NYSERDA 2007 to 2010 Commercial and Industrial Existing Facilities Sector Nonparticipant Spillover and Market Effects Study

Impact Evaluation Report

Final

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ABSTRACT

The Commercial and Industrial Existing Facilities Nonparticipant Spillover and Market Effects Study is a survey-based evaluation that quantifies nonparticipant spillover in New York State (NYS) from the NYSERDA Energy $mart programs. Five surveys of facility decision-makers (end users) and contractors were fielded in NYS and a comparison area consisting of Alabama, Georgia, Mississippi, and South Carolina. The cross-state component of the study only addressed high bay lighting technologies and installation practices. Results from these surveys provided information about the characteristics, decision-making process, and influence of NYSERDA programs on remodeling projects in existing commercial facilities in NYS.

The results of the study support a nonparticipant spillover rate of 25% based on surveys with NYS contractors and end users. The survey results suggest that NYSERDA programs are influencing contractors to recommend higher efficiency levels to nonparticipating end users, resulting in more efficient equipment being installed in remodeled facilities. These surveys also collected valuable information regarding the types, sizes, and decision-making mechanisms in the NYS remodeling market.

The cross-state component of the study did not provide the expected corroboration of market effects primarily due to confounding market factors. However, insights into the influence of energy codes and corporate market actors on the market for efficient technology were obtained. There is a strong indication from the study that the sustainability and installation policies of large chains and franchises may be influencing the market for efficient lighting.

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GLOSSARY OF ACRONYMS AND DEFINITIONS[1]

AAPOR – American Association for Public Opinion Research – A leading association of public opinion and survey research professionals.

building shell/envelope – The assembly of exterior components of a building that enclose conditioned spaces and through which thermal energy may be transferred to or from the exterior, unconditioned spaces or the ground.

construct validity – The extent to which an operating variable/instrument accurately taps an underlying concept/hypothesis, properly measuring an abstract quality or idea.

contact rate – This is one of the final disposition and outcome rates for surveys defined by the AAPOR [2] The contact rate has all outcomes where an eligible respondent was reached and the interview attempted divided by these plus those not contacted. The three contact rate outcomes are completions, refusals, and break-offs (the numerator of the contact rate).

cooperation rate – This is one of the final disposition and outcome rates for surveys defined by the AAPOR[3]. The proportion of all cases interviewed of all eligible units ever contacted. Those contacted (the denominator) includes completions, refusals and break-offs.[4]

cross-state comparison – A strategy for estimating market effects by comparing the evaluation state to other states that do not have a history of energy efficiency programs. This approach is based on the assumption that the comparison area is similar to the evaluation state except for the presence of efficiency programs.

enhanced self-report (ESR) – Used in impact evaluations to identify a self-report approach that has more than one source of information or additional/enhanced parts. This can include using self-reports from multiple market actors for a single site, additional site visit interviewing, or observational analyses that are incorporated into a site's estimate.

free rider, free ridership (**FR)** – A program participant who would have implemented the program measure or practice in the absence of the program.

HBL – High bay lighting

HVAC – Heating, ventilation and air conditioning

market effects – A change in the structure or functioning of a market or the behavior of participants in a market that result from one or more program efforts. Typically these efforts are designed to increase in the adoption of energy efficient products, services, or practices and their subsequent energy savings, and are causally related to market interventions.

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[1]Parts of the glossary are taken from the *2004 California Evaluation Framework*, which was prepared for the California Public Utilities Commission and the Project Advisory Group in September 2004 by a team led by TecMarket Works and included a lead role by one of the authors of this report from Megdal & Associates.

[2]American Association for Public Opinion Research (AAPOR) 2011, *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, revised 2011. Each of the rates presented here has many more specific categories and definitions provided by AAPOR. *Standard Definitions* is available on the AAPOR website: www.aapor.org

[3]Ibid.

[4]Ibid.

MW – A megawatt is one thousand kilowatts (1,000 kW). A megawatt or kilowatt is a measure of the amount of electricity delivered to users at a given point in time. It reflects the demand for power at that point in time.

MWh – A megawatt hour is one thousand kilowatt hours (kWh) and measures of the amount of electricity used over time. If a 60W light bulb is on for one hour, it uses 60 Watt hours or 0.060 kWh.

nonparticipants/ nonparticipating – Any customer or contractor who was eligible but did not participate in the program under consideration. Nonparticipating contractors can include contractors that have never participated in the program and contractors that formerly participated, prior to the year(s) being evaluated and have not participated since then.

net-to-gross, net-to-gross ratio (NTG, NTGR) – – The relationship between net energy and/or demand savings, where net is measured as what would have without the program, *i.e.*, occurred naturally, and evaluated gross savings. The NTGR is the ratio of net savings to program reported savings. For NYSERDA programs, the NTGR is defined as one minus free ridership plus spillover (1 – FR + SO).

program year (PY) – The calendar year when a NYSERDA project was completed.

refusal rate – This is one of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR).[5] The proportion of all cases in which an eligible respondent refuses to be interviewed, or breaks-off an interview, of all potentially eligible cases.

response rate – This is one of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR) [6] The response rate estimates the fraction of all eligible working numbers where a request for an interview was made. The denominator of this ratio is inclusion of all possible components where a request for an interview could be attempted. More specifically the response rate is the number of completed interviews divided by the sum of: completions, refusals, break-offs, not contacted and the figure estimated for unknown eligibility. Response rate = (Completions)/(Completions + refusals + break-offs + not contacted + (e × (unknown eligibility)).

spillover (SO) – Includes **participant inside spillover (ISO)** and **participant outside spillover (OSO)** and **nonparticipant spillover (NPSO)** -- Reductions in energy consumption and/or demand caused by the presence of the energy efficiency program, beyond program evaluated gross savings of participants. The rates are these savings estimates divided by program reported savings.

- "Inside" spillover occurs when, due to the project, additional actions are taken to reduce energy use at the same home, but these actions are not included as program savings.
- "Outside" spillover occurs when an actor participating in the program initiates additional actions that reduce energy use at other sites that are not participating in the program.
- "Nonparticipant spillover" is the reductions in energy consumption and/or demand from measures installed and actions taken or encouraged by nonparticipating vendors or contractors because of the influence of the program.

[5]Ibid.

[6]Ibid.

EXECUTIVE SUMMARY

The New York Energy Smart programs are designed to increase efficiency measure adoption in New York State (NYS) through resource acquisition and market transformation. The Nonparticipant Spillover and Market Effects Study was designed to measure nonparticipant spillover (NPSO) and market effects in existing commercial and industrial facilities sector. The evaluation includes both a traditional means (participant self-reporting) of assessing market effects, as well as exploration of an alternative method (cross-state study). The evaluation period covers projects installed from 2007 to 2010. The following subsections describe the goals, approach and methods, and results of the evaluation**.**

GOALS

This study was designed to quantify changes in efficiency measure adoption by nonparticipating owners and vendors as a result of NYSERDA's Commercial and Industrial (C&I) programs providing services to the existing facilities sector.

Goals of the evaluation were twofold:

1. To estimate the effects of NPSO in the C&I existing facilities sector from the NYSERDA programs[7] that target these markets
2. To test alternative methods to the self-report approach used to estimate SO and free ridership (FR) within the individual program evaluations.

APPROACH AND METHODS

Since 2005, NYSERDA has estimated both net and gross impacts for its efficiency programs, integrating the results through the net-to-gross (NTG) formula to estimate total net program savings. These savings can be impacted by FR, SO from both participants and nonparticipants, and market effects.

In the past, self-reports have been the primary method of estimating the impact of these factors on the NTG performance of NYSERDA's efficiency programs. This study is also largely reliant on self-reports with two additional components initially added: a cross-state study and a nested logit analyses. The cross-state study was designed to assess market effects for a single technology as a reality check on the NPSO findings, while the nested logit analysis was designed to estimate program FR for a specific technology promoted by NYSERDA's C&I programs, allowing comparison of results to earlier FR estimates. The nested logit analysis was eventually dropped due to the difficulty and cost associated with obtaining a sufficient sample size.

Data Sources

NYSERDA provided program data for the target time frame (2007 through 2010) and the Impact Team gathered secondary data from the Illuminating Engineering Society of North America (IESNA).

[7] These results should be applied to programs that are providing services for existing buildings to the general C&I sector, such as the Existing Facilities Program and FlexTech. It may not be appropriate to apply these results to programs that are targeted toward specific subsets of C&I existing building market, such as the Industrial Process Efficiency program.

Five surveys were conducted to provide data for the NPSO and the focused high bay lighting market effects studies, as described in

Table ES-1-1 below.

Table ES-1-1. Telephone Survey Descriptions

Evaluation Activity	Sample	Study Component	Purpose
Screener survey of NYS end users	2,578	ESR and cross-state	Estimate incidence of remodeling, C&I space remodeled and difficulty of obtaining required sample sizes for evaluation components; compare sample frames
Survey of NYS end users	570	ESR and cross-state	Obtain data required for ESR and cross-state analyses
Survey of NYS contractors	225	ESR and cross-state	Obtain data required for ESR and cross-state analyses
Survey of comparison state end users	121	Cross-state	Obtain data required for cross-state analysis
Survey of comparison state contractors	72	Cross-state	Obtain data required for cross-state analysis

The screener survey formed the basis for the sample frame for the New York End User Survey used for the enhanced self-report and high bay lighting cross-state study. The Impact Team created lists of buildings that had remodeled and those with high bay lighting (HBL) purchases from the screener component of this survey to determine quotas for each target population.

Nonparticipant Spillover

An estimate of NPSO based on enhanced self-reports was developed from the contractor and nonparticipant telephone surveys for the period of 2007 to 2010. The surveys covered a range of equipment and end uses including the following:

- Building shell or envelope (such as adding insulation or replacing windows or adding a cool roof)
- Heating, ventilation and air conditioning (HVAC) systems (such as replacing the air-conditioning or heating systems)
- Lighting
- Motors and drives
- Building controls (such as energy management systems)
- Water heating systems
- Industrial processes
- Combined heat and power (CHP) system

The results include end user decision-making regarding the energy-related remodel(s) conducted from 2007 to 2010, their interaction with contractors, and the contractors' actions in these markets. Results are also reported regarding the awareness of NYSERDA and its efficiency programs and whether there was any NYSERDA influence in their decisions or actions and if so, the level of that influence.

Overlap between Nonparticipant and Participant Spillover

NYSERDA's previous NPSO estimates were based only on survey results from end users due to concerns about double counting SO savings. However, since NYSERDA programs also influence actions by midmarket actors, such as vendors and contractors, which may be invisible to the end user, this approach may also tend to underestimate actual SO savings.

Details on the methods used for the enhanced self-report (ESR) study component can be found in the beginning of Section 4. The ESR survey was designed to represent all New York contractors, including those who may have participated in NYSERDA's programs during the analysis period as participation status may change over time. It is reasonable to assume that participant outside spillover (OSO) is a subset of the NPSO estimated from the contractor activity. To avoid double counting, the NPSO rate was calculated and then adjusted by subtracting out the estimated OSO from the Existing Facilities and FlexTech programs.

Cross-State Study

The cross-state study was conducted for one technology: HBL. This comparison effectively incorporates all market effects and mirrors the approach recently used in California and Massachusetts to compare efficiency levels for HBL. As this approach is essentially an observational study, it is not possible to control for (or even to define) all of the confounding factors that could be affecting the results, making it difficult or impossible to establish causality. The comparison was based on primary research through surveys of end users and contractors in NYS and the comparison area. Secondary data was used to estimate the efficiency levels of the HBL products. Details on the methods used for the cross-state study can be found in the beginning of Section 5.

The cross-state study included surveys of end users and contractors in the comparison area. The underlying assumption is that the absence of efficiency programs operating in the comparison area during the study period is the primary difference between NYS and the comparison area. However, other unknown factors affecting the installation of high efficiency lighting may influence the results of the comparison.

RESULTS

The screener survey, used to identify nonparticipants for the enhanced self-reports, obtained valuable information about the market characteristics in the C&I sector of NYS. These included the distribution of facilities across commercial sectors, the size of C&I facilities in both aggregate and by sector and the distribution of NYSERDA participants across the facility types and sizes. The three sectors with the highest proportion of nonparticipating facilities in New York are as follows: services with 28%, retail trade with 18%, and health care with 13% of the facilities surveyed. Each of the other individual sectors accounted for less than 10% of the facilities with survey responses. The average weighted size of these facilities is 57,514 square feet. The annual remodel rate was estimated from the screener survey to be 14%.

RESULTS FROM THE ENHANCED SELF-REPORT SURVEYS

The responses to this series of questions provide preliminary information suggesting that NYSERDA's influences extend to nonparticipating end users in a variety of ways as summarized in Table ES-1-2. Almost a quarter of nonparticipants recognize NYSERDA, and many of these indicated that NYSERDA has had some level of influence on their actions.

Table ES-1-2. Summary of Types of NYSERDA Influence on Nonparticipating NYS End Users

Due to NYSERDA Activities, the End User . . .	Percentage of NYS End Users[1,2]
Mentioned (unprompted) a specific NYSERDA program	14%
Implemented the project early	6%
Received financial assistance	6%
Worked with an assigned NYSERDA staff member	4%
Improved their awareness of efficient options	2%
Increased the efficiency of the projects	1%
Was motivated to implement projects	1%
Received information/advice on projects	1%
None of the above	76%

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

[2] Respondents may be counted in more than one category and the percentages do not add to 100%.

The NYS contractor survey did not distinguish between participating and nonparticipating contractors, as participation occurs at the project level and contractors are likely to be engaged in a variety of projects, some of which may be enrolled in NYSERDA programs and others completed outside of the program. Fifty-nine percent of the New York contractors had at least some NYSERDA participating projects during the four years of 2007 to 2010 and 28% of their projects on average went through a NYSERDA program.

About half of the contractors stated that NYSERDA influenced the way they work. These contractors were asked about the NYSERDA's influence on four areas of their work. The responses are shown in Table ES-1-3.

Table ES-1-3. Influence of NYSERDA Programs on New York State Contractors

NYSERDA Influenced . . . [1]	% Contractors Reporting No/Low Influence[2,3]	% Contractors Reporting High Influence[2,4]
Efficiency levels of equipment recommended to customers	59%	29%
How the benefits of energy efficient equipment are explained to customers	61%	26%
Methods or techniques used	67%	17%
Manufacturers and distributors to stock higher efficiency equipment	73%	19%

[1] Contractors were asked to rank NYSERDA's influence on a 1 to 5 scale, with 1 being the lowest and 5 the highest.

[2] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused." Contractors were asked to exclude work done on Long Island.

[3] "No/low" influence indicates the contractor selected "1" or "2" or reported that they were unaware of NYSERDA prior to the survey.

[4] "High" influence indicates the contractor selected "4" or "5." The percentages will not add to 100% as contractors who responded "3" were omitted from this table.

Estimation of the Nonparticipant Spillover Rate

The ESR surveys demonstrated the complex interactions between NYSERDA, contractors, and end users in the market. The critical insights into the decision-making process are summarized below.

- There is a low assessment of NYSERDA influence among end users, as 86% of NYS end users were either unfamiliar with NYSERDA or reported no NYSERDA influence on their decision to install efficient equipment.
- The vast majority of contractors recognizes and works with NYSERDA on some level, with 80% of contractors reporting involvement with NYSERDA.
- Contractors estimate that 80% of NYS end users rely on contractors to recommend equipment, either accepting the contractor's assessment entirely or engaging in a discussion on selecting the appropriate equipment.
- Eight-six percent of contractors report that they recommend energy efficient equipment either always or most of the time.

These market conditions set the stage for extending NYSERDA's influence beyond direct participant activity.

The NPSO rate for existing buildings is 25% with a relative precision of 15% at the 90% confidence level. This value should be incorporated into the formula used by NYSERDA to estimate net savings at the program level (see Equation ES-1):

Equation ES-1. Net-to-Gross Ratio Formula

$$NTGR = 1 - FR + ISO + OSO + NPSO$$

The NPSO rate reported by the end users is estimated at 23%, and the indirect SO from contractors, when the OSO from NYSERDA's main C&I programs is removed, contributes the remaining 2%.

RESULTS FROM THE CROSS-STATE STUDY

The results of the cross-state study did not demonstrate that there are market effects from NYSERDA's efforts on the HBL market. Unlike the recent studies conducted for Massachusetts and California, the efficiency of the HBL market in NYS and the comparison states was very similar. This outcome was a combination of a substantial increase in the efficiency of the HBL market in the comparison area and the determination that the efficiency of the NYS HBL market is lower than the efficiency levels found in Massachusetts and California.

There are two primary components to estimating market effects:

1. The difference between the efficiency of HBL in NYS as compared to the baseline (the comparison area)
2. The size of the NYS HBL market

The difference in the efficiency of HBL equipment sales (lumens per watt) between the two areas is the basis for the savings due to market interventions. The percentage of penetration for each technology type was determined from the contractor surveys, and the weighted average of the efficiency for HBL as a whole was calculated for NYS and the comparison area. These results were then compared to assess whether the differences were statistically significant. Unlike the similar earlier studies conducted in California, Wisconsin, and Massachusetts, this evaluation identified no statistically significant market effects.

These results reflect the specific time period covered in the survey and are affected by a wide range of influences on the market that are not fully understood. Some specific differences among the three studies include the following:

- Some of the comparison area, California and Massachusetts all had code updates that went into effect during the time period of the study. During this same period NYS code requirements lagged behind the other areas in terms of efficiency.
- Both Massachusetts and California had a dramatically higher technology share in the HBL market for high output T5s, about double the New York and comparison-area technology shares (65% to 30%). This single factor is the largest contributor to the higher efficiency HBL lighting in these two states.
- While the California and Massachusetts studies did not separate high efficiency (super) T8s from standard T8s, the overall technology share of T8s was substantially higher (almost double) for New York and the recent NYSERDA survey conducted in the comparison area as compared to California, Massachusetts, and the earlier KEMA comparison area survey. The comparison area went from a 16% share for T8s in the earlier KEMA survey to a 26% share (combined super and standard T8s) in the more recent NYSERDA survey.
- The increase in T8s in the comparison area is accompanied by a decrease in technology share for the less efficient metal halide figures. These two changes make the greatest contribution to the increase in efficiency in the comparison area between the two study periods.
- The market share for inefficient T12s dropped in the comparison area from 11% in the KEMA survey to 1% in the NYSERDA survey. This finding is most likely due to the change in federal standards designed to phase out T12s.

In aggregate, this analysis suggests a major improvement in efficiency of the HBL market in the comparison states from the 2006 to 2008 analysis period to the more recent surveys covering 2007 to 2010, and also that NYS lags California and Massachusetts in the overall efficiency of the HBL market.

The inability of the study to quantify market effects from this effort seems to stem mainly from other market influences that have confounded the ability of the study to identify and quantify the market effects in this manner. While the primary research conducted for the cross-state study is not conclusive, it appears that there are two major factors that have propelled the comparison states to near the same efficiency level for this application:

1. The adoption and strengthening of codes in several of the comparison states resulted in the minimum efficiency allowed in those states being higher than in NYS during a portion of the study period. Thus the baseline efficiency was higher in the comparison area than in NYS. Not only were code efficiencies more stringent in part of the comparison area from 2008 through 2010 but contractors also reported a stronger influence from the codes in the comparison area (23%) as opposed to NYS (14%).
2. Many corporations have policies regarding sustainability, and efficiency levels are likely impacting upward to 40% of the market for these projects. These policies cut across state lines and tend to raise the average efficiency in the market, regardless of state codes or policies. In particular, for corporate entities that use a chain or franchise model, contractors in both NYS and the comparison area reported that over 90% had efficient lighting requirements.

It is also possible that NYSERDA's programs are less focused on HBL than the efficiency programs in California and Massachusetts. On the other hand, a higher percentage of NYS contractors reported being influenced by efficiency programs for the recommendation, acceptance, and installation of efficient HBL than did contractors in the comparison area. NYS contractors also identified NYSERDA incentives as a

driving force in the market. These are clear indications that in NYS the NYSERDA programs are a positive influence on the adoption of efficient lighting.

INTEGRATION OF RESULTS

The estimate of NPSO is 25% and yet the cross-state study did not find market effects for HBL. Given that NPSO would be expected to be a subset of market effects, these findings appear to be contradictory. However, the cross-state study was limited in scope to a particular technology and the findings from this component of the evaluation suggest that confounding factors, such as changes in state energy codes and the expansion of national chains with higher energy efficiency standards, are impeding our ability to make a clear and direct comparison that reflects the impacts of NYSERDA program implementation.

RECOMMENDATIONS FOR NYSERDA COMMERCIAL AND INDUSTRIAL PROGRAMS

The Impact Team's recommendations for the NYSERDA C&I Programs involve baseline considerations and program planning:

- When establishing program baseline assumptions, the influence of large market actors, including national chains and franchises, should be taken into consideration.
- NYSERDA should support the updating of the NYS energy code at least every three years.
- It may be possible for NYSERDA to identify opportunities to leverage corporate sustainability and efficiency policies and increase the positive influence these appear to be having on the market.

RECOMMENDATIONS FOR FUTURE EVALUATIONS

The Impact Team also recommends national evaluations and baseline studies. The cross-state study provided indications that some chains and franchises may be influencing the market for efficient technology. Ignoring the higher efficiency baseline for these projects could result in the overestimation of program savings. Supporting research at the national level in this area could be an important step toward addressing this issue.

Section 1: **INTRODUCTION AND APPROACH**

The New York Energy Smart programs are funded by an electric distribution System Benefits Charge (SBC) paid by customers of Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric and Gas Corporation, National Grid, Orange and Rockland Utilities, and Rochester Gas and Electric Corporation. The programs are available to all electric distribution customers that pay into the SBC. The New York State Energy Research and Development Authority (NYSERDA), a public benefit corporation established in 1975, began administering the SBC funds in 1998 through NYSERDA's New York Energy Smart Program.

1.1 BACKGROUND

Since 2005, NYSERDA has estimated both net and gross impacts for its efficiency programs, integrating the results through the net-to-gross (NTG) formula to estimate total net program savings. The NTG ratio (NTGR) is a combination of several program-specific factors determined by program and sector-wide evaluations. The components for NYSERDA's NTG are described below, along with the definition of market effects.

- **Free ridership** – Program-supported measures (or the proportion of the savings) that participants would have adopted within the same time frame in absence of the program.
- **Spillover** – Energy efficiency savings induced by NYSERDA's program but not a direct result of program activity. There are three types of spillover:
  - Inside spillover (ISO) occurs when energy saving actions are taken at the participating site but are not done as part of a NYSERDA program.
  - Outside spillover (OSO) occurs when efficiency upgrades are made by participating owners or vendors at additional sites without the benefits of a program.
  - Nonparticipant spillover (NPSO) occurs when nonparticipating owners or vendors make efficiency upgrades due to the program's influence but are not part of a program; vendors or owners may have participated in a NYSERDA program at some point in the past but are not current participants, or they may have never participated in a NYSERDA program.
- **Market effects** – "A change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to market intervention(s)."[8] Included in market effects are direct program participant savings, participant spillover savings, NPSO savings, and other energy savings that can be shown to be caused by the program.

The focus of this evaluation is NPSO and market effects.

This study was designed to quantify changes in efficiency measure adoption by nonparticipating owners and vendors who were induced to improve the energy efficiency of the equipment installed or their construction practices by those NYSERDA Commercial and Industrial (C&I) programs providing services to the existing facilities sector.

[8] Joe Eto, Ralph Prahl, and Jeff Schlegel, *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs* (Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory, 1996), LBNL-39059 UC-1322, p. 9.

NYSERDA recognizes these indirect effects of its market transformation and resource acquisition programs and has been periodically measuring the influence of its programs on nonparticipants.[9] The impacts of the NYSERDA programs[10] on the C&I existing facilities markets are complicated due to the number and variety of NYSERDA programs working in different components of this sector and the fact that overall outreach, education, and marketing efforts are undertaken by NYSERDA. Under these circumstances, reliably measuring NPSO impacts separately for specific programs becomes a highly complex and ultimately fruitless endeavor.

Recognizing the overlapping program activities in this sector, NYSERDA conducted a C&I NPSO study applicable across all C&I programs that target the existing facilities sector, initially in 2005 and later updated it in 2007.[11] The NPSO component of this evaluation is based on these earlier efforts and also uses an enhanced self-report approach. The NPSO covers all energy efficient technologies. In the past, enhanced self-reports for the different NTG components have been the primary method of estimating net savings for NYSERDA's efficiency programs. In the process of developing the evaluation plans for program years 2007 and 2008, reviewers suggested that alternative methods should be tested. For this reason, two additional components – a cross-state comparison and a nested logit analyses – were initially added to this study.

The cross-state study was designed to assess market effects for a single technology as a reality check on the NPSO findings. Since market effects are broader than a single spillover (SO) component and may reflect market interventions outside of NYSERDA's programs, these types of effects would be expected to be larger than NPSO and would place an upper bound on the possible magnitude of the NPSO. However, as the cross-state study was modeled on other recent studies and limited to a single technology that was a small part of NYSERDA's C&I programs, the extent of the comparison was limited.

A third component had been planned as part of the objective of testing alternative net-to-gross (NTG) methods. A nested logit analysis was designed to estimate program free ridership (FR) for a specific technology promoted by NYSERDA's C&I programs for the purposes of comparing the results to the FR estimated in the Existing Facilities impact evaluation for program years 2007 and 2008. Efficient lighting was selected as the technology since it accounts for a large percentage of the total savings achieved by NYSERDA's C&I programs. The evaluation component was subsequently dropped due to the difficulty and cost associated with obtaining a sufficient sample size, as discussed further in Section 1.4 below.

1.2 EVALUATION CONTEXT

This section provides an overview of market influences affecting efficiency levels, a discussion of market transformation and market effects, a comparison of net savings and market effects, an explanation of the issues surrounding the estimation of NPSO through enhanced self-reports (ESR) and the use of the cross-state study to estimate market effects.

[9] The commercial new construction market is generally distinct from the existing facilities market (in terms of architects and engineers acting as design firms, and building owners of new C&I facilities or those with major rehabilitation/renovation projects). Consequently, the new construction market is not included in this study.

[10] These results should be applied to programs that are providing services for existing buildings to the general C&I sector, such as the Existing Facilities Program and FlexTech. It may not be appropriate to apply these results to programs that are targeted toward specific subsets of C&I existing building market, such as the Industrial Process Efficiency program.

[11] The results of this work are reported in the *Commercial and Industrial Market Effects Evaluation*, prepared for NYSERDA by Summit Blue Consulting, October 2007.

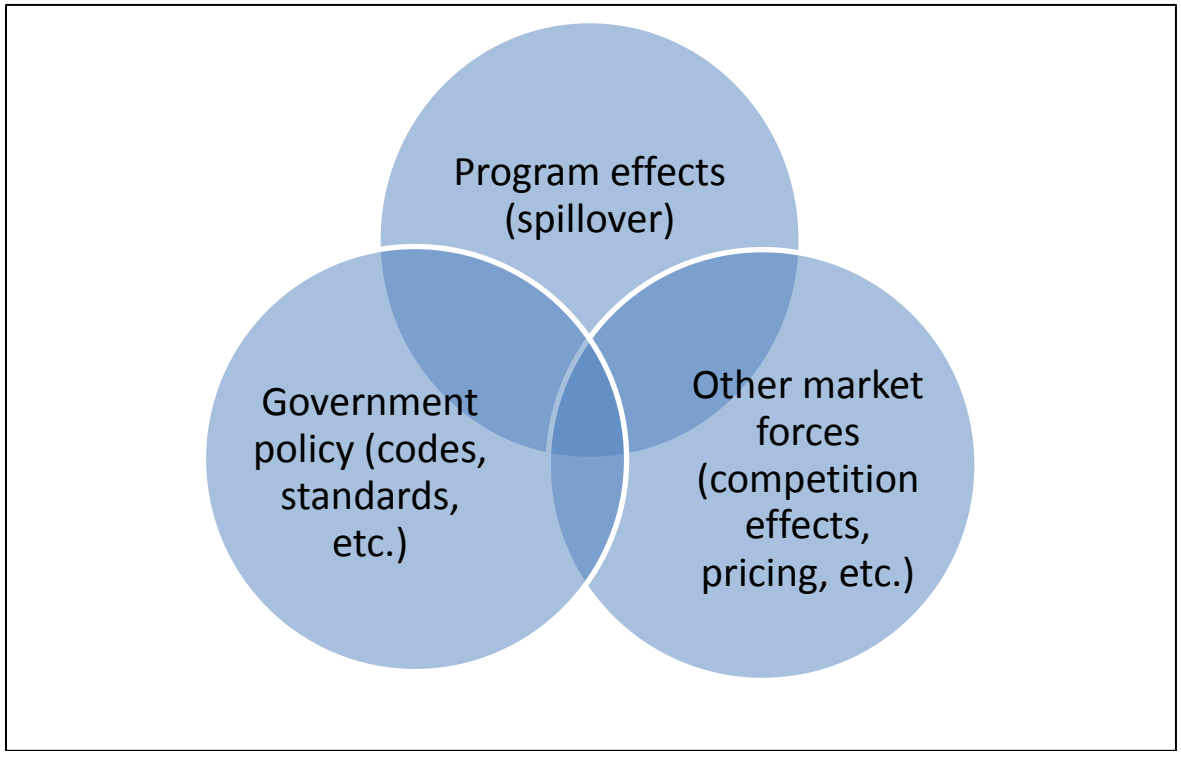
1.2.1 Overview

There are many factors affecting the efficiency levels achieved in the remodeling and renovation of C&I space. Information, training, and incentive levels serve to raise awareness of energy efficiency, improve the quality of work across the targeted market sectors, and increase the availability of efficient products and services. Federal and state codes and standards continue to improve the overall efficiency of buildings and equipment, and less efficient equipment can become unavailable over time. Knowledge of energy efficient equipment and practices may give contractors and engineering firms a competitive edge in the market place, particularly in a constricted market. The cost and quality of work are integral factors, and the cost of energy efficient equipment generally decreases as the technology becomes more common.

NYSERDA's programs are one of many influences in the market place. Both participating and nonparticipating market actors can be affected by program activities that influence the type and quantity of energy efficiency measures and systems installed in C&I buildings in New York State (NYS). Information, training, and incentive levels can raise awareness and increase impacts across the targeted market sectors. This effect is often the result of networking between participants and nonparticipants, the education of vendors and end users, or, less directly, market changes occurring due to NYSERDA's programs, e.g., nonparticipating vendors may wish to stay competitive in a market that is changing due to the program efforts.

Market influences on energy efficient equipment and practices can be conceptualized in three broad categories: (1) federal, state, utility, or local efficiency programs, (2) government policies that regulate efficiency practices, such as codes and standards, and (3) other market influences such as pricing and competition effects. These three broad categories overlap on different levels. For example, NYSERDA programs may increase the demand for specific energy efficient products, such as variable speed drives, and the higher demand eventually results in lower prices. State energy codes serve to increase the overall efficiency of installations and can create the climate that allows NYSERDA to continue to push participants to achieve higher efficiency levels. These relationships are illustrated in Figure 1-1 below

Figure 1-1. Potential Sources of Market Changes



1.2.2 Market Transformation and Market Effects

Theoretically, the comprehensive SO measurements with participants and nonparticipants, customers and midstream market actors should capture all the impacts that would be generated by the program in the market. However, market transformation is based on complex interactions, and it is possible that the overall program effects go beyond what can be easily measured in these specific categories.

The market transformation perspective of energy efficiency draws from the theory of the diffusion of innovation.[12] This theory is one that identifies and measures diffusion over time. In market transformation programs, the classic S-curve adoption model is seen as being pulled forward by the efficiency program interventions as shown in Figure 1-2.[13] The lower S-curve without the program intervention defines the baseline, and program impact is the measurement between the two curves.[14]

NYSERDA's New York Energy Smart Program has from its beginning in 1998 operated with a philosophy of market transformation that was clearly presented in the chapters of the early annual reports. Discussion of the philosophy of linking market-based energy efficiency programs with economic growth and sustainable development is summarized in a 1998 ACEEE paper.[15] This perspective is also clearly included in the intermediate and long-term outcomes in the current program logic models. At the same time, NYSERDA has always reported savings using the NTGR model, effectively assuming that net savings is equal to the net evaluated savings incorporating FR and SO.

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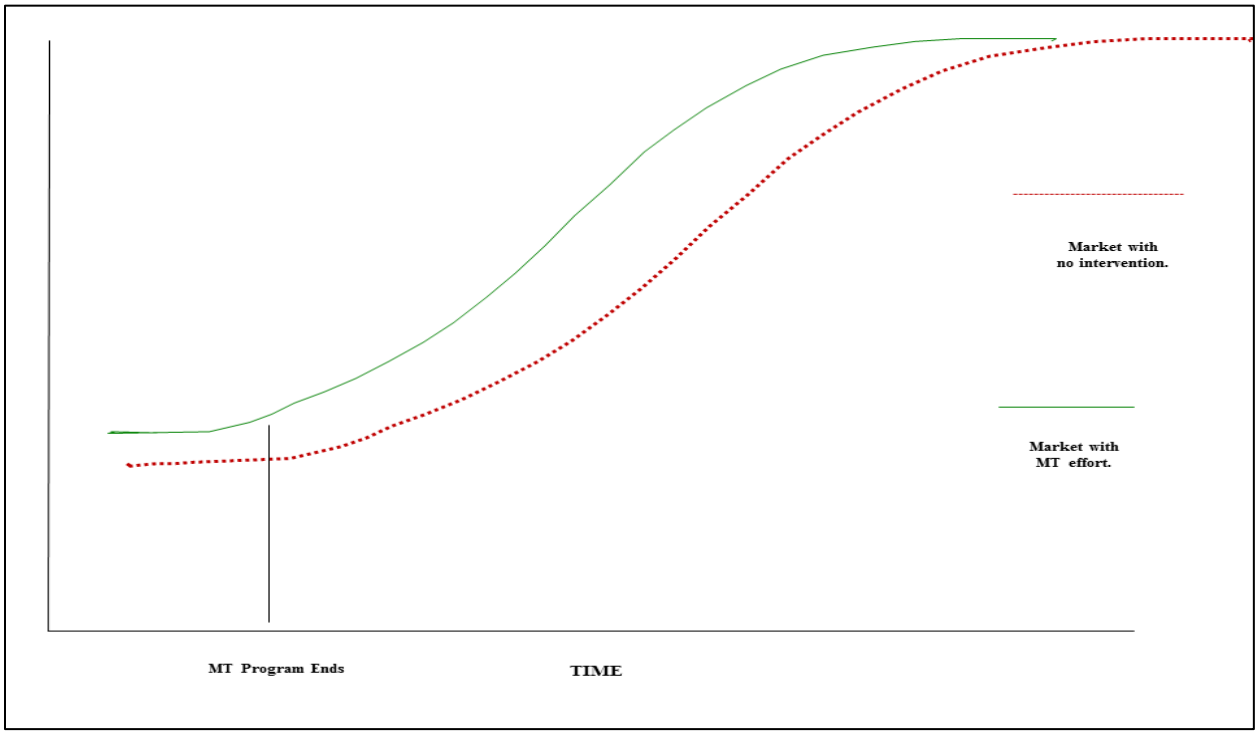
[12] Everett M. Rogers, *Diffusion of Innovations*, 4th edition (New York, N.Y.: The Free Press, 1995).

[13] Frederick D. Sebold,, Alan Fields, Lisa Skumatz, Shel Feldman, Miriam Goldberg, Kenneth Keating, and Jane Peters, *A Framework for Planning and Assessing Publicly Funded Energy Efficiency*, study ID PG&E-SW040 (Pacific Gas & Electric, 2001).

[14] There are many evaluations, papers, and possible citations in the energy efficiency evaluation field. Just a couple of readily available ones are listed here.
TecMarket Works, *2004 California Evaluation Framework*, prepared for the California Public Utilities Commission, 2004 (see Chapter 10).
Shel Feldman, "Measuring Market Effects: Sales Data Are the Last Thing You Should Look At," proceedings of the 1995 AESP Annual Meeting, Competition: Dealing with Change, Boca Raton, FL, 1995, 83–90.
Lori Megdal, Allen Lee, Todd Board, Betsy Wilkins, and Mary O'Drain, "Using Diffusion and Communications Theory to Expand Market Barrier Examination in MT Measurement," proceedings from the 10th National Energy Services Conference, Tucson, AZ, December, 1999, 584–595.
Jane S. Peters, Bruce Mast, Patrice Ignelzi, and Lori M. Megdal, "Measuring Market Transformation: The 1997/1998 California Market Effects Studies," Leading the Retail Revolution, 1998 Edition, *Proceedings from the 9th National Energy Services Conference*, Association of Energy Services Professionals, Boca Raton, FL, 1998, 121–128.
Lori Megdal, "Integrating Perspectives from Alternative Disciplines to Understand Market Transformation Policy in Energy Markets," Proceedings from the 1998 International Association of Energy Economist Conference, Québec City, Québec Canada, May, 1998, 417–424.

[15] Peter Smith, Paul DeCotis, and Karl Michaelm "Linking Market-Based Energy Efficiency Programs to Economic Growth, Sustainable Development and Climate Change Objectives," proceedings from the 1998 Summer Study on Energy Efficiency in Buildings, ACEEE, Washington, D.C, 1998, 9.185–9.195.

Figure 1-2. S-Curve of Diffusion of Innovation within the Market Transformation Paradigm



1.2.3 Net Savings and Market Effects

The key differences between net savings and market effects are briefly discussed below and summarized in Table 1-1.

- Net savings were initially designed for resource acquisition programs and the concept of market effects was conceptualized in response to the development of market transformation programs.
- Net savings are focused on program activity during a specific period and market effects measure changes in the market over time.
- SO and FR are generally measured through surveys of participating and/or nonparticipating market actors and the effects are expanded to the market from this individual level, whereas market effects are most often measured at the market level through broader indicators such as increases in market share or overall improvements in efficiency levels.
- Net savings include FR and the three types of SO – inside spillover (ISO), outside spillover (OSO) and NPSO – whereas market effects measurements may incorporate changes in market structure and other effects that have not yet been fully defined.
- While relying on self-reports is the most common method of estimating NTG factors – and this approach raises concerns about bias among some reviewers – measurements of market effects may include other market influences beyond the efficiency program interventions.

In general, net savings are expected to be a subset of market effects.

Table 1-1. Summary of Key Aspects of Measuring Net Savings and Market Effects

Factor	Net Savings	Market Effects
Type of program	Initially conceptualized for resource acquisition programs	Motivated by assessing impacts of market transformation programs
Timing	Focused on specific period	Assessing efficiency improvements over time
Approach	Bottom up estimates constructed from surveys of market actors	Top down using broader indicators such as change in market share[1]
Types of effects	FR, ISO, OSO, NPSO	All market influences
Issues	Relying on self-reports may lead to bias	It is difficult, if not impossible, to separate program effects from other market influences.

[1] An example is collecting market share data for a specific technology and measure changes in market share over time..

An example of the difference in perspective on timing is that high FR rates could actually be caused through market transformation. Over time, the NPSO effect may improve the efficiency practices of nonparticipants, and those nonparticipants may later decide to take advantage of NYSERDA's program offerings. However, using the net savings model, these savings would be considered to be FR, although the former nonparticipant was actually affected by the program. "Prior definitions and evaluation measurement approaches on a static basis do no properly consider how these definitions change when examined over time."[16] An evaluation for Consolidated Edison of New York in 1996–1997 found that much of identified FR could be credited as program-induced market transformation.[17]

To date, there is little direct experience with reconciling the two approaches. The top-down nature of comparing markets can offer a vastly different measurement of program-induced efficiency gains. A pilot market effects study was conducted as part of the NYSERDA New Construction Program Impact Evaluation completed in 2012 to assess the likelihood that there were program-induced savings that were not captured by the traditional NTG evaluation methods. According to that evaluation "[t]he pilot market effects study found that the current net-to-gross (NTG) analysis methods used by NYSERDA are likely to be leaving out some level of program-induced market changes and market effects. This study found that the upper bound for the uncaptured NCP market effect may be as high as 14 GWh or one-third as large as the NPSO measured and reported for this [the NCP] evaluation. Further evaluation research needs to be undertaken to provide a reliable estimate of market effects . . ."[18]

1.2.4 Cross-State Study

As NPSO is likely to be a subset of market effects, a reality check for the magnitude of the NPSO is to assess whether the total market effects are larger than the NPSO. A cross-state study was added to this study to provide such a reality check by comparing the NYS market to comparison states that have not had statewide energy efficiency programs.

[16] Lori Megdal, Steve Pertusiello, and Bonnie Jacobson, "Measuring Market Transformation Due to Prior Utility Efforts," proceedings from the 1997 Energy Program Evaluation Conference, Chicago, IL, August, 1997, 163.

[17] Ibid. See Table 10, page 169.

[18] NYSERDA, *New Construction Program (NCP) Impact Evaluation Report for Program Years 2007 –2008. Final Report*, prepared by Megdal & Associates, LLC., Cx Associates, LLC, and West Hill Energy and Computing, Inc., 2012, ES-9.

The conceptual underpinning of a cross-state study is the idea that efficiency levels in states with no efficiency programs provide a good indication of the NYS efficiency levels if no NYSERDA programs had been implemented. This comparison effectively incorporates all market effects, including SO, FR, and possibly other, nonprogram effects. This approach was recently used in California and Massachusetts to compare efficiency levels in one specific market: high bay lighting (HBL).

One limitation of this approach is that it is not possible to control for (or even to define) all of the confounding factors that could be affecting the results, making it difficult or impossible to establish causality. However, this type of top-down technique was previously used by NYSERDA for evaluating its market transformational programs for residential appliances and compact fluorescent lamps (CFLs). These types of comparisons focus upon specific technologies. This technology focus fits well in NYSERDA's evaluation of its programs for residential appliance and CFLs. A limiting aspect of the technology-specific approach is that NYSERDA's C&I programs cover a wide range of technologies and the market effects would be estimated for only a subset of these (or a single technology).

1.2.5 Enhanced Self-Report for Estimating Nonparticipant Spillover

While enhanced self-report (ESR) is the standard method for estimating SO, concerns have been raised about relying solely on self-reports of end users and contractors. In addition, specific causal mechanisms for achieving SO have not been thoroughly established at the program level. These issues are complex, and it was not within the scope of this study to try to determine and verify the causal mechanisms and/or conduct direct verification of SO savings. These concerns led to the inclusion of the cross-state comparison to this evaluation.

This evaluation was designed to address some of the other concerns about the use of self-reports to estimate NPSO. For example, the contractor surveys include both participating and nonparticipating contractors and, thus, OSO by participating contractors would be included in the estimated NPSO. Consequently, the Impact Team subtracted out the OSO calculated for the Existing Facilities and FlexTech programs. These concerns and the methods of addressing them are summarized in the table below.

Table 1-2. NPSO Issues and Approach

Issue	Implications	Approach
NYSERDA program influence may be invisible to end users.	NPSO could be underestimated.	The combination of end user and contractors surveys provided sufficient information to estimate SO due to contractor influence where program effects could be invisible to the end user.
Market conditions change over time.	NPSO can only be calculated for a specific period.	All survey questions covered years 2007 through 2010; the same period was used for the program savings to calculate the SO ratio.
Survey respondents may have difficulty separating NYSERDA program influence from other market factors or may have trouble providing accurate answers to complex questions.	Bias of unknown direction could be introduced into the estimate of NYSERDA influence.	Questions were asked from multiple perspectives and both end users and contractors were interviewed; a cross-state study was conducted to estimate total market effects for one technology for comparison purposes.

Issue	Implications	Approach
OSO could be indistinguishable from NPSO as contractor surveys included both participants and nonparticipants.	NPSO could be overstated.	OSO estimated savings for the Existing Facilities and FlexTech programs were subtracted from the NPSO savings.
Survey respondents may confuse NYSERDA programs with other efficiency programs	NPSO could be overstated.	All survey questions covered years 2007 through 2010. Utility programs were just starting to ramp up during that period and would not be expected to affect the results. Federal efficiency activities could be a confounding factor.

1.3 EVALUATION OBJECTIVES

This evaluation study was designed to address the following goals:

1. Estimate the effects of NPSO in the C&I existing facilities sector from the NYSERDA programs[19] that target these markets.
2. Test alternative methods to the self-report approach used to estimate SO and FR within the individual program evaluations.

This evaluation covers a number of NYSERDA programs targeting the existing facilities sector segment of the C&I market. These programs are designed to work with a variety of midstream market actors (*e.g.*, vendors, energy service companies, project developers) and end-use customers to promote installation of more efficient equipment. This evaluation covers the group of SBC C&I programs designed to address the existing facilities markets including: the Existing Facilities Program[20], the Flex Tech/Technical Assistance Program, the Loan Fund Program, the Business Partners Program, the Energy Smart Focus Program and the Distributed Generation/Combined Heat and Power Program.

This evaluation was initially designed to have three components:

1. Estimation of NPSO through enhanced self-reports of NYS businesses and other market actors (the enhanced self-report study or ESR)
2. Estimation of market effects for one technology by conducting a cross-state survey (the Cross-state study)
3. Estimation of FR for one technology using a nested logit approach

Each of these three components is described briefly below.

1.3.1 Enhanced Self-Report to Estimate Nonparticipant Spillover

The primary purpose of the ESR component is to develop more current estimates of NPSO rates across NYSERDA's C&I programs based on the methods used in NYSERDA's previous NPSO evaluations. The results of this component reflect the influence of NYSERDA programs on nonparticipants in the C&I

[19] These results should be applied to programs that are providing services for existing buildings to the general C&I sector, such as the Existing Facilities Program and FlexTech. It may not be appropriate to apply these results to programs that are targeted toward specific subsets of C&I existing building market, such as the Industrial Process Efficiency program.

[20] The Existing Facilities Program is a combination of the former Commercial/Industrial Performance, Smart Equipment Choices and Peak Load Management programs.

market as realized over the four years of 2007 through 2010. Given the recent ramp-up of utility efficiency programs, this ESR study will probably be the last that can only focus upon the impacts of NYSERDA programs on nonparticipants. NYSERDA recognizes that future study efforts would need to consider the potential impacts of the utility programs and may need to be undertaken jointly with other program administrators.

The second and third components of this evaluation were designed to investigate the use of alternative methods to estimate NPSO and FR on a technology-specific basis. In the recent round of evaluations, the NTG analysis for the program-specific evaluations were all based on enhanced self-reports from market actors, and the NTG factors were estimated for the program as a whole. The NPSO rate for the programs serving C&I existing buildings was taken from the most recent NPSO study discussed above.[21]

1.3.2 Cross-State Study to Estimate Market Effects for High Bay Lighting

In this evaluation, a cross-state study was used to measure and assess the impacts of market effects from NYSERDA programs in the C&I HBL market. While SO impacts are by definition smaller than the total market effects observed in this market, the cross-state study is designed to provide an overview of the potential magnitude of the market effects from this particular technology.

1.3.3 Nested Logit to Estimate Free Ridership

A third component had been planned as part of the objective of testing alternative NTG methods. A nested logit analysis was designed to estimate program FR for a specific technology promoted by NYSERDA's C&I programs for the purpose of comparing the results to the FR estimated in the Existing Facilities impact evaluation for program years 2007 and 2008. Efficient lighting was selected as the technology since it accounts for a large percentage of the total savings achieved by NYSERDA's C&I programs. The nested logit approach requires a large sample for three mutually exclusive types of lighting installations:

1. NYSERDA program participant (high efficiency)
2. Nonparticipant high efficiency
3. Nonparticipant standard efficiency lighting

However, the screener survey found a low incidence rate of standard efficiency installations among nonparticipants. This low rate would have significantly increased the costs of the study by substantially raising the number of calls to be made to meet the required sample size for nonparticipant standard efficiency lighting. It was difficult to justify the costs for the nested logit study component in this market at this time and this component was dropped. Further detail on the screener survey findings that drove the decision to drop the nested logit component are provided in Section 2.

1.4 EVALUATION APPROACH

The evaluation approach applied to the estimation of NPSO and the cross-state study are described below, followed by a discussion of the evaluation activities.

[21] Other program evaluations included their own NPSO estimates, such as from vendors for the commercial new construction market or the home remodeling market.

1.4.1 Nonparticipant Spillover

The first component of this study builds on NYSERDA C&I NPSO studies conducted in 2005 and updated in 2007.[22] The studies estimated NPSO through direct analyses of telephone surveys with various market actors in New York. Study results were applicable across C&I programs that targeted existing facilities. This study component is similar to the prior studies, but was expanded and conducted to develop updated estimates of NPSO rates across all of NYSERDA's C&I programs.

As with the previous NPSO evaluations, the foundation of the study was interviews with nonparticipating end user and vendors. The self-report study provided a NPSO estimate that reflected the wide range of NYSERDA interventions and technologies in the C&I existing buildings sector. Like the 2005 and 2007 NPSO studies, the current study does not provide different SO estimates for different programs because nonparticipants may have been influenced by more than one program. Instead, these results are to be applied to all NYSERDA C&I existing building programs.

Details on the method used for the ESR study component can be found in the first subsection of Section 4.

1.4.2 Cross-State Study

The cross-state study was conducted for one application only: HBL. This comparison effectively incorporates all market effects, including SO, FR, and other, non-program effects. This approach was recently used in California and Massachusetts to compare efficiency levels for HBL. This method is an alternative to the self-reported approach and is the technology-specific alternative NTG method tested in this overall NPSO study.

As this approach is essentially an observational study, it is not possible to control for (or even to define) all of the confounding factors that could be affecting the results, making it difficult or impossible to establish causality. The California and Massachusetts studies were used as models for this component of the evaluation. The comparison was based on primary research through surveys of end users and contractors in NYS and the comparison area. Secondary data was used to estimate the efficiency levels of the HBL products.

Detail on the method used for the cross-state study component can be found in the first subsection Section 5.

1.4.3 Evaluation Activities

The following evaluation activities were designed to be able to develop defensible estimates of NPSO and market effects (for HBL):

- The list of market actors to be interviewed was reviewed and expanded.
- A screener survey of C&I businesses (end users) was conducted to estimate the incidence of remodeling, the total C&I space (square footage) associated with the remodeling, and the potential sample sizes for each of the study components (ESR, cross-state. and nested logit).
- An end user survey of NYS businesses was conducted to obtain the data required for the ESR and cross-state study.
- An end user survey of businesses in the comparison area was conducted to obtain the data to support the cross-state study.

[22] The results of this work are reported in the *Business and Institutional Sector-Wide Non-Participant Market Characterization, Market Assessment, and Causality Evaluation,* prepared for NYSERDA by Summit Blue Consulting, May 2005, and *Commercial and Industrial Market Effects Evaluation*, prepared for NYSERDA by Summit Blue Consulting, October 2007.

- Contractor surveys of NYS contractors were fielded to obtain the data required for the cross-state study.
- Contractor surveys of both NYS and comparison area contractors were fielded to obtain the data required for the cross-state study.

These evaluation activities, the study components, and the purposes are summarized in the table below.

Table 1-3. Summary of Evaluation Activities

Evaluation Activity	Study Component	Purpose
Review market actors	ESR	Ensure that all key market actors are considered.
Screener survey of NYS end users	ESR, cross-state, nested logit	Estimate incidence of remodeling, C&I space remodeled. and difficulty of obtaining required sample sizes for evaluation components.
Survey of NYS end users	ESR and cross-state	Obtain data required for ESR and cross-state study
Survey of comparison area end users	Cross-state	Obtain data required for cross-state study
Survey of NYS contractors	ESR and cross-state	Obtain data required ESR and for cross-state study
Survey of comparison area contractors	Cross-state	Obtain data required for cross-state study

1.5 ORGANIZATION OF THE REPORT

Section 2 provides an overview of the data sources, sampling, and surveys used in the evaluation. Section 3 provides the information learned about the NYS C&I market and remodeling. Section 4 describes the methods and findings of the enhanced self-report study used to estimate the NPSO rate for the C&I existing facilities sector. Section 5 describes the methods and findings of the cross-state study on the HBL market and decision-making. The primary output includes an estimate of NYSERDA HBL market effects, the net of program savings and participants (NPSO), and the rate for the latter. Section 6 summarizes the recommendations, conclusions, and lessons learned during this evaluation.

Section 2: **DATA COLLECTION DESIGN, SURVEYS, AND SAMPLING**

This section covers the data sources used in the calculation of the nonparticipant spillover (NPSO) and the market effects for high bay lighting (HBL), development of the sample frames and description of the sampling approach, survey dispositions, and data collection design and implementation.

2.1 DATA SOURCES

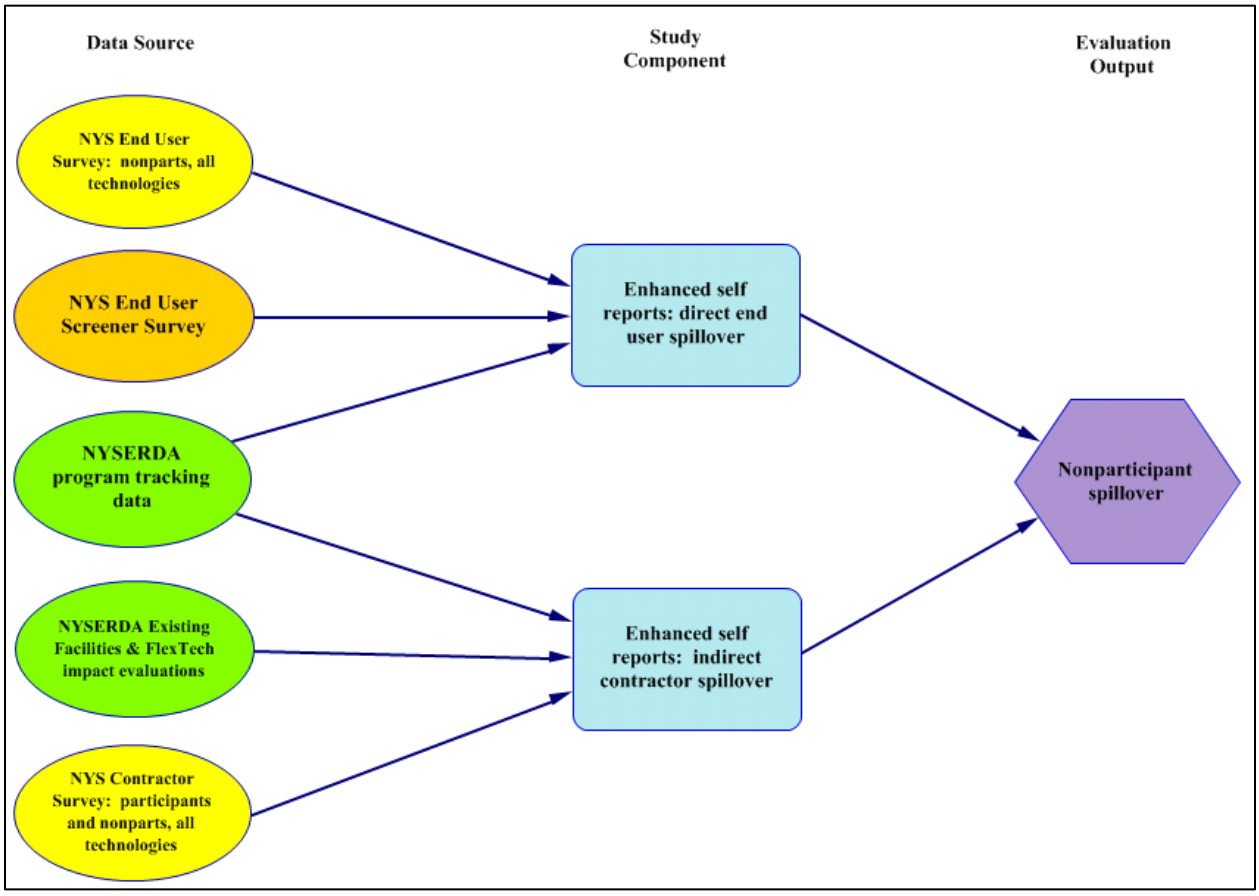
The enhanced self-report (ESR) and cross-state studies required different information. However some data sources were the same, as the end user and contractor surveys were designed to provide the required data for both components of the study. Through the screening process, survey respondents were assigned to specific components and asked the relevant questions for that component.

The NPSO study required data from the following data sources:

- Screener survey of commercial and industrial (C&I) end users in New York (excluding Long Island)[23]
- Surveys of C&I end users in New York who conducted remodeling projects from 2007 to 2010
- Surveys of nonparticipating contractors in New York who conducted remodeling projects from 2007 to 2010
- Program savings estimates from NYSERDA's C&I programs targeted to existing buildings for projects completed from 2007 to 2010
- Previous impact evaluations from NYSERDA's Efficient Products and FlexTech programs for program years 2007 and 2008. The data sources for the ESR component of the study are shown in Figure 2-1 below.

[23] The report will often shorten this to New York or abbreviate as NYS and unless otherwise stated, this stands for the NYSERDA territory of New York excluding Long Island.

Figure 2-1. Data Sources for the Enhanced Self-Report Component



The cross-state study evaluating the adoption of energy efficient HBL technologies required the following data sources:

- Surveys of end users in New York State (NYS) and the comparison area of South Carolina, Georgia, Alabama, and Mississippi that purchased lighting products between 2007 and 2010 for high bay areas
- Surveys of contractors in NYS and in the comparison area that installed HBL technologies
- Secondary data from the Illuminating Engineers Society of North America (IESNA) concerning the average lumens per square foot by building type, and information concerning the average number of lumens per watt for different technologies
- Program savings estimates from NYSERDA's C&I programs targeted to existing buildings for projects with HBL completed between 2007 and 2010

One of the common inputs to both study components is the total square footage and other remodeling information from the New York End User Screener Survey. Program tracking data plays a similar role for the two study components, although the ESR study looks at NYSERDA's complete C&I effort for existing buildings and their impact evaluations while the cross-state study only uses program data related to HBL. More detailed information concerning the surveys is provided in Sections 2.3 and 2.4 below.

2.2 PROGRAM DATA

NYSERDA provided the Impact Team with the full program database, which included both project-level and measure-level data. The program data consisted of information from four NYSERDA C&I programs: Commercial Industrial Performance, Existing Facilities, Peak Load Reduction, and Smart Equipment Choice. The primary analysis work with the program data was to identify likely HBL projects and obtain the total program reported savings for HBL from 2007 to 2010.

2.2.1 Surveys

NYSERDA's survey implementation contractor obtained the sample frame lists, provided input to the Impact Team for the sample design, pulled the samples, and conducted the surveys in New York and the comparison area. In addition, prior to fielding the New York End User Survey, the survey implementation contractor conducted a screener survey with end-use customers in New York. This screener supplied the sample frame for the full New York End-User Survey and provided early data to refine the sampling plans.

There were five surveys conducted to provide data for the ESR and the cross-state studies. These five surveys are listed below and each is described in detail in Section 2.3.

1. New York End User Screener Survey
2. New York End User Survey
3. New York Contractor-Survey
4. Comparison Area End User Survey
5. Comparison Area Contractors Survey

Table 2-1 provides a description of the evaluation activities and their relationship to the studies.

Table 2-1. Survey Descriptions

Evaluation Activity	Study Component	Purpose
Screener survey of NYS end users	ESR, cross-state, nested logit	Estimate incidence of remodeling, C&I space remodeled and difficulty of obtaining required sample sizes for evaluation components; compare sample frames
Survey of NYS end users	ESR and cross-state	Obtain data required for ESR and cross-state analyses
Survey of comparison state end users	Cross-state	Obtain data required for cross-state analysis
Survey of NYS and comparison state contractors	Cross-state	Obtain data required for cross-state analysis

2.2.2 Engineering and Secondary Data

Secondary data from IESNA was used to determine the required lighting levels by business type. IESNA data is the expert source on lighting design and requirements in North America. Efficacy (lumens per watt) for the different types of lighting technologies was taken from designlights.org. DesignLights is a consortium of utilities and efficiency program administrators.

2.3 DATA COLLECTION DESIGN AND CHANGES

This subsection discusses the design of the data collection effort and how overlapping needs were incorporated into the surveys and survey process. As discussed in the first part of this section, the NYS surveys were designed to allow one survey instrument to be used to provide the required inputs for the

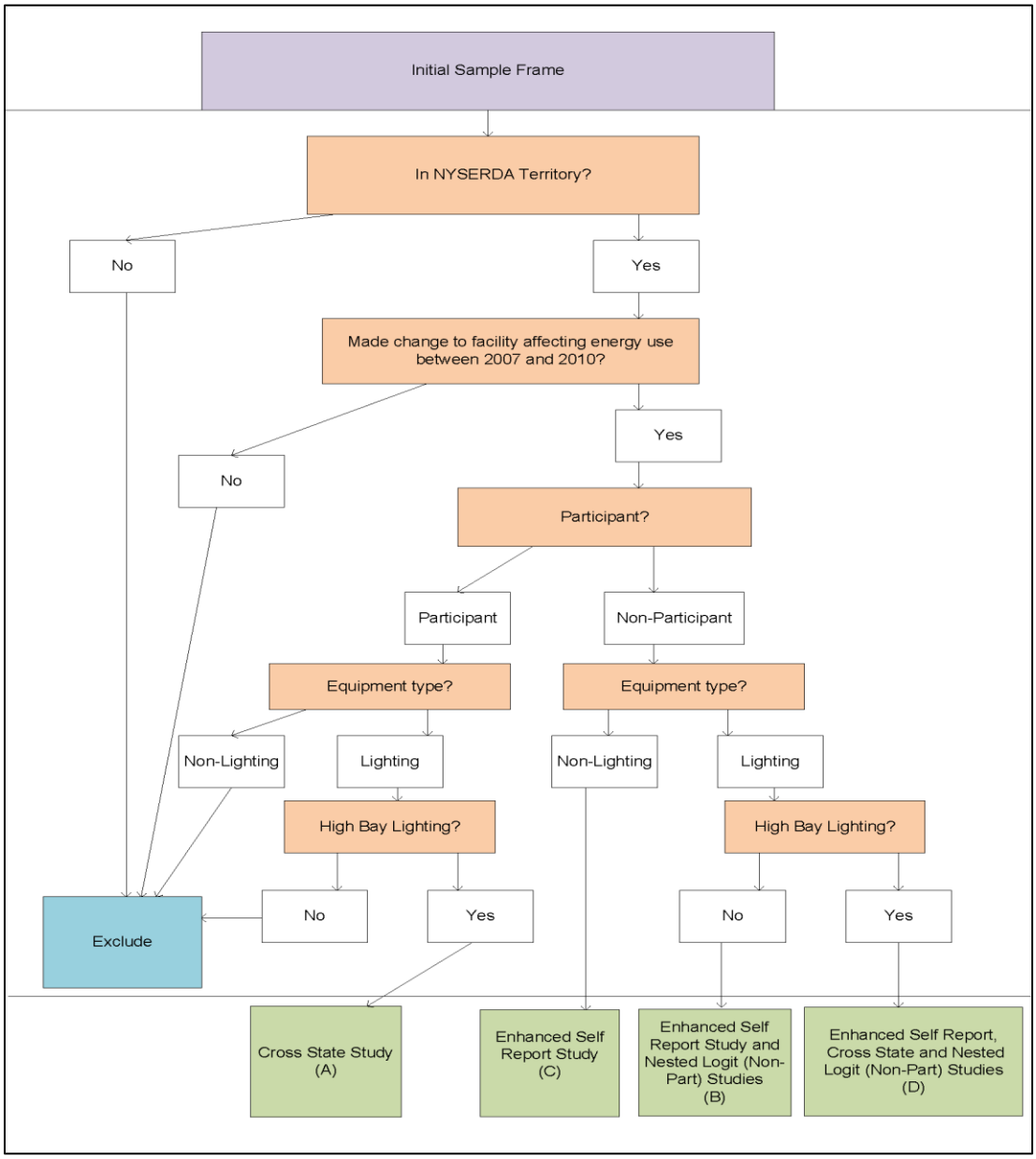
ESR, the cross-state study, and the nested logit. Since the comparison area surveys were used only for the cross-state study, this data collection was planned independently and there was no need to use the surveys for more than one purpose. The changes that were made based on the results of the initial screening efforts and fielding of the surveys are described in the following sections.

2.3.1 Description of Multiple Purposes for the New York Surveys

There were three evaluation study components in the original evaluation plan and work plan: the ESR, the cross-state study, and the nested logit (which was subsequently dropped due to the high cost of meeting the required sample size). As part of the original planning, the Impact Team developed a method to meet the data collection needs for each of the three studies with two surveys fielded in NYS (one for end users and one for contractors). The two surveys did "double duty" as respondents were identified through the screening process, and the survey flow was modified to ensure that each respondent received the appropriate battery of questions. This approach allowed us to use the sample frame efficiently, avoid wasting samples as would occur if the surveys were fielded independently, and meet quotas more easily for some categories with small populations.

The steps used to meet the targets for each study component of the end user survey are presented graphically in Figure 2-2 and discussed briefly below.

Figure 2-2. Original New York End-User Respondent Guide



To manage this process, a large spreadsheet of the data requirements by topic area for each of the different components was developed. Survey questions were labeled with the designations from the previous studies being replicated (the prior NYSERDA NPSO studies[24] and the Massachusetts HBL Market Effects Study[25]). This process served as a "crosswalk" between the prior work and the study

[24] NYSERDA, *Commercial and Industrial Market Effects Evaluation*, prepared for NYSERDA by Summit Blue Consulting, October 2007, and NYSERDA, *Business and Institutional Sector-Wide Non-Participant Market Characterization, Market Assessment, and Causality Evaluation*, prepared for NYSERDA by Summit Blue Consulting, May 2005.

[25] KEMA, *Final Report HBL Market Effects Study: Project 1A New Construction Market Characterization*, prepared for the Massachusetts Energy Efficiency Program Administrators by KEMA, June 2011.

components and helped identify overlapping data requirements between the NYS screener survey and the end user survey. Many of the survey questions were replicated from the previous studies except where flow or potential to reduce programming errors had counterbalancing benefits.[26]

2.3.2 Surveys and Sample Frames for New York State End Users and Contractors

This section describes the three surveys conducted of NYS end users and contractors.

New York End User Screener Survey

The initial fielding of the New York end user screener survey was designed to provide additional information in the following areas:

- The incidence of businesses with upgrades to energy-related systems in the time frame of interest
- The incidence of renters and owners and how to obtain reliable information regarding upgrades to rented space
- The distribution of businesses to sectors
- The knowledge of end users regarding lighting technologies (for the cross-state and nested logit surveys)

In addition, the screener survey was used to gather data from the overall New York C&I end user population needed for the calculation of NPSO and HBL market effects.

Two major sources of the sample frame for the end user survey – the McGraw-Hill Construction Dodge (Dodge) Database and the Dun and Bradstreet (D&B) Database – were considered by the Impact Team, with input from NYSERDA's survey contractor, APPRISE. The advantages and disadvantages of these two potential sources of the sample frame are explained in below in Table 2-2.

Table 2-2. Sample Source Comparison

Dodge Construction Projects	Dunn and Bradstreet
Description	
The Dodge database is comprised of listings of construction projects that are in the bidding phase. Dodge updates the information on the projects as the bids are won and work is completed.	D&B contains a listing of all commercial establishments.
Advantages	
More likely to have a higher incidence of remodels, thus reducing the costs of the survey	More likely to be representative of the population
Disadvantages	
May not be representative of the population Likely to overstate the incidence of remodeling in the population	Incidence of remodels could be lower, increasing the costs of the survey Does not sufficiently cover some sectors, such as manufacturing or educational institutions

[26] The MA HBL study was based upon a much larger and more comprehensive HBL market effects study conducted in California and used their data for its comparison data. That study, along with one in Wisconsin, were reviewed as this study was being designed and as the survey instruments were being developed.

The screener survey was initially fielded using the D&B list, and the remodel incidence rate was found to be high enough to support the use of the D&B list as the sample frame for the end user survey, supplemented with other lists to improve coverage for specific sectors. The supplemental lists used were for colleges and universities, elementary and secondary education, local government, and manufacturers.

The results from the screener survey were used to assess whether it would be possible to obtain complete information about remodels from renters. Early results from the screener survey showed that most establishments owned their space (64% in the completed screener survey dataset). Table 2-3 shows that the percentage of renters who make decisions related to energy-related upgrades is 54%, indicating that the survey respondent had responsibility for the energy-related remodeling decisions for about 80% of the completed surveys. This result indicates that the survey adequately covers both owners and renters.

Table 2-3. Decision-Making Responsibility for Tenants

Who Is the Decision-Maker on Energy-Related Upgrades?	Weighted Number of Renters in the New York[1] Screener Survey	Weighted[2] Percentage of Renters
Owner	1,729	54%
Renter	839	45%
Don't know/refused[3]	10	1%

[1] New York excluding Long Island.

[2] The NYS screener survey weights were used so the average represented the full C&I population.

[3] There were 46 responses of "don't know" and 14 refused. This question was asked of only those renters that said the owner was the decision-maker.

The screener survey formed the basis for the sample frame for the NYS end user survey used for the ESR and HBL cross-state study. The Impact Team created lists of buildings that had been remodeled and those with HBL purchases from the screener component of this survey to determine quotas for each target population.

The screener survey was also used to collect data utilized in the analyses. The remodeling incidence rate is one of these key data requirements. The results of the screener survey provided the estimate of the area (square footage) of all NYS C&I businesses, which is a critical input into the calculation of NPSO within the ESR study. In addition, the percentage of the facility with high bay space and the number of firms that made HBL purchases were estimated from the screener survey.

The New York End User Screener Survey is attached as Appendix A.

New York End User Survey

The purpose of this survey was to gather information on the incidence of installations of energy-related equipment among end users and the process of deciding whether to install high efficiency equipment. Most of the survey instrument was a combination of the questions used in the studies being replicated, i.e., the NYSERDA NPSO studies and the Massachusetts HBL market effects study. A few questions were added for nonparticipants to meet the needs of the nested logit study.

Building on past NYSERDA NPSO studies, the results of the New York End User Survey were used to calculate end user spillover (SO) savings. This survey targeted nonparticipants who conducted any type of retrofit that affected energy use, ranging from lighting to building shell upgrades to heating, ventilation and air conditioning (HVAC) equipment. Specific questions about HBL projects were asked of

respondents who met the criteria to provide the data for the cross-state comparison study and to replicate the MA HBL study[27]. Additional topics covered in this survey included the following:

- Efficiency, age, and condition of equipment replaced and reasons for replacement
- NYSERDA's and/or contractor's influence on moving forward with projects
- Decision-making processes and energy efficiency practices and policies implemented at project sites

The New York End User Survey is attached as Appendix B.

New York Contractor Survey

The purpose of the New York Contractor Survey was to gather data on potential SO impacts that occur through contractors in NYS. In addition to the direct SO estimated from the end user survey, the current evaluation was designed to capture SO that was unknown to the end user by estimating indirect SO from NYSERDA-influenced contractor actions. This indirect SO was estimated only for the C&I space associated with end users who reported no NYSERDA influence on their actions and for contractors who indicated that they increased the efficiency level of their recommendations and installations due to NYSERDA's programs. More detail on these calculations is provided in Section 4.

Another objective of this survey was to obtain data for the cross-state study to estimate market effects for HBL. The survey included the following areas of inquiry:

- Screening questions to establish that the contractors work in NYSERDA territory and remodel or install upgrades in C&I projects related to energy use
- The incidence of HBL contractors (among all lighting contractors)
- Equipment recommendations and efficiency, interactions with the customers, and decision-making
- NYSERDA program awareness and participation, including the estimation of the proportion of all projects that are participating projects
- NYSERDA's program influence and how it affects their work
- Lighting technologies used for HBL and changes in the HBL market over the past two years and expected over the next two years
- The influence of building codes and chains or franchises in the HBL market

The New York Contractors Survey is attached as Appendix C.

2.3.3 Surveys in the Comparison Area

The cross-state study included surveys of end users and contractors in the comparison area. The underlying assumption is that the absence of efficiency programs operating in the comparison area during the study period is the primary difference between NYS and the comparison area. However, other unknown factors affecting the installation of high efficiency lighting may influence the results of the comparison.

[27] KEMA, *Final Report HBL Market Effects Study: Project 1A New Construction Market Characterization*, prepared for the Massachusetts Energy Efficiency Program Administrators by KEMA, June 2011.

This study replicated the methods used in past California and Massachusetts studies and updated the data by fielding new surveys in the same comparison area using similar survey instruments. These surveys are described in the following sections.

Comparison Area End Users and Changes to the Sampling Method

This survey was designed to enable comparisons of the incidence of high efficiency HBL between NYS and the comparison areas. The same comparison area was used for this study as was used in the California and Massachusetts HBL studies, i.e., South Carolina, Georgia, Alabama, and Mississippi.[28] The comparison area needed to be generally free of efficiency program intervention during the 2007 to 2010 time period.

A comparison area end user survey was developed to match the HBL portion of the NYS end user survey, as was done in the prior California study. The areas covered by the survey included the following:

- Square footage of the facility and of the area with the HBL retrofit
- Lighting technology and controls installed in the HBL upgrade
- Age, condition, and reason for replacement of old HBL equipment
- Awareness and perceptions of equipment efficiency
- Sources of equipment information and influence on the decision to install energy efficient equipment

The original data collection plan was to have a screener as in the NYS end users case. Early results showed that the remodel rate in the comparison area was half that of the rate in NYS, which meant that obtaining results from HBL remodelers by screening the full population was cost prohibitive.

The NYS end user surveys had been completed, i.e., the NYS HBL data was already available. HBL spaces and HBL purchasers were not proportionately distributed across sectors, i.e., the proportion of HBL was more prevalent in some sectors than others. With the completed survey data from NYS, it was possible to construct a list of HBL purchasers by sector or two-digit SIC code and set quotas for the comparison area end users on the basis of the NYS completed surveys by the industry categories. Undertaking the comparison area end user survey in this manner allowed it to be completed at a reasonable cost. The Comparison Area End User Survey is attached as Appendix D.

Comparison Area Contractors

The cross-state contractor survey gathered HBL data similar to that acquired through the surveys of NYS lighting contractors. The lighting contractor industry classification codes used for the sample frame for NYS contractors were also used for the sample frame for lighting contractors in South Carolina, Georgia, Alabama, and Mississippi. This survey covered the following topics:

- Screening for work in lighting design or installations in the C&I sector in the state and for HBL projects completed during the four-year period of 2007 to 2010
- Recommended equipment, efficiency levels and equipment controls, interactions with the customers, and decision-making

[28] The Massachusetts HBL study used the data from California for their comparisons and only collected new data from Massachusetts. The Massachusetts data was for 2007 to 2010. This was the time period also selected for the New York study. The comparison area data collected and used in the California study was for 2008 and that is what Massachusetts compared itself against. The New York study collected both New York and data from the comparison area for 2007 to 2010.

- Utility energy efficiency program awareness and participation, the proportion of projects that were participating projects and the influence of efficiency programs on their work
- Lighting technologies for HBL, the influence of the energy efficiency program on HBL technologies, and the influence of firms that are a part of chains or franchises
- Changes in the HBL market over the past two years and expected over the next two years
- Influence of building codes

The Comparison Area Contractor Survey is attached as Appendix E.

2.4 SURVEY SAMPLE DISPOSITIONS

All survey instruments were drafted by the Impact Team with input from NYSERDA's survey implementation contractor and NYSERDA evaluation staff. The final instruments were approved by NYSERDA and the DPS prior to fielding the survey.

The interviews were conducted using a computer-assisted telephone interview (CATI) survey instrument. Comprehensive checks were conducted by NYSERDA's survey contractor prior to fielding to ensure that all skip patterns were correct and all question wording was comprehensible to respondents. Interviewers called potential respondents during daytime weekday hours and calls were rotated between the morning and afternoon on different days of the week to minimize nonresponse bias.

2.4.1 Sample Dispositions for the New York End User Screener Survey

Interviewers from APPRISE and partner call centers conducted the screening interviews. Screening began in early October 2011 and continued simultaneously with the full survey, ending on April 16, 2012. In total, 11,812 pieces of sample were dialed and 2,578 completed screeners were obtained for a completion rate of 21.8%. As shown in

Table 2-4, the New York End User Screener Survey achieved a contact rate of 56.8%, a cooperation rate of 55.9%, and a response rate of 25.3%.

Table 2-4. Sample Disposition for the New York End User Screener Survey

Disposition		Number of NYS[4] End Users in Sample Frame	Percentage of NYS[4] End Users
Total sample used		11,812	100.0%
Excluded sample	Not working/unusable number	1,145	9.7%
	Wrong number/nonbusiness/duplicate	483	4.1%
Not contacted	Respondent never available/callback	434	3.7%
	Answering machine/no answer busy	1,099	9.3%
	No such person/cannot locate	1,723	14.6%
	Referred	566	4.8%
	Quota met	238	2.0%
	Max attempts	338	2.9%
Contacted	Termed out (no knowledgeable respondents)	1,063	9.0%

Disposition		Number of NYS[4] End Users in Sample Frame	Percentage of NYS[4] End Users
	Language barrier	113	1.0%
Refused/	Refused	1,961	16.6%
Breakoff	Breakoff	71	0.6%
Completed interview		2,578	21.8%
Contract rate [1] $(2{,}578 + 2{,}032 + 1{,}176) / (2{,}578 + 2{,}032 + 1{,}176 + 4{,}398) = 0.568$			56.8%
Cooperation rate [2] $2{,}578 / (2{,}578 + 2{,}032) = 0.559$			55.9%
Response rate [3] $2{,}578 / [2{,}578 + 2{,}032 + 1{,}176 + 4{,}398 + (0.942 \times 0)] = 0.253$			25.3%

[1] Contact rate = (Completions + refusals + breakoffs + contacted) / (Completions + refusals + breakoffs + contacted + not contacted).

[2] Cooperation rate = Completions / (Completions + refusals + breakoffs).

[3] Response rate = Completions / [Completions + refusals + breakoffs + contacted + not contacted + (e×(unknown eligibility))]. For this survey, e = 0.942.

[4] New York excluding Long Island.

2.4.2 Sample Dispositions for the New York End User Survey

Advance letters to introduce the survey were sent by NYSERDA to the sample frame developed from the completed New York End User Screener Survey. The letter mentioned the retrofit measures found during the screening, introduced the phone center, encouraged participation, and provided NYSERDA contact information if the respondent wanted to learn more about the study, verify the validity of the survey effort, or check the confidentiality policy.

There were 570 out of 1,021 New York end users who completed this survey, which resulted in a completion rate of 55.8%. As shown in Table 2-5, the New York End User Survey achieved a contact rate of 75.4%, a cooperation rate of 75.6%, and a response rate of 56.9%.[29]

Table 2-5. Sample Disposition for the New York End User Survey

Disposition		Number of NYS[1] End Users in Sample Frame	Percentage of NYS[1] End Users
Total sample used		1,021	100.0%
Excluded sample	Not working/unusable number	8	0.8%
	Duplicate	1	0.1%
Not contacted	Respondent never available/callback	26	2.5%
	Answering machine/no answer/busy	7	0.7%

[29] The cooperation rate is lower if refusals by gatekeepers are included; however, this approach blurs the distinction between eligible and ineligible end users.

Disposition		Number of NYS[1] End Users in Sample Frame	Percentage of NYS[1] End Users
	No such person	31	3.0%
	Over quota	126	12.3%
	Max attempts	56	5.5%
Contacted	Language barrier	1	0.1%
Not eligible	No project measures indicated	11	1.1%
Refused/	Refused	182	17.8%
Breakoff	Breakoff	2	0.2%
Completed interview		570[a]	55.8%
Contact rate [2] $(570 + 184 + 1) / (570 + 184 + 1 + 246) = 0.754$			75.4%
Cooperation rate [3] $570 / (570 + 184) = 0.756$			75.6%
Response rate [4] $570 / [570 + 184 + 246 + 1 + (0.984 \times 0)] = 0.569$			56.9%

[1] New York excluding Long Island.

[2] Contact rate = (Completions + refusals + breakoffs + contacted) / (Completions + refusals + breakoffs + contacted + not contacted).

[3] Cooperation rate = Completions / (Completions + refusals + breakoffs).

[4] Response rate = Completions / [Completions + refusals + breakoffs + contacted + not contacted + (e × (unknown eligibility))]. For this survey, e = 0 due to the NYS End User Screener Survey providing the sample frame for this survey.

[a] Five hundred and one of the completed interviews were used for the enhanced self-report and 145 for the cross-state study.

2.4.3 Sample Dispositions for the New York Contractor Survey

The contractor survey sample frame was pulled from D&B for New York firms in the standard industrial classification (SIC) codes as provided in Appendix I. These were grouped into lighting, HVAC, and other contractors. NYSERDA's influence on market actors may vary depending on the size of the firm. Consequently, the Impact Team also stratified the sample based on the number employees.[30]

Advance letters to introduce the survey were sent by NYSERDA to the sample frame. Those who had responded to previous NYSERDA surveys were thanked for the prior participation and requested to participate in this additional research effort. Both letters explained the study effort, introduced the phone center, encouraged participation, and provided NYSERDA contact information if the respondent wanted to learn more about the study, verify the validity of the survey effort, or check the confidentiality policy.

There were 225 out of 1,514 NYS contractors who completed the New York Contractor Survey, which resulted in a completion rate of 14.9%. As shown in Table 2-6, the NYS contractor survey achieved a contact rate of 39.8%, a cooperation rate of 61.8%, and a response rate of 23.7%.

[30] The prior NYSERDA NPSO study stratified their market actor sample based on revenue whereas the prior cross-state comparison study stratified based on number of employees. This study was intended to directly compare the New York results to the previous cross-state studies so the Impact Team chose to follow their sampling approach.

To be consistent with prior cross-state studies, this study only interviewed market actors with at least five employees.

Table 2-6. Sample Dispositions for the New York Contractor Survey

		Number of Total NY[1] Contractor Interviews	Percentage of Total NY[1] Contractor Interviews
Total sample used		1,514	100.0%
Excluded sample	Not working/ unusable number/ duplicate	157	10.4%
Not contacted	Respondent never available or callback	368	24.3%
Unknown eligibility	No answer/busy	54	3.6%
	Answering machine	334	22.1%
	Gatekeeper refusal	219	14.5%
Excluded contractors	Not eligible/not qualified	137	9.0%
	Language barrier/quota	4	0.3%
Refused/breakoff	Refused	13	0.9%
	Breakoff	3	0.2%
Completed interview		225[a]	14.9%
Contact rate[2]			39.8%
Cooperation rate[3]			61.8%
Response rate[4]			23.7%

[1] New York excluding Long Island.

[2] Contact rate = (Completions + refusals + breakoffs + contacted) / (Completions + refusals + breakoffs + contacted + not contacted).

[3] Cooperation rate = Completions / (Completions + refusals + breakoffs + (gatekeeper refusals × e)).

[4] Response rate = Completions / [Completions + refusals + breakoffs + contacted + not contacted + (e × (unknown eligibility))]. For this survey, e = 0.563 over all the NYS contractors.

[a] Seventy interviews were used in the cross-state study and all 225 were used for the ESR.

2.4.4 Sample Dispositions for the Comparison Area End User Survey

No advance letters were used because the eligibility rate was expected to be low. Survey implementation under the original sample design began January 27, 2012. Incidence rates even lower than expected were found and the survey was put on hold as of February 15, 2012. The revised sample design, as described earlier in Section 2.3.3, was created and the survey was relaunched on April 27, 2012. An incentive of $100 to complete the survey was offered.[31] The 121 survey completions were obtained and the survey ended on June 29, 2012.

There were 121 out of 21,190 comparison area end users that completed the Comparison Area End User Survey, which results in a completion rate of 0.6%. As shown in Table 2-7, the Comparison Area End User Survey achieved a contact rate of 1.6%, a cooperation rate of 34.7%, and a response rate of 21.4%.

[31] The incentive was not in the original data collection design but was tried and found to help obtain completions with a difficult low incidence group.

Table 2-7. Sample Disposition for the Comparison End User Survey

Disposition		Number of Comparison Area[1] End Users in Sample Frame	Percentage of Comparison Area[1] End Users
Total sample used		21,190	100.0%
Excluded sample	Not working/unusable number	2,190	10.3%
	Duplicate	12	0.1%
Unknown eligibility	Respondent never available/callback	2,047	9.7%
	Answering machine/no answer/busy	2,227	10.5%
	No such person	27	0.1%
	Quota met	2,406	11.4%
	Max attempts	1,033	4.9%
	Gatekeeper refusal	1,456	6.9%
	Other DK/ refusal	390	1.8%
Ineligible	No project measures indicated	2,430	11.5%
	No high bay spaces	6,616	31.2%
	Less than five employees	59	0.3%
Refused/breakoff	Refused	129	0.6%
	Breakoff	3	0.0%
	Scheduled callback after eligibility confirmed	20	0.1%
	No one familiar with upgrade	24	0.1%
Completed interview		121	0.6%
Contact rate [2]			1.6%
Cooperation rate [3]			34.7%
Response rate [4]			21.4%

[1] The comparison area includes South Carolina, Georgia, Alabama, and Mississippi.

[2] Contact rate = (Completions + refusals + breakoffs) / (Completions + refusals + breakoffs + ineligible + unknown eligibility).

[3] Cooperation rate = Completions / (Completions + refusals + breakoffs + (gatekeeper refusals × e)).

[4] Response rate = Completions / [Completions + refusals + breakoffs + (e × (unknown eligibility))]. For this survey, e = 0.028.

2.4.5 Sample Dispositions for the Comparison Area Contractor Survey

Advance letters were not sent for this study. If the survey respondent requested additional written information, a letter was sent to explain the study effort, introduce the phone center, and provide NYSERDA contact information if the potential respondent wanted to learn more about the survey effort or check the confidentiality policy.

There were 72 out of 880 comparison area contractors that completed the Comparison Area Contractor Survey, which resulted in a completion rate of 8.2%. As shown in Table 2-8, the comparison area

contractor survey achieved a contact rate of 12.0%, a cooperation rate of 56.3%, and a response rate of 23.1%.

Table 2-8. Sample Disposition for the Comparison Area Contractor Survey

Disposition		Number of Comparison Area[1] Contractors in Sample Frame	Percentage of Comparison Area[1] Contractors
Total sample used		880	100.0%
Excluded sample	Not working/unusable number	140	15.9%
Unknown eligibility	Respondent never available/callback	214	24.3%
	Answering machine/no answer/busy	240	27.3%
	No such person		0.0%
	Gatekeeper refusal	96	10.9%
Ineligible	No project measures indicated	100	11.4%
	Language barrier	1	0.1%
Refused/breakoff	Refused/breakoff	17	1.9%
Completed interview		72	8.2%
Contact rate [2]			12.0%
Cooperation rate [3]			56.3%
Response rate [4]			23.1%

[1] The comparison area includes South Carolina, Georgia, Alabama, and Mississippi.

[2] Contact rate = (Completions + refusals + breakoffs) / (Completions + refusals + breakoffs + ineligible + unknown eligibility).

[3] Cooperation rate = Completions / (Completions + refusals + breakoffs + (gatekeeper refusals × e)).

[4] Response rate = Completions / [Completions + refusals + breakoffs + (e × (unknown eligibility))]. For this study, e = 0.406.

2.5 SAMPLING WEIGHTS

The process to develop the relative weights was the same for all of the surveys and is described below:

1. Create the expansion weight for each size category for each list as the establishment count divided by the survey completions for that group.
2. Determine the average population weight across all lists and size groups (i.e., one number for the survey) as the total number of establishments divided by the total number of survey completions.
3. Calculate the relative weights for each list and size group (each cell) as the expansion (or case) weight for that cell divided by the average population weight.

The inputs into the calculations are provided for each survey in the sections below.

2.5.1 Sampling Weights for the New York End User Screener Survey Analysis

This study used the relative weights for the New York[32] End User Screener Survey that were created by NYSERDA's survey contractor, APPRISE. APPRISE used D&B and several supplemental lists to create a comprehensive NYS C&I sampling frame. The lists of NYS establishments were organized by size groups, but the definition of those size groups varied by list.[33] The survey completions by list and size group were used with the sample frame lists by size group as the inputs into the sampling weights.

The results of the screening process are summarized in Table 2-9 below. As there is no list of establishments in NYS that have conducted remodeling or upgrades to energy-related equipment, the screener survey was used to identify eligible respondents for the end user survey and to estimate the remodeling rate.

Table 2-9. Screener Survey Population and Survey Completions

Stratum	Sector	Source of Sample Frame	Number Screened	Number Eligible for Any Study Component	Estimated Population
1	Colleges	Institute of Education Sciences (IES) – Integrated Postsecondary Education Data System (IPEDS)	76	49	379
2	K-12 schools	New York State Education Department, National Center for Education Statistics	77	43	2,571
3	Manufacturing	Manufacturers' News, Inc.	213	119	9,962
4	Local government	FOIL – Office of the State Comptroller	201	90	1,461
5	D&B manufacturing	Dun & Bradstreet	92	49	3,629
6	D&B commercial	Dun & Bradstreet	1,364	665	120,583
7	D&B government	Dun & Bradstreet	25	13	800
8	D&B hospitality	Dun & Bradstreet	218	115	6,392
9	D&B health care	Dun & Bradstreet	312	112	14,196
Total			**2,578**	**1,255**	**159,973**

[32] As mentioned earlier in this report, New York is used to refer to the NYSERDA territory which is New York excluding Long Island. NYSERDA's survey contractor removed establishments in Long Island from the sample frame lists as part of developing these for this study. They also removed duplicates so the establishment counts would be correct and the survey calls would be appropriate.

[33] The sample frame lists were the list of establishments from D&B and smaller supplemental lists to improve coverage where D&B was weak. These included colleges and universities, elementary and secondary education, and local government and manufacturing. Each had establishment size categories but only the D&B list and the manufacturing list had employment size categories. The colleges and universities and elementary and secondary education had size categories by number of students and the local government had size categories by size of the town (population).

2.5.2 Sampling Weights for the New York End User Survey Enhanced Self-Report Respondents

The population of NYS remodelers was estimated based on the percentage of those in the screener survey that made upgrades during the period of 2007 to 2010 to any one of the eight energy-related end uses. The relative weights were adjusted for nonresponse by comparing the quotas (based on population totals) to the survey completions by sector. Table 2-10 provides the population with respect to these calculations as well as the associated completion rates.

Table 2-10. New York End User Survey Enhanced Self-Report Population and Survey Completions

Stratum	Establishment Type	Completions	Population
1	Manufacturing	49	952
2	Colleges	2	2
3	K-12	9	53
4	Government	9	26
5	Health care	43	1,309
6	Lodging	11	136
7	Religious & member organizations	46	971
8	Agriculture, extraction, construction	17	1,069
9	Services	154	12,685
10	Transportation, commodities, utilities	21	368
11	Wholesale	37	635
12	Retail	103	5,458
Total		**501**	**23,661**

2.5.3 Sampling Weights for the New York End User Survey High Bay Lighting Respondents

The population of HBL participants was estimated based on the percentage of screener survey respondents who indicated that they were a participant in the HBL market in the 2007 to 2010 time period. This rate of participation in the HBL market was calculated by sector as the percentage of end users with high bay spaces and was expected to vary by sector, which was shown to be the case. The highest HBL market participation rates over the four-year period consisted of 21% in retail, 20% in services, and 15% of the manufacturers. The lowest HBL market participation rates were 0% for colleges and universities and 1% for government. The sector HBL participation rate was applied to the population of establishments by sector to calculate the HBL market population.

Table 2-13 provides the calculated population as well as the number of completed surveys. The relative weights were adjusted for nonresponse by comparing the quotas (based on population totals) to the survey completions by sector.

Table 2-11: New York End User Survey High Bay Lighting Population and Survey Completions

Stratum	Establishment Type	Completions	Estimated Population
1	Manufacturing	26	1,999
2	Colleges	1	1
3	K-12	3	53
4	Government	1	27
5	Health care	2	360
6	Lodging	2	183
7	Religious & member organizations	10	997
8	Agriculture, extraction, construction	3	720
9	Services	28	8,992
10	Transportation, commodities, utilities	12	534
11	Wholesale	28	1,215
12	Retail	29	5,733
Total		**145**	**20,815**

2.5.4 Sampling Weights for the New York Contractors

Two sets of weights were constructed for NYS contractors, one set was for use with the ESR analysis and the other for the cross-state as not all lighting contractors interviewed were part of the HBL market. Consequently, the number of lighting contractor completions is different for the two groups with 84 lighting contractor interviews available for the ESR analyses and 70 available for the cross-state analysis.

Contractors were sampled by the three groups targeted for the ESR study and by size as measured by number of employees. As discussed earlier, firms with less than 5 employees were not interviewed enabling this comparison HBL study to be consistent with prior HBL comparison studies.

Table 2-12 provides the total population and survey completions by contractor group and firm size.

Table 2-12. New York State ESR Contractor Population and Completions

Firm Size by Number of Employees	Lighting[1]		HVAC[1]		Other[1]	
	Population	Survey Completions	Population	Survey Completions	Population	Survey Completions
5 to 20	546	26	1,337	34	849	26
21 to 50	117	16	244	18	181	16
51 to 100	40	12	55	9	59	11
101 +	29	17	30	9	47	17
Total	**732**	**70**	**1,666**	**70**	**1,136**	**70**

[1] Contractor firms located in NYS that conduct projects in areas of New York outside of Long Island.

The NYS contractor weights for the ESR study are the relative weights adjusted for nonresponse by comparing the quotas (targets) to the survey completions as shown in Table 2-6.

There were no targets by firm size for HBL lighting contractors, so it was not possible to adjust for nonresponse. More importantly, the sample frame of NYS HBL contractors was not determined by a list count but through the survey question on whether the lighting contractor had HBL projects. The percentage of lighting contractors that have HBL projects by firm size was used to estimate the HBL population by firm size. This population estimate was used alongside the HBL survey completions by firm size to derive the NYS HBL contractor weights. The population and completions for the NYS HBL survey are provided in Table 2-13.

Table 2-13. New York State High Bay Lighting Contractor Survey Completions

Stratum	Firm Size by Number of Employees	New York HBL Population[1]	New York HBL Survey Completions[1]
1	5-20 employees	432	34
2	21-50 employees	106	20
3	51-100 employees	36	8
4	100+ employees	23	8
Total		**597**	**70**

[1] Contractor firms located in New York that conduct projects in areas of New York

2.5.5 Sampling Weights for the Comparison Area End Users

The comparison area end user quotas were set by two-digit industry code as the number of HBL respondent completions achieved in the New York End User Survey. As discussed in Section 2.3.3, this was done to enable completion of these surveys at a bearable cost and allows the comparison area to better represent what NYS might have been like without program intervention, i.e., a HBL sector mix in the comparison area similar to that found in NYS. No sampling weights needed to be developed.

2.5.6 Sampling Weights for the Comparison Area Contractors

The comparison area contractor survey is only used in the comparison area study so only one set of sampling weights is required. There were 72 completions for this survey and the breakdown by firm size is provided in Table 2-14.

Table 2-14. Comparison Area HBL Contractor Population and Survey Completions

Stratum	Firm Size by Number of Employees	Comparison Area[1] HBL Population	Comparison Area[1] HBL Survey Completions
1	5-20 employees	189	43
2	21-50 employees	76	16
3	51-100 employees	41	7
4	100+ employees	19	6
Total		**325**	**72**

[1] The comparison area includes South Carolina, Georgia, Alabama, and Mississippi.

As is the case for the New York lighting contractors, a list of comparison area lighting contractors by firm size was used in the sampling. For the comparison area, contractor interviews were only conducted for HBL contractors as identified by the response to the screener question. Consequently, the comparison area HBL

contractor population estimates by firm size are derived by using the comparison area lighting contractor population by firm size and multiplying by the eligibility rate by firm from the survey. [34]

[34] The eligibility rates for the comparison area lighting contractors to obtain HBL lighting contractors by employment size are as follows: 5-20 employees: 0.297; 21-50: 0.457; 51-100: 0.808; and over 100: 0.692.

Section 3: NEW YORK COMMERCIAL AND INDUSTRIAL REMODELING MARKET

This section provides an overview of some of the key characteristics of Commercial and Industrial (C&I) remodeling and its impacts on energy consumption as ascertained through the telephone surveys of participating and nonparticipating NYSERDA program end users and contractors. These results were used to identify New York State (NYS) population characteristics required for the nonparticipant spillover (NPSO) estimate or the market effect estimate and to create sampling weights to represent the overall population.

Data reported in this section was collected through the screener survey as well as the survey conducted as part of the enhanced self-report (ESR) study. All of the analysis and reporting in this section covers NYS only and the results were weighted by the appropriate sampling weights described in the previous section.

The purpose of this analysis is to provide market and decision-making information to program planners and implementers and for market analysis. The key components discussed in this section were used to calculate the ESR NPSO rate and the market effects estimate identified in the subsections that provide those calculations. This section covers some key findings from the New York End User Screener Survey and ESR survey results. The final subsection includes a discussion of assessing the validity of end user responses on lighting technologies.

3.1 SCREENER SURVEY RESULTS

With 2,578 completions, the screener survey provided some comprehensive information about the C&I existing facilities market. Some of the key findings are the distribution of facilities by sector, the size of C&I existing facilities sector, the remodeling rate, and NYSERDA program participation. The distribution of facilities was used to develop the weights used in the ESR and cross-state end user surveys. The size of the facilities and remodeling rate was used in the NPSO calculations.

3.1.1 Distribution of C&I Existing Facilities by Sector

The majority of surveyed C&I facilities fell into three sectors: services, retail trade, and health care. Services represented 28% of respondents while retail trade and healthcare represented 18% and 13%, respectively. The overall distribution of all facilities in the NYSERDA territory by sector is provided in Table 3-1.

Table 3-1. Sector Distribution of New York State Commercial and Industrial Facilities

Sector	Weighted Number of New York End User Screener Survey Respondents[1] (n=2,578)	Percentage of Respondents[2]
Manufacturing	181	7%
Colleges	7	0%
Elementary and secondary schools	46	2%
Government	26	1%
Health care	329	13%
Lodging	54	2%
Religious and member organizations	213	8%
Agriculture, extraction, construction	243	9%
Services	725	28%

Sector	Weighted Number of New York End User Screener Survey Respondents[1] (n=2,578)	Percentage of Respondents[2]
Transportation, communication and utilities	124	5%
Wholesale trade	168	7%
Retail trade	462	18%
Totals	2,578	100%

[1] New York excluding Long Island.

[2] These results are weighted to the population using the weights discussed in Section 2. Responses of "don't know" or "refused" were excluded.

3.1.2 Size of C&I Facilities

As part of the screener survey, respondents were asked to identify the area occupied by their organization in the facility. The total area of the population was derived by multiplying the weighted average area of all facilities in the survey by the number of establishments in the population. This calculation, as outlined below in Table 3-2, provided an estimated total area of 8,386 million square feet. This number is a key input into the derivation of the NPSO estimate from the ESR study.

Table 3-2. Total Area of New York State Commercial and Industrial Facilities[35]

	Weighted Number of Screener Survey Respondents[1] (n=2,578)	Calculation
Area of facility in use by survey respondent	1,779a	53,497 weighted average area per facility (sq ft)[2]
Number of NYS C&I establishments[2]		145,806
Total area of NYS C&I facilities ($Row\ 1\ \times\ Row\ 2$)		7,800,161,721 sq ft

[1] New York excluding Long Island.

[2] A total of 2,567 screening surveys were completed, but only 1,779 participants provided an estimate of the area of the space. Responses of "don't know" or "refused" were excluded and weights were adjusted within the strata to reflect only the respondents with valid answers.

The average and median area by sector are presented in Table 3-3. The sector with the smallest facilities is agriculture, extraction, and construction at approximately 11,000 square feet. The largest facilities are found in the colleges sector at an average of almost 900,000 square feet. While manufacturing facilities comprise the second largest industry sector, averaging 116,000 square feet, they are far smaller than the colleges sector, in which facilities average seven times larger.

By comparing the mean and median square feet per facility, insight can be gathered regarding the underlying distribution of a sector. In some cases, a large margin will exist between the median and a significantly higher mean. This would suggest that a few large facilities are affecting the mean facility

[35] Facilities identified as having fewer than five employees in the D&B database were excluded from this analysis.

size of the sector. The three sectors with the most uniform size are elementary and secondary schools, colleges, and retail.

As seen in Table 3-3, the greatest diversity by far is in health care. The results are most likely reflective of the differences in types of health care venues, from many small doctors' offices to a few hospitals, most of which would be large or very large.

Table 3-3. Size of New York State Commercial and Industrial Facilities by Sector

Sector	Weighted Number of Survey Respondents[1] (n=2,578)	Area per Facility (sq ft)[2]	
		Average	Median
Manufacturing	133	116,193	16,000
Colleges	6	882,811	760,000
Elementary and secondary schools	41	106,144	98,000
Government	15	15,363	5,000
Health care	168	85,512	4,000
Lodging	27	61,773	30,000
Religious and member organizations	106	37,685	10,000
Agriculture, extraction, construction	160	11,218	3,500
Services	506	78,647	5,000
Transportation, communication, and utilities	78	42,057	10,000
Wholesale trade	132	23,949	10,000
Retail trade	347	16,131	5,000
"Don't know"	133	-	
"Refused"	6	-	

[1] New York excluding Long Island.

[2] Sampling weights were applied, as described in Section 2. Percentages exclude responses of "don't know" or "refused."

3.1.3 Remodeling Rates

The remodeling rate among all screener survey respondents (including participants) is very close to the remodeling rate of nonparticipants, at 57% and 54%, respectively. The survey questions covered the time period of 2007 to 2010, and the annual remodeling rate was approximated by dividing these rates by 4, as provided in Table 3-4.

Table 3-4. Remodeling Incidence Rate

At Least One Energy-Related Remodeling Project	Weighted Number of Survey Respondents[1] (n=2,578)	Remodeling Incidence Rate[2]

Overall during the period of 2007 to 2010	1,467	57%
Annual remodeling incidence rate	1,467	14%a

[1] New York excluding Long Island. Sampling weights were applied, as described in Section 2.

[2] The respondents that said "other" provided more information on their participation. These responses are provided as Appendix H.

As previously mentioned, one of the primary purposes of the screener survey was to develop a sample frame of NYS end users that remodeled or installed energy related upgrades within the 2007 to 2010 time frame. Table 3-5 provides an overview of the remodeling rate. Just under half of the screener survey respondents, 45%, did not conduct any energy related remodeling projects during the four years. Of those who conducted a remodeling project, 60% completed one project and 40% finished multiple projects.

Table 3-5. Energy-Related Remodeling Projects Completed from 2007 to 2010

Nonparticipant Remodeling Projects	Number of Survey Respondents[1] (n=2,578)	Percentage of Respondents with Remodeling Projects
None	742	45%
At least one type of remodel	900	55%
One or Multiple Projects in 2007–2010 Period		
One project	475	60%
Multiple projects	314	40%

[1] Sampling weights were applied. "Don't know" and "refused" were excluded from the percentage. Multiple responses were allowed, i.e., respondents could report updates in more than one project type.

The remodeling incidence rate by project type is provided in

Table 3-6. Both the rate over the entire four-year period and the estimated annual remodeling rate are presented. The highest remodeling rate is for lighting at 18% per year for all respondents and 17% for nonparticipants. The second highest incident rate is for heating, ventilation and air conditioning (HVAC) upgrades. The differences in the remodeling rates for all respondents and for nonparticipants are very small across all the project types.

The incident rates do not take into account how many establishments are eligible for this type of upgrade. Thus, low incidence rates may primarily be due to the limited applicability of particular types of upgrades. For example, almost all facilities have lighting and HVAC systems, so the high incidence rates may be partially explained by the fact that these types of upgrades apply to almost all establishments. In contrast, the low incidence rates for motors and industrial processes could be significantly driven by the fact that few establishments have motor systems or industrial processes.

Table 3-6. Remodeling Incidence Rate by Type of Project

Energy-Related Remodeling Project Type	Remodeling Incidence Rate[1] (n=2,578)	
	Overall from 2007 to 2010	Annual Rate
Building shell or envelope	32%	8%
HVAC systems	44%	11%

Energy-Related Remodeling Project Type	Remodeling Incidence Rate[1] (n=2,578)	
	Overall from 2007 to 2010	Annual Rate
Lighting	72%	18%
Motors and drives	13%	3%
Building controls (such as energy management systems)	28%	7%
Hot water heating systems	26%	7%
Industrial processes	3%	1%
Combined heat and power (CHP) system	7%	2%

[1] Sampling weights were applied. "Don't know" and "refused" were excluded from the percentage. Multiple responses were allowed, i.e., respondents could report updates in more than one project type.

3.1.4 NYSERDA Participation

One goal of the screener survey was to identify respondents who had participated in any NYSERDA program since 2007 as these respondents were excluded from the ESR survey. In general, the survey questions were worded to inquire about activity at the particular location. However, the participation question specifically asked about any participation in a NYSERDA program by the company, regardless of the location. This approach was taken to ensure that participants were correctly identified and that NPSO could be separated from participant spillover (SO). For example, if a company installed measures through a NYSERDA program at a different location and then, due to their experience with the program, decided to install the same measure at other facilities outside of the program, this activity would be considered participant SO.

Twenty-three percent of the respondents reported that their companies had participated in a NYSERDA program since 2007, as shown in Table 3-7.

Table 3-7. NYSERDA Program Participation by End Users

Respondent Had Participated in NYSERDA or New York Energy Smart Program Since 2007	Number of NYS Screener Survey Respondents[1] (n=2,578)	Percentage of Respondents Who Participated in a NYSERDA Program[2]
Yes	489	23%
No	1,675	77%
Don't know	385	
Refused	29	
Total	2,578	

[1] New York excluding Long Island.

[2] Sampling weights were applied, as discussed in Section 2. The percentages were calculated excluding the "don't know" and "refused" responses.

Program participation by sector was analyzed in two ways: (1) the percentage of participating respondents by sector in relation to the total number of participating respondents and (2) the penetration of participating respondents within each sector. The first part of the analysis showed that 43% of the participating respondents were either retail or service establishments. As shown in Table 3-8, health care and manufacturing account for another 22% of the self-reported participants.

The highest penetration of program participation is within the college sector, with 41% of the respondents in this sector reporting that they participated in a NYSERDA program. The second highest penetration is within the government sector at 40% penetration. The sector with the lowest penetration rates is lodging at 17%.

Table 3-8. Participation and Penetration of Participation by Sector

Sector	Weighted Number of Respondents Reporting NYSERDA Participation[1] (n=2,578)	Proportion of All Participating Respondents[2]	Penetration of Participating Respondents within the Sector[3]
Manufacturing	48	10%	31%
Colleges	2	0%	41%
Elementary and secondary schools	12	3%	30%
Government	10	2%	40%
Health care	58	12%	22%
Lodging	7	1%	17%
Religious and member organizations	41	8%	22%
Agriculture, extraction, construction	42	9%	19%
Services	123	25%	20%
Transportation, communication and utilities	21	4%	21%
Wholesale trade	37	8%	26%
Retail trade	88	18%	23%
Total	**489**	**100%**	

[1] Sampling weights were applied, as described in Section 2. Responses of "don't know" or "refused" were excluded from the calculations of the percentages.

[2] This column is the percentage of all respondents that participated in a NYSERDA program. For example, 18% of all participating respondents were retail establishments.

[3] This column is the percentage of the respondents in the sector that reported participating in a NYSERDA program. For example, 31% of the manufacturing respondents reported that they had participated in a NYSERDA program. The overall penetration is given in the prior table: 23%.

Larger facilities are more likely to participate in NYSERDA's programs, as demonstrated by comparing the average area per facility for all respondents and for participant respondents. On average, NYSERDA participants reside in facilities over two times as large as the average of all respondents. These results are presented in Table 3-9.

Table 3-9. Comparison of Facility Size for All Respondents and NYSERDA Participants

	Number of Survey Respondents[1,2] (n=2,578)	Area per Facility (sq ft)	
		Average	Median
Overall respondents	1,779	57,514	6,000
Respondents who reported participating in a NYSERDA program	538	135,445	15,000

[1] New York excluding Long Island.

[2] Sampling weights were applied, as described in Section 2. Responses of "don't know" or "refused" were excluded from the calculations of the percentages.

NYSERDA participants were asked to identify which NYSERDA program they used. The program with the highest self-reported participation was NYSERDA's largest program, the Existing Facilities Program (EFP), with 27% stating their firm participated in this program. FlexTech had the second highest level of participation with 13%, with the New Construction Program at 5%, and the Business Partners at 1%. About one-third of participants (35%) reported they did not know the name of the NYSERDA program in which they participated. Table 3-10 presents the number and percentages of survey respondents.

Table 3-10. Respondents Reporting Participation in Specific NYSERDA Programs

	Number of Survey Respondents[1] (n=2,578)	Percentage of Respondents Who Participated in the NYSERDA Program[2]
FlexTech/ Flexible Technical Assistance	65	13%
New Construction Program	24	5%
Existing Facilities Program	134	27%
Business Partners	6	1%
Other[3]	137	28%
"Don't know"	197	35%

[1] New York excluding Long Island. Sampling weights were applied, as described in Section 2.

[2] Multiple responses were allowed, so the percentages do not add to 100%.

[3] The respondents that said "other" provided more information on their participation. These responses are provided in Appendix H.

3.2 ENHANCED SELF-REPORT SURVEY RESULTS

The purpose of the ESR survey was to gather more detailed information pertaining to NYS nonparticipants than could be addressed in the screener survey. Using this survey, information pertaining to remodeling project types, existing equipment, and the decision-making process of the firm were collected on a more granular level.

3.2.1 Distribution of Project Types

Table 3-11 represents the mix of project types completed by nonparticipating end users. Overall, 70% of nonparticipating remodelers remodeled only one project type from 2007 to 2010, although they may have completed multiple remodeling projects within that project type. The other 30% had more than one type of remodeling project within the four-year period. As can be seen in Table 3-11, there were 64

respondents whose only remodeling project was a lighting project, 38 respondents who installed only HVAC measures, and 9 who installed both HVAC and lighting measures.

The most common combinations of remodeling projects, excluding lighting, are project types that are interactive and those closely related in terms of work to be conducted. These include the combination of building controls and HVAC, building shell and HVAC, CHP and HVAC or CHP and building controls, and water heating systems and HVAC.

Table 3-11. Remodeling by Mix of Project Types

NYS End Users with One or More Retrofit Projects by Type[1]	Only One Project Type	And at Least One Project with . . .[2]						
		Lighting	HVAC	Building Shell	Motors and Drives	Building Control	Water Heating Systems	Industrial Process
Lighting	64							
HVAC systems	38	9						
Building shell or envelope	25	7	5					
Motors and drives	2	5	2	2				
Building controls	8	7	11	3	1			
Water heating systems	26	2	10	1	1	0		
Industrial process	0	0	0	0	5	0	0	
Combined heat and power (CHP) system	7	1	4	1	0	4	1	0

[1]Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

[2] The shaded boxes in the body of the table indicate that the cell is left blank intentionally.

3.2.2 Condition and Age of Replaced Equipment and Reason for Replacement

Respondents were asked to expand and provide more detail regarding the decision-making process of two of their remodeling project types. For lighting, HVAC, motors and drives, and water heating system projects inquiries were made requesting that the condition of the equipment that be categorized as either good, fair, poor, or not working. Lighting projects had the highest percentage – almost 50% – of replaced equipment that was in good condition. The lowest replacement of equipment in good condition occurred in HVAC and motors and drives projects. The distribution of the condition of equipment replaced for these four types of projects is shown in

Table 3-12. Condition of Equipment Replaced

	Lighting Projects[1] (n=276)	HVAC Projects[1] (n=116)	Motors and Drive Projects[1] (n=37)	Water Heating Projects[1] (n=76)
Good condition	49%	15%	15%	23%
Fair condition	35%	26%	37%	21%
Poor condition	12%	32%	29%	25%
Not working	4%	27%	19%	31%
Total	100%	100%	100%	100%

[1]Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

Along with identifying the condition of the existing equipment, respondents were asked an open-ended question concerning the reason for equipment replacement for these same four project types. The responses to this question were reviewed and categorized by evaluators into nine categories and an "other" category. The results of this analysis are provided in Table 3-13. Sixty-eight percent of lighting projects and 30% of the water heating projects were initiated to improve the efficiency of the equipment.

Table 3-13. Reasons for Equipment Replacement

	Lighting Projects[1] (n=276)	HVAC Projects[1] (n=116)	Motors and Drive Projects[1] (n=37)	Water Heating Projects[1] (n=76)
Equipment was inefficient/wanted to increase efficiency	68%	29%	25%	30%
Funds/ incentives/programs were available for new equipment	10%	0%	0%	2%
Appearance/functioning of equipment was not ideal	9%	3%	2%	1%
Wanted to add on or modify existing equipment	0%	2%	5%	3%
Part of larger renovation/retrofit project	7%	4%	8%	0%
Needed equipment of a different type	3%	5%	3%	4%
Equipment was old and would need to be replaced soon anyway	12%	37%	37%	40%
Equipment needed frequent maintenance	3%	6%	4%	3%
Other	3%	17%	11%	3%
Equipment not working and needed immediate replacement	1%	11%	12%	22%

[1] New York End User Survey respondents corresponding to the ESR components of the survey, specifically designed for the ESR study. Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused." When applicable multiple responses were recorded.

The other commonly cited reason for nonlighting remodeling projects is primarily aging equipment. Almost half of HVAC and motors and drives remodeling projects occurred due to aging equipment or equipment that was not working at all. For water heating systems this percentage is even higher at 62%.

While most respondents indicated that existing lighting was in good condition, over half of the lighting replaced was more than 15 years old, as can be seen in

Table 3-14. These results indicate that fixtures are being replaced at a much higher rate than they are aging.

Table 3-14. Age of Lighting Equipment Replaced in a Lighting Retrofit Project

	Weighted Number of Respondents[1] (n=501)	Percentage of Respondents[1]
Less than 5 years old	16	9%
Between 5 and 10 years old	31	18%
Between 10 and 15 years old	33	19%
More than 15 years old	94	54%
Total	**174**	**100%**

[1]Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

3.3 ASSESSING THE VALIDITY OF END USERS' RESPONSES REGARDING LIGHTING TECHNOLOGIES

Obtaining technical information through telephone surveys can be difficult. Respondents may not understand the question or know how to answer it. One way to assess the validity of responses is to analyze the percentage of respondents who provided valid answers. Comparing the rate of refusals or "don't know" answers using questions that can easily be answered as a baseline can help to identify the types of information that can be reliably obtained through self-reports. For example, one of the easier survey questions was whether the facility had made changes to its lighting systems during the period of 2007 to 2010. For this particular question, only 1% of respondents did not provide a valid response.

As the sample size was so high for the end user screener survey, it was possible to review the survey responses to assess the validity of the answers to the technical lighting questions. As would be expected, a relationship seems to exist between the level of specificity of the question and the number of valid responses. As seen is Table 3-15, as the specificity of a question increases, the number of respondents with invalid answers also increases.

Table 3-15. End Users' Ability to Provide Estimates of Square Footage and Cost

Survey Question – (Valid responses)	Number of Respondents with a Valid Response[1]	Number Answering "Don't Know"	Weighted Percentage Answering "Don't Know"
Validity Comparison			

Did your facility make energy-related changes to the facility's lighting during the period of 2007 to 2010? (yes, no)	498	3	1%
Square Footage and Project Costs			
How many square feet of space does your organization occupy in this facility? (record number)	468	33	7%
Approximately how many square feet did your retrofit project affect?	418	83	18%
What were the approximate costs of this retrofit project? (Eight categories with 1 being "below $5,000" and 8 being "$500,000 or more")	437	64	15%

[1]Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study.

This relationship between the level of specificity and the ability of end users to provide accurate information becomes particularly problematic when applied to the lighting technologies. When end users were asked a general question pertaining to the type of lighting equipment that was installed, the number of respondents answering that they didn't know was relatively low at 5%. However, when end users were asked more specific questions pertaining to fixture types the percentage of end users who could not identify the technologies increased dramatically to a range of 23% to 57%.

In the case of lighting technologies, evaluators were seeking high levels of specificity. For example, identifying a high efficiency high intensity discharge (HID) fixture requires the knowledge that a pulse start metal halide is not as efficient as a pulse start ceramic metal halide as well as the ability to visually differentiate between the two. The level of expertise required to answer this question could likely be correlated to the large percentage of respondents who responded that they did not know the answer (see Table 3-16).

Table 3-16. New York End Users' Knowledge of Lighting Technologies

Survey Question	Level of Detail in the Inquiry	Number of with a Valid Response[1,2]	Number Answering "Don't Know"	Weighted Percentage Answering "Don't Know"
Overall Lighting Type				
What type or types of lighting equipment did you install?	1. High intensity discharge lamps 2. Fluorescent tube fixtures 3. Compact fluorescent lamps 4. Incandescent fixtures	240	17	5%
HID				
What type of metal halide lighting did you install?	1. Probe start metal halide 2. Pulse start metal halide 3. Ceramic metal halide	4	6	57%
Fluorescent Fixture Type				
What type or types of fluorescent tube equipment did you install?	1. T12 2. T8 3. T5 4. Induction	212	78	27%
What type of T5 fluorescent lighting did you install?	1. Standard T5 2. T5 High Output	33	10	23%

Survey Question	Level of Detail in the Inquiry	Number of with a Valid Response[1,2]	Number Answering "Don't Know"	Weighted Percentage Answering "Don't Know"
What type of T8 fluorescent lighting did you install?	1. Standard T8 2. High performance or "Super" T8s	66	39	37%

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study.

[2] Invalid responses can include "don't know," and "refused."

The ability to draw reliable conclusions becomes increasingly compromised as the information received from end users becomes less accurate. Respondents may either provide inaccurate information or refuse to answer. The high level of end users refusing to answer some questions suggests that respondents are willing to admit when they are unable to provide a reliable response. However, this could also suggest that the survey results may include a high level of invalid answers to the technical questions about lighting technologies.

The ground level question is whether this inability to provide technical detailed responses creates bias in the study results. Bias is created if there is a connection between the ability to answer the question and the key variables being collected. If, for example, more knowledgeable end users are also more likely to install high efficiency lighting, then bias could be introduced. However, it is equally likely that some end users were not involved in the selection of the lighting products and lack of knowledge about the lighting technology is not related to the presence of high efficiency equipment.

If evaluators conclude that there is no such connection and the error is random, then the obvious solution is to increase the sample size to obtain a sufficient number of valid responses. More research is needed to investigate this issue.

Section 4: **RESULTS FROM THE ENHANCED SELF-REPORT SURVEYS**

4.1 INTRODUCTION

The primary purpose of this evaluation is to estimate the nonparticipant spillover (NPSO) generated by NYSERDA's Commercial and Industrial (C&I) programs in the existing facilities market during the analysis period of 2007 to 2010. In the existing facilities segment of the C&I market, NYSERDA has several efficiency programs designed to work with a variety of midstream market actors (e.g., vendors, energy service companies, project developers) and end-use customers.[36] This chapter presents estimates of the NPSO savings that can be attributed to the multiple NYSERDA programs operating in the C&I market prior to and during the period of 2007 to 2010.

The study investigated aspects of the market that affect energy efficiency upgrades during the years of 2007 to 2010, including the following:

- End user decision-making with respect to energy related facility investments
- End user interactions with contractors and acceptance of contractor's recommendations
- Contractor's recommendation of high efficiency equipment
- NYSERDA influence on end users' and contractors' decisions to install high efficiency equipment

Section 4.2 provides a description of the methods use in calculating the estimate of NPSO. Sections 4.3 and 4.4 cover information about end user decision-making, the contractors' role, and NYSERDA's influence in the New York State (NYS) C&I remodeling market to support the estimation of the NPSO rate and provide additional information that may be useful for program planning purposes. The derivation of the NPSO estimates are provided in Section 4.5 followed by a discussion of the uncertainty associated with the estimates.

4.2 METHODS

NYSERDA's previous NPSO estimates were based only on survey results from end users due to concerns about double counting spillover (SO) savings. However, since NYSERDA programs also influence midmarket actors, such as vendors and contractors, who may be invisible to the end user, this approach may also tend to underestimate actual SO savings.

NPSO savings can be defined as the combination of the NYSERDA influence level, the savings per unit (kWh per square foot), and the quantity (nonparticipant remodeled C&I area in square feet), as shown in the equation given below.

Equation 4-1. General Equation to Estimate Nonparticipant Spillover

$$kWh_{NPSO} = I_{NYSERDA} \times \frac{kWh}{sq\ ft} \times C\&I\ area_{NP\ remodel}$$

where,

kWh_{NPSO} represents the NPSO kWh savings per year

[36] The group of SBC-funded C&I programs designed to address the existing facilities market includes: The Existing Facilities Program (a combination of the former Commercial/Industrial Performance, Smart Equipment Choices and Peak Load Management programs), the Flex Tech/Technical Assistance Program, the Loan Fund Program, the Business Partners Program, the Energy Smart Focus Program and the Distributed Generation/Combined Heat and Power Program.

$I_{NYSERDA}$ is the NYSERDA influence factor, reflecting the percentage of the remodeled C&I area with high efficiency installations influenced by NYSERDA

$\frac{kWh}{sq\ ft}$ is the estimated average kWh savings per square foot for the C&I nonparticipating projects

$C\&I\ area_{NP\ remodel}$ is the total area of remodeled C&I space from nonparticipating end users

The NPSO savings in this evaluation were calculated from two market perspectives:

1. The direct NPSO savings are derived from end users survey responses.
2. The indirect NPSO savings are generated through NYSERDA's involvement with contractors providing services to the end users.

The total estimated NPSO kWh saved is the combination of the two.

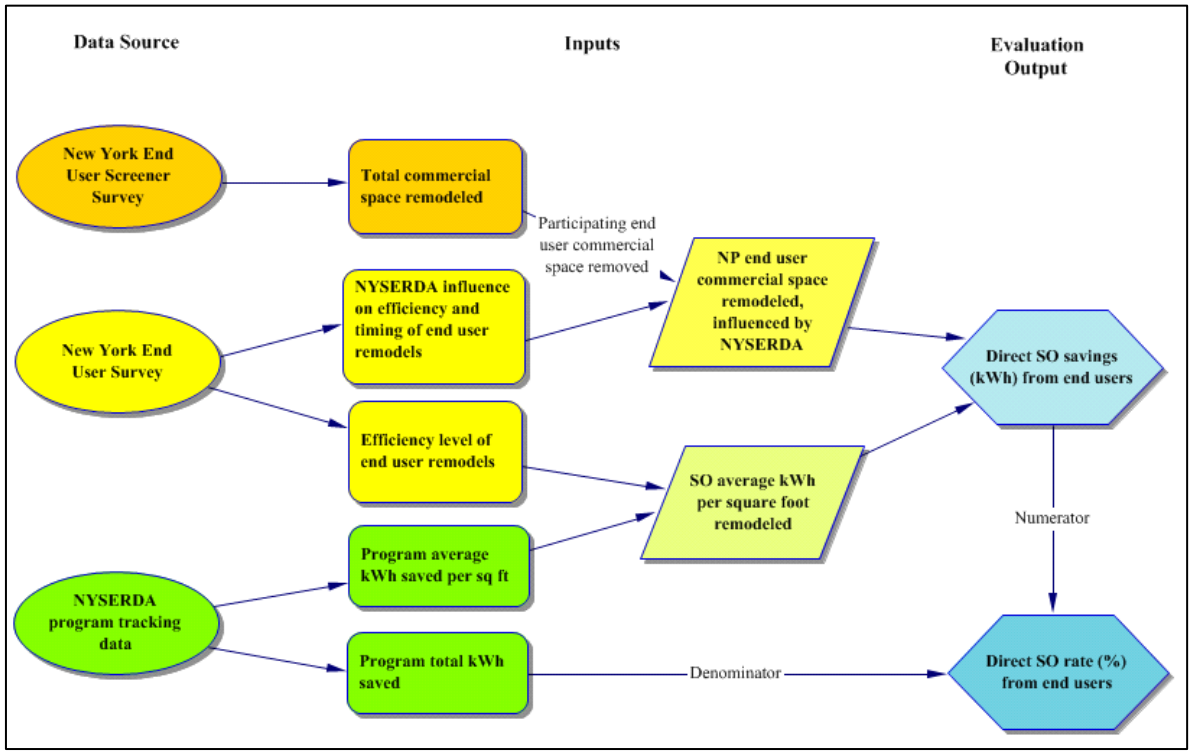
The energy-related equipment, end uses, and markets examined in this study include the following:[37]

- Building shell or envelope (such as adding insulation, replacing windows or adding a cool roof)
- Heating, ventilation and air conditioning (HVAC) systems (such as replacing the air conditioning or heating systems)
- Lighting
- Motors and drives
- Building controls (such as energy management systems)
- Water heating systems
- Industrial processes
- Combined heat and power (CHP) system

The data sources, inputs, and evaluation output for the direct end user NPSO is shown in Figure 4-1. Figure 4-2 provides the same information for the contractor NPSO. The calculations are described further in Section 4.5 below.

[37] This is also the energy-related equipment that constituted most of the savings in NYSERDA's C&I programs for existing buildings.

Figure 4-1. Deriving the ESR Direct End User Spillover Savings

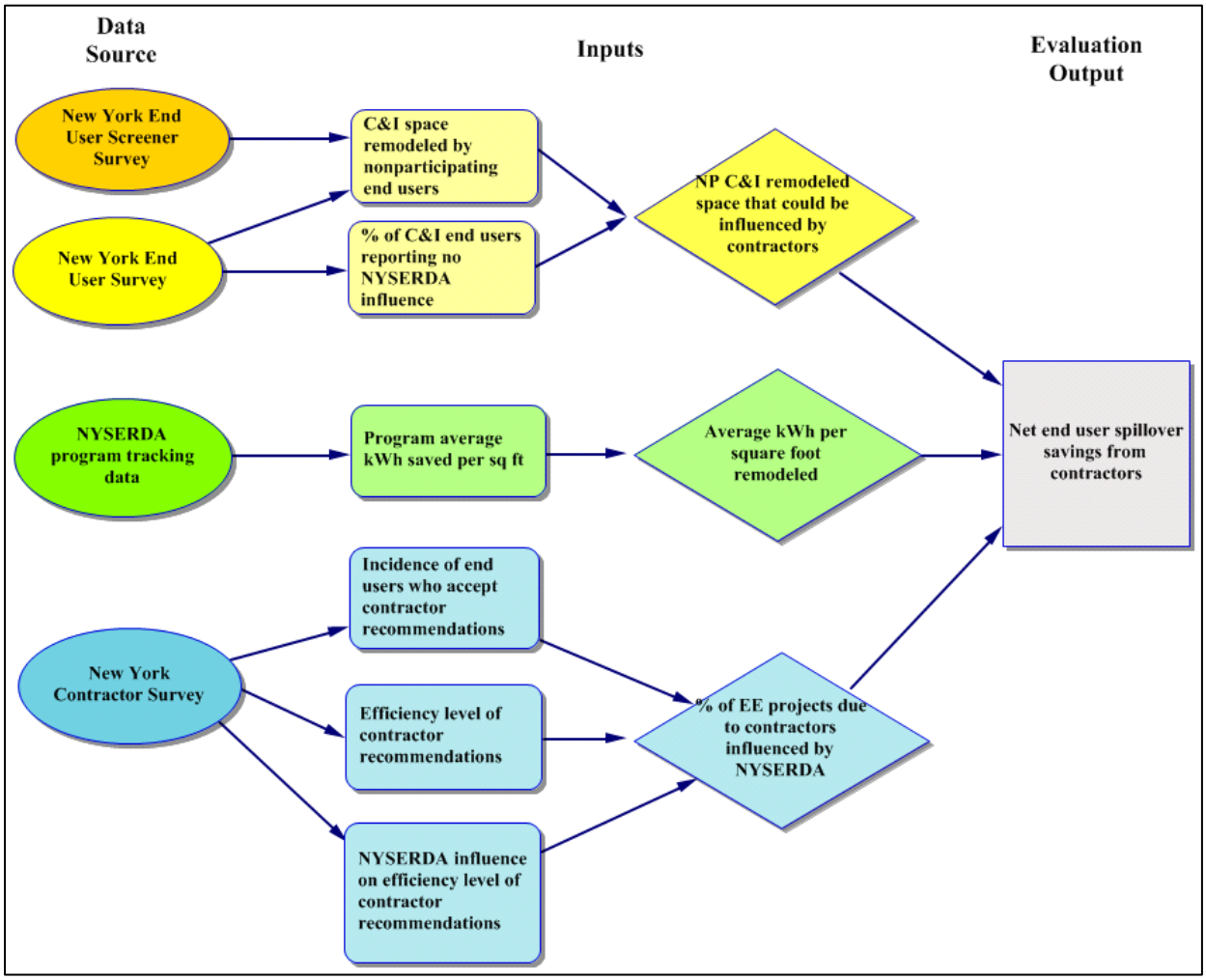


The starting point for calculating the indirect NPSO is the eligible remodeled C&I area (square footage). These savings are considered indirect NPSO savings as they are generated by the interaction between the end user and NYSERDA-influenced contractors, but not necessarily noticed as a program influence by nonparticipating end users. The top rows in Figure 4-2 illustrate the removal of the end user sites where direct NPSO was identified.

The decision-making that creates the indirect NPSO through contractors is represented as the last group of row(s) in Figure 4-2. Three inputs from the decision-making process are required to derive the indirect NPSO, as described below:

1. The percentage of end users who accept high efficiency measures or systems based on the contractor's recommendations
2. The percentage of recommendations by the contractor for high efficiency equipment or systems
3. NYSERDA influence on the contractors decision to recommend high efficiency equipment or systems

Figure 4-2. Deriving ESR Indirect Spillover Savings through Contractors



4.3 DECISION-MAKING AMONG NONPARTICIPATING NEW YORK END USERS

The findings regarding the decision-making process by NYS C&I end users who engaged in remodeling activities are presented in this section. The findings include insight into the composition of the market and decision-making by market actors.

4.3.1 C&I Remodeling and Project Types

From 2007 to 2010, almost two-thirds of the ESR survey participants conducted a remodeling or upgrade in at least one of the eight energy-related project types.[38] Almost one-quarter of the respondents reported installing at least three types of remodeling projects and 3% of respondents completed six or more project types over the analysis period, as presented in Table 4-1.

[38] The end user screener survey was a better indicator of the entire population of C&I facilities, and the remodel rate from that survey is presented in Section 3.

Table 4-1. Number of Retrofit Project Types by End User

	Three or More Project Types	At Least Four Project Types	At Least Five Project Types	At Least Six Project Types
Weighted number of respondents (n=501)[1]	115	64	26	14
Percentage of respondents	23%	13%	5%	3%

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

These results suggest that nonparticipants are engaging in remodeling activities on a regular basis.

4.3.2 End User Decision-Making Process

This section covers two key aspects on the end user decision-making process: the impact of contractors or other outside professional and the role of corporate energy efficiency policies and practices. These topics are discussed more fully below.

Role of Contractors and Outside Professionals

As shown in Table 4-2, end users most often used parties outside of their firm to specify the equipment or provide them with equipment recommendations. The use of outside sources ranged from a high of 75% for HVAC upgrades to 52% for industrial-process upgrades.[39] Overall, end users reported that this group exerted a great deal of influence on most energy-related projects, with 55% of end users with lighting projects reporting a high level of influence by the outside professionals. The lowest level of influence was found for motor and drive replacements and improvements, as only 31% of respondents credited the outside source as exerting a "great deal of influence."

[39] See the table in Appendix H for the type of professional that made the equipment recommendations by project type.

Table 4-2. Level of Influence of the Outside Source

Project Type	Weighted Number of End User Respondents with Project Type[1,2] (n=501)	Weighted Number of End User Respondents Using Outside Sources[1] (n=357)	Percentage of End User Respondents Using Outside Sources	Percentage of End User Respondents Who Reported the Outside Source was Highly Influential[3]
Building shell or envelope	67	44	65%	38%
HVAC systems	116	87	75%	55%
Lighting	276	200	73%	55%
Motors and drives	37	22	61%	31%
Building controls	64	38	59%	51%
Water heating systems	76	54	72%	48%
Industrial processes	9	5	52%	52%
CHP system	34	22	64%	43%

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

[2] End users may be represented in multiple categories if they completed multiple projects of different types, so the column does not add to the total sample size.

[3] This is the highest category of influence on a 1 to 4 scale.

These results are supported by the contractor survey.

Table 4-3 shows the degree of influence contractors had with respect to the specification of equipment. As shown in Table 4-3, contractors estimated that only 20% of their customers select the equipment and the remaining 80% are close to evenly split between taking the contractor's advice and requesting a recommendation for discussion.

Table 4-3. Contractor Roles in Assisting Customers

Customers Want the Contractor to . . .[1]	Percentage of Customers Estimated by NYS Contractors[2] (n=225)
Specify the equipment to install	46%
Make recommendation and discuss before installing	34%
Install the equipment selected by the customer	20%

[1] Contractors were asked to estimate the percentage of their customers who fall into each one of these three categories, with the total adding to 100%.

[2] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused" as only four respondents were unable to answer this question.

Energy Efficiency Policies and Practices

Contractors estimate that about 52% of their customers are aware of the full range of energy efficiency options. This result is consistent with the end user survey, which indicates that less than half (40%) of nonparticipating end users have energy use reduction goals and less than one-third (29%) have corporate

environmental or sustainability initiatives. Among those that do have corporate sustainability initiatives, most (90%) include energy management.

4.3.3 NYSERDA Influence on Nonparticipating End Users

NPSO is based on the premise that NYSERDA's programs are generating savings among nonparticipants. Consequently, it is useful to have a greater understanding of the mechanisms that promote the dissemination of information and encourage energy efficiency outside of the program. While this evaluation did not include a detailed review of the logic models and identification of causal mechanisms for NYSERDA's C&I programs, the end user survey included a series questions about the influence of NYSERDA's programs as perceived by the end user. As seen in Table 4-4, about 28% ranked their familiarity with NYSERDA at a 4 or 5 on the 5-point scale (with 5 the highest) and about one-third said they were not at all familiar with NYSERDA.

Table 4-4. Familiarity with NYSERDA Programs

		Not at All Familiar				Very Familiar
	Don't Know	**1**	**2**	**3**	**4**	**5**
Weighted number of NYS end user survey respondents (n=501)	1	170	91	98	73	68
Percentage of NYS end user survey respondents	0%	34%	18%	20%	15%	14%

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study.

[2] Respondents were asked to rate their familiarity on a five-point scale with 1 indicating "no familiarity at all" and 5 indicating "very familiar." Respondents answering "not at all familiar" are not asked any of the other influence questions in this section of the survey.

For those with at least some familiarity with the NYSERDA programs, respondents were asked an open-ended question to identify specific NYSERDA programs. These responses were placed in categories and are reported in Table 4-5. Most of the responses were general in nature, indicating low recognition of the specific NYSERDA programs by nonparticipating end users.

Table 4-5. Recognition of NYSERDA and Other Energy Efficiency Programs

	Weighted Percentage of NYS End User Respondents Familiar with NYSERDA Program[1,2] (n=240)
NYSERDA programs	
Flexible Technical Assistance (FlexTech) Program	3%
New Construction Program	3%
Existing Facilities Program	4%
Business Partners	9%
General or other NYSERDA program	14%
Utility company/utility program	8%
General program (No mention of NYSERDA or utility)	
Lighting program	28%

	Weighted Percentage of NYS End User Respondents Familiar with NYSERDA Program[1,2] (n=240)
Renewable energy program	7%
Gas/heating programs	5%
Audit programs	5%
Other energy efficiency programs	34%
Other	10%

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

[2] Multiple responses were allowed; percentages do not add to 100.

Respondents who showed familiarity with NYSERDA were asked whether the NYSERDA programs had any influence on the completion of their energy-related project.[40] The responses for the two main project types are presented below in Table 4-6.

Table 4-6. NYSERDA Influence on Efficiency Level of the Retrofit Measure

	Respondents Reporting No/Low Influence[1,2,3]		Respondents Reporting High Influence[1,2,4]	
Project Type	**Weighted Number of Respondents**	**% of Respondents with Project Type**	**Weighted Number of Respondents**	**% of Respondents with Project Type**
HVAC systems	108	93%	5	4%
Lighting[2]	225	82%	30	11%

[1] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused," as there were very few of these responses. Facilities on Long Island were excluded from the sample frame.

[2] End users were asked to rank NYSERDA's influence on a 1 to 5 scale, with 1 the lowest and 5 the highest.

[3] "No/low" influence indicates the end user selected "1," or "2" or reported that they were unaware of NYSERDA prior to the survey.

[4] "High" influence indicates the end user selected "4" or "5." The percentages will not add to 100% as end users who responded "3" were omitted from this table.

The end users were also asked about NYSERDA's influence on the timing of the project, specifically whether they had undertaken the project earlier than they otherwise would have. Overall, NYSERDA had little influence on the timing of the projects. End users with lighting projects account for the large majority of the timing influence.

Table provides more information about NYSERDA's influence on timing.

[40] This question referred to the specific project identified by the respondent and was asked for up to two project types.

Table 4-7. NYSERDA Influence on Timing

	Weighted Number of Respondents with NYSERDA Influence on Timing[1]	Years and Months Earlier	
		Mean[2]	Median[2]
Building shell or envelope	0	N/A	N/A
HVAC systems	3	1 year	1 year
Lighting	19	1 year 7 months	2 years
Motors and drives	0	N/A	N/A
Building controls	1	1 year 6 months	1 year 6 months
Water heating systems	0	N/A	N/A
Industrial processes	0	N/A	N/A
CHP system	1	2 years	2 years
Total	**24**		

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

[2] Some respondents indicated that NYSERDA had an influence on timing but were unable to specify how much earlier. These respondents were omitted from the estimate of the mean and median.

Summary of NYSERDA Influence

The responses to this series of questions provide preliminary information suggesting that NYSERDA's influences extend to nonparticipants in a variety of ways as summarized in Table 4-7 below. Almost a quarter of nonparticipants recognize that NYSERDA has had some level of influence on their actions.

Table 4-7. Summary of Types of NYSERDA Influence

Due to NYSERDA Activities, the End User . . .	Weighted Number of NYS End User Survey Respondents Who Indicated NYSERDA Influence[1] (n=501)	Percentage of NYS End Users[1,2]
Mentioned (unprompted) a specific NYSERDA program	71	14%
Implemented the project early	30	6%
Received financial assistance	26	6%
Had an assigned NYSERDA staff member	18	4%
Improved their awareness of efficient options	9	2%
Increased the efficiency of the projects	6	1%

Was motivated to implement project	5	1%
Received information/advice on projects	5	1%
None of the above	380	76%

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study and totals do not include respondents that indicated "don't know" or "refused."

[2] Respondents may be counted in more than one category and the percentages do not add to 100%. The "none of the above" category was calculated by subtracting the unique number of end users in the other categories from the total sample size.

4.4 NEW YORK CONTRACTORS AND ENERGY EFFICIENCY

The NYS contractor survey did not distinguish between participating and nonparticipating contractors, as participation occurs at the project level and contractors are likely to be engaged in a variety of projects, some of which may be enrolled in NYSERDA programs and others completed outside of the program.

Awareness and Participation in Energy Efficiency Programs

Table 4-8 shows that over one-third of NYS contractors are familiar or very familiar with NYSERDA. At the other end of the spectrum, 11% of contractors are not aware of or not at all familiar with NYSERDA.

Table 4-8. Contractor Awareness and Familiarity with NYSERDA Programs

		Not at All Familiar				Very Familiar
	No Awareness of NYSERDA	**1**	**2**	**3**	**4**	**5**
Weighted number of NYS contractor survey respondents[1] (n=225)	22	4	33	80	51	33
Percentage of respondents[2]	10%	2%	15%	36%	23%	15%

[1] Sampling weights were applied as described in Section 2. Contractors working primarily in Long Island were excluded from this study and totals do not include respondents who indicated "don't know" or "refused." The weighted count of participants who responded "don't know" or "refused" was 3.

[2] The percentages do not add to 100% due to rounding.

Fifty-nine percent of the NYS contractors had at least some NYSERDA participating projects during the four years of 2007 to 2010, as shown in Table 4-9. The contractors with NYSERDA projects reported that 28% of their projects on average went through a NYSERDA program.

Table 4-9. NYSERDA Participation among New York Contractors

	Weighted Number of NYS Contractor Survey Respondents[1] (n=225)	**Percentage of Respondents**	**Average Percentage of Contractor Projects Using NYSERDA Programs**
No awareness of NYSERDA	22	10%	0%
No NYSERDA participating projects	62	28%	0%
Had NYSERDA participating projects	121	54%	28%
Don't know/refused	26	12%	0%

Total	**225**	**100%**	

[1] Sampling weights were applied as described in Section 2. Contractors working primarily in Long Island were excluded from this study.

The survey also asked contractors on average how many projects they had with utility programs. Overall, the percentage of contractors working with utility programs and the percentage of their projects participating in utility programs is similar to NYSERDA's programs.

4.4.1 Contractor Influence on Energy Efficient Equipment Decisions

An overwhelming majority (86%) of the contractors reported that they recommend energy efficient equipment always or most of the time. Table 4-10 shows that only 8% of contractors rarely or never recommend energy efficient equipment.[41] In addition, contractors estimate that 68% of their energy efficient recommendations are either always or most of the time accepted by the customer.

Table 4-10. Frequency of Recommendations and Acceptance of Energy Efficient Equipment

	Never	Rarely	Sometimes	Most of the Time	Always
Contractors recommend energy efficient products[1]	4%	4%	6%	22%	64%
Customer accept energy efficiency recommendations[1]	0%	2%	30%	51%	17%

[1] Sampling weights were applied as described in Section 2. Contractors working primarily in Long Island were excluded from this study and totals do not include respondents who indicated "don't know" or "refused."

About half of the contractors stated that NYSERDA influenced the way they work. These contractors were asked about the NYSERDA's influence on four areas of their work. The responses are shown in Table 4-11.

Table 4-11. Influence of NYSERDA Programs on Contractors

	Respondents Reporting No/Low Influence[2,3]		Respondents Reporting High Influence[2,4]	
NYSERDA Influenced . . . [1]	**Weighted Number of Respondents**	**% of Respondents**	**Weighted Number of Respondents**	**% of Respondents**
Efficiency levels of equipment recommended to customers	133	59%	66	29%
How the benefits of energy efficient equipment are explained to customers	137	61%	58	26%
Methods or techniques used	149	67%	37	17%
Manufacturers and distributors to stock higher efficiency equipment	161	73%	42	19%

[1] Contractors were asked to rank NYSERDA's influence on a 1 to 5 scale, with 1 the lowest and 5 the highest.

[2] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused." Contractors were asked to exclude work done on Long Island.

[41] Contractors could be expected to have a definition of energy efficiency similar to NYSERDA's, particularly since 60% of contractors have had participating projects since 2007.

NYSERDA Influenced . . . [1]	Respondents Reporting No/Low Influence[2,3]		Respondents Reporting High Influence[2,4]	
	Weighted Number of Respondents	% of Respondents	Weighted Number of Respondents	% of Respondents

[3] "No/low" influence indicates the contractor selected "1," "2" or reported that they were unaware of NYSERDA prior to the survey.

[4] "High" influence indicates the contractor selected "4" or "5." The percentages will not add to 100% as contractors who responded "3" were omitted from this table.

Contractors who were aware of NYSERDA were asked an open-ended question about how NYSERDA affected their work. Table 4-12 presents the results placed into groups and ordered from positive to negative. Some of the key responses are discussed below.

- Thirteen percent of contractors stated NYSERDA's program helped increased the number of customers and generated more work for them.
- Another 35% said that the NYSERDA effort saved the customers money and/or allowed them to upsell equipment.
- Almost one-quarter of the affected contractors stated that the NYSERDA programs caused them to use and recommend more efficient equipment.

There were also a few negative responses, as described in the following table.

Table 4-12. NYSERDA Program Effect on Contractors

	Weighted Number of NYS Contractor Respondents[1,2]	Percentage of NYS Contractors[1,2]
Contractor Positive about NYSERDA Programs		
Programs have attracted more customers and/or increased sales	13	13%
Rebates or incentives have saved customers money, impacted customer product choices, and/or allowed us to up-sell	36	35%
Positive Response for NYSERDA Programs Impact on Market		
Programs have led firm to use or recommend more efficient or qualifying equipment	23	23%
Programs have provided knowledge and/or information about equipment, work practices, and/or the market	15	15%
Neutral Response – Impact on Contractor's Operations Unknown		
Programs have changed the focus of our work/projects	7	7%
Contractor Negative about NYSERDA Programs		
Programs have had a negative influence or firm is dissatisfied with rebates, information, or approval process	7	7%
Other (responses provided in Appendix H)	11	11%
Total respondents	**112**	

[1] Sampling weights were applied as described in Section 2. Contractors working primarily in Long Island were excluded from

this study and totals do not include respondents who indicated "don't know" or "refused."

[2] NYS contractors earlier reporting they are unaware of or not at all familiar with the NYSERDA programs were not asked this survey question and are assumed to have no knowledge of NYSERDA influences on the market or their actions.

NYS contractors report that 21%, over one in five, of all of their projects are high efficiency due to influence from NYSERDA.

4.5 NONPARTICIPANT SPILLOVER ESTIMATE

This section covers the calculation of the NPSO estimate savings and rates. As explained in Section 4.5.1, SO savings are calculated using a combination of data from the end user screener survey, the end user survey, and NYSERDA's program tracking data. At a fundamental level, the NPSO savings is the combination of the NYSERDA influence level, the savings per unit (kWh per square foot), and the quantity (nonparticipant remodeled C&I area in square feet). Equation 4-1 is repeated here (now as 4-2) for convenience.

Equation 4-2. General Equation to Estimate Nonparticipant Spillover

$$kWh_{NPSO} = I_{NYSERDA} \times \frac{kWh}{sq\ ft} \times C\&I\ area_{NP\ Remodel}$$

where,

kWh_{NPSO} represents the NPSO kWh savings per year

$I_{NYSERDA}$ is the NYSERDA influence factor, reflecting the percentage of the remodeled C&I area with high efficiency installations influenced by NYSERDA

$\frac{kWh}{sq\ ft}$ is the estimated average kWh savings per square foot for the C&I nonparticipating projects

$C\&I\ area_{NP\ remodel}$ is the total area of remodeled C&I space from nonparticipating end users

This calculation process was conducted twice, once to estimate the direct SO savings from end users and once for the indirect NPSO savings that are generated through NYSERDA's involvement with midmarket actors. The total estimated NPSO kWh saved is the sum of the two.

The potential size of SO compared to program savings is mostly dependent upon the penetration of the program to the market and how well the program is able to leverage impacts toward market transformation. The maximum potential SO would occur if there were full market transformation and NYSERDA created all the changes in the market for those efficiency gains.

Market transformation includes many elements not in SO estimates to date such as market structure, efficiency availability, size of educated contractor market, and other market-level attributes. Using the information from the two tables above, the maximum potential NPSO can be calculated by assuming that the C&I remodeling market is entirely efficient and all of efficiency gains in the market are due to NYSERDA. This exercise suggests that the upper bound on the NPSO rate under these ideal circumstances would be about 400%.[42] To extend the exercise, if 40% of the market is high efficiency and

[42] The ratio of the proxy NYSERDA-influenced, nonparticipant remodeled space (square feet) to the annual program square feet is the maximum potential NPSO rate. The C&I space served through the Existing Facilities Program is about 250 million square feet and the total C&I annual remodeled square feet is approximately 1,000 million (or, 1 billion) square feet, giving a ratio of 4 to 1.

NYSERDA's influence accounts for one-third of the efficiency, then the NPSO rate would be expected to be about 50%. This theoretical analysis provides some context for the range of the NPSO rates.

The remainder of this section is organized as follows:

- Section 4.5.1 provides the steps and calculation of the direct NPSO energy savings as reported directly from NYS nonparticipating end users.
- Section 4.5.2 provides the steps and calculates the indirect NPSO energy savings for end users who are not directly influenced by NYSERDA but rely heavily on contractor recommendations.
- Section 4.5.3 puts these two NPSO savings estimates together and also incorporates NYSERDA evaluation information to calculate the NPSO rates.
- Section4.5.4 provides an assessment of the primary sources of uncertainty, a discussion of sensitivity and recommendations on the use of the NPSO estimates provided.

4.5.1 Direct Nonparticipant Spillover Estimates

A description of the factors and the data sources are provided in Table 4-13 below. The specific inputs into each of the components (influence, savings per square foot, and size of C&I facilities remodeled) are described and summarized to calculate the direct NPSO savings in the following sections.

Table 4-13. Overview of Direct End User NPSO Inputs and Calculation

Factor	Description	Source
$I_{NYSERDA}$	$I_{\text{efficiency adoption}} + I_{\text{timing}}$	End user survey: • Weighted average % NYSERDA influence on efficiency and adoption • Weighted average % NYSERDA influence on timing
$\frac{kWh}{sq\ ft}$	$\frac{kWh}{sq} ft$ $= program\ average \frac{kWh}{sq} ft$ $\times\ efficiency\ level\ adjustment$	NYSERDA program tracking: • Program average kWh/sq ft End user survey: • Efficiency level adjustment for reports of nonparticipating end users
$C\&I\ area_{Remodel}$	$Nonparticipant\ remodeled\ C\&I\ space$ $= Total\ C\&I\ remodeled\ space$ $- Participant\ remodeled\ C\&I\ space$	End user screener survey: • Total C&I remodeled space NYSERDA program tracking: • Participant remodeled C&I space

Estimating the Influence Factors

The NYSERDA influence factors referenced in Table 4-13 were calculated from two questions from the end user survey covering (1) NYSERDA influences on the level of efficiency and the installation of measures that enable high efficiency and (2) NYSERDA influence on completing the project earlier than would have otherwise occurred. For the first factor, the influence ranking provided by the survey respondent was used to estimate the percentage of efficiency improvements that can be attributed to NYSERDA (the NYSERDA efficiency factor). This value is then multiplied by the frequency in each influence rank to obtain the weighted influence score. The interaction of these factors is shown in table 4-15.

Table 4-14. NYSERDA Influence on Efficiency Level and Installation

NYSERDA Influence	Weighted Number of End User Respondents[1] (n=501)	NYSERDA Efficiency Factor[2]	Efficiency Influence Score[3]
No NYSERDA influence	431	0%	0.00
1 – Not at all influential	6	0%	0.00
2	3	25%	0.70
3	26	50%	12.79
4	15	75%	11.56
5 – Very influential	21	100%	20.51
Total	501		45.56

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study.

[2] The NYSERDA efficiency factor reflects the assumed percentage of the savings from the efficiency improvement due to NYSERDA influence. This method was also used in NYSERDA's previous NPSO evaluations.

[3] The weighted influence score is the weighted number of respondents × NYSERDA efficiency factor.

The timing factor was estimated by adding a specified percentage to the efficiency factor depending on how much earlier the action occurred.[43] This approach is based on the premise that the total NYSERDA influence includes the influence on improving efficiency and on encouraging earlier installation of efficiency measures. For each six months that the installation is moved up, the NYSERDA influence effect on timing is assumed to be 5% of the measure savings, up to a maximum of 25%.

The same calculation process is used for influence on timing as for influence on installing the high efficiency equipment, as shown in Table 4-15. The overall result is quite small as 94% of end users reported that the NYSERDA program had no effect on the timing of their action.

Table 4-15. NYSERDA Influence on Timing

	Weighted Number of End User Respondents[1] (n=501)	NYSERDA Timing Factor[2]	Timing Influence Score[3]
No NYSERDA influence	471	0%	0.00
Don't know how much earlier	7	0%	0.00
Less than 6 months earlier	1	+5%	0.03
6-12 months earlier	10	+10%	0.99
13 to 23 months earlier	0	+15%	0.00
24 months or more earlier	12	+25%	3.00
Total	**501**		**4.02**

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study. Respondents who indicated "don't know" or refused to answer were included in the "No NYSERDA influence" category.

[2] The NYSERDA timing factor reflects the assumed percentage of the savings from installing the efficiency improvement earlier due to NYSERDA influence.

[3] The timing influence score is the weighted number of respondents times the NYSERDA timing factor.

[43] This is similar to how timing responses are often handled in free ridership algorithms.

The influence and timing scores were combined and weighted by the number of respondents to the survey, as shown below in Table 4-16. This analysis indicates that the direct NYSERDA influence on end users accounts for about 10% of the energy savings from the installation of higher efficiency equipment and adoption of efficient practices.

Table 4-16. Calculation of the Influence Factor

Row[1]	NYSERDA Influence	Source	Calculations
1	Efficiency influence score	Table 4-14	46
2	Timing influence score	Table 4-15	4
3	*Combined efficiency and timing score*	*Row 1 + Row 2*	*50*
4	Total respondents	End user survey completions	501
5	*Total influence effect*	*Row 3 / Row 4*	*10%*

[1] Rows with calculations are in italics.

Estimating the Unit Savings

The third component of the calculation is the estimate of the savings per square foot. The Existing Facilities Program (EFP) tracking database was used to make this estimate, and the savings were adjusted to reflect the likelihood that nonparticipant end user projects are likely to meet a lower efficiency standard than projects that are enrolled in the EFP. This adjustment was based on the end users' assessment of the efficiency of the equipment they installed.

The adjustment factor was calculated in a manner similar to that for the influence factors, except that the survey question asking end users to rank the efficiency level of their installations was used. As with the other questions, a scale from 1 to 5 was used to rank the efficiency level. Each rank was assumed to reflect a percentage of the program savings, as presented in Table 4-17.

Table 4-17. Efficiency Adjustment for Nonparticipant Projects

Efficiency Rank Reported by End User	Weighted Number of End User Respondents[1] (n=501)	Efficiency Level Adjustment[2]	Weighted Efficiency Level Adjustment[3]
Don't know	59		
1 – Standard efficiency	33	0%	0.00
2	20	25%	4.89
3	106	50%	52.75
4	135	75%	100.99
5 – Highest efficiency available	150	100%	149.94
Total	**442a**		**308.57**

[1] Sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study.

[2] The efficiency level adjustment reflects the lower efficiency level of the nonparticipant projects in comparison to the NYSERDA EFP projects used to estimate the unit savings.

[3] The weighted efficiency level adjustment is the weighted number of end users times the efficiency level adjustment.

[a] The respondents who answered "don't know" were excluded from the total, and the weighted efficiency adjustment was calculated assuming that this group of respondents is similar to the respondents who provided a valid answer.

The average savings per square foot from the EFP database was calculated. The area values recorded in the EFP data reflect the total area of the facility, which is consistent with the estimation of the size of the C&I nonparticipant remodeled facilities from Table 4-19. The savings for each facility was summed and then divided by the area of the facility to obtain the kWh savings per square foot. The efficiency adjustment was made as shown in Table 4-18 below.

Table 4-18. Calculation of the Unit Savings

Row[1]	Inputs	Source	Outcomes
1	kWh savings per square foot	EFP tracking database for program years 2007 through 2010	0.79 kWh/sq ft
2	Weighted efficiency adjustment	Table 4-17	309
3	Total number of end user respondents	Table 2-5	501
4	*Percentage efficiency adjustment*	*Row 2 / Row 3*	*70%*
5	*Adjusted savings per square foot*	*Row 1 × Row 4*	*0.55 kWh/sq ft*

[1] Rows with calculations are in italics.

Estimating the Size of the C&I Nonparticipant Remodeled Space

The estimated C&I total area of remodeled space estimated in Section 3.1.2 from the New York End User Screener Survey provides the starting point for the direct NPSO estimate (see Table 3-2).

. Subtracting out program square footage provides the maximum possible square footage that could be effected by the program and create NPSO, as shown in Table 4-19.

Table 4-19. Size of New York State Commercial and Industrial Nonparticipant Remodeled Facilities

Row	Metric	Source/ Calculation	Estimate
1	Estimated size of total C&I existing buildings market[2]	New York End User Screener Survey[1] Section 3, Table 3-2	7,800 million square feet[2]
2	C&I area affected in 2007 to 2010 by NYSERDA's EFP [2]	Program tracking database	995 million square feet[2]
3	C&I area eligible for NPSO (nonprogram retrofit)	Row 1 – Row 2	6,805 million square feet[2]
4	Annual remodel rate	New York End User Screener Survey Section 3, Table 3-6	14%[a]
5	Size of C&I nonparticipant facilities remodeled annually	Row 3 × Row 4	953 million square feet[2]

[1] Square footage is from the screener survey and sampling weights were applied as described in Section 2. End users located in Long Island were excluded from this study, and totals do not include respondents that indicated "don't know" or "refused."

[2] Establishment square footage was used to be consistent with the program tracking data used to estimate the savings per square foot.

[a] The remodel rate is based on all respondents to the New York End User Screener Survey with valid responses (1,779 observations).

Estimating the Direct NPSO Energy Savings

These inputs were entered into the NPSO savings formula as shown in equation 4-3.

Equation 4-3. Direct Nonparticipant Energy Savings Formula

$$kWh_{NPSO\ direct} = I_{NYSERDA\ direct} \times \frac{Adjusted\ kWh}{sq\ ft} \times C\&I\ area_{NP\ remodel}$$

$$= 11\% \times 0.55\ kWh/sq\ ft \times 953\ million\ square\ feet/year$$

$$= 57{,}657{,}000\ kWh\ per\ year$$

4.5.2 Indirect Nonparticipant Spillover Estimates

The indirect SO effects are a result of NYSERDA's work with contractors and other midmarket actors, although the end user is completely unaware of the program influence. The contractor surveys bolster the presumption that contractors are highly aware of and influenced by NYSERDA's C&I programs, as over 80% of the contractors reported some involvement with NYSERDA.

A description of the factors and the data sources are provided in

Table . This table helps to illustrate the interaction between contractors and end users that result in indirect NPSO savings. The specific inputs into each of the components (influence, savings per square foot, and size of C&I facilities remodeled) are described and summarized to calculate the indirect NPSO savings in the following table.

Table 4-21. Overview of Indirect Nonparticipant Spillover Calculation

Factor	Description	Source
$I_{NYSERDA}$	$P_{EE} \times I_{ConNYSERDA}$ P_{EE} = [% *EUs always accept contractor recommendations* + (% *EUs discuss with contractors* × % *EUs accept EE*)] × % *contractors' projects that are EE*	Contractor survey: P_{EE} = Percentage of contractor projects that are energy efficient and accepted by end user due to contractor influence $I_{ConNYSERDA}$ = Percentage of contractor projects that are efficient due to NYSERDA influence
$\frac{kWh}{sq\ ft}$	$kWh/sq\ ft$ = *Program average* $kWh/sq\ ft$ × % *contractors' projects with EE recommendations*	NYSERDA program tracking: • Program average kWh/sq ft Contractor survey: • % contractor projects with EE recommendations
$C\&I\ area_{Remodel}$	*Nonparticipant remodeled C&I space with possible contractor influence* = (*Total C&I remodeled space – Participant remodeled C&I space*) × (% *of NP end users who reported no NYSERDA influence*)	End user screener survey: • Total C&I remodeled space End user survey:

		• % of NP end users who reported no NYSERDA influence NYSERDA program tracking: • Participant remodeled C&I space

Estimating the Size of the C&I Nonparticipant Remodeled Space Eligible for Indirect NPSO

A key aspect of estimating the indirect NPSO is avoiding double counting of direct and indirect NPSO. For this reason, the size of the C&I remodel market that could be affected by indirect NPSO was prorated to include only the portion of the market occupied by end users who are unaware of NYSERDA. The end user survey provided the percentage of respondents who indicated that they were unaware of NYSERDA prior to the survey. As can be seen in Table 4-22, these 431 respondents account for 86% of the end users (weighted to the population).[44]

Table 4-20. Size of the Nonparticipant Remodeled Market Eligible for Indirect NYSERDA Influence

Row	Metric	Source or Calculation	Estimate
1	Size of C&I nonparticipant facilities remodeled annually[1]	Row 5 from Table 4-19	953 million square feet
2	Percentage of nonparticipant end users unaware of NYSERDA influence	Table 4-14 (431/501)	86%
3	Total size of C&I nonparticipant facilities that remodel annually,[1] eligible for indirect NYSERDA influence through contractors	Row 1 × Row 2	801 million square feet[2]

[1] Establishment square footage (not retrofit square footage) as in program tracking data, obtained in order to be able to use program tracking data for savings per square foot estimate.

[2] In the final review, a small discrepancy was found in the calculations. Rather than 86%, the 801 million square feet was calculated using 84%. As the impact of this error was negligible and resulted in a small downward bias, the final NPSO estimate was not revised.

Estimating the Unit Savings

As with the direct NPSO, the EFP tracking database was used to make this estimate. No adjustment to savings was made because the efficiency level of equipment as reported by the contractors was quite high, and it seemed reasonable to assume that the contractors would be a better judge of the efficiency level than the end users. The value of 0.79 kWh per square foot was used to estimate the indirect NPSO. (See Table 4-18, row 1.)

Estimating NYSERDA's Indirect Influence

The step-by-step approach to calculating NYSERDA's indirect influence along with the source of the inputs is shown in Table 4-23.

. The goal is to determine the percentage of projects that meet the following criteria:

- The equipment installed is energy efficient.
- The contractor influenced the end user to select high efficiency equipment.

[44] The 86% was calculated by dividing the 431 respondents by the total number of completed surveys (501).

- NYSERDA's influence increased the efficiency of the contractor's recommendation.

Table 4-21. Calculation of the Indirect Influence Factor

Row	Step	Source or Calculation[1]	Result
1	End users accept contractor recommendations	Row 1 in Table 4-3 (NYS contractor survey)	46%
2	End users discuss recommendations with contractors	Row 2 in Table 4-3 (NYS contractor survey)	34%
3	End users who accept contractors' efficient recommendations always or most of the time	Row 2, (Column 5 + Column 6) in Table 4-10 (NYS contractor survey)	68%
4	*Combined end user acceptance of contractors' efficient recommendations*	*Row 1 + (Row 2 × Row 3)*	*69%*
5	Contractors' recommendations are efficient always or most of the time	Row 1, (Column 5 + Column 6) in Table 4-10 (NYS contractor survey)	86%
6	*Percentage of projects that are energy efficient and accepted by end user due to contractor influence*	*Row 4 × Row 5*	*59%*
7	Percentage of contractors' projects that are efficient due to NYSERDA influence	Section 4.4.1, at the end	21%
8	*Total indirect influence effect*	*Row 6 × Row 7*	*12%*

[1] Rows with calculations are in italics.

Estimating the Indirect NPSO Energy Savings

These inputs were entered into the NPSO savings formula as shown below.

Equation 4-4. Indirect Nonparticipant Energy Savings Formula

$$kWh_{NPSO\ indirect} = I_{NYSERDA\ indirect} \times \frac{kWh}{sq\ ft} \times C\&I\ area_{NP\ remodel\ adjusted}$$

$$= 12\% \times 0.79\ kWh/sq\ ft \times 801\ million\ square\ feet/year$$

$$= 78{,}944{,}000\ kWh\ per\ year$$

4.5.3 Derivation of the NPSO Rate

NYSERDA calculates net savings as shown in the following equation.

Equation 4-5. Net Savings Formula

$$Net\ savings = Gross\ savings\ x\ (1 - FR + ISO + OSO + NPSO)$$

The inputs to the NPSO equation are combined to calculate the NPSO rates as shown in Table 4-22. The results of this study indicate that the overall NPSO rate is 25% with a relative precision of 15% at the 90% confidence level.

Table 4-22. Derivation of the Final NPSO Rates

Row[1]	Input	Source or Calculation[2]	Result
1	Direct NPSO savings from end users (kWh/year)	Section 4.5.1, estimating the direct NPSO savings	52,415,000 kWh/year
2	Indirect NPSO savings through contractors (kWh/year)	Section 4.5.2, estimating the indirect NPSO savings	78,944,000 kWh/year
3	*Total NPSO savings (kWh/year)*	*Row 1 + Row 2*	*131,359,000 kWh/year*
4	Total NYSERDA C&I existing building annual savings	EFP and FlexTech[2]	230,647,000 kWh/year
5	*Interim NPSO rate (includes OSO)*	*Row 3 / Row 4*	*57%*
6	OSO savings for NYSERDA C&I existing buildings programs[2]	OSO from most recent EFP & FlexTech impact evaluations	73,142,000 kWh/year
7	*Estimate of NPSO savings net of OSO*	*Row 3 – Row 6*	*58,218 MWh*
8	*Final NPSO rate (excludes OSO)*	*Row7 / Row 4*	*25%*

[1] Rows with calculations are in italics.

[2] The average annual program savings is used since the remodel rate used is the annual rate. Program reported savings were used. The FlexTech Impact Evaluation's 2007–2009 program reported savings were adjusted for the long-term measure adoption rate (MAR). The ex ante program reported savings were used as the kWh/sq ft estimate used to calculate the NPSO savings was also developed from program reported savings. Thus, the basis for both the numerator and denominator in the calculation of the NPSO rate are consistent.

4.5.4 Sources of Uncertainty, Sensitivity Analysis, and Recommended Use of the NPSO Results

While the effects of free ridership (FR) and SO on program impacts are well established, the measurement of these effects continues to be complex and fraught with controversy. Attempting to determine what would have happened without the program becomes much more complicated as NYSERDA's programs have been in the field for well over 10 years. Many evaluators and program implementation staff have developed strong opinions about the validity of specific methods and approaches. Although alternative approaches have been tested in a variety of settings, most net-to-gross evaluations are based on self-reports, as are the NPSO rates estimated in this evaluation.

NYSERDA recognizes the indirect effects of its market transformation and resource acquisition programs and has been periodically measuring the influence of its programs on nonparticipants. The complexity of the measurement does not detract from the importance of attempting to estimate the effects of SO. Beyond the goal of estimating specific net-to-gross factors lies the commitment to achieving market transformation and the desire to be able to measure its impacts.

There are sources of uncertainty in the many elements that go into the calculation of NPSO. This study was designed to minimize overall bias with the goal of obtaining an estimate of the actual NPSO rate that is neither systematically too high or too low. Considering construct validity, measure error, and sampling error as the primary sources of uncertainty in this evaluation, only sampling error can be quantified. However, construct validity and measurement error can create bias in the final results.

The first step in assessing the potential sources of uncertainty and bias was to review the overall results. As discussed extensively in the previous sections, the estimated of NPSO has two components: direct NPSO as reported by end users and indirect NPSO as reported by contractors. If only the direct effects from NYS end users were considered, the NPSO rate would be 23%. The indirect NPSO from contractors contributes the remaining 2%, for a total NPSO of 25%. Thus, the bulk of the NPSO is supported by the end user analysis.

In the design and implementation of this study, the Impact Team, with assistance from DPS reviewers, identified two key sources of bias that are specific to the end user NPSO:

1. End users may not be aware of NYSERDA influence on contractors, vendors, and distributors, and thus understate NPSO.
2. End users may unknowingly report some savings that were already included in the contractor-based estimates of OSO from EFP and FlexTech, and thus overstate NPSO.

From this perspective, any potential bias could be in either direction and it is equally possible that these two sources of bias may counterbalance each other. This overview provides support for the NPSO estimate of 25% and suggests that the NPSO is unlikely to be lower than 23%.

The primary sources of uncertainty are discussed briefly below and summarized in Table 4-25. This review includes an assessment of whether the potential issue is more likely to create a downward bias (a NPSO rate that is too low) or an upward bias (a NPSO rate that is too high). In addition, a sensitivity analysis was conducted to assess the magnitude of the potential bias for the five sources of uncertainty identified by the DPS reviewers as the greatest areas of concern. The outcome of these analyses suggests that there is potential for both upward and downward bias in the NPSO estimate.

Definition of the Sample Frame and Population

The planning process for this evaluation involved an extensive discussion of methods to develop the sample frame for the screener survey. Since the screener survey was used to characterize the population, this level of scrutiny was considered to be a critical component of the evaluation design. The sample frame was developed from the Dunn & Bradstreet (D&B) database as this source lists all commercial establishments and is more comprehensive than the Dodge database. The D&B list was supplemented with sector-specific sources as necessary. This approach is based on primary research and is an improvement over previous NPSO evaluations. There is no clear source of bias from the methods used to develop the sample frame.

Size of New York C&I Remodeled Facilities

The size of the market was estimated through the screener survey with a very large sample size. While this approach is better than previous methods (which relied on the Dodge database), there is a tremendous variation in facility sizes and the precision was worse than expected. The stratification was based on the number of employees from the D&B database. However, comparing the survey responses regarding the number of employees to the D&B records suggests that D&B is not an entirely reliable source for this information.

The high variability in the survey responses suggests that large sample sizes are needed to estimate C&I facility size. While the stratification method did not improve precision to the extent expected, the facility sizes varied substantially by sector, suggesting that stratifying by sector is an important component to expanding the survey results to the population. It seems that the error is more likely to be random than systematic. Bias could occur if one or more sectors is not properly represented.

Annual Remodel Rate

Remodeling rate and the population of remodelers was estimated from the screener survey with over 2,500 completed surveys. Interpreting the data to determine the remodel rate required some assumptions. The remodel rate was based on the assumption of one remodel per year per end user, although some end users had multiple remodels. Calculating the remodel rate by limiting each end user to a single remodel resulted in a remodel rate of 14%. This input has a large impact on the size of the C&I remodel market used in the estimation of the NPSO energy savings.

Program Savings per Square Foot

To estimate the NPSO energy savings, the program savings per square foot was estimated from the EFP tracking database. The area of the establishment was used, as this value was available in the program database. To be consistent, the size of the total C&I remodel market for existing buildings was estimated from the screener survey using the total area of the facility rather than the portion of the facility that was remodeled. The unit savings (kWh/sq ft) was calculated for each project from the program tracking database, incorporating all savings at that site, and then divided by the total area of the facility. The differences in the definition and scope of a "project" between the end user survey respondents and EFP staff could result in bias. Additional analysis was conducted to assess whether the EFP and nonparticipating projects were similar in scope by comparing the survey and program data. This analysis indicated that the scope of the projects, on average, was similar.[45]

It seems possible that EFP projects may be more efficient than the nonparticipant projects, although there is no direct evidence to support this suggestion. If this is the case, using the program unit savings would tend to create an upward bias leading to an overstatement of the NPSO. In the calculation of the direct NPSO savings, this issue was partially addressed by adjusting the program unit savings downward based on respondents' perception of efficiency levels from the end user survey. The indirect NPSO savings, however, were based on the contractors' assessments, and no additional adjustment was made as contractors were assumed to be more knowledgeable and able to report efficiency levels more accurately.

Number of Remodeling Projects per Facility

Another potential source of bias is the assumed number of projects per facility. The weighted average number of projects per end user survey respondent was 2.2 on average over the four-year period. However, in the EFP program data, facilities completed 1.1 projects, on average, over the same period. This analysis suggests that the unit kWh/square foot applied to estimate the NPSO could be substantially understated as it reflects only 1.1 projects as opposed to the 2.2 projects implemented on average in C&I existing buildings.

Estimates of NYSERDA Influence

Influence was measured at both the end user and contractor level. The influence questions may be difficult for respondents to answer accurately, and socially desirable responses could affect the outcome. A variety of questions were asked regarding the types of influences and the actions taken by end users and contractors. Where surveys overlapped, such as the role of the contractor in making recommendations, the results from the two surveys were quite similar, lending credibility to the responses.

The influence factors were calculated at the end user or contractor level, i.e., they were not weighted by the number of projects completed by specific contractors. However, a validity check on one of the influence factors suggested that weighting by the number of projects produces slightly higher results.

Participating contractors were included in the contractor survey, and the influence rate may have included some participating projects. Thus, to the extent that contractors were including participating projects in their assessment of NYSERDA influence on efficiency levels, it is possible that the influence rate would be overstated, leading to an upward bias in the NPSO savings.

[45] For this additional analysis, the EFP tracking data for program years 2007 through 2010 were used and project cost was used as a proxy for the scope of the project, as this field was available in both data sets. The project costs from the screening survey and the program tracking data were compared using the same cost categories as used in the screening survey. This analysis indicates that average project costs are in the same range ($100 K for the program data as compared to $110 K for the screener survey respondents), further suggesting that the scope of a program "project" is reasonably consistent with a "project" as defined by the screener respondents (within 10%).

In addition, DPS reviewers expressed concerns that self-reports of NYSERDA influence are used to allocate savings to NYSERDA. They argue that "strongly influential" does not necessarily translate to the sole cause for adopting efficiency, as there are many other factors that are likely to play into the decision-making process. The Impact Team understands that the decision-making process is complex and supports continuing research in future evaluations. Savings were allocated to NYSERDA on a proportional basis to incorporate the level of influence reported by the respondents. The method used in this report is consistent with NYSERDA's prior evaluations.

Baseline Efficiency Level

Energy savings are calculated from a baseline, and the NPSO estimate is based upon end users' and contractors' assessments. While the survey instruments were carefully worded to emphasize the study period of 2007 to 2010, it is entirely possible that assessments of high efficiency reflects the current standards in 2012. However, it is possible that NYSERDA was instrumental in raising the baseline over the past decade as the NYSERDA efficiency programs were designed to raise the definition of high efficiency and continually push the market. These potential savings were not captured, which would create a downward bias in the NPSO estimate.

Overlapping Reports of SO from Contractors and End Users

DPS reviewers expressed concerns about the potential for overlapping reports of SO from contractors and end users, i.e., a contractor may report that some projects were influenced by the program and one or more end users may report the same projects as influenced by the program. The Impact Team took two direct steps to try to avoid this source of bias. First, the outside spillover (OSO) from FlexTech and EFP was subtracted from the potential NPSO savings to avoid double counting SO savings from participating contractors in nonparticipating facilities. Second, the indirect savings from contractors was calculated by first removing the area of all facilities associated with end users reporting no awareness of, or no influence by, NYSERDA and the area of all facilities served through the EFP during the four-year period of 2007–2010.

Once the OSO from NYSERDA's C&I programs has been removed, the magnitude of the indirect SO from contractors accounts for 2% of the 25% NPSO rate. While it is still theoretically possible that some of the direct SO reported by end users could have some overlapping SO reported by contractors, it seems that the methods used have largely mitigated the potential bias associated with this overlap. In addition, given that only 14% of end users reported NYSERDA influence, it seems entirely likely that many contractors did not work with any end users who would have reported NYSERDA influence. It is also worth noting that the 14% "no-influence factor" incorporates some conservative assumptions.[46]

Table 4-23. Issues and Associated Potential Direction of Bias

Issue	Description	Direction of Bias
Definition of the sample frame and population	Sample frame was developed from the D&B database to avoid potential known biases in the Dodge database. D&B database was supplemented with sector-specific lists where D&B is known to be weak. Remodeling rate and the population of remodelers was estimated from the screener survey with over 2,500 completed surveys.	Bias unlikely

[46] These issues are discussed in more detail in the memo attached as Appendix J.

Issue	Description	Direction of Bias
Size of NYS C&I remodeled facilities	Size of the market was estimated through the screener survey with a very large sample size. While this approach is better than previous methods (which relied on the Dodge database), there is a tremendous variation in facility sizes and the precision is worse than expected, suggesting there may be random error. Bias could occur if one or more sectors is not properly represented.	Unknown direction
Annual remodel rate	Remodel rate is based on assumption of one remodel per year per end user, although some end users had multiple remodels. This input has a large impact on the size of the C&I remodel market used in the estimation of the NPSO energy savings. Area of C&I facilities served through the EFP may not be a direct comparison to the end user screener survey; this area was subtracted from the estimated size of the C&I remodel market to isolate the nonparticipant facilities.	Unknown Direction
Program savings per square foot	Differences in efficiency level as reported by the ESR respondents and as claimed in the EFP database may contribute to error in NPSO savings; EFP projects may be more efficient than those of nonparticipating end users; the EFP kWh/sq ft was adjusted downward for the direct NPSO to account for lower efficiency levels.	Upward Downward
Estimated number of projects per facility	The weighted average number of projects per end user survey respondent was 2.2 on average over the four-year period. However, in the EFP program data, facilities completed 1.1 on average projects over the same period. This result suggests that the unit kWh/square foot based on 1.1 projects could be substantially understated.	Downward
Estimates of NYSERDA influence	Influence was measured at both the end user and contractor level. Savings were allocated to NYSERDA on a percentage basis with 100% of savings when NYSERDA was reported to be “highly influential.” Where surveys overlapped, such as the role of the contractor in making recommendations, the two surveys meshed well. Participating contractors were included in the contractor survey and the influence rate may have included some participating projects; if so, the influence rate would be overstated.	Upward
Baseline efficiency level	Market effects occur over time, and the efficiency baseline changes. Using the current baseline does not give credit to NYSERDA’s contribution in raising the baseline over time.	Downward
Overlapping reports of SO from contractors and end users	OSO from FlexTech and EFP was removed, and the area of C&I remodeled facilities was adjusted to reflect only the end users who reported no NYSERDA influence. However, it is still possible that there could be some overlap.	Upward

While this analysis identifies the potential sources of bias, it does not address the relative importance of these various factors. In addition to this qualitative assessment, a sensitivity analysis was conducted to estimate the potential magnitude of the bias that could be associated with the five critical sources of bias

identified by DPS reviewers. To compare the impacts of each of the main sources of bias, all other inputs were held constant except for the item most closely associated with the potential source of bias.

This analysis shows that the upward bias due to the first four potential sources is dramatically overshadowed by the downward bias (see Table 4-26) due to assuming that the number of projects completed per facility was the same in the EFP program as in the population of C&I facilities with remodels. This result suggests that the estimated NPSO rate of 25% is more likely to be understated than overstated. Please refer to Appendix J for a more detailed explanation.

Table 4-24. Results of NPSO Sensitivity Analysis

Potential Source of Bias	Expected Direction of Bias	Estimated NPSO MWh/Year	Estimated NPSO as Percentage of Program Savings	Description
Base case: NPSO study final estimate		58,217	25%	
Overlap in contractors' and end users' reports of NPSO	Upward	52,415	23%	Removes all indirect, contractor SO Possible that end users' SO reports may still overlap with program-related OSO, but also possible end users are not aware of NYSERDA influence on upstream actors
Equating NYSERDA influence with causality	Upward	47,734	21%	Adjusted influence factors down by 20%
Contractors' estimates of NYSERDA influence may include some program activity	Upward	52,415	23%	Removes all indirect, contractor SO
Relying on contractors' estimates of efficiency	Upward	52,415	23%	Removes all indirect, contractor SO
Undercounting the number of remodeling projects per facility	Downward	113,494	49%	Assumes 1.6 projects per site, which is substantially lower than the 2.2 projects per site from the screener survey

Section 5: NEW YORK COMMERCIAL AND INDUSTRIAL REMODELING MARKET

5.1 INTRODUCTION

This section relies on the definitions of market effects and market changes first cited in the *Scoping Study, 2004 California Evaluation Framework* that have been used in most subsequent market transformation evaluations.[47] The scoping study defines "market effect" as "a change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy efficient products, services, or practices and is causally related to market intervention(s)."[48] Thus, market effects include direct program participant savings, participant SO savings, and nonparticipant spillover NPSO savings, as well as the impacts of federal and state codes and standards and other types of market inventions. However, other market forces, such as competition effects and economic factors, also affect the adoption of energy efficiency outside of specific market interventions. The remainder of this section describes the background, scope of study, methods, comparison of efficiency level to other cross-state studies, review of the survey results, and conclusions of this study.

5.2 BACKGROUND

NYSERDA's programs have been designed to achieve market transformation goals (sustainable market effects) since their initial designation as the New York state (NYS) entity to administer the System Benefits Charge (SBC), providing energy efficiency programs under the name Energy Smart since July 1998. The market infrastructure and demand side goals of the C&I portfolio are provided in Table 5-1. NYSERDA's most recent C&I program logic model diagrams are provided in Appendix F of this report.

Table 5-1. Market Transformation Goals for NYSERDA C&I Programs

Market Infrastructure/Policy[1]	Demand Side[1]
Expanded delivery channels for energy efficiency, demand response and renewable energy services Larger, robust and sustainable market for energy efficiency, demand response, and renewable energy services and products Increased capacity of energy services companies to deliver quality projects that produce reliable benefits Increased number of firms with experience and confidence in delivering energy efficiency, demand response, and renewable energy equipment or strategies.	Projects demonstrate persistent energy savings, enable participation in demand response programs, result in renewable energy generation, and provide other benefits to end users Customers have reliable information on which to base energy-related decisions Customers have confidence in energy savings estimates and value the energy efficiency, demand response, renewable energy, and/or green building features of their projects Access to energy efficiency, demand response, and renewable energy services is improved for all types of customers including those who are underserved

[1] These market transformation goals were part of NYSERDA's energy efficiency programs prior to 2007, at the beginning part of this study period, and through current efforts. These goals are cited in NYSERDA documents in 2007 and again in 2010.[49]

[47] Joe Eto, Ralph Prahl, and Jeff Schlegel, *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs* (Ernest Orlando Lawrence Berkeley National Laboratory, 1996) and TecMarket Works Framework Team, *The California Evaluation Framework* (Southern California Edison Company Study ID K2033910, 2004).

[48] Eto, Prahl, and Schlegel, *A Scoping Study on Energy-Efficiency Market Transformation*, page 9.

[49] GDS Associates, *New York Energy $mart[SM] Business and Institutional Programs Sector-Level Logic Model Report*, May 2006.

5.3 STUDY SCOPE

The cross-state component of this study is limited in scope as it focuses only on one specific application – high bay lighting (HBL) – which was selected to be consistent with other recent cross-state studies conducted in California, Wisconsin, and Massachusetts, as these other studies served as a model for the data collection, analysis, and results. Review of NYSERDA's program tracking data indicates that savings from efficient HBL are slightly less than 9% of the reported savings for the C&I Existing Facilities Program (EFP) during the analysis period (2007 to 2010). A more comprehensive market transformation evaluation would cover multiple end uses and types of equipment.

Three prior studies were reviewed as part of developing the original evaluation plan and then the revised work plan for this evaluation: (1) a study that examines the impact of Wisconsin's Focus on Energy Business Programs,[50] (2) a study of California's HBL market,[51] and (3) an HBL market effects study for the new construction market in Massachusetts.[52]

As the Massachusetts study replicated part of the approach from the California study, and its scope was similar to the scope of work envisioned for this evaluation, the Impact Team replicated the Massachusetts study with one key difference: rather than relying on the contractor survey completed as part of the previous California study, the Impact Team conducted the primary data collection from the comparison area. The comparison states for the California study were Mississippi, Georgia, Alabama, and South Carolina. These states have only recently been starting to invest in energy efficiency programs and were assumed to be the closest proxy to a "true" baseline condition of no publicly funded energy efficiency programs or interventions. It was beyond the scope of this study to investigate the possibility that other market forces (outside of efficiency programs) could account for some of the differences between NYS and the comparison area.

The NYSERDA territory is defined as all of the counties in NYS excluding Long Island. The comparative information gathered for NYS and the comparison area is on the HBL market defined as purchases for C&I spaces with ceiling heights of 15 feet or greater.

The NYS contractor dataset for this study consists of the HBL contractors from the New York Contractor Survey. Telephone surveys were conducted with C&I end users that purchased HBL during the four-year period of 2007 to 2010 and lighting contractors that conducted C&I lighting projects in high bay spaces during the same time period. The NYS end user dataset used was a subset of the respondents of the New York End User Survey, who responded to questions about HBL purchases. The surveys for the comparison area end users and contractors were specifically conducted for this comparison study. (More information on the survey instruments and sampling is provided in Section 2. The survey instruments are Appendices to this report.)

5.4 METHODS

This section discusses the methods used in this component of the analysis. The following subsections cover the data sources, the development of the survey instrument, and estimation of market effects.

NYSERDA, *Existing Facilities Program, Program Logic Model Report, Final Report,* prepared by GDS Associates, November 2010.

[50] PA Consulting, *Focus on Energy Evaluation: Business Programs Supply-Side Evaluation,* prepared for the State of Wisconsin Public Service Commission of Wisconsin, 2010.

[51] KEMA, Inc., *High Bay Lighting Market Effects Study: Final Report*, prepared for the California Public Utilities Commission, 2010.

[52] KEMA, Inc., *Final Report, HBL Market Effects Study, Project 1A New Construction Market Characterization,* prepared for the Massachusetts Energy Efficiency Program Administrators, 2011.

5.4.1 Data Sources

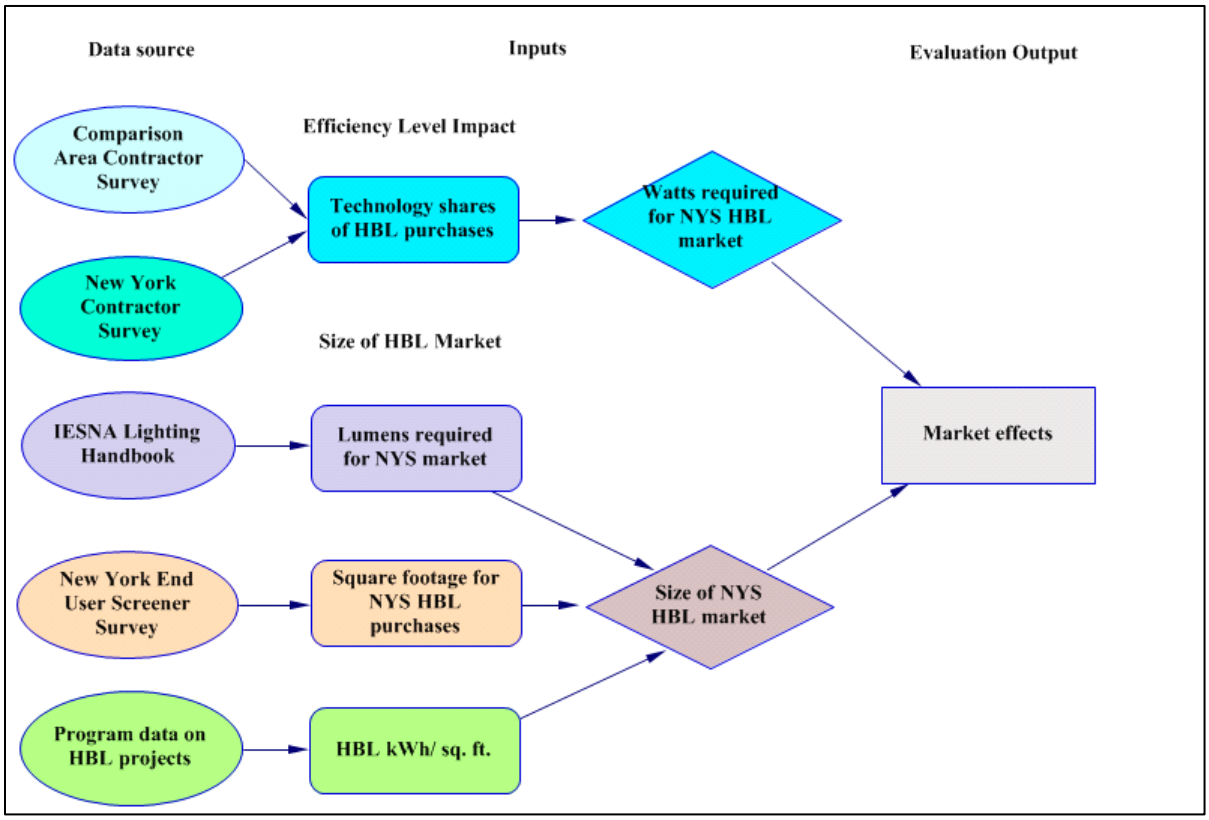
The following data sources were used in the calculation of the market effects.

- NYS and comparison area end user surveys
- NYS and comparison area contractor surveys
- NYS end user screener survey
- Secondary data to estimate the lumens per square foot required in the sectors with HBL
- Program data to estimate the savings per square foot for HBL upgrades

The purpose of each data source in estimating the market effects is illustrated in Figure 5-1.

The instruments used were designed to include the same survey questions used in the Massachusetts HBL study to ensure comparable results. Survey instruments for the comparison area and for NYS were the same and were consistent with the prior collection of HBL market data in the California HBL market effects study.

Figure 5-1. Data Sources, Inputs, and Evaluation Outputs of the HBL Market Effects Study



5.4.2 Development of the Contractor Survey Instrument

Eleven technologies were identified that are appropriate for high bay applications. An initial component of the survey was to establish which types of technologies were most often installed by the contractor and

which required the contractors to estimate the percentage of specific technologies that were installed. The series of questions began at a high level and then became more detailed by running through the technologies category by category. For example, contractors were first asked about the proportion of their HBL sales that were fluorescent tube lighting, high-intensity discharge (HID) lighting, light emitting diodes (LEDs), and other technologies. The next set of questions covered the proportions of the different types of fluorescent lighting, followed by another set asking about the proportions of different types of HID lighting. This approach was designed to improve the reliability of the results as respondents may have had difficulty parsing out proportions that add to 100% for eleven technologies.

5.4.3 Estimation of Market Effects

There are two primary components to estimating market effects:

1. The difference between the efficiency of HBL in NYS as compared to the baseline (the comparison area)
2. The size of the NYS HBL market

The difference in the efficiency of HBL equipment sales (lumens per watt) between the two areas is the basis for the savings due to market interventions. The percentage of penetration for each technology type was determined from the contractor surveys, and the weighted average of the efficiency for HBL as a whole was calculated for NYS and the comparison area. These results were then compared to assess whether the differences were statistically significant. Depending on the results of the first stage of this analysis, the next step would be to expand the results to the market using the size of the NYS HBL market during the study time period. As is discussed in more detail in the following sections, this final step was not performed.

5.5 COMPARISON OF EFFICIENCY LEVELS

The results of the contractor surveys provided detailed information about HBL installations by technology and efficiency levels for the NYS and comparison area HBL markets. Table 5-2 lists the lighting products used in high bay applications, the design efficacy of the lighting product (lumens/watt, adjusted for location), and the percentage of contractors installing this type of product in NYS and in the comparison area. The Design Lights Consortium[53] and KEMA HBL market effects study for Massachusetts[54] were the sources for determining the efficacy (design lumens per watt).

Table 5-2. Efficiency in HBL Applications

Technology	Design Lumens/ Watt Midlife Efficacy	Weighted Average Percent of Fixtures Installed in HBL Applications	
		New York[1,2] (n=70)	Comparison Area[1,3] (n=72)
Fluorescent tube: T5 high output	66	30%	33%
Fluorescent tube: high performance, reduced wattage, or super T8	75	15%	11%
Fluorescent tube: standard T8	68	14%	15%

[53] DesignLights Consortium, *Know How: High Bay Industrial Lighting*, page 3.

[54] KEMA, Inc., *Final Report, HBL Market Effects Study, Project 1A New Construction Market Characterization*, Prepared for the Massachusetts Energy Efficiency Program Administrators, 2011.

Technology	Design Lumens/ Watt Midlife Efficacy	Weighted Average Percent of Fixtures Installed in HBL Applications	
		New York[1,2] (n=70)	Comparison Area[1,3] (n=72)
Fluorescent tube: T12	45	2%	1%
HID: pulse start metal halide	48	16%	17%
HID: probe start metal halide	40	3%	4%
HID: high pressure sodium	53	7%	4%
HID: low pressure sodium	36	1%	1%
HID: mercury vapor	44	1%	1%
LED	47	10%	8%
Other: technologies such as induction	47	1%	5%
Total[4]		**100%**	**100%**
Lumens/watt weighted by percentage of technology installed for 2007 to 2010 HBL installations		60.0	59.5

[1]Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[2] Contractors were asked to exclude work done on Long Island.

[3] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

[4] Contractors were asked to estimate the percentage of all HBL fixtures for each type of technology, and the total percentages add to 100%.

The technology with the highest shares in NYS and comparison area HBL markets was the T5 high output fluorescent tube, which comprised 30% of the NYS HBL market and 33% of the comparison area HBL market during the study period. NYS has a slightly higher technology share of super T8s than the comparison area at 15% for NYS and 11% for the comparison area. The lighting technology with the lowest efficacy was low pressure sodium HIDs with 36 lumens per watt. Both the NYS and comparison area contractors reported that this technology has fallen to 1% of the HBL lighting installations.

For most of the technologies, the differences between NYS and the comparison area are not statistically significant. The only statistically significant comparison in the table above is the "other" category, which represents only 1% of the NYS HBL market. Overall, the weighted average lumens per watt in NYS was 60.0 and the comparison area was 59.5, representing a difference of 0.9%. This difference is not statistically significant and, thus the results of this analysis do not show clear signs of market effects for HBL applications.

This result indicates that the efficiency levels in the comparison states have improved and/or the NYS HBL market is not as efficient as found in California and Massachusetts. The findings from the previous studies were compared to assess the reason for this result, and the contractor and end user survey data was analyzed further to investigate the issues. The results are described in the following section.

5.6 COMPARISON TO OTHER CROSS-STATE HBL STUDIES

Two prior market effects studies used comparison surveys to estimate HBL market effects, and the methods were replicated in this study. These other studies found significant market effects in California

and Massachusetts, states that, like NYSERDA in NYS, have been making substantial investments in energy efficiency. A review of the findings from these studies suggest that the comparison areas have made gains in efficiency from the analysis period covered in the Massachusetts and California studies and that the efficiency of HBL in NYS is lower than found in the other two states. The data collection methods and analysis periods for the two earlier studies and the current NYSERDA study are summarized in Table 5-3.

Table 5-3. Comparison of California, Massachusetts, and New York Cross-State Evaluation Data Sources

	Time Period Covered in Evaluation State Survey	Data Source for Evaluation State Survey	Time Period Covered in Comparison Area Survey	Data Source for Evaluation State Survey	HBL Market
California	2006 to 2008	Primary data collection	2006 to 2008	Primary data collection	Existing buildings
Massachusetts	2007 to 2010	Primary data collection	2006 to 2008	Data collected in California study	New construction
NYS Cross-state	2007 to 2010	Primary data collection	2007 to 2010	Primary data collection	Existing buildings

By comparing the results from these three evaluations, it is possible to determine whether the efficiency of HBL improved from the 2006 to 2008 survey to the more recent one conducted for this study and also to see how the efficiency of HBL in California and Massachusetts compares to NYS. A comparison of the technology shares from the three studies is show in Table 5-4.

Table 5-4. Comparison of Technology Shares from California, Massachusetts, and NYSERDA High Bay Lighting Market Effects Studies

	Weighted Average Percentage of Fixtures Installed in HBL Applications				
Technology	NYS, 2007 to 2010[1,2] (n=70)	Comparison Area, 2007 to 2010[1,3] (n=72)	Massachusetts, 2007 to 2010	California, 2006 to 2008	Comparison Area, 2006 to 2008
Fluorescent tube: T5 high output	30%	33%	64%	65%	29%
Fluorescent tube: high performance, reduced wattage, or super T8	15%	11%	13%[a]	14%[a]	16%[a]
Fluorescent tube: standard T8	14%	15%			
Fluorescent tube: T12	2%	1%	1%	1%	11%
HID: pulse start metal halide	16%	17%	3%	14%	31%
HID: probe start metal halide	3%	4%	1%	1%	3%
HID: mercury vapor	1%	1%	N/A	N/A	N/A
HID: high pressure sodium	7%	4%	1%	3%	8%
HID: low pressure sodium	1%	1%	N/A	N/A	N/A

LED	10%	8%	17%a	2%a	2%a
Other: technologies such as induction	1%	5%			

[1]Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[2] Contractors were asked to exclude work done on Long Island.

[3] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

[a] The California and Massachusetts evaluation reports did not differentiate between super and standard T8s or between LED and other lighting technologies.

The average efficiency of HBL from the three states is compared in Table 5-5. This analysis suggests that the efficiency of HBL in NYS is about 4% lower than Massachusetts, and the efficiency in the comparison area improved by about 5%, thus largely eliminating the market effects for this application.

Table 5-5. HBL Efficiency in California, Massachusetts, New York State, and Comparison Area

	Weighted Average Efficiency by Technology (Lumens per Watt)			
	Evaluation State	**Comparison Area[1]**	**Difference**	**Percentage Difference**
California	61.8[a]	56.0[a]	5.8	9.4%
Massachusetts	61.6[a]	56.0[a]	5.6	9.1%
New York	60.0	59.5	0.5	0.9%

[1] The comparison area consists of South Carolina, Georgia, Alabama and Mississippi for all three studies. For the California and Massachusetts study, the comparison area survey covered the period of 2006 through 2008. The comparison area survey for this evaluation asked about installations from 2007 to 2010.

[a] KEMA, *Final Report HBL Market Effects Study, Project 1A New Construction Market Characterization*, prepared for the Massachusetts Energy Efficiency Program Administrators, 2011, 42.

This analysis points to some trends that contributed to explaining the reasons for the outcome of this study, as described below.

- Both Massachusetts and California had a dramatically higher technology share for high output T5s, about double the NYS and comparison area technology shares (65% to 30%). This single factor is the largest contributor to the higher efficiency HBL in these two states.
- While the California and Massachusetts studies did not separate high efficiency (super) T8s from standard T8s, the overall technology share of T8s was substantially higher (almost double) for NYS and the recent NYSERDA survey conducted in the comparison area compared to California, Massachusetts, and the earlier KEMA comparison area survey. The comparison area went from a 16% share for T8s in the earlier KEMA survey to 26% (combined super and standard T8s) in the more recent NYSERDA survey.
- The increase in T8s in the comparison area is accompanied by a decrease in technology share for the less efficient metal halide figures. These two changes make the greatest contribution to the increase in efficiency in the comparison area between the two study periods.
- The market share for inefficient T12s dropped in the comparison area from 11% in the KEMA survey to 1% in the NYSERDA survey. This finding is most likely due to the change in federal standards designed to phase out T12s.

In aggregate, this analysis suggests a major improvement in efficiency of the HBL market in the comparison states from the 2006 to 2008 analysis period to the more recent surveys covering 2007 to 2010 and that NYS lags California and Massachusetts in the overall efficiency of the HBL market.

5.7 REVIEW OF SURVEY RESULTS

Responses from the screener survey indicate that the overall awareness and penetration of HBL efficiency measures is increasing in the comparison area faster than in NYS. A number of the survey questions provide some additional insight into these issues. The subsequent subsections cover the following components of the contractor survey:

- Awareness and penetration of energy efficient HBL
- Contractor recommendations and custom acceptance of energy efficient HBL
- NYSERDA and utility program influence
- Impacts of state energy codes
- Effects of chains and franchises on efficiency of HBL

This discussion is followed by a comparison of the end user and contractor survey results that provides a validity check on the results of the contractor survey.

5.7.1 Awareness and Penetration of Energy Efficiency

NYS and comparison area (South Carolina, Georgia, Alabama, and Mississippi) contractors were asked about changes in the HBL market for fluorescent and HID technologies and their driving forces. As can be seen in Table 5-6, a much higher percentage of comparison area contractors reported that the market share of fluorescent HBLs has increased over the past two years (80% of the comparison area and 62% of NYS) and will continue to increase over the next two years (68% and 42%). These comparison area results are close to those from the California study, where about three-quarters of contractors in both California and the comparison area reported increased fluorescent usage for HB applications during the 2006 to 2008 time period. The results from the earlier California comparison area survey and the recent NYSERDA comparison area survey suggest that the comparison area may be rapidly closing the gap regarding fluorescent technologies in the HBL market.

Table 5-6. Contractors Perceptions of Changes in the Fluorescent Technology Market Share

Fluorescent Market Share Has or Will . . .	NYS[1,2]		Comparison Area[1,3]	
	Weighted Percentage of Contractors (n=70)		Weighted Percentage of Contractors (n=72)	
	Past Two Years	Next Two Years	Past Two Years	Next Two Years
Increase(d)	62%	42%	80%	68%
Decrease(d)	9%	19%	12%	11%
Stay(ed) the same	29%	39%	8%	21%
Total	100%	100%	100%	100%

[1]Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[2] Contractors were asked to exclude work done on Long Island.

[3] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

Contractors identified the main driving forces for increases in fluorescent technology as they see it, and the results from this question are presented in

Table **5-7**. The same three driving forces – lower purchase price of fluorescent fixtures, the cost of electricity, and better performance – were the top choices of both sets of contractors. Comparison area contractors focused on better performance to a higher degree than the NYS contractors (39% to 24%).

Table 5-7. Main Factors Driving the Fluorescent Lighting Market

	New York State[1,2]		Comparison Area[1,3]	
	Weighted Number of Contractors (n=70)	**Percentage of Contractors[4]**	**Weighted Number of Contractors (n=72)**	**Percentage of Contractors[4]**
Lower purchase price of fluorescent fixtures	29	44%	19	28%
Cost of electricity	25	39%	23	34%
Better performance from new fluorescent technologies	16	24%	26	39%
Rebates from NYSERDA or utilities	13	19%	6	9%
Concern or greater awareness of saving energy	11	18%	11	17%
Government regulations or building codes	5	7%	2	3%
Other	4	6%	8	12%

[1]Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[2] Contractors were asked to exclude work done on Long Island.

[3] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

[4] Multiple responses were allowed, so the percentage of contractors does not add to 100%.

The HID portion of the HBL market has gone from probe start HIDs to pulse start metal halide and then to pulse start ceramic metal halide, indicating a steady move toward more energy efficient options. As shown above, sales of new probe start HIDs for both the NYS market and the comparison area are down to 1% of sales. The pulse start metal halides are decreasing more than increasing in NYS and in the comparison area as seen in Table 5-4, probably because fluorescents are an increasing portion of the HBL market.

5.7.2 Contractors Recommendations and Customer Acceptance of High Efficiency HBL

As shown in Table 5-8, the frequency of recommending energy efficient HBL equipment is very similar between NYS and the comparison area. Only 10% to 12% of contractors in either area "rarely" or "never" recommend high efficiency and over three-quarters report that they recommend energy efficient equipment either "always" or "most of the time."

Table 5-8. Contractor Recommendations and Customer Acceptance of High Efficiency Fixtures

High Efficiency HBL Fixtures Are . . .[1]	**Percentage of Contractors Reporting High Efficiency Is Rarely Recommended or Accepted[2]**	**Percentage of Contractors Reporting High Efficiency Is Often Recommended or Accepted[3]**

	New York[4,5] (n=70)	Comparison Area[4,6] (n=72)	New York[4,5] (n=70)	Comparison Area[4,6] (n=72)
Recommended by contractors	10%	12%	77%	81%
Accepted by customers	4%	5%	63%	59%

[1] Contractors selected among five options: always, most of the time, sometimes, rarely, and never.

[2] "Rarely" includes respondents who specified rarely or never.

[3] "Often" includes respondents who specified always or most of the time. The percentages will not add to 100% as contractors who responded "sometimes" were omitted from this table.

[4] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[5] Contractors were asked to exclude work done on Long Island.

[6] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

5.7.3 Corporate Energy Policy, Sustainability, and Energy Management

As seen in Table 5-9, 38% of NYS end users in the HBL market state their facilities have energy use reduction goals, while 45% of end users in the comparison area have energy reduction goals. Similarly, the comparison between the two areas for end users having corporate environmental or sustainability initiatives is 34% in NYS and 45% in the comparison area. Most of the firms with environmental initiatives include energy management plans as part of that initiative. Among these, 94% of the comparison area end users and 78% of NYS end users with corporate sustainability initiatives have energy management plans. These differences are statistically significant at the 90% confidence level.

Table 5-9. Sustainability Policies among HBL End Users in New York State and the Comparison Area

	NYS HBL End Users[1,2]		Comparison Area End Users[1,3]	
Facility Has . . .	Weighted Number of End Users (n=145)	Percentage of End Users	Weighted Number of End Users (n=121)	Percentage of End Users
Energy use reduction goals	51	38%	50	45%
Corporate environmental or sustainability initiatives	45	34%	48	45%
Sustainability initiatives, including energy management plan[4]	35	78%	45	94%

[1] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[2] The end user survey excluded Long Island.

[3] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

The Effects of Chains and Franchises on HBL Purchasing Decisions

The contractor survey provided some possible insights into differences between the NYS and comparison area HBL markets. The two key findings are as follows:

- Chains and franchises may represent a larger share of the comparison area market than found in NYS
- Chains and franchises have corporate policies that require high efficiency lighting

This combination of higher market share and policies that set a higher efficiency standard for lighting could be a contributing factor to the higher overall technology shares of efficient lighting for the comparison area compared to the earlier studies.

Table 5-10 shows that 46% of contractors installed HBL for a chain or franchise in the comparison area. The percentage in NYS was much lower at 24%. Of the contractors who installed HBL for chains or franchises, this type of project accounted for 34% of the HBL projects among NYS contractors and 39% among comparison area contractors. A third level of analysis was conducted by estimating the chain and franchise HLB projects as a percentage of all HBL projects. When all surveyed contractors were included, the NYS and comparison area results are very similar at 24% and 22%, respectively. However, the higher percentage in NYS is almost entirely driven by one large contractor. When the two areas are compared with the largest contractor removed from each data set, the percentage of projects for chains and franchises is 7% and 18% for NYS and the comparison area, respectively. These results are summarized in Table 5-10.

Table 5-10. Installation of High Bay Lighting by Chains or Franchises

	Installed High Bay Lighting for a Chain or Franchise	
	NYS[1]	**Comparison Area[3]**
Contractors with one or more chain or franchise projects[2]	24%	46%
Percentage of total projects at chains or franchises[2, 3]	24%	22%
Percentage of total projects at chains or franchises with largest contractor removed[2, 3]	7%	18%

[1]Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[2] Contractors were asked to exclude work done on Long Island.

[3] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi

It is not possible to know if the largest contractor in NYS is skewing the percentage of projects associated with chains and franchises upward or if there is a larger market share in NYS for these projects that is served by a small number of contractors.

As can be seen in Table 5-11, contractors who worked with chains or franchises in the HBL market, in both NYS and the comparison area, overwhelmingly report that these companies have consistent policies across all facilities requiring energy efficient lighting. These findings suggest that adoption of high efficiency HBL is common among chains and franchises.

Table 5-11. Policies of Chains and Franchises

	NYS[2,3]		Comparison Area[2,4]	
Do Chains and Franchises…[1]	**Weighted Number of Contractors with Responses (n=70)**	**Contractor Reported Percentage of Chains and Franchises**	**Weighted Number of Contractors with Responses (n=72)**	**Contractor Reported Percentage of Chains and Franchises**
Have lighting specification policies for high bay applications?	13	90%	29	93%
Have policies that incorporate energy	13	97%	27	93%

efficient fixtures or controls?				
Tend to use the same specifications across facilities?	13	100%	22	85%

[1] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[2] Contractors were asked to exclude work done on Long Island.

[3] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

[4] These questions were only asked of those contractors who worked with chains or franchises.

The potential market influence of decisions by large chains and franchises can be appreciated by just considering the expansion of the largest retailer from 2008 through 2010. Walmart increased their United States Walmart store square footage from 567 million square feet in 2008 to 603 million square feet in 2010.[55] In addition to these 36 million square feet of high bay space, Walmart also added 1.2 million square feet to their US Sam's Club chain.[56] On average, this one retailer added three quarters of a million square feet to each state and, although the largest, Walmart is still just one of many chains.

5.7.4 Influence of NYSERDA and Utility Energy Efficiency Programs

Initial screening questions asked whether contractors were aware and familiar with energy efficiency programs and whether these programs influenced the way they conducted business. As the comparison states were selected due to the absence of efficiency programs, one would expect the awareness and familiarity with these types of interventions to be low. The survey results indicate that 57% of the NYS contractors and 77% of the comparison area contractors were either unaware of the efficiency efforts or those efforts had no influence on their business.

Contractors were asked to assess the influence of NYSERDA or utility programs on a variety of efficiency-related decisions. The influence scale went from 1 to 5, with 1 indicating no influence and 5 signifying that the program was the primary reason for their decision. The responses to these questions are summarized in Table 5-12.

Table 5-12. Influence of NYSERDA or Utility Programs

	Percentage of Contractors Reporting No Program Influence[1,2]		**Percentage of Contractors Reporting High Program Influence[1,3]**	
Contractors Reported . . .	**NYS[4,5] (n=70)**	**Comparison Area[4,6] (n=72)**	**NYS[4,5] (n=70)**	**Comparison Area[4,6] (n=72)**
Installing above code HBL fixtures	62%	81%	17%	7%
Recommending high efficiency HBL fixtures	52%	78%	32%	5%
Estimated impact on customer acceptance of high efficiency fixtures	54%	77%	33%	9%

[1] Influence was measured on a 1 to 5 scale with 1 indicating no influence and 5 signifying that the program was the primary reason.

[2] No program influence includes respondents who specified no influence (1 on the influence scale) and also those contractors who indicated that they were unaware or unfamiliar with the efficiency programs.

[3] High program influence includes respondents who specified 4 or 5 on the influence scale. The percentages will not add to 100%

[55] Walmart 2010 Annual Report. p. 21

[56] Ibid p. 23

as the midrange influence (2 to 3) were omitted from this table.

[4] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[5] Contractors were asked to exclude work done on Long Island.

[6] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

Efficiency program influence in NYS is much greater in the specific areas of contractors recommending energy efficient equipment and in customers accepting energy efficient equipment for high bay applications. Almost one-third of the NYS contractors responded that NYSERDA had a great deal of or strong influence on the decision to recommend efficient equipment while only 5% of comparison area contractors reported such an influence by a utility program (see Table 5-12).

5.7.5 Reported Effects of Building Codes on HBL Purchasing

The surveys also inquired about the effect of buildings codes on HBL purchases. During the period of 2007 to 2010, statewide energy codes were updated in three of the four comparison states as well as NYS. About one-third of contractors in both areas cite building codes having an effect on the selection of HBL equipment. For context, the timing and efficiency standard for the adoption and changes in statewide energy codes in NYS and the comparison area states (Alabama, Georgia, Mississippi, and South Carolina) are summarized in Table 5-13.

Table 5-13. Timing and Adoption of Statewide Energy Codes for Commercial and Industrial Buildings by State

State	Adoption History	Efficiency Level of Most Recent Energy Code	Notes
NYS	1979–First energy code 07/01/2002 – State energy code updated to model energy code 01/01/08 – Updated to IECC 2003 04/2008 – Adopted ASHRAE 90.1-2004 01/01/2011 – IECC 2009 effective date	Equivalent to 2009 IECC	As of 12/2010, applies to building system replacement
Alabama	2005 – Adopted ASHRAE 90.1-2001* 12/01/2008 – Adopted IECC 2006* 10/01/12 – IECC 2009 effective statewide	Equivalent to 2009 IECC	*State-funded buildings only
Georgia	7/16/1978 – First energy code based on model energy code effective date 1/01/2005 – IECC 2000 effective date 1/01/2008 – IECC 2006 effective date 1/01/2011 – IECC 2009 effective date	Equivalent to 2009 IECC	
Mississippi	07/01/1980 – (90-1975) effective date * No statewide energy code		*State, public, and high-rise buildings only

State	Adoption History	Efficiency Level of Most Recent Energy Code	Notes
South Carolina	1979 – Energy standard 7/01/2001 – IECC 2000 effective date 1/01/2005 – IECC 2003 effective date 7//01/2008 – IECC 2006 effective date 1/01/2013 IECC 2009 effective date	Equivalent to 2009 IECC	

The percentage of contractors who reported installing equipment above the required energy code standards was approximately the same for NYS and the comparison area (62% to 68%, respectively). However, as can be seen in Table 5-13, two of the comparison states, Georgia and South Carolina, enacted IECC 2006 in 2008 at the same time that NYS enacted the less stringent IECC 2003 code. A third state, Alabama, applied IECC 2006 to buildings that received state funding. Contractors meeting the standards of IECC 2006 in these three states would be installing equipment that exceeded the NYS code requirements from 2008 through 2010.

The contractor surveys suggest there is a difference in the role of the codes in improving the efficiency of HBL, as shown in Table 5-14. While 14% of the NYS contractors reported that the building codes were a primary influence on their selection of the HB fixtures, 23% of the comparison area contractors provided the same response. This difference is statistically significant at the 95% confidence level.

Table 5-14. Influence of Building Codes on Equipment Selection

Building Codes Had an Effect on . . .[1]	Percentage of Contractors Reporting No Effect from Building Codes[2]		Percentage of Contractors Reporting High Effect from Building Codes[3]	
	New York[4,5] (n=70)	Comparison Area[4,6] (n=72)	New York[4,5] (n=70)	Comparison Area[4,6] (n=72)
Determining the selection of HBL fixtures	65%	66%	14%	23%

[1] The impact of the building codes on the selection of HBL equipment was measured on a 1 to 5 scale with 1 indicating no effect and 5 signifying that the building codes were the primary reason for the selection of the HBL equipment.

[2] The "no effect from building codes" category includes respondents who specified no effect (1 on the influence scale) and also those contractors who indicated in the screening question that building codes had no effect on their selection of HBL fixtures.

[3] The "high effect from building codes" category includes respondents who specified 4 or 5 on the influence scale. The percentages will not add to 100% as the midrange influence (2 to 3) was omitted from this table.

[4] Sampling weights were applied as described in Section 2. Totals do not include respondents who indicated "don't know" or "refused."

[5] Contractors were asked to exclude work done on Long Island.

[6] The comparison area consists of South Carolina, Georgia, Alabama, and Mississippi.

5.7.6 Comparison of End User and Contractor Survey Results

The end user survey explored the underlying reasons that purchasers of HBL chose efficient equipment in both NYS and the comparison area. As a validity check on the contractor surveys, a few key questions from the end users were analyzed. The contractor surveys suggested that NYS and the comparison area were similar in respect to the installation of high efficiency HBL. However, the end user survey shows a different picture. Some of the key findings from the end user survey are presented below:

- The end user and contractor reports are reasonably consistent regarding the installation of fluorescent tube fixtures, with 66% and 53% reported by NYS and comparison area end users,

respectively as opposed to 61% and 60% by contractors. These results are not statistically different.

- The estimated installation rates of HID fixtures were more variable between the two surveys, with end users reporting 10% and 28% for NYS and the comparison area and contractors estimating 28% and 27%, respectively. The discrepancy between the end user and contractor reports is statistically significant for NYS and may reflect the disparity in the way the data was collected as the end user survey measures the percentage of technologies end users install, not the installation rate at the market level.[57]
- Awareness of fluorescent technologies for HB applications was similar among NYS and comparison area end users.
- Seventy-four percent of NYS end users reported that they decided to replace their HBL to improve the efficiency, as compared to 58% of the comparison area end users.
- There was no difference in the frequency of recommending lighting controls such as occupancy sensors between NYS and the comparison area.
- Almost three-quarters (72%) of NYS end users reported that they received an estimate of savings from installing high efficiency lighting, while the end users in the comparison states reported obtaining savings estimates less than half the time (43%).

Overall, this comparison suggests that the emphasis on energy efficiency for HBL applications may be stronger in NYS than in the comparison areas and stronger than indicated by the NYS contractor survey. However, there is no strong evidence to cast doubt on the validity of the results from contractor surveys.

5.8 CONCLUSIONS

Lighting markets in the commercial sector are complex with many product choices and a variety of other market influences. In addition to efficacy there are important other attributes of luminaires to consider in any application such as color rendering index and lamp temperature. There are also a myriad of other market influences that affect purchase decisions ranging from state and local building codes to the price of rare earth metals.

The cross-state comparison does not demonstrate that there are market effects in the HBL market resulting from NYSERDA's programs. The inability of the study to quantify market effects from this effort seems to stem mainly from other market influences that have confounded the ability of the study to identify and quantify the market effects in this manner. There are two major factors that have propelled the comparison states to near the same efficiency level for this application.

- The adoption and strengthening of codes in several of the comparison states resulted in higher minimum efficiencies allowed in those states than in NYS during a portion of the study period, i.e., the baseline efficiency was higher in the comparison area than in NYS. Not only were code efficiencies more stringent in part of the comparison area from 2008 through 2010 but contractors also reported a stronger influence from the codes in the comparison area (23%) as opposed to NYS (14%).

[57] Comparing the contractor and end user responses suggests that more of the larger customers in NYS purchase HID lighting for high bay spaces, and more of the larger customers in the comparison area purchase fluorescent lighting than indicated by the end user responses.

- Many corporations have policies regarding sustainability and efficiency levels that may be impacting upwards to 40% of the market for these projects. These policies cut across state lines and tend to raise the average efficiency in the market, regardless of state codes or policies. In particular for corporate entities that use a chain or franchise model, contractors in both NYS and the comparison area reported that over 90% had efficient lighting requirements.

Another confounding factor is that NYS has not mandated the same level of efficacy found in California and Massachusetts. The difference in the overall efficacy in these three markets could also be the result of the timing of the code update cycle. California updates its code on a three-year cycle and the current code, adopted in 2008 and effective in 2010, is more efficient than ASHRAE 90.1 2007.[58] In Massachusetts, since 2008, there is a requirement to adopt each new IECC edition within one year of its publication. Cities and towns are also adopting the stretch code that was designed to be about 30% more efficient than 2006 IECC/ASHRAE 90.1-2004.[59] In 2008, NYS had only moved to the efficiency of ASHRAE 90.1-2004.

On the other hand, a higher percentage of NYS contractors reported influence by efficiency programs than the comparison area for the recommendation, acceptance, and installation of efficient HBL. NYS contractors also identified NYSERDA incentives as a driving force in the market. These are clear indications that in NYS the NYSERDA programs are a positive influence on the adoption of efficient lighting. It is possible that the difference in NYS efficacy in the HBL market compared to other states that mandated higher standards sooner would be greater if not for the influence of NYSERDA programs.

[58] http://www.energycodes.gov/adoption/states/california

[59] http://www.energycodes.gov/adoption/states/massachusetts

Section 6: **CONCLUSIONS AND RECOMMENDATIONS**

6.1 CONCLUSIONS

This evaluation included two components: the enhanced self-report (ESR) component to develop an updated estimate of the nonparticipant spillover (NPSO), and a cross-state study to assess market effects for a single technology. The ESR component is the basis for the new estimate of NPSO to be used in NYSERDA's net-to-gross ratios for its programs that serve C&I existing buildings. The ESR surveys also produced a wealth of information on New York State (NYS) commercial and industrial (C&I) energy-related remodeling projects by nonparticipants from 2007 to 2010 and insights into C&I nonparticipant decision-making.

The cross-state study investigated market effects for high bay lighting (HBL) as an alternative method to provide context for the results of the ESR. The efficiency of the high bay market in NYS and the comparison area are presented for 2007 to 2010 HBL purchasers. The comparisons are between NYS HBL purchasers and contractors compared to HBL purchasers and contractors from South Carolina, Georgia, Alabama, and Mississippi. As this component is a comparison of HBL markets as a whole, the NYS surveys include both NYSERDA program participants and nonparticipants. Although this study component did not demonstrate market effects in NYS for HBL, it provided valuable insights into the influence of codes and corporate policies on the market for this technology.

All evaluation and research studies have some uncertainty and the potential for bias. In this large evaluation study, many elements in the study design and execution were intended to minimize the potential for bias and reduce uncertainty. The evaluation fielded five surveys of end users and contractors for a total of 3,566 completed interviews. NYSERDA's previous NPSO evaluations in this sector did not include surveys of as many market actors. Some other design features and improvements over previous studies are discussed briefly below.

- The sample frame was developed from Dunn & Bradstreet (D&B) data as opposed to the Dodge database that was used in previous efforts.[60] The D&B data covers a wider spectrum of the market, and when augmented with other lists, provides a better representation of the market as a whole.
- The D&B data allowed the study to field an extensive screener survey (over 2,500 completions) that provided primary research into the total size of the C&I market and the remodel rate. The information collected through the screener survey is a key component of the NPSO estimate and also provides valuable information on the C&I market in general.
- Contractor surveys were utilized to measure indirect NPSO occurring when contractors are influenced to recommend and install efficient technology in nonparticipating facilities.
- The calculation of NPSO was refined by removing OSO from the Existing Facilities Program and FlexTech Program that overlaps with the estimate of indirect NPSO savings from contractors.
- Energy use for HBL applications were developed using space-specific lm/ft^2 standards from IESNA rather than generic values.
- The contractor survey from the comparison states was updated and indicated a substantial increase in efficiency in the HBL market. This additional primary research was critical to the accurate assessment of the potential market effects in NYS for this type of technology.

[60] Additional supplemental lists were used for specific sectors under represented in D&B data but these are a small proportion of the population so are not discussed in this summary.

- The methods were refined from previous evaluations and all of the inputs came from the survey or specific secondary sources. There was no need to apply arbitrary caps or adjustments.

These enhanced methods improved the reliability of the results.

6.1.1 Key Findings

The subsections below detail the key findings of the evaluation.

Enhanced Self-Report

There are two important results that came out of the screener survey and were used in the NPSO calculations: the size of the facilities in NYS (an average of 57,514 square feet per facility) and the annual remodel rate (14% a year).

The enhanced self-report (ESR) surveys demonstrated the complex interactions between NYSERDA, the contractors, and the end users in the market. The critical insights into the decision-making process are summarized below.

- There is a low recognition of NYSERDA among end users, as 76% of NYS end users were unaware of NYSERDA.
- The vast majority of contractors recognizes and works with NYSERDA on some level, with 80% of contractors reporting involvement with NYSERDA.
- Contractors estimate that 80% of NYS end users rely on contractors to recommend equipment, either accepting the contractor's assessment entirely or engaging in a discussion on selecting the appropriate equipment.
- Eighty-six percent of contractors report that they recommend energy efficient equipment either always or most of the time.

These market conditions set the stage for extending NYSERDA's influence beyond direct participant activity.

The NPSO rate for existing buildings is 25% with a relative precision of 15% at the 90% confidence level. This value should be incorporated into the formula used by NYSERDA to estimate net savings at the program level:

Equation 6-1. Net-to-Gross Ratio Formula

$$NTGR = 1 - FR + ISO + OSO + NPSO$$

As may be expected from the key findings, the indirect NPSO savings from contractors that are invisible to the end user is greater than the direct NPSO from end users.

Cross-State Study

The results of the cross-state study did not demonstrate that there are market effects from NYSERDA's efforts. Unlike the recent studies conducted for Massachusetts and California, the efficiency of the HBL market in NYS and the comparison states was very similar. This outcome was a combination of a substantial increase in the efficiency of the HBL market in the comparison area and the determination that the efficiency of the NYS HBL market is lower than found in Massachusetts and California.

The inability of the study to quantify market effects from this effort seems to stem mainly from other market influences that have confounded the ability of the study to identify and quantify the market effects in this manner. While the primary research conducted for the cross-state study is not conclusive, it

appears that there are two major factors that have propelled the comparison states to near the same efficiency level for this application:

1. The adoption and strengthening of codes in several of the comparison states resulted in the minimum efficiency allowed in those states being higher than in NYS during a portion of the study period. Thus the baseline efficiency was higher in the comparison area than in NYS. Not only were code efficiencies more stringent in part of the comparison area from 2008 through 2010, but contractors also reported a stronger influence from the codes in the comparison area (23%) as opposed to NYS (14%).
2. Many corporations have policies regarding sustainability and efficiency levels that are likely impacting upward to 40% of the market for these projects. These policies cut across state lines and tend to raise the average efficiency in the market, regardless of state codes or policies. In particular for corporate entities that use chain or franchise model contractors in both NYS and the comparison area reported that over 90% had efficient lighting requirements.

It is also possible that NYSERDA's programs are less focused on HBL than the efficiency programs in California and Massachusetts.

On the other hand, a higher percentage of NYS contractors reported influence by efficiency programs than the comparison area contractors for the recommendation, acceptance, and installation of efficient HBL. NYS contractors also identified NYSERDA incentives as a driving force in the market. These are clear indications that in NYS the NYSERDA programs are a positive influence in the adoption of efficient lighting.

Integration of Results

The estimate of NPSO is 25% and yet the cross-state study did not find market effects for HBL. Given that NPSO would be expected to be a subset of market effects, these findings appear to be contradictory. However, the cross-state study was limited in scope to a particular technology and the findings from this component of the evaluation suggest that confounding factors, such as changes in state energy codes and the expansion of national chains with higher energy efficiency standards, are impeding our ability to make a clear and direct comparison that reflects the impacts of NYSERDA program implementation.

6.2 LESSONS LEARNED

This study was highly complex with many moving parts. The lessons learned through this process may be useful to future evaluation efforts. Some of the key lessons are discussed below.

- The D&B database lists all businesses in NYS and is the most comprehensive list of the existing buildings market. The remodel rate was high enough to use this source as the primary sample frame for the evaluation, with supplemental lists where D&B was known to be weak.
- Overall, there is a lot of variability in this market in terms of sectors, size of establishments, and approach to energy efficiency. Consequently, large sample sizes are required to be able to obtain reliable results. Even with the large sample sizes, the relative precision of the NPSO estimate is about 15% at the 90% confidence level.
- Additional methods of validating key inputs could be investigated. For example, there is a tremendous amount of variability in the size of C&I facilities and even with the large sample size of 1,779 respondents, the estimate of the overall size of the C&I existing buildings market had a relative precision of 14%. Part of this result was due to using the D&B database to stratify by the number of employees. Review of the data suggests that there is a correlation between facility size and number of employees, but comparing the end user reported number of employees to the value

in the D&B database further suggests that inaccuracies in the D&B database increase the variability of this critical parameter.

- The indirect NPSO from contractors is an important component, as the ESR shows that while the end users have low familiarity with NYSERDA, a high percentage of contractors are involved with NYSERDA activities. Ignoring this aspect of the market interactions will underestimate NPSO.
- While there is uncertainty surrounding the inputs into the calculation of the NPSO, the review of the potential sources of bias suggest that a variety of factors could be creating bias in opposite directions. Thus, there is no clear evidence indicating the method of calculating whether the NPSO is either understating or overstating the actual impact of NYSERDA's programs in the C&I existing buildings market.
- The results of the cross-state study raise questions about the validity of the underlying assumption that the comparison area and the evaluation state are sufficiently similar except for the presence of efficiency programs. Under current conditions, it may no longer be possible to identify comparison areas that are an effective proxy for this type of evaluation. Potential impacts from state and federal activities should be considered.
- As parties have different understandings of key concepts, and the surveys are designed to try to obtain information on complex questions, there is always the potential for miscommunication. Wording of the survey questions is critical to the construct validity and extensive attempts are needed to define the calculation methodology and minimize the possibility that questions could be misinterpreted. This is an area where continual improvement is needed.

This type of discussion is often missing from impact evaluation reports and is provided here with the intention of improving the quality of future evaluations.

6.3 RECOMMENDATIONS FOR NYSERDA COMMERCIAL AND INDUSTRIAL PROGRAMS

6.3.1 Baseline Considerations and Program Planning

- When establishing program baseline assumptions, the influence of large market actors, including national chains and franchises should be taken into consideration.
- NYSERDA should support the updating of the NYS energy code at least every three years.
- It may be possible for NYSERDA to identify opportunities to leverage corporate sustainability and efficiency policies and increase the positive influence these appear to be having on the market.

6.4 RECOMMENDATIONS FOR FUTURE EVALUATIONS

The cross-state study provided indications that some chains and franchises may be influencing the market for efficient technology. Ignoring the higher efficiency baseline for these projects could result in the overestimation of program savings. Supporting research at the national level in this area could be an important step toward addressing this issue.