National Grid
Niagara Mohawk

Energy Initiative Energy Efficiency Program: Impact Evaluation of Prescriptive and Custom Lighting Installations

Prepared by: DNV GL, October 5, 2015

PROGRAM SUMMARY

The Energy Initiative (EI) Program provides rebates for the installation of energy-efficient measures for large commercial and industrial (C&I) customers. Key measure types installed through the program include lighting, lighting controls, energy management systems (EMS), economizer controls and air compressors.

EVALUATION OBJECTIVE AND KEY FINDINGS

The primary objective of this evaluation is to quantify the gross annual energy and summer demand impacts of lighting measures installed through the EI program, including both prescriptive and custom. The savings and factors of interest to the study includes the coincident summer on-peak factor, connected kW savings and realization rate, kWh savings and realization rate, percent on peak kWh, summer demand HVAC interactive effect factor and kWh HVAC interactive effect factor. The study was designed to utilize on-site verification and monitoring to assess gross impacts. The evaluation was designed to achieve ±10.0% at the 90% confidence level for gross energy (kWh) savings. The M&V study provides results by primary discrepancy, including HVAC interactive.

The saving values in Table 1 and Table 2 below are for prescriptive lighting installed without lighting controls installed through the program[1] and for custom lighting installed, respectively. The prescriptive realization rate was found to be 91% and the custom realization rate was found to be 92% for the 2011/12 program years. The values are based on the M&V site results discussed below. A net-to-gross ratio was not developed in this study.

Table 1. Prescriptive Lighting without Controls Gross Program Impact

Parameter	Electric Energy (MWh/yr)	Electric Demand (MW)	Natural Gas (MMBtu/yr)
Ex Ante Tracked Savings	31,146,989	6,105	N/A
Evaluation Realization Rate (RR)	90.9%	95.8%	N/A
Evaluation Net-to-Gross Ratio (NTG)	N/A	N/A	N/A
Ex Post Gross Impact	28,308,142	5,849	N/A

Table 2. Custom Lighting Gross Program Impact

Parameter	Electric Energy (MWh/yr)	Electric Demand (MW)	Natural Gas (MMBtu/yr)
Ex Ante Tracked Savings	61,681,541	12,348	N/A
Evaluation Realization Rate (RR)	92.4%	101.4%	N/A
Evaluation Net-to-Gross Ratio (NTG)	N/A	N/A	N/A
Ex Post Gross Impact	56,969,116	12,519	N/A

[1] The lighting measures may have had pre-existing controls installed.

DETAILED FINDINGS: REALIZATION RATE AND NET-TO-GROSS

Realization Rate:

- The final energy savings realization rate for prescriptive lighting without controls from the on-site M&V work is 90.1% with a precision of +/- 13.6% at the 90% confidence interval.
- The connected demand realization rate for prescriptive lighting without controls from the on-site M&V work is 95.8% with a precision of +/- 3.9% at the 90% confidence interval.
- The final energy savings realization rate for custom lighting from the on-site M&V work is 92.4% with a precision of +/- 7.0% at the 90% confidence interval.
- The connected demand realization rate for custom lighting from the on-site M&V work is 104.4% with a precision of +/- 3.6% at the 90% confidence interval.

Net-to-Gross:

A net-to-gross rate was not developed in this study.

Other Results:

There were several other savings factors of interest to National Grid that were assessed as part of this study. For prescriptive lighting these include:

- Summer kW coincidence factor of 79% with a precision of +/-9.6% at the 90% confidence interval.
- HVAC kW Interactive Effect Factor of 114.8% with a precision of +/-3.5% at the 90% confidence interval.
- HVAC kWh Interactive Effect Factor of 106.3% with a precision of +/-2.5% at the 90% confidence interval.
- Average annual hours realization rate among all sampled sites of 90.0% with a precision of +/-11.7% at the 90% confidence interval.
- % on peak kWh of 63.5% with a precision of +/-5.7% at the 90% confidence interval.

For custom lighting these include:

- Summer kW coincidence factor of 80.4% with a precision of +/-8.3% at the 90% confidence interval.
- HVAC kW Interactive Effect Factor of 99.3% with a precision of +/-4.9% at the 90% confidence interval.
- HVAC kWh Interactive Effect Factor of 100.4% with a precision of +/-2.3% at the 90% confidence interval.
- Average annual hours realization rate among all sampled sites of 93.9% with a precision of +/-5.8% at the 90% confidence interval.
- % on peak kWh of 53.8% with a precision of +/-6.2% at the 90% confidence interval.

EVALUATION METHODS AND SAMPLING

DNV GL performed on-site assessments at 32 participants with program installed prescriptive lighting without controls and 31 custom lighting participants from the 2011/12 program years. These on-site visits were statistically selected, and included comprehensive inventories and time-of-use metering performed for a year. The method for the on-sites with metering adheres to IPMVP Option A.

The evaluation team installed approximately 550 loggers for this study, or approximately 9 loggers per site. Larger sites had about 15 loggers installed on average, while the smaller sites had fewer. When allocating multiple loggers, DNV GL considered the combination of lighting type and hours of use as unique usage areas. More loggers were installed to capture the more significant usage areas with respect to connected wattage and hours. This approach allows for better logger coverage to spaces which contribute the most to energy savings.

A spreadsheet engineering model was used to develop all savings estimates and factors of interest for each sampled site. This analysis was performed in a manner that allowed the determination of impacts at each site and the primary reason for discrepancies observed between the gross and tracking savings estimates. These site level results were then expanded up to represent the impacts of both the full prescriptive lighting without controls population and the custom lighting population, along with all accompanying precisions.

RECOMMENDATIONS AND PROGRAM ADMINISTRATOR RESPONSE

The following recommendations were made by the evaluators conducting this study. National Grid's initial response to these recommendations is also summarized below and will be tracked over time.

Recommendation 1: The tracking lighting hours of use assumptions appear to be high in general with hours of use realization rates of 90% and 94% for prescriptive and custom lighting, respectively. However, the tracking hours of use estimates, which are based on vendor estimates, are closer than the default hours of use estimates for many building types in the New York Tech Manual. As such, while there is evidence from this study that the Tech Manual hours might be underestimating actual usage, we encourage National Grid and the DPS to compile added evidence from other New York Program Administrators ("PAs") to be sure this trend holds across other territories before making Tech Manual revisions on this matter.

Response to Recommendation 1: Further evaluations or literature reviews should be conducted to determine the best approach. Additionally, statewide discussions with the other New York Program Administrators and NY DPS should inform the best approach foreward.

Recommendation 2: One particular building type of note was hospitals. Both the tracking estimates and Technical Manual estimates for hours of use in "hospitals" are found to be very high. One potential reason for this is that many lighting fixtures that are going into hospitals are not being installed exclusively in common areas or in functional areas unique to hospitals. A good portion of lighting installations are being done in medical offices and exam rooms, which follow more of an office type of operating schedule. For grocery sites, the evaluation found hours to be higher than the Technical Manual. Since grocery lighting is dominated by the sales floor, which corresponds with hours of operation, grocery hours tend to be higher. These specific observations apply to a small sample of the projects in this study, but it is important to ensure that vendors take space type into account when estimating hours of use rather than only building type. Likewise, if Technical Manual hours of use estimates are adopted by National Grid, consider the proportion of lighting fixtures that are not going into high use, common areas when deciding on which building type hours to use. Hours of use should be space dependent rather than building dependent.

Response to Recommendation 2: Further discussions need to occur statewide amongst the NY Pas to ensure that their Implementation groups understand the implications of doing a building type versus space type analysis.

Recommendation 3: The New York Technical Manual currently assumes a summer kW coincidence factor of 1.0 for commercial indoor lighting measures, which we regard as very high. The estimated summer coincidence factor from this study is approximately 0.8 for both prescriptive and custom. Currently, National Grid is using a 0.8 coincidence factor for custom lighting, which we recommend they continue to use. However, we would suggest that National Grid work with DPS to combine this data with that from other New York PAs to inform this value for prescriptive lighting.

Response to Recommendation 3: Further discussions need to occur statewide amongst the NY Pas to ensure that their Implementation groups understand the implications of doing a building type versus space type analysis.

Recommendation 4: Currently, National Grid uses HVAC interactive estimates of 1.19 for summer kW and 1.07 for annual energy savings for prescriptive lighting. These values are proxies that represent average factors from the table of HVAC interactive factors by Building Type in the Tech Manual. This study found the summer kW HVAC Interactive Effect Factor to be 114.8% (1.148), and the kWh interactive factor to be 106.3% (1.063). We would suggest that National Grid work with DPS to combine this data with that from other New York PAs to inform these values.

Response to Recommendation 4: Further discussions need to occur statewide amongst the NY Pas to ensure that their Implementation groups understand the implications of doing a building type versus space type analysis.

Recommendation 5: Currently, National Grid uses custom engineering calculations to estimate HVAC interactive effects for custom lighting. This study found that both the summer kW and annual energy savings estimates for HVAC interactive effects are being calculated accurately, with realization rates of 99.3% and 100.4%, respectively. We recommend continued use of custom engineering calculations to estimate HVAC interactive effects for custom lighting.

Response to Recommendation 5: Agreed.

Recommendation 6: National Grid employs a post-inspection process for lighting projects in which a follow-up visit is performed by company representative. This visit typically includes a visual inspection of installed equipment. DNV GL supports this process, and encourages continued and improved implementation of it. This study did not find many significant quantity discrepancies, which is an indication that the post-installation process is providing benefit. DNV GL believes that the process could be improved by doing more to collect and verify the reasonableness of the assumed hours of use during this post-installation visit.

Response to Recommendation 6: Further evaluations should be pursued to analyze the post inspection process.

Recommendation 7: The project documentation provided for this impact evaluation was generally good. We recommend continuing to collect as much information as possible during the implementation process. Specifically, the following pieces of documentation are needed to better evaluate projects following installation: Spreadsheet savings calculations that match tracking estimates, Description of pre-installation conditions if a retrofit project, post-inspection report, TA study (if custom), details of annual operating hours used by space type or location.

Response to Recommendation 7: Agreed.

Recommendation 8: We recommend that future impact evaluations prescriptive lighting use an error ratio of 0.5 for energy when developing on-site metering sample sizes. The error ratio we recommend for targeting demand savings is a 0.2 error ratio. Likewise, we'd target an error ratio of 0.4 for estimating on-site metering sample sizes for custom lighting, since the custom engineering estimates tend to produce results with less variability than prescriptive.

Response to Recommendation 8: Agreed.

Recommendation 9: • Consider implementing a rolling evaluation framework, which would provide ongoing monitoring and feedback into the lighting programs. A continuous evaluation approach could benefit the program by providing fast feedback by targeting certain segments of interest such as the largest projects or specific sectors or technologies.

Response to Recommendation 9: Further discussions need to occur statewide amongst the NY PAs to ensure that there is consistency with each PAs evaluation study timelines and methodologies.