EFFICIENT TECHNOLOGY ACCELERATOR

LLLC Energy Savings and Market Evaluation Plan

Center for Energy and Environment

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CONTENTS

BACKGROUND AND SUMMARY OF POTENTIAL

Minnesota Efficient Technology Accelerator

The Efficient Technology Accelerator (ETA) is a statewide market transformation program to accelerate deployment and reduce the cost of emerging and innovative efficient technologies, bringing lower energy bills and environmental benefits to Minnesotans. The ETA is funded by the state's investor-owned utilities (IOUs),[1] administered by the Minnesota Department of Commerce, Division of Energy Resources (DER), and implemented by Center for Energy and Environment (CEE). Savings generated by the program will be claimed by the funding utilities to help meet state goals.

As a market transformation program, ETA will work to overcome market barriers, leading to greater market adoption of targeted technologies, and ultimately, energy savings. In the initial years of a market transformation program, energy savings can be small as it can take time to grow the market. In addition, the savings methodology for counting savings from market transformation initiatives (described further in this document) is more involved than is typically the case for utility rebate programs. Therefore, a careful evaluation plan is a complementary endeavor to estimating savings from market transformation programs because it can provide additional evidence of the effectiveness of programmatic efforts to break down barriers and support the estimation and claiming of energy savings.

Within the overall ETA program, individual market transformation initiatives (a programmatic effort around a specific technology or approach) are developed. This Energy Savings and Market Evaluation Plan focuses on the Luminaire Level Lighting Controls (LLLC) Initiative. We attempt here to provide a well-thought-out plan for both the estimation of savings, and for measuring market progress, in advance of launching our initiative in the market. As we learn more about the market through additional research and through our market engagement, we will continue to refine and update our approach.

Luminaire Level Lighting Controls

Summary

While lighting has long been a key opportunity for electric energy savings, widespread market adoption of efficient solid-state lighting shifts the opportunities for savings from loads to controls.[2] Building energy code also requires implementation of advanced lighting control

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[1] Specifically, electric and natural gas IOUs with more than 30,000 customers as specified in Minnesota Statutes § 216B.241 subd. 14, which includes Xcel Energy, Minnesota Power, Otter Tail Power, CenterPoint Energy, and Minnesota Energy Resources.

[2] U.S. Department of Energy, "Energy Savings Forecast of Solid-State Lighting in General Illumination Applications" (December 2019). Available here.

strategies in commercial and industrial buildings. LLLCs simplify compliance with energy codes and offer cost advantages over traditional lighting controls, making them a beneficial choice for new buildings, renovations, and retrofits. In addition, they provide the foundation for smart, connected buildings, enabling spatial data acquisition and delivering value beyond energy savings.

Despite this, less than 1% all luminaires in the United States are connected,[3] due to barriers including lack of awareness of the value proposition and, for some applications, lack of a compelling value proposition; high upfront product cost; and a lack of technical skills among market actors. However, several market opportunities also exist — there has been growing demand for energy efficient lighting post market adoption of solid-state lighting; interest in these products is evident across market actors; there is a high profit potential for installers; changes in utilization of commercial buildings since COVID-19 has created opportunity for change; and codes and standards can be an effective leverage point. Given these barriers and opportunities, the market is ripe for intervention, and ETA plans to lead a number of market support strategies to enhance adoption of LLLCs. Anticipated market support strategies include the following.

1. Drive pilots and leverage installations; publish case studies
2. Ensure comprehensive training and tools are available for specifiers, installers, and programmers
3. Establish installation support mechanisms
4. Identify and deeply engage with qualified lighting controls professionals
5. Collaborate within the industry to define and categorize qualified products consistently, ensuring default configurations are incorporated
6. Collaborate with utilities and program implementers to differentiate, increase, align and promote incentives and maximize grid value
7. Create marketing strategy and tools to promote LLLCs and build awareness among end-users/building owners
8. Collaborate with key partners to drive Energy Code adoption

For more information about barriers, opportunities, and market support strategies, please see the Market Transformation Plan.

Product description

LLLCs are connected systems of luminaires, which each contain control and sensor components.

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[3] U.S. Energy Information Administration, "2018 CBECS Survey Data." Available here.
Connected lighting is an umbrella term used to describe lighting systems with distributed intelligence and are also referred to as networked or internet-of-things lighting systems. Multiple technologies fall under this category, including smart lamps, power over ethernet systems, ancillary accessories like sensors, circuit-level power and energy metering, LLLCs, and more.

Application focus

This initiative will focus on interior commercial and industrial spaces where LLLCs are most applicable, typically where linear troffer and low/high bay fixtures are present. These fixtures are found in various building types, including offices, warehouses, manufacturing facilities, and MUSH (Municipalities, Universities, Schools, Hospitals) market buildings, where significant energy savings are possible.

For this initiative, we will also focus on both retrofit and new construction/major renovation. Major renovation and new construction applications are similar as they trigger code compliance, whereas code compliance is less extensive in retrofit scenarios. For that reason, we will generally group new construction and major renovation together and consider retrofit separately.

Energy savings potential

To understand a technology's savings potential, we can consider both the absolute maximum amount of savings possible with the technology (the technical potential) and, more realistically, the savings the program may expect to achieve (program potential).

Technical potential is the theoretical maximum amount of energy use (first-year savings) that could be displaced by the measure with consideration of engineering constraints. It is a snapshot in time, assuming immediate implementation of the technology across all buildings and applications where it is feasible. In other words, if we were to change out all existing technology in our building stock with this technology, including projected new construction, the savings of that transition would be our technical potential.

The technical potential is helpful to compare savings across initiatives and provide an order of magnitude of savings potential. Technical potential assumes that all possible retrofit opportunities and all new construction opportunities over a 20-year timeframe are fully captured.

The program potential is a smaller subset of the technical potential that considers both broader factors like turnover rates and workforce limitations, other market barriers as well as program implementation constraints.

The technical potential estimates are described below. Program potential will be estimated over the next year as more data become available.

Technical potential

To project technical potential, we used 2018 Commercial Buildings Energy Consumption Survey (CBECS) data to estimate the interior square footage of existing commercial buildings and new construction, along with 2018 Manufacturing Energy Consumption Survey data to estimate manufacturing/industry square footage. [4] However, we know that LLLC technology isn't applicable for all form factors of light fixtures; for example, decorative fixtures are much less likely to be LLLCs compared to linear troffers. Thus, we will consider only the form factors for which LLLCs are most appropriate: linear and low/high bay luminaires. Using DOE projections for the proportion of energy use by form factors in 2035 (which accounts for increase in LED technology efficiency), it's estimated that linear and low/high bays use 64% of interior lighting energy compared to other form factors. [5,6] Thus, we prorate square footage by 64% in calculating the technical potential. Multiplying the square footage by the lighting power density (W/sq. ft.), operating hours, and appropriate savings factors, results in an estimate of total technical potential for LLLCs in Minnesota of 2,900,000 MWh.

LOGIC MODEL

Market transformation programs are different than traditional energy efficiency programs (i.e., resource acquisition programs) in that savings do not occur necessarily at the same time as activities. Market transformation relies on removing barriers in the market to increase product adoption and eventually achieve savings, so it is important to document the theory of market progress that will lead to energy savings. The program theory is derived from carefully documenting market barriers and opportunities, identifying activities to leverage opportunities and overcome barriers, and describing intended outcomes in the market, which will ultimately lead to energy savings. This theory draws a through line of logic from the current market conditions, to what we plan to do, and how we think the market will change as a result. Given that the market will take time to develop and absorb these changes before energy savings are fully realized, ETA will rely on other market progress indicators (MPIs) to show intermediate progress.

To document the program theory and identify MPIs, ETA engaged in a logic modeling process with support from NEEA. The logic model is a visual flow chart representation of the program theory, showing the key barriers and opportunities; ETA's market support strategies; the immediate results of ETA's market support strategies (outputs); and the short-, medium-, and long-term market outcomes that we anticipate being the market result from these support strategies. All these lead to the overarching, long-term impact that we hope to make at the end of our market intervention work. Market progress indicators are then derived from the outcomes indicated in the logic model, and outputs will also be tracked to document that the market support strategies are implemented. For more details about market support strategies, please see the Market Transformation Plan.

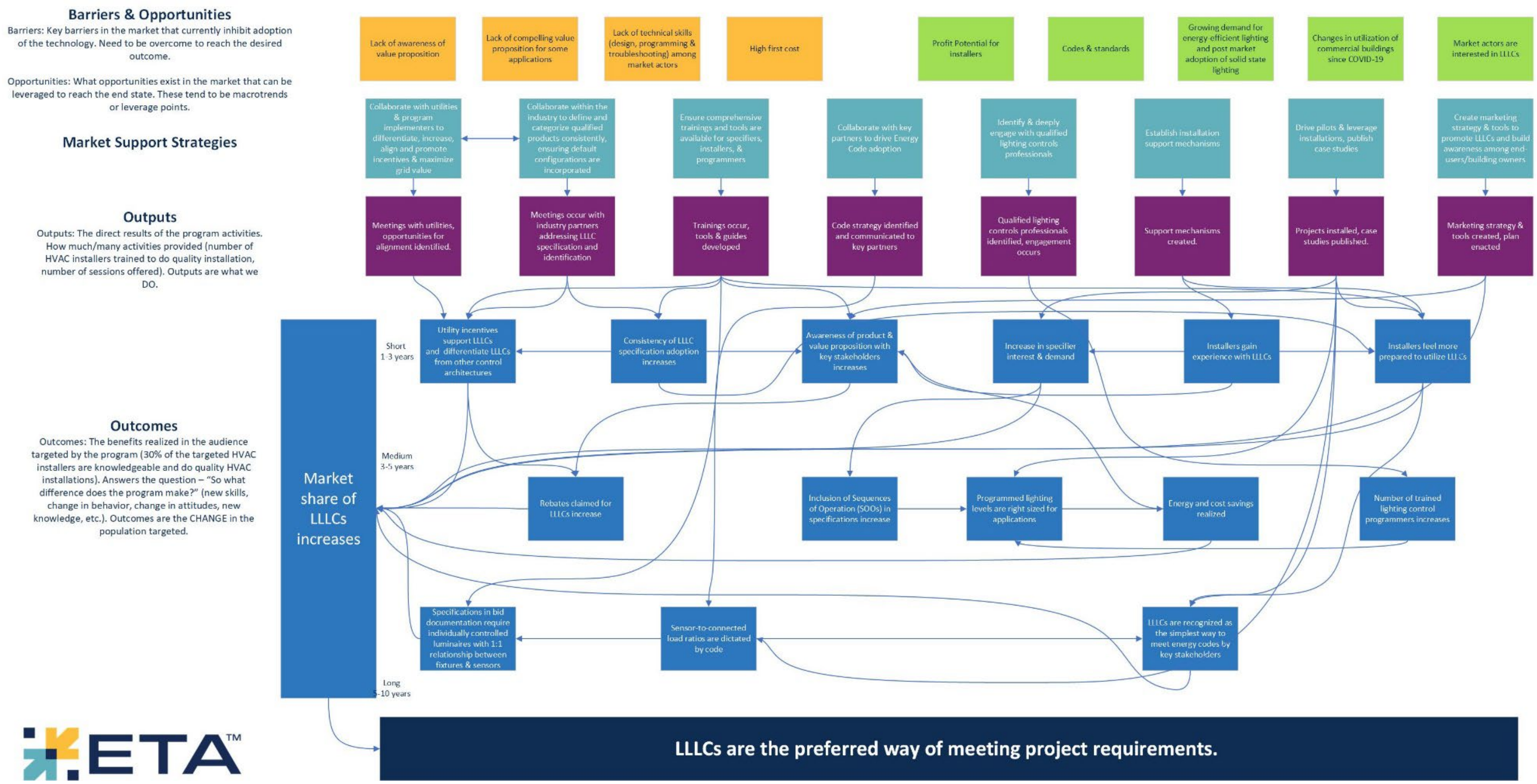
[4] While LLLCs are appropriate for exterior applications, that is not the focus of the initiative currently.

[5] U.S. Department of Energy, "Energy Savings Forecast of Solid-State Lighting in General Illumination Applications" (December 2019). Available here.

[6] This proportion considers all loads are converted to LED.

The logic model serves as a guiding document for the program and is used as a check for specific market activities to ensure alignment with the intended plan. We anticipate reviewing the logic model periodically to ensure the program theory remains sound and to adjust for new barriers and opportunities that arise. The logic model and identified MPIs will also serve as a basis for market progress evaluation, benchmarking the progress the initiative has made in the outlined program theory. The current logic model for the LLLC initiative is shown in Figure 1.

Figure 1: LLLC Logic Model



Evaluation efforts

Various data, in addition to energy savings inputs, will need to be collected and tracked to understand the market and the initiative's progress. Output tracking will help show that we are implementing the outlined market support strategies, indicating implementation progress and completion of important milestones. Market progress indicators will show the state of the market and whether we are achieving the intended outcomes from our work. For more information about data sources and collection, see the Data collection plan section.

Outputs

Outputs are the direct result of ETA's actions and are therefore largely something we can measure and/or document internally or on a collective partner level depending on the market support strategy. The metrics used to assess outputs are essentially to show that the strategy is being implemented and the expected outputs and milestones are occurring not that the market is changing, which is captured through outcomes and MPIs. Unlike with some market outcomes where the goal may be to achieve a year over year increase in a specific metric (MPI), outputs and associated metrics do not necessarily result in continued increases. Rather, they indicate how we anticipate reporting on our activities. For example, an output-based metric may be the number of trainings held. We may do four trainings one year, and only two the next as we are focusing on other strategies. That difference is acceptable; we will simply plan on reporting the number of trainings held and qualitative details about the trainings each year.

In other times, we may want to focus our strategies and subsequent outputs on quality over quantity, though quality may require more resources and outside market actor perspectives to effectively gauge. We intend to focus resources and market actor time on MPI tracking rather than output tracking as MPIs are more critical to showing market progress. When quality can be proxied via internally trackable metrics, we will denote those metrics. For example, we may include the number of individuals contacted and number of times we engaged with those individuals; we may only engage with a small number of key market actors, but engage with them deeply through numerous encounters, which is a proxy for quality engagement.

The market support strategy, output, and metric to measure the output are listed in the table below (Table 1). Outputs will be tracked and documented on an ongoing basis by program staff.

Table 1: Market support strategies and associated outputs and metrics

Strategy	Output	Metric
Collaborate with utilities and program implementers to differentiate, increase, align, and promote incentives and maximize grid value (MSS 6)	O1. Meetings with utilities, opportunities for alignment identified	# of meetings held, % of program implementers met with, opportunities identified and communicated
Collaborate within the industry to define and categorize qualified products consistently (MSS 5)	O2. Meetings occur with industry partners addressing LLLC specification and	# of meetings held, specification differences and qualified products documented

Strategy	Output	Metric
	identification of qualified products, including their capabilities and default configurations	
Ensure comprehensive training and tools are available for specifiers, installers, and programmers (MSS 2)	O3. Identification of training and resource gaps O4. Trainings occur and tools and guides developed	Resources exist that address identified gaps, # of trainings, level of satisfaction with trainings, tools exist
Identify and deeply engage with qualified lighting controls professionals (MSS 4)	O5. Qualified professionals identified, engagement occurs	Process exists and is in place, materials developed, outreach channels identified and documented, # of participants reached and/or proportion of identified professionals engaged with, level of satisfaction
Establish installation support mechanisms (MSS 3)	O6. Support mechanisms identified (e.g. connecting installers with technical support, facilitating project management, tools/training) O7. Support mechanisms developed	Support mechanisms are identified and documented, process for tracking support is documented and tracked, level of satisfaction with support mechanism
Drive pilots and leverage installations; publish case studies (MSS 1)	O8. Projects installed and case studies published	# of projects installed, # of partners for projects, # of connected light points, # of case studies published
Collaborate with key partners to drive Energy Code adoption (MSS 8)	O9. Code strategy identified and communicated to key partners	Code strategy documented and communicated
Create marketing strategy and tools to promote LLLCs and build awareness among end users/building owners (MSS 7)	O10. Marketing strategy and tools created, and plan enacted	Strategy documented, materials developed, outreach channels identified and documented, # of partners materials are delivered to

Market progress indicators

Outcomes are the anticipated *market* result of the market support strategy implementation. As they are a market result, they rely on market actors to come to fruition and are not fully within ETA's control. Thus, they require evaluation of indicators (MPIs), which are tracked via and external data sources or primary data collection. The logic model outcomes, MPIs, associated metrics, and data sources are listed below. A single outcome may require measuring multiple MPIs to assess progress. Conversely, progress toward multiple outcomes might be tracked via the measurement of a single MPI. Table 2 lists all outcomes and their respective MPIs, so there may be duplicative MPIs listed. Similarly, multiple strategies can lead to the same outcome, or conversely, one strategy can lead to multiple outcomes, so strategies are not included in the table for simplicity. However, one can review the logic model to see the connection between strategies and associated outcomes. Table 5 also includes anticipated data sources to gather information about MPIs; these are discussed in more detail in the Data collection plan section.

As MPIs also relate to short-, medium-, and long-term outcomes, not all MPIs will be tracked initially or concurrently. We anticipate evaluating the time relevant MPIs every one to three years, depending on how quickly ETA can implement market support strategies and how frequently market insights are needed to guide strategies.

Table 2: Logic model outcomes and associated MPIs

Logic Model Outcome	MPI	Data source
Utility incentives support LLLCs and differentiate LLLCs from other control architectures	A. Increasing # of utility programs with aligned LLLC incentives	Utility data
LLLC terminology and product definitions are used consistently across the market	B. LLLC product definition is aligned across key stakeholders	Program documents, specifier survey, installer/programmer survey, program partner survey, web search
Awareness of product and value proposition among key stakeholders increases	C. Increasing % of stakeholders reporting familiarity with LLLC	Specifier survey, installer/programmer survey, building owner survey
	D. Increasing % of stakeholders reporting agreement that LLLCs are appropriate for different applications	Specifier survey, installer/programmer survey, building owner survey
Installers feel more prepared to utilize LLLCs	E. Increasing % of installers feel prepared to utilize LLLCs	Installer/programmer survey, training surveys
Increase in specifier interest and demand	F. Increasing % of specifiers who report interest in LLLC products	Specifier survey
	G. Increasing % of projects where specifiers use LLLC	Specifier survey, Dodge data
Installers gain experience with LLLCs	H. Increasing # of installers report installing an LLLC system	Installer/programmer survey

Logic Model Outcome	MPI	Data source
	I. Increasing # and % of projects where LLLC is used	Installer/programmer survey
Rebates claimed for LLLCs increases	J. Increasing # of projects claim rebates	Utility data, potentially new construction implementers
Inclusion of Sequences of Operation (SOOs)[7] in specifications increase	K. Increasing % of lighting specifications include SOOs	Specifier survey, Installer/programmer survey Dodge data
Market share of LLLCs increases	L. Increasing % of market share	Encentiv data, installer/programmer survey Supply chain survey (manufacturer, manufacturer reps, and distributors)
LLLCs are recognized as the simplest way to meet energy codes by key stakeholders	M. Increasing % of stakeholders indicate LLLCs are their preferred system to meet code	Specifier survey, installer survey/programmer
Programmed lighting levels are right sized for application	N. Increasing % of installations are right sized for application	Site visits, Installer/programmer survey, potentially utility program information/ implementers
Specifications require individually controlled luminaires with 1:1 relationship between fixtures and sensors	O. Decreasing ratio of fixtures to sensors	Specifier survey, Dodge data, site visits, stakeholder survey, potentially utility program information/implementers
Sensor-to-connected load ratios are dictated by code	P. Code includes sensor-to-connected load ratios	Code language

ENERGY SAVINGS ESTIMATION

Energy savings methodology overview

As outlined in the ETA filing, ETA will apply an approach consistent with how savings are estimated for traditional CIP programs.

[7] SOOs are detailed instructions providing clear direction on how lighting controls should be programmed.

In its most basic form, energy savings are estimated using the following equation:

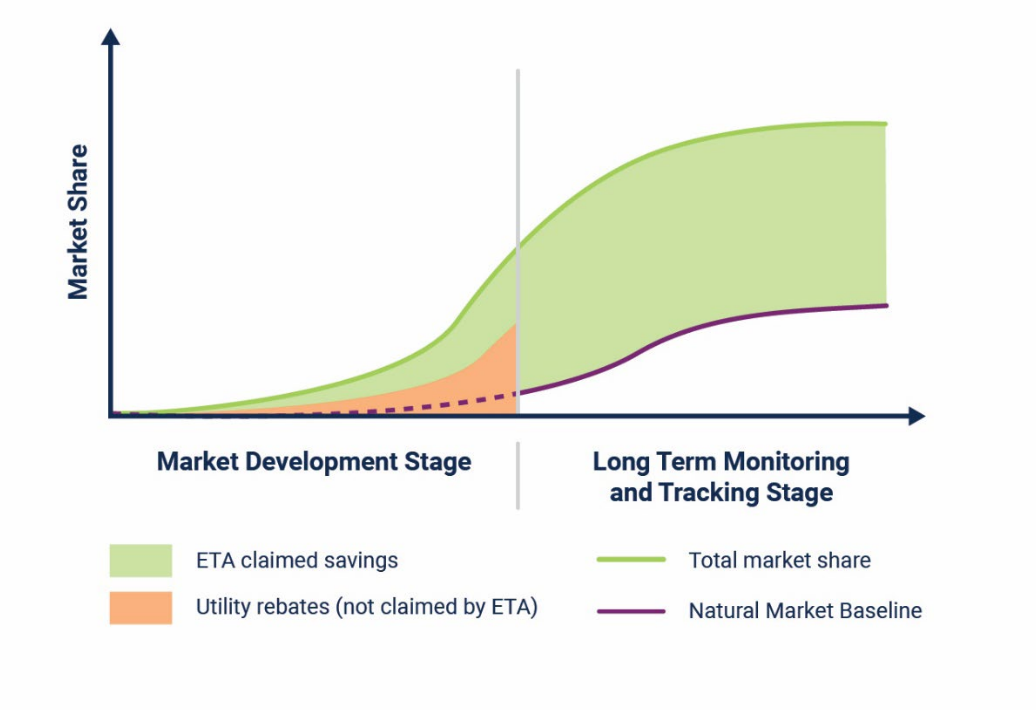
[market transformation savings] = [number of units] x [savings per unit]

However, there are some key differences in approach and additional adjustments that are made to estimate market transformation savings, which were described in the filing and approved in the ETA final order. In summary, the approach involves three basic steps:

1. **Counting total statewide savings from market sales data.** For market transformation, the number of units is counted at the whole market level, rather than at the individual customer level. This is because the market support strategies influence the whole market, not just a single customer's decision. Thus, because the program will not be collecting site-level data for the whole state, the program will use an average statewide savings number across all applicable customer sites, and multiply that by data typically collected at the manufacturer, distributor, or retailer level.[8] In traditional CIP programs, savings accuracy depends on precisely capturing customer site information, while in market transformation it is more important to accurately characterize the whole market.
2. **Adjusting the total savings to account for utility rebates.** Frequently, at least a portion of a market transformation initiative's life cycle will overlap with rebates offered by a traditional CIP program, as entities work together to advance the adoption of energy efficient products and practices in the market. Savings from this type of joint program effort are referred to as co-created savings because both programs contribute to the total savings and to the market transformation effects. However, these savings should not be double counted in savings claimed through ETA. Therefore, when rebates are provided by a traditional CIP program during the course of a market transformation initiative, the savings claimed through these rebates will be subtracted from the total market transformation savings to avoid double counting.
3. **Adjusting for a natural market baseline during the Long-Term Monitoring and Tracking Stage.** The natural market baseline is a forecast of the future in which no utility-funded intervention exists (CIP or ETA). It is a counterfactual, hypothetical forecast that allows us to recognize that there is some current market adoption, albeit very minimal, and that market adoption may change on its own. Minnesota, however, does not require the subtraction of the natural market baseline from the statewide savings data during the Market Development Stage, as it is a gross savings state (Figure 2). However, it is appropriate to adjust for the natural market baseline in the Long-Term Monitoring and Tracking Stage, per the filing.

[8] We note that distributors could provide product to contractors in Minnesota that may install them in other states. A similar situation can occur for retail products sold directly to customers. In this case, an adjustment to account for this leakage to adjacent states may be needed. NEEA has developed methodologies for accounting for this leakage, and we would follow best practices in making those adjustments.

Figure 2: Market Development and Long-term Monitoring and Tracking savings accounting

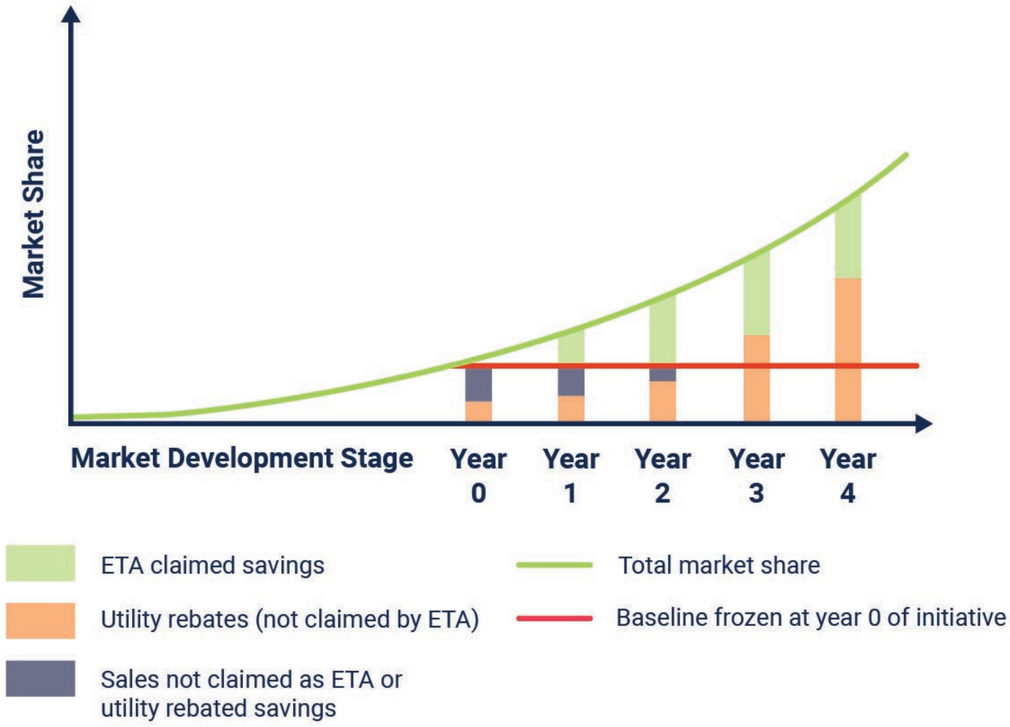


Modification for simplified baseline approach

While it is not a regulatory requirement to account for the natural market baseline (NMB) during the Market Development Stage, there are currently commercially available products that meet our product definition in the market with a small portion of sales prior to ETA strategy implementation. Therefore, we plan to modify the approach outlined in the filing and follow a more conservative, simplified baseline approach to adjust for some naturally occurring sales during the Market Development Stage. This will be accounted for by freezing a baseline at the total market share of the product in the year prior to the Market Development Stage (Figure 5). Trendlines or averages may also be considered if we believe the year before contained anomalies (e.g., supply chain shortages, COVID-19).

With this simplified baseline approach, ETA will only claim savings for sales above the initial frozen baseline. In early years, rebate participation may be below the simplified baseline (e.g., yr. 1 and 2). Therefore, there is no need to subtract the rebated savings from ETA savings since they are already accounted for within the simplified baseline. Once utility rebate amounts cross the simplified baseline amount, we will simply subtract utility savings instead of the baseline. Utility rebate participation will likely grow over time, and while we anticipate having positive influence on volume of rebated sales, we plan to only count ETA savings above the rebated amount, so it is possible that ETA savings may temporarily shrink over time until reaching Long Term Monitoring and Tracking (e.g., yr. 3–4 in Figure 3).

Figure 3: Simplified baseline approach for savings calculations in market development stage



The simplified baseline approach is more conservative than claiming all gross savings, as is allowable in statute, and requires less evaluation spend than a full NMB. The NMB is also hypothetical and uncertain, and this approach relies on a more tangible sales figure. We will, however, still provide NMB projections and use the NMB in the Long-Term Monitoring and Tracking Stage.

For the LLLC initiative, we will plan to freeze sales estimates based on 2022 data we receive from Encentiv (discussed in greater detail in the Data Collection Plan section). After five years, the program will review the baseline assumptions to account for unforeseen market disruptions or new data to inform the baseline adoption, and we may adjust the baseline accordingly.

LLLC specific savings equation

kWh savings equation

The equation for LLLCs is modified slightly from the overall basic equation, discussed above, to be more specific and account for several different savings factors (SF) in accordance with the TRM. In addition, other initiatives count savings on a per unit or widget basis. However, based on the nature of LLLCs, savings is calculated based on kW entering the market rather than a savings per widget. This yields the following equation, per the TRM:

Equation 1: TRM Algorithm for annual kWh savings

Unit kWh Savings per Year = kW x (SF_new - SF_old) x Hrs x HVAC_cooling_kWhsavings_factor

Where:

kW = Total connected fixture load (kW of LLLC entering the market)

Hours = Deemed annual operating hours

SF_new= Deemed savings factor for newly installed lighting control (LLLC)

SF_old = Savings factor for existing lighting control (for new construction, we assume multiple controls)

HVAC_cooling_kWhsavings_factor = Cooling system energy savings factor resulting from lighting. Reduction in lighting energy results in a reduction in cooling energy, if the customer has air conditioning.

Each of these inputs is discussed in more detail below. Additionally, we will calculate both retrofit and new construction/major renovation savings separately and add them together to estimate the full savings amount.

kW savings equation

In addition to kWh savings, it will be helpful to track peak kW savings for utilities. The TRM provides the following equation for calculating peak KW (demand) savings:

Equation 2: TRM algorithm for annual peak kw savings

Unit Peak kW Savings = CF x kW x (SF_new - SF_old) x HVAC_cooling_kWsavings_factor

Where:

CF = Coincidence factor, the probability that peak demand of the lights will coincide with peak utility system demand

HVAC_cooling_kWsavings_factor = The demand savings factor used to account for air conditioning savings due to reduced heat from lighting, as outlined in the TRM

All other inputs are the same as for calculating energy savings, as shown in Equation 1.

Inputs for savings calculations

Each input used to calculate energy savings and complete the necessary adjustments is discussed in more detail below. As noted in the LLLC methodology, we plan to estimate statewide kW of LLLC and multiply it by several savings factors. We will then subtract the simplified baseline or the utility rebates (whichever is greater) when the initiative is in the Market Development Stage. Once the initiative moves to the Long-Term Monitoring and Tracking Stage, we will instead subtract the natural market baseline (assuming the natural market baseline is greater than any rebate activity that may still be occurring).

Statewide sales and associated kW estimates

NEEA staff have tried numerous approaches to identify LLLC and whole lighting market sales data — however, it has proved difficult. Their current strategy includes a partnership with a third-party vendor (Encentiv) to acquire LLLC shipment data by destination zip code for a number of manufacturers. Then, NEEA creates a model to extrapolate those data to the full market in their area. Since sales occur between different market actors at different points in time throughout project cycles, we are using shipments as a proxy for sales. Shipment data represents the quantity of LLLCs entering the market and are a consistent proxy for the volume of LLLCs and sales coming into the state. We will refer to these as *sales data* throughout this report, noting that they are technically shipment data.

We are currently working with NEEA and Encentiv to establish a similar approach to receive partial LLLC data and create estimates for LLLC sales in Minnesota. The Encentiv data will include both the number and type of fixtures or devices sold, as well as the wattages of the luminaires. However, it does not indicate the building type where the LLLC is installed, which determines the savings factor in the TRM savings equation.

Hours

Hours of use are delineated by building type in the TRM. However, since we will not know the building type where LLLCs are installed, we will use the hours estimate for the other/misc. category of 4,576 hours of use for all LLLC installations.

Coincidence factor

Coincidence factor is also delineated by building type in the TRM. Since we won't know the LLLC building type, we'll use the TRM's "other/misc." value of 66%.

Savings factor (SF_new – SF_old)

Savings factors vary for different types of buildings. However, as we are calculating statewide savings and will not know the building type or control type where an LLLC is installed, we calculated a universal savings factor of 0.510, accounting for both retrofit and new construction, using the Commercial Buildings Energy Consumption Survey (CBECS) data and the TRM to account for various control types and building types, described below.

SF_new

Currently, we will not know the building type where an LLLC is installed. Thus, for the SF_new variable, we will use the other/unknown deemed savings factor of 0.63 from the TRM for all installations.

Figure 4: TRM LLLC Savings Factors, by Building Type

Table 2. Deemed Savings Factors for NLC

Control Type	Subtype	Savings Factor			SF Source
		With LLLC	Without LLLC	Unknown	
Networked lighting controls	Assembly	0.32	0.24	0.28	Ref. 3, Table 1 and Table 7, see Notes
	Manufacturing	0.51	0.26	0.40	Ref. 3, Table 1 and Table 7
	Office	0.77	0.40	0.64	Ref. 3, Table 1 and Table 7
	Education	0.52	0.35	0.41	Ref. 3, Table 1 and Table 7
	Restaurant	0.67	0.51	0.59	Ref. 3, Table 1 and Table 7, see Notes
	Retail	0.50	0.38	0.44	Ref. 3, Table 1 and Table 7, see Notes
	Warehouse	0.78	0.58	0.68	Ref. 3, Table 1 and Table 7, see Notes
	Other / unknown	0.63	0.35	0.49	Ref. 3, Table 1 and Table 7

SF_old

To derive the SF_old, the TRM specifies different savings factors depending on building type and existing controls. Energy savings is allocated to different groups, based on whether the buildings in that category have:

1) No controls (SF_old = 0)
2) Any one of the following controls (each with their own TRM savings factor):
    a. Occupancy sensors
    b. Personal tuning ("multi-level lighting or dimming" in CBECS)
    c. Daylight harvesting
    d. Task tuning ("high-end trimming or light-level tuning" in CBECS)
3) Multiple lighting controls (use the "multiple of the above" TRM savings factor)*

*Note that we assume new construction will have multiple lighting controls as dictated by code and will use the multiple lighting controls factor for new construction.

Retrofit AND Control types

CBECS provides information about what lighting controls are available in each building, including:

- Occupancy sensors
- Multi-level lighting or dimming
- Daylight harvesting
- High-end trimming or light-level tuning

The percentage of existing building square footage with each control type is shown in Table 3 below. For each specific lighting control, the value shown represents the estimated square footage of buildings with just that control (i.e., no other controls installed).

Table 3: Percentage of buildings square footage with each control type

Control Type	% of total square footage
No controls	56.9%
Occupancy sensors	27.5%
Personal tuning	3.4%
Daylight harvesting	0.4%
Task tuning	0.8%
Multiple controls	11.0%

When CBECs data indicates that a lighting control strategy is employed in a building, it is assumed that it applies evenly across the entire lighting load of that building (i.e., occupancy sensors are controlling all lighting and not just in some spaces within the building). We believe this is an appropriate assumption because it is as conservative as possible, especially considering that buildings employing daylight harvesting are typically only doing so for lighting adjacent to windows.

The TRM also outlines the specific savings factors for each type of control. Since we will not know the specific building type for an LLLC installation, we will use the other/unknown category within each building type (Figure 5) in our calculations described further below. We may adjust this methodology if we are able to better understand where LLLCs are installed. For example, we may be able to break out warehouses based on high/low bay fixture types and apply specific savings factors for that building type. We may also adjust this methodology if additional data, such as utility rebate data, become available.

Figure 5: TRM-specified control savings factors, by building type

Control Type	Building type	Savings Factor	SF Source
Occupancy Sensor	Office	0.22	Ref. 2, Table 7 For warehouse new construction, occupancy sensors with 50% dimming are required (Ref. 8). This reduces the baseline NC savings factor in this scenario to SF_{OCC} * (1 - 0.50) = 0.31 * 0.50 = 0.16
	Warehouse	0.31 (upgrade) 0.16 (NC baseline)	
	Lodging	0.45	
	Education	0.18	
	Assembly	0.36	
	Healthcare, outpatient	0.23	
	Other / unknown	0.24	Ref. 2, Abstract
Daylighting	Office	0.27	Ref. 2, Table 7
	Warehouse	0.28	
	Education	0.29	
	Retail	0.29	
	Assembly	0.36	
	Other / unknown	0.28	Ref. 2, Abstract
Personal tuning	Office	0.21	Ref. 2, Ref. 5: 0.35 x 0.22 / 0.36 = 0.21 (see Notes)
	Education	0.04	Ref. 2, Ref. 5: 0.06 x 0.22 / 0.36 = 0.04 (see Notes)
	Other / unknown	0.19	Ref. 2, Ref. 5: 0.31 x 0.22 / 0.36 = 0.19 (see Notes)
Task tuning	Office	0.37	Ref. 6 and Ref. 9, see Notes
	Education	0.26	
	Manufacturing	0.05	
	Warehouse	0.07	
	Other / unknown	0.22	Ref. 5
Multiple of the above		0.38	Ref. 2, Abstract

Assuming we will not know the control type or existing building type where an LLLC is installed, SF_Old is derived from multiplying the percentage of building square footage[9] with each control type by the savings factor for that control type, and adding each control type product, illustrated below.

- No control *0.569*0*
- \+ Occupancy sensors *0.275*0.24*
- \+ Personal tuning *0.034*0.19*
- \+ Daylight harvesting *0.004*0.28*
- \+ Task tuning *0.008*0.22*
- \+ Multiple controls *0.110*0.38*
- = *0.117*

Subtracting the SF_Old from SF_New for retrofit yields a total savings factor of 0.513.

New construction

To include new construction, we assume all new construction and major renovation projects can be characterized as having multiple lighting control strategies, as is dictated by code. Therefore, the savings factor for multiple control strategies, 0.38, is used for SF_old for new

[9] We estimated 2023 building square footage values by increasing CBECS 2018 numbers by 1% annually to account for the estimated increased square footage from new construction.

construction and 0.63 for SF_new. Assuming a 1% year-over-year increase in square footage from new construction,[10] the adjusted savings factor becomes 0.510. This is likely a conservative estimate, as code indicates an additional break down of space types, which is a more complex analysis that would likely yield a lower savings factor. ETA will work to collect market data on actual new construction practices in Minnesota, so that we can refine this approach over time to represent the savings impact of LLLCs more accurately in new construction.

HVAC savings factor

The TRM outlines a savings factor of 1.095 for air-conditioned spaces and 1.00 for unconditioned spaces. CBECS data suggest that 87% of all square footage of buildings use some amount of energy for cooling.[11] Assuming this pattern will hold true with new construction, which is a conservative approach, we will prorate the HVAC savings factor by the percentage of conditioned vs. unconditioned spaces. This yields a savings factor of 1.083 (1.095*0.87+1.00*0.13=1.083).

The weighted HVAC_cooling_kWsavings_factor is calculated in the same way as the weighted HVAC_cooling_kWhsavings factor, using the same estimate of square footage that uses cooling energy (87%). The TRM outlines a savings factor of 1.254 for air-conditioned spaces and 1.00 for unconditioned spaces; this yields a savings factor of 1.221 (1.254*0.87+1.00*0.13=1.221).

Utility rebate data

Utilities often have incentives for lighting controls, which LLLCs can meet. However, there are fewer rebates designated for LLLCs specifically. Currently, the three electric funding utilities all have lighting controls rebates that could incorporate LLLCs, and Xcel Energy has an LLLC specific rebate, but they are not fully aligned with our definition of LLLCs. We anticipate working with utilities to increase LLLC specific rebates, aligned with our definition, and will track rebates accordingly. In the absence of an LLLC specific incentive, we will work with utilities to parse out LLLC qualifying systems in their current rebate approach to determine LLLC rebated savings, but we anticipate this initial amount of LLLC rebates to be less than the baseline annual sales data amount. This data will be collected annually for savings calculations.

We will also work with utilities to estimate co-created savings from their new construction programs, where LLLCs may be embedded into the program savings. Program savings are frequently based on modeled savings above code, so any LLLCs employed would likely be counted in the modeled savings claimed by these programs.

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[10] U.S. Department of Energy, "Energy Savings Forecast of Solid-State Lighting in General Illumination Applications" (December 2019). Available here.

[11] One drawback of CBECS is that it does not provide a clear picture of how cooling energy use is distributed across square footage (e.g., a building with some office space and some warehouse space may use AC in the entire facility, but the AC use could be concentrated in the office portion and virtually nonexistent in the warehouse portion) — we will refine these estimates if and as we receive better data.

We will also work with DER and non-funding consumer-owner utilities (COUs) to identify additional rebate programs and amounts.

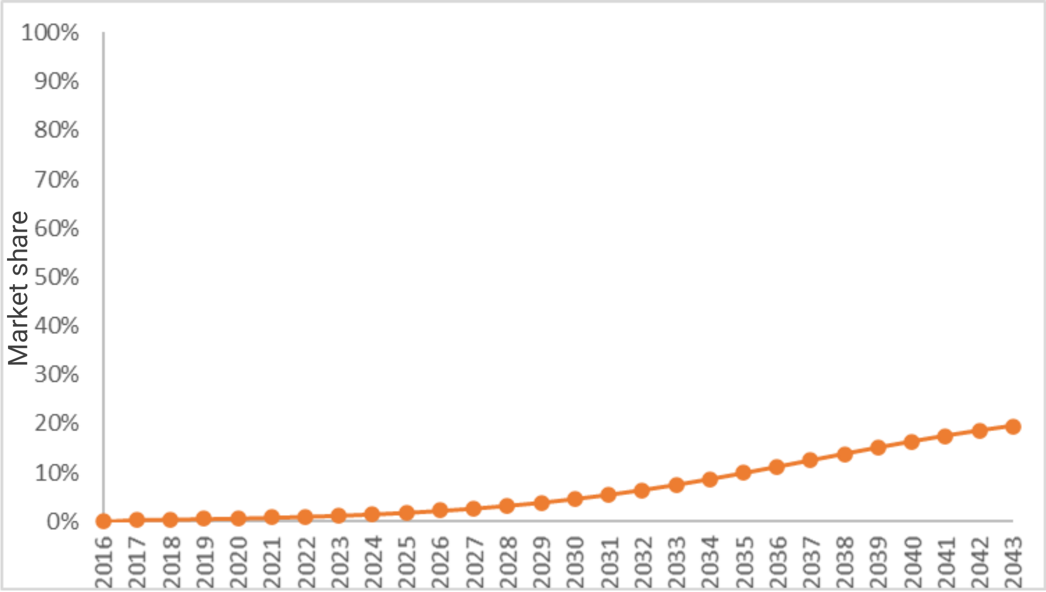
Simplified baseline

As mentioned, we anticipate working with Encentiv to receive partial sales data and develop statewide extrapolated estimates. We anticipate using 2022 data from these estimates to serve as the simplified baseline. We may also consider an average of the past three years if available to account for anomalies in single year data.

Natural market baseline

The natural market baseline is created using a methodology developed by NEEA, and it results in an s-curve shaped model of the projected market adoption for LLLCs if the ETA did not intervene in the market. Since these are hypothetical models, a large amount of uncertainty around estimated figures exists. However, market characterization, expert opinion on future projections, and current understandings of the market inform the NMB inputs. They will be refined over the next year as the program launches and reviewed periodically to confirm the assumptions are still appropriate. Based on our current understanding of the market, we anticipate the natural baseline curve over the program lifetime of 20 years to be similar to that in Figure 6.

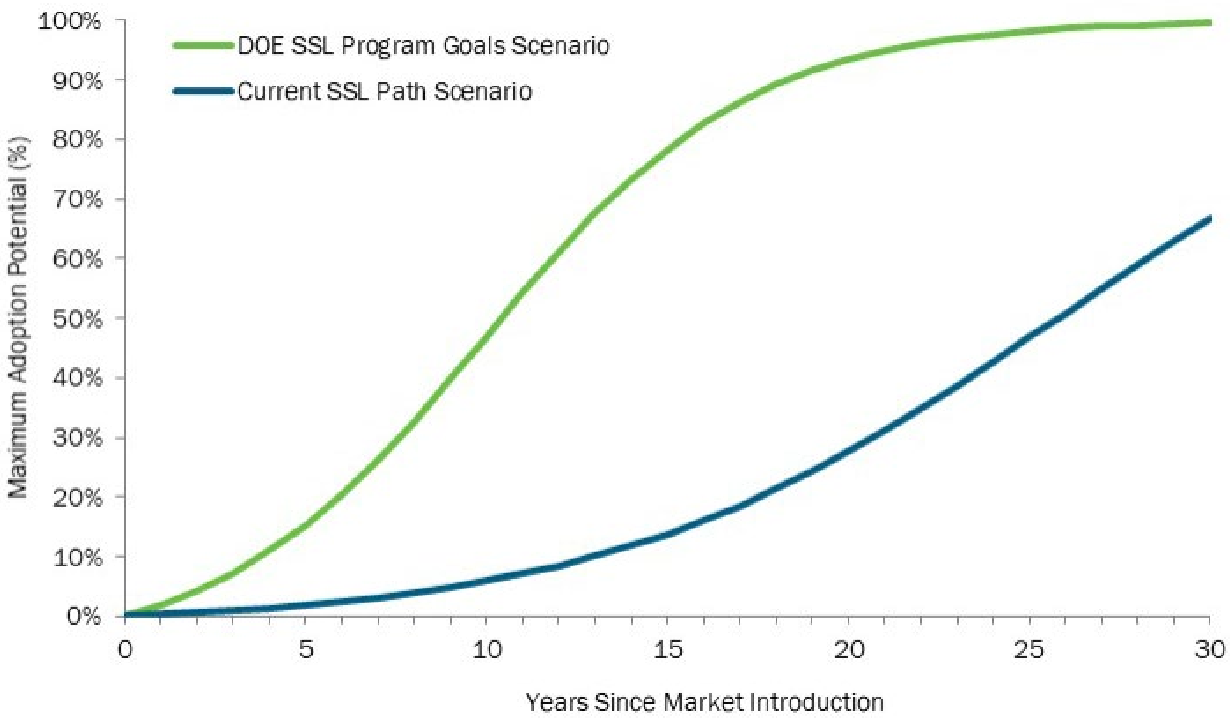
Figure 6: LLLC natural market baseline over the 20-year program life



Rationale

For our NMB, we are basing our assumptions on DOE's current diffusion curve projections for connected lighting (Figure 7).

Figure 7: DOE diffusion curves for connected lighting



Diffusion Curves for Connected Lighting[12]

Consistent with the DOE's current solid-state lighting path scenario, this initiative assumes that without intervention, the rate of market penetration of connected lighting is similar to that of DALI (digitally addressable lighting interface systems) and dimmable linear fluorescent ballasts, two similar and prior innovations in the lighting controls market.[13] LLLCs and other connected luminaires were introduced into the market around 2016; following the DOE's diffusion curve for the current SSL path scenario for connected lighting, this puts us at approximately 3% of the maximum adoption potential in 2023. Electrical and lighting contractors surveyed in our recent market characterization indicated that 1.5% of their commercial lighting projects in the past three years included LLLCs or other types of NLCs.

While trends may change, if we extrapolate these data, we could anticipate market saturation of connected lighting to be 50% of lighting projects by 2051. However, LLLCs are only a portion of connected lighting. The exact ratio of LLLCs within connected lighting is unknown, but we can assume LLLCs comprise no more than 50% of connected lighting. Thus, we could anticipate market saturation of LLLCs to be 25%.

While the DOE diffusion curve does not extend to a point where the current SSL path scenario reaches 100%, if we assume that it continues relatively linearly, annual LLLC sales will approach

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[12] U.S. Department of Energy, "Energy Savings Forecast of Solid-State Lighting in General Illumination Applications" (December 2019). Available here.

[13] Ibid

saturation approximately 35 years after market introduction, around 2051. If we assume a similar diffusion curve occurs in MN, we anticipate that in 20 years without intervention, LLLCs would be used on approximately 20% of projects, and on those projects LLLCs would be used in every applicable fixture type.

This estimate is based on the overall lighting market. For applications using primarily high and low bay fixtures (warehouses, manufacturing, etc.), saturation will be higher, as will applications using linear fixtures (offices, schools, universities, etc.). In buildings that primarily use decorative fixtures (restaurants, bars), saturation will be lower. For this reason, we have adjusted our energy savings potential based on the relative consumption of these submarkets within commercial lighting, as described previously in this document.

Utility savings allocation

The allocation of statewide savings to individual utilities is based on their level of funding. Under this approach, statewide savings are allocated based on an individual utility's total fuel-specific funding as a percentage of total initiative funding. As this is an electric-only initiative, savings will be allocated to the three funding electric utilities based on their current funding percentages. The 2023 funding allocations are listed in Table 4. Funding percentages will be reviewed on an annual basis for adjustments in funding (e.g., updated triennial plans, additional utilities voluntarily contributing).

Table 4: 2023 Funding and savings percentages for the LLLC initiative

Electric utilities	% of funding/savings
Xcel electric	88%
MN Power	7%
Otter Tail Power	5%
Total	**100%**

ETA savings attribution

While ETA plans to claim savings only above and beyond the simple baseline and utility rebates, we anticipate that ETA activities will increase product demand in a way that will benefit utility rebate programs, which should be partially attributed to ETA when the program is evaluated. When the state evaluates the program, we anticipate highlighting co-created savings, which is a mixture of utility rebated savings and ETA claimed savings, as an overall indicator of ETA's effectiveness. We will also work with the third-party evaluator to determine any additional adjustments necessary to account for these activities as they arise.

Post code/standard adoption plan

Energy codes or appliance standards are often the endpoint of market transformation efforts. A given market transformation initiative helps accelerate the technology's adoption into the code or standard, and savings can continue to accrue from the ETA initiatives after they have been adopted into a code or standard. The method to calculate savings post-code adoption is well established nationally and involves adjusting the savings by an attribution rate[14] to account for the degree to which the market transformation effort influenced the code or standard. Thus, the basic savings equation for market transformation initiatives post code or standard adoption is as follows:

- *[market transformation savings] = [number of units*] x [savings per unit*] x [attribution rate]*
  - **Note: for LLLCs units is kW rather than unit sold*

The number of years after the code or standard is adopted that the program can claim savings must also be determined. NEEA generally claims savings from energy codes for 10 years, while savings claimed from appliance standards vary more based on the extent to which earlier standards were adopted due to market support activities. Therefore, we plan to claim savings for 10 years for energy codes, while standards changes will be based on an estimate by an independent evaluator of how much earlier the standard was adopted. The attribution rate will be determined based on an evaluation completed by an independent evaluator after the code or standard has been adopted.

For this LLLC initiative, we are still developing our code strategy. If there is a new code adoption, we will generally follow the process outlined above.

NET BENEFITS

Calculation and allocation of net benefits

In addition to energy savings, we will calculate net benefits, which are the total benefits of an efficiency measure minus the total costs over its lifetime. They are used to assess the cost-effectiveness of programs and as inputs to calculate the financial incentive mechanism for the IOUs. All net benefits will be allocated to utilities based on funding level, following the same formula for attributing energy savings.

The inputs needed to calculate net benefits can be divided into measure-level inputs, utility inputs, and DER-specified inputs, and vary based on fuel type. For the LLLC initiative, only electric inputs will be needed. All inputs are outlined in Appendix A. In general, DER specified

[14] The attribution rate is initiative-specific and determined as an outcome of the evaluation. It is an estimate of the extent to which market transformation efforts influenced the savings (considering other factors) and is typically expressed as a percent.

inputs are set by the DER and publicly available, and we will work with utilities to gather utility input data including confidential trade secret data. For the LLLC initiative, we anticipate the following measure-level values and data sources (Table 5).

Table 5: LLLC measure-level input values and sources

ELECTRIC INPUTS	
Measure-level inputs	**Data source**
Utility project costs (program costs)	ETA program
Incremental cost	NEEA[15]
Project life	MN TRM v4.0 (11 years)
Energy savings/unit	MN TRM v4.0 (see savings section above)
Capacity savings/unit	MN TRM v4.0 (see kW section above)
Number of units	Annual sales data
Load shape	NREL or similar

MARKET PROGRESS REPORTING

To monitor progress, we will create an annual status report, referred to in the filing as the Energy Savings and Market Progress Reports.

The content of each of these reports will include:

1. Output tracking and MPI progress
2. Total savings and net benefits
3. Savings and net benefit allocations to individual utilities

Some outputs and MPIs may not be appropriate to track initially or annually based on when we focus on particular market support strategies and whether the outcome is intended to be a short-, medium-, or long-term outcome. Thus, every report will include an update of outputs and MPIs, however, the particular metrics reported will be tailored to include only those that are most appropriate at that time. Savings and net benefits, as well as utility allocations, will be included in each annual Energy Savings and Market Progress Measurement Report. The reports will fully document the final methodology and data sources used to calculate energy savings and net benefits.

These reports will continue throughout the Market Development and Long-term Monitoring and Tracking stages. When the initiative switches into the Long-Term Monitoring and Tracking, the Energy Savings Report will include the same contents listed in 1–3 and will periodically assess

[15] Northwest Energy Efficiency Alliance, “Luminaire Level Lighting Controls Incremental Cost Study” (2022). Available here.

the need for market re-entry (i.e., additional Market Development work). Re-entry to the market may be justified if market indicators show that progress and increased market share, or diffusion, are not proceeding as anticipated.

We will periodically assess the right time to sunset long-term monitoring and tracking of an initiative. For initiatives with an end goal that includes an energy code or standard, the initiative often continues to accrue savings for many years after the technology or practice is included in that code or standard. The methodology for calculating savings from the ETA initiatives after a technology is adopted into codes or efficiency standards is covered in the post code/standard adoption plan.

DATA COLLECTION PLAN

There are many different data types and sources discussed throughout this document. These are compiled in Table 6 to provide a comprehensive view of how we plan to collect or access data for this initiative. We also acknowledge that this data landscape represents our current understanding of potential data availability, which may change in the future as other data sources are discovered or become available. We will also plan to work with third party evaluators to collect supplemental data and review approaches and assumptions as necessary.

Table 6: Evaluation data purpose, type, and sources

Purpose	Data type	Data source
Market support outputs tracking	Output tracking	Internal data documents: ■ Engagement plans ■ Meeting records ■ Activity records ■ Additional documents as relevant
MPI measurement – secondary data sources	Dichotomous outcome confirmation	Web searches/literature review, program documents, Minnesota building code, utilities, Dodge data
	Sales data	Encentiv data
MPI measurement – primary data collection	Primary survey/interview data for appropriate MPIs (see Table 2)	Specifier survey, installer/programmer survey, supply chain survey, building owner/manager survey, training surveys, program partner conversations/survey, site visits
Energy savings	Sales data for LLLC	Encentiv data
	Per unit savings	TRM, applicable Commercial Energy Code, and CBECs calculations

Purpose	Data type	Data source
	Utility rebate data	Utilities and DER database
Net benefits	DER inputs	DER guidance
	Utility data	Utility data transfers, IRPs, filings
	Measure-level inputs (see Table 5)	TRM, NREL, utilities

Encentiv sales data

Sales data is used for both calculating energy savings and tracking MPIs and is thus very important. NEEA has attempted to get sales data many ways and found Encentiv data to be the best option. As mentioned, Encentiv will give us partial ship-to data representing a portion of manufacturers. CEE will develop a model to extrapolate data to the full MN market. We will receive fixture type, fixture wattage, and lumen bin represented to create appropriate calculations. We will continue to look for more comprehensive data sources.

Utility data

Data from utilities will also be used for a variety of purposes including energy savings, net benefits calculations, and additional benefits tracking. More specifically, we will request a variety of data from funding utilities including:

- Utility rebate data
- Measure-level inputs for net benefits calculations (e.g., project costs, incentive amounts, load shapes)
- Utility-level inputs for net benefits calculations (e.g., avoided energy costs, avoided emissions)

Given that these data span a wide range of utility functions, we will work with each funding utility to determine the appropriate person for each data point to ensure smooth data transfer. We will also use existing documentation, such as Integrated Resource Plans and filings to glean appropriate information.

We will also connect with non-funding COUs for these data points to ensure statewide representation, though we recognize data collection efforts and quality may vary based on utility, and not all metrics are needed from COUs. We will also work with DER to utilize their Energy Savings Platform database to glean additional information entered by COUs.

Output tracking - internal data documents

Most logic model outputs, or results of our market support activities, will be tracked through internal sources. This may include records of trainings, participant lists, meeting notes, engagement or strategy plans, and materials created. We are planning to utilize an adapted version of SalesForce for tracking market engagement and will have documents saved on our internal systems to share with future evaluators. Specific tracking processes for each output will be developed as the market support activities are rolled out.

MPI secondary data sources

Dichotomous outcome confirmation

There are a several dichotomous MPIs that rely on proof that something happened or is in existence. It either happens or it doesn't. These include outcomes such as, "Utility incentives support LLLCs and differentiate LLLCs from other control architectures," and, "Sensor-to-connected load ratios are dictated by code programs." These outcomes have a variety of data sources but are relatively easy to track as most are publicly available or available via utilities and proof of achievement is only needed once.

MPI primary data collection

Many of the MPIs will need to be measured outside of sources that currently exist. In general, this will be done using survey, interviews, focus groups, or other data collection options. Often, this will involve a third-party evaluator or subcontractor. However, in areas where ETA has extensive knowledge and skillsets, we may undertake research in house and in some situations have a third-party review results. We anticipate the following groups will be important to engage with data collection:

- Specifiers
- Installers/programmers
- Manufacturers/manufacturer reps/distributors
- Building owners/decision makers
- Utility program implementers

More details about the specific primary data collection plans will be included in our annual work plan as research questions are solidified and adjusted each year.

Net benefits

For information about net benefits inputs and data sources, please see Appendix A.

APPENDIX A. NET BENEFITS MEMO

TECHNICAL MEMORANDUM

Draft Methodology for Calculating ETA Net Benefits

September 13, 2023

Authors: Chidinma Emenike, Isaac Smith, Carl Nelson, Maddie Hansen-Connell

Purpose

ETA statute requires the calculation and allocation of net benefits as well as energy savings. This document lays out a draft methodology for calculating net benefits from ETA initiatives. This methodology will be included as part of the Market Transformation Plan documents to be approved by the ETA Coordinating Committee prior to launching ETA initiatives.

Net benefits are used for assessing program cost-effectiveness and as inputs for calculating utility financial incentives. As with other CIP programs, net benefits for ETA will be reported when there are savings from specific initiatives to be claimed. Once ETA initiatives are approved and launched, CEE will file annual ETA Energy Savings Reports (similar to an individual utility's Status Report) of total savings and net benefits for each participating utility.

Background

The ETA filing approved by DER provides some overall guidance on calculation of net benefits[16]. As described in the filing, ETA net benefits calculations differ from other CIP programs in several key respects, as outlined in Table 1 below.

Table 7: ETA net benefits calculations compared to traditional CIP program savings calculations

ETA net benefits	CIP program net benefits
Calculated on a statewide basis	Calculated by individual utility territory
Allocated based on financial contribution to ETA (same as ETA savings)	Calculated based on each individual utilities' spending and savings

[16] Center for Energy and Environment. "Minnesota Efficient Technology Accelerator Program Proposal" (2022). Submitted to Minnesota Department of Commerce, Division of Energy Resources. Docket No. E,G999/CIP-21-548. P. 21-34.

ETA net benefits will be calculated based on the primary approved cost-effectiveness test (Minnesota Test) and all other secondary approved cost-effectiveness tests (Societal, Utility, and Ratepayer Impact Tests). Consistent with the approved filing, we will not calculate participant net benefits[17]. Participant cost-effectiveness is a more impactful metric earlier in the program cycle (i.e., when considering program rebates, as opposed to reporting net benefits), and is already considered as part of the ETA initiative selection process.

Included impacts for calculating net benefits

Table 2 below shows a list of various impacts (benefits and costs). Per DER guidance, these impacts will be included in each of the four cost-effectiveness tests. Shaded cells indicate values that are currently not quantified and/or do not have an approved estimation methodology[18].

Table 8: DER-approved cost-benefit impacts (non-quantified impacts in grey)

Utility	Category	Impact	MN Test	Societal Test	Utility Test	RIM
Electric Utility	Generation	Energy Generation	X	X	X	X
		Capacity	X	X	X	X
		Environmental Compliance	X	X	X	X
		RPS Compliance	X	X	X	X
		Market Price Effects	X	X	X	X
		Ancillary Services	X	X	X	X
	Transmission	Transmission Capacity	X	X	X	X
		Transmission System Losses	X	X	X	X
	Distribution Costs	Distribution Costs	X	X	X	X
		Distribution System Losses	X	X	X	X
	General	Program Incentives[19]	X	X	X	X

[17] The participant test is designed to assess cost-effectiveness from a participant's perspective, considering rebates provided by the program. As described in the filing, this test is not as meaningful for ETA initiatives (which may intervene in the market prior to a technology being cost-effective, and do not provide rebates).
Center for Energy and Environment. "Minnesota Efficient Technology Accelerator Program Proposal" (2022). Submitted to Minnesota Department of Commerce, Division of Energy Resources. Docket No. E,G999/CIP-21-548.

[18] DER Decision. "In the Matter of 2024-2026 CIP Cost-Effectiveness Methodologies for Electric and Gas Investor-Owned Utilities" (March, 31, 2023). Docket No. E,G999/CIP-23-46.
[19] Note that ETA is not expected to have any costs in this category as ETA initiatives do not provide customer rebates.

Utility	Category	Impact	MN Test	Societal Test	Utility Test	RIM
		Program Administration Costs	X	X	X	X
		Utility Performance Incentives	X	X	X	X
		Utility Revenue Impacts				X
		Credit and Collection Costs	X	X	X	X
		Risk	X	X	X	X
		Reliability	X	X	X	X
		Resilience	X	X	X	X
Gas Utility	Commodity / Supply	Fuel and Variable O&M	X	X	X	X
		Capacity and Storage	X	X	X	X
		Environmental Compliance	X	X	X	X
		Market Price Effects	X	X	X	X
	Transportation	Transportation	X	X	X	X
	Delivery	Delivery	X	X	X	X
	General (same as Electric)	Program Incentives[19]	X	X	X	X
		Program Administration Costs	X	X	X	X
		Utility Performance Incentives	X	X	X	X
		Credit and Collection Costs	X	X	X	X
		Risk	X	X	X	X
		Reliability	X	X	X	X
		Resilience	X	X	X	X
Non-Utility System	Other Fuels	Other Fuels	X	X		
	Participant	Participant Costs		X		
		Participant Benefits		X		
Societal	Societal Impacts	GHG emissions	X	X		
		Criteria air emissions	X	X		
		Other environmental	X	X		
		Economic and Jobs (Macroeconomic)	X	X		
		Energy Security	X	X		
		Energy Equity	X	X		

Basic methodology – electric utilities

Below we outline the methodology plan to employ to calculate these impacts for the ETA. In general, this is very similar to calculating net benefits for an individual utility, with the exception of calculating the time value of avoided energy for electric utilities, as described below.

Step 1: Calculate total annual energy and capacity savings. This is based on energy savings calculation methodology, discussed in the Energy Savings and Evaluation plans (generally, it will be total units * energy savings/unit or capacity savings/unit). To the extent possible, savings will be consistent with the most recent TRM.

Step 1a (electric utilities only): DER guidance provides for calculating the benefits of avoided energy by each hour of the year (8760 hours) for each year of measure life, resulting in a high level of data granularity that is needed to calculate net benefits. It is reasonable to expect that we might be able to get this level of granularity of data from ETA-participating utilities; but data for the rest of the state will be challenging. Thus, a simplified method will be used for calculating the time value of efficiency, by breaking down the year into periods, and estimating the $/kWh value for each time period. Savings from measure-specific load shapes will also allocated to these discrete time periods.

For illustrative purposes, Table 3 shows the time periods used for calculating energy savings in the 2018 Minnesota Potential Study. We will base the actual time periods and percentage allocations used for ETA net benefits calculations according to what makes the most sense based on the data that is received.

Table 9: Potential Study energy time periods, for calculating time value of electric energy savings

Period	Period definition	% of year
Summer on-peak	Jun-Aug: weekdays 9 a.m. – 10 p.m.	10%
Summer off-peak	Jun-Aug: weekdays 10 p.m. – 9 a.m.	8%
Winter on-peak	Nov-Mar: weekdays 8 a.m. – 10 p.m.	17%
Winter off-peak	Nov-Mar: weekdays 10 p.m. – 8 a.m.	12%
Shoulder on-peak	Apr-May & Sep-Oct: Weekdays 7 a.m. – 11 p.m. + All weekend days 9 a.m. – 11 p.m.	33%
Shoulder off-peak	Apr-May & Sep-Oct: Weekdays 11 p.m. – 7 a.m. + All weekend days 11 p.m. – 9 a.m.	20%

Step 2: Multiply energy and capacity savings by the appropriate values. Energy savings will be multiplied by each relevant $/kWh value (value of avoided energy, value of avoided emissions, etc.), for each period shown in Table 3. Capacity savings will be multiplied by each relevant

$/KW value (value of avoided capacity, value of avoided T&D, etc.) per year of measure life. Calculate total benefits by adding together all resulting dollar amounts for each value.

Step 3: Discount benefits in future years by the appropriate discount rate. The ETA would use the discount rates provided by DER guidance, with some extrapolation needed to calculate statewide values for the utility test, as described in a below section.

Step 4: Calculate total net costs, in keeping with current DER methodology. If available, these inputs will be sourced from the most recent TRM. If costs occur beyond year one (e.g., O&M costs), they will be subtracted from the benefits in the year in which they occur.

Step 5: Calculate net benefits (total benefits minus total costs).

Electric inputs

Table 4 shows the inputs needed to calculate net benefits for electric utilities (Table 4). These inputs are divided into three categories:

1) *Measure-level inputs.* These will be different for each ETA initiative. The method for estimating these inputs will be defined in the Energy Savings Plan for each initiative.
2) *Utility-specific inputs.* These are inputs that are specific to each utility; as described in the "calculating statewide inputs" section below, load-weighted statewide averages will be calculated for these values. Some utility-specific inputs utilize DER-specified values for individual utilities – refer to the footnotes for more information about these values. The statewide average will be based on DER-specified inputs where possible (not available for all utilities).
3) *Global inputs*. These are inputs that apply statewide and are provided by DER.

Utility-specific inputs and global inputs are largely derived from Triennial Plan filings and associated decisions. See the Relevant Filings section for specific filing references.

Table 10: Benefit-cost inputs for electric-saving measures

Measure-level Inputs	Utility-specific Inputs	Global Inputs
Utility Project Costs	Avoided Energy Costs	Participant Discount Rate (residential customers)
Project Life	Avoided Emissions	Societal Discount Rate
Energy Savings/Unit	Avoided T&D[20]	Environmental Compliance
Capacity Savings/Unit	CIP Utility Discount Rate[21]	Non-gas Fuel Cost

[20] DER-approved annual values per utility.

[21] Specified by DER in their order, for each investor-owned utility (IOU).

Measure-level Inputs	Utility-specific Inputs	Global Inputs
Number of Units	Participant Discount Rate (non-residential customers)[22]	Non-gas Environmental Damage Factor
Load Shape		Non-Gas Fuel Loss Factor
Incremental Costs		Avoided Capacity Costs
Electric Non-Energy Benefits		
Variable O&M		

Basic methodology - gas utilities

The gas utility methodology follows DER guidance.

Step 1: Calculate total annual energy savings. This is based on energy savings calculation methodology, discussed elsewhere (generally, it will be total units * energy savings/unit). To the extent possible, savings will be consistent with the most recent TRM.

Step 2: Multiply energy savings by the appropriate values. Energy savings will be multiplied by each relevant $/Dth value (value of avoided energy, value of avoided emissions, etc.). Calculate total benefits by adding together all resulting dollar amounts for each value.

Step 3: Discount benefits in future years by the appropriate discount rate, as provided by DER.

Step 4: Calculate the total net costs, in keeping with DER methodology. If available, these inputs will be sourced from the most recent TRM.

Step 5: Calculate net benefits (total benefits minus total costs).

Gas inputs

Table 5 shows the gas inputs that will be used to calculate net benefits, divided into the categories described above in the electric section.

Table 11: Benefit-cost inputs for gas-saving measures

Measure-level Inputs	Utility-specific Inputs	Global Inputs
Utility Project Costs	CIP Utility Discount Rate[23]	Participant Discount Rate (residential customers)

[22] Same as the CIP utility discount rate.

[23] Specified by DER for each IOU.

Measure-level Inputs	Utility-specific Inputs	Global Inputs
Project Life	Participant Discount Rate (non-residential customers)[24]	Societal Discount Rate
Energy Savings/Unit	Gas Retail Rate[25]	Environmental Compliance
Number of Units	Demand Cost[26]	Gas Environmental Damage Factor
Incremental Costs		Gas Escalation Rate
Variable O&M		Gas Commodity Cost
		Peak Reduction Factor

Relevant filings

Utility-specific inputs are filed every three years in the utility Triennial Plans and approved by the DER. The 2024-2026 Triennial Plans include:

- Minnesota Department of Commerce. "Decision in the Matter of Xcel Energy's 2024-2026 Energy Conservation and Optimization Triennial Plan" (December 1, 2023). Docket No. G,E002/CIP-23-092.
- Minnesota Department of Commerce. "Decision in the Matter of Minnesota Power's 2024-2026 Energy Conservation and Optimization Triennial Plan" (December 1, 2023). Docket No. E015/CIP-23-093.
- Minnesota Department of Commerce. "Decision in the Matter of Otter Tail Power Company's 2024-2026 Energy Conservation and Optimization Triennial Plan" (December 1, 2023). Docket No. E017/CIP-23-094.
- Minnesota Department of Commerce. "Decision in the Matter of CenterPoint Energy's 2024-2026 Energy Conservation and Optimization Triennial Plan" (December 1, 2023). Docket No. G008/CIP-23-095.
- Minnesota Department of Commerce. "Decision in the Matter of Minnesota Energy Resources Corporation's 2024-2026 Energy Conservation and Optimization Triennial Plan" (December 1, 2023). Docket No. G011/CIP-23-098.

DER specified inputs and global inputs are noted in the Minnesota Department of Commerce Decision on the 2024-2026 CIP Cost-Effectiveness Methodologies for Electric and Gas Investor-Owned Utilities (Docket No. E,G999/CIP-23-046; filed March 31). All filings can be found on the

[24] Same as the CIP utility discount rate.

[25] Per DER, this is calculated using each utility's currently-approved tariffed non-natural gas margin (using a weighted average if multiple customer classes are participating), demand cost, and the DER-specified gas commodity cost.

[26] Per DER, this value is sourced from the utility's March 2023 Purchased Gas Adjustment filing.

State of Minnesota's Public Utilities Commission electronic docket system, eDockets available here.

Calculating statewide inputs

Measure-level inputs will be estimated based on the methodology outlined in each ETA initiative's Energy Savings Plan. Global inputs will be per the latest DER guidance.

To estimate statewide values for utility-specific inputs (as shown in Tables 4 and 5 above), CEE will calculate a load-weighted statewide average using values from ETA utilities, as well as from non-ETA utilities when available. Other statewide data source may supplement utility-specific data. This follows the methodology employed in the 2018 Minnesota Potential Study. Data sources will include:

- NREL's Cambium data sets (to estimate the value of avoided energy and avoided emissions)
- Confidential data requests for trade secret utility-specific data points
- Appropriate proxies (co-op borrowing rates, muni bond rates, etc.) to determine the value of benefits occurring outside of ETA funder utility service areas and calculate load-weighted statewide average