confidence Rating	LLLC	Other NLC
Very confident	45%	66%
Somewhat confident	36%	29%
Not too confident	17%	2%[a]
Not at all confident	2%	3%

Source: Installer and Designer/Specifier surveys, QF6: "Using a scale of very confident, somewhat confident, not very confident, or not at all confident, how confident are you in your company's ability to sell LLLC to customers?" (n=29). And QF7: "Using that same scale, how confident are you in your company's ability to sell other types of networked controls systems to customers?" (n=29)

[a] This value is significantly different (p<0.10).

The Number of LLLC Trainings Increased this Year to Educate and Promote Manufacturers' Products

Trainings offered by manufacturers covered NLC products broadly and included information on LLLC, before getting more specific about the functionality of their specific systems. Respondents shared that the length of trainings that they offered ranged from 60 minutes to 16 hours, depending on the manufacturer and target audience. One respondent stated that their trainings were 16 hours over three to four days and were offered to their partner community, which included manufacturing partners who design and manufacture components, the branded partner community who takes their apps and brands and creates solutions, and the system partners who brand their apps, manufacture, or subcontract their own components and provide that as an entire system to luminaire original equipment manufacturers. Another respondent said their trainings lasted approximately 60 to 90 minutes and were targeted to contractors and wholesale distributors. Three of four manufacturers interviewed said there were no changes to the topics covered in their trainings over the past year, while one respondent said their only change was an increased focus on LLLC. All seven of the manufacturer's representatives interviewed said that the quantity of lighting systems trainings has increased in the past year. One respondent said that

the content of the trainings has changed to narrow the scope to more specific target audiences, and another respondent said the content has changed to introduce LLLC-specific trainings.

When asked why they offer trainings, manufacturers provided a variety of answers. One respondent said they began offering trainings on LLLC to help sell their products, another said their trainings began to educate people on the market technologies, and a third said they started trainings to educate customers on the prevailing direction of the lighting systems market. One respondent said, "there are different ways [they] can design projects, so [their] company offers trainings to make sure [their] customers fully understand all of the options available to them to match the right design with the right customer."

Of seven manufacturer's representative respondents, six have participated in NLC trainings, with one of these stating that their company primarily provides trainings. The trainings attended by all respondents included details about LLLC systems as a distinct type of NLC, as well as separate trainings for LLLC systems and NLC systems. The trainings were offered by manufacturers, local workshops and factories, NEEA, and utilities. Among the five utilities interviewed as part of the MPER, all reported using the NEEA-provided trainings on LLLC. One utility specifically mentioned using the LLLC toolkit and included case studies in promotional material.

When asked what additional training or resources would help the manufacturer's representatives more effectively promote LLLC, two requested more information on continual case studies measuring energy savings at a per-widget level (to help with savings estimations for their customers) and one requested assistance with C-suite level engagement. Three respondents said there was not anything additional that would be helpful due to a relative inundation with trainings and resources already within their line of the business. Utilities suggested additional topics for LLLC trainings: savings from light harvesting associated with smaller businesses; face-to-face trainings, interactions, and demonstrations; and circadian rhythm for use in hospital and recovery settings.

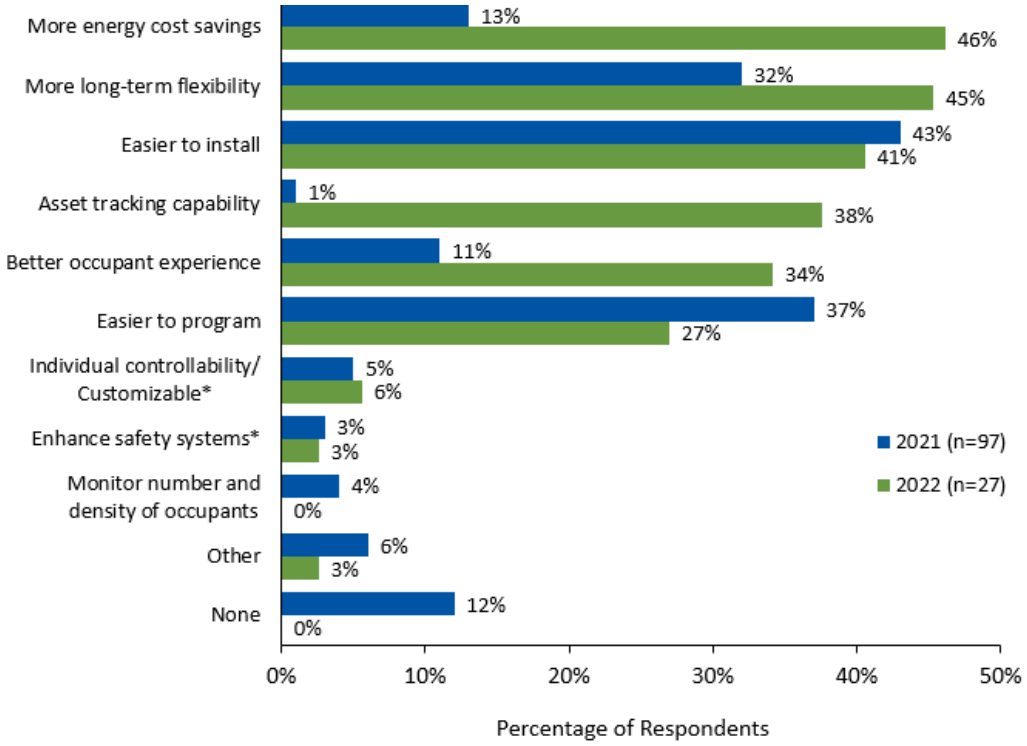
Two interviewed manufacturers who worked with NEEA both stated that they ran trainings and presentations in conjunction with NEEA. One of these respondents said that they engaged with NEEA because they "believe the cause they are pushing for [with the LLLC initiative] is the right way to move." Overall, the two reported that the collaborations were going well and they have been well supported by the implementation team, but one respondent reported that they were unsure who to contact as the program implementer when a former representative left the company.

Installers perceived that LLLC offered More Energy Cost Savings and Benefits Relative to Other NLC

The survey asked installers aware of LLLC to list what they considered the benefits of LLLC systems compared to other networked controls. As shown in Figure 1, respondents were most likely to say LLLC offered more energy cost savings (46%), offered more long-term flexibility (45%), were easier to install (41%), and provided asset tracking capabilities (38%). Compared to 2021, respondents were much more likely to mention energy cost savings (only 1 in 10 people mentioned these previously), better occupant experience, and asset tracking capabilities, but were less likely to say LLLC were easier to program.

Notably, all respondents were able to share at least one benefit of LLLC relative to other NLC in 2022, whereas in 2021, 12% were not.

Figure 1. Installer Perceptions of Benefit of LLLC Systems

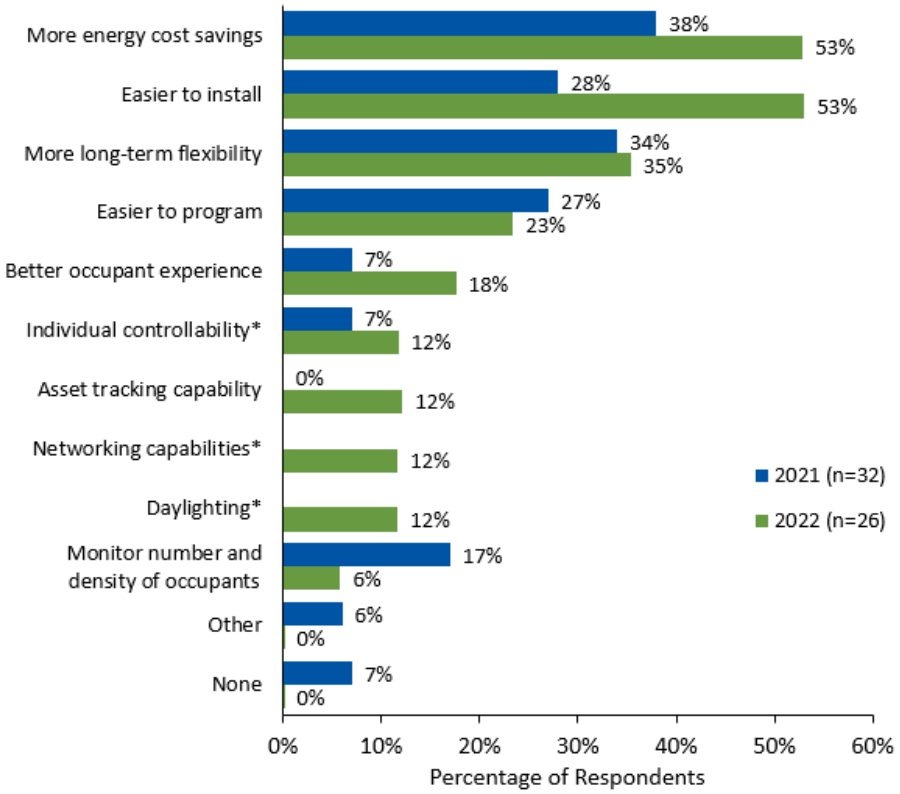


* These options were not asked directly and were coded from open-ended responses.

Source: Installer and Designer/Specifier survey, QF4: What are the benefits of LLLC over other networked controls systems, if any? Please list up to three.

Designer/specifiers were also asked to list what they considered to be the benefits of LLLC systems compared to other networked controls. Overall, they were more likely to state that LLLC were easier to install (53%), provided more energy cost savings (53%), and offered better long-term flexibility (35%) than other NLC. Compared to 2021, designer/specifiers in 2022 were much more likely to mention that LLLC were easier to install (a 25% increase) and provide better asset tracking capabilities (none mentioned this previously)

Figure 2. Designer/Specifier Perceptions of Benefit of LLLC Systems



* These options were not asked directly and were coded from open-ended responses.

Source: Installer and Designer/Specifier survey, QF4: What are the benefits of LLLC over other networked controls systems, if any? Please list up to three.

New Construction Projects were Integrating LLLC with Other Building Systems

LLLC may be increasingly integrated with other systems in new construction projects. Two manufacturer respondents had seen integration of lighting sensors with HVAC and other building systems in increasing numbers, especially with larger-scale projects in new construction. Two others did not, which may be due in part to their individual business focus (possibly in retrofit instead of new construction).

Amongst all the manufacturers and manufacturer's representatives interviewed, the most requested or desirable features or capabilities of LLLC products included daylight sensing/harvesting, occupancy sensing, and app-control. Other features mentioned included auto-dimming, high-end trim solutions, using controls with other building systems, and energy/cost savings. More broadly for all NLC products, popular features included scheduling capabilities, centralized programming and management for standardization, and the ability to control from an app.

LLLC Remains Widely Applicable Across Large Building Types, but Manufacturers and Manufacturer Representatives Believed that NLC may Meet the Needs of Some of these Spaces at a Lower Price Point

Manufacturers continued to report that office, warehouse, medical, manufacturing, and industrial building types were typical building types served by LLLC. Manufacturer representatives also mentioned

schools and “other large-scale customers” were strong building type matches for LLLC. While these spaces tended to be large in general, one respondent noted that this was not an issue, saying that his projects range from “everything from dentists’ offices to large plant facilities encompassing hundreds of thousands of square feet”.

However, manufacturers and manufacturer representatives felt that many of these spaces could also be served by other NLC that may be less expensive than LLLC. They agreed that other NLC are popular with buildings that better accommodate zone-based lighting, such as large office spaces and schools. The respondents said these spaces were not likely to change their use frequently and were less likely to need additional granularity with control of their lighting fixtures, so other NLC installations would be a lower-cost solution relative to LLLC. One respondent shared that hospitals, schools, and government facilities were common customers for other NLC, adding that, “contractors push for [other] NLC because in their mind it is simpler and cheaper [than LLLC].” The notion that NLC is less expensive than LLLC aligns with responses from MPER 1, where respondents claimed cost and return on investment (ROI) as the strongest reasons behind choosing other NLC.

Market Actors felt that NLC (including LLLC) Sales were Increasing Slowly or Remaining Flat

The survey asked installation companies that were aware of LLLC whether they thought sales of LLLC in the Northwest were increasing, staying the same, or decreasing, then asked the same question about other NLC. Overall, 52% of installation companies said LLLC sales were increasing, relatively consistent with results from 2021. Forty-two percent of respondents said sales for other NLC were also increasing. For both LLLC and other NLC, only a few installers reported that sales were decreasing (3% and 0%, respectively). Designers/specifiers generally agreed with installers: 61% said LLLC sales were increasing and 47% said other NLC sales were increasing. Very few designers/specifiers said sales of either were decreasing (0% and 6%, respectively).

Relatedly, manufacturer representatives unanimously agreed that the trend in LLLC sales and order activity was increasing slowly or remaining nearly flat. All manufacturers interviewed reported an increasing number of product types with embedded sensors and controls in the market, so all of them increased their number of product offerings with these features in accordance. One respondent said his company was “50% of the way to making all of [their] products individual sensor capable.” Similarly, the manufacturers’ representatives unanimously agreed is an increasing number of product types in the market with embedded sensors and controls.

All the manufacturers interviewed said that utility incentives have played a large role in incentivizing customers to use NLC and LLLC systems by lowering the overall costs for a project. Three of the five manufacturer’s representatives concurred, specifically related to driving the use of NLC and LLLC in retrofits. One other manufacturer’s representative said that incentives just recently became available in most of their territory, so they have not had enough time to assess the influence. Another respondent said that their local utility was not pushing NLC and LLLC enough. This respondent said that the current incentives were not large enough to move the market, and the primary mechanisms for obtaining savings from incentives were too indirect.

Overall, manufacturers said NEEA's initiatives have been effective and NEEA had done a good job at educating the market, but they have not seen the amount of LLLC adoption that they would like. One respondent reported more LLLC adoption in areas with strong rebates, because ROI plays a strong role with the contractor performing project work, and there is a perception that LLLC are unnecessary and add cost. This respondent said, "the market is still pushing NLC zone-based controls."

COVID Disruptions were Easing and were also Providing more Examples of LLLC Applications within Office Spaces

Manufacturers and manufacturer representatives had seen some form of supply-chain issues during the pandemic, but no one expects them to persist over the long term, and there was no notable difference between impacts on LLLC and on other NLC. The stakeholder interviews (with NEEA and the utility program managers) corroborated these findings. Specifically, they said that the pandemic caused significant disruption in the market, specifically with LLLC incentives, in-person trainings, and utility programs. With the return of in-person events following the ending of pandemic restrictions, the respondents reported that these disruptions have been easing.

The pandemic may have shifted how people understand the applications of LLLC, however. Two respondents reported that customers were reassessing how their spaces were used and were likely to change in the future as a result of the pandemic, and that LLLC was a tool for planning around these situations. One respondent went on to share that LLLC could provide additional savings with emptier office spaces, as a result of more work being done from home Finally, while earlier pandemic results from the MPER 1 suggested that LLLC could be used as a tool for in-office COVID safety protocols, none of the current respondents have shared an interest in this particular application with the easing of the pandemic.

Utility Program Managers were not in Agreement on how much Contribution Lighting Controls will have to Energy Savings

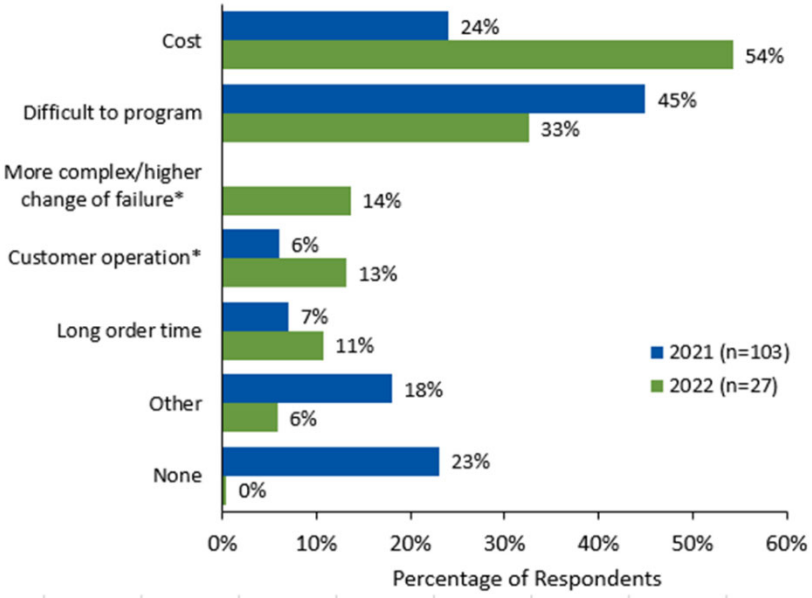
When asked if they believed NLC would be a significant driver of energy savings in the future, the utility program managers interviewed gave mixed reactions. Two respondents said that controlled lighting would generate significant energy savings, sharing that NLC systems were likely to be broadly implemented, with one comparing the uptake of NLC to LED retrofits that completely revolutionized the lighting industry. One noted that there were still a lot of savings to be had in lighting as "there is still a lot of old lighting left in our service territory." A third respondent, however, did not believe NLC would be a driver of large-scale energy savings and did not have plans to expand NLC incentives.

Market Actors were Noting Fewer Drawbacks to LLLC than in the MPER1

Cadmus assessed barriers to further LLLC adoption and remaining opportunities for product improvement. When asked about the drawbacks of LLLC compared to other NLC, installers in 2021 and 2022 mentioned cost and difficulty of programming as the top two items (Figure 3). However, installers were significantly more likely to mention cost in 2022 than 2021. While not asked in this study, the increased focus on cost may be due to economy-wide changes in cost; between the two survey periods,

the total manufacturing producer price index rose by 12%.[5] Additionally, only one installer[6] said there were no drawbacks, compared to 23% of installers from 2021.

Figure 3. Installer Perceptions of Drawbacks of LLLC Systems Relative to Other NLC



* These options were not asked directly and were coded from open-ended responses.

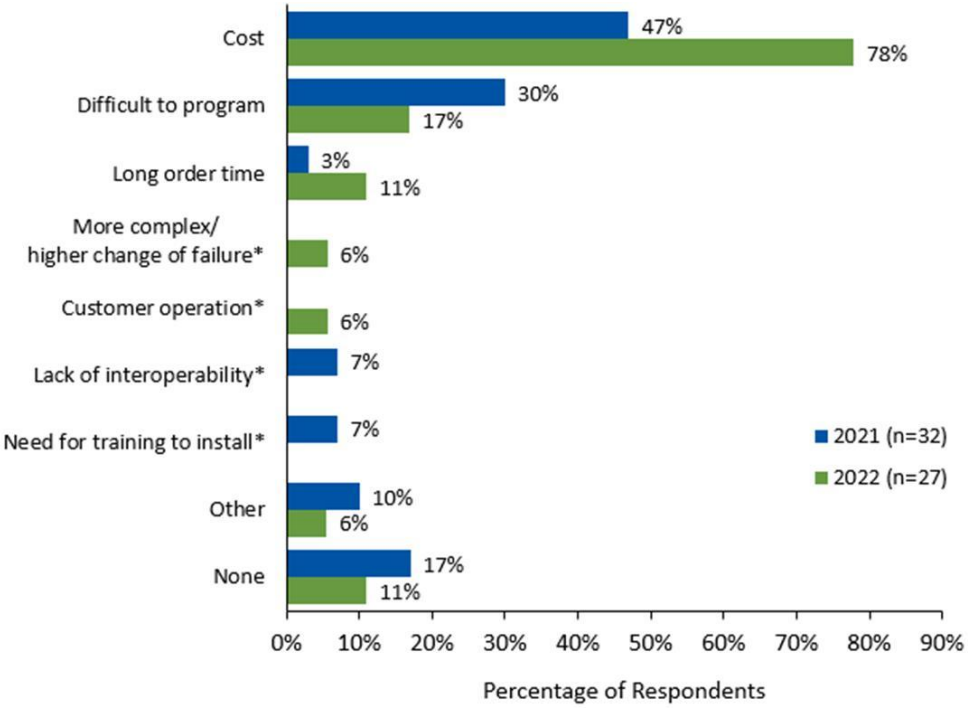
Source: Installer and Designer/Specifier survey, QF5: What are the drawbacks of LLLC over other networked controls systems, if any. Please list up to three.

The survey asked designers/specifiers the same question on drawbacks of LLLC relative to other NLC (Figure 4). Designers/specifiers were most likely to mention cost as the top drawback; 11% said there were no drawbacks relative to other NLC. Compared to MPER 1, cost and long order time were more frequently mentioned, likely due to the same factors referenced regarding installer results.

[5] U.S. Bureau of Labor Statistics. "*Producer Price Index by Commodity – Inputs to Industry.*" https://www.bls.gov/ppi/tables/. The Producer Price Index measures the average change over time in the prices domestic producers receive for their output and is considered a measure of price changes at the wholesale level. For example, the hard costs measured in this study are part of the Producer Price Index. This differs from the Consumer Price Index (CPI), which measures the changes in the price of goods and services paid by consumers.

[6] Due to the weighting methodology, this one installer represented <1% of the total weighted sample.

Figure 4. Designer/Specifier Perceptions of Drawbacks of LLLC Systems Relative to Other NLC



* These options were not asked directly and were coded from open-ended responses.

Source: Installer and Designer/Specifier survey, QF5: "What are the drawbacks of LLLC over other networked controls systems, if any. Please list up to three." (n=27).

When asked about remaining barriers to further market adoption of LLLC, most market actors and utility program managers shared that added up-front costs was were still an issue, while one respondent said that cost was not a barrier "like it was five years ago." This sentiment was supported by recent incremental cost studies, which have reported a 44% drop in prices for the most basic LLLC luminaires since 2017 (Cadmus, 2023). Market actors were also concerned about the return on investment.

Aside from these, top market actors shared that they did not believe that the average installation professional trusted wireless lighting control systems to be both safe and reliable, and this may continue to affect LLLC sales. Utility program managers also suggested that education around the value proposition may still be necessary, and one of these respondents felt that "the value proposition aligns with offices, but might not for other cases."

Utility program managers also felt that the widespread recent LED retrofit projects might be dampening the uptake of LLLC. One explained that a substantial portion of customers in their service territory had recently completed LED retrofits, making them "reluctant to do another retrofit with controls, especially if the value proposition is nebulous, as opposed to LEDs, which is clear."

Finally, one manufacturing representative pointed out that LLLC do not currently interface with emergency lighting (as most manufactures do not provide any device inside LLLC fixtures to bypass the standard controls in emergency situations.

When specifically asked about market actor engagement, utilities noted that the pandemic, available literature, and product confidence among market actors are barriers to LLLC adoption. One respondent said that the pandemic caused a great deal of disruption in the market at a time when their LLLC program was ramping up. The lack of in-person trainings and events for local contractors hurt their ability to promote LLLC. This respondent noted that in-person LLLC trainings have resumed for contractors, which will help the utility spread awareness of LLLC. Another respondent mentioned that contractors in their service territory found that NEEA literature on controls did not match their experience—they found it significantly more difficult to install and get to function properly. Another utility respondent said that the lack of confidence in the product among architects and resistance from installers made it challenging to implement LLLC installations.

Opportunities for improvement for LLLC products on the market noted by manufacturer and manufacturer's representative respondents include programming improvements to be implemented on the software side of the product (three responses), higher compatibility amongst different products (two responses), better education/training for the customer (two responses), upgradability (one response), greater simplicity of the product (one response), and remote product commissioning (one response).

3.4. RO #4: LLLC Decision-Making Factors

Cadmus completed phone surveys with eight decision-makers involved in lighting controls projects. We used these results to build on the in-depth interview insights collected in MPER 1. Table 17 illustrates several characteristics of the decision-makers who responded to this study, including their building type, installation type, and ownership structure. All eight respondents installed LLLC and said their prior system was not networked.

Table 17. LLLC Installation Decision-Maker Characteristics

Attribute	Number of Respondents
Building Type	
Education	5
Commercial office	1
Industrial	1
Retail	1
Installation Type	
Building retrofit	3
Partial retrofit (new wing/building added)	3
New construction	2
Ownership Structure	
Own building	7
Rent building	1

Decision-Makers were Influenced by Various Factors to Upgrade their Lighting and Lighting Controls

Respondents chose to upgrade their lighting for several reasons, but most mentioned improved light quality and either a reduced energy bill or increased energy savings. Table 18 lists the full set of reasons that respondents gave for upgrading their lighting.

Table 18. Reasons for Upgrading Lighting

Reasons for Upgrading Lighting	Count of Mentions
Better quality of light	4
Reduce energy bill/energy savings	4
Better ability to control lights	3
Meeting code requirements	2
Built a new wing/building	2
Part of a larger retrofit of the space	1

Source: Decision-Maker Survey, QD1: "Why did you decide to upgrade the lighting controls in your facility?" (n=8).

When deciding to upgrade their lighting system to include controls, respondents reported a variety of motivating factors (Table 19). The most common motivators included three different features: ability to interface with the building management system or with another business application system, centralized programming, and system flexibility, as well as total project cost. When asked for the top motivating factor for choosing a lighting control system, respondents similarly provided a variety of responses, with only two respondents picking the same item. This trend is the same as in MPER 1, when end-use customers were motivated to install lighting controls for numerous reasons.

Table 19. Lighting Controls Motivations

Motivations/Considerations	All Considered Factors	Most Important Factor
Centralized programming	3	1
Total project cost	3	1
System flexibility	3	1
Ability to interface with the building management system/ another business application (i.e., asset tracking, conference room])	3	-
Easy to maintain	2	2
Ability to have multiple zones	2	1
Best lighting experience for occupants	2	1
Maximize energy savings/ ROI	2	1
Product availability/project speed	1	-
Recommended by a trusted vendor	1	-
Product brand	1	-

Source: Decision-Maker Survey, QD2: "What factor(s) did you consider when choosing a lighting control system? What features were most important to you?" (n=8). And QD3: "What was the most important factor when choosing a lighting control system?" (n=8).

Respondents consulted with a variety of sources to understand and select the appropriate lighting controls, including manufacturer's representatives, lighting designers, lighting engineers/specifiers, distributors, the Washington State Department of Commerce, and an in-house electrician. These sources provided the following types of information:

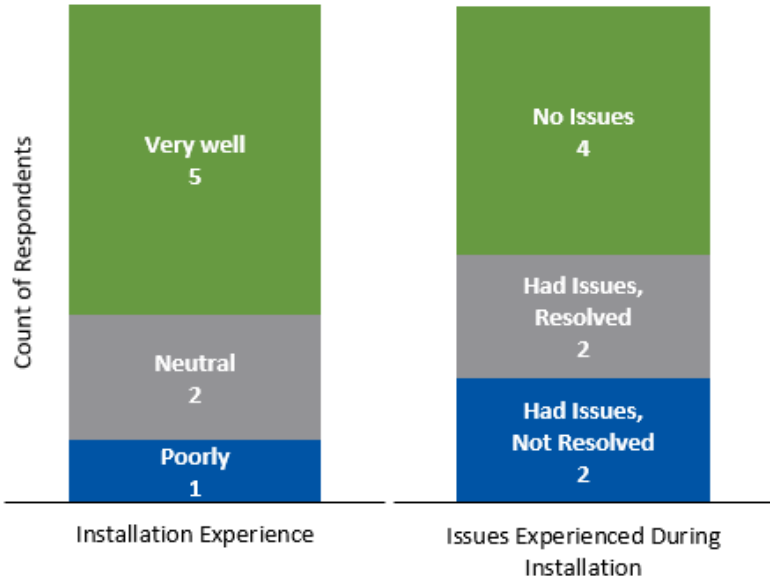
- Product specification/information and required building standards, including lighting intensity levels
- Quality of light information and how to maintain and control the lights after install
- Cut sheets, layout diagrams, and building flow to the current building architect

Additionally, two respondents said they were knowledgeable about lighting controls already and applied their own knowledge.

Decision-Makers generally had Positive Experiences with their Lighting Controls Installations

Most respondents (five out of eight) said the installation went *very well*, as shown in Figure 5. However, four respondents said they encountered issues during the installation process: issues with city permitting, light fixtures not working, long waits to replace broken light fixtures, and technical issues setting up the programming. Two respondents said that their issues were resolved (by the vendor or being grandfathered into the program), whereas the other two were still working through these issues.

Figure 5. Installation Experience and Issue Resolution



Source: Decision-Maker survey, QE1. "Overall, how did the installation go on a scale from 1 to 5, where 1 means very poorly and 5 means very well?" (n=8). QE2. "During the installation, did you encounter any issues? (n=8). QE3. "How, if at all, did you address these issues?" (n=4)

When asked about installation challenges or issues identified in MPER 1, respondents most frequently mentioned coordination with IT systems. Respondents emphasized the need to engage IT staff at the outset of the project to ensure a successful installation, though another respondent avoided concerns about IT coordination by giving the facilities department sole responsibility for the lighting controls system.

The survey asked how likely they would be to install the same type of system again on a scale from 0 to 10, where 0 means *not at all likely* and 10 means *extremely likely*. Six of eight respondents gave a ranking of 8 or higher and said that they would not do anything differently. Remaining respondents reported a lower likelihood of installing the same controls again, mainly related to issues controlling the system. One respondent said, if given the chance, they would not have installed an NLC system for their lighting.

Decision-Makers Found Value from the LLLC Systems they Installed

Respondents discussed which features of their lighting control system they did and did not find valuable (Table 20). The most commonly valued features were networking devices and zoning. The majority of respondents said there were no unvaluable features, with remaining respondents stating individual addressability, cybersecurity features, high-end trim, and occupancy sensing features.

The decision-makers discussed any feedback they have received from others regarding the new lighting control system. Four respondents said they have received feedback, specifically from occupants, IT personnel, and facilities managers. Among occupants, decision-makers said that they have heard that the lighting intensity has improved and that teachers like the dimming feature but do not like the

occupancy sensors. IT personnel who provided feedback to decision-makers reported controllability issues and the need for general system troubleshooting.

Table 20. Value of Lighting Control System Features

Valuable Features of the Lighting Control System	Valuable	Not Valuable
Networking of devices	4	-
Zoning	3	-
Occupancy sensing	2	1
Individual addressability	2	1
Daylight harvesting/ photocall control	1	-
High-end trim	1	1
Continuous dimming	1	-
Timing/programming	1	-
Cybersecurity	-	1
None of these (single select)	1	5

Source: Decision-Maker Survey, QE7: "Which features of your lighting control system, if any, have you found to be valuable?" (n=8; multiple responses allowed) And QE9: "Which features of your lighting control system, if any, have you found to not be of value/use?" (n=8; multiple responses allowed).

4. Conclusions and Recommendations

Based on the research conducted for this MPER, Cadmus offers the following conclusions about the market for LLLC and recommendations to improve the LLLC Initiative.

4.1. Assess Program Foundation

Conclusion 1: NEEA's program modifications have kept pace with LLLC market changes and continue to advance LLLC market share.

Following the results from MPER 1, the NEEA team modified existing program documentation, specifically the Logic Model and LLLC Program Plan. These documents received several updates to ensure they accurately reflected the LLLC market and the required market interventions. NEEA staff also reported that sales data collection efforts have been successful at improving data quality and quantity over time and estimated that NEEA's data now covers 40% to 50% of the LLLC market.

Interviews with NEEA staff and utility program managers supported the idea that NEEA has been responsive to the market. NEEA staff reported strong support from utilities around NLC and LLLC programs, with NEEA focused on deepening the message and improving communication about the value proposition for LLLC to utilities. Utility respondents corroborated these statements regarding their experiences in their own jurisdictions. Among manufacturers, the two who were interviewed and work with NEEA both said that they run trainings and presentations in conjunction with NEEA.

Recommendation 1: Continue to have close coordination with upstream market actors so that market-facing materials, trainings, and other related documentation are updated when market changes occur.

4.2. Track Market Progress

Conclusion 2: NEEA's efforts to advance LLLC have resulted in progress in several aspects of the LLLC market.

NEEA's efforts have resulted in progress on several MPIs related to training (3B), the inclusion of LLLC into project plans (5A and 5B), and installer perceptions of LLLC (9B). Additionally, Cadmus was able to set initial measurements several MPIs, including the distribution of trained installers (3E) and the availability of products (6A and 6B). All other MPIs had the same status from MPER 1—either achieved or not different. These changes show the effects of NEEA's market interventions, specifically related to their engagement with market actors, including manufacturers, manufacturer's representatives, installers and designers/specifiers.

Conclusion 3: Ability to install LLLC among market actors remained strong.

As found in MPER 1, the majority of installation companies are aware of and able to install LLLC (MPIs 4A and 3D). The share of market actors who have received training on installing LLLC has grown from 2021 by over one-third (MPI 3B), showing the continued training efforts of manufacturers and other market actors. Additionally, trained lighting installers are distributed across the Northwest region, with

the highest share in Oregon and Washington (MPI 3E). This resulted in over six in 10 installation companies reporting they have experience installing LLLC (MPI 9A).

Recommendation 2: Continue existing program activities until the NEEA's specified criteria for market transformation (i.e., achievement of MPIs) are met.

4.3. Lighting Controls Market Research

Conclusion 4: While awareness and perceptions of LLLC products have improved, market actor confidence and current market conditions still impede market uptake.

NEEA staff reported high levels of awareness for LLLC, a statement that was corroborated by MPI 4A (installers 78% aware; designers/specifiers 82% aware). Additionally, the majority of installers with experience installing LLLC (74%) said LLLC requires less time and labor than other NLC, an increase from 43% who said the same in 2021. However, installer confidence in their ability to sell LLLC compared to other NLC differs slightly—on a 4-point scale, installers were more likely to say that they are *not too confident* in their ability to sell LLLC, whereas only 2% said the same for other NLC.[7]

When asked about barriers to LLLC compared to other NLC, installers and designers/specifiers were more likely to say that cost was the top barrier in 2022 compared to 2021 (54% for installers and 78% for designers/specifiers in 2022), even though the incremental cost of LLLC luminaires has decreased 44% since the first incremental cost study in 2017). However, between MPER 1 and MPER 2, economy-wide impacts resulted in a 12% increase in the total manufacturing producer price index.

Conclusion 5: Continue to focus on benefits beyond energy/cost savings will be important to grow LLLC market share.

LLLC sales have made steady progress recently, with 52% and 61% of installers and designers/specifiers, respectively, saying that LLLC sales have increased. All manufacturers interviewed are seeing an increasing number of product types with embedded sensors and controls in the market, so all of them have increased their number of product offerings with these features in accordance.

When asked about the benefits of LLLC systems, installers and designers/specifiers noted many different benefits, including energy savings, ease of installation, long-term flexibility, occupant experience, and asset tracking. There was not one singular benefit that installers and designers/specifiers could point to, showing the versatility of LLLC and varying applicability based on a specific project or customer.

However, while manufacturers said NEEA's initiatives have been effective and NEEA had done a good job at educating the market, they have not seen the amount of LLLC adoption that they would like.

When asked what additional training or resources would help the manufacturer's representatives more effectively promote LLLC, two requested more information on continual case studies measuring energy

[7] Direct sales of LLLC are completed by various market actors, including sales representatives and installers, among others.

savings at a per-widget level (to help with savings estimations for their customers) and one requested assistance with C-suite level engagement.

When asked for specific feedback, one respondent mentioned that contractors in their service territory found that NEEA literature on controls did not match their experience—they found it significantly more difficult to install and get to function properly. Another utility respondent said that the lack of confidence in the product among architects and resistance from installers made it challenging to implement LLLC installations.

Recommendation 3: Ensure that market actors have easy access to resources helping them understand the value proposition of LLLC and how it differs for different types of customers. In these resources, ensure that both detailed energy savings and benefits beyond energy/cost savings are clearly articulated. Continue to regularly publish updates to these resources and encourage upstream market actors to distribute materials to downstream market actors.

4.4. LLLC Decision-Making Factors

Conclusion 6: Motivators for choosing a specific lighting technology reflect the varied and specialized use cases that can be applicable for LLLC.

Customers who installed LLLC reported a wide set of motivators that led to their lighting system choice. The most common motivators included three different features (ability to interface with the building management system or with another business application system, centralized programming, and system flexibility) as well as total project cost. The eight respondents listed another seven items beyond these such as ease of maintenance, zonal capabilities, and lighting experience (among others). When asked about the top motivating factor, responses were similarly varied, with only one item (easy to maintain) receiving two mentions.

Conclusion 7: A varied set of LLLC system features likely led to positive installation and usage experiences.

When asked about what features they found valuable, respondents most often cited networking capabilities and zoning followed by occupancy sensors and individual addressability. Respondents only noted three items as features they did not value, with each only mentioned once, showing that customers generally placed a high value on the features of LLLC systems.

Respondents had positive experience with the installation and usage of their LLLC systems, with over half providing positive ratings.

Recommendation 4: Work with upstream market actors to ensure that installers and designers/specifiers have the appropriate understanding of the LLLC value proposition for different customer segments and are prepared to tailor their sales pitch to a customer's unique needs.

Appendix A. Detailed Methodology

The MPER 2 has four core research objectives:

- Review updates to the LLLC market transformation theory, program logic model, and MPIs since MPER 1 to assess their clarity and alignment in conveying the program's strategy and planned activities to overcome market barriers and drive market changes that will increase LLLC adoption and NEEA's proposed approach for evaluating LLLC market progress.
- Track the LLLC Initiative MPIs to assess progress over time on several short- and near-term outcomes.
- Conduct limited additional research on market changes related to the lighting controls market more broadly.
- Identify what leads end-use customer decision-makers to purchase LLLC (versus other NLC), as well as what features they value after the product is installed to gain a better understanding of barriers and opportunities for LLLC in the market.

To inform MPER 2, the Cadmus team conducted several primary and secondary research tasks and designed each to address a specific subset of research questions related to the core research objectives. This section provides additional detail on the methods and purpose for each task listed in Table A-1.

Table A-1. Research Activities for NEEA LLLC Initiative MPER 2

Task	Research Objectives Addressed	Target Group	Completes
Document review	1	N/A	N/A
Stakeholder interviews	1, 2, 3	Interviews with 3 NEEA program staff (conducted as a single interview), 1 NEEA implementation contractor staff person, and 5 staff from NEEA's funding utilities	7
Supply-chain market actor Interviews	2, 3, 4	Interviews with 4 controls manufacturers, 7 manufacturer representatives, and 1 distributor	12
Installer survey	2, 3	Surveys of Northwest commercial lighting and controls installers	30
Designer/specifier survey	2, 3	Surveys of Northwest commercial lighting and controls designer/specifiers	27
Decision-maker survey	2, 4	Decision-makers at customers that installed lighting controls	8

Document Review and Stakeholder In-Depth Interviews

Cadmus reviewed NEEA's program documents to ensure that its strategy for overcoming market barriers was clear and reflected market research and that the identified program MPIs corresponded to the market transformation narrative, addressed all identified outcomes, and were measurable. In parallel with this effort, Cadmus interviewed NEEA program staff, implementation contractor staff, and utility program staff (collectively, stakeholders).

Objectives

Through the documentation review and stakeholder interviews, Cadmus addressed several objectives:

- Evaluated the alignment of the LLLC Logic Model and MT Program Theory with key market barriers identified in market research and other resources.
- Reviewed the appropriateness of the program MPIs.
- Documented program accomplishments, challenges, and improvement opportunities as described by the stakeholders.
- Documented LLLC and other NLC incentives offered by Northwest utilities.

Approach

Cadmus conducted a review of all program documentation, including the LLLC Logic Model, MT Program Theory, MPIs, description of LLLC features and capabilities, description of the target market, and other program documents. *Appendix A* lists all of the documents reviewed. Given that we completed a detailed review of program documentation in MPER 1, the review for the MPER 2 focused on changes from MPER 1. To inform the review of program documents, we consulted recent NEEA market research, utility websites, and NEEA and utility program staff interview responses.

Cadmus conducted the stakeholder interviews with NEEA program staff and utility representatives in parallel with the documentation review to assess the alignment of program documentation and actual implementation. This provided insight on the status of the market, including any evidence of expected outcomes or NEEA influence. Cadmus completed four interviews with program staff—three with NEEA program staff (conducted in a single session) and one with Cadeo Group, the program implementer. We conducted five interviews with utility program staff in NEEA's territory.

Supply-Chain Market Actor In-Depth Interviews

Cadmus interviewed representatives from lighting and controls manufacturers, manufacturer representatives, and a distributor.

Research Topics

During the market actor interviews, we addressed several topics about key supply-chain functions and market demand:

- Whether manufacturers were offering training, the contents of those trainings, and how the trainings were received by participants
- Comparison of the market presence of LLLC and other NLC products
- Characteristics of LLLC and other NLC buildings and project characteristics and differences between the two
- What LLLC or other NLC product features were most interesting to prospective buyers and whether buyers valued integration with other building systems
- Perception of NEEA influence on the lighting controls market (manufacturers only)

- Whether product changes introduced or accelerated for the COVID-19 pandemic were likely to endure

Sample

Cadmus recruited respondents from a contact list that NEEA developed. Two of the manufacturer respondents had direct engagement with NEEA's LLLC program. Table A-2 shows the target and number of completed interviews with each market actor group.

Table A-2. Supply-Chain Market Actor Interview Sample

Respondent Type	Target	Completed
Manufacturers	4	4
Manufacturer Representatives	4	7
Distributors	2	1

The line of products that the manufacturers made ranged from one NLC product to dozens, and even up to hundreds. For the manufacturer's representatives interviewed, their representation of NLC and LLLC product manufacturers ranged from two to about fifteen. All seven represented NLC products, with about half of their products lines being LLLC.

Installer and Designer/Specifier Survey

Cadmus conducted a survey of installers, as well as designers and specifiers (grouped together as the designer/specifier population for this report). We used this survey to assess several LLLC MPIs and address research questions about these market actors and the companies they represented. Cadmus worked with a phone survey vendor to field the surveys from February to April 2023, offering respondents a $50 gift card and chance to win a $500 gift card as an incentive to participate in the survey.

Research Topics and Survey Design

The primary objective of the survey was to assess the MPIs related to these market actors and their companies, in particular their knowledge, experience, and preferences related to LLLC.[8]

Through the survey, Cadmus also addressed several topics related to market status:

- Types of training installers and designers/specifiers have received and training providers
- Supplier perceptions of trends in LLLC and other NLC market share
- Types of organizations that have installed LLLC
- Awareness of and engagement with utility programs incenting LLLC and other NLC
- Supplier perceptions of LLLC benefits and drawbacks

[8] The MPIs covered in the survey were 3B, 3D, 3E, 4A, 5A, 5B, 9A, and 9B. ***Error! Reference source not found.*** contains full descriptions of these MPIs.

We used the survey fielded in MPER 1 as a base for the survey design, ensuring that questions used for MPI measurement were kept consistent in MPER 2.

Sample Design

Cadmus defined the population of installers and designers/specifiers as belonging to all commercial lighting installation and/or design/specification firms that worked with lighting controls, served the Northwest (Idaho, Montana, Oregon or Washington), and had at least one office or base of operations in the Northwest. We stratified this population as follows:

- **Installers – Trade Allies:** Northwest commercial lighting and controls installers from lists of affiliated trade allies provided by NEEA alliance member utilities. Trade allies were likely to have attended trainings on controlled lighting installations provided through either the Lighting Design Lab (LDL) or NXT Level[9].
- **Installers – Non-Trade Allies:** All other Northwest commercial lighting and controls installers without a known affiliation with a NEEA partner.
- **Designers/Specifiers**: Professionals providing lighting design or specification services, specifically around commercial lighting and controls, to clients in the Northwest, including architecture firms, mechanical and engineering firms, independent designers, energy service companies, and others.

To determine the size of the populations and sample sizes wanted for each market actor, we purchased installer and designer/specifier contact information from Data Axle and Exact Data, third-party vendors. These contacts were supplemented with the trade ally contact lists provided by NEEA.

Cadmus developed a detailed set of rigorous data-cleaning protocols to merge these sample sets and account for duplicate contacts in an organized, replicable manner. The protocols accomplished several objectives:

- Removed firms known to be outside the target populations of installers and designers/specifiers
- Identified the unique firms by state present in the data based on company names, addresses, and phone numbers
- Selected a single point of contact for each unique firm[10]
- Assigned individuals to sampling strata using North American Industry Classification Systems (NAICS) code to determine best fit
- Created sample frames for each stratum

When fielding the survey, the screening included several questions intended to determine the respondent's knowledge level and if the respondent's company fit best with the installer or

[9] NXT Level is a commercial lighting controls training program designed to enhance the capabilities of commercial lighting design and installation companies in the Northwest.

[10] Should the single point of contact not respond to the survey request, we used secondary and tertiary points of contact.

designer/specifier population. Because designers/specifiers are less common than installers (see population estimates in Table A-3), a respondent that qualified as both was classified as a designer/specifier and shown that set of questions. Thus, the respondent's initial stratum classification based on NAICS code was not necessarily the stratum they ended up in for the survey.

Based on the adjusted population calculated in MPER 1 (the "Population" column)[11] and final sample sizes in MPER 2, Cadmus applied strata weights to estimate results at the population level. Table A-3 shows the population and number of completed surveys in the final sample by stratum.

Cadmus did not reach the target sample sizes for all strata during fielding. Across the sample frame we had a high degree of non-responders, resulting in a 1% response rate across the sample. Cadmus has experienced a drop-off in response rate among its other projects targeting contractors in the past two years.

Table A-3. Installer and Designer/Specifier Populations and Survey Samples

Stratum	Population	Target Completions	Achieved Completions	Expected Precision at 90% Confidence [a]
Installers [b]	**2,136**	**40**	**30**	**≤ ±24.8%**
Trade allies	496	13	10	≤ ±25.6%
Non-Trade Allies	1,640	27	20	≤ ±28.6%
Designer/Specifier [b]	**1,353**	**40**	**27**	**≤ ±24.2%**

[a] Confidence and precision are calculated at the question level. Therefore, in this table, Cadmus has reported the highest precision for each stratum. Due to the low sample size, precision at 90% confidence is very variable for some questions where respondents answered drastically differently. When respondents aligned well on their responses, precision was within ±2.6%.

[b] The *Sample Design* section above includes definitions of the strata for market actors at installation and designer/specifier companies. Each respondent (and company) would count as either an installer or designer/specifier based on the respondent's answers to the survey question. If a respondent had experience in both design/specification and installation, they were asked the designer/specifier set of questions.

Across the survey, most questions asked the respondent about perceptions on behalf of their company (i.e., question C4. "For each of the following, please indicate if any staff at your company, including yourself, have been trained on this subject."). We crafted the survey questions in this manner due to the structure of the MPIs, with most referring to installation or design/specification "companies." Some metrics that were difficult to assess at a company level, such as awareness of LLLC or perceptions of LLLC product suitability, were asked about the individual's own experience. In these instances, we assumed that an individual's own experience was representative of the company for the purpose of MPI tracking. This assumption required the sample frame to contain a primary contact listed for each firm-state combination, which was built into the data cleaning procedures.

[11] Cadmus calculated the adjusted population values shown in **Error! Reference source not found.** during the work for MPER 1. This involved a comprehensive assessment of the population of installers and designers/specifiers in the Northwest, estimating the total number of market actors in each stratum.

Decision-Maker Surveys

Cadmus conducted a survey of representatives from decision-maker organizations that had completed a lighting project within the past three years, focusing on organizations that completed LLLC projects. We used this survey to collect data to assess several LLLC MPIs and to conduct corresponding research on other areas of interest to NEEA. Cadmus worked with a phone survey vendor to field the surveys in February-April 2023, offering respondents a $50 gift card and chance to win a $500 gift card as an incentive to participate in the survey.

Research Topics

Cadmus used the survey to explore topics related to customer decision-making with regard to lighting controls purchase and installation:

- Respondent awareness of and past experience with lighting controls generally, and with LLLC and other NLC specifically, including perceptions of attributes and features
- How the decision-making process was structured, including how customers became aware of the controls they selected, influential actors, and details of specific equipment proposals (at what point they were made and how they were vetted)
- Relative importance of decision-making factors for installing LLLC and other NLC (such as cost, maintenance, futureproofing, flexibility, aesthetics, or others), even if respondent ultimately did not install
- Real and perceived barriers or challenges related to LLLC or other NLC along with possible solutions
- Decision-maker customer experience and satisfaction with LLLC and other NLC
- Where benefits are intangible or difficult to measure (such as aesthetics or flexibility), how respondents became convinced of these benefits, and how strongly these benefits influenced their decisions
- For those who *did not* purchase LLLC or other NLC, what equipment was installed and why that specific equipment was chosen
- Space and building characteristics, such as industry segment, space uses, vintage, own versus lease, single versus multiple building ownership, and retrofit versus new construction

Sample Design

Cadmus primarily used CoStar data to develop the sample frame. CoStar is a private data vendor that maintains a database of all commercial properties in the United States, organized by building type and including owner/property manager contact information. Cadmus worked with NEEA to refine the dataset using fields such as NAICS code/industry, owner information, and property manager information to identify the set of relevant contacts for the sample frame. We supplemented this information with lists of program participants from NEEA's partners' NLC programs obtained by NEEA.

Cadmus intended to recruit respondents across five strata: commercial office, retail, education, industrial, and hospital, targeting 17 completed surveys in each stratum. However, several factors led to a low response rate:

- First, the data from CoStar typically provided corporate-level owner or property manager contacts rather than site-level. Second, the phone numbers available were primarily main office numbers, leading to most calls routing through administrative staff. Finally, CoStar did not provide any email addresses.
- The survey required decision-makers to have completed a lighting retrofit including NLC in the past three years. The primary source for the sample frame (CoStar) did not provide any information on the completion of lighting retrofits, leading to the need for cold calling possible respondents.

After several attempts for each record, Cadmus completed eight surveys with decision-makers. We will work with NEEA to fully debrief on the sample frame development and research design to better target this group in the future.

Appendix B. Program Documents Included in Document Review

To address the research objectives, the Cadmus team reviewed the documents listed in Table B-1. Cadmus focused the review during MPER 2 on documents that received updates since MPER 1. Links are provided to online resources.

Table B-1. Documents Reviewed

Document Title	Last Updated
LLLC Logic Model Documentation Packet	October 30, 2018
LLLC Logic Model	May 10, 2022
LLLC Market Transformation Story	May 2022
LLLC – Theory of Market Transformation	No Date
LLLC Work Plan	2022
LLLC Market Progress Indicator Table	January 2021
LLLC Product Assessment Plan	2018
LLLC Product Definition	August 2018
Initiative Lifecycle Milestone Documentation	February 25, 2019
LLLC Marketing Strategic Plan	No Date
LLLC Marketing Plan (2022)	January 25, 2022
LLLC Program Implementation Plan	2022
LLLC Product Plan	May 10, 2022
LLLC Implementation Activity Tracker	No Date
BetterBricks – NXT Level Lighting Training	Accessed October 2022
BetterBricks – Luminaire Level Lighting Controls Toolkit	Accessed October 2022

Appendix C. NEEA LLLC MPER 2 – Market Actor Survey

This survey is the second iteration of a market actor survey for NEEA's Luminaire Level Lighting Controls Market Progress Evaluation Report. The goal of this survey is to understand the state of LLLC in the Northwest by addressing the below Market Progress Indicators.

MPI	Question Number
3B. YOY increase in the percentage of lighting installation companies with at least one installer trained in LLLC	C1,C4
3D. YOY increase in the percentage of lighting installation companies with the capability to bid on a project that involves LLLC installation	C5
3E. YOY, companies with at least one LLLC-trained installer become more evenly distributed across the region	G1
4A. YOY increase in (1) the percentage of lighting installation companies and (2) the percentage of companies with lighting designers/specifiers who are aware of LLLC	B6
5A. YOY increase in the percentage of companies with lighting designers/specifiers who have recommended LLLC to a project decision maker for at least one project	D6
5B. YOY increase in the percentage of companies with designers/specifiers who say they have written LLLC into at least one project plan	D8
9A. YOY increase in the percentage of installation companies that report having installed at least one LLLC system ("experienced installation firms")	C6
9B. YOY increase in the percentage of these experienced installation companies that say LLLC systems are easier to install than non-LLLC systems	C8
9C. YOY increase in the average number of LLLC projects that companies have completed in the past 12 months	C7

A. Introduction

A1. Hello! May I please speak with [CONTACT NAME]?

A2. My name is [NAME] from Leede Research, calling on behalf of the Northwest Energy Efficiency Alliance (or NEEA). We are conducting research on commercial lighting systems being installed in the Northwest. Are you the best person to speak to regarding commercial lighting installation or design/specification services?

1. IF YES, CORRECT PERSON – MOVE INTO SURVEY
2. IF NOT THE RIGHT PERSON, ASK FOR INDIVIDUAL MOST KNOWLEDGABLE ABOUT COMPANY'S COMMERCIAL LIGHTING SERVICES.
3. IF COMPANY DOES NOT OFFER LIGHTING-RELATED SERVICES USE DISPOSITION CODE 08 TO TERMINATE

[IF CONTACT IS HESITANT TO PASS ON TO APPROPRIATE PERSON, STATE "WE ARE OFFERING A $25 INCENTIVE FOR REFERRING US TO THE APPROPRIATE PERSON WITHIN YOUR ORGANIZATION WHO WOULD BE ABLE TO COMPLETE THE SURVEY. IF THEY END UP COOMPLETING THE SURVEY, WE WILL SEND YOU A $25 GIFT CARD. IF YOU'RE INTERESTED IN THIS, PLEASE PROVIDE YOUR NAME AND EMAIL ADDRESS] [RECORD NAME AND EMAIL ADDRESS IF INTERESTED]

A3. Do you have approximately 10-15 minutes to speak with me today? Because we value your time, we will provide you with a $50 gift card and enter you in a sweepstakes for a $500 VISA gift card if you are eligible and complete this survey.

1. [IF NOT A GOOD TIME – SCHEDULE A CALL-BACK FOR A MORE CONVENIENT TIME FOR RESPONDENT]

[IF NEEDED, STATE "THIS SURVEY IS FOR RESEARCH PURPOSES ONLY. THIS IS NOT A MARKETING CALL AND WE ARE NOT TRYING TO SELL YOU ANYTHING. THIS IS ONE OF THE PRIMARY METHODS NEEA USES TO UNDERSTAND THE STATE OF THE MARKET. YOUR PERSPECTIVE HELPS NEEA TRACK ENERGY USE, TRENDS, AND TECHNOLOGY IN THE NORTHWEST."]

[ONLY IF ASKED FOR A NEEA CONTACT TO VERIFY THE SURVEY AUTHENTICITY, OFFER ZDANNA KING AT ZKING@NEEA.ORG**]**

B. Screeners

B1. Thank you. First, can you confirm that [COMPANY NAME], meaning the direct employees of [COMPANY NAME], does commercial interior lighting installation?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

B2. **[IF B1 = 1]** Does your company also install lighting control systems?

1. (Yes) [ASSIGN INSTALLER = TRUE] [SKIP TO B6]
2. (No)
98. (Don't know)
99. (Refused)

B3. Does your company offer lighting design services, meaning you design the lighting layout, appearance, and function of a space for major renovations or new construction projects?

1. (Yes) [ASSIGN D/S = TRUE]
2. (No)

98. (Don't know)
99. (Refused)

B4. **[IF B3=1]** Does your company provide commercial lighting specification, meaning you select and document the performance requirements and costs of system components, including controls for major renovations or new construction projects?
1. (Yes) [ASSIGN D/S = TRUE]
2. (No)
98. (Don't know)
99. (Refused)

B5. **[IF INSTALLER ≠ TRUE AND D/S ≠ TRUE]** What business is your current company in?
1. [ALLOW TEXT ENTRY] **[SET AS NOT QUALIFIED AND** SKIP TO I1**]**
98. (Don't know) **[SET AS NOT QUALIFIED AND SKIP TO I1]**
99. (Refused) **[SET AS NOT QUALIFIED AND SKIP TO I1]**

B6. Are you aware of a type of networked lighting control system in which each fixture is programmable and has its own built-in sensor, allowing flexible grouping and granular fixture control? These are known as Luminaire-level Lighting Control systems, or LLLC.
1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

B7. Are you aware of another type of networked lighting control system, in which one sensor– typically mounted in the ceiling – controls a group of programmable fixtures, usually wirelessly?
1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[IF B6 ≠1, SET AS NOT QUALIFIED AND **SKIP TO** I1**]**

B8. **[IF INSTALLER = TRUE]** Is your company a franchise?
1. Yes
2. No
98. (Don't know)
99. (Refused)

B9. Does your company have multiple office locations?
1. Yes
2. No [SKIP TO B12]
98. (Don't know) **[SKIP TO B12]**
99. (Refused) **[SKIP TO B12]**

B10. **[IF B9=1]** Are you more knowledgeable about the company's capabilities just at your specific location, or generally across all locations?

1. (specific location)
2. (all locations)
3. (Other [SPECIFY: _____])
4. (Don't know) [SKIP TO B12]
5. (Refused) [SKIP TO B12]

B11. **[IF B9=1]** Ok. For the rest of these questions, please answer from

1. [IF B10=1] the perspective of your specific location
2. **[IF B10=2]** the perspective of your company as a whole across all locations
3. [IF B10=3] that perspective

B12. [IF D/S=TRUE, SKIP TO SECTION D]

B13. [IF INSTALLER = TRUE AND D/S≠TRUE, CONTINUE TO SECTION C]

C. Installer Only Questions

C1. Have you or other staff at your company received training on LLLC or other network lighting controls?

1. (Yes)
2. (No) [SKIP TO C5]

98. (Don't know) **[SKIP TO C5]**
99. (Refused) **[SKIP TO C5]**

C2. What organization offered the training? **[MULTIPLE RESPONSE ALLOWED].**

1. (Lighting Design Lab [LDL])
2. (Utility sponsored)
3. (BetterBricks)
4. (Professional or industry association)
5. Which association? [ALLOW TEXT RESPONSE]
6. (Manufacturer)
7. (Manufacturer representative)
8. Distributor
9. (Other) [ALLOW TEXT RESPONSE]

98. (Don't know)
99. (Refused)

C3. Are you familiar with the contents of this training?

1. (Yes)
2. (No) [SKIP TO C5]

98. (Don't know) **[SKIP TO C5]**
99. (Refused) **[SKIP TO C5]**

C4. For each of the following, please indicate if any staff at your company, including yourself, have been trained on this subject.

1. **[IF B6=1]** First, have any staff been trained on the best types of buildings and spaces for LLLC?
2. (Yes)
3. (No)
4. (Don't know)
5. **[IF B6=1]** Have any staff been trained on the benefits and capabilities of LLLC relative to other types of control systems?
6. (Yes)
7. (No)
8. (Don't know)
9. [IF B6=1] Have any staff been trained on how to install LLLC?
10. (Yes)
11. (No)
12. (Don't know)
13. [IF B6=1] Have any staff been trained on how to program LLLC?
14. (Yes)
15. (No)
16. (Don't know)

C5. **[IF B6=1]** Without hiring subcontractors, would you say that your company is currently capable of installing an LLLC system, installing and programming an LLLC system, or neither?

1. (Installing)
2. (Installing and programming)
3. (Neither)
4. (Don't know)
5. (Refused)

C6. **[IF B6=1]** How many LLLC systems has your company installed, not including work done by subcontractors? Your best estimate is fine.

1. [ENTER NUMERIC VALUE]
98. (Don't know)
99. (Refused)

C7. **[IF C6>0]** And about how many of these LLLC systems has your company installed in the last 12 months?

1. [ENTER NUMERIC VALUE]
98. (Don't know)
99. (Refused)

C8. **[IF C6>0]** Based on your experience with lighting controls, do you think customers are more likely to be satisfied with LLLC or with another type of networked lighting control?

1. (LLLC system)
2. (Another type of networked controls system)
98. (Don't know)
99. (Refused)

C9. **[IF C6>0]** Based on your experience, which type of system is likely to require less time and labor to install and program – an LLLC system, or another type of networked controls system?
1. (LLLC system)
2. (Another type of networked controls system)
98. (Don't know)
99. (Refused)

D. Designers and Specifiers Only Questions

[ASK IF D/S=TRUE, ELSE SKIP TO SECTION E]

D1. Have you or other lighting professionals at your company received training on LLLC or other networked lighting controls?
1. (Yes)
2. (No) [SKIP TO D4]
98. (Don't know) **[SKIP TO D4]**
99. (Refused) **[SKIP TO D4]**

D2. **[IF D1=1]** What organization or organizations offered the training? **[MULTIPLE RESPONSE ALLOWED]**.
1. (Lighting Design Lab [LDL])
2. (Utility sponsored)
3. (BetterBricks)
4. (Professional or industry association)
5. Which association? [ALLOW TEXT RESPONSE]
6. (Manufacturer)
7. Manufacturer representative
8. Distributor
9. (Other) [ALLOW TEXT RESPONSE]
98. (Don't know)
99. (Refused)

D3. **[IF B6=1]** Please indicate if you or other lighting professionals at your company have been trained on the following subjects.
1. First, have you or other staff been trained on the best types of buildings and spaces for LLLC?
2. (Yes)
3. (No)
4. (Don't know)

5. Have you or other staff been trained on the benefits and capabilities of LLLC relative to other types of controls systems?
6. (Yes)
7. (No)
8. (Don't know)
9. Have you or other staff been trained on the requirements for connecting through wireless protocols such as WiFi or Dali
10. (Yes)
11. (No)
12. (Don't know)

D4. **[IF B4=1 AND B6=1]** Would you say your company is capable of specifying an LLLC system?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

D5. **[IF B4=1 AND B6=1]** Would you say that your company is capable of diagnosing and troubleshooting post-installation issues with an LLLC system?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

D6. **[IF B6=1]** How many times would you estimate your company has included a recommendation for LLLC in a project?

1. [NUMERIC ENTRY FOR VALUE]
2. (Not applicable)
98. (Don't know)
99. (Refused)

D7. How many times would you estimate your company has recommended networked control systems other than LLLC in a project? Again, your best estimate is fine.

1. [NUMERIC ENTRY FOR VALUE]
2. (Not applicable)
98. (Don't know)
99. (Refused)

D8. **[IF B6=1]** Approximately how many times would you estimate your company has written LLLC into a project plan?

1. [NUMERIC ENTRY FOR VALUE]
2. (Not applicable)

98. (Don't know)
99. (Refused)

D9. Approximately how many times would you estimate your company has written networked control systems other than LLLC into a project plan?
1. [NUMERIC ENTRY FOR VALUE]
2. (Not applicable)
98. (Don't know)
99. (Refused)

E. Utility Program Awareness and Influence

E1. Are you aware of any utility programs in your service territory that provide incentives for installing LLLC or other networked lighting control systems?
1. (Yes)
2. Please list which utilities: **[OPEN RESPONSE]**
3. (No) [SKIP TO F1]
98. (Don't know) **[SKIP TO F1]**
99. (Refused) **[SKIP TO F1]**

E2. **[ASK IF E1=1]** What level of influence, if any, do you think this/these utility program(s) have on the sales of LLLC or other networked lighting control systems? Would you say it/they have a:
1. High level of influence
2. Moderate level of influence
3. Low level of influence
4. No influence
98. (Don't know)
99. (Refused)

F. Market Insights

F1. **[IF B6=1]** Would you say sales of LLLC in the Northwest are increasing, staying about the same, or decreasing?
1. (Increasing)
2. (Staying about the same)
3. (Decreasing)
4. Don't know)
5. (Refused)

F2. Would you say sales of networked control systems other than LLLC in the Northwest are increasing, staying about the same, or decreasing?
1. (Increasing)
2. (Staying about the same)
3. (Decreasing)

4. Don't know)
5. (Refused)

F3. **[IF C6>0 OR D6>0 OR D8>0]** Thinking about your customers, what types of businesses or industries have you worked with that have installed LLLC? Please list as many as you know of. **[MULTIPLE RESPONSES ALLOWED]**

1. (Commercial office)
2. (School)
3. (Local Government)
4. (Industrial)
5. (Military base)
6. (Warehouses)
7. (Retail)
8. (Hospitals)
9. (Other) [ALLOW TEXT ENTRY]

98. (Don't know)
99. (Refused)

F4. **[IF B6=1]** What are the benefits of LLLC over other networked controls systems, if any. Please list up to three. **[MULTIPLE RESPONSES ALLOWED]**

1. (Easier to install)
2. (Easier to program)
3. (More long-term flexibility)
4. (More energy cost savings)
5. (Better occupant experience)
6. (Asset tracking capability)
7. (Monitor number and density of occupants)
8. (Enhance safety systems)
9. (Integrate with HVAC)
10. (Other) [ALLOW TEXT ENTRY]
11. (None)

98. (Don't know)
99. (Refused)

F5. **[IF B6=1]** What are the drawbacks of LLLC over other networked controls systems, if any. Please list up to three. **[MULTIPLE RESPONSES ALLOWED]**

1. (Cost)
2. (Difficult to program)
3. (Long order time)
4. (Other) [ALLOW TEXT ENTRY]
5. (None)

98. (Don't know)
99. (Refused)

F6. **[IF INSTALLER=TRUE AND B6=1]** Using a scale of *very confident*, *somewhat confident*, *not very confident*, or *not at all confident*, how confident are you in your company's ability to sell LLLC to customers?

1. (Not at all confident)
2. (Not very confident)
3. (Somewhat confident)
4. (Very confident)
98. (Don't know)
99. (Refused)

F7. **[IF INSTALLER =TRUE AND B6=1]** Using that same scale, how confident are you in your company's ability to sell other types of networked controls systems to customers? **[REPEAT SCALE IF NEEDED]**

1. (Not at all confident)
2. (Not very confident)
3. (Somewhat confident)
4. (Very confident)
98. (Don't know)
99. (Refused)

F8. What impact, if any, do you think the Covid-19 pandemic has had on the sales and installation of LLLC and other networked lighting control systems?

1. [OPEN RESPONSE]

G. Firmographics

Just a few more questions.

G1. In which of the following Northwest states does your company operate? **[ALLOW MULTIPLE RESPONSE]**

1. Idaho
2. Montana
3. Oregon
4. Washington
99. (Refused)

G2. Does your company partner with utilities in the Pacific Northwest? This could be through a rebate program, or any other way.

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

H. Incentive & Closing

H1. Those are all my questions today! Would you like to receive the $50 gift card and be entered into the drawing to win a $500 VISA gift card?

1. (Yes)
2. (No)

99. (Refused)

H2. **[IF H1=1]** Great! Can I get the name and email address I should send the $50 gift card to and the $500 gift card if you are selected? [IF NEEDED: We will not use your information for any other purpose.] **[FILL OUT EACH FIELD]**

1. Name: [ALLOW TEXT ENTRY]
2. Address Line 1/Street: **[ALLOW TEXT ENTRY]**
3. Address Line 2/Suite Number/etc: **[ALLOW TEXT ENTRY]**
4. City: [ALLOW TEXT ENTRY]
5. State: [ALLOW TEXT ENTRY]
6. Zip: [ALLOW TEXT ENTRY]

99. (Refused)

H3. We would also like to email you with a link to the terms and conditions of the gift card drawing. May I have the best email to send the link to? We will not use your email for any other purpose.

1. [ALLOW TEXT ENTRY FOR EMAIL]

99. Refused

[IF H1=1 and H2=/=99] Thank you so much for your time today, we really appreciate it. If you win, you should receive the gift card within 6 to 8 weeks. I hope you have a wonderful rest of your day!

[IF H1=/=1] Thank you so much for your time today, we really appreciate it. I hope you have a wonderful rest of your day!

I. Non-Qualified Incentive & Closing

I1. Unfortunately, you do not qualify for the survey, but we'd still like to offer you a chance to win the $500 VISA gift card. Would you like to be entered into that drawing?

1. (Yes)
2. (No)

99. (Refused)

I2. **[IF I1=1]** Great! Can I get the name and email address I should send the $500 gift card if you are selected? [IF NEEDED: We will not use your information for any other purpose.] **[FILL OUT EACH FIELD]**

1. Name: [ALLOW TEXT ENTRY]

2. Address Line 1/Street: **[ALLOW TEXT ENTRY]**
3. Address Line 2/Suite Number/etc: **[ALLOW TEXT ENTRY]**
4. City: [ALLOW TEXT ENTRY]
5. State: [ALLOW TEXT ENTRY]
6. Zip: [ALLOW TEXT ENTRY]

99. (Refused)

I3. We would also like to email you with a link to the terms and conditions of the gift card drawing. May I have the best email to send the link to? We will not use your email for any other purpose.

1. [ALLOW TEXT ENTRY FOR EMAIL]

99. Refused

Thank you so much for your time today, we really appreciate it. If you win, you should receive the gift card within 6 to 8 weeks. I hope you have a wonderful rest of your day!

Appendix D. NEEA LLLC MPER 2 – Decision-Maker Survey

This survey is the first iteration of a survey with LLLC decision-makers for NEEA's Luminaire Level Lighting Controls Market Progress Evaluation Report. The goal of this survey is to help NEEA gain a more thorough understanding of the NLC market and will support the development of tailored messaging that resonates with various market actors, customer types, and end users.

Topic Area	Question Number
Awareness and perception of LLLC/ other NLC products and features	B4-B10, C1-B7, , E7
Factors that influenced decision to install LLLC/ other NLC	D1-D3, D6-D10
Experience and challenges during LLLC/ other NLC installation	E1-E3, F1-F2
Experienced and challenges with LLLC/ other NLC operation	E4-E10
Understand space and building characteristics	B1-B2, B13-B14, F3-F4

Quotas

Stratum	Target Completions
Commercial Office	17
Retail	17
Education	17
Industrial	17
Hospitals	17
Total	**85**

Survey Variables

- CONTACT_NAME: Contact name from sample
- COMPANY_NAME: Company name from sample
- PHONE_NUMBER: Phone number from sample
- UNIQUE_ID: Unique identifier from sample
- INDUSTRY: See Quota list above for possible values
- SYSTEM_TYPE: LLLC or OTHER_NLC
- CITY_STATE: City and State where project completed

Introduction

Hello! May I please speak with **[CONTACT_NAME]** at **[COMPANY_NAME]**?

[IF CONTACT NAME IS NOT AVAILABLE, STILL CONTINUE TO A1]

[IF NOT COMPANY NAME, THANK AND TERMINATE]

A1. My name is [NAME] from Leede Research, calling on behalf of the Northwest Energy Efficiency Alliance (or NEEA). We are conducting research on commercial lighting systems being installed in the Northwest – we are not trying to sell you anything. Are you the best person to speak to regarding lighting upgrade decisions at your facility?

1. IF YES, CORRECT PERSON – MOVE INTO SURVEY
2. IF NOT THE RIGHT PERSON, ASK FOR INDIVIDUAL MOST KNOWLEDGABLE ABOUT COMPANY'S LIGHTING UPGRADES.

A2. Do you have approximately 15 minutes or so to speak with me today? Because we value your time, we will provide you with a $50 gift card and enter you in a sweepstakes for a $500 VISA gift card if you are eligible and complete this survey.

1. [IF NOT A GOOD TIME – SCHEDULE A CALL-BACK FOR A MORE CONVENIENT TIME FOR RESPONDENT]

[IF NEEDED, STATE "THIS SURVEY IS FOR RESEARCH PURPOSES ONLY. THIS IS NOT A MARKETING CALL AND WE ARE NOT TRYING TO SELL YOU ANYTHING. THIS IS ONE OF THE PRIMARY METHODS NEEA USES TO UNDERSTAND THE STATE OF THE MARKET. YOUR PERSPECTIVE HELPS NEEA TRACK ENERGY USE, TRENDS, AND TECHNOLOGY IN THE NORTHWEST."]

[ONLY IF ASKED FOR A NEEA CONTACT TO VERIFY THE SURVEY AUTHENTICITY, OFFER ZDANNA KING AT ZKING@NEEA.ORG**]**

B. Screeners

B1. Thank you. First, can you confirm that [COMPANY_NAME] is in the [INDUSTRY] industry?

1. (Yes)
2. (No)

98. (Don't know) **[TERMINATE]**
99. (Refused) **[TERMINATE]**

B2. **[IF B1 = 2]** What industry is [COMPANY_NAME] in? **[SINGLE SELECT]**

1. (Commercial office)
2. (Education- Primary/Secondary School)
3. (Education – College/University)

4. (Local Government)
5. (Industrial)
6. (Warehouses)
7. (Retail)
8. (Hospitals)
9. (None of the above) **[TERMINATE]**

98. (Don't know) **[TERMINATE]**
99. (Refused) **[TERMINATE]**

[RECODE RESPONSE TO B2 AS 'INDUSTRY']

B3. Thank you. First, has your company built a new building/wing or upgraded and/or replaced any of its lighting in the past 5 years? This could include replacing some or all of the lights in your building(s) or installing new controls for the existing lights.

1. (Yes)
2. (No) [TERMINATE]

98. (Don't know) **[ASK TO SPEAK TO SOMEONE WHO WOULD KNOW AND START AGAIN]**
99. (Refused) **[TERMINATE]**

B4. Were you involved in any way with the purchase of these lights?

1. (Yes)
2. (No) [ASK TO SPEAK TO SOMEONE WHO WAS INVOLVED AND START AGAIN]

B5. Are you involved in the day-to-day operations of these lights?

1. (Yes)
2. (No)

B6. Are the lights you purchased able to be controlled by a system? **[IF NEEDED:** This means that a computer system can change light levels in response to occupancy or the amount of daylight, among others.**]**

1. Yes
2. No [SKIP TO B8]

B7. Is the system controlling your lights networked? **[IF NEEDED:** This means that the system can interface with other lighting control or building management systems in other rooms/wings of the building.**]**

1. Yes [SKIP TO B10]
2. No [SKIP TO B8]

B8. When you installed the new lights, did the contractor offer to install any controls?

1. (Yes) [ASK B9]
2. (No) [SKIP TO G4]

B9. Why did you decide to install the new lighting without any controls? **[MULTI SELECT; DO NOT READ LIST]**

1. (Too expensive)
2. (Didn't think we needed it)
3. (Too complicated to program)
4. (Too complicated to operate)
5. (Didn't understand the technology)
6. (Other) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

[AFTER B9, SKIP TO G4]

B10. Do you know if each individual light fixture has its **own built-in sensor and controller** or if the sensors/controllers are separate (i.e., one sensor or controller controls a group of lights)? [IF NEEDED: If you're not sure, please give your best guess.]

1. (Each light fixture has its own built-in sensor and controller) **[CODE SYSTEM_TYPE AS LLLC]**
2. (The sensors/controllers are separate equipment) **[CODE SYSTEM_TYPE AS OTHER_NLC]**

98. (Don't know)
99. (Refused)

B11. What manufacturer and brand are the new lights/control systems?

1. [OPEN ENDED]

B12. What is the address of the building where your company had lights installed with the features you just mentioned? Just the city and state are fine. If you did this work in multiple locations, please select the most recent.

1. [RECORD CITY]
2. [RECORD STATE]

98. (Don't know)
99. (Refused)

[RECODE ANSWER TO B5 AS "CITY_STATE"]

B13. Please describe the use of the space where the new lights were installed.

1. [OPEN ENDED]

98. (Don't know)
99. (Refused)

B14. Was the space where the new lights were installed newly constructed or a retrofit of an existing space?

1. (New construction)
2. (Retrofit)
3. (Retrofitted some space but also built a new wing/building)

98. (Don't know)
99. (Refused)

Thank you. For the remainder of the survey, we'd like you to think only about the lighting control system installed at the [COMPANY_NAME] location in [CITY_STATE]. Please only think about the **control elements of the lighting system** for the remainder of the survey.

C. LLLC Awareness

First, I have a few questions regarding your awareness of lighting control system types and why you opted to upgrade your lighting.

C1. Are you aware of a type of networked lighting control system in which each fixture is programmable and has its own built-in sensor, allowing flexible grouping and granular fixture control? These are known as Luminaire-level Lighting Control systems.
1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

C2. Are you aware of another type of networked lighting control system, in which one sensor– typically mounted in the ceiling – controls a group of programmable fixtures, usually wirelessly?
1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

D. Decision Influencers

D1. Why did you decide to upgrade the lighting controls in your facility? **[MULTI SELECT; DO NOT READ LIST]**
1. (Reduce energy bill/energy savings)
2. (Better quality of light)
3. (Better ability to control lights)
4. (Part of a larger retrofit of the space)
5. (Built a new wing/building)
6. (Ability to interface with the building management system)
7. (Ability to interface with another business application [i.e., asset tracking, conference room])
8. (To meet the required building code)
9. (Other) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

D2. What factor(s) did you consider when choosing a lighting control system? **[MULTI SELECT; DO NOT READ LIST]**

1. (Total cost)
2. (Cost effectiveness/ return on investment (ROI))
3. (Maximize energy savings)
4. (Ability to have multiple zones)
5. (Centralized programming)
6. (Easy to maintain)
7. (System flexibility)
8. (Product availability)
9. (Project speed/ lead times)
10. (Best lighting experience for occupants)
11. (Ability to interface with the building management system)
12. (Ability to interface with another business application [i.e., asset tracking, conference room])
13. (Other) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

D3. **[IF SELECTED MORE THAN 1 OPTION IN D1.9]** What was the most important factor when choosing a lighting control system? **[SINGLE SELECT]**

1. [INSERT OPTIONS FROM D2]

D4. Was your old lighting control system networked? That is, were groups of different light fixtures and sensors linked together and controllable as a unit?

1. (Yes)
2. (No)

D5. Did your old lighting control system have any features that your new system does not? If so, please describe.

1. [OPEN END]

D6. When you were completing this project, who or what did you consult to help you understand and select lighting controls? **[MULTI SELECT]**

1. (Manufacturer's representative)
2. (Distributor)
3. (Lighting designer)
4. (Lighting engineer/specifier)
5. (Professional and industry organizations [i.e., BOMA, IFMA, Seattle 2030])
6. (Lighting installer)
7. (Internet research)
8. (Asking a peer or coworker)

9. (Conference or association)
10. (Training course)
11. (Own knowledge)
12. (Other) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

D7. **[IF ANY OPTION 1-8 SELECTED IN D6]** What types of information did these sources provide?
1. [RECORD RESPONSE]

D8. You mentioned you consulted with the following when deciding on which lighting controls to install: [INSERT OPTIONS SELECTED IN D6]. Which of these sources was most influential?
1. [INSERT OPTIONS SELECTED IN D6]

D9. **[ONLY ASK IF SYSTEM_TYPE=OTHER_NLC]** Earlier, you mentioned that you installed lighting with a separate sensor/controller at your facility. Did the designer or installer give you the option to install light fixtures with an integrated sensor/controller?
1. (Yes) [ASK D10]
2. (No)
98. (Don't know)
99. (Refused)

D10. Why did you decide not to install light fixtures with an integrated sensor/controller? **[MULTI SELECT]**
1. (Too expensive)
2. (Didn't think we needed it)
3. (Too complicated to program)
4. (Too complicated to operate)
5. (Didn't understand the technology)
6. (Necessity to consult with IT staff on the system)
7. (Other) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

E. Installation and Operation Experience

Now, I have a few questions about the experience installing and using your new lighting control system.

E1. Overall, how did the installation go on a scale from 1 to 5, where 1 means *very poorly* and 5 means *very well*?
1. (1 – very poorly)
2. (2)
3. (3)

4. (4)
5. (5 – very well)
98. (Don't know)
99. (Refused)

E2. During the installation, did you encounter any issues?
1. Yes
2. What specific issue(s) occurred? [RECORD RESPONSE]
3. No

E3. **[IF E2=1]** How, if at all, did you address these issues?
1. [OPEN END]

E4. Overall, how has the system been operating on a scale from 1 to 5, where 1 means *very poorly* and 5 means *very well*?
1. (1 – very poorly)
2. (2)
3. (3)
4. (4)
5. (5 – very well)
98. (Don't know)
99. (Refused)

E5. Have you faced any issues with your new lighting control system?
1. Yes
2. What specific issue(s) have you faced? [RECORD RESPONSE]
3. No

E6. **[IF E5=1]** How, if at all, did you address these issues?
1. [OPEN END]

E7. Which features of your lighting control system, if any, have you found to be **valuable**? [DO NOT READ LIST; MULTI-SELECT]
1. (Networking of devices)
2. (Occupancy sensing)
3. (Daylight harvesting/photocell control)
4. (High-end trim)
5. (Zoning)
6. (Individual addressability)
7. (Continuous dimming)
8. (Cybersecurity)
9. (Other) [RECORD RESPONSE]

E8. **[IF ANY OPTION SELECTED IN E7]** What about these features made them valuable?

1. [OPEN ENDED]

E9. Which features of your lighting control system, if any, have you found to **not be of value/use**? [DO NOT READ LIST; MULTI-SELECT]
1. (Networking of devices)
2. (Occupancy sensing)
3. (Daylight harvesting/photocell control)
4. (High-end trim)
5. (Zoning)
6. (Individual addressability)
7. (Continuous dimming)
8. (Cybersecurity)
9. (Other) [RECORD RESPONSE]

E10. Have you received any feedback from occupants or others interacting with the system regarding the performance of the new lighting control system? [MULTI SELECT]
1. Yes, from occupants
2. What have you heard from these people? [RECORD RESPONSE]
3. Yes, from facilities manager(s)
4. What have you heard from these people? [RECORD RESPONSE]
5. Yes, from IT personnel
6. What have you heard from these people? [RECORD RESPONSE]
7. (No)

F. Wrap-up and Firmographics

I have a few final questions regarding the facility and the lighting upgrade you completed.

F1. After going through the process of installing the new lighting control system, is there anything you would have done differently?
1. [RECORD RESPONSE]

F2. How likely would you be to install the same type of system again? Please use a scale from 0 to 10, where 0 means not at all likely and 10 means extremely likely.
1. [RECORD 0-10 RESPONSE]

F3. Approximately when was the building where you completed the lighting upgrade built?
1. (New construction)
2. (2011 or newer)
3. (2001-2010)
4. (1991-2000)
5. (1971-1990)
6. (1951-1970)

7. (1931-1950)
8. (1930 or older)
98. (Don't know)
99. (Refused)

F4. What is the approximate square footage of the area in your building where the lighting upgrade took place?
1. [OPEN ENDED]

F5. Do you own or lease this facility?
1. (Own)
2. (Lease)
98. (Don't know)
99. (Refused)

G. *Incentive & Closing*

[IF FULL COMPLETE; ASK G1-G3]

G1. Those are all my questions today! Would you like to receive the $50 gift card and be entered into the drawing to win a $500 VISA gift card?
1. (Yes)
2. (No)
99. (Refused)

G2. **[IF G1=1]** Great! Can I get the name and address WHERE I should send the $50 gift card to and the $500 gift card if you are selected? [IF NEEDED: We will not use your information for any other purpose.] **[FILL OUT EACH FIELD]**
1. Name: [ALLOW TEXT ENTRY]
2. Address Line 1/Street: **[ALLOW TEXT ENTRY]**
3. Address Line 2/Suite Number/etc: **[ALLOW TEXT ENTRY]**
4. City: [ALLOW TEXT ENTRY]
5. State: [ALLOW TEXT ENTRY]
6. Zip: [ALLOW TEXT ENTRY]
99. (Refused)

G3. **[IF G1=1]** We would also like to email you with a link to the terms and conditions of the gift card drawing. May I have the best email to send the link to? We will not use your email for any other purpose.
1. [ALLOW TEXT ENTRY FOR EMAIL]
99. (Refused)

[IF TERMINATED AFTER B9; ASK G4-G5]

G4. Those are all my questions today! Unfortunately, you aren't eligible for the full survey, but as a thank you for your time we'd like to offer you an entry into the $500 VISA gift card drawing. Would you like to be entered into the drawing?

1. (Yes)
2. (No)

99. (Refused)

G5. **[IF G4=1]** Great! Can I get the name and email address to contact you if you are selected? We will also use this to email you the gift card drawing terms and conditions. [IF NEEDED: We will not use your information for any other purpose.] **[FILL OUT EACH FIELD]**

1. Name: [ALLOW TEXT ENTRY]
2. Email Address: [ALLOW TEXT ENTRY]

99. (Refused)

[IF G1 OR G4=1 and H2 OR G5=/=99] Thank you so much for your time today, we really appreciate it. If you win, you should receive the gift card within 6 to 8 weeks. If you are interested in seeing the results of this study, you can check the NEEA website later this year, where responses are shared in anonymously and in aggregate. I hope you have a wonderful rest of your day!

[IF G1 OR G4=/=1] Thank you so much for your time today, we really appreciate it. I hope you have a wonderful rest of your day!

Appendix E. NEEA LLLC MPER 2 – Guide for Manufacturers, Manufacturers' Representatives, and Distributors Interviews

Interviewee:

Company:

Date:

This document includes draft interview guides for manufacturers, manufacturer representatives, and distributors. It is meant for review and comment to support the NEEA LLLC market progress evaluation.

The purpose of the LLLC market supply chain market actor interviews is to develop an understanding of the key market progress indicators (MPIs) identified for this evaluation and other topics identified in the workplan. These interviews will also establish starting values for the MPIs to build upon in future evaluation years. Cadmus plan to conduct 10 interviews following the targets outlines in Table E-1.

Table E-1. Market Actor Interview Approach

Market Actor	Target Completes	Sample Description	Notes
LLLC Manufacturers	4	To be determined based on suitability among interviewees from MPER 1	If the contractor exhausts the list of interviewees, they will work with NEEA to review additional options.
LLLC Manufacturer Representatives	4	To be determined based on suitability among interviewees from MPER 1	If the contractor exhausts the list of interviewees, they will work with NEEA to review additional options. Some secondary research and/or referrals may be fruitful, but contacts need to be cleared with NEEA program staff.
LLLC Distributors	2	To be determined based on suitability among interviewees from MPER 1	If the contractor exhausts the list of interviewees, they will work with NEEA to review additional options.
Total	**10**		

This interview guide is broken into different sections to cover various topics:

- The **preamble**, which is common to all three types of interviewees, provides context for the interviewee and establishes rapport with the interviewer.
- The **background**, which is common to all three types of interviewees, collects basic information from the interviewee and confirms their level of experience and knowledge related to LLLC.
- Several topics are covered separately for each key market actor type:
  - The **market actor engagement** section collects information on the interviewee's awareness and engagement with the LLLC market. This includes products/services offered, offering (manufacturers) and/or awareness of trainings on LLLC, and overall knowledge of the LLLC market.

- The **market landscape** section collects information on the types of projects the interviewee is installing for LLLC and other types of NLC systems, as well as additional information on the breakdown of LLLC compared to NLC and more broadly with all luminaires.
- The **LLLC and NLC capabilities** section asks about features that are desirable for the market.
- The **COVID impacts** section asks if COVID-19 has changed the level of interest in LLLC due to changes in feature preferences or supply chain issues.
- The **closing** section ends the interview and gives the interviewee an opportunity to ask questions.

Table E-2 maps the collection of MPIs and other information stated in the work plan to the interview questions. **Due to the limited time available for interviews of this nature (which are typically a maximum of 30 minutes to ensure that the interviewee does not experience fatigue), we prioritized the information that we are able to gather.** We prefer to have about 15 to 20 open-ended questions for an interview of this length.

Table E-2. MPI or Research Topics Addressed by Interviews

MPI or Research Topic	Information Captured	Question # [a]
-	General candidate information	Background section
Market Actor Engagement	LLLC and NLC market participation (products manufactured, represented, or distributed)	Mfgs: 1 Reps: 1-2 Dists: 1-4
MPI 3	LLLC and other NLC training through manufacturers offered to market actors	Mfgs: 2-7
Market Actor Engagement	Engagement and satisfaction with NEEA initiatives: collaboration, action plan development, and being positioned as LLLC "champions" to provide training	Mfgs: 8-11
Market Actor Engagement	Engagement and satisfaction with LLLC training received, where applicable	Reps: 3-7 Dists: 5-9
Market Landscape	Characteristics of typical buyers/target audiences and industries for LLLC and other NLC	Mfgs: 12, 13 Reps: 8, 9, 10, 11 Dists: 10, 11
Market Landscape	Commercial and industrial building types and circumstances best suited for LLLC and/or other NLC systems, and why	Mfgs: 13 Reps: 8, 9, 10 Dists: 10, 11
Market Landscape	Trends in total sales and in market mix between LLLC and NLC	Mfgs: 16 Reps: 13, 14 Dists: 12
Market Landscape	Trends arising in distributors' direct person-to-person sales to end-use consumers, stocking of LLLC and other NLC	Dists: 13, 14
MPI 6	Trends in product types with embedded controls	Mfgs: 17 Reps: 15
Market Landscape	Customer motivations and barriers in choosing control systems (LLLC vs. NLC vs. basic)	Mfgs: 18, 19, 20 Reps: 16, 17, 18 Dists: 15
LLLC Integration	Trends in integration with other buildings systems	Mfgs: 21 Reps: 19 Dists: 16

MPI or Research Topic	Information Captured	Question # [a]
COVID Impacts	COVID-19 impacts on product features and whether features such as occupant density sensors and individual temperature monitoring are expected to persist in products over the long term. Insights into any continuing supply chain issues.	Mfgs: 22, 23 Reps: 20 Dists: 17, 18

[a] Mfgs = Manufacturers, Reps = Manufacturer representatives, Dists = Distributors

Cadmus will initially ask the interviewees what area of the market supply chain they participate in (if it is not known) and then select that question path. The questions below may be slightly modified, re-ordered, or skipped depending on the interviewee's experience and the time available.

Topics for All Interviewee Types

Preparation

Interviewer will review company website prior to interview to familiarize themselves with the general scope of products/services offered by the company.

Company website link: _____

If interviewing a manufacturer, manufacturer representative, or distributor who was interviewed in MPER 1, the interviewer will pull in their training-related responses from the previous year to confirm accuracy rather than re-asking same questions. Prior to the interview, the interviewer will confirm with the project team whether the respondent is a repeat interview from MPER 1.

DLC QPL Presence (Manufacturers Only)

Number and types of LLLC products listed on the DLC QPL	
Number and types of other NLC products listed on the DLC QPL	

Preamble

1. Thank you for taking the time to speak with us today. As a reminder, we are conducting this interview on behalf of the Northwest Energy Efficiency Alliance (NEEA) to help them better understand the market for commercial lighting controls. NEEA is a non-profit organization in the Northwest that works to accelerate the market adoption of energy-saving technologies, such as networked lighting controls. NEEA is funded by many of the largest utilities in Idaho, Montana, Oregon, and Washington, as well as by the Bonneville Power Administration.
2. The information you provide will be used to develop strategies and recommendations related to lighting controls program offerings. Your participation in this interview will remain anonymous and any answers you provide will be pooled with responses from the other participants.

We will provide you with a $50 gift card for participating in this interview, which should take approximately 30 minutes. Do you have any questions before we get started?

Background

1. What is your title or role?
2. How long have you been in this role?

Before we start the questions, let me provide some background definitions.

- Luminaire level lighting controls, or LLLC, are a type of networked lighting control system. In an LLLC system, each individual light fixture has its own built-in sensor and controller, and those sensors can communicate wirelessly and transmit data. The sensors can be programmed in any grouping needed, all the way down to the individual fixture level.
- By comparison, in non-LLLC networked lighting control systems, the sensor and controller are external to the fixtures. One sensor and one controller—typically mounted in the ceiling—will control a group of fixtures, usually wirelessly. We'll call these "other NLC" during today's interview.

Manufacturers

Market Actor Engagement in LLLC Market

1. How many distinct products do you currently sell/manufacture/distribute that might be used in networked lighting control systems? Of these, how many are useable in LLLC systems? How, if at all, has this changed over the last two years? *(Probe: increased, decreased, stayed the same? More LLLC or more NLC? Proportion of LLLC to other NLC?)*

IF INTERVIEWED IN A PREVIOUS YEAR, PULL IN PREVIOUS RESPONSES AND CONFIRM THAT RESPONSES ARE STILL ACCURATE RATHER THAN ASKING SAME TRAINING-RELATED QUESTIONS.

2. Does your company offer training(s) on lighting controls?
   a. *(If no)* Do you have any plans to offer controls trainings in the future?
   b. *(If no)* Why don't you offer trainings? *(Skip to Q8)*

IF OFFER/PLAN TO OFFER CONTROLS TRAINING

3. What types of lighting controls [do][will] your trainings cover? *(Probe: LLLC, other types of NLC, non-networked controls).*
   a. *If they currently offer training on LLLC:* In the past year, have there been any **changes to the lighting controls** covered by your trainings? If so, what were these changes and why were they made? *(Probe for any changes in balance of LLLC vs. other NLC material)*
4. Who [will][does] the training target? *(Probe: manufacturer reps, distributors, designers/specifiers, other). If they currently offer training on LLLC:* In the past year, has the target audience for the trainings shifted at all? If so, what group(s) did these trainings target and why did the target audience change?
5. What topics [are][will be] covered and how long [is the training][will the training be]? *(For topics, probe on product benefits, product challenges for end-users and installers, system design,*

installation, communications, wiring and wireless systems, etc.). If they currently offer training on LLLC: In the past year, have there been any changes to the topics covered in your trainings? If so, what were these changes and why were they made?

6. *If they currently offer/plan to offer training on LLLC:* When [did][will] you start offering the LLLC training(s) and how many sessions [have you held][do you plan to hold]?
    a. *If they currently offer training on LLLC:* In the past year, have there been any **changes to the number of lighting control trainings offered** (i.e., increasing or decreasing frequency)? If so, what were these changes and why were they made?
7. Why did your company decide to offer trainings on LLLC?

ASK Q8 THROUGH Q11 IF MANUFACTURER IS ENGAGED WITH NEEA (FOR ALL OTHER MANUFACTURERS SKIP TO Q12)

8. I understand from NEEA that your company has been working with NEEA's program team (including staff from its program implementers Cadeo and Evergreen Consulting) on LLLC-related activities. What are the activities and what assistance is that team providing? *(Probe: trainings, action plans development, etc.)*
9. Why did your company decide to work with NEEA's program team on these activities?
10. How has the collaboration been going so far? *(Probe on what is going well, what might be improved, any suggestions)*
11. How effective have NEEA's initiatives been overall to increasing awareness and adoption of LLLC in the Northwest? Why? *(Probe for what is beneficial, what might be improved, any suggestions)* How about for other NLC products?

Market Landscape

12. Who are the typical customers or market sectors that are purchasing LLLC systems? What factors do you think make certain industries or market sectors [office, retail, schools, universities, hospitals] more likely to use LLLC systems than other types of NLC? *(Record sectors and specific factors influencing each sector)*
13. Now I'd like you to think about other types of NLC systems. Again, we're defining "other NLC" as systems with an external sensor and controller controlling a group of fixtures. Are different types of customers or market sectors purchasing these as compared to customers who purchase LLLC? *(Probe on differences)*
14. Now I'd like to go back again to LLLC. Think about the LLLC projects you're aware of. What are the typical characteristics of those projects? That is, in what situations do LLLCs seem like the best fit? *(Prompt for and check off all that are applicable:*
    a. ☐ *Large vs* ☐ *small floor area*
    b. ☐ *Type or vintage of building:*
    c. ☐ *Owner-occupied versus* ☐ *leased/rented building*
    d. ☐ *New construction vs.* ☐ *renovation vs.* ☐ *retrofit*

e. ☐ *Ownership and/or management of multiple buildings vs.* ☐ *single buildings*
f. ☐ *Participation in utility incentive programs or building certification:*
g. ☐ *Access to internet and/or building personnel IT capabilities:*
h. ☐ *Particular organizational needs or opportunities, such as asset tracking:*
i. ☐ *Other features that are chosen, etc. if needed:*

15. And now think about projects that involve other types of NLC. What are the typical characteristics of those projects? Are those different from LLLC projects? *(Probe on differences)*
16. What role have utility incentives had in encouraging LLLC and NLC? Are there other actions utilities could take to encourage greater adoption of LLLC and NLC? *(Probe: difference in sales/interest in regions with incentives and those without)*
17. Of the total indoor office luminaires sold in the Northwest—not just by your company but across all companies—approximately what percentage is LLLC? A ballpark estimate is fine.
18. In the past year, have you observed an increasing number of product types equipped with embedded sensor and controls in the market?
    a. *If yes:* Has your company increased the number of products available with embedded sensors and controls?
    b. *If yes to either/both previous questions:* In which applications or product types have these embedded features gained popularity? What factors, resources, or entities do you find responsible for this trend?

LLLC and Other NLC Capabilities

19. What appears to be the most requested or desirable feature or capability of LLLC products based on sales and product requests? And what is the most desirable feature or capability of other types of NLC? Why?
20. What are the remaining barriers to further market adoption of LLLC? And what about other types of NLC: what are the remaining barriers to those? *(Probe for LLLC and other NLC: For customers or players on the supply-chain side.) (If barriers to LLLC and/or NLC)* What suggestions do you have for overcoming these barriers?
21. In general across the brands of LLLC products on the market, what opportunities do you see for improvement? *(Probe: Ease of system installation? Ease of programming? Training? Technical support? Interoperability of different system brands? Customer experience?)* And what opportunities do you see for improvement to other types of NLC? *(Same probes)*
22. How often, if at all, are your customers integrating LLLC sensor outputs with HVAC systems or other building systems?

COVID Impacts

23. Have you noticed any persisting changes in interest in LLLC as a result of COVID? Has there been any sustained interest in using LLLC or NLC sensors to support COVID safety protocols, such as occupant density sensors or temperature monitoring?

24. Have you encountered any supply chain issues that have made it hard to provide the needed products to the market?
    a. (*If yes)* Do you expect these needs to persist in the market over the long term?
    b. (*If yes)* Have you noticed any differences between LLLC and other NLC?

Closing

Thank you so much for your time today.

Finally, to ensure that you get the $50 gift card, can you please provide a mailing address? It may take up to four weeks for the gift card to arrive; thank you for your patience.

Those were all of my questions. Do you have anything else you'd like to add?

Thank you again for your time. If you have any follow-up thoughts or questions on this research project please feel free to contact me at…

Manufacturer Reps

Market Actor Engagement in LLLC Market

1. How many manufacturers does your company represent that offer NLC product lines? Of these, how many are classified as LLLC?
2. What role does your company have in the sales process for LLLC or other NLC? Does your company engage with the project decision-makers on whether to include those products for a particular project, or influence their decision? In what way?

IF INTERVIEWED IN A PREVIOUS YEAR, PULL IN PREVIOUS RESPONSES AND CONFIRM THAT THOSE RESPONSES ARE STILL ACCURATE.

3. Have you or other staff at your company participated in trainings on NLC systems?
4. Did the training include details about LLLC systems as a distinct type of NLC?
5. Who offered the training? *(Probe: Manufacturers? Other entity and, if so, who?)*
6. *If interviewed in previous year AND trainings offered in both interview years:* Have there been any changes to the quantity or content of the trainings? If so, what were these changes?
7. What additional training or resources would help your staff more effectively promote LLLC?

Market Landscape

8. Who are the typical customers or market sectors that are purchasing LLLC systems? What factors do you think make certain industries or market sectors [office, retail, schools, universities, hospitals] more likely to use LLLC systems? *(Record sectors and specific factors influencing each sector)*

9. Now I'd like you to think about other types of NLC systems. Again, we're defining "other NLC" as systems with an external sensor and controller controlling a group of fixtures. Are different types of customers or market sectors purchasing these as compared to LLLCs? *(Probe on differences)*
10. Now I'd like to go back again to LLLC. Think about the LLLC projects you're aware of. What are the typical characteristics of those projects? That is, in what situations do LLLCs seem like the best fit? *(Prompt for and check off all that are applicable:*
    a. ☐ *Large vs* ☐ *small floor area*
    b. ☐ *Type or vintage of building:*
    c. ☐ *Owner-occupied versus* ☐ *leased/rented building*
    d. ☐ *New construction vs.* ☐ *renovation vs.* ☐ *retrofit*
    e. ☐ *Ownership and/or management of multiple buildings vs.* ☐ *single buildings*
    f. ☐ *Participation in utility incentive programs or building certification:*
    g. ☐ *Access to internet and/or building personnel IT capabilities:*
    h. ☐ *Particular organizational needs or opportunities, such as asset tracking:*
    i. ☐ *Other features that are chosen, if needed:*
11. And now think about projects that involve other types of NLC. What are the typical characteristics of those projects? Are those different from LLLC projects? *(Probe on differences)*
12. Who are the main decision-makers for choosing to install LLLC or other types of NLC in the new construction market? *(Probe for role of architect/engineer, contractor, owner, lighting designer)* Does this vary by market sector? If so, how?
    a. Are the decision-makers different for major renovation projects? Are they different for lighting retrofits?
13. What is the role of utility incentives in encouraging LLLC and NLC? Are there other actions utilities could take to encourage greater adoption of LLLC and NLC?
14. Of the total luminaires sold in the Northwest—not just by your company but across all companies—approximately what percentage are LLLC luminaires? A ballpark estimate is fine.
15. How would you describe the overall trend in LLLC sales and order activity? Is it increasing, staying about the same, or decreasing?
16. In the past year, have you observed an increasing number of product types in the market that are equipped with embedded sensors and controls?
    a. *If yes:* Has your company increased the number of products available with embedded sensors and controls?
    b. *If yes to either/both previous questions:* In which applications or product types have these embedded features gained popularity? What factors, resources, or entities are responsible for this trend?

LLLC and Other NLC Capabilities

17. What appears to be the most requested or desirable feature or capability of LLLC products based on sales and product requests? And what is the most desirable feature of capability of other types of NLC?
18. What are the remaining barriers to further market adoption of LLLC? And what about for other types of NLC: what are remaining barriers to those? *(Probe for LLLC and other NLC: For customers or players on the supply-chain side) (If barriers to LLLC and/or NLC)* What suggestions do you have for overcoming these barriers?
19. In general across the brands of LLLC products on the market, what opportunities do you see for improvement? *(Probe: Ease of system installation? Ease of programming? Training? Technical support? Interoperability of different system brands? Customer experience?)* And what opportunities do you see for improvement to other types of NLC? *(Same probes)*
20. How often, if at all, are your customers integrating LLLC sensor outputs with HVAC systems or other building systems?

COVID Impacts

21. Have you noticed any persisting changes in interest in LLLC as a result of COVID? Has there been any sustained interest in using LLLC or NLC sensors to support COVID safety protocols, such as occupant density sensors or temperature monitoring?
    a. (*If yes, then follow with…)* Do you expect these needs to persist in the market over the long term?
    b. (*If yes)* Have you noticed any differences between LLLC and other NLC?

Closing

Thank you so much for your time today.

Finally, to ensure that you get the $50 gift card, can you please provide a mailing address? It may take up to four weeks for the gift card to arrive; thank you for your patience.

Those were all of my questions. Do you have anything else you'd like to add?

Thank you again for your time. If you have any follow-up thoughts or questions on this research project please feel free to contact me at…

Distributors

Market Actor Engagement in LLLC Market

1. How many different brands of NLC product lines does your company distribute? Of these, how many are classified as LLLC?
2. What services does your company offer related to [LLLC][other NLC] systems? *(Probe for each type: order fulfillment, direct sales to customers, system design or specification, system installation, training)*

3. Do you have a division or department that focuses on controls? *(If yes)* How long have you had this department? What was the driver for creating this department?
4. What role does your company have in the sales process for LLLC or other NLC? Does your company engage with the project decision-makers on whether to include those products for a particular project, or influence their decision? In what way?

IF INTERVIEWED IN A PREVIOUS YEAR, PULL IN PREVIOUS RESPONSES AND CONFIRM THAT THOSE RESPONSES ARE STILL ACCURATE.

5. Have you or other staff at your company participated in trainings on NLC systems?
6. Did the training include detail about LLLC systems as a distinct type of NLC?
7. Who offered the training? *(Probe: Manufacturers? Other entity and, if so, who?)*
8. *If interviewed in previous year AND trainings offered in both interview years:* Have there been any changes to the quantity or content of the trainings? If so, what were these changes?
9. What additional training or resources would help your staff more effectively promote LLLC in particular?

Market Landscape

10. Who are the typical customers or market sectors that are purchasing LLLC systems? What factors do you think make certain industries or market sectors [office, retail, schools, universities, hospitals] more likely to use LLLC systems? *(Record sectors and specific factors influencing each sector)*
11. Now I'd like you to think about NLC systems other than LLLC. Again, we're defining "other NLC" as systems with an external sensor and controller controlling a group of fixtures. Are different types of customers or market sectors purchasing these than customers who are purchasing LLLC? *(Probe on differences)*
12. How would you describe the overall trend in LLLC sales and order activity? Would you say it is increasing, staying about the same, or decreasing?
13. How effective has direct person-to-person sales (to end-use consumers) been for LLLC adoption? Have you experienced any change (greater, fewer, or a consistent degree of involvement) in person-to-person sales of LLLC? How about for NLC?
    a. Has your company encouraged any other sales platforms for promoting LLLC?
14. What are your company's standard LLLC stocking practices? Do these practices differ between LLLC and other NLC? *(Probe for differences)* In the past year, have you observed any changes in LLLC stocking practices? *(Probe for changes)*

LLLC and Other NLC Capabilities

15. In general across the brands of LLLC products on the market, what opportunities do you see for improvement? *(Probe: Ease of system installation? Ease of programming? Training? Technical support? Interoperability of different system brands? Customer experience?)*
    a. And what opportunities do you see for improvements to other types of NLC? *(Same probes)*
16. How often, if at all, are your customers integrating LLLC sensor outputs with HVAC systems or other building systems?

COVID Impacts

17. Have you encountered any supply chain issues related to LLLC as a result of COVID? How about for NLC?
    a. (*If yes)* Do you expect these issues to persist in the supply chain over the long term? Why or why not?
    b. *(If yes)* Have you noticed any differences between LLLC and other NLC?
18. Have you noticed any persisting changes in interest in LLLC as a result of COVID? Has there been any sustained interest in using LLLC or NLC sensors to support COVID safety protocols, such as occupant density sensors or temperature monitoring?
    a. (*If yes)* Do you expect these needs to persist in the market over the long term?

Closing

Thank you so much for your time today.

Finally, to ensure that you get the $50 gift card, can you please provide a mailing address? It may take up to four weeks for the gift card to arrive; thank you for your patience.

Those were all of my questions. Do you have anything else you'd like to add?

Thank you again for your time. If you have any follow up thoughts or questions on this research project please feel free to contact me at…

Appendix F. NEEA LLLC MPER 2 – Guide for Utility Interviews

Researchable Questions	Question Number
Understand utilities' current LLLC and NLC market engagement and offerings	H1-H9
Assess awareness of and motivation to participate in NEEA's efforts in the LLLC market	I1-I4; J1
Understand utility perspectives and feedback on the LLLC Program	J2-J3
Identify utilities' perceptions of NEEA's influence on utility programs and the market adoption of LLLC and other NLC	J2-J3

Target Quota = five (5) interviews with utilities, each interview lasting ~30 minutes.

Recruitment Email

Cadmus to send recruitment emails to each of the contacts identified by NEEA.

Hello [RESPONDENT NAME],

I received your contact information from Elaine Miller and Anne Curran at NEEA. On behalf of NEEA, I am conducting market evaluation for Networked Lighting Controls, in particular Luminaire Level Lighting Controls or LLLC, in the Northwest. As part of our study, **I would like to schedule an interview with you** to discuss your insights and your expectations for this market, and the role of this technology in your energy efficiency portfolio. I would also get your feedback on any engagement you have had with NEEA or its partners related to LLLC or other Networked Lighting Controls – such as participation in trade ally training, or discussion of how to incorporate LLLCs into your nonresidential energy efficiency programs.

This interview should take about 30 minutes. Do you have time to participate in the next couple of weeks?

Thanks,

[NAME SENDING EMAIL]

Interview Guide

Interviewee(s) and Organization: ____ _____

Interviewer: _____ _____

Date of Interview: _____

Thank you for making the time to speak with me (us). The purpose of this interview is to better understand your thoughts on the market for Luminaire Level Lighting Controls and other types of Networked Lighting Controls, and the programs and other efforts your utility offers. And then we'd like to get your impressions of the various aspects of NEEA's LLLC Program that you're aware of. This interview should take ~30 minutes and all quotes will be kept anonymous (we won't identify who said what). Do you have any questions before we begin?

[IF NEEDED: LLLC stands for Luminaire Level Lighting Controls, which is a subset of NLC, Networked Lighting Controls. Throughout the interview we will refer to both LLLC and other NLC. Luminaire Level Lighting Controls, or LLLC, are a type of networked lighting control. In an LLLC system, each individual light fixture has its own built-in sensor and controller, and they can communicate wirelessly and transmit data. So you can program them in any grouping you need, all the way down to the individual fixture level.

By comparison, in non-LLLC networked lighting control systems, the sensor and controller are external to the fixtures. One sensor and controller – typically mounted in the ceiling – will control a group of fixtures, usually wirelessly.]

H. Current LLLC/NLC Engagement

I'd like to begin the interview by discussing [UTILITY'S] engagement and efforts with LLLC and other types of NLC to date. Please note that for today's discussion, we would like to focus on programs that actively target customers for LLLC or other NLC installations.

H1. [IF NOT INTERVIEWED DURING MPER 1] Can you please provide details on what programs you offer for LLLC and other types of NLC? *(Probe: design, delivery channel, year launched, incentive structure, annual performance, educational efforts, marketing efforts)*

1. Do you have any offerings that are specific to LLLC? For example, do you offer difference incentive levels for LLLC compared to other NLC? Please explain any differences.
2. Do you offer incentives that are specific to lighting controls that are <u>not</u> networked? Some utilities refer to these as "basic" lighting controls.

H2. [IF INTERVIEWED DURING MPER 1] During our prior interview, you provided the following details on the program(s) you offer for LLLC and other types of NLC: [INSERT ANSWER FROM MPER 1 INTERVIEW]

1. Is this still accurate or have you made changes to this program design? (Probe: design, delivery channel, year launched, incentive structure, annual performance, educational efforts, marketing efforts)

[IF UTILITY INTERVIEWED DURING MPER 1, BRING IN ANSWERS AND USE INTERVIEW TO CONFIRM IF ANYTHING CHANGED]

H3. Who is the target market for your Networked Lighting Control offerings? *(Probe for both customer type [office, warehouse, etc.] and the project type [new construction/ renovation versus retrofit].*
   1. Why is this your target market?*)*
   2. [IF NOT ADDRESSED] Are there any differences in the target market for LLLC versus other types of NLC, from your perspective?

H4. How successful have your Networked Lighting Controls offerings been to date? *(Probe for* specifics*, such as customer participation, trade ally participation, engagement with market actors, cost-effectiveness of program offerings, etc.)*
   1. What's led these offerings to be successful?
   2. [IF OFFERING INCENTIVES FOR BOTH LLLC AND OTHER NLC] How do trade allies or customers respond differently to incentives for LLLC versus other NLC, if at all?
   3. [IF OFFERING INCENTIVES FOR BOTH LLLC AND OTHER NLC] What is the proportion of incentive funding given to LLLC vs. other NLC? How, if at all, is this proportion changing?

H5. What challenges have you encountered with your Networked Lighting Control offerings? Have you encountered challenges specific to LLLC? And how about any challenges specific to other types of NLC? *(If offering both LLLC and other NLC programs, probe for differences across LLLC versus other NLC)*
   1. What's caused these challenges? (If offering both LLLC and other NLC programs, probe for differences)
   2. What actions have you taken to overcome these challenges? (If offering both LLLC and other NLC programs, probe for differences)

H6. What plans do you have for your Networked Lighting Control offerings in the future and specifically for LLLC? How will these offerings be designed? *(Probe: technical assistance, trade ally engagement, incentive structure, tracking, etc. Ask about differences across LLLC versus other NLC.)*
   1. What support do you need to achieve these plans, if any?

H7. How important do you think NLC in general are as a driver of savings for your portfolios, both now and in the future?
   1. Do you expect LLLC or other NLC products to replace some of the savings you will lose when LEDs are no longer incented through your programs?

[IF RESPONDENT WAS INTERVIEWED IN MPER 1, BRING IN ANSWERS FOR H8 AND H9 TO CONFIRM AND ASK ABOUT ANY CHANGES]

H8. What key barriers do you see to the increased adoption of **LLLC**?
   1. What do you think is needed to overcome these barriers?
   2. Is there a difference between LLLC and other NLC for how easy the barriers are to overcome?

H9. What key barriers do you see to the increased adoption of **other NLC** (i.e., non-LLLC)? *(Probe if not addressed: Are the barriers different for LLLC as compared to other types of NLC? If so, please describe the differences.)*
   1. What do you think is needed to overcome these barriers? (Probe if not addressed: Is there a difference between LLLC and other NLC for how easy the barriers are to overcome?)

H10. [IF INTERVIEWED IN MPER 1] Have any of these barriers been addressed?
   1. [IF YES] How have these been addressed?
   2. [IF NO] What do you think is needed to address these barriers?

I. Program Awareness

Next, I'd like to discuss your awareness of NEEA's LLLC Program.

I1. Before this interview, were you aware of NEEA's LLLC Program?

I2. [IF I1=NO] What had you heard about NEEA's LLLC Program?
   1. What specific activities are you aware of?

   [IF NOT AWARE, PROVIDE DESCRIPTION: NEEA is working to accelerate market adoption of LLLC in the region in a number ways including helping utilities develop incentive programs and co-funding Trade Ally training, supporting manufacturers to train their reps in selling LLLC, and raising supply chain awareness and knowledge of LLLC through targeted media and educational materials.

I3. [IF NOT MENTIONED] Are you aware of the LLLC trainings that are offered through Lighting Design Lab (LDL)? *(Probe on both on-site trainings offered before COVID and current online trainings)*
   1. If you are aware, do you think the LDL training has an impact on the market? Why or why not? *(Probe on on-site versus online)*
   2. Are there additional training topics not currently covered that you'd like to suggest?

I4. [IF NOT MENTIONED] Are you aware of the LLLC research and case studies by NEEA?

I5. [IF YES] Have you used these or referred these resources to anyone, or do you see a potential use for them? *(Probe on whether have used NEEA research for program design.)*
   1. Are there other research topics that would like to suggest?

I6. Are there any other aspects of NEEA's LLLC Program that we haven't discussed that you have heard about?

J. Program Perceptions

[ASK IF AWARE OF NEEA'S PROGRAM.] Now, I'd like to discuss your thoughts on NEEA's LLLC Program. Just as context NEEA began full program implementation in early 2020, and for several years prior to that had started working with utilities on trainings and incentive program development.

J1. How have you engaged with NEEA's LLLC Program so far, and if so in what ways? *(Probe for the following* components*: collaborated with NEEA on Trade Ally trainings, collaborated with NEEA in developing LLLC incentive programs, served on one of NEEA's LLLC-related committees, used LLLC marketing templates, case studies, and other educational materials that NEEA offers on the BetterBricks website, used research and reports for program planning, other)*

1. Can you describe your role in engaging with NEEA?
2. How long (in months) have you been involved with NEEA's work on LLLC?
3. [IF NOT INVOLVED IN ALL COMPONENTS] Why are you involved in some aspects of the LLLC Program but not in others? OR Why are you not involved in the program?

J2. Thinking about the past [INSERT RESPONSE FROM J1.2] months of your interactions/work with NEEA related to LLLC, what has worked well for you? *(Probe if needed: How has NEEA's work on LLLC supported your work? What about it did not work as well from your perspective?)*

J3. [ASK IF RESPONDENT MENTIONS ANYTHING THAT DIDN'T WORK IN J2] Are there any near-term adjustments that NEEA can implement to help support you better or improve their work in the area of LLLC. *(Probe as needed to identify actionable improvements.)*

K. Closing

K1. Is there anything else you'd like to add that we didn't discuss today?

This completes the interview – thank you very much for your time. Have a good [evening/day].

Memorandum

March 11, 2024

TO: Zdanna King, MRE Scientist, NEEA

FROM: Anne Curran, Sr. Program Manager, NEEA

SUBJECT: Response to Luminaire Level Lighting Control (LLLC) Market Progress Evaluation Report #2

NEEA posted its second Market Progress Evaluation Report (MPER) for the Luminaire Level Lighting Control Program on 11/29/23. The purpose of this memorandum is to summarize the program's response to the major findings and associated recommendations of MPER 2. Note that MPER 2 included four recommendations. This response addresses only a subset of those recommendations that the program team judged would have the most meaningful impact on the program (in terms of overall strategy, specific interventions, program logic, and/or resources). Where the MPER's recommendations imply a modification in program strategies or activities, this memo outlines the program's anticipated adaptation and timeline for doing so. NEEA programs are not required to accept every MPER recommendation. In instances where the program chooses to reject (or accept with caveats) an MPER recommendation, this memo provides a rationale.

Recommendation 1: Continue to have close coordination with upstream market actors so that market-facing materials, trainings, and other related documentation are updated when market changes occur.

The LLLC program accepts this recommendation. This is a continuation of the approach the program has used in its approach to supporting both upstream market actors. Regular outreach to manufacturer local sales channels is built into the program's 2024 Operation Plan. The program has already developed a toolkit of resources that can be used by upstream market actors, as well as local utilities. The plan is to keep it updated and add resources over time.

Recommendation 2: Continue existing program activities until NEEA's specified criteria for market transformation (i.e., achievement of MPIs) are met.

The LLLC program accepts this recommendation. The MPER #2 acknowledged that there were positive signs of progress in the market and that changes since MPER #1 show the effects of NEEA's market interventions, specifically related to their engagement with market actors, including manufacturers, manufacturer's representatives, installers and designers/specifiers. The program agrees there is more to do to solidify long-lasting, self-sustaining market transformation. The LLLC program has been incorporated in NEEA's draft plan for the next business cycle.

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Recommendation 3: Ensure that market actors have easy access to resources helping them understand the value proposition of LLLC and how it differs for different types of customers. In these resources, ensure that both detailed energy savings and benefits beyond energy/cost savings are clearly articulated. Continue to regularly publish updates to these resources and encourage upstream market actors to distribute materials to downstream market actors.

The programs accepts this recommendation with a caveat. As noted above in the response to recommendation 1, the program has a toolkit in place with a variety of resources to help market actors understand LLLC and its value proposition. Upstream market actors are actively encouraged by the program implementation team to leverage those materials to educate their own clients. High-level case studies of successful projects are a key component of the program's 2024 Operation Plan. However, the program is not funded to do additional studies of energy savings and non-energy benefits to further quantify the value and include validated results in those case studies.

Recommendation 4: Work with upstream market actors to ensure that installers and designers/specifiers have the appropriate understanding of the LLLC value proposition for different customer segments and are prepared to tailor their sales pitch to a customer's unique needs.

The programs accepts this recommendation with caveats. The program has high-level marketing and technical materials for key customer segments that are available to installers, designers and specifiers to use. The program also incorporates some segmentation of customer value in its training curriculum and has a module of selling LLLC to clients. While the program helps educate these market actors in collaboration with local utilities and in those efforts encourages the use of available materials to foster an understanding of LLLC and its value proposition, the program does not manage a trade ally network and does not perform direct one-on-one outreach to installers, designers and specifiers. Instead, the program supports local utilities in their trade ally education efforts, performs outreach to local manufacturer sales channels to help them in educating designers and specifiers, and also works with professional and trade associations to reach installers, designers and specifiers.

The LLLC Program acknowledges the importance of regular evaluations, both as a demonstration of our fiduciary duty to our funders and other stakeholders and as a tool for adaptive management. We appreciate the opportunity to reflect on these evaluation results and to leverage them in the ongoing effort to improve the program and hasten progress toward our market transformation goals. If you have any questions about the LLLC Program's response to the findings of MPER 2, please contact me at acurran@neea.org.