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Comprehensive Commercial Lighting Initiative Pilot Evaluation Report

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EXECUTIVE SUMMARY

The Comprehensive Commercial Lighting Initiative (CCLI) was a regional energy-efficient lighting retrofit pilot effort funded primarily by Northwest Energy Efficiency Alliance (NEEA), and implemented by Evergreen Consulting (Evergreen). Three utilities – Idaho Power, Idaho Falls Power, and NorthWestern Energy – as well as the Energy Trust of Oregon participated and funded extra incentives. The pilot started in the Energy Trust of Oregon territory in May of 2011, with the rest of the participating utilities starting in September of 2011. Each participating entity offered a comprehensive lighting retrofit program as part of its program portfolio. The pilot ended in July of 2012.

This is the first time that NEEA has undertaken a program and a role of this nature in the region. The CCLI was not a typical market transformation initiative where NEEA identifies barriers that impede market adoption, then strategically intervenes to remove those barriers in collaboration with our partners.

NEEA and utility stakeholders conceived of the CCLI pilot as a means to test a comprehensive retrofit offering that moved away from focusing on individual measures to an integrated, design-based approach that makes much greater use of lighting controls. In addition, the utilities offered tiered incentives on overall kWh reductions to encourage deeper energy savings instead of incentives per piece of equipment. To support this pilot, the CCLI provided in-depth training for participating trade allies, as well as one-on-one design support for individual projects conducted as part of the pilot programs.

Rather than focusing on one-for-one technology replacements, a comprehensive retrofit provides a designed solution, based on professional light level and light quality standards, such as those recommended by the Illuminating Engineering Society (IES). A comprehensive lighting retrofit may include removing or relocating light fixtures instead of, or in addition to, upgrading or replacing existing fixtures. This report discusses findings from the evaluation of the CCLI pilot conducted by the Heschong Mahone Group (HMG), including an assessment of the initial effectiveness of the pilot projects, and recommendations for future lighting program initiatives. Evaluation activities included the following four tasks:

1. Evaluable Measures and Metrics – Ensure that NEEA's established criteria for comprehensive lighting retrofit projects are evaluable
2. Project Tracking for Evaluability – Recommend strategies for reporting and tracking the evaluable measures and metrics established in the previous task
3. Impact Analysis – Assess the energy savings and cost-effectiveness of the CCLI pilot projects from the business owners' perspective
4. Process Analysis – Qualitatively assess the CCLI pilot, based on interviews with the program implementers and program participants

Evaluable Measures and Metrics: NEEA and Evergreen established seven criteria to define "comprehensive" lighting retrofit projects. HMG coordinated with NEEA and Evergreen to refine each criterion to ensure evaluability. The seven criteria are as follows:

1. Program incentives based on project kWh reduction (not equipment change-outs)
2. Retrofit project incentives based on new construction practice, such as energy code lighting power density (LPD) limits
3. Tiered incentive rates
4. Light quantity and quality based on professional standards, such as Illuminating Engineering Society (IES) recommendations
5. Use design tools and templates
6. Minimum equipment performance requirements
7. All savings opportunities should be identified and presented

However, due to varying market and utility conditions across the Northwest region, the participating entities did not implement these criteria uniformly. Minimum performance requirements varied across the participating entities, and two of the participating entities did not establish specific standards to define new construction practice or minimum equipment performance requirements.

Project Tracking for Evaluability: HMG coordinated with NEEA and Evergreen to develop reporting and tracking strategies for comprehensive projects. However, NEEA, Evergreen and HMG did not finalize these reporting and tracking methods until after the program was already in progress, and the participating entities were not able to incorporate all of the reporting and tracking into their program forms.

Impact Analysis: The study included seventeen retrofit projects completed prior to July 31, 2012, which together resulted in a total annual energy savings of 2,373,888 kWh. HMG also evaluated each project for the incremental cost-effectiveness of the comprehensive retrofit approach compared to a traditional lighting retrofit approach, from the building owners' perspective, by calculating whether added energy savings of projects using a comprehensive retrofit approach outweighed the added associated cost, as compared to traditional lighting retrofits.[1] This assessment found that all but three of the seventeen comprehensive projects were incrementally cost-effective compared to what would have been the case had traditional retrofit program approaches been used. In addition, all seventeen projects were cost-effective to the owner when evaluated independently of traditional retrofit alternatives.

Process Analysis: Overall, the process analysis portion of the evaluation found that program implementers and program participants were generally satisfied with the outcomes of the pilot program. Building owners reported satisfaction with the improved light quality delivered by the

[1] To differentiate between this type of cost-effectiveness (i.e., from the building owner's perspective) and that of the program as a whole, this report refers to the former as "project cost-effectiveness" and the latter as "program cost-effectiveness." The subject study did not include an analysis of program cost-effectiveness.

comprehensive retrofit projects. Program implementers and utility program managers stated that the training and education provided by the CCLI increased the skill level of the participating trade allies. However, they also felt that trade allies need even more education and training to effectively implement comprehensive retrofit approaches and new lighting technologies.

In addition, program implementers, utility program managers, and participating trade allies all reported that added administrative burdens, such as additional reporting and paperwork required for comprehensive projects, and longer wait times to receive incentive payments, were barriers to participation in the CCLI pilot. The relatively short time period for the pilot program (less than a year) also limited participation, as trade allies need a longer time to develop and complete business. Many utility program managers reported challenges developing an appropriate incentive structure for comprehensive lighting retrofits that was distinct enough from traditional incentive offerings and balanced with the added effort required by trade allies, while still maintaining program cost-effectiveness.

Recommendations: Based on these findings, HMG provides the following recommendations for widespread future implementation of a comprehensive lighting retrofit program:

- For initiatives like the CCLI, NEEA is most effective at regional support and coordination, rather than specific program and incentive structure design. The wide variety of market conditions across the Northwest makes it very challenging for NEEA to create a single replicable model for the entire region.
- Develop uniform project criteria and reporting requirements in advance of program implementation to better ensure desired project results and effective program evaluation.
- Provide a longer program implementation period to allow trade allies to develop business and complete projects.
- Streamline administrative processes to ease the reporting burden on trade allies, and bring the timeline for project approval and incentive payments in line with typical retrofit program offerings.
- Expand and simplify education and training efforts to provide access and resources to a broader pool of trade allies, and to deepen the knowledge of trade allies who participated in the CCLI pilot. Some suggestions include:
  - A hotline to the Lighting Design Lab for trade allies to get lighting design support
  - A financial analysis tool that trade allies could use to communicate the added benefits of a comprehensive approach to their customers
  - A simplified version of the light level recommendations in the new IES Lighting Handbook
  - Expanding trainings to broader audiences of trade allies
- Balance incentive structures to encourage deeper energy savings and reward the added effort of the trade allies, while maintaining program cost-effectiveness for the utilities. Traditional one-for-one retrofit incentives are often high enough that trade allies are not

motivated to change their practices to achieve deeper energy savings. This will likely require a careful assessment by each utility to create incentive structures that are most effective for their local market conditions.

1. INTRODUCTION

NEEA and utility stakeholders conceived of the CCLI pilot as a means to test a comprehensive retrofit offering that moved away from focusing on individual measures to an integrated, design-based approach that also uses more lighting controls. In addition, the utilities offered tiered incentives on overall kWh reductions to encourage deeper energy savings instead of incentives per piece of equipment. To support this pilot, the CCLI provided in-depth training for participating trade allies, as well as one-on-one design support for individual projects conducted as part of the pilot programs.

This is the first time that NEEA has undertaken a program and a role of this nature in the region. The CCLI was not a typical market transformation initiative where NEEA identifies barriers that impede market adoption, then strategically intervenes to remove those barriers in collaboration with our partners.

The CCLI was an energy efficient lighting retrofit program offered by the Northwest Energy Efficiency Alliance (NEEA) and partnering entities in the Northwest region (defined by NEEA as Idaho, Montana, Oregon, and Washington) from May 2011 to July 2012. Its primary goal was to create a body of learning around training needs, trade ally acceptance, incentive structures, design tools, market barriers and project requirements in order to pave the way for future commercial lighting programs using a comprehensive approach. NEEA and utility stakeholders conceived of the CCLI pilot as a means to test a comprehensive retrofit offering that moved away from focusing on individual measures to an integrated, design-based approach that makes much greater use of lighting controls. The pilot also provided resources, such as training and online tools for participating utilities, trade allies and retrofit contractors, to support the greater design effort required for this approach.

Through the CCLI, NEEA provided funding for training, tool development and program design support to pilot comprehensive lighting retrofit programs in the service territories of four entities, including:

- Energy Trust of Oregon
- Idaho Power
- Idaho Falls Power
- NorthWestern Energy

Evergreen Consulting (Evergreen) served as the overall implementer of the CCLI pilot on behalf of NEEA, providing training and support to the trade allies who participated in the program and completed comprehensive projects. Initial trainings introduced the concept of "comprehensive" lighting retrofits to a select group of high-performing trade allies invited from each participating entity territory. Following the initial trainings, Evergreen staff served as "lighting specialists," assisting the participating trade allies in developing and delivering comprehensive retrofit solutions for each program project.

This report discusses findings from the evaluation of the CCLI pilot conducted by the Heschong Mahone Group (HMG), including an assessment of the initial effectiveness of the pilot projects, and guidance on how to improve the program prior to wider regional implementation.

Because of the small scale of the pilot program, these activities do not constitute a program evaluation in the full technical sense. This analysis does not evaluate free-ridership, spillover, or overall program cost-effectiveness from NEEA's or the utilities' perspective.

1.1 Comprehensive Commercial Lighting Initiative

The key to the CCLI pilot was the "comprehensive" approach to commercial lighting retrofits. A comprehensive retrofit aims to provide the most cost effective energy savings possible, and addresses all lighting retrofit opportunities in a proposed project space. Rather than focusing on one-for-one technology replacements, a comprehensive retrofit provides a designed solution, based on professional light level and light quality standards, such as those recommended by the Illuminating Engineering Society (IES). A comprehensive lighting retrofit may include removing or relocating light fixtures instead of, or in addition to, upgrading or replacing existing fixtures. Section 3 provides a more detailed discussion of the characteristics of a comprehensive lighting retrofit.

2. METHODOLOGY

For this evaluation project, HMG conducted the following four main tasks:

1. Evaluable Measures and Metrics – Ensure that NEEA's established criteria for comprehensive lighting retrofit projects are evaluable
2. Project Tracking for Evaluability – Recommend strategies for reporting and tracking the evaluable measures and metrics established in the previous task
3. Impact Analysis – Assess the energy savings and cost-effectiveness of the CCLI pilot from the building owners' perspective
4. Process Analysis – Qualitatively assess the CCLI pilot, based on interviews with the program implementers and program participants

The subsections below describe the methodology for each of these tasks.

2.1 Evaluable Measures and Metrics

The first task in the evaluation of the CCLI pilot program required HMG to ensure that the criteria that NEEA's evaluation team and Evergreen developed to define "comprehensive" lighting projects were evaluable. The intent was to ensure that the measures were specific, well defined, evaluable and quantifiable, and that they were able to meet both the market transformation and energy savings goals of the program. Over the course of two meetings involving all three parties, these metrics were developed and later revised to better reflect the efforts of utilities throughout the Northwest region. Section 3 outlines the final measures and metrics established in this task.

2.2 Project Tracking for Evaluability

HMG developed a reporting and tracking method for each criterion established for the evaluable measures and metrics in order to set uniform standards by which to evaluate project results. In so doing, HMG developed an initial list of reporting and tracking methods for comprehensive projects and shared it with NEEA and Evergreen. In coordination with NEEA and Evergreen, HMG revised the list to better reflect the processes of the actual comprehensive programs. Section 4 outlines these reporting and tracking methods in full.

2.3 Impact Analysis

The impact analysis provides a quantitative assessment of the energy savings and cost-effectiveness of the CCLI pilot. The subsections below outline the methodology for determining these two aspects.

2.3.1 Overall Energy Savings

The first piece of the impact analysis task was an assessment of the overall energy savings provided by each project. Participating utilities and the Energy Trust of Oregon provided validated energy savings and lighting calculator tools for each project. As NEEA accepts utility-

validated energy savings data, HMG did not conduct any additional evaluation or verification of this data.

Section 5.1 discusses the energy savings of each comprehensive project, as well as the total energy savings for the pilot as a whole. That section also provides a breakdown of the completed projects by state, urban versus rural locations[2], and building type. Evergreen and the partner entities provided all necessary project information for this assessment.

2.3.2 Project Cost-Effectiveness from the Building Owners' Perspective

As part of the impact analysis, HMG conducted a cost-effectiveness analysis to understand how the costs of implementing the comprehensive approach compared with the energy savings it yields. Because of the small scale of the pilot program, and the large investment in trade ally training and project support from Evergreen, NEEA chose to investigate cost-effectiveness on a project-by-project basis (or from a building owner perspective), in order to determine whether a comprehensive lighting retrofit was a better investment than a traditional one focused on one-for-one technology replacements.

In brief, HMG's goal was to calculate the incremental cost-effectiveness of the comprehensive approach compared with the traditional approach. The incremental cost-effectiveness compares the incremental savings (i.e., additional energy bill savings from the comprehensive approach beyond those from a traditional approach) with the incremental costs (i.e., additional project costs from the comprehensive approach beyond those from the traditional). If the incremental savings exceeded the incremental cost (the ratio was greater than one), HMG considered the project cost-effective.

Overall, HMG used the following equation to calculate incremental cost-effectiveness:

$$\textit{Incremental Cost-Effectiveness} = \textit{Incremental Savings} / \textit{Incremental Costs}$$

where Incremental is the difference between the comprehensive and traditional approach, and both Savings and Costs are in dollars ($).

HMG also calculated the internal rate of return (IRR) for projects. The IRR reflects the project "break-even" interest rate – the discount rate that that the project would earn for it to break even. The IRR describes how good of an investment the comprehensive project was to the owner; the higher the IRR, the better the investment.

HMG calculated the IRR, as defined in the following equation:

$$\textit{NPV} = \textit{Sum over EUL of (Comprehensive Savings in year n} / [1+r]n) - \textit{Comprehensive Project Cost}$$

[2] To distinguish between urban and rural areas, NEEA uses Rural Urban Continuum Codes (RUCC) which classifies geographical areas into one of nine different zones, based on zip code, with RUCC 1-5 classified as urban and 6-9 classified as rural.

where r is the internal rate of return, NPV is the net present value of the project, EUL is the effective useful life of the project (in years), and n is the number of years since project installation.

Some of the values in these equations, such as Comprehensive Project Cost, were included in the comprehensive project data Evergreen provided. Other values, such as Incremental Savings, Incremental Costs, and Comprehensive Savings in year n, needed to be calculated. To calculate these, HMG used the information provided by Evergreen, as well as industry reference materials (see Appendix A: Cost-Effectiveness Calculation Details).

In addition to providing the validated energy savings for each comprehensive project, Evergreen also estimated the energy savings, project costs, and incentive amounts for each project had they been completed under existing traditional lighting retrofit programs in their respective utility territories. Although it is impossible to know exactly what each project would have entailed if they had been completed under traditional programs, the Evergreen staff were familiar with each project, and were the most reliable source for estimating the traditional retrofit strategies. Ideally, an independent entity would have carried out these traditional retrofit estimates, but that process would have required a detailed knowledge of each project building, as well as awareness of the typical practices of the respective trade allies for each project. The scope of the evaluation study did not allow for this in-depth analysis, and Evergreen was the only source with this detailed knowledge. Whenever possible, HMG reviewed the lighting worksheets that Evergreen used to estimate traditional program practices to ensure that the estimates used reasonable assumptions. HMG used these energy savings and project cost estimates to calculate incremental energy savings and costs for these cost-effectiveness calculations.

Appendix A: Cost-Effectiveness Calculation Details provides more detail on the background calculations that informed the cost-effectiveness assessment.

Additional Cost-Effectiveness Metrics

HMG calculated two metrics in addition to those described above to provide a more thorough understanding of the comprehensive retrofit projects.

First, using the following formula, HMG calculated the cost-effectiveness ratio for the owner for the comprehensive approach alone. If the ratio was greater than one, it indicated that lifecycle energy savings outweighed the project cost for the comprehensive project:

Comprehensive Cost-Effectiveness Ratio = Comprehensive Lifecycle Savings / Comprehensive Project Cost

This differs from the Incremental Cost-Effectiveness Ratio in that the Comprehensive ratio relates solely to the comprehensive project, whereas the Incremental ratio is a comparison of the comprehensive project to the traditional project.

Similarly, using the equation below, HMG also calculated the cost-effectiveness ratio after excluding the incentive amount granted to the comprehensive project. In this case, the comprehensive project cost represents the cost of the comprehensive approach without an incentive, and would thus be higher than that in the equation above. A ratio greater than one indicated that the comprehensive project was cost-effective (i.e., produced more lifecycle savings than costs) even without the incentive. Although this analysis is limited to the building owner's

perspective, if projects are cost-effective even without the incentive, it may suggest that the value of the energy savings justifies the incentive cost of comprehensive retrofits to the utilities.

Comprehensive (Without Incentive) Cost-Effectiveness Ratio = Comprehensive Lifecycle Savings / (Comprehensive Project Cost – Incentive)

2.4 Process Analysis

The process analysis portion of the project provided a more qualitative assessment of the outcomes of the CCLI pilot program. HMG conducted an in-person group discussion with the program implementers from Evergreen, as well as phone interviews with program participant groups, including utility program managers, trade allies, and building owners and property managers.

The subsections below describe the methodology of these efforts in more detail.

2.4.1 Program Implementer Group Discussion

On June 25, 2012, HMG conducted a group discussion with the program implementers from Evergreen to determine the overall effectiveness of the CCLI pilot. HMG asked the program implementers to assess the strengths and weaknesses of the pilot program, and to suggest recommendations for future improvements. The discussion included current and potential future trends in the lighting retrofit market and retrofit programs. Rather than following highly structured surveys, the discussion was more of a free-flowing conversation in order to allow for greater insights and for deeper probing on interesting topics that arose.

Five staff members from Evergreen took part in the group discussion:

- Roger Spring – Design and development of the CCLI pilot program
- Doug Oppedal – Program implementation and training for Energy Trust of Oregon and NorthWestern Energy territories
- Angela Pilant – Program implementation and training for Idaho Power territory
- Dan Kuhl – Program implementation and trade ally training for Idaho Falls Power territory, and assistance with Idaho Power territory
- Danita Skoglund – Overall CCLI program reporting, monthly reports, and database management

Both Dave Vacken, a Senior Manager at Evergreen, and Rita Siong, NEEA's evaluation manager, were present for the discussion as observers. Discussion moderators from HMG were Marian Goebes and David Douglass.

HMG used a discussion guide developed in coordination with NEEA (see Appendix B: Group Discussion Guide for Program Implementers for the full discussion guide). However, the discussion flowed somewhat freely, and HMG asked some additional follow-up, probing questions. Due to time constraints, HMG also skipped some questions from the original interview guide if the discussion had already covered those topics, or if the questions were of secondary importance.

In addition to the discussion guide, the meeting included an activity in which the program implementers wrote down five successes and five challenges with the pilot program. HMG then organized these by category, and led a discussion to probe more on the results.

2.4.2 Program Participant Interviews

HMG conducted phone interviews with program participants from the following groups:

- Utility Program Managers
- Trade Allies / Installing Contractors
  - Participating Trade Allies (those who completed training for CCLI, and completed a comprehensive retrofit project)
  - Non-participating Trade Allies (those who completed training for CCLI, but did not complete a comprehensive retrofit project)
- Participating Building Owners / Facility Managers

The goal of these interviews was to determine the effectiveness of the CCLI pilot program. HMG asked the various interviewees to identify strengths and weaknesses of the program.

Although there was only a small number of pilot participants, HMG did not expect to be able to complete interviews with all of the individuals involved in the program due to non-response, so HMG set the desired sample at a slightly lower rate than the actual number of program participants. Table 1 below illustrates the number of potential interviewees that participated in the program, as well as the desired and achieved sample sizes for the various sub-groups.

Table 1: Interview Sample Disposition

	Program Participants (n)	Desired Sample (n)	Achieved Sample (n)
Utility Program Managers	5	5	5
Participating Trade Allies	13	10	8
Non-Participating Trade Allies	14	10	7
Participating Building Owners / Facility Managers	17	10	9
Total	49	35	29

Note: HMG set the desired sample sizes based on the expectation that not all program participants would be available or willing to participate in the interviews.

HMG attempted to contact all pilot program participants for interviews. Interviewers contacted each participant at least four times, including at least one email and three phone calls.

Although HMG was able to interview all five of the program managers at the participating entities, achieved sample sizes for the other groups are slightly short of the desired values for the following reasons:

- HMG completed eight of the ten participating trade ally interviews desired. Reasons for this shortfall are as follows:
  - Three trade allies did not respond to requests for interviews
  - One was unable to participate in the interview process due to a family emergency
  - One trade ally had changed jobs since the completion of the comprehensive project and new contact information was not available
- HMG completed seven non-participating trade ally interviews instead of the ten desired. Reasons for this shortfall are as follows:
  - Five of these trade allies did not respond to requests for interviews
  - Two others had changed jobs and new contact information was not available
- HMG completed nine building owner and facility manager interviews instead of the ten desired. Reasons for this shortfall are as follows:
  - Two refused
  - Six others did not respond to requests for interviews

These small sample sizes require caution in projecting findings to the wider population. However, achieved sample sizes represent at least fifty percent of participants for each group (five of five utility program managers, eight of thirteen participating trade allies, seven of fourteen non-participating trade allies, and nine of seventeen building owners and facility managers).

Sections 6.2 through 6.4 below outline the key findings for each participant group, as well as overall findings from the combined responses.

Full interview guides for each group are included below in the following appendices:

- Appendix C: Utility Manager Interview Guide
- Appendix D: Trade Ally Participant Interview Guide
- Appendix E: Trade Ally Non-Participant Interview Guide
- Appendix F: Building Owner Interview Guide

2.5 Profile of Participating Projects

This report includes an analysis of seventeen projects completed prior to July 31, 2012, under the four programs funded by the CCLI pilot. To preserve the anonymity of the participating businesses, this report refers to each project by unique project identification number based on the participating entity territory where the project was located. HMG established the project identification numbers using the following formula:

[Project utility territory][Project chronological order per utility territory]

For example, HMG labeled the third project from the Idaho Power territory as "IDP3." Because the comprehensive pilot programs included design strategies specific to space types, the programs processed buildings with two separate space types as separate projects to allow easier verification of space-specific lighting strategies. When discussing the results of the comprehensive pilot projects, this report shows these projects as two separate entities. In these cases, HMG added a letter designation for the separate space types using the following formula:

[Project utility territory][Project chronological order][Space type designation]

or

[Project ID][Space type designation]

For example, some tables show project PGE3 broken down as PGE3a and PGE3b to distinguish the results of the warehouse retrofit from the office retrofit. However, in relation to traditional retrofit program practices, the report discusses them as a single project, in keeping with how traditional retrofit programs assess projects.

Table 2 shows a summary of the participating projects.

Table 2: Profile of Projects Participating in the Comprehensive Lighting Pilot

Project ID	State	Year	Area (sq. ft.)	Building Type	Participating Entity
NWE1	MT	2011	4,500	Office	NorthWestern Energy
PGE1	OR	2011	10,000	Office	ETO/PGE
PGE2	OR	2011	196,051	Warehouse	ETO/PGE
PGE3	OR	2011	31,850	Warehouse and Office	ETO/PGE
PGE4	OR	2012	26,166	Healthcare Common Area	ETO/PGE
IDP1	ID	2012	6,000	Warehouse	Idaho Power
PPL1	OR	2012	9,100	Office	ETO/PPL
PGE5	OR	2012	211,000	Manufacturing and Office	ETO/PGE
PGE6	OR	2012	14,555	Warehouse and Office	ETO/PGE
PGE7	OR	2012	380,310	Manufacturing	ETO/PGE
IDFP1	ID	2012	20,000	Warehouse	Idaho Falls Power
IDP2	ID	2012	6,000	Retail	Idaho Power
IDP3	ID	2012	30,000	Food Processing	Idaho Power
IDP4	ID	2012	68,000	Warehouse and Office	Idaho Power
IDP5	ID	2012	10,000	Retail	Idaho Power
NWE2	MT	2012	7,081	Service	NorthWestern Energy
IDFP2	ID	2012	27,000	Warehouse	Idaho Falls Power

Notes: All data provided by Evergreen Consulting.
ETO = Energy Trust of Oregon; PGE = Portland General Electric;
PPL =Pacific Power & Light

As Table 2 illustrates, the pilot projects spanned a variety of building types and a wide range of building sizes. The table shows the projects in chronological order of completion. For the sake of consistency, subsequent tables show the projects in this same order.

3. EVALUABLE MEASURES AND METRICS

Outlined below are the criteria that NEEA and Evergreen developed to define a "comprehensive" lighting retrofit. NEEA and Evergreen worked with HMG to define each criterion in order to facilitate evaluation of the participating projects against these criteria.

It is important to note that no single factor by itself makes a program comprehensive, but rather a combination of several or all of these factors. The characteristics shown below represent the final criteria and language agreed on by NEEA, Evergreen and HMG.

1. **Program incentives based on overall project kWh reduction (not equipment change-outs)**

   Programs must calculate energy use and savings from the overall actual operating hours of use of each fixture and space, and from the installed load before and after the project. This method is in contrast to the equipment change-out approach, in which utilities give a fixed incentive for each combination of old/new equipment (e.g., replacing a T12 fixture with a T8 fixture).

2. **Retrofit project incentives based on new construction practice**

   Programs should only award incentives to retrofit projects when the lighting installation as a whole meets the standards of practice expected in new construction. Trade allies should base retrofit practices on nationally recognized criteria, such as those of the 2009 International Energy Conservation Code (IECC) or American National Standards (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/IES Standard 90.1-2010. Utility programs should establish maximum lighting power density (LPD) thresholds for project eligibility.

3. **Tiered incentive rates**

   A key goal of a comprehensive program should be to maximize the "depth" of savings achieved in each project. One way to help do so is to provide progressively higher per-kWh incentives when projects achieve a level of energy use that is significantly below the baseline threshold established by the program.

4. **Light quantity and quality based on professional standards**

   Programs should ensure that projects are meeting nationally recognized standards for light quality (e.g., the criteria set out in the Illuminating Engineering Society of North America (IESNA) Handbook and/or the relevant IESNA Recommended Practices publication for that building type). Programs should:

   a. Measure illuminance levels on-site following the installation of the lighting system in at least ten percent of projects using a calibrated illuminance meter.

   b. Ensure that measured illuminance and uniformity levels, recorded by space type, are consistent with target values.

5. **Use design tools and templates**

   To ensure that projects meet lighting quality recommendations:

   a. Every project should include a calculation of illuminance level for each space, based on calculation methods approved by IESNA. Note that many luminaire manufacturers provide free software for this purpose.

   b. The program should provide guidance on calculations and design templates to participating contractors.

6. **Minimum equipment performance requirements**

   To maximize savings and ensure quality, utilities should continue to require performance thresholds or third-party certifications for fixtures and replacement lamps in their programs. Examples of third-party certifications include the Commercial Building Energy Alliance (CBEA) High Performance Troffer specification, ENERGY STAR certified LED replacement lamps, and the Design Lights Consortium certification for LED luminaires.

7. **All savings opportunities should be identified and presented**

   Because deep savings are a key goal of comprehensive programs, the program should require that the trade ally consider all lighting opportunities within the project space. This means that the ally and customer need to consider not just the ”low hanging fruit” retrofit options, but all opportunities for cost-efficient energy efficient lighting.

   Table 3, below, provides an outline of the lighting technologies that trade allies should recommend for each applicable retrofit project. The program should record whether each of the following technologies and approaches was suggested to the customer, and which were implemented in which types of space.

Table 3: Recommended Lighting Technologies by Space Type

Space Type	Recommended Lighting Technologies
All building/space types	Emergency/egress lighting controls (i.e., shut off when unoccupied) Automatic shut-off controls based on astronomical time clocks or vacancy sensors LED exit signs Dimming ballasts "tuned" to optimize illuminance level Load shedding/demand response Vacancy sensors with partial load control for corridors and stairways Monitoring/logging of energy use via central control system
Offices	Vacancy sensors for private offices (on/off) Occupancy sensors with partial load control for open offices Daylight controls Personal control of dimming ballasts Adjusting appropriate ballast factor High-performance lens kits Task ambient (desk lamps) Smart Plug strips
Warehouses	Skylights Optimized fixture distribution (narrow-beam optics) Integral daylight and/or occupancy sensors per fixture Optimized spacing of luminaires Occupancy sensors with partial load control for aisles/racks
Retail	Skylights LED spotlights Daylight control for window displays LEDs for display cases/refrigerator cases Proximity controls for display cases/refrigerator cases "Adaptation compensation" (i.e., reducing light levels when the store is open after dark) Lighting shut off after hours for security
Schools	Teacher wall lighting/control Vacancy sensors in classrooms AV/lighting controls Optimizing vertical illumination on walls
Exterior Lighting	Bi-level controls using occupancy sensors or "part-night" controls

Each participating utility crafted its comprehensive offering to best meet its needs. Because of this, the actual comprehensive offerings from the utilities did not always include each of the

measures described above. Table 4, below, provides an outline of the specific project requirements that each participating entity developed for its comprehensive program.

Table 4: Comprehensive Program Requirements by Participating Entity

	Energy Trust of Oregon	NorthWestern Energy	Idaho Power	Idaho Falls Power
LPD Requirement	Oregon Energy Code, 2009 IECC, or ASHRAE/IESNA 90.1-2007	2009 IECC, or ASHRAE/IESNA 90.1-2007	No LPD requirement	No LPD requirement
Lighting Controls	Required			
Light Level Requirement	IESNA Recommendations			
Uniformity and Spacing	Manufacturer or IESNA Recommendations			
Lighting Calculation or Template Requirement	Design Requirement Determined by Lighting Specialist (Evergreen)	Design Requirement Determined by Lighting Specialist (Evergreen)	Design or Template Required, as Determined by Lighting Specialist (Evergreen)	Design or Template Required, as Determined by Lighting Specialist (Evergreen)
Minimum Fixture Efficiency Requirement	≥80%	≥75%	≥78% recommended	≥78% recommended
Address All Lighting Opportunities	Required			

Note: Individual program data provided by NEEA.

As shown in Table 4, program requirements were not always consistent across the participating entities. For example, while the Energy Trust of Oregon and NorthWestern Energy used LPD requirements, Idaho Power and Idaho Falls Power did not. Minimum fixture efficiency requirements and the use of design templates also varied across the participating entities, with the Energy Trust of Oregon and NorthWestern Energy using specific fixture efficiency thresholds, while Idaho Power and Idaho Falls Power used fixture efficiency recommendations.

4. PROJECT TRACKING FOR EVALUABILITY

As guidance to NEEA and the program managers, HMG suggested a set of information that the programs should record to confirm meeting each of the "comprehensiveness criteria." HMG coordinated with NEEA and Evergreen to revise the reporting and tracking methods to better reflect the actual comprehensive programs. The final criteria and language are:

1. **Program incentives based on project kWh reduction (not equipment change-outs)**

   Worksheets should indicate how the kWh savings were calculated, using what baseline, and from what measured data, collected over what period of time.

2. **Retrofit project practices based on new construction practice**

   If possible, worksheets should record LPDs for each space, the square footage of the space, and any lighting controls used. Ideally, worksheets should note compliance with one or more codes or standards, along with the percentage by which the project exceeds the standard.

3. **Tiered incentive rates**

   Worksheets should record what incentive rate was offered to the customer and should reference how the incentive was calculated.

4. **Light quantity and quality based on professional standards**

   Post-installation inspections should ensure that measured light levels meet criteria for average illuminance set out in the IESNA Handbook and/or the relevant IESNA Recommended Practices publications.

5. **Use design tools and templates**

   Worksheet should record which entity is responsible for the lighting equipment choices and lighting layout, and which best-practices guidance the project followed, if any.

6. **Minimum equipment performance requirements**

   Worksheet should record fixture efficiency values, and whether these meet any established minimum efficiency requirements.

7. **All savings opportunities should be considered**

   For each space, the worksheet should record which of the strategies outlined in Table 3, above, were included in the incentive offer, and which strategies the program implementers verified as installed in the space.

Unfortunately, because this evaluation study did not begin until after the program had started, HMG, NEEA and Evergreen did not finalize these criteria until after the program was underway, and the participating utilities were not able to integrate many of these aspects into their lighting worksheets and documentation. In most cases, participating utilities used slightly modified versions of their existing lighting worksheets, which did not record most of the criteria listed above. Although the trade allies or lighting specialists may have recorded the information listed

above for each project, program worksheets used by participating entities did not record many of these details:

- All four lighting worksheets recorded kWh savings. All four worksheets were clear in calculating fixture savings, but one worksheet did not clear indicate estimated control savings.
- Only one of the four lighting worksheets recorded LPD values, and none of the four referenced any standards or maximum LPD limits.
- All four lighting worksheets showed the total incentive for each project, but only three indicated the incentive rate, and none of the worksheets referenced incentive tiers nor how the incentive rate was determined.
- None of the worksheets recorded any light quantity measurements such as illuminance levels.
- None of the worksheets recorded any information regarding lighting calculations or design templates.
- None of the worksheets recorded fixture efficiencies, although one did record fixture efficacy (lumens/Watt).
- None of the worksheets documented whether trade allies presented all lighting retrofit opportunities in the incentive offer.

5. IMPACT ANALYSIS

The sections below present the energy savings and cost-effectiveness results of the CCLI pilot program.

5.1 Overall Pilot Program Energy Savings

Using data provided by Evergreen, Table 5 shows the key characteristics and the validated savings of the pilot projects. As discussed in section 2.5, the table, arranged in order of completion, splits several projects into two lines because they comprise two space types.[3] Most projects were in either Oregon (47%) or Idaho (41%), and all seventeen projects were in urban areas. To distinguish between urban and rural areas, NEEA uses Rural Urban Continuum Codes (RUCC) which classifies geographical areas into one of nine different zones, based on zip code, with RUCC 1-5 classified as urban and 6-9 classified as rural.

The majority of the total 2,373,888 kWh savings came from manufacturing and food processing facilities (46%), and warehouses (31%). An additional 14% of the savings came from offices. The remaining savings were attributable to a mix of retail, service and healthcare common area spaces.

Trade allies completed four of the seventeen projects (24%) in 2011, with the remainder completed in 2012.

[3] As noted in Section 2.5, because the comprehensive pilot programs included design strategies specific to space types, the programs processed buildings with two separate space types as separate projects to allow easier verification of space-specific lighting strategies. When discussing the results of the comprehensive pilot projects, this report shows these projects as two separate entities (as in Table 5). However, in relation to traditional retrofit program practices, the report discusses them as a single project, in keeping with how traditional retrofit programs assess projects.

Table 5: Characteristics and Savings from Seventeen Pilot Projects

Project ID	State	Year	RUCC	Area (sq. ft.)	Building Type	Electric Utility	Validated Savings (kWh/year)
NWE1	MT	2011	3 (Urban)	4,500	Office	NorthWestern Energy	14,221
PGE1	OR	2011	1 (Urban)	10,000	Office	ETO/PGE	59,110
PGE2	OR	2011	1 (Urban)	196,051	Warehouse	ETO/PGE	281,827
PGE3a	OR	2011	1 (Urban)	26,350	Warehouse	ETO/PGE	66,624
PGE3b	OR	2011	1 (Urban)	5,500	Office	ETO/PGE	15,909
PGE4	OR	2012	1 (Urban)	26,166	Healthcare Common Area	ETO/PGE	90,382
IDP1	ID	2012	2 (Urban)	6,000	Warehouse	Idaho Power	54,219
PPL1	OR	2012	1 (Urban)	9,100	Office	ETO/PPL	26,855
PGE5a	OR	2012	1 (Urban)	200,000	Manufacturing	ETO/PGE	460,423
PGE5b	OR	2012	1 (Urban)	11,000	Office	ETO/PGE	109,768
PGE6a	OR	2012	1 (Urban)	11,500	Warehouse	ETO/PGE	56,199
PGE6b	OR	2012	1 (Urban)	3,055	Office	ETO/PGE	5,414
PGE7	OR	2012	1 (Urban)	380,310	Manufacturing	ETO/PGE	529,724
IDFP1	ID	2012	3 (Urban)	20,000	Warehouse	Idaho Falls Power	93,945
IDP2	ID	2012	2 (Urban)	6,000	Retail	Idaho Power	57,426
IDP3	ID	2012	5 (Urban)	30,000	Food Processing	Idaho Power	90,310
IDP4a	ID	2012	2 (Urban)	40,000	Office	Idaho Power	91,586
IDP4b	ID	2012	2 (Urban)	28,000	Warehouse	Idaho Power	104,479
IDP5	ID	2012	2 (Urban)	10,000	Retail	Idaho Power	38,057
NWE2	MT	2012	3 (Urban)	7,081	Service	NorthWestern Energy	11,261
IDFP2	ID	2012	3 (Urban)	27,000	Warehouse	Idaho Falls Power	116,229
TOTAL				1,057,613			2,373,888

Notes: All data provided by Evergreen Consulting. The respective utilities have validated all energy savings values shown in this table. ETO = Energy Trust of Oregon; PGE = Portland General Electric; PPL =Pacific Power & Light; RUCC = Rural Urban Continuum Code

5.2 Project Cost Effectiveness from Building Owners' Perspective

The subsections below outline the results of the cost-effectiveness calculations described in section 2.3.2. Because of the small scale of the pilot program, and the large investment in trade ally training and project support from Evergreen, NEEA chose to investigate cost-effectiveness on a project-by-project basis (or from a building owner perspective), in order to determine whether a comprehensive lighting retrofit was a better investment than a traditional one focused on one-for-one technology replacements.

5.2.1 Incremental Cost-Effectiveness and Internal Rate of Return

Table 6, below, shows the results of the calculations of the incremental cost-effectiveness and IRR for each project individually, as well as totaled for all the projects in the pilot program. As described in section 2.3.2 above, this analysis considers any project with an incremental cost-effectiveness ratio greater than one to be cost-effective as compared to a traditional retrofit alternative.

In several cases, the comprehensive project cost was equal to or less than the traditional cost (the comprehensive approach provided incentives for removing fixtures instead of replacing them, which sometimes resulted in lower project costs). All these projects are cost-effective, as they provide more savings than a traditional retrofit approach, at equal or less cost. The table indicates these projects with an asterisk for the incremental cost-effectiveness ratio, as the typical ratio calculation does not work with negative or zero values.

As Table 6 shows, this assessment found that only three of the seventeen projects were not cost-effective when compared to the traditional retrofit alternative. In addition, the total of all program projects was cost-effective compared to traditional retrofits, delivering more energy savings, at a lower overall cost to the building owners.

The IRR calculated for each project suggests that the comprehensive projects were usually a good investment for the owners of the respective buildings. The question of what constitutes a "good" investment will vary depending on the investment strategies of each building owner as well as prevailing economic conditions at the time. However, considering current interest rates as well as bonds and mutual funds, this evaluation considers a project with an IRR of five to seven percent to be a good investment. The IRRs for the comprehensive retrofit projects ranged from 2% to 48%. Only two projects had IRRs less than 5%.

Appendix A: Cost-Effectiveness Calculation Details contains detailed information on the calculations used to determine incremental cost-effectiveness.

Table 6: Incremental Cost-Effectiveness and Internal Rate of Return

Project ID	Incremental Lifecycle Savings ($)	Incremental Cost ($)	Incremental Cost-Effectiveness Ratio (Savings/Cost)	Internal Rate of Return
NWE1	$622	$1360	0.46	16%
PGE1	$3,778	$0	*	24%
PGE2	$38,803	$539	71.99	48%
PGE3	$5,937	$4,089	1.45	21%
PGE4	$22,184	-$62,363	*	4%
IDP1	$3,362	$4,122	0.82	43%
PPL1	$10,886	-$1,652	*	11%
PGE5	$45,674	-$1,759	*	19%
PGE6	$9,180	$12,900	0.71	23%
PGE7	$9,376	-$4,325	*	21%
IDFP1	$15,071	$0	*	37%
IDP2	$9,770	-$3,205	*	22%
IDP3	$17,175	$11,071	1.55	31%
IDP4a	$14,787	$2,250	6.57	36%
IDP4b	$15,999	$13,854	1.15	31%
IDP5	$3,155	$1,050	3.00	48%
NWE2	$2,523	$2,424	1.04	2%
IDFP2	$20,102	$16,739	1.20	21%
All Projects	$248,387	-$2,906	*	17%

*For these projects, incremental cost was either zero or negative. These projects are cost-effective as they resulted in more savings at the same or lower cost than traditional programs.

5.2.2 Comprehensive Cost-Effectiveness

In addition to the incremental cost-effectiveness presented above, HMG assessed the cost-effectiveness of each project, independent of traditional program practices, to determine if the projects were cost-effective on their own. Table 7 shows the cost-effectiveness ratios for the comprehensive projects, independent of the traditional retrofit program alternatives. Again, a cost-effectiveness ratio greater than one is considered cost-effective (savings are greater than costs). The table shows cost-effectiveness ratios both with and without program incentives. As Table 7 illustrates, all of the comprehensive projects were cost-effective on their own when the incentive is included. When the incentive is not included, three of the comprehensive projects were not cost-effective from an owner's perspective. The cost-effectiveness of the projects

without the incentives also suggests that the value of the energy savings from a comprehensive lighting retrofit justifies the incentive cost to the utilities in most cases.

Table 7: Comprehensive Cost-Effectiveness Ratios

Project ID	Comprehensive Lifecycle Savings ($)	Comprehensive Cost After Incentive ($)	Comprehensive Cost-Effectiveness Ratio (Savings/Cost)	Comprehensive Cost Without Incentive	Comprehensive Cost-Effectiveness Ratio Without Incentive (Savings/Cost)
NWE1	$13,767	$6,560	2.10	$8,360	1.65
PGE1	$37,713	$14,102	2.67	$28,204	1.34
PGE2	$176,877	$37,770	4.68	$75,539	2.34
PGE3	$51,556	$20,851	2.47	$42,143	1.22
PGE4	$56,465	$46,202	1.22	$64,278	0.88
IDP1	$23,872	$5,656	4.22	$13,746	1.74
PPL1	$18,575	$10,808	1.72	$20,207	0.92
PGE5	$348,367	$148,942	2.34	$315,459	1.10
PGE6	$38,489	$14,616	2.63	$28,348	1.36
PGE7	$304,563	$123,238	2.47	$243,526	1.25
IDFP1	$43,763	$11,606	3.77	$19,000	2.30
IDP2	$22,565	$8,848	2.55	$17,049	1.32
IDP3	$35,486	$10,739	3.30	$21,246	1.67
IDP4a	$35,987	$9,753	3.69	$23,527	1.53
IDP4b	$41,054	$12,572	3.27	$28,244	1.45
IDP5	$14,954	$3,202	4.67	$8,911	1.68
NWE2	$8,713	$7,592	1.15	$10,424	0.84
IDFP2	$58,176	$23,836	2.44	$37,739	1.54
All Projects	$1,330,942	$516,893	2.57	$1,005,950	1.32

6. PROCESS ANALYSIS

The following sections outline the results and findings of the program implementer group discussion, as well as the program participant interviews.

6.1 Program Implementers

As described in section 2.4, on June 25, 2012 HMG conducted a group discussion with five program implementers from Evergreen representing all utility territories as well as overall pilot program management. The subsections below present the findings from this group discussion, including successes, challenges, recommendations, and other observations. Group discussion findings fall into the following categories:

- Education and Training
- Program Management
- Program Design and Incentives
- Project Achievements
- Market Trends and Transformation
- Regional Coordination

Sub-sections include only those categories discussed for the respective sub-topic. For example, Regional Coordination does not appear in the Challenges and Barriers sub-section, because the implementers did not mention that it was a challenge.

6.1.1 Successes

Education and Training

Program implementers identified the education and training provided through the program as a main area of success. The training provided through the pilot program was one of the few technical trainings on comprehensive lighting retrofits offered in the NEEA territory. By contrast, many standard utility program trainings only consist of how to fill out program forms.

Trade ally training offered through the CCLI pilot program has helped increase participant knowledge in a broad range of topics, including what constitutes comprehensiveness, new lighting strategies and the basics of lighting design, new technologies, lighting controls, and how to identify light quality aspects and opportunities in their projects. Program implementers described the trainings as "opening the trade allies' eyes" to new opportunities and new strategies that they had not traditionally considered. Trainings were intentionally ambitious; setting a high bar for top-performing trade allies in order to see what level of achievement was possible for the program.

While training was an investment for trade allies because of the time commitment (see Challenges), the program provided free training, unlike many similar technical training options, such as IES lighting courses. The program implementers also reported that trade allies felt a sense of privilege in being included in the limited group of trade allies selected to participate in

the pilot program. The implementers also reported that trade allies have used the tools to apply comprehensive strategies in their own projects, and some have passed on their knowledge to others at their company, or other market actors.

The trainings have also influenced trade ally practices beyond the pilot program. In one of the participating utility territories, following a training on lighting controls, program implementers saw a 40% increase in the use of controls in participating trade allies' projects.

Program Management

The program implementers all agreed that, overall, the NEEA program manager has done an outstanding job shaping a program that started out with few specifics and little direction. She also went into the field, which many program managers are resistant to do.

Another success identified by the implementers was the program manager's willingness to let the program implementers experiment, so they could improve the program.

Program Design and Incentives

Evergreen worked with the participating utilities to provide appropriate incentive structures for the pilot program, with varying degrees of success. The flexibility to adjust the incentives during the pilot program also helped identify appropriate incentive structures that provided sufficient motivation while controlling overpayment. However, some utilities struggled to develop an appropriate incentive structure sufficiently differentiated from other program offerings.

For Idaho Power, Evergreen created a calculator that compared incentives under the prescriptive approach to those under the comprehensive approach, to show the additional incentive payment from the comprehensive approach.

Project Achievements

Overall, the program implementers reported that the pilot projects are achieving higher savings and higher quality installations (e.g., appropriate light levels and better color rendering), than projects under typical one-for-one programs. In many instances, trade allies were able to change projects that started out as prescriptive to meet the comprehensive program requirements once building owners learned about the benefits of taking a more comprehensive retrofit approach.

The program implementers also saw trade allies adopt more of the practices encouraged in the comprehensive program following the trainings, including (in order of prevalence) de-lamping, de-lamping with retrofit kits, de-commissioning fixtures, and installing controls. These occurred on projects that did not meet all of the comprehensive requirements and are thus not included in this analysis, but they were improved because of the offering.

Market Trends and Transformations

The program implementers reported that the CCLI pilot program had already begun to influence the lighting retrofit market. For the program implementers, one of NEEA's main values is its ability to create programs and opportunities outside the normal approaches of utility programs which help transform the market. The comprehensive lighting pilot has pushed both utilities and

trade allies "out of their comfort zones," and has "opened some eyes" about what comprehensive lighting means, and how to achieve it.

According to program implementers, the program made "something out of nothing." While there were very few comprehensive lighting programs in the region before, there now appears to be real interest in a comprehensive approach among utilities and trade allies. The pilot program instigated discussions with the utilities on comprehensive approaches to lighting retrofits. Program implementers reported that most utilities in the NEEA territory were aware of the pilot, even if they did not directly participate. External market forces, like the upcoming phase-out of T12s, have helped make the utilities more receptive to a comprehensive program approach as they are looking for strategies to fill the void when they no longer offer incentives for T12 change-outs. Comprehensive approaches, as well as LEDs and controls, may help to fill that void.

The CCLI has also influenced the practices of the trade allies. The program implementers described at least one example of spillover from the pilot program: A contractor active in a comprehensive lighting program territory used a comprehensive approach in a utility territory that was not part of the pilot.

Regional Coordination

The program implementers reported that the pilot program has encouraged regional discussions and interaction on the need for comprehensive lighting program approaches in the future. One of the NEEA program manager's successes has been her ability to facilitate regional discussions and to bring diverse stakeholders to the table for discussions.

6.1.2 Challenges and Barriers

The challenges and barriers identified by the program implementers tended to be closely related to the successes they described. The sections below summarize these challenges and barriers, grouped into the same categories described above.

Education and Training

Although program implementers mentioned education and training as one of the main successes of the pilot program, they also mentioned it as one of the key challenges of the program. Overall, the implementers suggested that trade allies need more training and more experience to successfully apply comprehensive lighting strategies in their projects, presenting a barrier to this pilot and to future lighting program initiatives.

While the trainings are significant, a single eight-hour session is not enough to fully transition a contractor from a one-to-one retrofit approach to a comprehensive one. Understanding appropriate LPDs and light levels for a given space is a key aspect of the learning process. However, the primary source for light level recommendations, the IES Lighting Handbook (DiLaura et al. 2011), is long and complicated, and the latest versions of the light level charts can be difficult to interpret for the uninitiated.

The trainings represent an opportunity cost to trade allies. Time spent in trainings is time that trade allies could be spending in the field installing or selling new projects. Although the trainings are free, trade allies received no compensation for their time.

Program implementers reported that some market actors – including some trade allies and some utility program staff – are simply set in their ways and resistant to change. Some trade allies have struggled to understand and communicate the added value that comprehensiveness brings to their projects, including increased light quality and reduced maintenance.

Program Design and Incentives

Similar to the education and training challenges described above, the program implementers found that some utility staff and trade allies had trouble adapting to the requirements of the comprehensive program. The comprehensive approach requires more work per project, including additional program requirements, and new or different paperwork. Some trade allies have the perception that the time investment required of a comprehensive project does not have the financial payback to make their efforts worthwhile.

Another barrier has been overly onerous program requirements in some cases. For example, NorthWestern Energy required room-by-room information, including the square footage of each room, which trade allies considered too time-consuming compared to the typical whole building approach. The other three participating utilities did not have the room-by-room requirement.

The short time span of the pilot program may have also limited more widespread adoption. The sales cycles of some projects can be very long (on the order of years) and the pilot program did not accommodate this.

Incentive structures also posed a challenge to the participating utilities and trade allies. Incentives were not always high enough (relative to prescriptive incentives) to convince the trade allies to use a comprehensive approach. One potential solution may be reducing incentives for prescriptive projects, but this could reduce overall (portfolio-level) savings. In addition, incentive structures were not always clear to the trade allies, making it difficult for them to understand the differences between prescriptive and comprehensive incentives.

Program implementers stated that both they and trade allies are concerned about liability issues that arise from retrofit approaches with which they are unfamiliar. For example, if the building owner complains that the final project delivers too little light or that the control systems do not work properly, the blame will fall on the trade ally, and perhaps on the Evergreen "lighting specialists" if they were involved in the design.

Energy Codes and Performance Standards

The program implementers reported that references to energy codes have been a significant challenge in the implementation of the comprehensive lighting initiative pilot. They noted that energy codes and enforcement practices vary by jurisdiction, and lighting retrofit market actors, including utilities and trade allies, are often hesitant to discuss code requirements or compliance with their customers. However, the program implementers believe that utilities cannot provide incentives unless retrofit projects go beyond code.

6.1.3 Program Implementer Recommendations

Education and Training

The program implementers suggested that if the pilot is scaled up to a full program, NEEA could create a hotline for participating trade allies to call a lighting specialist or the Lighting Design Lab[4] for guidance on comprehensive lighting strategies. This could be especially useful for trade allies in territories where the utility does not have a lighting expert.

NEEA could also help create a financial analysis tool that trade allies could use to communicate the added benefits of the comprehensive approach to their customers. Ideally, the tool would include the costs of the design (less the incentives), and all savings, including savings from reduced energy use and reduced operation and maintenance, and include a net present value calculation (i.e., go beyond simple payback). The results of the tool would show return on investment (ROI) or other financial metric. NEEA would also need to deliver training on how to use the tool.

Simplified design resources and guidelines could also be more useful to trade allies. For example, there is a need for a simplified version of the new IES light level recommendations.

Program Design and Incentives

The program implementers recommended that the comprehensive lighting program should be more flexible and not overly complicated. Rather than providing specific checklists of requirements or performance metrics, the program should provide recommendations or best practices for trade allies to follow on their projects.

Stakeholder Communication and Relationships

In order to encourage broader acceptance of comprehensive lighting programs, NEEA could host a regional discussion on the CCLI pilot and the comprehensive approach. NEEA could create a document of recommended guidelines, including lighting power density, and simplified IES guidelines for utilities to create a comprehensive program. The document could also include a list of successful comprehensive lighting programs.

6.1.4 General Observations and Lessons Learned

Education and Training

Response to the trainings among the trade allies varied widely. Some embraced the comprehensive approach and submitted multiple projects, others only submitted one or two, and still others who attended the training did not submit any projects. Similarly, some trade allies changed their practices to adopt comprehensive strategies, while others merely documented aspects of the comprehensive approach that they already doing.

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[4] A Northwest utility funded lighting education facility promoting commercial and industrial energy conservation located in Seattle. For more information, see http://lightingdesignlab.com/.

The trade allies also have diverse lighting backgrounds. Some are electrical contractors that only recently started including lighting in their portfolio, while others have extensive lighting expertise. This range of experience leads to diverse training needs.

There are no clear trends on what type of trade ally leads to successful participation in the program. Some of the less experienced trade allies were very successful in the pilot program and embraced the comprehensive approach. One of the most successful trade allies cited by the program implementers is a lighting efficiency consultant that generally subcontracts the installation work.

Program Management

Utility involvement in the pilot program also varied. While some utility program managers coordinated with program implementers to help shape the program, others did not take an active role.

Program Design and Incentives

NEEA's comprehensive lighting pilot was distinct from other lighting programs in the region in that it offered higher incentive rates in exchange for meeting higher performance thresholds and requiring more knowledgeable trade allies.

One word program implementers all used to describe the pilot program was "variability." Program requirements and incentive structures varied among the participating utilities. Individual project success also varied depending on the trade allies and the project needs. Consumer awareness of the pilot initiative varied, too, as trade allies often rolled the incentive into the total project cost. Project owners may not have even realized they participated in the pilot program.

Incentive structures and rates also varied over the course of the pilot. An early version of the pilot program in one utility territory included a cash sales performance incentive fund (SPIF) for the trade ally. However, the SPIF usually went to the trade ally company rather than the person doing the work, so it was not a significantly motivating factor. The program implementers later switched to giving the trade allies tools such as light meters. Trade ally personnel were excited about the tools, but the main motivation for program participation continued to be the number of projects they could sell.

Market Trends and Transformations

Energy savings may be the primary benefit for owners to pursue lighting retrofits, but it is not the only aspect they consider. Owners are also attracted to strategies that control operating and maintenance costs, and/or that improve light quality. The "third-party" endorsement of lighting strategies that the utilities provide through their programs is also important to customers.

Since the real estate collapse of 2008 that led to a major recession, program implementers have seen an increase in trade allies who did not previously work on lighting projects, but have incorporated lighting into their offerings, sometimes by bringing in another contractor. For example, in some cases, HVAC companies are now working on lighting projects as well.

The program implementers believed that some of the pilot program participating entities, such as The Energy Trust of Oregon and Idaho Power, would likely continue some version of the comprehensive lighting program after the pilot. At Idaho Falls Power, staff changes make the future of comprehensive lighting programs uncertain. However, Bonneville Power Administration (BPA), which supplies part of Idaho Falls Power's portfolio, may incorporate components of the comprehensive lighting pilot into future lighting program efforts. (HMG notes that NEEA or Evergreen could also reach out to the incoming program manager at Idaho Falls to continue a comprehensive lighting program.) At NorthWestern Energy, a comprehensive lighting program will probably continue (the pilot leveraged an existing program), but without the training component. The program implementers reported that the utilities are generally aware that the T12 phase-out will eliminate much of the "low-hanging fruit" for lighting program savings, and they will have to adjust their program offerings.

6.2 Utility Program Managers

As described in section 2.4.2, HMG interviewed each of the five program managers involved with the CCLI across the four participating entities (Energy Trust of Oregon had two program managers working on the pilot program, one for commercial projects and one for industrial projects). The utility program manager interviews focused primarily on the successes and challenges of the CCLI pilot program.

Some key successes of the pilot program mentioned by the utility program managers were as follows:

- All five reported that the training and coaching offered by the program increased the skill level of the trade allies and gave them a sales advantage with customers.
- All five also mentioned the coaching and training as a key factor in transforming the market toward comprehensive retrofit approaches.
- Three mentioned that the new construction standards and whole project approach provided high quality projects to customers and addressed all opportunities for each building.
- Four reported that the structure of the CCLI pilot (that is, that it was developed and managed by Evergreen and NEEA) and the advanced nature of the program helped free up utility resources to prepare for the upcoming federal regulations, and helped extend the reach of the utilities to more potential participants.
- In response to a question asking what was most successful about the CCLI pilot, one of the five utility managers stated that the pilot program was not successful.

Some key challenges mentioned by the utility program managers were as follows:

- Three mentioned challenges bringing trade allies into the CCLI pilot program for various reasons:
  - Three program managers reported challenges in getting the trade allies to approach projects from a whole project perspective rather than the traditional component-based retrofit approach.

  - One also reported that trade allies' design skills are generally lacking, and that participating trade allies were learning as they went along on their comprehensive projects.

- Three reported that the CCLI pilot required more paperwork and administration, and took longer to process incentive payments than traditional programs.
- One stated that the pilot program timeline was too short to enroll and complete projects.
- Two reported that the higher initial cost of the comprehensive projects was a barrier for some owners.
- Three mentioned challenges designing the incentives for the CCLI to provide the appropriate motivation for participation. Each utility structured their CCLI incentives as they saw fit.
  - One reported that incentive bonuses on other programs might have undercut the CCLI in that market.
  - Two reported that for some projects existing traditional or custom programs offered competitive incentives with less administrative burden than the CCLI.
- One reported that the primary challenge with the CCLI pilot was a lack of communication from NEEA and Evergreen regarding program status and details.
- One utility manager reported that the structure of the CCLI pilot in that territory was too similar to the existing custom offering.

In general, utility program managers reported that the trade ally training and coaching provided by Evergreen was very successful. However, they also reported that administrative challenges such as increased paperwork, longer wait times for approvals and incentives compared to traditional programs, and the brief pilot period limited the effectiveness of the program.

6.3 Trade Allies

As described in section 2.4.2, HMG interviewed a total of fifteen trade allies or installing contractors. All fifteen participated in the initial training offered through the program, but only eight of those fifteen completed at least one comprehensive project through the CCLI pilot program. This report refers to those trade allies who completed a comprehensive project as "participating trade allies," and those who did not as "non-participating trade allies."

6.3.1 Responses from All Trade Allies

Figure 1, below, shows the roles that each trade ally's company plays in a typical retrofit project, separated by participating and non-participating trade allies.

Figure 1: Trade Ally Company Role

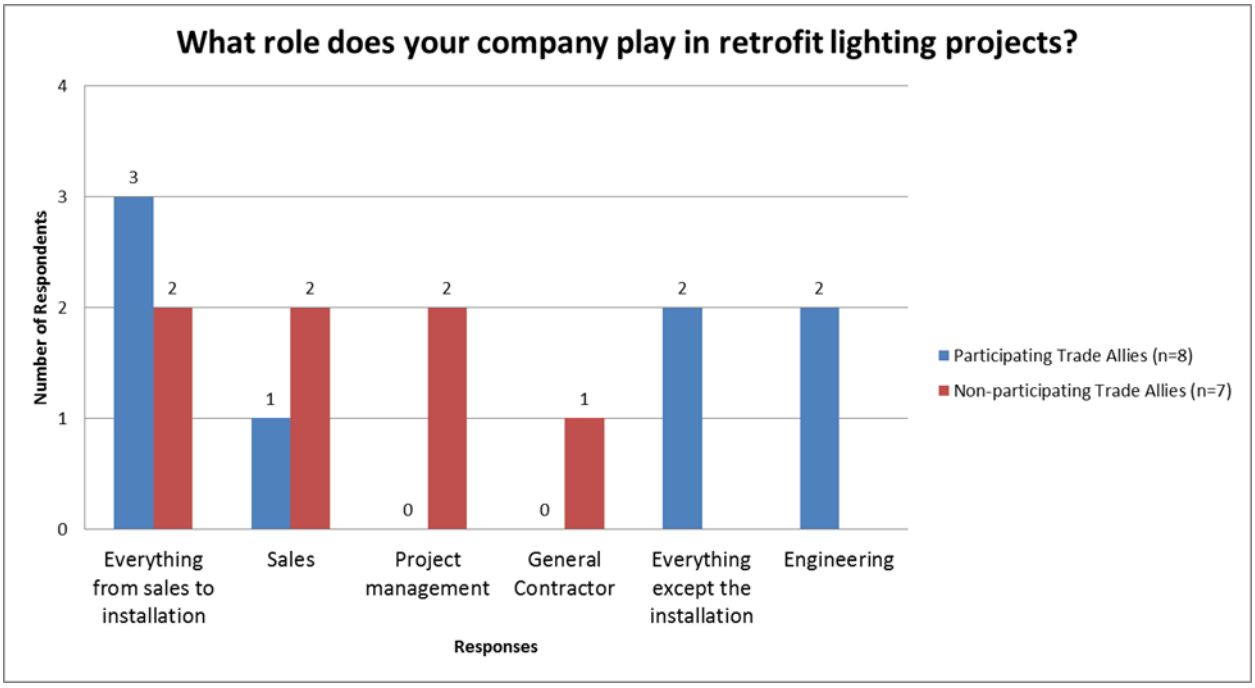

Figure 1 shows that trade ally companies participating in the CCLI play a wide variety of roles. However, perhaps more telling are the roles that the individual trade allies play in lighting retrofit projects. Table 8, below, provides an outline of the roles that the individual interviewees play in lighting retrofit projects. Although these results are not statistically significant,[5] of the interviewed trade allies, those who reported being involved in all aspects of their projects appear more likely to have completed a comprehensive project (four of five) than their counterparts who were not involved in all project aspects (four of ten).

[5] Chi-squared with Fisher's exact test for small sample sizes (n=15), confidence interval of 1%.

Table 8: Trade Ally Individual Role

What is your role in lighting retrofit projects?		
	Participating Trade Allies (n = 8)	Non-Participating Trade Allies (n = 7)
Involved in all aspects of the project	4	1
Sales	2	4
Design	1	0
All aspects except installation	1	2

When asked why clients sometimes decline to pursue comprehensive projects, trade allies responded as follows, with the predominant answer being financing and upfront costs:

- Ten of the fifteen trade allies cited financing and upfront costs.
- Two cited a lack of customer understanding of the program.
- Two cited the length of time it takes to complete the projects.

Finally, HMG asked all trade allies if their participation in the CCLI would influence how they approached lighting retrofit projects in the future. Participant and non-participant groups provided nearly identical responses. Table 9 summarizes these responses.

Table 9: Influence of CCLI on Future Retrofits

Has your participation in the pilot program influenced how you will approach lighting retrofits in the future?		
	Participating Trade Allies (n = 8)	Non-Participating Trade Allies (n = 7)
Yes	4	4
No	4	3

Of those who said their participation would influence their future projects (n = 4, in both groups), three respondents in each group said it made them more aware of the options available for projects. One respondent in each group said they would do fewer traditional one-for-one retrofits.

6.3.2 Responses from Participating Trade Allies

The interview asked the eight participating trade allies about differences they noticed in their comprehensive projects, as compared to traditional programs. The two most common responses were "higher incentives" and "comprehensive projects are larger in scope and cost than traditional programs." Responses break down as follows:

- Three of the eight cited higher incentives.
- Two mentioned that comprehensive projects were larger in scope and cost than traditional programs because the CCLI required each project to address the entire building.
- One mentioned that overall participation in the CCLI took longer than traditional programs, including receiving necessary approvals and payment of incentives.
- One mentioned that customers are more satisfied with the end result.
- One noticed no difference.

When asked about the benefits of the comprehensive approach, three participating trade allies cited the full-building solutions that the program provides, and two mentioned the higher incentives and higher energy savings.

Asked if they had applied comprehensive principles in other retrofit projects outside of the pilot, half of the participating trade allies (four of eight) said yes, the other half said no.

When asked about challenges of the comprehensive approach, interviewees divided their responses almost equally among the following three answers:

- Three cited the added time to complete the project and process the incentives.
- Two cited the additional design requirements.
- Two mentioned the challenge of explaining the comprehensive approach to customers.

The interview asked participating trade allies how satisfied they were with the incentives provided by the CCLI. Almost all respondents were satisfied, three "extremely" so and four "somewhat." One respondent reported being "extremely unsatisfied."

There was little consistency in the responses relating to motivations and barriers for the participating trade allies. However, when asked about what barriers customers face, a majority (five of eight) cited the higher cost of comprehensive projects.

HMG asked these trade allies how successful they thought the program was. The majority (six out of eight) rated the program as "somewhat" or "extremely" successful:

- Three said the program was extremely successful.
- Three stated it was somewhat successful.
- One said it was neither successful nor unsuccessful.
- One said it was extremely unsuccessful.

The respondent who rated the program "extremely unsuccessful" was the same respondent who was "extremely unsatisfied" with the incentive provided by the program.

HMG also asked how well run participating trade allies thought the program was. The majority (seven of eight) said the program was either "somewhat" or "extremely" well run:

- Two said the program was "extremely well run."
- Five said the program was "somewhat well run."
- One said the program was "neither well run nor poorly run."

Finally, when asked which aspects of the CCLI were most effective in moving the market toward comprehensive lighting retrofits, four of the eight respondents cited the higher incentives. One respondent mentioned utility endorsements, one cited added education, one reported lighting tools, and one had no response.

6.3.3 Responses from Non-Participating Trade Allies

The interview asked seven non-participating trade allies if the CCLI training had adequately prepared them to deliver comprehensive projects, and all seven respondents said yes. The interview also asked an open-ended question about what additional training would help trade allies better understand the comprehensive approach. Five of the seven said "none," one mentioned more training on controls, and the other suggested better training on how the incentives work. HMG also asked non-participating trade allies whether they had projects enrolled in the CCLI and then dropped out. This was not the case for any of the respondents. When asked if they had used comprehensive approaches on projects outside of the CCLI, only one of the seven interviewees said yes.

When asked what additional resources NEEA or their local utility could provide to help them sell comprehensive retrofits, the most common answer was "none" (three of seven). Other responses included more building owner education and outreach (two of seven), higher incentives to compensate for added design work (one of seven), and additional sales tools like case studies (one of seven).

6.3.4 Conclusions

Overall, most participating trade allies were either somewhat or extremely satisfied with the incentives provided by the CCLI, and most thought the program was either somewhat or extremely successful. The increased incentives were the most common motivator for trade allies to pursue a comprehensive project. The most common challenge for the trade allies was the added administrative burden of the program, which resulted in slower projects and longer wait times to receive incentive payments.

Responses from non-participating trade allies do not present any clear conclusions, but some responses suggest that the CCLI may simply have not been a good fit for their business models, their levels of experience or their client bases.

6.4 Building Owners and Facility Managers

As described in section 2.4.2, HMG interviewed nine building owners or facility managers, out of a total of seventeen who participated in the CCLI pilot program. Of those nine, only one was the building owner, while the other eight interviewees were responsible for building maintenance or management. Job descriptions for the group broke down as follows:

- Four property managers
- Three operations managers
- One president of the company
- One energy specialist

Most of the respondents (six of nine) were responsible for only one building.

Less than half (four of nine) of the respondents were aware that their retrofit projects were part of the CCLI pilot program.

When asked about motivations for pursuing lighting retrofits, respondents most often cited energy and cost savings, and improved lighting quality:

- Four cited energy or cost savings.
- Three mentioned improved lighting quality.
- One reported financial incentives.
- One cited the T12 phase-out.
- None mentioned reduced maintenance as a motivation.

Respondents cited few barriers to participation in lighting retrofits, equally split among the following three answers:

- The cost of a retrofit (three)
- A lack of understanding of program measures (three)
- No barriers to participation (three)

When asked specifically about motivations for participating in a comprehensive retrofit, interviewees gave more varied responses. The most common motivation was providing the best overall solution for the building, as cited by three respondents. Two respondents cited energy and cost savings.

When asked about barriers specific to participating in a comprehensive retrofit, four respondents cited the upfront cost, while three stated there were no barriers to a comprehensive retrofit approach for them.

The interview asked building owners if they were aware of the T12 phase-out, and eight of the nine said that they were. When asked how they planned to respond to the phase-out, the vast majority (seven of the nine) responded that the retrofit project completed under the CCLI had replaced all their T12s. One respondent stated that they plan to participate in more programs to

replace remaining T12s, and one respondent said they would wait and continue using T12s they already have.

The following paragraphs discuss the results of questions about the specific comprehensive projects undertaken by interviewees. One of the respondents did not have direct knowledge of the details of the retrofit project and did not answer these questions. The following paragraphs discuss the responses of the remaining eight interviewees.

Five respondents mentioned noticing a difference in the CCLI project from other lighting retrofit projects. Those differences were as follows:

- Three mentioned better lighting quality.
- One cited a different set of measures.
- One mentioned the higher cost of the comprehensive project.

HMG asked the respondents what, if any, benefits they had noticed from the retrofit, and their responses were as follows:

- Two mentioned better lighting quality.
- One reported higher energy savings.
- One mentioned reduced maintenance.
- Four cited all of the above benefits.

Four respondents each cited higher energy savings, and better lighting quality, respectively, as the most important benefits of the comprehensive retrofit for them.

When asked about challenges with the comprehensive project, the most common response was a lack of understanding of the specific measures involved. All eight respondents reported no problems with the utility incentive program as the installing contractor handled all program issues.

When asked if they would be interested in using a comprehensive approach on other retrofit projects, three respondents said "yes," two said "no," and three said "maybe." The interview also probed to assess what contributed to that response. Of those respondents who said "yes" (three of eight), two reported that their projects ran smoothly and they were happy with the results, but one reported that they would need to more closely review the savings versus the costs before making a decision. Of those who said "maybe" (three of eight), one was not the final decision-maker on such issues, and the other two only managed the one building which already completed a comprehensive retrofit. Of those who said "no" (two of eight), both were only responsible for the one building that had already completed a comprehensive retrofit.

Overall, when asked about their satisfaction with their comprehensive retrofit projects, most were satisfied:

- Four reported being extremely satisfied.
- Three were somewhat satisfied.
- One was somewhat unsatisfied.

In summary, most building owners and facility managers cited energy savings as the primary motivation for pursuing a lighting retrofit. However, project cost is a common barrier for the owners. Three of the nine respondents cited project cost as a barrier to lighting retrofits in general, and four of the nine respondents cited project cost as a barrier to comprehensive projects specifically, suggesting that cost may be more of a barrier for comprehensive projects than for traditional retrofits. Overall, seven of the participating building owners/facility managers were either somewhat or extremely satisfied with the results of the retrofit, and only one was somewhat unsatisfied (one other was not familiar with the specific conditions at the project site). Of the eight respondents who were familiar with the project outcomes, three expressed interest in using a comprehensive approach on future projects, although one of those three said they would want to look more closely at the savings versus the cost before deciding. The other five respondents who said "maybe" (two of five) or "no" (three of five) were only responsible for the one building that had already been retrofitted (four of five), or were not the final decision maker (one of five). This may suggest that some of these respondents might be interested in pursuing additional comprehensive projects given the opportunity, but it was not clear from the responses.

7. CONCLUSIONS AND RECOMMENDATIONS

The following sections summarize the findings of HMG's evaluation activities, and provide recommendations for future implementation or expansion of similar comprehensive lighting retrofit programs.

7.1 Evaluation Findings

7.1.1 Evaluable Measures and Metrics and Project Tracking for Evaluability

Although NEEA and Evergreen, developed specific criteria and tracking methods for comprehensive projects in coordination with HMG, by the time NEEA, Evergreen and HMG finalized these standards the program was well underway and the participating utilities had developed their own criteria for comprehensive lighting projects. Some of the participating utilities were resistant to including certain requirements such as maximum lighting power density limits, due to the varying market forces across the Northwest region. In the end, the comprehensive criteria were not specific, well defined, or evaluable, due to a need to accommodate program activities that were already underway.

In addition, because there were no uniform criteria for project tracking and reporting across the participating utilities, project tracking and reporting did not include several of the key factors of the comprehensive strategy, such as light levels and lighting power densities.

7.1.2 Impact Analysis Conclusions

In total, the CCLI pilot program resulted in 2,373,888 kWh of annual lighting energy savings, spread across seventeen projects. Due to the locations of the participating utilities, the bulk of the projects were in Oregon or Idaho, with a few in Montana, and all seventeen projects were located in urban areas.

An assessment of the incremental cost-effectiveness found that for all but three of the seventeen comprehensive projects, the added cost of the comprehensive retrofit was justified by the added energy savings, as compared to a traditional retrofit strategy. Furthermore, seven of the projects resulted in more energy savings than a traditional retrofit, at equal or lesser cost, due to the savings generated by removing unnecessary fixtures on these projects rather than replacing them with new equipment. In addition, all seventeen projects were cost-effective to the owner when evaluated by themselves.

Fourteen of the seventeen projects would be cost-effective to the owner even without the incentives, suggesting that the value of the energy savings is likely to justify the cost of the incentives to the utility.

Although these results are specific to the individual projects, and apply only to a building owner's perspective, the cost effectiveness analysis indicates that the added savings generated by comprehensive lighting retrofits justify the costs of the comprehensive retrofit approach.

7.1.3 Program Implementer Discussion Conclusions

Overall, the program implementers were enthusiastic about the successes and the future potential for comprehensive lighting programs, but they acknowledged that there were many challenges to implementing the pilot, and barriers to wider implementation of the comprehensive approach. While the education provided by the pilot program provided a unique opportunity for trade allies, they generally need more education and experience with the advanced lighting strategies advocated by the comprehensive approach. Determining appropriate incentive rates and structures will be vital to the future success of any comprehensive lighting programs. Utility program manager buy-in remains a barrier, but the pilot program has encouraged a regional discussion on the need for new approaches to lighting programs. Finally, several of the participating trade allies are already applying comprehensive practices and strategies on their projects outside of the pilot program, suggesting that the pilot program is already beginning to drive market transformation.

7.1.4 Participant Interview Conclusions

Overall, participants were mostly satisfied with the CCLI pilot program and its results. A majority of respondents in each group reported that the pilot program was either somewhat or extremely successful (four of five utility program managers, six of eight participating trade allies, and seven of eight building owners and facility managers).

However, it is difficult to draw clear conclusions about specific aspects of the program from such a small sample size. The small scale of the pilot program, and the varying standards and structures of the CCLI pilots across the four participating entities further complicated this effort.

Responses also varied across the participant groups, with each group citing slightly different key advantages of the CCLI pilot program:

- Utility program managers emphasized the importance of the specialized training for the trade allies.
- Trade allies tended to cite the higher incentives as their main motivation for participating.
- Building owners/facility managers were most motivated to conduct comprehensive retrofits by increased energy savings and improved lighting quality.

Responses were more consistent about challenges and barriers:

- Both utility program managers and trade allies reported that administrative issues, such as added paperwork, and longer wait times to receive payment, were challenges to participating in the CCLI pilot.
- Both trade allies and building owners stated that initial project cost was the most significant barrier to participation in the CCLI pilot.

Eight of the fifteen trade allies interviewed reported that their participation in the CCLI pilot would influence future projects, having made them more aware of various retrofit options and less inclined to pursue only one-for-one retrofits. However, an almost equal number (seven of fifteen, including four of the eight participating trade allies) reported that their participation would not influence their future work.

Most building owners/facility managers (seven of nine) reported that they no longer had any T12s in their buildings following the comprehensive retrofit. One owner said they would participate in additional programs to replace remaining T12s, and one respondent reported that they would wait to replace remaining T12s and continue to use the lamps already on hand.

7.2 Recommendations

Based on the findings summarized in the sections above, HMG presents the following recommendations for future implementation or expansion of the CCLI program:

- **NEEA is most effective at regional support and coordination, rather than specific program and incentive structure design** – Due to the variations in the retrofit lighting market across the Northwest region, utility program managers are in the best position to determine their incentive structures based on the local market conditions and individual utility drivers. This makes it very challenging for a regional organization like NEEA to create a single replicable model for the region. NEEA can continue to facilitate the movement towards more comprehensive programs across the region through such regional efforts as supporting training and education for trade allies, and providing resources such as design templates.
- **Develop uniform project criteria and tracking methodologies in advance of program implementation** – Although variations in program criteria could be tolerated in future iterations of regional program efforts like the CCLI, participating utilities should agree on mandatory and optional program criteria in advance of program implementation. Similarly, program sponsors or implementers should develop program tracking and reporting criteria in advance so that all participating utilities can make the necessary preparations to comply. These efforts will result in more effective and informative evaluation results at the end of the program.
- **Provide a longer program implementation period** – Typical utility incentive programs run on two- or three-year cycles, but the CCLI pilot programs were in the field for less than a year. This abbreviated time period limited the ability of some trade allies to develop business and complete projects in the time allowed.
- **Streamline program administrative processes** – One of the primary complaints from trade allies and program managers was the additional time required to get projects approved and to receive incentive payments. Specifically, trade allies mentioned longer than normal wait times to receive incentive payments, sometimes exceeding ninety days. This added wait time to receive the incentive payments represents a significant financial burden for the trade allies. Future iterations of the CCLI should attempt to resolve this potential barrier to participation by ensuring that utilities make incentive payments in a timely manner.
- **Expand and simplify education and training** – Program implementers and utility program managers frequently cited the education and training provided by the CCLI pilot as the primary success of the program. However, they also reported that trade allies need more education and training to adapt to the new technologies and strategies in the market, and to provide truly comprehensive retrofits. Expanded training will be vital to future comprehensive lighting retrofit programs. However, it will also be necessary to simplify

the education and training tools to reach a broader market. Program implementers recommended the following strategies for expanded access to training and education for trade allies:

- A hotline to the Lighting Design Lab for trade allies to get lighting design support
- A financial analysis tool that trade allies could use to communicate the added benefits of a comprehensive approach to their customers
- A simplified version of the light level recommendations in the new IES Lighting Handbook

Expanding training to a broader audience will be vital to the future success of comprehensive lighting retrofit programs. NEEA's program manager reported that in 2012 the Northwest Trade Ally network (funded by BPA), Energy Trust of Oregon and Rocky Mountain Power, condensed the key features of the comprehensive pilot retrofit training into an hour, and then deployed it throughout the region in 25 different trade ally events. These trainings introduced over 1500 trade allies to the basics of lighting design and taking a comprehensive approach to lighting retrofits. This portion of the 2012 Northwest Trade Ally network trainings received some of the highest marks from trade allies throughout the region per evaluation results.

- **Balance incentive structure with added trade ally effort and energy savings** – Determining an effective incentive structure was a common challenge for the participating utilities. Utilities should carefully craft incentive structures for comprehensive projects to encourage deeper energy savings and reward the added effort required by the trade allies. In many cases, traditional one-for-one retrofit incentives are high enough that trade allies are not motivated to change their practices to achieve deeper energy savings. Incentives for comprehensive retrofit projects should be high enough to set them apart from traditional program incentives, while maintaining cost-effectiveness for the respective utilities. This will likely require a careful assessment by each utility to create incentive structures that are most effective for their local market conditions.

  In addition, NEEA's program manager reported that even though the impact of the federal legislation on the manufacturing of T12s has taken some unexpected turns, utility program staff continues to look for new program opportunities to replace savings from T8s to T12 conversion. Many in the region consider comprehensive lighting retrofits to be one of the needed solutions, but each utility will migrate towards this kind of program at their own speed and with their own unique requirements.

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APPENDIX A: COST-EFFECTIVENESS CALCULATION DETAILS

Incremental Cost-Effectiveness Calculation

As described above, HMG calculated incremental cost-effectiveness and internal rate of return (IRR) for each project.

As noted in section 2.3.2, HMG used the following equation to calculate the incremental cost-effectiveness:

Incremental Cost-Effectiveness = Incremental Savings / Incremental Costs

where Incremental is the difference between the comprehensive and traditional (rebate) approach, and both Savings and Costs are in dollars ($).

The overall equation for calculating the IRR is the following:

NPV = Sum over EUL of (Comprehensive Savings in year n / [1+r]n) – Comprehensive Project Cost

where NPV is the net present value of the project, and r is the internal rate of return, EUL is the effective useful life of the project (in years), and n is the number of years since project installation.

Although some of the values in these equations, such as Comprehensive Project Cost, were included in the comprehensive project data Evergreen provided, HMG needed to calculate other values, such as Incremental Savings, Incremental Costs, and Comprehensive Savings in year n. To calculate these, HMG used the information provided by Evergreen, as well as reference materials.

The following sections describe these calculations in detail.

Incremental Savings Methodology

Outlined below is HMG's methodology for calculating the Incremental Savings (i.e., the energy bill savings (in $) from the comprehensive approach compared with the savings that would have been realized through a traditional, rebate-based project). HMG calculated the Incremental Savings as follows:

Incremental Savings ($) = Lifecycle Savings_Comp ($)– Lifecycle Savings_Trad ($)

where:

Lifecycle Savings_Comp (in $) is the lifecycle value of the energy bill savings from the comprehensive approach (not provided directly), and

Lifecycle Savings_Trad (in $) is the lifecycle value of the energy bill savings from the traditional approach (not provided directly).

Because neither of the values used in this equation was available directly, HMG calculated them, as described below.

The annual energy bill savings (in $) from the comprehensive approach is provided in the utility (or Energy Trust of Oregon) lighting calculators provided by Evergreen, and accounts for both demand and electricity savings. While costs will only be incurred at the beginning of the project (year 0), savings will continue to be generated over the lifetime of the measures. Thus, summing the annual savings over the project's lifetime provides lifecycle savings.

To estimate lifecycle savings, HMG first estimated the EUL of the installed measures. Because there are often various measures included in a project, HMG assumed the EUL of the measure providing the majority of electricity savings for a project. HMG used the EUL values recommended by the Regional Technical Forum (RTF). The RTF website provides a link to a Measure Life study conducted by Energy and Resource Solutions, prepared for the Massachusetts Joint Utilities (Havervill, MA: Massachusetts Joint Utilities, 2005). This document provides the following EUL values, as shown in Table 10. The EUL is generally 13 years for fixtures, which usually deliver the majority of energy savings.

Table 10: Effective Useful Life of Lighting Measures

Measure	EUL (years)
T8	13
T5	13
CFL	13
Occupancy sensor	9

Note: Data source: Energy and Resource Solutions, *Measure Life Study* (Haverhill, MA: Massachusetts Joint Utilities, 2005).

The simple lifecycle savings is the annual savings multiplied by the EUL. However, a more accurate lifecycle savings accounts for the present value (in 2012 $) of future savings. Thus, the lifecycle savings (in $) equals the sum of the present value of savings for each year, summed across the project lifetime (i.e., the EUL).

Lifecycle Savings_Comp ($) = Sum over EUL of (Present Value of Annual Savings [$])

The Present Value of Annual Savings was not directly available, so it HMG calculated it as follows:

Present value of Annual Savings ($) = Annual Savings ($) / (1+discount rate)n

where:

Annual Savings (in $) is the energy bill savings from the comprehensive project (provided by Evergreen),

Discount rate is assumed to be 8.6% (National Action Plan for Energy Efficiency, 2008),[6] and

n is the number of years since the project installation.

Summing the annual savings across the project's lifetime provides the total lifecycle savings.

Similarly, HMG calculated the lifecycle savings from a traditional retrofit approach. The estimate of annual savings (in $) from the traditional approach was not available, so the traditional lifecycle savings could not be calculated in the same manner as for the comprehensive approach. However, Evergreen provided estimates of the electricity savings (in kWh) of the traditional approach, and the comprehensive approach. Using these values and the lifecycle energy savings from the comprehensive approach calculated above, we can calculate the lifecycle savings from the traditional approach, as follows:

Lifecycle Savings_Trad ($) = Lifecycle Energy Costs_PreRetrofit ($) - Lifecycle Energy Costs_Trad ($)

where:

Lifecycle Energy Costs_PreRetrofit is the lifecycle value (in $) of energy costs prior to the retrofit (not directly available), and

Lifecycle Energy Costs_Trad is the lifecycle value (in $) of energy costs if a traditional approach had been used (not directly available).

Because neither of these values was directly available, each was calculated. HMG calculated Lifecycle Energy Costs_PreRetrofit as follows:

Lifecycle Energy Costs_PreRetrofit ($) = Lifecycle Savings_Comp ($) / % Savings_Comp

where:

Lifecycle Savings_Comp is the lifecycle energy savings (in $) of the comprehensive approach, compared with pre-retrofit (provided), and

% Savings_Comp is the percent energy savings of the comprehensive approach compared with pre-retrofit (provided).

HMG calculated Lifecycle Energy Costs_Trad as follows:

Lifecycle Energy Costs_Trad ($) = (100% - Savings_Trad[%])x Lifecycle Energy Costs_PreRetrofit

[6] As described in an EPA document, "California currently uses 8.6 percent in evaluating the investor-owned utility energy efficiency programs." www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf

where:

% Savings Trad is the percent energy savings of the traditional approach compared with pre-retrofit (provided), and

Lifecycle Energy Costs_PreRetrofit is as described and calculated above.

HMG then calculated the incremental savings of the comprehensive approach compared with the traditional approach by combining results from above, as follows:

Incremental Savings ($) = Lifecycle Savings_Comp ($) - Lifecycle Savings_Trad ($)

Incremental Cost Methodology

The incremental cost refers to the difference between the cost of an installed, comprehensive project and the cost of a project if it had used a traditional approach:

Incremental Cost ($) = Cost_Comp ($) - Cost_Trad ($)

where:

Cost_Comp refers to the cost of the comprehensive project to the project owner (after the incentive has been awarded) (provided), and

Cost_Trad refers to the cost of the traditional project to the project owner (after the owner receives the incentive) (provided, as described below).

Evergreen provided the cost of the comprehensive project. The data Evergreen provided included both the pre-incentive project cost, the amount of the incentive, and the post-incentive project cost. In addition, Evergreen estimated what the hypothetical project costs and incentive amounts for each project would have been if the trade allies had completed the projects under traditional programs.

Primary Cost-Effectiveness Metrics

After estimating the values above, HMG calculated the Incremental Cost-Effectiveness Ratio and the IRR.

As described above, the Incremental Cost-Effectiveness Ratio compares incremental savings with incremental costs. When the value is greater than one, the additional savings from the comprehensive approach compared with the traditional approach are greater than the additional costs compared with the traditional approach. HMG calculated this as follows:

Incremental Cost-Effectiveness Ratio = Incremental Savings / Incremental Cost

The IRR reflects the discount rate at which the cost of the comprehensive project equals the net present value of its savings. HMG calculated the IRR as follows:

NPV = Sum over EUL of (Comprehensive Savings in year n / [1+r]n) – Comprehensive Project Cost

where NPV is the net present value of the project, and r is the internal rate of return.

Incremental Energy Savings

Table 11 shows the incremental energy savings for each project, as well as a total for all seventeen projects in the CCLI pilot. The table shows the incremental savings in kWh/year as well as percent improvement over traditional program savings.

Table 11: Incremental Energy Savings

Project ID	Estimated Traditional Program Energy Savings (kWh/year)	Comprehensive Program Energy Savings (kWh/year)	Incremental Energy Savings (kWh/year)	Incremental Energy Savings (%)
NWE1	13,578	14,221	643	5%
PGE1	53,188	59,110	5,922	11%
PGE2	220,000	281,827	61,827	28%
PGE3	73,029	82,533	9,504	13%
PGE4	54,872	90,382	35,510	65%
IDP1	46,582	54,219	7,637	16%
PPL1	11,116	26,855	15,739	142%
PGE5	495,434	570,191	74,757	15%
PGE6	46,917	61,613	14,696	31%
PGE7	513,417	529,724	16,307	3%
IDFP1	61,619	93,865	32,246	52%
IDP2	32,561	57,426	24,865	76%
IDP3	46,600	90,310	43,710	94%
IDP4a	53,953	91,586	37,633	70%
IDP4b	63,764	104,479	40,715	64%
IDP5	30,028	38,057	8,029	27%
NWE2	8,000	11,261	3,261	41%
IDFP2	76,068	116,229	40,161	53%
All Projects	1,900,726	2,373,888	473,162	25%

APPENDIX B: GROUP DISCUSSION GUIDE FOR PROGRAM IMPLEMENTERS

Copied below is the text of a memo outlining the program implementer group discussion guide, sent to NEEA on June 22, 2012.

Overview

The goal of the program implementer interviews is to determine the effectiveness of the Comprehensive Commercial Lighting Initiative pilot. Based on their experience with the pilot program, interviewers asked the program implementers to assess the strengths and weaknesses of the pilot program, and to suggest recommendations for future improvements. The discussion will also address current and potential future trends in the lighting retrofit market and retrofit programs. Rather than being highly structured surveys, the interviews will be more free flowing conversations in order to allow for deeper insights.

The results of these discussions will also help to form current and future baselines for the lighting market and lighting incentive programs.

Discussion Topics

The discussion topics outlined below will ask the program implementers about their experience and perspective on the Comprehensive Commercial Lighting Initiative pilot program.

Introduction (5 min)

Introduction from moderator: Thank you for participating in this discussion. We are here today to discuss your experiences working on the Comprehensive Lighting Initiative pilot program. We want to understand your perspective, both good and bad, to help inform future planning and refinement for NEEA's lighting programs. There are no right or wrong answers, we want to hear your candid opinions. Because each of you has a unique perspective on the pilot program, we want to hear from all of you. In order to make sure that we accurately understand and portray your answers, we will be recording the audio of our discussion today. The recording will only be for internal HMG and NEEA use, and will not be distributed to any other parties. Quotes or statements will not be attributed to any individual without their permission. Do you all agree to be recorded? (Get verbal agreement from each participant.) (Comment on Rita's presence, noting that she is here to evaluate us.)

- Please introduce yourself and briefly describe your role in the Comprehensive Commercial Lighting Initiative pilot program.

Successes and Challenges Activity (5-15 min)

Following the introductions, each participant will be given one yellow and one pink sticky note. They will be asked to identify five (can be more or less) successes of the comprehensive lighting pilot, writing one on each of the yellow sticky notes, and five challenges or barriers of the comprehensive lighting pilot, writing one on each of the pink sticky notes. (When we contact them to confirm their attendance at this meeting, we will let them know we will be asking for success and challenges, so as to get them thinking about the issues prior to in-person meeting.)

Once completed, the sticky notes will be collected by the moderator, arranged together by topic, where similar responses are found, in a location visible to the entire group (e.g. white board or wall). The topics identified by the participants will be used to guide the following discussion, in order of most common issues. We will make sure that all responses/issues are discussed during the meeting.

Comprehensive Program Characteristics and Reactions to the Program (20 min)

- In your opinion, what makes the Comprehensive Lighting Initiative different from existing utility lighting programs?
  - What do you consider the key components of the comprehensive approach?
- How did the participating utilities respond to the different practices required by the comprehensive program?
  - How likely do you think the utilities are to continue with comprehensive program offerings after the pilot ends? (Probe: what makes you say that?)
- How have contractors had to change their practices, if any, to participate in the comprehensive program approach?
  - How have contractors responded to the changes required?
  - Do you expect these changes to persist after the pilot program ends? (Probe: what makes you say that?)
- Was there a particular type of trade ally who was better suited for the comprehensive approach than others, and if so, what type?
- How did individual projects change as a result of participation in the comprehensive program?
  - How did the contractors react to these changes?
  - How did the utilities react to these changes?

Program Successes and Challenges (25 min)

The following questions will build on the successes and challenges identification exercise. We will use the topics identified by the participants to guide the discussion.

- What are the advantages to the comprehensive program approach vs. the existing utility lighting programs? What are the disadvantages?
  - What factors will encourage utilities to adopt a comprehensive program approach? What factors will prevent utilities from adopting a comprehensive approach?
  - What are the advantages of a comprehensive program for utility program staff? What are the disadvantages for utility program staff?
  - What factors will encourage contractors to participate in a comprehensive program? What factors will prevent contractors from participating in a comprehensive program?

  - What factors will encourage building owners to participate in a comprehensive program? What factors will prevent building owners from participating in a comprehensive program?
  - What are the advantages of a comprehensive program for NEEA? What are the disadvantages for NEEA?

- Overall, how successful do you think the program has been?
  - What aspects of the program, if any, do you consider successful? (Probe if needed: what makes that aspect successful?)
  - What aspects, if any, do you consider unsuccessful? (Probe if needed: what makes that aspect unsuccessful?)
  - Follow-up on specifics based on how they define "success."
- Overall, how well do you think the program was run?
  - What aspects of the program, if any, do you think were well run? (Probe as needed)
  - What aspects, if any, were not well run? (Probe as needed)
  - Follow-up on specifics based on how they define "well run."

Future Program Planning (10 min)

- What, if anything, would you do differently in the future when implementing a comprehensive lighting program?
  - What support have you received from NEEA?
    - How has that support helped the program?
    - What additional support from NEEA is needed?
  - What kind of training or marketing support has been successful in helping contractors participate in a comprehensive program? What additional training or marketing support is needed?
  - What additional advantages or challenges would be presented by widespread implementation of a comprehensive lighting program that were not present in the pilot program?

Market Effects (15 min)

- How important are utility programs to the lighting retrofit market?
  - How much influence do utility programs have on retrofit practices?
  - What motivates contractors to sell energy efficient lighting retrofits to their clients?
  - What motivates owners to install energy efficient lighting retrofits?
  - How do these motivations change in comprehensive lighting retrofits, if at all?

- How do you expect utility lighting programs to develop over the next five years?
  - How do you expect utility lighting programs to respond to the T12 phase out?
  - How do you expect utility lighting programs to adapt to new technologies or new market opportunities?
  - How would you like to see lighting programs develop in the future?
- How do you expect lighting contractor practices to change over the next five years?
  - How do you expect contractors to respond to the T12 phase out?
  - How do you expect contractors to adapt to new technologies or changes in utility programs?
  - How would you like to see contractor practices change in the future?
- In your opinion, how has NEEA influenced the direction of utility lighting programs in the Northwest?
  - How do you foresee NEEA influencing utility lighting programs in the future?
  - How has NEEA influenced the lighting market as a whole?

APPENDIX C: UTILITY MANAGER INTERVIEW GUIDE

Copied below is the text of the utility program manager interview guide.

Introduction

Thank you for participating in this interview. The goal of the interview is to gather feedback on the Comprehensive Lighting Initiative Pilot Program sponsored by NEEA, which encourages a new and comprehensive approach to a lighting retrofit projects incorporating best lighting design practices with efficient equipment and lighting controls. As a utility program manager that participated in the pilot, your feedback is very important.

Role and Background

1. What is your position title? (program manager, program administrative support, other)
2. How long have you served in this position? (< 1 yr, 1-5 yrs, > 5 yrs)
3. Please briefly describe your primary role, in connection with the Comprehensive Lighting pilot program? (open ended)

Program offerings

4. (Only ask for NW Energy): We understand that NW Energy offered a comprehensive program before. What aspects set it apart from traditional programs? (higher incentive levels than standard programs, technical training, recommended and/or required strategies for comprehensiveness – provide list)
5. (Only ask for NW Energy)
    a. How was the comprehensive lighting pilot program structured in your utility territory prior to the NEEA pilot initiative?
    b. Does your utility still offer this comprehensive incentive option or program?
    c. Did your utility make any changes to the prior comprehensive lighting program as a result of the NEEA pilot? (list aspects above)
    d. If so, how did it change? (list aspects above)
6. Now that the comprehensive lighting pilot is over, are you considering offering this type of program in the future? (Y/N/Maybe) What makes you say this?
7. If so, what aspects would it include? (list aspect above)

Successes and Challenges

8. How have projects in the comprehensive lighting pilot differed from retrofit lighting projects under typical rebate programs? (open ended, probe if necessary: greater energy savings achieved; more emphasis on different measures: (–specify measures), more program work to process rebate, more lighting specialist time)

9. In your opinion, what has been successful about the comprehensive lighting pilot program?
10. In your opinion, what have been the pilot's greatest benefits for owners?
11. In your opinion, what have been the pilot's greatest benefits for trade allies?
12. In your opinion, what have been the pilot's greatest benefits for your utility?
13. Which project requirements do you think are most useful in moving the lighting retrofit market towards a comprehensive lighting retrofit approach? (open ended, probe if necessary: use of a design, IES lighting levels, templates, other - specify)
14. Which trade ally support aspects of the program do you think where the most useful in moving the lighting retrofit market towards a comprehensive approach? (open ended, probe if necessary: initial training, coaching by Lighting Specialists, increased incentives, other - specify)
15. In your opinion, what have been the challenges for the comprehensive lighting pilot program?
16. What challenges have owners had in participating in the pilot program?
17. What challenges have trade allies had in delivering projects under the pilot program?
18. What challenges have you, or your utility, had in supporting, managing or administering the pilot program?
19. What challenges have you, or your utility, had (if any) in integrating the pilot program with existing program offerings?

Training and Resources

20. What, if any, training did you or other utility staff receive as part of the comprehensive lighting pilot program? How helpful was that training? (extremely unhelpful, somewhat unhelpful, neither helpful or unhelpful, somewhat helpful, extremely helpful)
21. What training, forums, or resources would be useful to you or other utility staff to incorporate a comprehensive lighting retrofit approach into your portfolio?

Future Trends

22. What lighting retrofit technologies or strategies do you plan to incorporate into your utility's future program offerings in the next 1, 3, 5 years? (LEDs, controls, comprehensive approach, other - specify)
23. What are the primary barriers (if any) that you face in incorporating these technologies or strategies into your utility's program offerings (open-ended)

Role of NEEA

24. In general, what value (if any) do you think NEEA provides to your utility territory in relation to comprehensive lighting? (open ended, probe if necessary: support to utilities,

education of trade allies, developing innovative initiatives / programs, fostering communication among utilities, tool development, etc…)

25. What other role or service(s) would you like NEEA to provide in relation to comprehensive lighting? (open ended)

Closing

26. Thank you for your time. Do you have any final comments about the comprehensive lighting pilot? (open ended)

APPENDIX D: TRADE ALLY PARTICIPANT INTERVIEW GUIDE

Copied below is the text of the trade ally participant interview guide.

Introduction

Thank you for participating in this interview. The goal of the interview is to gather feedback on the Comprehensive Lighting Initiative Pilot Program sponsored by your local utility or for Energy Trust of Oregon, which encourages a new and comprehensive approach to a lighting retrofit project incorporating best lighting design practices with efficient equipment and lighting controls. As a trade ally that participated in the pilot, your feedback is very important.

Thank you again for your time and feedback.

Role and Background

1. Did you complete the online trade ally survey conducted last month? (Y/N/don't remember)
2. What type of services does your company provide? (select one: only lighting, all electrical, HVAC and lighting, general contracting, lighting sales [not installation], energy efficiency consulting, other - specify)
3. What role does your company play in retrofit lighting projects? (–open ended, probe if necessary: sales, installation, product sales, consulting, other)?
4. How long has your company been active in the retrofit lighting market? (<= 2 years, 3- 5 years, > 5 years)
5. What type of businesses does your company generally provide lighting retrofit services for? [–open ended, probe if necessary: offices, warehouses, schools, retail, hospitals and healthcare, hospitality, other - specify]
6. What is your position at your company? (open-ended)
7. What is your role in lighting retrofit projects? (open ended, probe if necessary - sales, installer, expertise [consulting], other – specify)
8. Does your company offer lighting design services? (Y/N/ Don't know)

Training and Resources

9. We understand from Evergreen that participating trade allies should have received training on the lighting calculator, the basics of lighting design, lighting power density and light level requirements, lighting controls, incentive calculations, selling efficiency, and other topics. Did you receive this training? (Y/N/don't remember)
10. Based on your experience with the comprehensive pilot program, what other training could NEEA or your local utility provide to improve your understanding of a comprehensive approach to lighting retrofits? [–open ended, probe if necessary: training

on specific space design strategies, controls, pay-back calculations for comprehensive approach, other – please specify]

Project Participation

11. How many projects have you delivered under the comprehensive lighting retrofit pilot?
12. (For ETO utility allies only) How many comprehensive projects do you have in the pipeline?
13. For how many projects have you suggested that the owner or decision maker use a comprehensive lighting approach to the retrofit?
14. What conditions would prevent you from suggesting a comprehensive approach to your customers? (–open ended, probe if necessary: If it does not seem appropriate to the project, If I don't think the decision maker will be open to the idea, If the cost is too high even with the added incentive, if I did not feel trained enough to deliver the approach successfully, incentive was higher for traditional approach, concern about sales/profit, liability concerns - specify, other - specify)
15. Why do clients sometimes decline to pursue comprehensive projects? (–open ended, probe if necessary: initial costs too high, approach too complicated, already had lighting retrofit plan in mind, did not believe energy savings or other benefits projected, other – specify)
16. Have you had any projects enroll in the comprehensive pilot program, and then drop out? (Y/N)
17. (If yes to 16), how many?
18. (If yes to 16), Why did the projects drop out? (open ended)
19. (If yes to 16), what type of project was installed in the majority of these projects? (select the response that best applies - comprehensive project through a custom rebate program, comprehensive project through a standard rebate program, standard energy efficient [e.g., 1-for-1 switch out] project through rebate program, energy efficient retrofit without utility incentive or rebate, did not install retrofit, other – specify)
20. (If yes to 16), What is the main reason they dropped out of the comprehensive program? (select the response that best applies - comprehensive approach upfront cost was too high, rebate program offered as much or more incentive, paperwork was too onerous, comprehensive approach seemed to complicated (too much work) or risky, other – specify)
21. Have you used aspects of a comprehensive approach in other lighting retrofit projects, not incented through the pilot program (e.g., in utilities not participating in the pilot)? (Y/N)
    a. (If yes), what motivates you to do this? (open ended, probe if necessary: greater energy savings for customers, better light quality in projects, sets me apart from competition, other - specify)

22. Would you continue to use the comprehensive approach in projects if the comprehensive program was no longer offered (but utility rebates could still be leveraged)? (Y/N/Maybe)

23. What makes you say this? (open ended)

Project Quality and Program Differences

24. How have your comprehensive projects differed from lighting retrofits installed under typical rebate (prescriptive) programs? [open ended]

25. What benefits (if any) did the comprehensive approach deliver, that would not have been delivered using a standard retrofit programs? (open ended, probe if necessary: greater energy savings, reduced maintenance, improved light quality, greater customer satisfaction, more controls, other- specify, no benefits, don't know)

26. What challenges (if any) did the comprehensive approach present that would not have been presented by standard retrofit programs? (open ended, probe if necessary: more work to submit incentive applications, more work to complete retrofit projects, too many requirements, too much time to do the design, unfamiliar technologies, other-specify, no challenges, don't know)

27. How satisfied were you with the incentive that the comprehensive lighting pilot provides? (extremely unsatisfied, somewhat unsatisfied, neither satisfied or unsatisfied, somewhat satisfied, extremely satisfied)

28. Do you feel the incentive amount was enough of an increase above the rebate amount to encourage your clients to use the comprehensive approach? (Y/N/Maybe)

Motivations, Barriers, and Decision Makers

29. What do you think are significant benefits to you and your company for offering a comprehensive approach? (–open ended, probe if necessary: brings in more projects, brings in higher profit per project, customer loyalty, increases company's reputation, makes us stand out from competition, other - specify)

30. What barriers are there for you to use a comprehensive lighting approach? (–open ended, probe if necessary: upfront time investment to learn strategies, not enough profit difference compared with standard approach [e.g., 1-for-1 change out], clients are not interested, need better resources, other – specify)

31. What motivates building owners and clients to install a comprehensive approach? (check all that apply - greater energy savings and/or lower operating costs, less maintenance, higher quality, other – specify)

32. What barriers are there for building owners and customers to use comprehensive approach? (–open ended, probe if necessary: higher upfront costs, payback too long, lack of knowledge, too much occupant disruption, concerns that building occupants will complain about light levels, other – specify)

33. If you are involved in sales, to whom do you typically provide a proposal? (select the response that best applies - owners, developers, facility managers, consultants, other - specify)

34. What resources could NEEA or your local utility provide that could you help you promote a comprehensive approach to customers (–open ended, probe if necessary: financial analysis tool to show cost and savings from comprehensive approach (beyond simple pay back), 1-page lighting design guides, other – specify)

35. Overall, please rate the success of the program. (extremely unsuccessful, somewhat unsuccessful, neither successful or unsuccessful, somewhat successful, extremely successful)

36. Overall, please rate how well the program was run (extremely poorly run, somewhat poorly run, neither poorly or well run, somewhat well run, extremely well run)

Future Trends

37. Has your participation in the pilot program influenced how you will approach lighting retrofits in the future? (Y/N)

    a. If yes, how? (open ended)

Role of NEEA

38. In general, what value do you think NEEA and your local utility (or the Energy Trust of Oregon) programs provides to your business overall? For comprehensive lighting? (open ended)

39. What other role or service(s) would you like NEEA and your local utility programs to provide for comprehensive lighting? (open ended, probe if necessary: more in-depth training, case studies of comprehensive projects, financial analysis tools, other – specify)

40. Which aspects of the comprehensive lighting pilot program do you think are most useful in moving the market towards a comprehensive lighting retrofit approach? (–open ended, probe if necessary: trade ally training, higher incentives than rebate programs, marketing tools, design services, owner education, other – specify)

Closing

41. Thank you for your time. Any final comments about comprehensive lighting pilot? (open ended)

APPENDIX E: TRADE ALLY NON-PARTICIPANT INTERVIEW GUIDE

Copied below is the text of the trade ally non-participant interview guide.

Introduction

Thank you for taking this survey. The goal of the survey is to gather feedback on the Comprehensive Lighting Initiative Pilot Program sponsored by your local utility or for Energy Trust of Oregon, which encourages a new and comprehensive approach to a lighting retrofit project incorporating best lighting design practices with efficient equipment and lighting controls. As a trade ally that received training through the pilot, your feedback is very important.

Thank you again for your time and feedback.

Role and Background

1. Did you complete the online trade ally survey conducted last month? (Y/N/don't remember)
2. What type of services does your company provide? (select one: only lighting, all electrical, HVAC and lighting, general contracting, lighting sales [not installation], energy efficiency consulting, other - specify)
3. What role does your company play in retrofit lighting projects? (–open ended, probe if necessary: sales, installation, product sales, consulting, other)?
4. How long has your company been active in the retrofit lighting market? (<= 2 years, 3- 5 years, > 5 years)
5. What type of businesses does your company generally provide lighting retrofit services for? [open ended, probe if necessary: offices, warehouses, schools, retail, hospitals and healthcare, hospitality, other - specify]
6. What is your position at your company? (open-ended)
7. What is your role in lighting retrofit projects? (open ended, probe if necessary: sales, installer, expertise [consulting], other – specify)
8. Does your company offer lighting design services? (Y/N/ Don't know)

Training and Resources

9. We understand from Evergreen that participating trade allies should have received training on the lighting calculator, basics of lighting design, lighting power density and light level requirements, lighting controls, incentive calculations, and other topics. Did you receive this training? (Y/N/don't remember)
10. Do you think that this training adequately prepared you to deliver a comprehensive project? (Y/N/ Maybe)
11. What makes you say this (open-ended)

12. Based on your experience with the comprehensive pilot program, what other training could NEEA or your local utility provide to improve your understanding of a comprehensive approach to lighting retrofits? [open ended, probe if necessary: training on specific space design strategies, controls, pay-back calculations for comprehensive approach, other – please specify]

Project Participation

13. For how many projects have you suggested that the owner or decision maker use a comprehensive lighting approach to the retrofit?

14. What conditions would prevent you from suggesting a comprehensive approach to your customers? (open ended, probe if necessary: If it does not seem appropriate to the project, If I don't think the decision maker will be open to the idea, If the cost is too high even with the added incentive, if I did not feel trained enough to deliver the approach successfully, liability concerns - specify, other - specify) (if more than one reason) Which of these is the most important condition that prevents you for suggesting a comprehensive approach?

15. Why do clients sometimes decline to pursue comprehensive projects? (open ended, probe if necessary: initial costs too high, approach too complicated, already had lighting retrofit plan in mind, did not believe energy savings or other benefits projected, too disruptive other – specify) (if more than one reason) Which of these is the most important decline to pursue a comprehensive approach?

16. Have you had any projects enroll in the comprehensive pilot program, and then drop out? (Y/N)

17. (If yes to 16), how many?

18. (If yes to 16), Why did the projects drop out? (open ended [go through each project individually])

19. (If yes to 16), what type of project was installed in the majority of these projects? (select the response that best applies - comprehensive project through a custom rebate program, comprehensive project through a standard rebate program, standard energy efficient [e.g., 1-for-1 switch out] project through rebate program, energy efficient retrofit without utility incentive or rebate, did not install retrofit, other – specify)

20. Have you used aspects of a comprehensive approach in other lighting retrofit projects, not incented through the pilot program (e.g., in utilities not participating in the pilot)? (Y/N)

    a. (If yes), what motivates you to do this? (open ended, probe if necessary: greater energy savings for customers, better light quality in projects, sets me apart from competition, other - specify)

21. What resources could NEEA or your local utility provide that could you help you promote a comprehensive approach to customers (–open ended, probe if necessary: financial analysis tool to show cost and savings from comprehensive approach, 1-page lighting design guides, design assistance, sales tools/support? other – specify)

Future Trends

22. Has your training in the pilot program influenced how you will approach lighting retrofits in the future? (Y/N)
    a. If yes, how? (open ended)

Role of NEEA

23. In general, what value do you think NEEA and your local utility (or the Energy Trust of Oregon) programs provides to your business overall and for comprehensive lighting projects? (open ended, probe if necessary: training, developing new initiatives, other – specify)
24. What other role or service(s) would you like NEEA and your local utility programs to provide for comprehensive lighting? (open ended, probe if necessary: more in-depth training, case studies of comprehensive projects, financial analysis tools, other – specify)

Closing

25. Thank you for your time. Any final comments about comprehensive lighting pilot? (open ended)

APPENDIX F: BUILDING OWNER INTERVIEW GUIDE

Copied below is the text of the trade ally non-participant interview guide.

Introduction

Thank you for participating in this interview. The goal of the interview is to gather feedback on the Comprehensive Lighting Initiative Pilot Program sponsored by NEEA and your local utility or the ETO, which encourages a new and comprehensive approach to a lighting retrofit project incorporating best lighting design practices with efficient equipment and lighting controls. As a building owner that participated in the pilot, your feedback is very important.

Role and Background

1. What is your position?
2. What is your role? (owner, developer, other)
3. About how many buildings do you own or manage? (open ended) (I imagine that most of these folks own and occupy judging on the kinds of projects that came through.. not big owners with multiple properties… just an FYI to try tailor your questions to this type of owners…)
4. (if 2 or more), About how many of the buildings that you own or manage have implemented a lighting retrofit? (open ended)
5. Of the projects that implemented a lighting retrofit, about how many included energy efficient measures or strategies? (open-ended)
6. (If > 0), What do your energy efficient lighting retrofits typically involve? (open ended)

Motivations and Barriers

7. What motivates you to install an energy efficient or energy savings approach to lighting retrofit projects? (list top 3 in order of importance: financial incentives, energy or cost savings, reduced maintenance costs, better light quality, company policy, concern for environment, other – specify)
8. What barriers do you have in installing energy efficient lighting products? (list top 3 in order of importance: higher first cost, do not understand some energy efficient measures or strategies, concern that the system will deliver energy savings as projected, concern that the system will not deliver enough light or quality of light as projected, concern over system or equipment failure, other – specify)
9. A "comprehensive" lighting approach involves a more thorough retrofit process that seeks to address all energy savings opportunities, potentially including redesigning the lighting layout, removing fixtures, and installing controls. The goal is to deliver a lighting system that meets current lighting best practices (as if the space was being built to the standards of current new construction) -What would motivate you to use a comprehensive approach to a lighting retrofit project? (list top 3 in order of importance: financial

incentives, energy savings, reduced maintenance costs, better light quality, company policy, concern for environment, other – specify)

10. What might be the barriers for you to use a comprehensive approach to a lighting retrofit project? (list top 3 in order of importance: upfront cost, potential disruption to work space, lack of understanding of strategies, concern that final product will not meet occupants' needs, other – specify)

T12 Phase Out

11. Are you aware that standard T12 fluorescent lamps are no longer being manufactured or distributed, because of a law requiring manufacturers to stop production of these products? (Y/N)
12. How do you plan to respond to the phase out of T12 lamps? (open ended, probe as necessary: stockpile T12 lamps while they are still available, replace T12s with T8 lamps, not applicable – do not currently have T12 lamps, switch to other lighting strategies – specify, other – specify)

Program Awareness

13. Are you aware that utilities offer incentive programs promoting energy efficiency? (Y/N)
14. Have you heard of the Northwest Energy Efficiency Alliance (NEEA), a regional organization that supports utilities and provides other initiatives to accelerate the innovation and adoption of energy-efficient products, services and practices? (Y/N)
15. The Comprehensive Commercial Lighting Initiative encourages a new and comprehensive approach to a lighting retrofit project incorporating best lighting design practices with efficient equipment and lighting controls. According to utility records, [name of project] participated in the comprehensive lighting pilot program. Are you aware of this? (Y/N/Maybe)

[Now we'll ask you a few questions specifically about the comprehensive project – [name of project].] (These questions will be asked of all respondents; even if they weren't aware they were participating in the pilot program.)

Project quality and satisfaction

16. Did you notice any differences in [name of project], compared with lighting retrofits in the past? (Y/N/Maybe)
17. If so, what were some differences? (open ended, probe if necessary: different measures used, different strategies used, better quality lighting, higher energy savings, other – specify)
18. What benefits (if any) have you seen from the installed lighting at [name of project]? (open ended, probe if necessary: energy savings, reduced maintenance, improved color quality, higher occupant satisfaction, other – specify)

19. Which of these benefits are the most important to you? (of those they mentioned, ask them to list up to 3 in terms of priority)
20. What challenges (if any) did you have with the [name of project] retrofit project? (list up to 3, in order of importance) (higher upfront cost, more planning required, longer timeline, did not understand strategy, other – specify)
21. What challenges (if any) did you have with the utility program on [name of project]? (more paperwork, incentive did not cover increased cost of comprehensive approach, trade ally work, other – specify, don't know)
22. Overall, how satisfied are you with the final installed project at [name of project]? (extremely unsatisfied, somewhat unsatisfied, neither satisfied or unsatisfied, somewhat satisfied, extremely satisfied)
23. (skip if not aware they participated in pilot) Overall, how satisfied are you with the pilot program? (extremely unsatisfied, somewhat unsatisfied, neither satisfied or unsatisfied, somewhat satisfied, extremely satisfied)
24. Would you be interested in applying a comprehensive lighting approach to other retrofits? (Y/N/Maybe)
25. What makes you say this? (open ended)

Closing

26. Thank you for your time. Any final comments about the comprehensive lighting pilot? (open ended)