New Construction Program (NCP) Impact Evaluation Report for Program Years 2007 - 2008

Final Report

Prepared for

The New York State
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ABSTRACT

NYSERDA's New Construction Program has been is funded through the Systems Benefits Charge (SBC). The New Construction Program (NCP) provides Technical Assistance and financial incentives to business customers who are building new facilities or undertaking extensive renovations of existing buildings. The businesses served by the NCP include commercial, multi-family, institutional, industrial, dairy, government, and nonprofit operations. This report describes an impact evaluation of the NCP projects completed for the calendar years 2007 – 2008.

The NCP Impact Evaluation included rigorous evaluation of the program-reported savings for a sample population of projects. The evaluated gross savings were determined as the difference between the as-built project energy use and the code baseline project energy use. The as-built project energy use was established based on metering, inspections, project documentation, and interviews. The as-built analysis was calibrated against utility billing data and normalized for typical weather. The code baseline project energy use was calculated using the calibrated, normalized as-built operating parameters and code minimum efficiency equipment and construction.

The program evaluated net savings were determined through a combination of modeled partial evaluated net savings analysis (described further below), participant outside spillover analysis, non-participant baseline, and non-participant spillover estimation. The modeled partial evaluated net savings were calculated as the difference between the project specific baseline energy use (expected building energy use absent the program) minus the as-built project energy use. The project specific baseline energy use was determined through modeling of the project specific baseline levels of efficiency and control as determined through project owner and design team interviews and was supported by findings from 150 interviews of nonparticipant project owners and designers. The modeled partial evaluated net savings included the impacts of free ridership and participant inside spillover. The participant outside spillover and nonparticipant spillover were determined from surveys and incorporated into the program net-to-gross ratio.

The report includes recommendations for the Program and future evaluation activities.

ACKNOWLEDGMENTS

This report was prepared with input from Judeen Byrne of NYSERDA's Impact Team and members of NYSERDA's New Construction Program staff.

GLOSSARY OF ACRONYMS AND DEFINITIONS[1]

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

building energy simulation software - Various modeling software such as DOE-2, eQUEST, TraneTrace, etc.

C&I - Commercial and industrial – Customers served under the New Construction Program, including multifamily (over four stories) and institutional facilities such as townhouse-style dormitories of less than four stories.

CBECS - Commercial Buildings Energy Consumption Survey - A national sample based survey that collects and reports information on the stock of U.S. commercial buildings, their energy-related building characteristics, and their energy consumption and expenditures.

contact rate - One of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR).[2] Includes all outcomes for which an eligible respondent was reached and the interview attempted divided by these plus those not contacted. The three contact rate outcomes are completes, 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 completes, refusals, and break-offs.[4]

ECM – Energy conservation measure.

EM&V – Evaluation, measurement and verification.

FR - Free rider, free ridership - A free rider is a program participant who would have implemented the program measure or practice in the absence of the program. Free ridership refers to the percentage of savings attributed to customers who participate in an energy efficiency program but would have, at least to some degree, installed the same measure(s) on their own if the program had not been available.

GSHP – Ground source heat pump.

HP – Heat pump.

HRU – Heat recovery unit.

HVAC – Heating, ventilation and air conditioning.

IPMVP – International Performance Measurement and Verification Protocol.

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[1] Portions of this 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*. Each of the rates presented here has multiple more-specific categories and definitions provided by AAPOR. *Standard Definitions* is available on AAPOR website: www.aapor.org.

[3] Ibid.

[4] Ibid.

IPMVP Option B: Energy Conservation Measure Isolation – An M&V protocol in which savings are determined by full measurement of the systems affected by the energy efficiency measures, separate from the rest of the facility.[5]

IPMVP Option D: Calibrated Simulation Modeling – An M&V protocol in which savings are determined at the whole-building level by measuring energy use at main meters and/or sub-meters and using whole-building energy models calibrated to the measured energy use data.

ISO – Participant inside spillover (see also SO – Spillover).

LPD – Lighting power density (lighting wattage/illuminated area (sq.ft.).

Market effects – Changes in the market caused by program or policy efforts that range from market structure changes to energy savings resulting from the induced market changes. These may include increased adoption of energy efficient practices and/or increased availability of energy efficient technologies. Market effects are not included in spillover.

Market Penetration – The proportion of sales of an efficient product or adoption of an efficient practice in comparison to all sales of the product or adoption of the practice that occur during a specific time period, such as the percentage of residential light bulb sales that are CFLs during calendar year 2011.

Market Saturation - the percent of a specific efficient product or other item of interest in use in comparison to all such items, *e.g.*, the percent of all residential bulbs in all homes that are CFLs, regardless of when they were bought or installed.

MPN – Modeled partial net savings, *e.g.*, evaluated savings calculated as the difference between the project-specific baseline (the energy use calculated for the project absent program intervention) and the as-operating project (the energy use of the installed project including energy savings from ISO and the installed measures). The MPN accounts for free riders and participant spillover, but not participant outside spillover or non-participant spillover.

MPNR - Modeled partial evaluated net savings ratio. The ratio of MPN to program reported savings.

M&V – Measurement and verification.

NCP – New Construction Program

NOAA – National Oceanic and Atmospheric Administration.

NPSO – Non-participant outside spillover (see also SO – Spillover).

NTG, NTGR – Net-to-gross, net-to-gross ratio – The relationship between net energy and/or demand savings, where net savings is measured as what would have occurred naturally without the program, and evaluated gross savings. The NTGR is the ratio of evaluated net savings to evaluated gross savings. For NYSERDA programs the NTGR is defined as one minus free ridership plus spillover (1 – FR + SO). This ratio incorporates all spillover components, including participant outside spillover and non-participant spillover.

NYECC – New York Energy Consumers Council.

NYISO – New York Independent System Operator.

OSO – Participant outside spillover.

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[5] Efficiency Valuation Organization, *International Performance Measurement and Verification Protocol: Concepts and Practices for Determining Energy Savings in New Construction*, vol. 3, revised January 2006, http://www.evo-world.org.

PQ – Prequalified measure.

Precision - The indication of the closeness of agreement among repeated measurements of the same physical quantity. In regression analysis (econometrics), the accuracy of an estimator as measured by the inverse of its variance.

Propagation of Error (POE) – Whenever two or more factors are used to derive an estimate, the total uncertainty can be estimated through a propagation of error analysis. The outcome of the POE is the total uncertainty in the type of error being included, *i.e.*, sampling error for analyses of samples (such as samples to derive realization rates for evaluated gross savings) or measurement error (for an engineering formula).

PSB – Project-specific baseline - the energy use calculated for a specific project absent program intervention including savings attributed to free ridership.

RE – Review engineer – Engineer from the Impact Evaluation Team assigned to complete project level M&V tasks.

Relative Precision – Relative precision reflects the variation due to sampling as compared to the magnitude of the mean of the variable being estimated.

Response Rate – One of the final disposition and outcome rates for surveys defined by the AAPOR[6]. The response rate estimates the fraction of all eligible working numbers for which a request for an interview was made. The denominator of this ratio is the inclusion of all possible components for which a request for an interview could be attempted. More specifically, the response rate is the number of completed interviews divided by the sum of completes, refusals, break-offs, not contacted, and the figure estimated for unknown eligibility.

RR – Realization rate - The ratio of the evaluation energy savings to the program's claimed savings. The RR represents the percent of program-estimated savings that the Impact Evaluation Team estimates as being actually achieved based on the results of the evaluation M&V analysis. The RR calculation for electric energy for a sampled project is shown below:

$$RR = \frac{kWh_{evaluation}}{kWh_{program}}$$

where RR is the realization rate, $kWh_{evaluation}$ is the evaluation M&V kWh savings (by evaluation M&V contractor), and $kWh_{program}$ is the program reported kWh.

SO - Spillover – Refers to the energy savings associated with energy efficient equipment installed by consumers who were influenced by an energy efficiency program, but without direct financial or TA from the program. Spillover includes additional actions taken by a program participant as well as actions undertaken by non-participants who have been influenced by the program. This evaluation addresses participant inside spillover (ISO), participant outside spillover (OSO), and non-participant spillover (NPSO).

inside spillover - Occurs when, due to the project, additional actions are taken to reduce energy use at the same site, 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.

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[6] Efficiency Valuation Organization, *International Performance Measurement and Verification Protocol: Concepts and Practices for Determining Energy Savings in New Construction*, vol. 3, revised January 2006, http://www.evo-world.org.

non-participant spillover - The reduction 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.

SRE – Stratified ratio estimation - An efficient sampling design combining stratified sample design with a ratio estimator. The ratio estimator uses supporting information for each unit of the population when this information is highly correlated with the desired estimate to be derived from the evaluation, such as the tracking savings and the evaluated savings.

TA – Program-funded technical assistance - The NCP funds TA studies directly through the program. The use of the term TA in this report refers to NCP-funded TA studies; there is no overlap with the FlexTech Program.

TMY3 – **Typical meteorological year 3 -** A typical meteorological year is a collation of selected weather data for a specific location generated from a data bank much longer than a year in duration. It is specially selected so that it presents the range of typical weather phenomena for the location in question, while still giving annual averages that are consistent with the long-term averages for the location in question. The third, and latest, TMY collection (TMY3) was based on data derived from 1991-2005 records. TMY3 data is published by the National Renewable Energy Lab.[7]

VAV – Variable air volume – a method for delivering heating, ventilation and air conditioned that changes the amount of air delivered in response to thermostat demands; the air temperature is held constant.

VFD – Variable frequency drive – an electronic control device that changes the speed of a motor based on control feedback regarding system loads.

WB – Whole building.

[7] S. Wilcox and W. Marion, *User's Manual for TMY3 Data Sets, NREL/TP-581-43156* (Golden, Colorado: National Renewable Energy Laboratory, 2008).

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EXECUTIVE SUMMARY

This report provides a detailed description of the impact evaluation conducted for NYSERDA's commercial and industrial (C&I) New Construction Program (NCP or Program) for projects completed in years 2007 and 2008. The evaluated project population included projects that initiated Program contact from 2001 – 2007. This summary provides a brief overview of the verified savings followed by a description of the Program, the evaluation approach, a discussion of the evaluation components, and an overview of the findings and recommendations.

OVERVIEW OF EVALUATED GROSS AND EVALUATED NET SAVINGS

The evaluation estimated program savings are shown in Table ES-1. The NCP evaluated gross savings for this period being evaluated are 58,887,988 kWh and 11,840 kW. The realization rates were 71% and 52% for electric energy and electric demand savings, respectively. These results are based on the 39 projects included in the sample. The overall net-to-gross ratio (NTGR) was 1.16 for kWh savings and 1.27 for kW savings; the variation in values is due to modeling of participant net impacts. The evaluated net savings achieved by NCP are 68,310,066 kWh and 15,037 kW.

Table ES-1. Summary of NCP Savings for Projects Completed in Years 2007-2008

	Annual Electric Savings (kWh/Yr)	Peak Electric Demand Savings (kW)
Program-reported savings	82,940,828	22,769
Realization rate	71%	52%
Evaluated gross savings	58,887,988	11,840
Net-to-gross ratio	1.16[a]	1.27[a]
Total evaluated net savings	**68,310,066**	**15,037**

a – The values for kWh and kW net-to-gross ratios varied due to modeling of partial net impacts.

Note: Tracking and claiming natural gas savings was not a focus of the Program during the years being evaluated. A few projects were found to have claimed gas and other fossil fuel savings, but the data was not adequate to establish a program level realization rate. The Program did not provide incentives for natural gas related measures.

The absolute precision at the 90% confidence level for the modeled partial net ratio (MPNR) is plus or minus 7% for kWh and 6% for kW, and the relative precision is 18% for kWh and 17% for kW. The relative precision is higher than the 90/10 standard due to high variability in the sample and the low value of the MPN (0.25). The MPNR is the ratio of modeled partial net savings (MPN) to program reported savings. The MPN is calculated as the difference between the project-specific baseline (modeled energy use for the project absent program intervention) and the as-operating project modeled energy use. The MPN accounts for free riders and participant inside spillover.

The non-participant spillover (NPSO) rate is 61%; the lower 90% confidence bound is 52%. Research showed significant increases in the adoption of energy efficient practices in non-participating buildings with a portion of the increase attributable to the influence of NCP on the market. The NPSO was calculated by extrapolating the estimated savings per square foot to the entire market. Since buildings in the NCP program account for only 16% of the total square footage of C&I new construction, the potential NPSO savings are substantially higher than the program savings. The MPNR and NPSO were combined to obtain the net-to-gross ratio for the program.

The values in this table and throughout the report have been modified to reflect the results found by multiplying the rounded numbers presented in these tables.

NEW CONSTRUCTION PROGRAM OVERVIEW

The NCP addresses a multifaceted and technically sophisticated market including building developers, owners, design firms, and contractors. It provides participants with technical assistance (TA) services and/or financial incentives for implementing energy efficiency measures in new construction and substantial renovation projects. NYSERDA shares the costs of the services of a NYSERDA-contracted TA consultant who identifies energy efficiency opportunities, quantifies the estimated incremental costs and savings of the efficiency improvements, and summarizes the findings in a TA Study. TA providers use simulation software such as DOE-2[8] and spreadsheets to analyze measures.

Whole building incentives are tiered and custom incentives are established at a fixed rate per kWh and kW. Greater financial assistance is provided to customers with projects achieving higher levels of energy savings. Prescriptive incentives (standardized incentives for specific equipment), are provided to participant projects with limited opportunities either because the projects are small or they have applied late in the project design and construction process. In some cases, prescriptive incentives for qualifying measures are combined with custom incentives for whole building and custom projects. The prescriptive incentives are for specific products, including lighting, variable frequency drives and HVAC.

While the efficiency measures funded under the Program often impact fossil fuel use, the Program has not historically focused on quantifying, or providing incentives for fossil fuel impacts. However, during the period addressed in this evaluation, in some cases fossil fuel impacts were included in the TA studies and quantified in the NYSERDA database.

EVALUATION APPROACH

The purpose of this impact evaluation is to establish rigorous and defensible estimates for the net energy and demand savings attributable to NYSERDA's NCP. The primary vehicle for evaluating savings was on-site measurement and verification (M&V) conducted for a sample of 39 participants. Based on the on-site findings and utility data, the evaluators determined the as-operating energy consumption of each project.

Savings estimates for new construction programs have engineering uncertainty associated with establishing the baseline practice because the baseline condition cannot be directly observed. The post-installation conditions and consumption are directly observed and measured to establish the as-operating energy use. The "pre-installation" or baseline is typically estimated using code for new construction. However, a code baseline does not necessarily reflect the standard or typical building practices that are occurring in the market. The objective of the evaluation is to determine the reduction in energy use below baseline usage for standard building practice that is attributable to the NCP. Thus, establishing a reasonable and defensible baseline to estimate pre-installation use was a critical component of this impact evaluation.

In the absence of a comprehensive New York State C&I baseline study, the Impact Evaluation Team developed an innovative approach to determining the baseline by establishing a project-specific baseline for each site in the sample. The project-specific baseline was developed based on detailed interviews with participants. A telephone survey of non-participating building owners and design teams was used to

[8] DOE-2 is a widely used and accepted freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, operating schedules, conditioning systems (lighting, HVAC, etc.), and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills, www.DOE-2.com.

provide a reality check. Since the project-specific baseline includes the net effect of free-ridership (FR), two baselines were used to determine the project savings:

1. Evaluated gross savings for each project were calculated using the applicable New York State energy code as baseline
2. Modeled partial net savings for each project were based on the project-specific baseline (the technologies, control strategies and efficiency levels planned for the project, absent the Program)

The post-installation energy consumption determined for each site included savings directly attributable to the Program and any savings resulting from inside spillover (ISO). ISO was identified through on-site investigation and participant surveys. ISO was subtracted out of gross savings calculations and included in modeled partial net savings.

This approach is different from standard impact evaluation techniques. Typically, FR and ISO are estimated based on self-reports regarding the level of influence exerted by the NCP on the decision to install the energy efficient measure. The typical process allows for partial FR according to the level of influence, but not in reference to the complex decisions regarding specific equipment purchases, which are likely to be a combination of energy efficient and standard models. In contrast, basing the evaluated net savings on the project-specific baseline created a more nuanced assessment by incorporating the intention to install specific equipment and controls in the absence of the NCP. Thus, this approach is superior to more typical strategies in that the final estimate of net effects addresses both of these critical components based on project specific technology inputs.

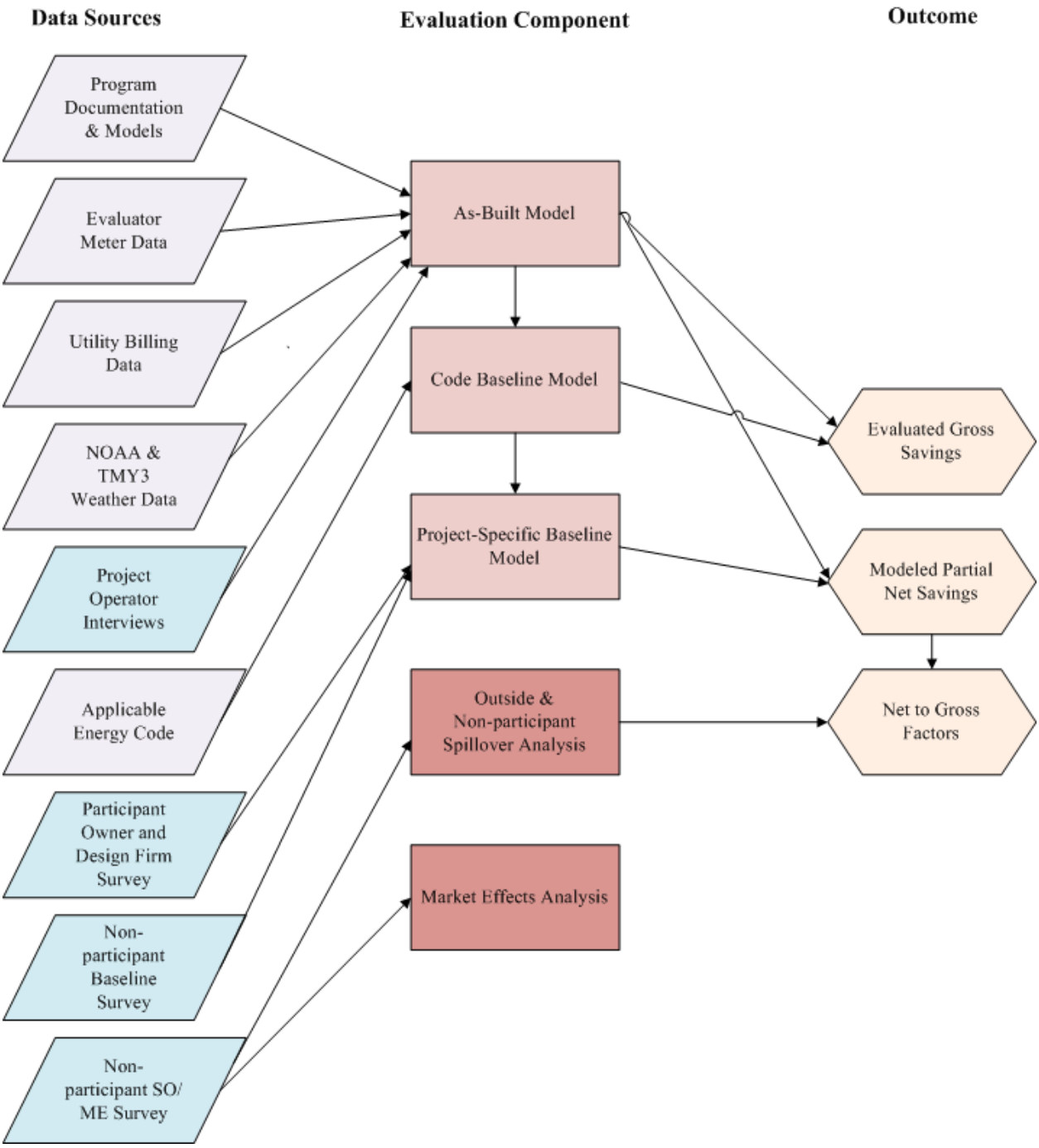
EVALUATION COMPONENTS

The NCP impact evaluation has several major components:

1. Determination of project evaluated gross savings
    a. Site-specific M&V of installed measures
    b. Modeled as-built annual energy use of the installed systems, calibrated to utility data where feasible and normalized to typical meteorological conditions
    c. Modeling of code baseline energy use for the systems affected by the Program
2. Determination of modeled partial net savings
    a. Participating owner and design firm surveys
    b. Modeling of project-specific baselines
    c. Non-participant baseline surveys
3. Determination of participant outside spillover (OSO) through survey data and review and use of participant outside spillover (OSO) data from the prior evaluation
4. Determination of NPSO through non-participant surveys
5. Pilot study of potential market effects not captured by spillover (SO)

Figure ES-1 shows how the data sources, evaluation components, and outcomes fit together, and each of the components is described briefly below.

Figure ES-1. Data Sources, Evaluation Components, and Outcomes



EVALUATED GROSS SAVINGS

The evaluated gross savings were estimated for every project in the sample, and the results were aggregated to program totals using stratified ratio estimation. The evaluated gross savings by project were calculated as follows:

Evaluated Gross savings=Energy use from code baseline model – Energy use from as-built model – Modeled ISO

The following three sections provide an overview of the measurement and verification methods employed to determine the NCP evaluated gross savings.

Site-Specific Measurement and Verification

Site-specific M&V of the installed measures was the foundation of the NCP Impact Evaluation and supported the development of the three models: as-built, code compliant and project-specific baseline. The purpose of the site-specific M&V was to gather sufficient information to conduct a rigorous analysis of the program-supported measures installed in the M&V sample.

Data, including program files and utility bills, was collected for each project in the sample. The review engineer (RE) assigned to perform project M&V developed a detailed site-specific measurement, verification and analysis plan. The plans outlined the baselines, analysis approach, and metering proposed for each measure. They also described the program analysis methodology and described differences between Program and evaluation methodology where they occurred. The plans also described project-level and measure-level sampling. In general the measures included in the M&V accounted for at least 95% of kWh and 90% of demand savings.

The REs conducted field inspections, interviewed participants regarding operational parameters, and performed metering for each site. They obtained additional project data not included in program files such as as-built drawings, sequences of operation, and trend logs showing HVAC equipment operation from the building automation system (BAS)[9]. The evaluation protocol required the REs to validate BAS data through on-site metering.

The participant interviews included questions regarding the operation of systems and the building over time and input on how representative the metered period was of annual and/or typical operation. This information was used along with meter and utility data to develop the model of annual energy use for the as-built model.

As-Built Model & Utility Calibration

The Impact Evaluation Team conducted an analysis of the installed measures for each project in the sample using either full building energy modeling or spreadsheet analysis of the efficient equipment or systems. The analysis determined the annual energy use and the performance period demand of the installed equipment. The analysis process involved the following steps:

- Computer simulation models or custom spreadsheet analyses were developed using 1) the detailed on-site data collected during the verification-site visits and operator interviews in combination with 2) information from NYSERDA's project files. Where the observed conditions

[9] Building Automation Systems (BAS) are digital control systems which capture data about system operation and respond to changing building and outside conditions to maintain comfort and ventilation set-points, control equipment on and off and in some cases to optimize system performance while minimizing energy use. These systems can typically provide trend logs which are recordings of system parameters over time. The M&V protocol used for this evaluation required that the RE independently verify the BAS data before relying on trend logs. This independent validation consisted of a comparison of field measurements made using calibrated test instruments to the BAS reading of the same data point.

differed from those used in the TA analysis, the evaluators used the observed conditions. This includes relying on operator interview statements regarding schedules.[10]

- Metered data from the sites was used to inform the models by calibrating the modeled energy use of major equipment, such as chillers and air handlers, to the actual metered energy use as measured on-site.
- The models were then calibrated or analyzed against monthly utility billing data. Calibration of whole building models to monthly utility data followed the protocols of International Performance Measurement and Verification Protocol Option D – Calibrated Simulation Modeling[11] and ASHRAE Guideline 14-2002 Measurement of Energy and Demand Savings[12].
- If measures were analyzed individually rather than with whole building simulation, the percent of the annual energy bill attributable to the efficient end use system was compared to that of a typical building as determined using the Commercial Buildings Energy Consumption Survey (CBECS)[13] database where feasible.
- The models were then weather normalized to reflect the energy consumption for a typical meteorological year for the locale in which the site is located.

If a project included an estimate of natural gas savings, the evaluators included natural gas savings in the analysis. Natural gas impacts were also evaluated for fuel switching measures regardless of whether the Program had captured the gas impacts.

Code Baseline Model

Once the as-built annual energy use for the building or the measures was determined, the model was adjusted to reflect code baseline equipment and the annual energy use of a code-compliant building or measure was calculated.

MODELED PARTIAL NET SAVINGS

The modeled partial net (MPN) savings reflect the savings that are attributable to the Program for each project. The MPN compares the as-operating energy use, which reflects the efficiency of the program measures and any inside spillover that occurred at the project, to the project-specific baseline, which includes the FR effects and is determined through energy analysis based on participant interviews. The partial evaluated net savings by project were calculated using the following formula:

$$\begin{aligned} &Modeled\ Partial\ net\ savings \\ &\quad = Energy\ use\ from\ project\ specific\ baseline\ model \\ &\quad - Energy\ use\ from\ as\ built\ model \end{aligned}$$

[10] In one case the evaluators used engineering judgment to revise a motor load estimate to lower loading than that used in the TA analysis. Based on feedback from Program Staff, the evaluators re-analyzed the measure using the TA assumed loading and found the impact on the realized savings to be negligible.

[11] Efficiency Valuation Organization, *International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings Volume 1(2011),* 28-32.

[12] American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. *ASHRAE Guideline 14-2002: Measurement of Energy and Demand Savings, (2002).*

[13] Energy Information Administration: http://www.eia.gov/emeu/cbecs/

The components required to facilitate the estimation of evaluated gross and modeled partial net savings are described below. Appendix F shows an example of the process for a sample project.

Project-Specific Baseline Model

The purpose of the project-specific baseline model was to estimate energy use based on what would have been installed in the absence of the NCP. This modeled energy use was then used to calculate the partial net (MPN) savings for each project. The process is explained below.

- REs trained in survey techniques conducted interviews with project owners and design team members in order to determine the technologies, control strategies and efficiency levels that would have been installed in the building absent the Program.
- Survey results were discussed in a triangulation teleconference between the NCP evaluation lead, the NTG lead, and the RE. The purpose of the triangulation meetings was to ensure consistency in interpretation of interview responses across the evaluation.
- The outcome of this process was a list of project-specific baseline technologies, control strategies and equipment efficiencies which were then used to develop a model of the project-specific baseline.

In most cases the triangulation teleconference results confirmed the RE-recommended baselines. In a limited number of cases (less than 5), the baselines were modified as a result of the teleconference or the RE was requested to obtain additional information through supplemental surveys. Responses from traditional FR and ISO participant survey questions were compared to the FR and ISO findings in the partial evaluated net savings.

In addition, baseline surveys of non-participating building owners and design firms were conducted. The sample was based on buildings that completed construction in 2007 and 2008 and that did not participate in the Program. The sampling memo located in Appendix D of this report describes the methods in detail. Owners and designers of the sampled buildings were surveyed specifically about technologies installed in the selected building. The responses obtained from this survey were used to validate the findings in the participant project-specific baseline surveys.

Spillover & Market Effects

All changes observed in a market are referred to as market changes and may have no relationship to the efficiency programs or policies being examined. Market effects are the impacts caused by program or policy efforts that range from market structure changes to energy savings resulting from the induced market changes.

Telephone surveys were conducted with participating design firms and included gathering data regarding participant outside spillover (OSO). Telephone surveys with non-participating building owners and design firms were conducted to gather information to estimate NPSO and to conduct the pilot market effects study.

Theoretically, the comprehensive SO measurements with participants and non-participants, customers, and mid-stream market actors should capture all the market impacts generated by the Program. However, market transformation is based on complex interactions and includes changes in market structure and operation.

The survey inquiries used in spillover measurement may not capture all the program effects since they only include direct inquiries and do not include changes in market structure or all possible changes in market operations that could be induced by the program. An example of this would be if the program induced owners to ask for a design option based upon lifecycle costing and the Program did this in a way that their behind the scenes work was unknown to end-users. This pilot effort involved testing whether it

is likely that some program effects are not captured in the current (and prior) NYSERDA evaluation design.

FINDINGS

The results of the evaluation include the project and program evaluated gross savings, the modeled partial net program savings, the program NTGR, and the evaluated program net savings,. These findings are summarized below.

Evaluated Gross Savings Findings

Evaluated gross savings deviated from program reported savings. Savings variations were generally attributable to the following reasons:

- Building operations and/or building loads were different than expected.
- Reported measures were not installed.
- Deemed savings for large ground source heat pump projects overstated the savings[14].
- Analysis and data entry errors were made.
- Installed equipment had a lower efficiency than reported.

Evaluated Net Savings Findings

The evaluated net savings analysis included three primary components: modeled partial net savings (MPN), participant OSO, and NPSO.

Net Savings = MNP + Participant OSO + Non-Participant Spillover

The modeled partial NTGR reflects the number of high efficiency measures or practices that would have been included in the customer-specific baseline absent the program and corresponds to a high FR rate. These adoption rates and practices are consistent with the findings of the non-participant baseline surveys, which showed that market actors are adopting energy efficient practices absent the program at a significant rate.[15]

Participant Outside Spillover and Non-participant Spillover

The survey with participating design teams did not contain enough complete data (low sample size, low SO rate, and incomplete responses) to provide a reliable estimate of participant OSO. The initial SO question was sufficient to identify that OSO was occurring and to compare responses to that inquiry to an identical one made in the prior NCP evaluation. A scaling factor was developed from that comparison and used to estimate participant OSO for the 2007-2008 program years. The participant OSO rate was estimated to be 20%.

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[14] The Program relied on deemed savings for all prequalified measures. In several cases whole building models estimated savings for everything related to ground source heat pump systems (except the heat pumps themselves) and then used the deemed savings for the heat pumps. This approach typically resulted in overestimates of the savings for the system because interactive affects were not captured.

[15] The participant and non-participant samples are believed to be representative of project types and the timelines for projects completed in 2007 and 2008 and for projects going forward from these completion years (given the nature of new construction).

NPSO was estimated based on changes in market penetration of several high efficiency technologies and practices and the proportion of the change identified by respondents as being caused by the New York energy efficiency program for commercial and industrial new construction (with the only program operating in 2007 and 2008 being NYSERDA's NCP). Using savings per square foot these survey results were used to derive a NPSO estimate of 61%.

PILOT MARKET EFFECTS STUDY

The 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 evaluation. Further evaluation research needs to be undertaken to provide a reliable estimate of market effects but the pilot shows that undertaking this additional research and obtaining DPS approval for reporting market effects as part of achieved evaluated net savings would be worthwhile for NYSERDA and for an accurate estimate of savings being achieved in New York toward the goals of the "15 by 15" policy.

CONCLUSIONS

The evaluation determined that the NCP gross electric kWh savings realization rate (RR) is 71% and found a RR of 52% for gross electric kW. The net-to-gross (NTG) components incorporate a modeled partial net rate of 35% for kWh, reflecting a 66% FR and 1% ISO. Participant outside spillover (OSO) and non-participant spillover (NPSO) were estimated at 20% and 61%, respectively. The total kWh (energy savings) NTGR is 1.16. The modeled partial net rate (MPNR) for demand (kW) is 0.46, for NTGR of 1.27. The MPNR varied for kWh and kW due to modeling.

The single most critical component of an impact evaluation for a new construction program is determining the baseline. Savings from new buildings are difficult to estimate due to the inherent uncertainty in defining baseline construction practices. An innovative evaluation design was developed for this Program to account for the absence of a comprehensive baseline study.

The evaluation design included development of project-specific baselines and comparing the as-built and project-specific baseline models to estimate net effects. This approach to estimating the modeled partial net ratio (MPNR), including FR and participant ISO, was highly informative and resulted in a rigorous and reliable estimate of net program impacts.[16] The more detailed, model-based approach improves the quality and rigor of the analysis for the following reasons:

1. It allows for a more nuanced definition of the baseline and net effects in that it reflects the equipment and controls the participant would have installed absent the program rather than relying on traditional FR and ISO self-report percentages.
2. The model-based approach included calibration of the energy consumption in the building to actual utility billing records, whenever possible, and thus, the project-specific baseline model reflects actual building operations.
3. The model-based approach provided a wealth of detailed and useful information about the construction practices in NCP participating buildings and directly addressed the baseline construction practices in the absence of the program.

[16] FR and ISO are only part of the NTG components, hence the name "partial net." The other NTG components are OSO and NPSO.

In the innovative, project-specific approach used in this evaluation, the distinction between FR and standard practice effects are blurred. However, the net program impacts correctly include all of the net effects and these effects are estimated with greater specificity than can be achieved from a standard NTG telephone survey alone. Thus the model-based approach results in more reliable evaluated net savings than could have been achieved by using more traditional baseline estimation methods in the absence of a comprehensive baseline study.

The sample of projects selected for this evaluation were completed in program years 2007 and 2008 and included projects that enrolled in the Program between September 13, 2000 and April 4, 2007. This long project development cycle means that the evaluation covers an extended period of program implementation over which changes have been made. As there can be a substantial lag between corrective actions taken by implementers and the visible impact of program changes on completed projects, some of the issues identified in this evaluation may reflect practices used early in the implementation of the NCP. The findings contained in this report should be interpreted in this context and with the understanding that some report recommendations may have already been implemented by program staff.

RECOMMENDATIONS

This evaluation identified a variety of recommendations regarding program approach, data tracking, and evaluation activities. NCP staff continues to improve the Program and it is the Impact Evaluation Team's understanding that NCP staff have incorporated some program changes in response to recommendations outlined in this evaluation. The following lists highlight the major findings and recommendations. The full list is detailed in Section 5:

<u>Major Findings, Recommendations and Program Actions</u>

- In new construction, the building operating parameters used in Program savings calculations are based on assumptions made during design. Actual operating conditions are frequently different from the design assumptions. The operating deviations had significant impacts on realized savings for several of the evaluated projects.
    - *Recommendation: For projects and measures with large savings, consider including more rigorous commissioning and validation protocols as well as independent third-party M&V as part of the Program.*
- The use of deemed savings for prescriptive measures in projects with complex whole building or custom analyses fails to address interactive effects and can result in the overestimation of savings.
    - *Recommendation: For projects with whole building or custom analysis, include all measures in the analysis. The savings for those measures receiving standardized incentives should be analyzed as part of the whole building or custom analysis to ensure accurate quantification of interactive effects.*
- Prescriptive lighting measures used equipment type as baseline while energy code uses lighting power density.
    - *Recommendation: Use code lighting power density (LPD) baseline for new construction lighting measures.*
- Project modeling files and participant utility data were difficult to obtain.
    - *Recommendation: Retain working copies of project model files. Increase duration and transferability of utility release forms.*

- Because of the long new construction project development cycle, this evaluation addresses Program practices that are over five years old. As program staff continues to make improvements to the program design, some issues identified in the evaluation have already been addressed.
    - *Recommendation: Accelerate the NCP evaluation cycle so that evaluations are occurring within two years of project completion.*
- Quantifying SO and market effects is extremely complex and has a major impact on realized savings.
    - *Recommendation: Pursue continuous improvement in the methods used for quantifying SO and market effects over time.*

SECTION 1:

INTRODUCTION

The **New York Energy $mart**[SM] 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 customers that pay in to 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 $mart**[SM] Program. NYSERDA oversees both program implementation and evaluation. The evaluation effort is essential to ensure that savings from ratepayer-funded programs are accurate and to identify opportunities to increase the savings resulting from program activities.

This report provides a detailed description of the impact evaluation conducted for NYSERDA's New Construction Program for projects installed in the years 2007 and 2008.

1.1 NEW CONSTRUCTION PROGRAM BACKGROUND

The New Construction Program (NCP or Program) addresses a multifaceted and technically sophisticated market including building developers, owners, design firms, and contractors. The Program includes the following delivery strategies to commercial and industrial (C&I) participants:

- Independent NYSERDA-contracted engineering TA providers help the customer and their design team to identify energy savings opportunities. They perform modeling and savings estimation for the customer. NYSERDA shares the costs of TA services.
- NYSERDA-contracted outreach project consultants (OPCs) provide customer support throughout the application and project participation processes. Additionally, OPCs review project TA studies.
- OPCs conduct site inspections for verification of as-built equipment installation.
- Post-installation commissioning is supported on some projects to ensure proper system operation.
- Prequalified incentives are provided for many common measures.

The Program began operation in 2000. The Program is dynamic and has made significant changes since the evaluation period. Measurement and verification (M&V) evaluations of the NCP were conducted in 2004, 2005, and 2006.

An additional level of TA provides specialized green building support to interested customers. These green building services include computer modeling, materials analysis, and help in complying with Leadership in Energy and Environmental Design (LEED), the rating system developed by the U.S. Green Building Council.

Whole building and custom incentives are tiered, with greater financial assistance provided to customers with projects achieving higher levels of energy savings. Prescriptive incentives are provided to participants for specific products, including lighting and HVAC. In some cases, prescriptive incentives are combined with custom incentives on whole building and custom projects that include qualifying equipment such as lighting, VFDs and packaged heat pumps.

While the efficiency measures funded under the Program often impact fossil fuel use, the Program did not historically focus on quantifying, or providing incentives for fossil fuel impacts. However, in some cases

fossil fuel impacts were included in the TA studies and in a subset of those, the natural gas impacts were quantified in the NYSERDA database.

The Program's whole building savings estimates are typically based on DOE-2[17] modeling of code-defined baseline and program-supported design conditions. Custom savings estimates use modeling software, such as DOE-2, and custom spreadsheets to analyze measures. For prescriptive measures deemed values are used to quantify savings.

1.2 EVALUATION OBJECTIVES

The purpose of impact evaluation is to establish rigorous and defensible estimates for the net electric energy and demand savings attributable to NYSERDA's Program for the period being evaluated. The Impact Evaluation Team determined the realization rate (RR), (*i.e.*, the ratio of the actual verified gross savings to the Program-reported savings) and also developed estimates of free riders (FR) and spillover (SO). The net-to-gross (NTG) factors were applied to the evaluated gross savings to produce evaluated net savings. During this effort, the Impact Evaluation Team also sought to identify opportunities to improve program processes and future evaluations.

1.3 ORGANIZATION OF THE REPORT

Section 2 provides an overview of the sources, sampling and surveys used in the evaluation. Section 3 details the gross savings methods and findings. Section 4 describes the methods and findings of the net-to-gross and market effects investigation. Section 5 summarizes the recommendations, conclusions, and lessons learned during this evaluation.

[17] DOE-2 is a widely used and accepted freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, construction, operating schedules, conditioning systems (lighting, HVAC, etc.), and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills, www.DOE-2.com.

SECTION 2:

EVALUATION APPROACH AND DATA IDENTIFICATION AND COLLECTION

This section describes the overall evaluation approach and the sources of data, sampling and surveys that were used in the evaluation. As mentioned in other sections of this report, it is essential to understand the diversity of measures, applications, and operating conditions found in New Construction projects. Even measures as simple as prescriptive lighting have site-specific parameters including the room geometry and operating hours that impact the baseline and the energy efficiency measure. This evaluation was designed to comprehensively investigate the realized savings for the diverse NCP projects and measures addressed by selecting a statistically valid sample of projects and rigorously evaluating the measures installed in those projects to determine their performance.

2.1 OVERALL APPROACH

The analysis process used to develop the evaluated gross and modeled partial net savings is described below and a project example is provided in Appendix ~~F~~E.

1. Development of the as-built model - Modeling and custom analysis based on 1) information gathered on-site from metering, operator interviews and building plans 2) utility data, and 3) TA studies was used to determine the as-built energy load profiles for the building and or equipment affected by the program. The as-built model includes the energy efficiency from program supported measures and any measures attributed to inside spillover (ISO).

   Natural gas measures were not part of the incentive program, nor were gas impacts reported by the program during the period being evaluated. The NYSERDA database contained limited documentation of gas savings for some projects. Where whole building analysis was used and in custom analyses of fuel switch measures, the evaluators included estimation of gas impacts where feasible in order to improve model calibration and provide feedback on total energy impacts at the project level. This evaluation does not provide realization rates for natural gas since natural gas is not claimed by the program during the years being evaluated.

2. Construction of the code baseline model - The as-built model for each project was adjusted by replacing the efficient measures with the code baseline. Evaluated gross savings were calculated by subtracting as-built energy use from the code baseline energy use and then subtracting out the impact of the savings attributable to ISO.

3. Estimation of the project-specific baseline - Based on interviews with the building owners and design team members, measures were set to the level of efficiency planned for the project without program intervention. This model incorporates FR. In addition, the non-participant baseline survey data was analyzed to inform baseline practice assumptions. Modeled partial net savings (with FR and inside SO) were calculated by subtracting the as-built energy use from the project-specific baseline energy use.

4. Outside and non-participant spillover analysis - Surveys with participating design teams associated with the projects included in the on-site survey gathered information to estimate participant outside spillover (OSO). Non-participant spillover (NPSO) surveys were analyzed to estimate the NPSO rate. These SO rates were used with the modeled partial evaluated net savings ratio (MPNR) to derive the net-to-gross ratio (NTGR) which, when used with evaluated savings, produced an estimate of the final evaluated net savings attributable to the NCP.

5. Pilot market effects analysis – Data based on telephone surveys with non-participating building owners and design teams was gathered and analyzed to determine whether the Program might be inducing market effects that were not being captured by the current NTG methods, including NPSO.

Surveys of participating owners and design firms were conducted by the engineering team. Two separate surveys of unique groups of non-participating design firms and owners were conducted to obtain information on (1) baseline practices and (2) OSO and market effects.

The primary method of evaluating the gross savings was a detailed analysis of the individual measures and projects. The project-level modeled partial net savings analyses from the on-site survey, a telephone survey of participating design team members, and non-participant surveys were used to determine net program impacts. The Market Effects pilot was designed to determine whether the methods used effectively captured market transformation effects that have resulted from the program.

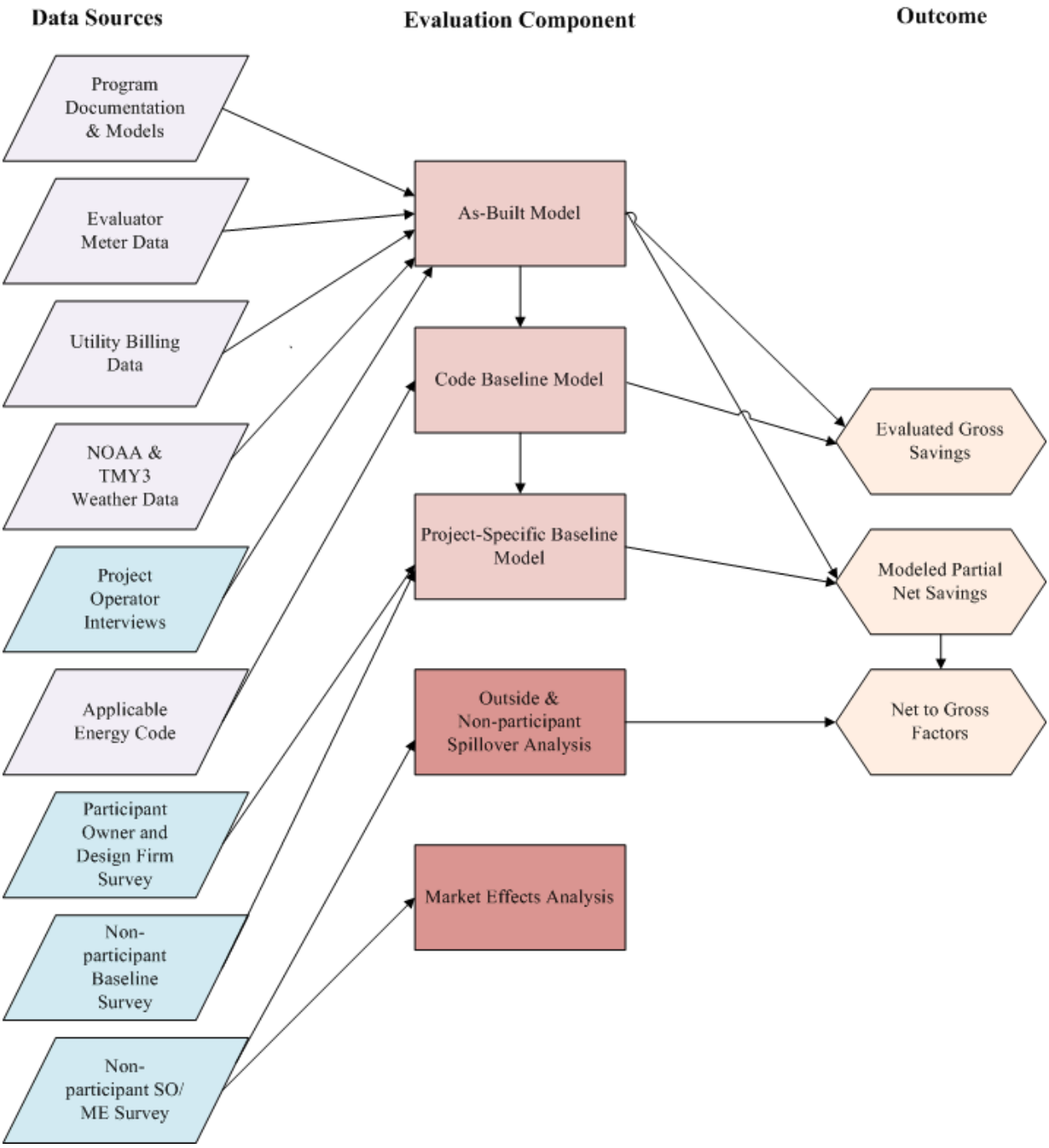
2.1.1 Data Sources

The NCP Impact Evaluation required data from a variety of sources which are outlined below and detailed in Appendix A. The data sources included:

1. Program information gathered from program files, program tracking database, and TA firms where model data was not retained by the program.
2. Applicable codes.
3. NOAA temperature data and TMY3 data for each site used to normalize savings.
4. Meter, trend log and equipment data gathered by evaluators on-site.
5. Information from building operators regarding year-round building operation, changes in operation since project completion, how representative the meter period was of typical operation and other information.
6. Participant and non-participant survey data.

The contribution of each data source to the final results is shown in Figure 2-1.

Figure 2-1. Evaluation Components, Data Sources and Outcomes



The project M&V methods used the Program files, including the original model and analysis files, to develop the M&V plan and to analyze the project where the original model and analysis files were available. The team was unable to obtain all original TA model files for a variety of reasons such as changes in computer systems and personnel at the TA firms. The acquisition of the TA model and analysis files was much more time consuming than expected.

Evaluation Approach and Data Identification and Collection
Data acquisition issues were also encountered in obtaining utility billing data for the projects. It was necessary to obtain a signed release form for each facility in the on-site sample to request billing records from the utilities. This was complicated by the fact that the original contacts were often no longer engaged in operating the buildings. The sample included multifamily buildings with tenant metering; the team was unable to obtain utility release waivers from residents. One utility was unable to provide data for projects completed in their territory.

As a result of the lengthy time required to obtain all necessary data the evaluation on sites could not begin until the fall. Two projects each required two separate metering periods due to the temperature dependence of measures, and some cooling measures could not be directly metered on other projects due to cooling equipment being off during the fall-spring metering period.

2.1.2 Sample Design

Sample projects were chosen using stratified ratio estimation (SRE) to meet a 90/10 confidence/precision level. The initial plan was to include 40 projects in the sample of participating projects that would receive on-site M&V and custom analysis of gross and modeled net savings. Two of these projects were dropped from the sample due to inability to gain customer cooperation; one was replaced, the other project was in the census stratum and could not be replaced. Therefore the final evaluation sample included 39 projects.

Given the level of detailed on-site field work and engineering modeling required for this evaluation, estimating gross and modeled net savings to the 90/10 confidence/precision standard at the upstate/downstate[18] could not be achieved within the project budget as it would have required a substantial increase in sample size.[19] Stratification was conducted to ensure that the sample was representative of the population; sample sizes were not designed to estimate gross or net savings at the 90/10 confidence/precision level for each stratum. The sample was stratified by

- project size (in terms of kWh savings)
- region (upstate/downstate) (see Table 2-1)
- fuel type of the savings (electric and/or natural gas)

After the sample was drawn, program staff indicated that natural gas savings were not a focus of the program during that period and the natural gas savings field in the program tracking database was not necessarily consistently or reliably filled in. The Impact Evaluation Team evaluated natural gas savings at the project level where feasible; however, evaluated gross and net natural gas savings are not reported for the program as a whole as it is not possible to determine whether the evaluated savings are representative of the population.

[18] For the purpose of this evaluation, downstate program activity is defined as the Consolidated Edison territory.

[19] For reference, during the SBCIII funding period, 16% of the completed projects and 34% of the expected energy savings have been located in the downstate area, while 84% of the completed projects and 66% of the expected savings have been upstate.

Table 2-1. Program Activity by Region and Natural Gas Savings

Summary	Number of Projects	MWh Savings
Upstate	190	49,915
Downstate	46	33,026
Projects with naturalgas savings[1]	39	219
Totals[1]	**236**	**82,941**

[1] The projects with gas savings are also included in the upstate/downstate categories, although only five of the projects with gas savings are located in the downstate region. Thus the totals reflect the program totals rather than a summation of the rows in the table.

The stratification by size of electric energy savings (kWh) is shown in Table 2-2.

Table 2-2. Sample Stratification by Size (kWh)

Stratum	Number of Projects	kWh Savings	% of Total kWh Savings	Min Project kWh	Max Project kWh	Projects in Sample
Tiny	100	6,886,268	3%	0	48,777	0
Small	94	18,622,078	22%	50,004	387,040	15
Medium	32	23,641,191	29%	413,987	1,049,706	15
Large (census)	10	38,206,469	46%	1,056,600	17,602,951	9[a]

[a] There were originally 10 projects in the Census stratum; one project was dropped due to lack of owner cooperation.

The sample memo summarizing the methodology is included in Appendix D.

2.1.3 Surveys and Interviews

Surveys were conducted to provide project- and market-level information to inform both the gross and net impact analysis for this evaluation.

Table 2-3 shows the surveys and interviews and how they were used in the evaluation.

Table 2-3. Summary of Interviews and Surveys

Survey	Interviewer	Evaluated Gross	Evaluated Net			
		MPN (Efficient case) [2]	MPN (Baseline Case)			
		As-built Model [3] OSO	Project-Specific BL Model [4]	NPSO	Market Effects	
Project Analysis Data Collection to Determine Operating Conditions						
Building Operations Interview[1]	Review Engineer	X				
Participant Data Collection to Determine the Project-Specific Baseline, Survey-based FR and OSO						
Building Owner	Review Engineer		X			
Designer	Review Engineer		X			
Non-Participant Data Collection to Investigate Standard Practice						
Building Owner	Survey Firm		X			
Designer	Survey Firm		X			
Non-Participant Data Collection to Determine NPSO and Market Effects[5]						
Building Owner	Survey Firm			X	X	
Designer	Survey Firm			X	X	

[1] Building Operations Interviews were developed and conducted by the REs,using questionaires customized for each project.

[2] MPN – is the Modeled Partial Net savings calculated by subtracting the "Efficient Case" as-built modeled energy consumption (or demand) from the "Baseline Case" project specific baseline energy consumption (or demand). The MPN includes the impacts of free ridership and inside spillover.

[3] As-built model conveys the annual energy use of the installed project or measures normalized to a typical meterological year. Because any inside spillover is part of actual use, inside spillover is included in the As-built model. The as-built model is used to calculate the evaluated gross savings (ISO savings are netted out of the gross savings) and to calculate the MPN. Operating characteristics determined in these interviews, such as annualized schedules, permeated through all model iterations (as-built, code baseline, and project-specific baseline).

[4] The project specific baseline model estimates the annual energy consumption (and demand) of the building that would have been constructed absent the NCP based on survey input from the building owner and their design team, observations of the Review Engineer and a triangulation call between the Review Engineer, the leader of this evaluation and the Team lead NTG social scientist.

[5]The sample design originally called for formerly participating design firms to be identified and surveyed to determine if they had higher spillover rates than non-participants. However, review of the Program database indicated that there was an insufficient number of formerly participating design firems to pursue this approach.

The following components were included:

- Interviews of building operators to obtain information on building operations outside the metering period.
- Surveys of participating owners and design firms to obtain information regarding the exact equipment that would have been selected without the Program.
- Telephone surveys of non-participating building owners and design firms to obtain information on non-participant baselines
- Telephone surveys of non-participating building owners and design firms to estimate NPSO and market effects.

An additional discussion of survey methods is included in the project and program net analysis in later sections.

SECTION 3:

EVALUATED GROSS SAVINGS

The Impact Evaluation Team applied International Performance Measurement and Verification Protocol (IPMVP)[20] Option B: Energy Conservation Measure Isolation and Option D: Whole Building Calibrated Simulation to determine the evaluated gross savings for each project in the sample. Calibration to utility data was completed for the majority of the projects analyzed using Option D; the Impact Evaluation Team also used utility billing data to validate the analyzed energy use of specific measures. The use of utility data to verify models and spreadsheet analysis is a necessary step to increase the accuracy of the estimated savings. Once the project-level analyses were completed, an aggregated RR was calculated using stratified ratio estimation, as was consistent with the sample design.

This section addresses the methods used and the issues encountered in implementing the planned EM&V approach. The extensive use of IPMVP Option D for efficiency program impact evaluation has been pioneered by this Impact Team on this evaluation and documenting the challenges the team faced in the process may inform future evaluators that seek to replicate the approach.

3.1 EVALUATED GROSS SAVINGS METHODS

The sample was selected as described in Section 2.1.2. Each project was assigned to a review engineer (RE) responsible for developing a project-specific M&V plan, conducting metering and equipment surveys while on-site, interviewing the owner and design team representatives for the project using an approved survey tool, analyzing the project, calibrating the modeled usage to the utility bills, and developing a project-specific report. This level of site-specific M&V was costly, and the evaluation as designed was expensive to implement.[21] The following sections describe the project-level M&V in detail.

3.1.1 Project M&V

Each sampled project was assigned to an individual RE based on the RE's familiarity with the building type, and the measures and analysis approach; geographic distribution of projects was also considered. Each RE developed a project-specific M&V plan using a program template. The plans addressed each measure in detail, describing:

- The program assumptions for baseline and efficient conditions
- The program analysis approach
- Proposed evaluation assumptions for baseline conditions and the basis for deviating from the program assumptions where such deviations occurred
- The evaluation analysis approach

[20] International Protocol for Measurement and Verification, Applications, Volume III – I Concepts and Practices for Determining Energy Savings in New Construction, http://www.evo-world.org/index.php?option=com_form&form_id=13&lang=en

[21] Due to the rigor of this evaluation, the use of calibrated simulation modeling, and the additional engineering effort associated with developing the MPN, the cost per site of this evaluation was significantly higher than typical. Future evaluations seeking to replicate these methods should ensure adequate budgets are available.

- Project- and measure-level sampling
- A detailed metering plan for each measure
- Proposed project budget and schedule

The projects in the sample typically included multiple measures and the M&V plans were lengthy, running from 15 to 45 pages. All plans were reviewed for technical approach by a senior engineer or the Impact Evaluation Team Lead. NYSERDA Evaluation staff reviewed the M&V Plans. In addition, M&V plans were initially provided to NCP staff for review. However, due to the length and complexity of the M&V plans, schedule constraints, and other obligations of program staff, the process was streamlined, eliminating the program staff review of M&V plans.

The evaluation team faced challenges in identifying the primary site contacts and gaining access to the sites for M&V activities. To try to facilitate this process, NYSERDA and the team agreed that the project-specific reports could be provided to the building owners by NYSERDA as a benefit of their participation, which increased interest and participation; 23 of the 39 participants have requested copies of the NCP project evaluation reports.

On-site work included the following:

- Observing and documenting installed equipment and operating parameters
- Metering installed equipment energy use and operating parameters; field deployed instrumentation including power loggers; data loggers recording equipment status, light levels, temperature, humidity; flow meters; and real-time power meters
- Reviewing and validating building direct digital control (DDC) capabilities and readings and set-up of DDC trend logs in cooperation with facility operators; obtaining historic trend data where available and relevant
- Conducting staff interviews regarding annual operations, seasonal changes, occupancy, and other building variables necessary for the analysis

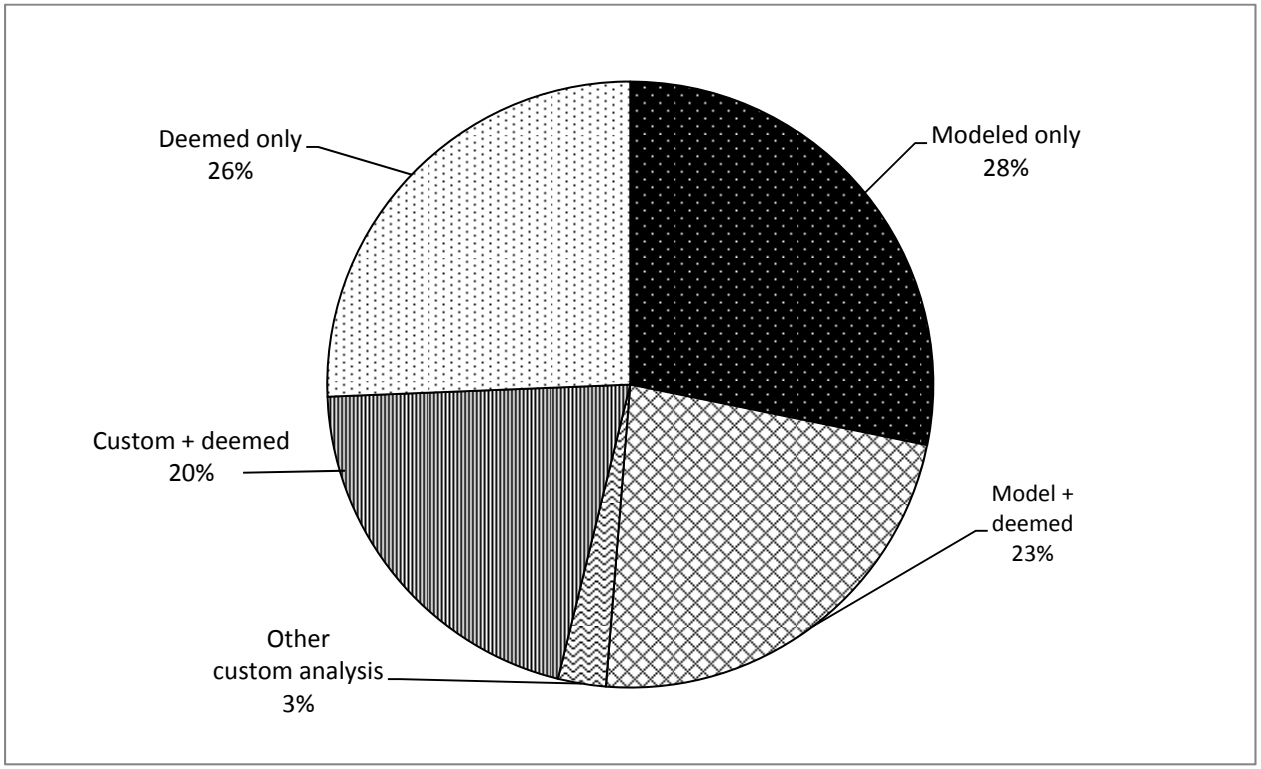
The project-level M&V effort typically addressed between 95% and 100% of the claimed savings on each project and focused primarily on annual electric energy use and peak period electric use.

3.1.2 Project Analysis by the New Construction Program

The projects selected in the sample included a variety of program analysis approaches.

Figure 3-1 shows the analysis approaches used by the NCP to develop energy savings estimates for the projects in the sample. For some projects, a model or other custom analysis was developed to estimate savings for a subgroup of measures, while deemed savings and incentives were used for prescriptive measures. In some whole building analyses the Program analyzed the gas impacts of the projects. A subset of these projects included gas in the Program database.

Figure 3-1. Program Analysis Approach for Sampled Projects



3.1.3 Impact Evaluation Project Analysis

The first step in the impact evaluation analysis process was to develop the as-built model, i.e., a model of the building as it is currently operating. This process involved either using building energy simulation software, such as DOE-2, eQUEST, TraneTrace, or customized spreadsheets. Measure analysis could include development of annual simulations of the energy use and load profile for 1) specific measures or 2) the whole building using hourly or temperature-related operating characteristics. The models used the actual weather data for the project location over the analysis period.

This approach resulted in measure and/or project energy use profiles that could then be compared to the utility billing history over the same period to validate the as-built models. Table 3-1 shows 1) the distribution of evaluation analysis approaches for the projects in the sample, 2) the utility validation approach described in more detail below, and 3) the approach used by program implementers in analyzing the sampled projects and measures.

Table 3-1. Impact Evaluation Analysis Approach

Evaluation Analysis Approach		Projects Using Approach	Utility Data[1]		
			Calibration	Analysis	Program Analysis Approach[6]
Calibrated Simulation Modeling	TA model[2]	7	5	2	7 modeled
	RE model[3]	7	5	1	5 modeled, 1 spreadsheet, 1 deemed
Measure Level Analysis		25		16	7 modeled[4], 9 spreadsheet[5], 9 deemed
Total		39	29		

[1] Utility billing data analysis was not completed for 10 projects. The reasons for this include lack of data (one utility was unable to provide data for two projects), the small size of the measures relative to the total building consumption, or the meter was for a large campus and the project use could not be separated from the campus use.

[2] The TA model indicates that the model developed by the program TA provider used originally to analyze the measures was used in the evaluation analysis.

[3] The RE model indicates that the Impact Evaluation Team created a new whole building or, in one case, a measure-level energy model using energy simulation software, primarily eQUEST. New models were necessary because either the original TA model was unavailable or it was no longer compatible with current software.

[4] The evaluation used IPMVP Option B for 7 projects that were modeled by the program. In these cases the RE determined that accurate measure analysis could be achieved for a lower cost than with modeling. In many of these cases the original model files were not available and would have required the RE to create a new model.

[5] Program spreadsheet analyses included projects that combined modeling and home energy ratings (multi-family) with spreadsheet analysis and those that were analyzed using NYSERDA's custom analysis tools.

[6] Where program analysis included deemed and custom or modeled analysis, the project is categorized as custom or modeled in this column. The evaluators did not use deemed savings approaches.

Calibrated Simulation Modeling

This method of analysis is based on IPMVP Option D and was selected for projects with the program measure type "whole building analysis" and for projects analyzed by the program as "custom" with highly interactive measures or measures that could be most effectively simulated using modeling software.

The calibration process involved running the model, comparing the modeled outputs to the metered outputs (equipment and utility data), and adjusting model parameters until the modeled operating profiles represented the known performance of the building or equipment. Calibration was performed either at the measure level or the building level, as described below.

- Measure-level calibration - Equipment specific meter and Building Management System (BMS) data were used to validate that the modeled operating characteristics of the specific measures corresponded to the measured operating equipment characteristics.
- Building-level calibration - Utility data calibration was performed for the full model at the building level to validate the whole building energy use after the calibration of end uses.
- The final as-built model showed the as-operating energy use for the building and measures including any inside spillover measures installed in the project for a typical meteorological year.

Measure-Level Analysis

For projects with analyses based on IPMVP[22] Option B, the measures were analyzed individually based on on-site collected meter data. As shown in Table 3-1, this approach was used for the majority of projects in the evaluation.

It was applied to projects in which the individual measures could be analyzed using custom spreadsheets and a whole building simulation was not required for savings estimation. The approach included validation of the modeled energy consumption in comparison to the field metered consumption and in comparison to the full utility bill where possible.

The final as-built model using measure-level analysis showed the as-operating energy use for the analyzed measures for a typical meteorological year.

For more details about measure-level analysis, please refer to Appendix B.

Baseline

The next step in the analysis process was to develop a model of the baseline energy use for the measures and/or projects. New York State has a statewide energy code providing a consistent basis for determining project gross savings. Two codes were in effect during the design and project analysis periods (2000-2007) for the projects in the sample; these were used to establish the baseline. Six projects were designed and evaluated under the amended 1991 NYS energy code; the remainder used the 2002 NYS energy code, formally adopted on March 6, 2002.

In the projects included in the sample, there were a variety of methods used by program staff to determine the baseline for lighting measures including building-wide lighting power density, space-specific lighting power density calculations and technology baselines (such as lower efficiency lamps for prescriptive projects). The NYS energy code did not provide for a technology-specific baseline approach for lighting in new construction. Evaluation lighting baselines used lighting power density (LPD) where possible. The evaluators' preferred approach was to use a space-by-space lighting power density baseline for two reasons. 1) The program did not typically address 100% of the lighting end uses in any of the projects analyzed, making a whole building approach not applicable and 2) the space-by-space LPD analysis is considered more rigorous and was consistent with the overall evaluation approach, *e.g.*, hours of operation often vary by space type therefore using a space-by-space analysis provides a more accurate estimate of kWh impacts. In some cases, where the whole building had been affected by the project, a whole building LPD was used. In a very few cases technology baselines were used when there was no applicable code baseline.

Baseline energy use and peak period demand were determined by setting equipment and or systems to the efficiency levels mandated by the applicable codes and reanalyzing the energy use for the baseline condition using the calibrated as-operating parameters. This ensured that the operating conditions, such as schedules and temperature set-points, were consistent between the baseline and efficient case analyses.

Operating Changes

Some of the projects analyzed showed significant discrepancies between the actual operating conditions and those modeled by the NCP TA. The REs reviewed the project data to determine whether the conditions at the time of measures installation were different from the as-operating conditions. The Impact Evaluation Team needed to ensure that the economic downturn, which could have driven

[22] International Protocol for Measurement and Verification, Applications, Volume III – I Concepts and Practices for Determining Energy Savings in New Construction, http://www.evo-world.org/index.php?option=com_form&form_id=13&lang=en.

reductions in load over the past three years, did not skew the evaluated gross savings. In most cases the as-operating conditions found by the evaluators were determined to be representative of the conditions at installation and no adjustments were made. In two cases, changes in operation that occurred between the time of installation and date of the evaluation site visit were incorporated into the analysis. For example, the commissioning documents for one project indicated that the efficiency measures were functioning correctly shortly after construction. When on site, the evaluation team found the equipment was no longer set to the efficient mode. In this case, the evaluator developed a weighted analysis, capturing both the efficient operation during the early measure life and the inefficient operation later in the measure life.

Gross Savings Analysis

The as-built and code baseline energy use models were compared to determine the evaluated gross savings for the measure or project. Savings for projects analyzed using calibrated simulation models were typically determined at the project level in order to ensure the interactions between measures were fully captured. Projects using measure-specific simulation models and spreadsheets were analyzed at the measure level. Where ISO occurred it was netted out of the gross savings calculations.

The evaluated gross savings by project were calculated as follows:

Evaluated Gross savings=
Energy use from code baseline model – Energy use from as-built model –Modeled ISO

3.1.4 Sampling and Weights

The initial sample size of 40 was based on an assumed error ratio of 0.60. However, there was high variability in the results since evaluated savings deviated substantially from the program savings both upward and downward. As discussed in Section 2.1.2, the sample was selected using project size (in kWh), region (upstate/downstate) and fuel type saved (electric or natural gas) as the stratification variables. After the stratification was completed, it was determined that the fuel type stratification was not necessary.

Due to the high variability in the sample and the post-sampling decision about the fuel type variable, *post hoc* stratification was conducted. The final results were calculated with three stratification variables - size, region, and project type (custom/whole building and prescriptive). The relative precision of the MPN was 0.23 using the original two relevant stratification variables (size and region); the *post hoc* stratification reduced the relative precision to 0.18.

Weights were calculated based on the number of projects in the population and in the sample, by stratification level.

3.1.5 Realization Rate

The RR is the ratio of evaluated energy savings to the program's reported savings. The RR represents the percentage of program-estimated savings that is actually achieved based on the results of the evaluation M&V analysis. The RR was calculated as follows:

$$b = \frac{\sum_{i=1}^{n} w_i y_i}{\sum_{i=1}^{n} w_i x_i}$$

where,

b = The RR (ratio estimator)

i = The project number, from the first project in the sample (1) through the last project (39)

n = The total number of verified projects in the sample (39)

w_i = The expansion weight (the total number of projects in the stratum divided by the number of verified projects in the stratum)

y_i = The verified savings for project i

x_i = The original claimed savings for project i

The basis for these calculations and the method for calculating the variance are provided in *The California Evaluation Framework.*[23]

3.2 EVALUATED GROSS SAVINGS FINDINGS

3.2.1 Electric Realization Rate

The realization rate results are shown in Table 3-2. Using the 71% RR for electric energy savings, NCP achieved 58,887,988 kWh of annual savings for the evaluated program years. The RR was 52% for electric demand.

Table 3-2. NCP Realization Rates for Projects Completed in Years 2007-2008

	Annual electric Savings (kWh)	Peak Electric Demand Savings (kW)
Program-reported savings	82,940,828	22,769
Realization rate	71%	52%
Evaluated gross savings	58,887,988	11,840

The project as-built and code baseline models were compared (net of ISO) to determine the evaluated gross savings for each project. Savings for projects analyzed using calibrated simulation models were typically determined at the project level in order to ensure the interactions between measures were fully captured. Projects using measure-specific simulation models and spreadsheets were analyzed at the measure level.

Through a measure-specific, in-depth analysis of the evaluated gross and program reported savings for each project, the Impact Evaluation Team found a number of issues that affect the accuracy of the claimed savings. Table 3-3 summarizes the most common reasons for discrepancies between the program reported and evaluated gross savings and the approximate impact at the project level. In the table, whole building projects are counted as a single measure and the issues are attributed to the category with the largest impact. This analysis focuses on the measures within projects that have the largest impact and is not inclusive of all measures or variations.

[23] TecMarket Works, et. al., *The California Evaluation Framework*, (Prepared for the California Public Utilities Commission and the Project Advisory Group, 2004) 327 – 339, 361 - 384.

Table 3-3. Issues Resulting in Differences in Realization Rates

Reason for RR Other Than One	Number of Projects in Which Issue Had a Significant Impact[1]	Difference between Evaluated and Program Reported Savings kWh	% Contribution to Reduction in Savings
Operations differed from preconstruction estimates	25	-10,363,181	56%
Issues with program analysis	7	-3,880,471	21%
Claimed measures not installed	3	-2,991,819	16%
Database entry issues	1	-686,558	4%
Installed equipment less efficient than claim	3	-544,051	3%
Program baselines different from code	4	-298,191	2%
Lighting analysis issues	14	120,204	-1%
Total difference	**57**	**-18,644,067**	**100%**

[1] This analysis assessed the reasons for significant variations in savings at the measure level and did not include all of the evaluated measures. Therefore the difference in savings shown in the table is smaller than that for the entire program. The number of projects is greater than for the evaluation because some projects had multiple measures with different reasons for discrepancies between the program and evaluated savings for each measure. No sampling weights were applied in this analysis which is another reason the values are not the same as for the entire program.

To determine whether these issues were broadly affecting all projects or tended to be specific to certain types of projects, the results of the project-level analyses were reviewed from a number of different perspectives, as described below.

- Project size: RRs were calculated for small, medium and large strata projects
- Project type: RRs were compared for prequalified/custom projects and whole building projects
- Measure level: A measure-level analysis was conducted to identify the measures that contributed the most to the difference between the program reported and evaluation gross savings

The NCP evaluated gross savings were estimated from the project evaluated gross savings. Realization Rates by project size and by project type are described briefly below.

Project Size

The kWh RRs by size category are shown in
Table 3-4 below. This analysis indicates that the RR for the smallest projects (94%) is substantially higher and has greater variability than the medium and large projects. Large projects have by far the lowest RR of the three categories (57%). This trend is common in that large projects tend to be much more complex and difficult to model than the smaller projects, and operating conditions are often more variable. In addition, the combination of deemed and custom or modeled savings analysis approaches affected the program savings estimates for several large projects.

Table 3-4. kWh Realization Rates by Size Category

Size Stratum		Total Number of Projects in Population	Number of Projects in Sample	Stratum RR	Standard Error
1	Small	94	15	0.94	0.223
2	Medium	32	15	0.74	0.126
3	Large	10	9	0.57	0.012

This analysis suggests that additional effort to try to improve the estimation of savings for large projects is likely to have a major impact on the overall RR. Additional internal review and post-installation M&V are viable approaches to achieve this objective.

Project Type

NCP has three tracks for program participation: prequalified, custom, and whole building. Although these findings were ultimately not used in the evaluation due to the small sample size, in the previous 2006 NCP evaluation[24], the evaluators found that the RR for prequalified projects was markedly lower than the other two categories.

While all three of these types of projects were included in the sample for the current evaluation, the sample was not designed to try to determine the differences in RR among the three tracks, and the sample sizes within each category are not sufficient to draw a firm conclusion. The projects were grouped into two categories: 30 whole building and custom projects constituted one group and 9 prequalified projects comprised the second group. This analysis indicated a RR of 72% for the whole building and custom projects and 92% for the prequalified-only projects.[25] As shown in Figure 3-1, the majority of custom and whole building projects included prescriptive measures as well, some of which had low RRs at the measure level. This combined approach did not adequately capture the interactive effects between the measures and frequently resulted in program savings estimates for the project that were significantly higher than the evaluated gross savings.

3.2.2 Evaluated Gross Electric Savings

At the project level, evaluated gross savings (kWh) varied significantly from the savings predicted by the Program. Figure 3-2 and Figure 3-3 graphically show that project savings fell above (more savings were achieved) than Program estimates and below (savings were lower than Program estimates) the ideal line[26]. The difference between reported and evaluated project savings ranged from 12.8 MWh to 9.9 GWh.

[24] Nexant, *M&V Evaluation New Construction Program Final Report* (Prepared for the New York State Energy Research and Development Authority, 2006) 8-9.

[25] Even with the small sample size for the prequalified projects, this difference is statistically significant at the 90% confidence level

[26] The Ideal Line represents a realization rate of 1 for every project. In other words Program Reported Savings equal to Evaluated Gross Savings for each project.

Evaluated Gross Savings

Figure 3-2. Reported vs. Evaluated Gross Electric Savings (kWh)

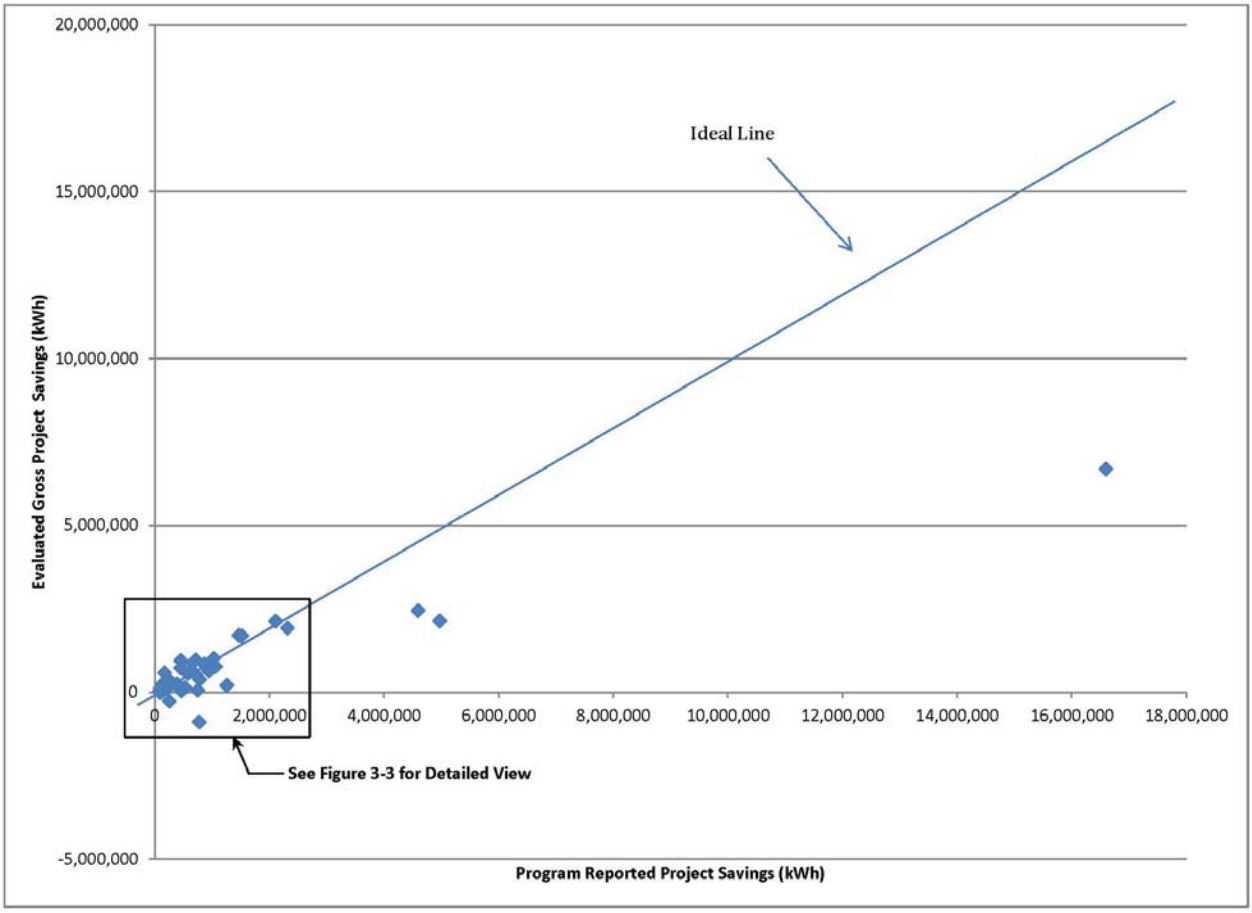
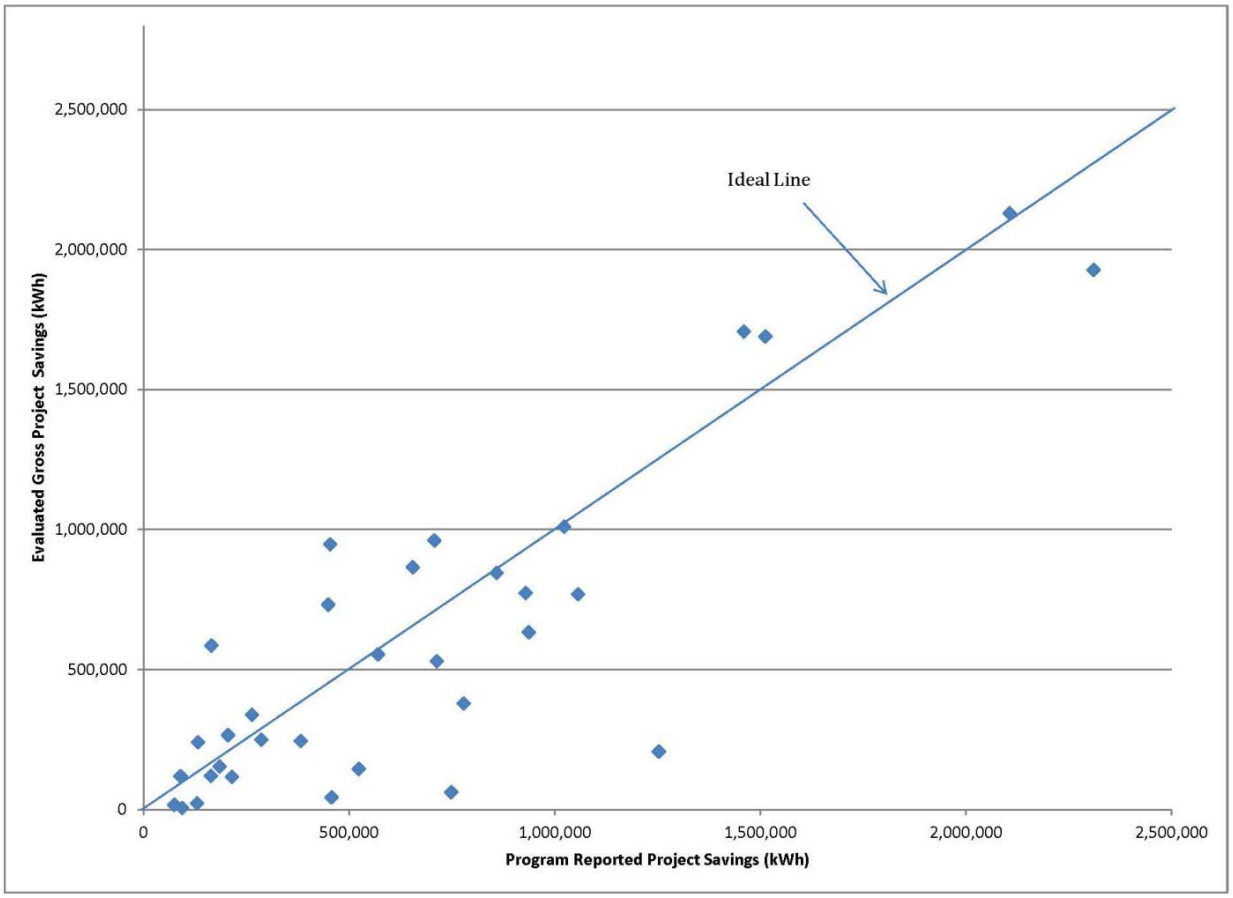


Figure 3-3. Detailed View: Reported vs. Evaluated Gross Electric Savings (kWh)



Measure Level Results

The Impact Evaluation Team performed a measure-level analysis in order to provide more information to program staff and planners about the issues resulting in program reported savings differing from evaluated gross savings. In many cases, the project-specific analyses included a bottom-up analysis from the measure-level. The exceptions were several of the whole building projects; these were evaluated only at the building level, with a single measure incorporating all of the energy efficiency improvements and interactive effects. Where feasible, the savings were disaggregated to the measure level; however, a few of the more complex whole building projects were retained as a single whole building measure in the measure level analysis.

Table 3-5 shows the measures with the largest variation between the reported and evaluated gross savings and provides explanations for the variances. The top three measures account for more than 75% of the total difference between the reported and evaluated savings.

Table 3-5. Largest Savings Variations by Measure

Measure Description	Program Analysis Type	Project Size	Reported MWh	Evaluated MWh	Reason for Variance
Variable air volume	Custom[1]	Large	15,769	6,632	Fans run at higher speeds during off hours reducing the savings
Whole building analysis HVAC[2]	Whole building[3]	Large	4,970	2,139	Claimed measures not installed or operating
Whole building analysis pumping and ice storage	Whole building	Large	4,593	2,448	Intermittent use of efficient equipment where continuous operation was assumed during analysis; ice storage not controlled, loads lower than assumed
Ground source heat pump (GSHP)	Pre-qualified[4]	Med	434	-1,084	GSHP analysis issues; IE used supplemental gas heat in baseline
Ground source heat pump	Pre-qualified	Large	1,253	207	GSHP analysis & operating issues, installed efficiencies lower than program reported
Variable Speed Drive HVAC	Pre-qualified	Med	740	53	Deemed savings data energy input error for VFD
Ground source heat pump	Pre-qualified	Small	128	-267	GSHP analysis issues, loop temp varies from 62ºF-94ºF; installed equip efficiency lower than deemed[5]
Integrated whole building	Whole building	Large	2,311	1,927	Installed equipment less efficient than proposed; operating variations reduce savings
Lighting efficiency	Pre-qualified	Large	1,057	769	Program baseline above code lighting power density (LPD)[6]; installed fixture count below claimed
Total			**31,255**	**12,824**	

[1] Custom - projects for which some measures received a project specific engineering analysis to determine savings associated with the energy efficiency upgrades supported by the Program.

[2] HVAC – Heating, Ventilating and Air Conditioning

[3] Whole Building Analysis – projects for which some measures received modeling to capture the interactive effects between multiple energy efficiency upgrades and to determine the cost effectiveness of the recommended package of measures.

[4] Pre-qualified – projects and measures that are prescriptive with a standard incentive and Program reported savings that are not project specific.

[5] Deemed – Program reported savings determined based on accepted algorithms and assumptions for prescriptive measures.

[6] Lighting power density (LPD) – the watts per square foot of a lighting system

In several cases prescriptive approaches were used by the Program for measures with very large claimed savings and coupled with custom analysis for the same system in the building. This approach, applied to such measures as ground source heat pumps and variable speed drives on HVAC fans, can result in savings claims that are significantly different from the savings that would be estimated through an integrated whole building model or custom calculation of the whole system energy impacts. Where a

custom or whole building analysis is used, including all measures in that analysis improves the overall accuracy of the analysis and the savings estimates.

In some cases buildings were found by the Impact Evaluation Team to operate quite differently from what was expected during design. In other cases, the installed measures are either less efficient than expected or were not installed. Some program files indicated the reduced efficiency or failure to install equipment in the commissioning documents, but the program database was not updated to reflect the change. In other cases, the commissioning agent failed to identify the reduced efficiency or absence of a measure in the project reports. Improving the connection between the commissioning provider scope and the program funded measures should increase attention to program supported measures in the commissioning process. A data validation process at project close out could improve accuracy of program reported measures.

The Impact Evaluation Team found a variety of issues with the estimation of savings from lighting measures; savings were underreported for some projects and over-reported for others. In several cases the Program used a prescriptive, equipment-based lighting analysis instead of a code-based lighting power density analysis. In some cases this resulted in baselines above code and in installed efficient projects with lighting power density above code. In aggregate the use of equipment based lighting savings by the program did not have a significant impact on the RR.

3.2.3 Natural Gas Evaluated Gross Savings

Five projects included claimed fossil fuel savings and two had estimates of the additional natural gas use required due to the measure installed. The evaluation included review of fossil fuel savings reported in the TA studies in addition to those with program reported gas savings claims. Since the measure-level data provided to the Impact Evaluation Team did not contain a complete record of the program reported natural gas savings, it was not possible to sample on natural gas savings. RRs developed from those projects in the sample with natural gas impacts cannot be applied to the program as a whole.

The review of natural gas savings identified issues with data tracking and reporting that resulted from errors in correlating the reported gas savings in the TA report forms and the data entry into the program database. The program database uses MMBtu as units, the TA report forms include a field for gas savings (therms) and for total project savings (MMBtu), the later field includes fossil fuel and electric savings. In most cases either the therms were directly entered in the database as MMBtu without making the appropriate adjustment or the total project MMBtu savings (including gas and electric impacts) were entered in the gas savings field. These issues resulted in significant discrepancies between the tracked gas impacts and those analyzed by the TAs and have been discussed with program staff and are being addressed.

In some cases fuel switches from electric to natural gas did not include analysis of the additional cost impacts of the natural gas consumption resulting in customer dissatisfaction with the operating costs of the installed measures.

3.2.4 Comparison with Prior Evaluations

The RR of 71% determined in this evaluation varies considerably from the RR of 1.06 established in Nexant's 2006 evaluation[27]. Nexant's evaluation included a finding of a 0.63 RR for prescriptive measures. However, Nexant applied an RR of 1.0 to prescriptive measures. As explained in Nexant's M&V report, this decision was made because of the high coefficient of variation associated with evaluated savings from the prescriptive measures. As shown in Table 3-5 above, many of the largest deviations found in this evaluation were associated with prescriptive measures, most of which were part

[27] Nexant, *M&V Evaluation New Construction Program Final Report* (Prepared for the New York State Energy Research and Development Authority, 2006) 2

of custom or whole building projects and contributed to the lower RR for those projects. These were not included in the 0.92 overall RR for prescriptive projects. The Nexant report indicated a high RR for the custom projects, which was different from what this evaluation found using metering based analysis. The Nexant evaluation included a sample size of 17 and consisted of file review and on site interviews and inspections. The funding for the 2006 Nexant evaluation was at 2% of program costs; therefore it did not include the level of analysis used in the current NCP Impact Evaluation which was funded at 5% of program costs.

SECTION 4:

NET-TO-GROSS AND MARKET EFFECTS

4.1 NET-TO-GROSS OVERVIEW

It is necessary to estimate net effects in order to separate program impacts from naturally occurring energy efficiency. This is accomplished through estimation of the ratio of impacts for those that would have taken the actions without the Program free ridership (FR) compared to program savings and the ratio of the savings from actions taken outside NYSERDA programs but due to the program spillover (SO). The combination of these in the form of a NTGR becomes the adjustment factor used to calculate net impacts.

The spillover rate can be composed of up to three components. Spillover estimates are developed for all the market actors that could be affected by the New Construction Program (NCP or Program), whether they are program participants or not, and by whether the spillover occurs at the participating facility or another facility. A matrix of the SO typology is provided in Table 4-1. Inside spillover (ISO) occurs when energy saving actions are taken at the site by participants but are not done as part of the Program. It is this type of SO that is included in the modeled partial net savings ratio (MPNR). Outside spillover (OSO) occurs when energy saving actions are taken by participating owners or design teams at sites that are not part of program participation. NPSO is savings resulting from actions taken by non-participating building owners and design firms due to the program, but not as part of the program. This evaluation initially intended to include assessment of OSO from formerly participating design firms. However, the population of former participants was too small to warrant investigation of this effect.

Table 4-1. Spillover Typology - Participation or Not and Same Site or Not

	Participating		Non-Participant
	Building Owner	**Design Team**	
At the program site	Inside Spillover (ISO)		
Non-participating site	Outside Spillover (OSO)[1]	Outside Spillover (OSO)	Non-Participant Spillover (NPSO)

[1] Outside Spillover data from participant owners was collected and used to validate Design Team OSO findings. Only Design Team OSO was used in calculation participant OSO in order to avoid double counting.

This evaluation applied both new and traditional NTG methods. There were three distinct components of this innovative NTG analysis:

1. Telephone surveys of participating building owners and design teams were used to develop a detailed project-specific baseline model that incorporated FR and participant SO. The project-specific baseline model was constructed by revising the as-built model to incorporate the specific equipment planned to have been installed prior to program participation. The as-built model was compared to the project-specific baseline model to determine modeled partial net savings (MPN). This approach was the primary method used to estimate FR and participant inside SO.
2. The telephone surveys were also used to develop survey-based estimates of FR and participant SO using enhanced self-reports. This approach was used to determine participant OSO and enabled comparison of traditional FR and participant ISO values with the modeled partial net approach.
3. Telephone surveys of non-participating building owners and design team members were conducted to estimate NPSO and conduct a pilot study of market effects.

This section describes the overall approach and methods used to estimate the MPN, the survey-based FR comparative and the three types of SO. A description of the methods used for the market effects pilot study is also provided in Section 4.6.

4.2 MODELED PARTIAL NET SAVINGS

4.2.1 Modeled Partial Net Savings Methods

Project-specific partial net savings estimates were developed for each project in the sample using engineering models that incorporated the project-specific baseline, which was primarily constructed from participant interviews with the building owners and design team members. In addition, a non-participant baseline survey was conducted as a reality check on the results of the participant interviews. Survey instruments are included in Appendix C of the report.

Participant Surveys

For the projects selected in the gross savings sample, the Impact Evaluation Team conducted in-depth interviews with the facility owner or manager and with the associated design firms to establish the site-specific FR and ISO, as well as to investigate OSO. These interviews focused on the following market players:

- The project design firm team members (architects or engineers)
- The customer representative(s) who were involved in or aware of decision-making during project design and construction such as facilities or operations personnel.

Each participant survey was customized by the RE and reviewed by the Impact Evaluation Team Lead, prior to field release. The REs were trained by social scientists to conduct surveys in a way that avoids potential bias. REs were used to deliver the in depth interviews because of their knowledge of the potential design approaches that could have applied to each end-use enabling more in-depth discussion of the project-specific baseline technologies. The participant surveys were constructed to meet the objectives listed below and were designed to be conducted within approximately 40 minutes. The purpose of these interviews was to determine project-specific baselines at the measure level and obtain information on project-specific FR and participant SO.

The survey addressed the following topical areas:

- Original plans for project design, equipment, efficiency, and modeling
- Design changes that resulted from TA and/or financial assistance provided through the program
- Self-reported FR, ISO, and OSO
- The drivers for decisions relative to the selection of equipment and systems that affect building energy use

These in-depth interviews were primarily conducted via telephone, though in at least one case an in person interview was completed using the same survey instrument. For large projects, the evaluation design included surveys of additional influential decision-makers such as chief financial officers; due to the time that elapsed between the development and evaluation of these projects, the Impact Evaluation Team faced significant challenges in engaging additional decision-makers in the interview process. In all cases at least one owner representative or design firm representative were interviewed. Table 4-2 documents the number of participant interviews that were conducted.

Table 4-2. Completed NTG Surveys of Participating Building Owners and Design Teams by Stratum

Projects	Number of Projects	Owner Interview[1]	Additional Owner Decision-maker Interviewed	Design Team Interview[2]	Total Interviews
Census stratum A	7	7		6	13
Census stratum B[1]	2	3	1	2	6
Medium	15	13		7	20
Small	15	14		10	24
Totals	**39**	**37**	**1**	**25**	**63**

[1] Census Stratum B includes two projects that were evaluated in NYSERDA's *Impact Evaluation Largest Energy-Savings Projects* October 2010[28].. Surveys for that evaluation were different from this evaluation. The largest savers FR and SO methods were estimated on a project-specific basis and findings were retained for these projects.

Table 4-3 shows the disposition of all sampled telephone numbers dialed for the participating building owner and participating design team surveys and demonstrates the high disposition rates achieved in the participant surveys. Contact and response rates were 100% for building owners and 95% completion and cooperation rate. The design team survey obtained 60%, 65%, 92%, and 63% for its completion, contact, cooperation, and response rates, respectively.

[28] *Impact Evaluation Largest Energy-Saving Projects Final Report*, for NYSERDA, by Megdal & Associates Team, Principal Investigators: Jon Maxwell, ERS, Lori M. Megdal, Ph.D., Megdal & Associates, LLC, October 2010

Table 4-3. Sample Disposition for the Net-to-Gross Survey of Participating Building Owners and Design Teams

Disposition		Building Owners		Design Teams	
		Number of Participating Building Owners	Percent of Participating Building Owners	Number of Participating Design Teams	Percent of Participating Design Teams
Total sample used		39a	100.00%	39a	100%
Excluded sample	Not working/unusable number	0	0%	0	0%
Not contacted	Respondent never available	0	0%	3	8%
	Voice mail/e-mail	0		6	16%
	Call back/left 800#	0			
	Part of large savings evaluation and so not re-interviewed for NCP	2a		2a	
Unknown eligibility	No Answer/Busy	0	0%	4	11%
	Records not yet called/scr. not complete	0	0%	0	0%
Not eligible	Not Eligible/not qualified	0	0%	0	0%
Refused/	Refused	2	5%	2	5%
Break-off	Break-off	0	0%	0	0%
Completed interview		37	95%	22	60%
Contact rate = [Design team: ((22 + 2)/(39 - 2)) =24/37 = .648]			100%		65%
Cooperation rate = [Design team: 22/24 = .916]			95%		92%
Response rate = [Design team: 22/[22+2 ((3+6+4)*1)] = 22/37 = .60]			100%		60%

Note: See the Glossary for formulas and definitions of contact rate, cooperation rate, and response rate as defined by AAPOR.

[a] There were cases that were included in NYSERDA's *Impact Evaluation Largest Energy-Savings Projects* October 2010[29], which included a rigorous FR study completed in 2008, and were not re-interviewed. The decision to use their prior interviews and estimates eliminates them from disposition calculations.

After the interviews were complete, the REs input the survey responses into a spreadsheet and developed a matrix of the responses at the measure level based on the owner and design team input. The RE's recommendation of the measure level baseline for each measure or measure category was also documented in the matrix. For example, if the measure was high-performance T-8's and the surveys

[29] *Impact Evaluation Largest Energy-Saving Projects Final Report*, for NYSERDA, by Megdal & Associates Team, Principal Investigators: Jon Maxwell, ERS, Lori M. Megdal, Ph.D., Megdal & Associates, LLC, October 2010

indicated that standard T-8 technology would have been selected absent the program, then the matrix indicated standard T-8 as the recommended baseline technology.

The matrix, survey response spreadsheet, and copies of the actual surveys were distributed to the NCP Evaluation Manager and the Net-to-Gross Manager for the project. A conference call was held among the REs and the two managers to determine the project-specific baseline through triangulation and consideration of measure-level information and data obtained regarding decision-making relevant to efficiency investments.

In most cases, either the building owner or the design professional was able to articulate the project plans prior to program involvement. Often the design professional was attributed with the influence on decisions pertaining to envelope efficiency and HVAC design. The design professionals were able to describe their standard approach to buildings such as the project under consideration. For the technologies where there was no clear indication of the planned approach absent the program, the code baseline was used; this occurred in a small subset of the measures evaluated.

Modeled Partial Net Calculation Method

The modeled partial net savings were estimated from the project-specific baseline developed from the participant interviews and supported by the non-participant surveys. The project-specific net energy use and demand were subtracted from the as-built model outputs to determine the modeled partial net savings for each project in the sample.

$$\begin{aligned} &Modeled\ Partial\ Net\ Savings \\ &\quad = Energy\ use\ from\ project\ specific\ baseline\ model \\ &\quad - Energy\ use\ from\ as\ built\ model \end{aligned}$$

Non-Participant Surveys

The evaluation included telephone surveys of non-participating building owners and non-participating design firms. The purpose of the survey was threefold: 1) to provide independent validation of the baseline assumptions reported by the owners and design team for the projects in the sample 2) to estimate NPSO and 3) to conduct a preliminary investigation into whether the program is generating market effects resulting in savings beyond the impacts estimated through ISO, OSO and NPSO.

The original intent for the non-participant survey effort had been to incorporate baseline questions into the SO and market effects surveys and complete a total of 74 interviews with building owners and 74 interviews with design firms. Initially the intention was to include formerly participating design firms. However, in developing the sample design, the population of formerly participating design firms was found to be too small to have a measurable impact on the quantity of NPSO and a separate survey with this small population would not be expected to produce useful results.[30]

The Impact Evaluation Team designed the baseline and market effects/SO survey in consultation with DPS staff and APPRISE, NYSERDA's survey contractor. Five comprehensive pretests were conducted

[30] Formerly-participating design firms were defined as firms who completed at least one project through NCP prior to 2007 and did not have any subsequent completions. The NYSERDA database of NCP completed projects was analyzed and 158 formerly-participating design firms were found. Fourteen (14) of these firms completed projects with no recorded electric savings (energy or demand savings) so would not be expected to change their behavior due to their prior program participation. The likelihood of changing firm behavior from the remaining 144 formerly participating design firms was also seen as unlikely since 82% of these had only completed one (1) NCP project and those with more than 2 projects was less than 5% and none of these firms had completed more than 6 NCP projects.

by APPRISE prior to fielding the survey to ensure that all skip patterns were correct and all question wording was comprehensible to respondents. These pretests were conducted between January 25, 2011 and February 24, 2011. The pretests indicated that the survey instrument was too long and burdensome for respondents and so it was split into two separate surveys (baseline survey and SO/market effects survey).

The sample frame development for both surveys is described below. Survey instruments are included in Appendix C of this report.

Sample Frame

The non-participant sample frame was drawn from the Dodge database[31] for New York State. NYSERDA's survey contractor developed the sampling frame. The approach to develop this frame was to identify and select eligible projects by including projects that fell into three categories:

1) projects that were buildings and not bridges, sewage systems, etc.

2) projects that were eligible for the NYSERDA NCP, *e.g.*, excluding Long Island or New York City government buildings

3) projects where construction had begun, *i.e.*, had moved beyond the permit stage

As part of the data cleaning process, duplicate records and NCP participant projects were removed from the Dodge sample frame.

The sampling approach called for the random selection of projects from the cleaned Dodge database. The building owners and design firms associated with the sampled projects were identified and a second cleaning process was conducted to ensure that projects associated with any design team members who had participated in NYSERDA's NCP program were removed from the sample. The process resulted in a sample frame of non-participating projects. The owners and design firms associated with those projects were selected for the surveys.[32] This approach enabled the team to inquire about actual efficiency levels in completed non-participating construction projects in addition to asking non-participants about market practices and conditions more generally.

The sample size of 74 was designed to meet the 90/10 confidence/precision standard for the statewide program, with a few extra surveys included to cover the possibility of inconsistent responses or other issues.

The sample was stratified by business type and size of the business. The magnitude of the construction activity represented by the firm was the best indicator of size among the available options. The sample was allocated to the business types proportionally based on construction value, with oversampling for the education and healthcare sectors to improve the sample size used to verify baselines for the participant on-site surveys.[33]

[31] The Dodge database is a service of McGraw-Hill Construction, which lists construction projects by state.

[32] The four surveys are the Non-Participant Building Owner Baseline Survey, the Non-Participant Design Team Baseline Survey, the Non-Participant Building Owner Spillover and Market Effects Survey and the Non-Participant Design Team Spillover and Market Effects Survey.

[33] Two projects were added to each of these two categories.

The size strata were defined to be consistent with the recent MCAC study.[34] As was done in that study, the very small owners (with construction value below $1 million) were excluded from the sample since they represent a small share of the total new construction market and are not representative of most projects that participate in the NCP, which tend to be larger construction projects. Within each business type, the goal was to complete interviews that were evenly divided between large and small projects. If the sample frame was insufficient to produce the required number of completed surveys for the large projects, the sample was completed with smaller projects in the same business type. The definitions of the size strata are described below:

- Large/moderate[35] – Owners with $15 million or more in new construction value
- Small – Owners with $1 million to less than $15 million in new construction value

Table 4-4 shows the number of non-participating projects and target sample size by business type. This table includes the entire sample frame before it was divided into two equal parts.

Table 4-4. Target Sample Sizes by Business Type for the Non-Participant Surveys

Business Type	Number Projects in Non-Participant Population	Total Construction Value (x $1,000)	Percent of Projects	Percent of Construction Value	Target Sample Size
Commercial	1,767	11,501,521	33%	31%	22
Education	508	3,341,330	9%	9%	8
Government/nonprofit	621	4,283,465	12%	12%	8
Healthcare	398	2,892,263	7%	8%	8
Manufacturing	109	5,251,981	2%	14%	10
Multifamily	1,996	9,515,567	37%	26%	18
Totals	**5,399**	**36,786,127**			**74**

The distribution into the size categories are shown in Table 4-5 below. The manufacturing business type was not separated by size due to the low number of projects in this category.

[34] *New Construction Program Market Characterization, Market Assessment, and Causality Evaluation: Final Report* (Prepared for New York State Energy Research and Development Authority by Summit Blue Consulting, LLC, 2006).

[35] In the MCAC study, the large and moderate categories were separate, with large projects identified as those with construction value of $50 million or more. Given the goals and size of the sample frame for the non-participant impact survey, these two categories were combined.

Table 4-5. Sample Frame Summary by Business Type and Size

Business Type	Number Small/Moderate Projects in Non-Participant Population	Number Large Projects in Non-Participant Population	Small/Moderate Projects Construction Value (x $1,000)	Large Projects Construction Value (x $1,000)
Commercial	1672	95	5,218,393	6,283,128
Education	463	45	1,779,218	1,562,112
Government/nonprofit	581	40	1,762,047	2,521,418
Healthcare	354	44	1,357,994	1,534,269
Multifamily	1902	94	6,375,174	3,140,393

The initial sample frame of non-participating projects was randomly divided in half to accommodate having two surveys targeted at this population. When the survey was separated into two parts, the target sample sizes were maintained for each survey, *i.e.*, the target was to complete 74 building owner baseline interviews and 74 building owner SO/market effects interviews as well as 74 designer baseline interviews and 74 designer SO/market effects interviews.

For the baseline survey, no weighting was used as the data was not aggregated to reflect the total population. For the SO and market effects survey, the results were weighted to take into account the number of projects and also the percent of the construction value in each category, as given in the equation below.

$$w_h = \frac{N_h}{n_h} \; x \; P_b \; x \; C_b$$

where w_h is the expansion weight for size and business stratum h

N_h is the total number of projects in size and business stratum h

n_h is the number of projects in the sample in size and business stratum h

P_b is the percent of total projects in the business stratum b

C_b is the percent of the total construction value in business stratum b

When expansion weights are applied, the results of the survey are extrapolated to the entire population. Case weights were developed by scaling the expansion weights to the sample.[36] Case weights are provided below in .

Table 4-6.

[36] When the survey results are presented as frequencies, i.e., the percentage of respondents providing specific answers, case weights and expansion weights give exactly the same answer. If the sample is used to calculate the total evaluated savings, for example, then the applying the expansion weights will result in evaluated savings for the entire program and applying the case weights will estimate the evaluated savings for the sample.

Table 4-6: Case Weights for the Non-Participant SO and Market Effects Survey

	Owners		Design Team	
Business Type	**Small**	**Large**	**Small**	**Large**
Commercial	0.825	1.403	0.600	2.386
Education	2.360	1.589	3.010	2.027
Government/nonprofit	0.668	1.395	1.023	0.356
Healthcare	0.782	0.787	1.122	0.669
Manufacturing	1.491	1.491	2.645	2.645
Multifamily	0.541	0.303	0.483	0.387

Non-Participant Baseline Survey

The non-participant baseline survey was designed to assess whether the project-specific baselines developed through interviews with the participating building owners and design firms were within a reasonable range. It included questions for the owner and design professionals associated with the buildings in the sample.

During the pretesting, the Impact Evaluation Team found that respondents needed advanced notice to be able to provide all of the requested information about the buildings. Consequently, a topic list was developed summarizing the areas of inquiry covered in the survey and distributed to respondents prior to the interview to enable them to prepare. Topics covered in the non-participant baseline survey included the following:

- Importance/influence of initial cost, performance, appearance, and operating cost on design of energy-using features
- The installed levels of efficiency in the building including insulation, HVAC, lighting, hot water, and appliances
- How energy-related aspects of the building project, such as insulation, HVAC , lighting, hot water, and appliances, compare to energy code
- The use and impact of whole building modeling
- Participation in the USGBC's LEED building certification program
- The level of influence of the design team or owner
- Information about the building including size, occupancy, etc.
- The impact of energy efficiency programs on the market

The survey was lengthy, requiring approximately 25 minutes for completion.

The non-participant baseline survey was fielded by APPRISE between June 1, 2011 and August 29, 2011. The long fielding period was due to the difficulty of reaching this market sector of building owners and design teams and completing the surveys. Extensive efforts were made to reduce non-response bias, including offering an incentive of $100. A significant challenge was the high number of projects in the sample frame that were found to be ineligible.

Table 4-7 shows the disposition for the non-participant building owner and design team baseline surveys conducted by APPRISE. The completion rates were 11% for the non-participating building owners and 18% for the non-participating design teams. The non-participating building owners contact, cooperation, and response rates were 41%, 49% and 18%, respectively. These same rates for design teams were 49%, 59% and 26%, respectively.

Table 4-7. Sample Disposition for the Baseline Survey of Non-Participating Building Owners and Design Teams

		Building Owners		Design Teams	
Disposition		**Number of Non-Participating Building Owners**	**Percent of Non-Participating Building Owners**	**Number of Non-Participating Design Teams**	**Percent of Non-Participating Design Teams**
Total sample used		658	100.00%	436	100%
Excluded sample	Not working/unusable number Quota filled	48	7%	28	6%
Not contacted	Respondent never available	194	29%	124	28%
	Voice mail/e-mail	15	2%	17	4%
Unknown eligibility	No answer/busy	16	2%	19	4%
	Screener[1] not complete	49	7%	28	6%
Not eligible	Not eligible/not qualified	189	29%	87	20%
Refused/ break-off	Refused/break-off	75	11%	54	12%
Completed interview		72	11%	79	18%
Contact rate = [Building owner: ((72+75)/(72+75+194+15) = 0.4129)]			41%		49%
Cooperation rate = [Building owner: (72/(72+75) = 0.4898)]			49%		59%
Response rate= [Building owner: (72/(72+75+194+15+(0.6003*65)) = 0.1823)]			18%		26%

Note: See the Glossary for formulas and definitions of contact rate, cooperation rate, and response rate as defined by AAPOR.

[1] Screener indicates that the survey was not completed due to a person who screened the call.

Table 4-8 and Table 4-9 show the target sample sizes and the actual completed surveys by business type and size strata. As was consistent with the sampling plan, surveys were completed for small projects within the building type when it was not possible to obtain enough interviews from the large projects. Since the survey was difficult to field, it was necessary to allow some leeway with the target number of completes within each business type.

Table 4-8. Non-Participant Baseline Owner Survey Completion

Business Type	Large Targets	Large Completes	Small Targets	Small Completes	Total Completes
Commercial	11	5	11	18	23
Education	4	3	4	7	10
Government/nonprofit	4	3	4	5	8
Healthcare	4	3	4	6	9
Manufacturing	0	0	10	10	10
Multifamily	9	5	9	12	17
Total	**32**	**19**	**42**	**58**	**77**

Table 4-9. Non-Participant Baseline Design Firm Survey Completion

Business Type	Large Targets	Large Completes	Small Targets	Small Completes	Total Completes
Commercial	11	3	11	20	23
Education	4	3	4	8	11
Government/nonprofit	4	1	4	7	8
Healthcare	4	5	4	3	8
Manufacturing	0	0	10	10	10
Multifamily	9	4	9	15	19
Total	**32**	**16**	**42**	**63**	**79**

For the baseline survey, no weighting was used as the data was not aggregated to reflect the total population.

4.2.2 Modeled Partial Net Savings Findings

This section covers the results of the non-participant baseline survey and the analysis of modeled partial net effects.

Non-Participant Baseline Survey

The non-participant baseline surveys support the FR findings at the project level. These surveys clearly indicated non-participant practices exceeded code both for design firms and building owners. Table 4-10 shows survey results demonstrating that non-participant practice indicated significant attention to energy efficiency and the adoption of better than code energy related practices.

Table 4-10. Non-Participant Baseline Survey Summary

Building Component	# of Owners[1]	# of Design Firms[2]
Building designs exceeded code	21	41
Whole building modeling	12 (n=50)	18 (n=76)
The following practices that were better than code were identified		
Improved insulating values of building envelope	26 (n=50)	38 (n=67)
White roofs	14 (n=60)	16 (n=58)
Low-e windows	27 (n=51)	44 (n=57)
Improved HVAC systems	28 (n=52)	34 (n=51)
The following lighting practices indicated levels of efficiency that may have been better than code		
Fixture types that would have been eligible for prescriptive incentives under the program such as T8, T5, and metal halide lamps	30 (n=51)	42 (n=51)
Application of occupancy sensors	39 (n=61)	40 (n=67)
Application of daylighting controls	16 (n=54)	14 (n=68)
Hard-wired efficient lighting installed in residential units	6 (n=14)	8 (n=14)
ENERGY STAR appliances in multifamily housing	14 (n=16)	10 (n=11)

[1] A total of 77 building owners participated in the survey

[2] A total of 79 design firms participated in the survey

Twelve building owners reported completing building energy models during the design phase of their projects. Survey results suggest that actual performance varied up and down from predicted performance; two reported higher than modeled energy use, four reported lower than modeled energy use, three reported the modeled and actual energy use to be the same, and three indicated they did not know how actual and modeled use compared to each other.

Not only did owners and design firms indicate that practices exceeded code, they identified specific measures that were better than code on a significant portion of the non-participant projects. Overall these findings indicate a strong trend in design and construction approaches that exceed the code for a significant subset of the C&I new construction market.

The survey response data was evaluated in comparison to the participant FR levels established at the project level and found to clearly support the high level of FR reported on many projects. Since the baseline survey was reasonably consistent with the results of the interviews used to develop the project-specific baselines for the participant sample, it was not necessary to adjust the project-specific baselines as a result of the non-participant baseline survey.

Modeled Partial Net Ratio

Modeled partial net effects (FR and ISO) were estimated on a project-specific basis, relying on participant owner and design firm survey data to create the project-specific baseline model, which was compared to the as-built model to estimate net effects.[37] The modeling process for determining modeled partial net

[37] The *post hoc* stratification strategy (size, region, project type) used for the realization rate was also applied to the model partial net ratio.

savings includes the participant's description of the construction plans developed prior to enrolling in the program. Thus, it accounts for participants who would have installed the measures without the program and also those who would have installed equipment better than required by code but less efficient than program standards.

The results of the partial net effects suggest that FR is high for this program and inside spillover is quite low. Larger projects have a lower MPNR (which means high FR) and smaller projects have a higher MPNR, as shown in Table 4-11. This result is most likely related to the greater complexity of, and higher costs involved with, the large projects. The complexity of these projects requires a higher level of knowledge of buildings systems by the design team; design professionals with this more sophisticated expertise are more likely to be aware of energy efficiency options and how to implement them. In addition the cost per square foot budgets for larger, more complex projects is higher than for smaller projects with simple systems. These larger budgets on a per square foot basis support the costs of more efficient, higher performing buildings from the beginning of the project.

The project-specific approach provided a highly nuanced method to determine the savings that can be attributed to the program. In traditional, survey-based self-reports participants who indicate they installed the measure due to the program are assumed to achieve the full savings from the code baseline to the efficient installation. Through the project-specific baseline, it was possible to determine the actual equipment that would have been installed in the absence of the program, and often the installed equipment was between code requirements and the efficient model. The high FR that resulted from this approach suggests that there is a greater level of complexity in the relationship between standard practice, the code baseline and efficient measures installed through the program than can be easily addressed in a standard net-to-gross telephone survey.

As with the RR, the MPNR was calculated using ratio estimation, comparing the evaluated gross savings to the evaluated net savings for each project in the participant sample. The result of this analysis is the percent of savings that can be attributed to the program, and the combined FR and ISO were estimated by subtracting this value from 1.00. The overall $MPNR_{kWh}$ is 0.35, resulting in a combined FR and ISO rate of 65% (also shown in Table 4-11). The absolute and relative precision of the partial net evaluation savings is 7% and 18%, respectively. MPNR for kWh and kW were modeled and therefor the values differed as expected.

$$Modeled\ Partial\ Net\ Savings\ Rate\ (MPNR) = (1 - FR + ISO)$$

$$(MPNR_{kWh})\ 0.35 = (1 - 0.66 + 0.01)$$

$$(MPNR_{kW})\ 0.46 = (1 - 0.55 + 0.01)$$

ISO was found to be minimal at the project level, which is a common finding for new construction projects as the buildings were recently completed.

Table 4-11. Modeled Partial Net Savings

Size Stratum		Total Number of Projects	Number of Projects in Sample	Evaluated Gross Savings (kWh)	Modeled Partial Net Savings (kWh)	Partial Net Savings Rate (1-FR+ISO)	Standard Error	Combined FR & ISO Rate[b]
1	Small	94	15	17,402,332	7,970,249	0.46	0.144	0.54
2	Medium	32	15	17,513,394	6,522,605	0.37	0.107	0.63
3	Large	10	9	21,663,068	3,582,621	0.17	0.010	0.83
Not sampled		46	0	2,471,105	2,471,105			0.0
Overall				**59,049,899[a]**	**20,546,580[a]**	**0.35[a]**	**0.045[a]**	**0.65[a]**
Absolute Precision of Partial Net Evaluated Savings								7.3%
Relative Precision of Partial Net Evaluated Savings								18.0%

[a] Weighted result; [b] The ISO rate was found to be minimal which is common for new construction programs. The overall rate is 1%

Note: Values in this table have been rounded. Partial Net Savings Rate is the rounded value obtained from dividing MPNS by Evaluated Gross Savings. However, the total values in the "overall" row do not reflect rounded values used elsewhere in the report. This table is presented for information regarding how the Modeled Partial Net was developed only.

4.3 SURVEY BASED FREE RIDERSHIP AND INSIDE SPILLOVER

The analysis of survey-based participant FR and ISO was conducted to offer a comparison between traditional methods and the more rigorous and innovative method used in this impact evaluation.

The modeling of partial participant net uses the most sophisticated and rigorous method to-date for NYSERDA NCP evaluations of free ridership and ISO. (Please see the previous discussion on the MPNR method.) The final program NTGR determined in this evaluation includes the MPNR plus the other types of spillover not included in the MPNR. The survey-based estimates of FR and ISO are presented only for information and comparison purposes.

Participant OSO could not be determined through the project-specific approach and is not included in the MPNR. The value used in the final NTGR was estimated from the participating design team telephone surveys. Non-participant spillover was also estimated separately using the survey-based approach. These components of the overall SO estimate are discussed in more detail in Section 4.4.

4.3.1 Methods for Survey Based Free Ridership and Inside Spillover

Survey Based Free Ridership Method *(Research Only)*

Initial FR estimates (direct FR) were developed for each site by the participating building owner and the participating design team. This estimate is based upon asking for the proportion of extra energy savings, across all measures, which would have been achieved without the program.[38]

[38] The respondents were also asked for their lower and upper bound for the estimate of extra savings. The upper and lower bound estimates were used in cases where the respondent did not provide a "best" estimate through use of the proportionally distance from the best estimate from those respondents that answered all three of these.

A consistency check was performed by comparing the direct FR estimates developed through the MPNR process to an average of responses to two traditional FR questions[39] regarding the influence of the Program.[40] These two survey questions inquire about plans for high efficiency prior to program participation and importance of the NCP. This overall program influence score is converted into an upper and lower bound range of plausible FR values. If the participant's direct FR estimate falls below the lower or above the upper bounds of FR, the preliminary FR estimate for that site is adjusted upward or downward to the edge of those bounds according to the influence score.

This survey-based FR method included improvements over the prior NYSERDA NCP FR survey methods.[41] Previously the building owner FR rates were averaged (savings weighted), and the design team's FR was averaged (savings weighted). Then these two figures were averaged to produce the program's FR rate. This method does not capture the relationship between building owners and design teams, which may range from projects in which the building owner makes all decisions to those in which the building owner relies entirely on the design team.

To address this issue, the Impact Evaluation Team added a survey question to assess the relative influence of each party in the decision-making process. For sites with survey responses from both the owner and design team, FR estimates were combined by project and weighted according to the influence score derived from this survey question.

Survey Based Inside Spillover Method *(Research Only)*

The building owner surveys included questions to estimate participant ISO and OSO, covering whether additional actions were taken due to the NCP and, if so, the energy savings expected from those actions as compared to the savings the participant achieved through the NCP. Participant ISO was accounted for in the modeled partial net analysis.

[39] NYSERDA's traditional battery of FR survey questions includes 6-8 questions. Only two key FR questions were included in the NCP surveys. The primary method for determining FR was the MPNR which was developed based on a battery of technology specific questions which resulted in survey lengths of 30 – 45 minutes. Therefore, to reduce survey length, some of the traditional FR questions were not included.

[40] Over 20 years of experience in estimating self-report FR for energy efficiency program evaluation has set standards for FR measurement. One of these is to include additional inquiries and perform consistency checks across the inquiries. The FR calculation also needs to measure what would have occurred in the absence of the Program, not what the participant "intended" to occur (as many good intentions do not actually become results). Estimating the hypothetical construct of FR based upon a decision that the participant might never have faced is quite difficult. This enhances the importance of the measurement method to be designed for construct validity. Reliability and rigor depend upon accuracy and sampling precision. The challenges in to obtain construct validity with little measurement error are great enough as to become far more important than sampling precision to obtaining a rigorous FR estimate.

[41] The model-based method is the primary method for this evaluation as it is based upon actual technologies available for each measure and end-use considered. This specificity can better target possible alternative actions without asking interviewees to go through the steps it takes to translate different technologies to differences in energy use. The questions then also become more easily understood and answered such that interviewees are more likely to be able to consider alternative responses. These should lead to a FR method that is more rigorous than the survey-based approach. The FR survey method done for comparative purposes was a significant improvement over the prior application of the FR algorithm and it is that improvement being discussed.

4.3.2 Survey Based Free Ridership and Inside Spillover Findings

Survey-Based Free Ridership Findings

In the process of conducting the interviews for the model-based FR analysis, the NTG survey was administered to the on-site sample. The Impact Evaluation Team conducted an analysis of the survey data for comparison purposes only, resulting in an NTG analysis that is more similar to that used for other NYSERDA programs. As shown in Table 4-12, the survey-based rate is substantially higher for large projects than for small projects, with the small projects having an FR of 30% and the large projects having an FR of over 50%. This trend of higher FR for large projects is consistent with the results from the model-based estimates of MPNR, as discussed in Section 4.2.2.

Table 4-12. Traditional Survey-Based Free Ridership for NCP Sample of Participating Sites (Developed For Comparison Only)

Population Strata by Project Size	Number of Sites (n = 33)	FR Rate
Small projects	13	30%
Medium projects	13	32%
Large projects	7	54%

In prior evaluations the influence score[42] was based only on the responses provided by the building owner, although discrepancies between building owner and design team responses were noted.[43] In this evaluation, the method was enhanced to incorporate the influence of both the design team and the owner in the adoption of energy efficiency. The projects included in the NTG survey were divided into two groups:

- projects with both a building owner and a design team survey
- projects with a design team survey only

All 33 owner surveys were able to be matched up with a corresponding design team survey. There were an additional two design team surveys that were for projects where no owner survey was completed. For the matched projects, the FR estimates were weighted to incorporate the relative influence of the two parties.

The project-level FR estimates include the consistency check by respondent from the influence score, adjustment for the relative influence of the design team versus the owner, and weighting to account for sampling probabilities. The Program FR is derived as a weighted average of the final project-level FR. Table 4-13 shows the average FR for the matched and design team only projects. The matched sites resulted in a FR estimate of 34%. The FR estimate for the two sites with only design team interviews was 19%. The overall survey-based FR was 33%.

[42] The influence score is part of the consistency check and is used to develop upper and lower bounds on the estimated FR,

[43] NYSERDA. 2006. *New Construction Program (NCP) Market Characterization, Market Assessment and Causality Evaluation*. Submitted by Summit Blue Consulting, May.

Table 4-13. Traditional Survey-Based Free Ridership by Type of Market Actor (Developed for Comparison Only)

Actor Group(s)	Number of Sites	FR Standard Deviation	FR Estimate
Building owners only	0	Not applicable	Not applicable
Both (Match sites with information from end-user and vendor)	33	0.33	34%
Design teams only	2	0.42	19%
Overall program	**35**	**0.33**	**33%**

Estimating the precision for FR calculations is complex due to the process used to develop the estimates.[44] For example, consistency adjustments are made based on the influence questions and the relative importance of the building owner or design team in the decisions are also incorporated into the estimate. In addition, most of the responses to questions estimating FR and the distribution of the final project-level FR rates are not normally distributed but are concentrated around 0% and 100%. Consequently, the standard deviations for these questions are quite high. The final survey-based FR rate of 0.33 shown above has an absolute precision of 0.06 so the 90% confidence level range for the survey-based FR is 27% FR to 39% FR. However, as with all net-to-gross analysis, the construct validity and potential for bias is a more critical factor in the accuracy of the results.

Survey-Based Inside Spillover Findings

There was insufficient information from the survey responses to estimate a survey-based ISO. The survey responses suggest that there may be ISO for 33% (13) of respondents. However, only three respondents answered the specific question that compared ISO to program savings and only two provided complete answers to all of the ISO questions. Through the project-specific modeling analysis, ISO was estimated at about 1%. This value is captured in the MPNR.

4.3.3 Reconciling Modeled Partial Net with Survey Based Free Ridership and Inside Spillover

This evaluation presented a unique opportunity to implement and compare two completely different approaches to the estimation of FR and participant ISO, i.e., the model-based approach and the traditional survey-based method.

Evaluators conducted on-site visits and detailed interviews with participants, allowing the opportunity to compare participants' reports with the actual on-site equipment and conditions. This process also included administering a telephone survey that included the enhanced self-report questions about FR and ISO, consistent with the approach used by NYSERDA for other evaluations. In addition to the standard survey approach, the surveys included questions regarding the design process and the specific technologies that were considered for the building and the decision-making process that resulted in the equipment that was installed. Based on the outcome of the surveys and triangulation calls, which were held to ensure consistent interpretation of participants' responses, detailed modeling of the customer-specific baseline was performed. In the limited instances in which the respondent was unable to recall what they would have installed for a specific measure, then code was assumed to be the baseline. This process resulted in the MPNR.

[44] Most FR algorithms in energy efficiency program evaluation contain mathematical combinations beyond multiplication (such as combining gross and net realization rates) or addition (such as adding together savings estimates across programs).

The second approach was to analyze the FR and SO questions from the telephone survey as if it were a stand-alone component. The analysis was based on the method used in previous NYSERDA evaluations, with enhancements to reflect the relative influence of the building owner and design team. This process resulted in estimates of FR and ISO using the traditional survey-based strategy.

These two methods employ diverse approaches to the same question. The model-based MPNR was developed based on a detailed analysis of the projects incorporating the following information obtained through the participant interviews, on-site observations, and additional research:

- Project-specific equipment and control baseline as defined through the participant interviews
- The technology available and appropriate for the project
- The decision-making process employed for the project

In contrast, the survey-based method calculates the FR ratio by asking the participant to estimate the percent of savings above standard efficient equipment that would have occurred in the absence of the program. While the survey-based approach includes consistency checks and is adjusted for the level of program influence, this inquiry is not measure-specific and does not investigate the specific equipment or practices that would have been used in the absence of program intervention.

While both approaches reflect different methods to try to quantify the counterfactual, the more detailed, model-based approach improves the quality and rigor of the analysis for the following reasons:

- It is based on more concrete information about the building and equipment. Participating building owners and design teams were asked to provide specific information about each of the equipment choices and building practices that would have been used in the absence of the NCP. This process included specifying possible equipment options rather than an approximation by a percentage that might not relate what is actually possible. It specifically used only the equipment types available for that application.
- Site observations, when available, were used in the assessment of the project-specific baseline. For example, if the project was an addition or a new building in a complex of similar buildings owned by the same building owner, the equipment installed in the original section or the other non-NCP buildings provide insight into what the building owner would have had selected in the absence of the Program.
- It allows for a more nuanced definition of the baseline and net effects in that it reflects what the participant claims they would have installed rather than relying on the evaluators or program staff to define the code-compliant equipment or building practices.
- The model-based approach included calibration of the energy consumption in the building to actual utility billing records, whenever possible, and thus, the project-specific baseline model reflects actual building operating characteristics, reasonably approximating the project-specific baseline energy use.
- While the survey-based FR questions inquire about standard efficient equipment, respondents may have interpreted the questions as either standard practice or energy code. The evaluated gross savings were calculated from a code baseline, which creates a potential disconnect if respondents were reflecting standard practice and standard practice is not the same as the energy code. The MPNR correctly accounts for all of the differences between the as-built and the project-specific baseline models.
- It does not rely on the respondents' estimates of the percentage of savings that would have been achieved without the NCP, which may be difficult to answer with accuracy.

The model-based kWh modeled partial net, including FR and participant ISO, is 65% with a FR of 66% shown in Table 4-11, as compared to the traditional survey-based FR of 33% as shown in Table 4-13.[45] While this evaluation was not designed to specifically investigate the reasons for this discrepancy, the evaluation results provide some potential insights into this question. To interpret the discrepancy between the two estimates of FR, it is important to understand that they measure two different things. The MPNR directly measures the net savings that can be attributed to the program as calculated through a detailed process of developing and modeling a project-specific baseline. The survey-based FR estimate reflects self-reports of the percent of savings that can be attributed to the program in comparison to a hypothetical standard.

The purpose of estimating FR and SO is to be able to estimate total program net savings. Using the MPNR, it is possible to calculate net savings directly. The survey-based FR is applied to the program savings to calculate net savings. However, since the survey-based FR rate is applied to program savings, the self-reports of the percent of savings have to be accurate and match up to the process used to calculate program savings.

Survey respondents were requested to estimate the percent of savings attributable to the Program in comparison to "standard efficiency" equipment. However, since there is no single baseline technology that applies to all applications, they were not asked to compare the installed equipment to a specific baseline technology. Consequently, the traditional survey questions were less detailed and concrete than the project-specific inquiry and left more room for interpretation on the part of the respondents. While a respondent may be able to specify the type of lighting they were planning to install prior to the program, providing an estimate of the percent of savings from the installed equipment to hypothetical "standard efficiency" lighting to be attributed to the Program could be much more challenging.

Issues may also arise in the interpretation of the "standard efficiency." If, for example, respondents interpret the survey questions as asking them to attribute savings to the program in comparison to standard practice rather than energy code and the program savings are estimated using energy code as the baseline, there is a disconnect between the survey responses and the calculation of net program savings. The participant and non-participant surveys conducted for this evaluation suggest that standard practice is above code; under these conditions, respondents who interpret the questions to ask about standard practice would be likely to underreport free ridership. Therefore, applying the survey-based FR to program savings would likely overstate the net program savings.

The model-based approach provided a wealth of detailed and useful information about the construction practices used in NCP participating buildings and directly addressed the construction of the baseline in the absence of the program. In a more traditional evaluation that relies on a comprehensive baseline study, the baseline would be reflected in the evaluated gross savings. In the innovative, project-specific approach used in this evaluation, baseline differences are incorporated into the MPN. While the model-based approach does not necessarily make the same distinction between net and gross effects, the net program impacts correctly include all of the net effects and the baseline, and the model-based approach results in evaluated savings that are more reliable than could have been achieved with alternative methods to estimate the baseline in the absence of a comprehensive baseline study.

[45] While the MPNR includes the participant ISO, this value was quite low (1%). Since it was not possible to calculate the participant ISO using the survey-based approach and the participant ISO is likely to be so small, the MPNR is compared to the survey-based FR rate rather than the combination of the FR and the participant ISO.

4.4 OUTSIDE SPILLOVER AND NON-PARTICIPANT SPILLOVER FROM NCP

4.4.1 Method to Estimate Participant Outside Spillover

Participant OSO occurs when additional high efficiency actions or measures are adopted by the participant at other non-program sites. These actions may have been implemented at other facilities by participating owners or promoted by design teams at non-program sites.

As is consistent with previous NYSERDA evaluations, the OSO was estimated only for participating design teams to avoid double counting. Double counting is a concern when estimating SO from two separate sources (participating building owners and participating design teams). For example, it is possible that projects identified as OSO from the building owners could also be projects that constitute OSO for the participating design teams. Thus, using both building owner and design team estimates would overestimate OSO. To ensure this does not occur, the evaluation design estimated OSO based only on the design team responses.

In the case of new construction programs, the OSO from building owners would be expected to be much smaller than the OSO from design teams since owners' OSO could only be based on other new buildings built for their company whereas the design firms are in the business of developing new buildings and would be more likely to apply techniques or install new technologies learned through the NCP in other applications. Since the participating design teams are likely to be the primary source of OSO, the OSO analysis focused on the data obtained from design firms. Owner survey responses regarding OSO were used to validate the design team OSO findings but were not used in the analysis.

The survey asked participants if they incorporated greater energy efficiency in projects outside the Program but due to the Program (OSO) and how many buildings were affected. Then they were asked about the approximate energy savings expected from those actions as compared to the savings for their participating projects.

4.4.2 Participant Outside Spillover Findings

The Impact Evaluation Team found the participating design team survey data to be insufficient to estimate OSO.[46] As detailed in Table 4-14, only 12 design teams indicated whether the NCP influenced additional energy efficiency actions at other non-program facilities, and the number of facilities affected by additional energy efficiency actions was not reported by any of the survey respondents. Additionally, only one response was obtained for the causality question.[47]

Table 4-14. New Construction Program Influence on Participant Design Team Outside Spillover

Did the NCP Experience Influence Additional Energy Efficiency Actions at Other NY Sites?	Number of Respondents[1]	Percent of Total
Yes	4	33%
No	8	67%
Total	**12**	**100%**

[1] Ten respondents either answered with "Don't know" or did not respond to the survey item.

[46] The sample size of respondents with SO was small and many respondents did not provide complete answers.

[47] This survey item asks the respondent to estimate the proportion of savings from energy efficient actions at a facility that could be attributed to the influence of the NCP.

However, the initial SO questions were sufficient to conclude that OSO was occurring, even it if could not be quantified from the survey responses.[48] As can be seen from Table 4-14, 33% of the survey respondents who answered this question indicated that the NCP had influenced them to take additional energy efficiency actions at other non-participating sites.

With one-third of the participating design firms stating that their firms are generating spillover, the survey results indicate that SO exists and it is greater than zero at the 95% confidence level. Under these circumstances, failing to include an estimate of the OSO would introduce a downward bias into the estimate of the NTGR. The MPNR includes FR and ISO, and FR is balanced by estimates of the OSO and NPSO.

To quantify an estimate of current participant OSO impacts, the Impact Evaluation Team reviewed the most recent market characterization, market assessment and causality (MCAC) evaluation, the 2006 New Commercial Program Market Characterization, Assessment and Causality Evaluation, which estimated OSO at 32%. Further examination of the 2006 MCAC study shows a much higher proportion, 52%, of the participating design firms confirmed that their firms were generating spillover, as compared to 33% of design firms from this evaluation's participant surveys (2011). The OSO from the 2006 MCAC evaluation was then adjusted downward to reflect the current lower OSO design firm response rate by developing an OSO Scaling Factor as follows:

$$\frac{Design\ Firm\ Percent\ Report\ OSO\ 2011}{Design\ Firm\ Percent\ Report\ OSO\ 2006} = OSO\ Scaling\ Factor$$

$$\frac{0.33}{0.52} = 0.63\ (OSO\ Scaling\ Factor)$$

The 2006 OSO rate of 32% was scaled using this factor to yield an OSO estimate of 20% for this evaluation. In the absence of better information, the Impact Evaluation Team has included this participant OSO estimate in the program NTGR.

$$(2006\ OSO\ Rate)x\ (OSO\ Scaling\ Factor) = 2011\ OSO\ Rate$$

$$(0.32)x(0.63) = 0.20$$

$$= 20\%\ 2011\ Participant\ OSO\ Rate$$

4.4.3 Non-Participant Spillover Method

Non-Participant Spillover and Market Effects Survey

In addition to the combination of gross and net surveys described above, telephone surveys of non-participating design firms (architects, engineers, and design-build firms) and non-participating building owners were conducted to estimate NPSO through enhanced self-reports and to assess program market

[48] The methods section above explains the need to use participating vendor OSO rather than participating owner OSO. The participating owners were asked OSO questions. Five of the 52 interviewed reported having outside spillover, approximately 10%. None of the 5 respondents provided an answer to percent greater than or percent less than inquiry for either electric OSO or natural gas OSO. This meant that no quantified OSO savings could be estimated for electric or natural gas. The OSO calculation then must have the percent due to NCP. There were only 2 responses for electric OSO (40% and 25%) and one response for natural gas OSO (22%). Participating owners are not the preferred measurement type for OSO but also they did not have enough complete information to estimate their OSO (given the rate of spillover of 10% so that a sample size of 52 only yielded possible OSO information from 5 participants).

effects. Survey instruments are included in Appendix C of the report. A screening question led the survey to verify that the survey respondents met the criteria for non-participating firms.

The NPSO survey included inquiries concerning energy usage, efficiency awareness, market penetration changes in energy efficient technologies and practices, and the Program's influence regarding them all to facilitate NPSO estimation. This survey information was used alongside program reported savings, the impact evaluation of evaluated gross savings, and information on square footage of new construction activities in New York (not including Long Island), to derive the NPSO estimates.

The Impact Evaluation Team provided a sample frame and the framework for fielding the telephone survey to NYSERDA's survey contractor. Efforts were made to minimize non-response by attempting to contact participants multiple times at different times of day. The Impact Evaluation Team worked with the survey contractor to iron out the details and establish the schedule.

The Non-Participant Spillover and Market Effects Surveys were fielded by NYSERDA's survey contractor between July 26, 2011 and November 4, 2011.

Table 4-15 shows the disposition for these surveys as conducted by the survey contractor. The completion rates were 10% for the non-participating building owners and 16% for the non-participating design teams. The non-participating building owners contact, cooperation, and response rates were 63%, 35% and 21%, respectively. These same rates for design teams were 62%, 45% and 27%, respectively.

Table 4-15. Sample Disposition for the Market Effects and Spillover Survey of Non-Participating Building Owners and Design Teams

		Building Owners		Design Teams	
Disposition		**Number of Non-Participating Building Owners**	**Percent of Non-Participating Building Owners**	**Number of Non-Participating Design Teams**	**Percent of Non-Participating Design Teams**
Total sample used		718	100.00%	465	100%
Excluded sample	Not working/unusable number	48	7%	44	9%
	Quota filled	44	6%	7	2%
Not contacted	Respondent never available	34	5%	34	7%
	Voice mail/e-mail	83	11%	68	15%
Unknown eligibility	No answer/busy	16	2%	14	3%
Not eligible	Not eligible/not qualified	294	41%	133	29%
Refused/	Refused	130	18%	90	19%
Completed interview		69	10%	75	16%
Contact rate = [Building owner: ((69+130)/(69+130+34+83) = 0.6297)]			63%		62%
Cooperation rate = [Building owner: (69/(69+130) = 0.3467)]			35%		45%
Response rate= [Building owner: (69/(69+130+34+83+(0.4501*16)) = 0.2135)]			21%		27%

Note: See the Glossary for formulas and definitions of contact rate, cooperation rate and response rate as defined by AAPOR.

Table 4-16 and Table 4-17 show the target sample sizes and the actual completed surveys by business type and size strata. As with the baseline survey, fielding the survey was a lengthy and difficult process. The long fielding period was due to the difficulty of reaching this market sector and completing the surveys. As was consistent with the sampling plan, surveys were completed for small projects within the building type when it was not possible to obtain enough interviews from the large projects. Since the survey was difficult to field, it was necessary to allow some leeway with the target number of completes within each business type.

Table 4-16. Non-Participating Owner Spillover & Market Effects Survey Completions

Business Type	Large Targets	Large Completes	Small Targets	Small Completes	Total Completes
Commercial	11	4	11	19	23
Education	4	2	4	8	10
Government/nonprofit	4	1	4	8	9
Healthcare	4	2	4	6	8
Manufacturing	n/a	2	n/a	5	7
Multifamily	9	4	9	14	18
Total	**32**	**15**	**32**	**60**	**75**

Table 4-17. Non-Participating Design Firm Spillover & Market Effects Survey Completion

Business Type	Large Targets	Large Completes	Small Targets	Small Completes	Total Completes
Commercial	11	3	11	25	28
Education	4	1	4	6	7
Government/nonprofit	4	5	4	5	10
Healthcare	4	3	4	4	7
Manufacturing	n/a	1	n/a	3	4
Multifamily	9	4	9	15	19
Total	**32**	**17**	**32**	**58**	**75**

Non-Participant Spillover Calculation Method

Key factors in the estimation of NPSO include design team reports of increases in penetration of efficiency measures and the proportion of increased market penetration due to the NCP. This part of the approach is described below.

1. The change in market penetration was calculated by subtracting the estimated market penetration from two years ago from the current market penetration of the high efficiency technology or practice. (This is a gain in percentage points, *e.g.*, if the market is at 40% penetration and 2 years ago it was at 30% penetration then the penetration increase is 10%.)
2. The change in market penetration due to NCP was calculated by multiplying the change in market penetration from Step 1 by the percent of the change that is attributable to NCP.

The NPSO savings is derived from estimates of the square footage of commercial new construction in NYSERDA's territory, the square footage covered by the surveyed non-participants, and the savings per square foot expected by efficiency measure or action.

The specific steps used to develop the NCP NPSO rate are described below.

1. Calculate the difference in the market penetration of high efficiency technology or actions using the following formula:

$$Current\ percent\ market\ penetration\ -\ Market\ penetration\ 2\ years\ ago = Gain\ in\ market\ penetration\ by\ high\ efficiency\ technology/action$$

2. Adjust for influence of NCP using the following formula:

$$\%\ gain\ in\ market\ penetration\ due\ to\ NCP = \%\ gain\ in\ market\ penetration \times \%\ due\ to\ NCP$$

3. Estimate the kWh savings per square foot by efficiency measure or practice type from the 2007-2008 NCP database.

4. Estimate the total area (square footage) of C&I 2007-2008 non-participating new construction and major renovations eligible for NCP.

   a. Determine the total area of 2007-2008 completed new construction or major renovations in Dodge database that were eligible for NYSERDA NCP and were not NCP participating projects.

   b. Adjust the total area calculated above due to ineligibility, as identified from the survey disposition information provided by APPRISE.[49]

   c. Add the area for projects not included in the survey to the area for the respondents to the survey.

5. Calculate the SO savings for each efficiency measure or practice using the following formula:

$$NPSO\ savings\ estimate = \%\ market\ penetration\ gain\ due\ to\ NCP * \frac{kWh}{square\ foot\ for\ each\ measure}(Step\ 3) * Square\ footage\ of\ NCP\ eligible\ nonparticipating\ projects\ built\ in\ 2007\ and\ 2008$$

6. Sum the NPSO savings (Step 5) across all efficiency measures.

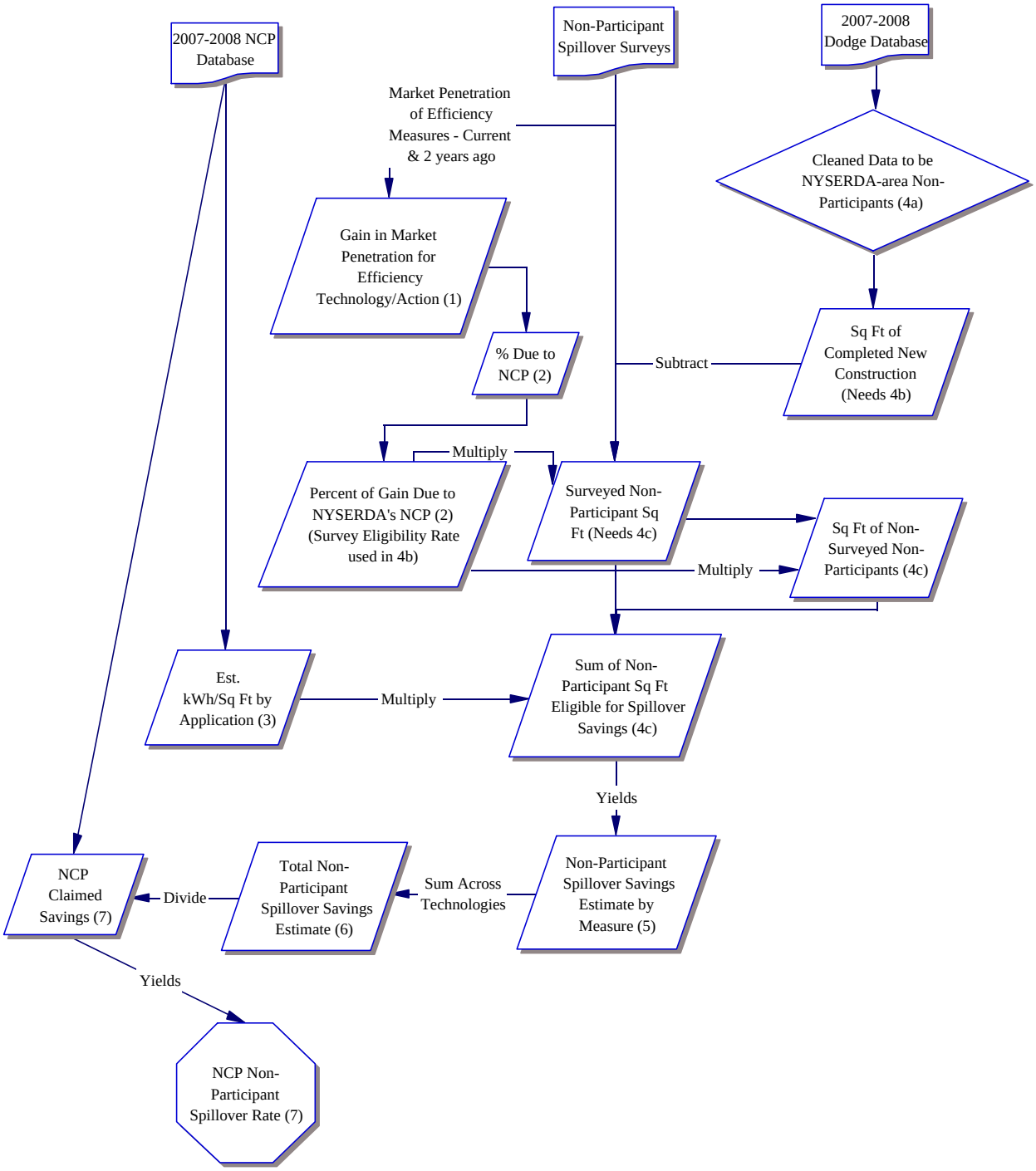
7. Determine NPSO rate using the following formula:

$$NCP\ NPSO\ rate = NPSO\ savings\ (Step\ 6)\ /(\ 2007 - 2008\ NCP\ claimed\ savings)$$

These steps are graphically represented in Figure 4-1 with the above steps identified within the graphic and detailed with data sources in Table 4-21.

[49] The survey disposition results show that the sample frame included some projects that were not eligible. Thus, the total area developed from the sample frame must be adjusted. The eligibility rate for those contacted was applied to the non-participant square footage of those projects that did not complete the survey screen for eligibility.

Figure 4-1. Graphic Representation of Spillover Calculation Process (Steps in Parentheses)[50]



[50] Steps are described in detail in the list preceding Figure 4-1.

4.4.4 Non-Participant Spillover Findings

The Non-Participant Spillover and Market Effects survey investigated several aspects of energy use and efficiency, including changes over time. The penetration of high efficiency technologies and practices are of primary interest for understanding energy efficiency in the New York C&I new construction and major renovation markets. The level of penetration also provides information critical to program planning and can be used to evaluate the list of measures to include in NCP efforts to assist owners and design teams with identifying high efficiency options. The change in market penetration is also the basis for developing the non-participant spillover (NPSO) ratio and the estimate of market effects. (A more detailed discussion of the market changes and market effects analyses can be found in Section 4.5; the survey instruments are included in Appendix C.)

NPSO was estimated by comparing the market penetration of high efficiency technologies and practices and estimating the proportion of the change that could be attributed to the Program. The NPSO in this evaluation and the Program's prior MCAC[51] evaluation were developed from the questions regarding the following topics:

- the current market penetration of high efficiency technologies or practices
- the change in the market penetration of high efficiency technologies or practices over time
- the extent to which the NCP caused the change in market penetration

These inquiries constitute some of the primary elements of most market effects studies.

These questions covered 16 types of equipment or practices, which can be aggregated into three groups: (1) heating, air-conditioning and ventilation (HVAC) and motors, (2) lighting, and (3) design practices. The three groups are defined below.

HVAC and Motors Group

- Efficient HVAC equipment
- Building control systems (BMS)
- Variable air volume systems
- High performance building shells
- Premium-efficiency motors
- Variable speed drives in motors

Lighting

- Efficient lighting technologies
- Efficient lamps and fixtures
- Lighting occupancy sensors/controls
- Daylighting technologies

Design Practices

- Advanced solar technologies

[51] NYSERDA (2008) *New Construction Program (NCP) Market Characterization, Market Assessment and Causality Evaluation, Final Report.* August. Submitted by Summit Blue Consulting LLC.

- Peak load reduction technologies
- Whole building design
- Green building design
- LEED certification
- Building commissioning

Market penetration reflects the proportion of the adoption of an efficient product or practice in comparison to all similar products or practices that occurred during a specific time period. Asking about market penetration is complex in that the survey results reflect the perspectives of the respondents in relation to their own projects and/or in relation to their understanding of the broader market.

In the process of fielding the survey, NYSERDA's survey contractor found that respondents were hesitant to answer the questions about market penetration. In order to facilitate the completion of the surveys, respondents were explicitly instructed that they could base their answers on their perceptions of the market from their experience and a survey question was included that asked whether their answers were based on their direct experience or their general market experience.[52] Approximately two-thirds of all respondents from both groups reported basing responses on their perceptions of the market based upon their own experiences, suggesting that the responses are primarily reflective of direct non-participant spillover.

In addition, the surveys were administered to both building owners and design team members, who typically have different perspectives and knowledge about the market. The design teams are expected to have greater experience in the New York new construction market than building owners, as they are instrumental in completing many more projects than would be expected for builder owners. Thus, the Impact Evaluation Team concluded that the design team responses are more likely to reflect the market as a whole (see discussion under Section 4.4.1) and the design team responses were used in the NPSO and market effects analyses. The Owner survey results were used to validate the trends demonstrated in the design firm surveys. The differences between the building owner and design team responses are provided in Table 4-18, which presents the current market penetration rates for each of these groups. For all but two technologies or practices, the building owners, on average, stated higher market penetration than the design teams.

[52] The instructions can be found in the Appendix C in the introduction to survey question M1 in the Spillover/Market Effects Survey.

Table 4-18. Current Market Penetration of High Efficiency Technologies

Current Market Penetration	Design Team (Non-Participant) Mean	Owners (Non-Participant) Mean	Percentage Point Difference (Difference between Owner and Design Team Reports of Market Penetration)
Efficient HVAC equipment	62%	71%	9%
Building control systems (EMS)	58%	65%	7%
Variable Air Volume Systems	49%	47%	(2%)
High performance building shells	43%	61%	18%
Premium-efficiency motors	63%	68%	5%
Variable speed drives in motors	45%	64%	19%
Efficient lighting technologies	72%	78%	6%
Efficient lamps & fixtures	73%	76%	3%
Lighting occupancy sensors/controls	60%	68%	8%
Daylighting technologies	43%	57%	14%
Advanced Solar Technologies	19%	24%	5%
Peak load reduction technologies	26%	49%	23%
Whole building design	45%	64%	19%
Green building design	52%	45%	(7%)
LEED certification	33%	37%	4%
Building commissioning	34%	35%	1%
Simple Average	**49%**	**57%**	**9%**

Design Team Responses

Table 4-19 displays the estimated market penetration two years ago and the current estimate, along with the penetration gain, the portion of the penetration gain credited to the NCP, and the estimated average kWh savings per square foot.[53] Efficient lighting technologies have the highest market penetration of all of the 16 technologies or practices examined, at over 70%, followed by efficient motors and HVAC, at more than 60%. The highest gains in the last two years were for efficient lighting technologies, efficient HVAC equipment, efficient lamps and fixtures, green building design, and lighting occupancy sensors. These measures gained 15 to 19 percentage points in market penetration. For example, market penetration for efficient lighting went from 53% two years ago to 72% currently, a gain of 19 percentage points. The technologies with the lowest market penetrations are advanced solar technologies at 19%, peak load reduction technologies at 26%, LEED certification at 33%, and building commissioning at

[53] The average kWh savings per square foot for the technologies and practices examined was obtained by examining the NCP participant database.

34%. Across all measures, design teams reported a 12 percentage point increase in market penetration of energy efficient measures and practices as compared to two years ago.

Table 4-19. Change in Market Penetration Caused by the New Construction Program

Non-Participating Design Team	% Market Penetration 2 Years Ago Mean[1]	% Current Market Penetration Mean[1]	Market Penetration Gain (Gain in % points) Subtraction	Market Penetration Gain Credited to NCP Mean[1]	Estimated Average kWh Savings per Square Foot[2]
Efficient HVAC equipment	44%	62%	18%	9%	0.7673
Building control systems (BMS)	44%	58%	14%	6%	0.1102
Variable Air Volume Systems	43%	50%	6%	3%	0.3365
High performance building shells	35%	43%	8%	4%	0.0863
Premium-efficiency motors	51%	63%	12%	3%	0.1485
Variable speed drives in motors	37%	45%	8%	4%	0.4860
Efficient lighting technologies	53%	72%	19%	11%	-
Efficient lamps & fixtures	55%	73%	17%	10%	0.8182
Lighting occupancy sensors/controls	45%	60%	15%	7%	0.0369
Daylighting technologies	30%	43%	13%	6%	0.0004
Advanced Solar Technologies	12%	19%	7%	3%	0.0164
Peak load reduction technologies	16%	26%	10%	4%	-
Whole building design	33%	45%	11%	5%	1.1490
Green building design	35%	52%	17%	7%	-
LEED certification	21%	33%	12%	4%	-
Building commissioning	27%	34%	7%	1%	0.1724
Simple average	**36%**	**49%**	**12%**	**5%**	

[1] Weighted mean.

[2] Estimated average kWh savings per square foot was determined from NCP records. It was not possible to calculate for all measures. Efficient lighting technologies could not be separated from efficient lamps and fixtures. There are no kWh savings from peak load reduction measures. NCP did not estimate savings for LEED certification or green building design.

The last column in Table 4-19 provides the savings per square foot for each efficient measure or practice. Using the method described in the methodology section, the new construction square footage for the technologies was estimated and the savings per square foot were calculated from the NCP program records.

The number of respondents with valid answers, the standard deviations with the percent due to NCP for the current market penetration, market penetration two years ago and the percent of the change due to NCP by high efficiency technology or action are provided below in Table 4-20. The percent difference in

market penetration is statistically significant at the 90% confidence interval for all of the measure groups.[54]

Table 4-20: Standard Deviations for NPSO Measure Level SO Savings

Non-Participating Design Team	Number of Respondents Used to Estimate Final Gain Credited to NCP[1]	Market Penetration Gain Credited to NCP	Standard Deviation in Penetration Gain Credited to NCP	Standard Error in Penetration Gain Credited to NCP	Error Bound of Penetration Gain Due to NCP
Efficient HVAC equipment	15	9%	0.114	0.029	0.048
Building control systems (BMS)	20	6%	0.082	0.018	0.030
Variable Air Volume Systems	21	3%	0.084	0.018	0.030
High performance building shells	27	4%	0.075	0.014	0.024
Premium-efficiency motors	27	3%	0.040	0.008	0.013
Variable speed drives in motors	28	4%	0.074	0.014	0.023
Efficient lighting technologies	35	11%	0.083	0.014	0.023
Efficient lamps & fixtures	37	10%	0.079	0.013	0.021
Lighting occupancy sensors/controls	38	7%	0.064	0.010	0.017
Daylighting technologies	38	6%	0.061	0.010	0.016
Advanced Solar Technologies	38	3%	0.040	0.007	0.011
Peak load reduction technologies	38	4%	0.044	0.007	0.012
Whole building design	38	5%	0.059	0.010	0.016
Green building design	39	7%	0.057	0.009	0.015
LEED certification	39	4%	0.040	0.006	0.011
Building commissioning	39	1%	0.017	0.003	0.004

[1] This column represents the number of respondents who provided valid answers for all component required to calculate the change in the market penetration attributed to the NCP.

[54] The market penetration gain credited to NCP for variable air volume systems is right at the margin of statistical significance at the 90% confidence interval. For all other measure groups, the NCP market penetration gain is clearly statistically significant.

Table 4-21. NPSO Calculation Steps with Descriptions and Data Sources

NPSO Step	Description	Data Source
1	Gain in market penetration (shown in Table 4-19: % market penetration two years ago – current % market penetration	Non-Participant Spillover/Market Effects Survey:
2	Adjust for % Due to NCP (shown in Table 4-19): Gain in market penetration (#1) x % due to NCP	Non-Participant Spillover/Market Effects Survey
3	Calculate kWh savings per square foot by measure (shown in Table 4-19: NCP program savings (kWh) per measure type/ total square foot of buildings with measure type	NCP tracking database
4a	Total non-participant C&I new construction square footage 2007-2008 Constant = 319,126,879 sq. ft.	Dodge Database, cleaned to exclude participants
4b	Use survey disposition rates to adjust for eligibility and calculate non-surveyed, non-participant eligible new construction square footage Constant = 157,057,408 sq. ft.	Non-Participant Spillover/Market Effects Survey disposition rates
4c	Total non-participant new construction square footage (eligible non-surveyed plus surveyed square feet) Constant for survey respondents - 9,427,497 sq. ft. Sum for Total Square Footage Eligible for NPSO = 166,484,905 sq. ft..	Non-Participant Spillover/Market Effects Survey
5	NPSO kWh by Measure % Points Gain Due to NCP (Step 1 x Step 2) * kWh Savings per Sq Ft (Step 3) * Total Eligible Non-pariticipant Square Footage (Step 4c)	See steps above; calculated by measure
6	Sum across all measures to get NPSO savings: NPSO kWh Saved = 43.7 GWh	See steps above
7	NPSO rate: NPSO kWh Savings/ Program Claimed Savings	Step 6 and Program Reported Savings NCP Rate = 43.7 GWh/ 72.2 GWh = 61%
Error Bound of SO kWh		6,554,366
Error Bound of NPSO Rate		9%
NPSO Upper Bound @ 90% Confidence		70%
NPSO Lower Bound @ 90% Confidence		52%

Note: Precision was calculated incorporating propogation of error

Following the step-by-step guide in the above description provides the calculation of the NPSO. The sum of these savings for each technology or practices gives the NPSO kWh savings. The sum of the NPSO savings (had been calculated by measure and practice) was 43,681,905 kWh (43.7 GWh as shown in Table 4-21). Dividing the NPSO savings by the program reported savings provides the NPSO ratio. The final result of this analysis is a NPSO rate of 61%. The NPSO rate was estimated with an error bound of 9% at the 90% confidence level. The upper confidence bound is 70% and the lower bound is 52%.

4.5 PROGRAM LEVEL NET-TO-GROSS RATIO AND NET IMPACTS

4.5.1 Program Net-to-Gross Methods

The net-to-gross ratio (NTGR) for the NCP is the Modeled Partial Net Ratio (MPNR) from the modeling plus the participant outside spillover (OSO) rate and the non-participant spillover (NPSO) rate, as shown below.

$$NTGR = MPNR + OSO + NPSO$$

Net impact measures the program savings after adjusting for the RR and the NTGR. The formula is given below

$$Net\ impact = Program\ reported\ savings \times RR \times NTGR$$

4.5.2 Program Net-to-Gross Findings

The MPNR, OSO, and NPSO estimates are combined to produce the evaluation's NTGR. Figure 4-2 presents a bar graph with the three components for NCP's NTGR for kWh savings: the model participant net ratio at 35% for kWh, the participant OSO at 20%, and the NPSO at 61%. The modeled partial net value for kW is 46%; the MPNR varies for kWh and kW because the analysis approach used modeling.

NCP's NTGR is represented as:

$$NTGR = MPNR + OSO + NPSO$$

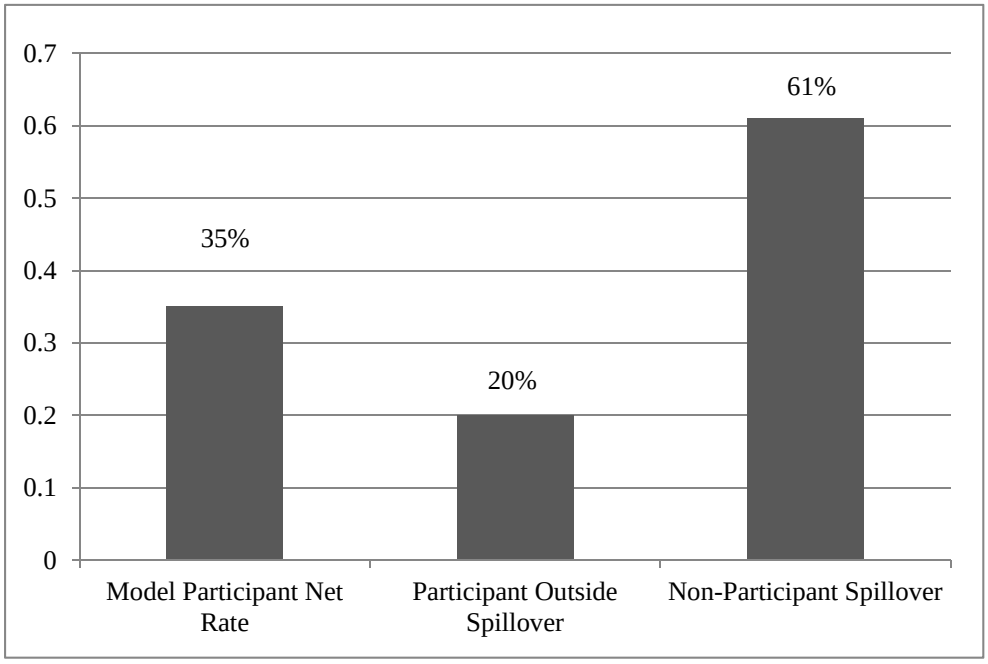
The results of this evaluation provide a kWh NTGR of 1.16 from the following:

$$NTGR_{kWh} = 0.35 + 0.20 + 0.61 = 1.16$$

The results for this evaluation provide a kW NTGR of 1.27 from the following:

$$NTGR_{kW} = 0.46 + 0.20 + 0.61 = 1.27$$

Figure 4-2. NCP kWh Net-to-Gross Ratio Components



4.5.3 Net Impacts

The evaluation estimated program savings are shown in Table 4-22. NCP achieved 58,887,988 kWh and 11,840 kW of evaluated gross savings during program years 2007 and 2008. The realization rates were 71% and 52% for electric energy and electric demand savings, respectively. These results are based on the 39 projects included in the sample. The overall net-to-gross ratio (NTGR) was 1.16 for kWh savings and 1.27 for kW savings. The evaluated net savings achieved by NCP are 68,310,066 kWh and 15,037 kW.

Table 4-22. Summary of NCP Savings for Projects Completed in Years 2007-2008

	Annual Electric Savings (kWh/Yr)	Peak Electric Demand Savings (kW)
Program-reported savings	82,940,828	22,769
Realization rate	71%	52%
Evaluated gross savings	58,887,988	11,840
Net-to-gross ratio	1.16	1.27
Total evaluated net savings	68,310,066	15,037

Note: Tracking and claiming natural gas savings was not a focus of the program during the program years being evaluated. A few projects were found to have claimed gas and other fossil fuel savings, but the data was not adequate to establish a program level realization rate.

The 90% confidence level for the modeled partial net ratio (MPNR) is plus or minus 7% for kWh and 5% for kW, and the relative precision is 18% and 17%, respectively. The non-participant spillover (NPSO) rate is 61% and NCP's NPSO at a 90% confidence level is at least 52%.

4.6 MARKET CHANGES AND MARKET EFFECTS PILOT

4.6.1 Methods for Market Effects Pilot

This evaluation also included a pilot effort to investigate whether there were market effects not captured by the participant and non-participant spillover approach and methodology. Theoretically, the comprehensive SO measurements with participants and non-participants, customers, and mid-stream market actors should capture all the market impacts generated by the NCP However, market transformation is based on complex interactions, and it is entirely possible that the overall program effects go beyond what can be measured from direct inquiries concerning NCP influence.

This section relies on the definitions in the *Scoping Study, 2004 California Evaluation Framework* that have been used in most subsequent market transformation evaluations.[55] All changes observed in a market are referred to as market changes and may have no relationship to the efficiency programs or policies being examined. Market effects are the changes caused by program or policy efforts that range from market structure changes to energy savings resulting from the induced market changes. 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)."[56]

The primary goal of the NCP market effects pilot was to determine if there are market effects that are not captured in the various SO estimates already being estimated in NYSERDA's evaluations.

The market effects pilot method uses the results from the NPSO estimation described and presented in detail earlier in Section 4: Rather than estimating the change in market penetration attributed to NCP by non-participants, the market effects analysis is based on the change in market penetration that *was not* directly attributed to NCP. If there are market effects from the NCP that have not been captured in the estimated SO, they would be within the remaining change in market penetration after taking out the portion that was directly attributable to NCP. This approach avoids double counting as the estimated SO savings are not included in the market gains being used for the market effects analysis.

The NCP logic model indicates that the NCP is designed to create market changes in structure and operation that may affect the following elements of the market:

- Knowledge of energy efficiency
- Availability of high efficiency measures and practices
- Promotion of energy efficiency by architects and engineering firms and retailers
- Behavior and decision-making regarding investing in high efficiency in new construction and major renovations

Any impacts from NCP's interventions that change one or more of these elements and are not identified by non-participating design teams as being induced by the NCP are market effects that are missed in the current NYSERDA evaluation designs.

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[55] 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 2004, *The California Evaluation Framework* (Southern California Edison Company Study ID K2033910).

[56] Eto, Prahl, and Schlegel, *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs* (Ernest Orlando Lawrence Berkeley National Laboratory, 1996), page 9.

The Non-Participant and Spillover Market Effects Survey made an extra effort to gather new information on the reasons for making energy efficient investments in the new construction market. To address this issue, the Impact Evaluation Team developed a list of reasons for deciding to adopt high efficiency that was comprehensive and unbiased and yet was not too burdensome to respondents. This process produced eight reasons for adopting high efficiency. These reasons were then divided into two groups, those that could reasonably be associated with NCP program activities but were not explicitly included in the other components of the SO analysis and those that were unrelated to NCP. The potential NCP related reasons include:

- Increased knowledge of energy efficient construction practices
- Increased availability of energy efficient products/technologies
- Increased promotion of efficiency by vendors, contractors, or retailers
- Increased promotion of efficiency by manufacturers

The four reasons that were either not related to NCP or were directly incorporated into the program net effects are the following:

- Energy efficiency programs and efforts by the State of NY
- Increased federal programs and promotions concerning energy efficiency
- Increased awareness of global environmental consequences of energy use
- Higher energy prices

Respondents were asked to estimate the relative influence associated with each reason, assuming the total percent of the responses across the eight reasons had to equal 100%. Responses for this type of question cannot be reliably provided in a telephone survey. Consequently, the survey process was modified to e-mail respondents with two survey questions relating to these eight reasons, asking them to provide the information when they participated in the telephone survey. This process was necessary to produce reliable and accurate information concerning decision-making. In this pilot study, potential market effects were estimated only for two of the four potential reasons that could be associated with NCP, i.e., increased knowledge of energy efficiency practices and increased availability of energy efficient products and technologies. The other two reasons that could be potentially linked to NCP were dropped to provide greater balance to the analysis.[57]

Since this pilot effort was intended to provide an initial assessment of whether additional market effects could be found and the length of the non-participant surveys was already at its maximum, the Impact Evaluation Team did not attempt to parse out program effects to a higher degree of granularity.

There are components of the analysis that could introduce an upward bias to the estimated savings of the potential NCP market effects and other factors that could result in a downward bias. First, the Program is not the only reason that high efficiency knowledge and availability has increased and the Program can only take credit for some portion of these. Since the proportion of these savings that can be attributed to NCP is unknown, there is an upward bias to the method of estimating the market gain savings by

[57] It is important to recognize that the pilot is seeking NCP induced changes that cannot be recognized by the interviewees as caused by NCP. If the interviewees recognize the NCP affect then that would already be captured in their reporting of the change due to NCP. These savings are those that are more indirect in how NCP changes the market, its market actors and its operation in ways that interviewees do not recognize and cannot simply be solved by a follow-up question on NCP affect.

including all of these savings. However, since the market effects are due to structural market changes that are not recognized by non-participant survey respondents as related to the NCP, there is no way to ask respondents to attribute these effects to the NCP.

Another factor is that the market effects estimate in this pilot does not include any potential NCP impacts on the promotion of high efficiency by design professionals, contractors, vendors or manufacturers. The Program is designed to increase both of these market activities, particularly the promotion by design professionals. Omitting these savings introduces a downward bias of unknown magnitude.

It is not possible to know if the upward bias and the downward bias completely cancel each other out[58] or if there is a remaining upward bias or downward bias in the final potential market effect estimate. This pilot was designed to test a method for determining whether there may be market effects attributable to NCP that are not captured by the NPSO estimate. The method used might provide a starting point for future research in this area.[59]

The specific steps used to develop the potential market effects estimate for NCP are described below. These calculations use outputs from the NPSO steps outlined in Table 4-21.

1. Calculate the kWh savings for market change. Market change kWh savings combines three outputs from the NPSO calculations. Market change kWh savings is the summed product of:

   [Market gain percentage points (Table 4-21-Step 1)] * [kWh savings per square foot (Table 4-21-Step 3)] * [Eligible non-participant square footage (Table 4-21-Step 4c)] over the efficient measures and practices as shown in the formula:

$$\sum_{m=1}^{p} Market\ change\ kWh\ savings$$

   Where:

   m is the individual measure or practice and

   p is total number of measures and practices for which market change kWh savings data is available (16 measures and practices as shown in Table 4-19)

2. Calculate the market change kWh savings NOT directly attributed to NCP. This step nets out NPSO market changes (which are directly attributable to NCP) from the total market changes. The market change kWh savings NOT directly attributed to NCP is based on outputs from the NPSO calculations as follows:

   a. Determine percent market change NOT attributed to NCP as: [Market gain percentage points (Table 4-21-Step 1) – [% market gain directly attributable to NCP (Table 4-21-Step 2)]

[58] It would be highly unlikely that there would be an exact match but the differences and direction could be small or large as this study provides as no additional information to inform this component of the pilot analysis.

[59] The test shows potential to use disassembling reasons for energy efficiency adoptions for indirect program affects. There is still a large challenge in finding a way to identify and measure program induced market structure and operational changes that cannot be directly linked by most market participants to the Program. Cross-sectional time-series analysis might be the desired tool but is just as challenging to conduct in a way to find indirect program induced impacts. The expansions of energy efficiency programs and green initiatives are closing, or have closed down, the opportunities for cross-sectional studies.

b. Calculate the kWh savings NOT attributed to NCP by measure as: [% market change not attributed to NCP (Market Effects Step 2a)] * [kWh savings per measure per square foot (Table 4-21-Step 3) * [Total eligible non-participant square footage (Table 4-21-Step 4c).

c. Sum across measures to obtain total market change kWh savings NOT directly attributed to NCP. Use this estimate of total market change kWh savings NOT attributed to NCP as a comparison checkpoint against the kWh savings estimates generated through the remaining steps.

3. Calculate the kWh savings by measure due to increased availability of energy efficient technology and practices (NCP influence factor)

   kWh Savings due to increased availability of energy efficient technology and practices = [kWh savings per measure per square foot (Table 4-21-Step 3)] * [Total eligible non-participant square footage (Table 4-21-Step 4c)] *[Percent market change due to increased availability of energy efficient technology and practices by measure (Table 4-26)]*[Percent market change NOT attributed to NCP (Market Effects-Step 2a)]

4. Calculate the kWh savings by measure due to increased knowledge of energy efficient technology and practices (NCP influence factor)

   kWh Savings due to increased knowledge of energy efficient technology and practices = [kWh savings per measure per square foot (Table 4-21-Step 3)] * [Total eligible non-participant square footage (Table 4-21-Step 4c)] *[Percent market change due to increased knowledge of energy efficient technology and practices by measure (Table 4-26)])]*[Percent market change NOT attributed to NCP (Market Effects-Step 2a)]

5. Sum by measure kWh savings from Step 3 and Step 4. Then sum across measures. This is the market change attributable to NCP influence factors and is this evaluation's estimate of potential NCP uncaptured market effects not included in NCP's NPSO savings.

6. Check total potential NCP uncaptured market effects relative to overall market change savings for reasonableness by comparing to market change savings due to other reasons.

7. Compare total potential NCP uncaptured market effects to NPSO savings.

4.6.2 Market Findings

This section covers the findings from the market effects survey, including energy code compliance.

Energy Code Compliance

The surveys included questions about energy code compliance. Since meeting energy code is a legal requirement, it is possible that respondents may have been unwilling to admit to practices that do not meet code. To address this issue, the survey questions were designed to inquire more generally about each respondent's opinion regarding the percent of commercial new construction projects in New York that met the energy code. The non-participating design teams stated that over two-thirds of the new commercial constructions currently meet energy code. Table 4-23 presents the results.

Table 4-23. Survey Responses on Percent Code Compliance

Non-Participating Design Teams	Current % Not Meeting Energy Code (n = 58)	% Not Meeting Energy Code as of 2 Years Ago (n = 66)
Average	30%[1]	40%[1]
Standard Deviation	0.06	0.08

[1] The survey asks non-participating design teams what percent of all New York C&I new construction does not meet Energy Code, or did not meet Energy Code 2 years ago. This is the average of the design team responses.

Interpreting the results is complex due to the characteristics of the C&I new construction market and the fact that many new construction and major renovation projects take a long time to plan and build.[60] These new building projects must comply with the code that was in place at the time the projects got their building permits. Of the participating projects completed in 2007 and 2008, the applicable energy code was 5 years old or more at the time of completion for 85% of projects and 16 years old or more for 15% of the projects.

In addition, the New York State Energy Code has been changing often, with revisions in 2002, 2008, and 2011. The New York State energy codes from 2002 and 2008 are likely to be those that were applicable for the recently completed projects. The timing of the survey and changes in the New York State Energy Code are such that the respondents may be considering different energy codes and the reported drop-in compliance may easily be related to a perceived increase in the code requirements. A recent New York State Energy Code Compliance Study found that compliance rates for commercial new construction projects ranged from 36% to 85% depending on the evaluation method used to determine compliance.[61]

Changes in Energy Use Over the Past Two Years

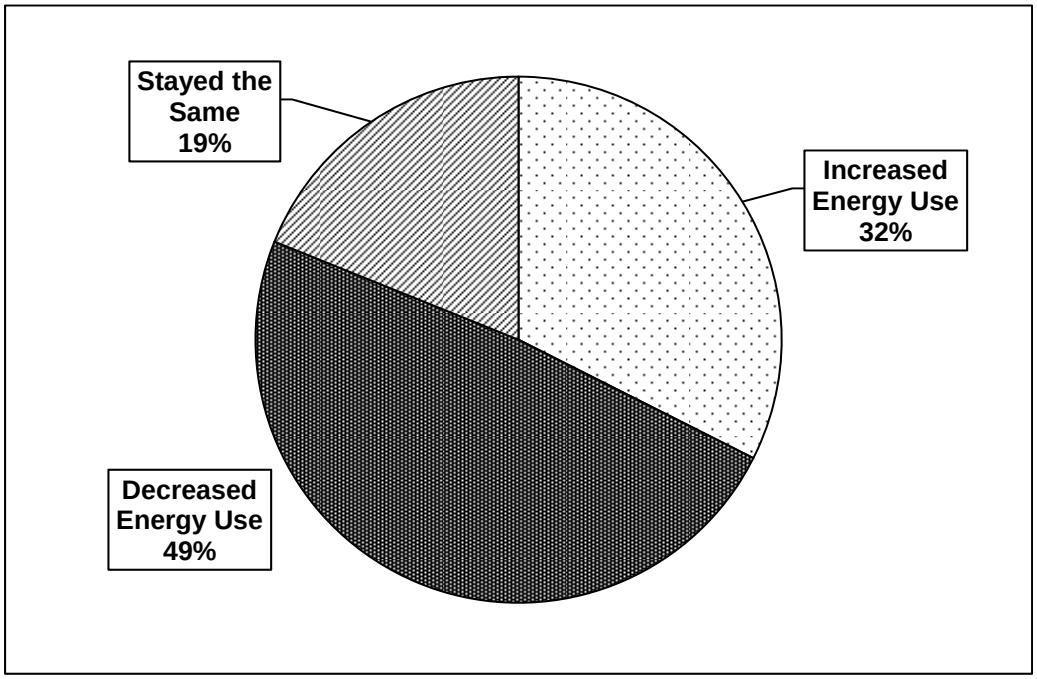
Two other global energy questions concerning the New York new construction market were asked. These questions investigated whether respondents thought that energy use had increased or decreased and the role of NYSERDA's NCP in that change. Other questions investigated the adoption of specific high efficiency technologies. The responses to specific high efficiency technology inquiries provide clear positive evidence of the Program's contribution to penetration gains. The responses regarding changes in energy usage, however, provide mixed results that are difficult to interpret, especially in light of the penetration data and its attribution to C&I new construction energy efficiency programs. (NYSERDA's NCP was the only such program during this time period.)

As seen in Figure 4-3, nearly half (49%) of the non-participating design teams reported a decrease in energy use in newly constructed and major renovation C&I buildings over the past two years. Energy use was reported to have stayed the same by 19% of the design teams and almost one-third say that energy usage in newly constructed New York buildings had increased.

[60] NYS recently adopted a more stringent energy code. Compliance rates typically drop when a new code is adopted and rise over time as the market gains knowledge of the new code requirements.

[61] *New York Energy Code Compliance Study* (Vermont Energy Investment Corporation, January 2012)

Figure 4-3. Changes in Energy Use in New Construction Over the Past Two Years (non-participant Design teams)



There can be many factors contributing to increases or decreases in energy use. The goal of the program is to promote reducing energy use through the adoption of energy savings technologies. The survey question did not explicitly ask about energy use on a standardized basis, so an increase in energy use could be interpreted as higher consumption on average in new buildings or more buildings being added to the building stock. For example, there may be additional electrical loads, such as air conditioning or computer equipment, if new commercial buildings are upgrading the space to be competitive in the market, resulting in higher use even if the new equipment is highly efficient. The economic recession during the time period of interest could also have affected the types of buildings that were completed and their energy use. Ideally, additional follow-up questions could have been asked to investigate these issues; however such inquiries would have made the surveys unreasonably long.

Thirty-six designers reported an average decrease in energy use of 10% and credited the NCP with almost one-third (3%) of that energy decrease. Twenty-four, 32%, perceived an increase in energy use, with the average increase in usage of 24%; 9% of that increase was attributed to the NCP.

Critical Factors in Decision-Making for Energy Efficiency Investments

The Non-Participant Spillover and Market Effects surveys asked respondents to allocate 100% of the decision making to adopt energy efficiency to eight different reasons discussed in 4.6.1. As would be expected, higher energy prices were the primary reason listed for investing in high efficiency. This trend has clearly been demonstrated over time as energy prices have changed abruptly (*e.g.*, during energy crises or other interruptions in the energy supply) and is also evident from differences in high efficiency adoption across utility territories in the U.S. and differences in efficiency adoption between the U.S. and Europe as compared to the differences in energy prices between these two markets. The percent influence due to higher energy prices is cited as 22% by the non-participating design teams and 19% by the non-participating building owners.

Somewhat surprising, however, is that the building owners' second and third reasons for high efficiency adoption are so close behind energy prices, differing only by 4% to less than 1%. Table 4-24 presents all eight reasons and their average percentage ranking for each respondent group. Ranking second, third and fourth are knowledge, availability and energy efficiency programs offered in New York. It is important to recognize that this ranking of New York efficiency programs as fourth is from non-participants only and does not reflect the full market, *i.e.*, does not include participants.

Table 4-24. Reasons to Adopt High Efficiency in C&I New Construction and Major Renovation

	Non-Participant Design Team	Non-Participant Building Owners
Higher energy prices	22%	19%
Increased availability of energy efficient products/technologies[1]	18%	19%
Increased knowledge of energy efficient construction practices[1]	15%	16%
Energy efficiency programs and efforts by the State of NY[1]	14%	13%
Increased promotion of efficiency by vendors, contractors, or retailers	9%	8%
Increased awareness of global environmental consequences of energy use	8%	8%
Increased promotion of efficiency by manufacturers	7%	8%
Increased federal programs and promotions concerning energy efficiency	7%	8%
Total	**100%**	**100%a**

[1]Highly linked to NCP activities.

[a] Numbers in the table were rounded and therefore do not exactly equal 100%.

4.6.3 Findings from the Market Effects Pilot

The market effects pilot produced the total potential change in market penetration that may be associated with the NCP but is explicitly attributed to the NCP by the survey respondents. The market change penetration gains as reported by survey respondents are presented in Table 4-25 with the last column providing the gain in market penetration due to market change that was not directly credited to influence from NYSERDA. These penetration gains could be due to a variety of things that cause market change and a portion could be indirect effects from the Program. These range from 3% penetration gain for variable air volume equipment to 10% from green building design and an average gain in market penetration of 7% across the measures and practices examined.

Table 4-25. Change in Market Penetration Not Directly Credited to NCP

Measure Group	Market Penetration Gain (Gain in % points)[1]	Penetration Gain Credited to NCP (Gain in % points x % due to NCP) [1]	Penetration Gain Not Directly Credited to NCP (Gain in % points - % due to NCP) [1]
Efficient HVAC equipment	18%	9%	9%
Building control systems (BMS)	14%	6%	8%
Variable air volume systems	6%	3%	3%
High performance building shells	8%	4%	4%
Premium-efficiency motors	12%	3%	9%
Variable speed drives in motors	8%	4%	4%
Efficient lighting technologies	19%	11%	8%
Efficient lamps & fixtures	17%	10%	7%
Lighting occupancy sensors/controls	15%	7%	8%
Daylighting technologies	13%	6%	7%
Advanced solar technologies	7%	3%	4%
Peak load reduction technologies	10%	4%	6%
Whole building design	11%	5%	6%
Green building design	17%	7%	10%
LEED certification	12%	4%	8%
Building commissioning	7%	1%	6%
Simple average	**12%**	**5%**	**7%**

[1] These market penetration percentages were reported in non-participant survey responses. The design firm survey responses were used to avoid double counting. The non-participant owner surveys were used to validate the design firm survey findings. Sampling weights were applied.

Note: Survey data is from Non-Participant Market Effects Surveys

The pilot market effects method described earlier drew upon much of the method and output used in the estimation of the NPSO.

The survey responses, savings per square foot from program data and the total estimated area of commercial and industrial new construction from the Dodge database allow the development of an estimate of energy savings obtained from market changes over the last two years. Market change in the new commercial, industrial and other business new construction has created total energy savings of approximately 87 GWh.[62] The estimate of NCP NPSO as shown in Table 4-21 was 43.7 GWh. Energy savings from market change that is not directly credited to NCP amounts to 43.3 GWh. A portion of these savings might be indirectly caused by NCP; identifying these savings was the purpose of this pilot effort.

[62] The 87 GWh represents the total savings associated with changes in market penetration across all measures. It was calculated as explained in Step 1 of the calculation of market effects savings described in Section 4.6.1 above.

$$87\ GWh\ (Total\ Market\ Change) - 43.7\ (NCP\ NPSO) = 43.3\ GWh\ (Market\ Change\ not\ attributed\ to\ NCP)$$

The next step in the analysis was to assess whether any of the market changes not attributed to NCP may be a result of program activity. As discussed above, survey respondents estimated the relative importance of eight influence factors in the decision-making process and assigned the percentage of the decision to install energy efficiency to each of the influence factors. Two of the influence factors, increasing knowledge and availability of energy efficient equipment and practices, are closely linked to the NCP objectives. The uncaptured market penetration that could be due to NCP was estimated by adjusting the change in market penetration not directly attributed to NCP to account only for the market change associated with the two NCP-linked influence factors.

The data for these estimates and the kWh savings by high efficiency measure and practice and overall are presented in Table 4-26.

Table 4-26. Input and Estimate of NCP's Uncaptured Market Effects

Measure	Penetration Gain Not Directly Credited to NCP (Gain in % points - % due to NCP) Mean[1]	Increased Availability Influence Factor for Those that Answered % Due to NCP Mean[1]	Increased Knowledge Influence Factor for Those that Answered % Due to NCP Mean[1]	Avg. kWh Savings per Square Foot	kWh Savings Not Credited to NCP but Due to Increased Availability[1]	kWh savings Not Credited to NCP but Due to Increased Knowledge[1]
Efficient HVAC equipment	9%	15%	12%	0.7673	1,724,620	1,379,696
Building control systems (BMS)	8%	17%	11%	0.1102	249,502	161,442
Variable air volume systems	3%	23%	13%	0.3365	386,510	218,462
High performance building shells	4%	18%	14%	0.0863	103,461	80,469
Premium-efficiency motors	9%	17%	13%	0.1485	378,203	289,214
Variable speed drives in motors	4%	17%	12%	0.4860	550,153	388,343
Efficient lighting technologies	8%	20%	15%	-	-	-
Efficient lamps & fixtures	7%	20%	15%	0.8182	1,906,990	1,468,382
Lighting occupancy sensors/controls	8%	21%	17%	0.0369	103,341	83,657
Daylighting technologies	7%	20%	13%	0.0004	897	583
Advanced solar technologies	4%	19%	16%	0.0164	20,713	17,443
Peak load reduction technologies	6%	19%	18%	-	-	-
Whole building design	6%	23%	15%	1.1490	2,639,830	1,721,629
Green building design	10%	19%	15%	-	-	-
LEED certification	8%	19%	13%	-	-	-
Building commissioning	6%	15%	7%	0.1724	258,244	120,514
Totals					**8,322,464**	**5,929,834**

[1] Sampling weights were applied.

[2] Sums may not total due to rounding.

It was not possible to determine the specific part of the increase in availability or knowledge of efficient products, technologies or practices that should be attributed to the Program. The market effects pilot was intended to identify and quantify *potential* Program impacts that non-participants do not directly associate with the Program. However, directly asking them whether these indirect impacts are due to the Program could potentially lead to confusion and result in market effects estimates that overlap with other net impacts already being estimated, such as NPSO. In addition, the survey could not be expanded to further explore these issues due to its length.

As discussed in the methods section, this analysis assumes that all of the change in knowledge or availability is due to the Program, which is likely to introduce an upward bias in the estimate. This bias may be counterbalanced by the omission of other key decision factors that may have been influenced by the Program, such as promotion by vendors.

The results of the steps described in Section 4.6.1 are as follows:

1. Calculate the total savings for market changes = 87 GWh
2. Determine the Market Change NOT attributed to NCP = 43.3 GWh

Steps 3-5. Calculate the kWh savings due to increases in availability in energy efficient technology, practices and knowledge as shown in Table 4-26.

8.3 GWh of unattributed savings are associated with increased availability of efficient technologies and practices

5.9 GWh of unattributed savings are attributed to increased knowledge of energy efficiency

14.3 GWh is the total uncaptured savings due to the NCP influence factors or the NCP market effects estimate which may potentially be attributable to NCP.

6. Compare total potential NCP uncaptured market effects to market changes occurring for other reasons. The market changes occurring for other reasons are calculated as:

43.3 GWh (total market change not attributed to NCP)– 14.3 GWh(market change potentially attributable to NC
30 GWh(market change NOT potentially attributable to NCP

The 30 GWh in market changes that is occurring for other reasons (NOT NCP) is twice the impact of the NCP potential market effects estimate of 14.3 GWh.

7. Compare potential market effects to NPSO: The NCP NPSO is 43.7 GWh; the estimated potential market effects attributable to NCP is 14.3 GWh which is about 33% of the NPSO value.

Table 4-27. Sample Sizes and Standard Deviations for Pilot Market Effects

Non-Participating Design Team	Increased Availability Influence Factor			Increased Knowledge Influence Factor		
	Sample Size (n) Answered % Due to NCP1 & Increased Availability Influence	Increased Availability Influence Factor for Those that Answered % Due to NCP Mean[1]	Increased Availability Influence Factor Standard Deviation[1]	Sample Size (n) Answered % Due to NCP1 & Increased Knowledge Influence	Increased Knowledge Influence Factor for Those that Answered % Due to NCP Mean[1]	Increased Knowledge Influence Factor Standard Deviation[1]
Efficient HVAC equipment	15	15%	0.095	15	12%	0.087
Building control systems (BMS)	11	17%	0.119	11	11%	0.099
Variable air volume systems	8	23%	0.159	8	13%	0.127
High performance building shells	15	18%	0.103	15	14%	0.093
Premium-efficiency motors	4	17%	0.217	4	13%	0.194
Variable speed drives in motors	10	17%	0.125	10	12%	0.108
Efficient lighting technologies	30	20%	0.074	30	15%	0.066
Efficient lamps & fixtures	26	20%	0.080	26	15%	0.071
Lighting occupancy sensors/controls	22	21%	0.089	22	17%	0.082
Daylighting technologies	16	20%	0.103	16	13%	0.087
Advanced solar technologies	16	19%	0.101	16	16%	0.095
Peak load reduction technologies	7	19%	0.160	7	18%	0.157
Whole building design	14	23%	0.117	14	15%	0.099
Green building design	27	19%	0.077	27	15%	0.070
LEED certification	22	19%	0.086	22	13%	0.073
Building commissioning	9	15%	0.126	9	7%	0.090

1 Sampling weights were applied.

The relative precision on this multi-step estimate, incorporating the propagation of error, is approximately 22%.

These preliminary results from the pilot market effects analysis suggest that it might worth considering a market effects evaluation for the NCP Program. Through the evaluation planning process, it will be necessary to explore alternative evaluation designs to attempt to measure NCP induced changes in the market where interviewees cannot identify the NCP contribution directly. With the number of components involved, further research should also be undertaken to determine appropriate sample sizes overall and for subcomponents.

SECTION 5:

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The evaluation determined that the New Construction Program (NCP) gross electric kWh savings realization rate (RR) is 71% and found a RR of 52% for gross electric kW. The net-to-gross (NTG) components incorporate a modeled partial net rate of 35% for kWh, reflecting a 66% FR and 1% ISO. Participant outside spillover (OSO) and non-participant spillover (NPSO) were estimated at 20% and 61%, respectively. The total kWh (energy savings) NTGR is 1.16. The modeled partial net rate (MPNR) for demand (kW) is 0.46, for NTGR of 1.27.

The single most critical component of an impact evaluation for a new construction program is determining the baseline; ideally this information comes from baseline studies. Savings from new buildings are difficult to estimate due to the inherent uncertainty in defining baseline construction practices. Unfortunately, there are many impact evaluations of new construction programs that must be conducted without solid baseline studies. An innovative approach was part of the evaluation design for this evaluation and it provided a more thorough and direct approach regarding baseline assessment for the participants.

The evaluation design involved estimating the MPNR, including FR and participant ISO, by developing project-specific baselines and comparing the as-built and project-specific baseline models to estimate net effects. This process was highly informative and resulted in a rigorous and reliable estimate of net program impacts. The more detailed, model-based approach improves the quality and rigor of the analysis for the following reasons:

1. It allows for a more nuanced definition of the baseline and net effects in that it reflects what the participant would have installed rather than relying on the evaluators or program staff to define the code-compliant equipment or building practices.
2. The model-based approach included calibration of the energy consumption in the building to actual utility billing records, whenever possible, and thus, the project-specific baseline model reflects actual energy use.
3. The model-based approach provided a wealth of detailed and useful information about the construction practices used in NCP participating buildings and directly addressed the construction of the baseline in the absence of the program.

In a more traditional evaluation that relies on a comprehensive baseline study, the baseline would be reflected in the evaluated gross savings. In the innovative, project-specific approach used in this evaluation, baseline differences are incorporated into the MPNR. While the model-based approach used blurs the distinction between FR and baseline effects, the net program impacts correctly include all of the net effects, and the model-based approach results in evaluated net savings that are more reliable than could have been achieved with alternative methods to estimate the baseline in the absence of a comprehensive baseline study.

5.2 NEW CONSTRUCTION PROGRAM RECOMMENDATIONS

The evaluation identified some areas for increasing the accuracy of savings claims and improving reporting as described below. In some cases findings were identified early in the evaluation and Program staff has advised the evaluators that Program changes have been made to address specific issues. In

addition, the NCP staff is continuing to improve the program and some changes, such as increasing the use of the Core Performance Guide, will reduce the number of projects that are modeled and thereby reduce some of the issues that arise from modeling.

5.2.1 Energy Savings

The accuracy of the program reported energy savings could be improved with some modifications to the process of estimating savings and additional quality control and/or M&V. The specific issues identified in this evaluation are described below.

- Operating conditions often differ from the assumptions made during the design phase of new construction projects. The impacts of these changes can be particularly significant for large projects with long lead times.
    - *Recommendation: For projects and measures with large savings, consider including more rigorous commissioning and validation protocols as well as independent third-party M&V as part of Program delivery.*
- The inclusion of measures with deemed savings in complex whole building or custom analyses fails to address interactive effects and can result in the overestimation of savings.
    - *Recommendation: For projects with whole building or custom analysis include all measures in the analysis. The savings for those measures receiving standardized incentives should be analyzed as part of the whole building or custom analysis to ensure accurate quantification of interactive effects.*
- Large prescriptive measures had a significant negative impact on realized savings.
    - *Recommendation: Limit the use of prescriptive measures to smaller projects and use custom analysis for large measures.*
- Several projects used lighting equipment deemed savings and incentives, which sometimes resulted in a baseline that exceeded the code and in other cases resulted in installed participant lighting projects that did not meet code. Operating hours for lighting efficiency measures often varied significantly from the default deemed hours.
    - *Recommendation: Institute a mechanism for using the code space-by-space lighting power density (LPD) as the baseline for lighting incentives in new construction. Require documentation of space-by-space installed lighting power density and provide incentives for lighting systems that are more efficient than code rather than providing equipment-based incentives.*
    - *Consider enabling program staff to use custom hours of operation for new construction lighting projects, or provide deemed hours of operation for various business types.*
- Variable frequency drive (VFD) losses were underestimated in some analyses.
    - *Recommendation: Develop a clear VFD analysis protocol that includes a conservative estimate of the losses associated with VFDs. Losses of approximately 3% for VFDs are typically used in energy efficiency analysis.*
- Heat recovery ventilation analyses did not always include the fan static pressure penalties associated with these systems and did not consistently report the significant fossil fuel savings that result from heat recovery ventilation systems.

- *Recommendation: Ensure that heat recovery ventilation analyses include the electric energy penalties associated with these systems and that they quantify the fossil fuel savings.*

- In many projects with significant fossil fuel impacts, including fuel switching, fossil fuel impacts were not accounted for in the program database and in some cases they were not accounted for in the TA analysis.
  - *Recommendation: Account for all energy impacts of measures in customer analysis and in the NYSERDA database including fossil fuels.*

- Current energy codes require the use of variable frequency drives (VFDs) on most mechanical systems and the application of VFDs is very common in new construction. While retrofits of drives on existing buildings is still a viable measure, variable speed drive measures should not be expected to result in significant savings for new construction applications going forward.
  - *Recommendation: Ensure that prescriptive VFD measures are not allowed for new construction projects due to advances in building code.*

- A few projects in the sample included high bay high intensity discharge (HID) lighting. Since fluorescent high bay fixtures are readily available on the market and are more efficient, provide better lighting quality and more control options than HID products, guiding customers to these fixtures is likely to yield longer term savings and increased customer satisfaction.
  - *Recommendation: As lighting technologies advance, ensure program incentives are leading customers to the most efficient options. Eliminate prescriptive rebates for high and low bay HID fixtures in the NCP.*

- Various issues were found with TA models and analyses. Developing a quality assurance protocol for these models and regular review process would likely increase the accuracy of the analyses.
  - *Recommendation: Adopt a standardized quality assurance protocol and review process for TA models and custom analyses. Consider adopting ASHRAE 90.1 chapter 11 tables for baseline determination.*

- Summer peak kW savings recorded in the program database most often reflected customer peak savings whereas evaluators calculated the average kW reduction over the summer performance hours of 12 p.m. to 6 p.m. weekdays, non-holiday, June - August. Consequently, the variation in the RR for the summer peak kW savings was highly variable.
  - *Recommendation: Modify the project analysis requirements so that both the customer peak and the NYISO peak demand impacts are quantified.*

5.2.2 Data

The Impact Evaluation Team experienced a number of issues in obtaining the necessary information to complete this evaluation. These issues and recommendations for future improvements are provided below.

- Obtaining the modeling files for the original TA analyses was difficult and time-consuming. NYSERDA program staff was instrumental in collecting these files for the evaluators. It is the evaluators' understanding that the NCP now obtains copies of the TA model files at the time the TA report is finalized.
  - *Recommendation: Ensure that working model files are retained by the program and are accessible for evaluations.*

- Utility releases were required to request billing data from the utilities, and the process of obtaining the waivers and the billing data was onerous. It is the understanding of the Impact Evaluation Team that the NCP now obtains utility release forms for NCP projects. However, the duration and transferability of the releases may require review.
    - *Recommendation: Obtain utility release forms that have a duration extending at least two calendar years beyond the year in which the incentive is provided. Determine whether there is a mechanism to transfer the release at the time of ownership transfer.*
- Several issues were found with data reporting in the program database, such as the incorrect entry of inputs on VFD measures. When data entry errors are repeated over time, it is likely to reflect an issue with the entry tool rather than with the individuals entering the data.
    - *Recommendation: It appears that some redesign of the data entry form to include required inputs and error checking could reduce VFD data errors without increasing the burden of the program staff.*
- In several cases the project files reflected changes in the installed measures that were not reflected in the program database.
    - *Recommendation: Verify that the database is updated to reflect post-installation inspections using a well-defined and detailed quality control protocol.*
- Fossil fuel impacts were not consistently entered in the database nor checked for accuracy. Persistent database entry errors likely require modifications to the database and/or project report formats rather than training of program staff responsible for data entry. Addressing the issue at this level to increase accuracy will be more effective over the long term.
    - *Recommendation: Revise the TA study savings report format to include fossil fuel type and report fossil fuel savings in MMBtu to align with NYSERDA database requirements. Verify that the fields currently used for gas and fossil fuel savings in the database are all needed, add identification of fuel type other than natural gas in the database, and improve the data entry fields for fossil fuel to minimize reporting errors.*
    - *Increase quality assurance of data entry of fossil fuel claims, particularly where large savings are being claimed.*

5.2.3 Deeper Savings

- Over the course of performing the impact evaluation, the REs identified energy efficiency opportunities that were not included in the TA analysis or other program documents. Areas such as comprehensive lighting efficiency were not typically addressed in the projects reviewed in this evaluation. The NCP can provide design teams with options to go beyond “typical” efficiency measures. Lost opportunities in new construction result in increased energy use over the life of the building for some measures.
    - *Recommendations: Work with TA and OPCs to continue to identify improvements to program delivery strategies and structures that will encourage early engagement in projects and support identification and adoption of comprehensive energy efficiency upgrades.*
    - *Continue education and outreach to market actors.*

5.3 EVALUATION RECOMMENDATIONS

The following findings regarding evaluation approach and associated recommendations are intended to support the continuous improvement of the evaluation process.

- Timing of evaluation for new construction is important. It is necessary to have at least one year of operation to provide utility data and ensure the building has reached steady-state operations. Timing evaluations closer to construction would mean less personnel turnover of the project team, the people involved with the project would have better recall, program approaches would be more current, and utility release forms would remain in effect.
    - *Recommendation: Accelerate the NCP evaluation cycle so that the evaluations are occurring within two years of project completion.*
- The commercial new construction market includes an increasing share of multifamily buildings. A whole building approach involves treating both the residential and common areas of these buildings. Impact evaluation methods often rely on gaining access to equipment for metering and obtaining utility data, which is complicated in multifamily buildings.
    - *Recommendation: The Impact Evaluation Team requests NYSERDA's support in enabling the evaluators to work with building management to obtain access to residential units and resident utility releases. This support will increase the effectiveness of the outreach effort, control evaluation costs, and reduce the elapsed time for obtaining this information.*
- The Impact Evaluation Team understands that the NCP has evolved substantially as reflected in many of the evaluated projects. In order to determine the next steps for the program, it is important to document the changes that have been instituted since 2008 and those that are in progress.
    - *Recommendation: Complete a short study of program changes in the NCP over the past five years and the potential of those changes to change the project RRs over time. This study should integrate the findings of this evaluation with the findings regarding program delivery and design in the subsequent years.*
- The spillover analysis found that significant loss in sample sizes and available data for developing spillover estimates occurred as interviewees moved through the spillover questions of whether spillover occurred for them or due to them, electric versus natural gas spillover, the number of buildings affected and the estimated energy savings involved.
    - *Recommendations: Investigate and develop more reliable methods for the estimation of participant OSO. Surveys used to gather data for SO estimation need to include SO-respondent quotas wherever possible. Additional validity checks and follow-up verification studies are needed, particularly for factors that act as multipliers within the calculation formulas.*
    - *Significantly more resources will be needed to conduct this level of research into SO.*
- The market effects pilot found there could be a significant level of market effects due to NCP not being captured in the methods currently used to derive overall net impacts, *i.e.*, non-participant spillover inquiry and estimation.
    - *Recommendations: Consider development and conducting a market effects study for the NCP and NYSERDA's overall impact on the commercial, industrial and institutional new constructions markets in New York. The market effects methods need to attempt to include NCP impacts on market structure and operation that may not be directly identifiable by most market participants but influences the operation of the market since*

NCP interventions. If spillover estimation still occurs or is used, then like this study the future evaluations must ensure that there is not a double-counting or overestimation between market effects and spillover.

- *Significantly more resources will be needed to conduct an evaluation that provides reliable and rigorous estimates of market effects.*

5.4 OTHER RECOMMENDATIONS

Obtaining clean non-participant population data for this evaluation was extremely onerous. The recent New York Energy Code Compliance Study[63] suggests that the state establish a new construction database in which all permit applications would be logged. Such a database would be an excellent resource for future new construction evaluations.

[63] *New York Energy Code Compliance Study* (Vermont Energy Investment Corporation, January 2012)

Appendix A: Evaluation Data Sources

Appendix A: Evaluation Data Sources

This appendix provides additional detail regarding the data used in the gross savings analysis.

1.1 PROGRAM LEVEL DATA

Project and measure level information for all projects completed during the 2007-2008 calendar years was provided from the NYSERDA Buildings Portal. The evaluation team and NYSERDA investigated a handful of sites at which more than one project was completed during the period of interest and determined that each NYSERDA project number indicates an independent project at the same site. The database labels all fossil fuel savings as gas savings and includes building square footage. Program data requirements included the following:

- Project information for 2007 and 2008 completions and all pipeline projects,
  - address, contact information for the site owner and design team members, the type of project (design/bid/build design/build, custom, prescriptive), type of business and key project dates for all projects completed in 2007 and 2008.
- Measure-level data for all installed measures
  - description of the measure, quantity installed, the energy savings (electric, gas and other fuels), demand savings, measure life, incremental costs.
- Project specific data for sampled projects
  - Technical Assistance (TA) Studies
  - Measure information such as a description of the measure, quantity installed, the energy savings (electric, gas and other fuels), demand savings, measure life, incremental costs.
  - For projects that have received calibrated simulation modeling as part of the TA study the team required input and output files from the original model, contact information for the firm that conducted the modeling, and an electronic copy of the model
  - Customer information, including the size of the firm, the number of employees, the fuels used for major end uses, and types of major electric and gas end uses.

1.1.1 Data from External Sources

- Utility bills for at least one year for projects selected to be in the sample.
- Weather data.
- Dodge database reports of new construction projects completed in New York during the evaluation timeframe (to comprise the potential participant population)

1.2 BILLING DATA

Measure analysis requires at least one full year of utility billing data. Because these are new construction and major renovation projects, no pre-installation data is available. A full year of post-installation data was required for all projects in the sample. Customer billing data was obtained at NYSERDA's request from the following utilities:

- Con-Ed
- Orange & Rockland

- National Grid
- NYSEG
- RG&E
- Central Hudson

1.3 WEATHER DATA

Two types of weather data are necessary for the project level savings analysis:

- Local hourly weather data for the analysis period
- Typical meteorological year (TMY) data for the locale

The evaluation team acquired hourly weather data from the National Oceanic and Atmospheric Administration (NOAA) weather station nearest to each site. Hourly weather data was obtained for the entire period for which billing data was available and for the month(s) during which metering was installed on the site. Calibrated modeling and measure specific analysis was based on the site specific local NOAA weather data for the analysis period.

Realized savings under actual operating conditions for calculation of gross annual savings over the measure life were normalized to typical meteorological year 3 (TMY3) data from the nearest available weather station.

TMY data provides an annual data set that includes hourly meteorological values typifying weather conditions at a specific location over a longer period of time, such as 30 years. TMY data sets are widely used in modeling energy system performance. TMY3 has been recently updated to typify more recent climatic conditions and serves as the best current model of typical near term temperature and weather conditions.

1.4 DATA COLLECTED BY THE EVALUATION TEAM

- Equipment electrical and run time logged data
- Equipment counts and nameplate data
- Operational data including schedules, set points, etc.
- Survey data

Appendix B: M&V Approach

Appendix B: M&V Approach

This appendix provides additional detail about the engineering analysis methods used in the evaluation.

1.5 ANALYSIS APPROACH

The impact evaluation will verify measure installation and gross savings estimates for a representative sample of projects in comparison to site-specific NYS code baseline usage levels. NYS has a statewide energy code providing a consistent platform for determining project specific gross savings.[1]

Estimation of gross savings will include detailed savings analysis based on project information, measure level metered data, utility bills, weather data, customer surveys and the code baseline. The two general strategies to be used for estimating savings are discussed below. The evaluation team will select the appropriate approach for each project based on the nature of the measures (whether energy use is directly measurable or not, the degree to which measures interact, the magnitude of savings, and cost) and whether project energy models exist and are available in electronic format to the evaluation team.

1.6 BASELINE ESTIMATION

The baseline that will be used for project gross savings analysis will typically be the 2002 NYS Energy Code which was formally adopted on March 6, 2002. There are five projects in the population that entered the system prior to that date; two of the five projects were encumbered prior to the adoption of the code. If the Review Engineer concludes that the TA study predates the adoption of the 2002 NYS Energy Code, then the M&V plan will explicitly cite the appropriate project baseline which will typically be the same baseline as used in the TA study. Otherwise project gross savings will be analyzed with a 2002 NYS Energy Code Baseline.

The review engineers will also develop project specific baselines to determine what would have been installed absent the program. These baselines will be developed using input from the NTG survey responses. Calculation of savings relative to the project specific baseline will be used in the determination of the project specific NTG ratio.

The Impact Evaluation Team will use the following approach to determine gross and net savings for the sampled projects. All models will include three simulations which will be developed consistent with the requirements of ASHRAE Standard 90.1 Chapter 12 (even when a full building model is not undertaken), as described below:

- The as-built conditions, reflecting the calibrated model of the actual building energy performance. Model calibration will be based on either utility data or measure-specific metered data.
- The code compliant building, based on the NYS 2002 Energy Code or the applicable code at the time the project was initiated.
- The site-specific baseline building, based on the survey responses for what the efficiency level would have been, absent participation in the NCP.

[1]New York does not currently have local codes that vary from the statewide Energy Conservation Construction Code (ECCC). New York City has discussed taking steps in this direction. The impact evaluation team will monitor New York code activities and adjust the baseline as appropriate if local codes deviate from the statewide ECCC.

The comparison of the as-built model with the code baseline model will provide the gross savings realization rate for the project. Each PON references a specific code or ASHRAE standard as baseline and savings are claimed based on incremental improvements above the baseline. In some cases, where a code transition occurred during a PON, the program makes adjustments in the savings claims relative to the applicable codes. The baseline energy use for each project will be evaluated relative to the requirements of the PON under which the project was enrolled. Projects in the sample population span PON 459 – PON 1155. The use of the site-specific baseline building will be to support the calculation of the net realization rate. This approach effectively captures the deviation of project specific baselines from code.

The foundation for each site-specific baseline will be constructed from interviews with the site owner and design firms, combined with any other available evidence, such as other recent non-participating projects completed by the same customer, building and/or engineer. These site-specific inputs will then be adjusted based upon a triangulation process with broader baseline market data. All applicable information will be used to determine the baseline for each sample project. This triangulation process will include a teleconference between the Team NCP evaluation manager, the site-specific lead engineer, the Team's Engineering Director and NYSERDA's NCP evaluation manager. DPS staff will be invited to participate, as they desire, in these teleconferences.

Market data for the baseline triangulation process in the 2009 evaluation will be collected from two sources. Several retrospective questions for 2007-2008 will be included in the Team's surveys with non-participating building owners, and non-participating and formerly participating design firms. To the extent possible, these questions will cover specific end-use or design parameters. The Impact Evaluation Team will develop a prioritized list of end-uses and design parameters to be included in the survey based upon reviewing the project summary reports for the sampled projects. In addition, the Impact Evaluation Team will work with the Process Evaluation Team to develop a few retrospective questions to be included in that Team's interviews with local code officials in 2009-2010 for the express purpose of providing additional broad market baseline information.

Following the completion of the 2009 evaluation, the results from this approach will be assessed and the Impact Evaluation Team will outline the advantages and disadvantages of this approach in comparison to estimating savings using a statewide baseline. This discussion will include recommendations for the approach to be applied for the 2012-2013 evaluation.

1.7 ANALYSIS METHODS

1.7.1 Calibrated Simulation Modeling

This method of analysis is based on updating the *ex ante* savings analysis using a calibrated simulation model as described in International Performance Measurement and Verification Protocol (IPMVP) Option D. This approach is likely to be selected for projects with the measure type "whole building analysis," indicating that the building energy measures were evaluated holistically using energy modeling software. The approach may also be used for projects with multiple highly interactive measures associated with disparate equipment, such as a project that includes both advanced air-side ventilation controls and advanced water-side chiller controls and is often the only reasonable option for projects with significant building shell enhancement measures. The steps in the calibrated modeling will be completed by the assigned review engineer as follows:

1. Review the project including the existing TA study and model and the utility data. Obtain the model input and output files (for EQuest modeling files these are the .pd2 and .inp files) in electronic format. Verify that all needed data from the original NYSERDA funded model is available to enable use of the original model as a basis for calibration. Modeling software will be the software used on the original model.

A. The availability of the original model in electronic format for use in calibrated simulation model development is a critical assumption in the evaluation plan. The sample will include a limited number of additional projects to enable replacement of projects for which the model is unavailable.

2. Develop an M&V plan based on review of the design model, measure and project documentation. The plan will identify the key parameters that affect the savings for each measure. M&V Plans will include documentation of any on-site sub-metering required to calibrate the model to actual usage.

3. Perform on-site data collection and short-term metering of the installed equipment and systems including equipment power, flow, or other relevant characteristics over a period of time. Typical on site data collection will include the following items:

   A. On site sub-metering of major mechanical systems

   B. Light logging for lighting systems

   C. Direct Digital Control System (DDC) trend logs for major equipment

   D. Equipment set-points

   E. Operating schedules

4. Calibrate the *ex ante* building model to the utility consumption history using the actual building operating parameters and sub-meter data. Where deviations from the modeled case are minimal and minor (such as where the only change is in operating hours), the Impact Evaluation Team may calculate adjustments using a spreadsheet analysis. This approach is consistent with IPMVP Option A. For all other cases, the modeling will be performed using one of the following methods:

   A. Where feasible, the Impact Evaluation Team will modify the *ex ante* DOE-2 model inputs and re-run that model.

   B. If it is infeasible to obtain access to the original model and it is infeasible to either replace the project or use IPMVP Option B for project analysis, then a budget for creating new 8,760 (hour) building simulation model (DOE-2 or equivalent) will be developed for review and approval by the Impact Evaluation Team and NYSERDA Evaluation project manager.

5. Once the model has been calibrated for the M&V period, it will be rerun with the TMY3 year data to obtain the normalized energy consumption for the building.

6. Recalibrate the normalized baseline model to reflect the code baseline for the building as operating. This model adjusts the baseline condition for real world conditions such as set points and occupancy schedules. One key aspect of this model is that it will use actual set points instead of code stipulated temperature set points based on the assumption that the required comfort conditions in the building would be the same regardless of the building efficiency. In commercial facilities building set points are normally established by personnel with no direct information regarding the cost of set point changes, and with a high motivation to minimize comfort complaints.

7. Construct a normalized model to reflect the project specific baseline which will include deviations from code that would have been expected to occur in the project absent the program as determined from participant interviews (building owners and design firms), non-participant surveys, and market research.

1.7.2 Measure Level Analysis

The second type of evaluation, based on IPMVP Option B, focuses on verifying performance of the individual measures that were installed. Examples of candidates for such analysis include projects that predominantly focus on lighting and pumps, both of which can be isolated for metering, and multi-measure projects designed to improve the efficiency of a specific end use, such as a combination of chilled and condenser water reset, a VFD-controlled chiller, and a VFD-controlled tower. In this second example, the chiller plant and overall project performance can be isolated. To conduct this type of evaluation, the evaluation engineer will use the following process:

8. Develop a measure-based M&V Plan
9. Perform on-site data collection and short-term metering of the installed equipment and systems including equipment power, flow, or other relevant characteristics over a period of time.
    A. Where feasible, the engineers will verify the Building Automation System (BAS) data and obtain trend logs from the BAS to either supplement or supplant equipment specific metering to reduce the costs of metering and, where available, to obtain seasonal data.
10. Model measure-level energy use using spreadsheets or simulation modeling to determine annual operating energy use, baseline energy use (code) and project specific baseline energy use.

This approach requires consideration of interactive effects between measures. For example, measures that are not readily metered, such as building envelope upgrades, will impact the metered energy consumption of the air conditioning and heating systems and must be accounted for in the baseline comparison. This strategy is the most exact approach because modeled savings are calibrated against measured performance at the measure level. Again, as built conditions will be field verified and used in the modeling of the efficiency case and the baseline will be adjusted accordingly. (For instance, if a system type is changed, then the baseline system would need to be the comparable baseline equipment in accordance with ASHRAE 90.1).

NYSERDA previously used such an approach for the Large Savers Evaluation of 2006-07 projects. Typical new construction participants incorporate multiple measures into their designs to reach the program's 10% minimum efficiency improvement requirement for an incentive. For this measure-based level of analysis, the engineer will instrument and perform an analysis to estimate the verified savings for the measures contributing most of the savings. Prior experience indicates that such a Pareto-based approach typically allows estimation of realization rates for over 90% of gross savings while keeping evaluation costs within a reasonable range.

1.8 CALIBRATED SIMULATION MODELING METHOD

This method of analysis is based on International Performance Measurement and Verification Protocol (IPMVP) Option D and was selected for projects with the program measure type "whole building analysis" and for projects analyzed by the program as "custom" with highly interactive measures or measures that could be most effectively simulated using modeling software.

The calibration process involved running the model, comparing the modeled outputs to the metered outputs (equipment and utility data) and adjusting model parameters until the modeled operating profiles represent the known performance of the building or equipment. Calibration was performed either at the measure-level or the building-level, as described below.

- Measure-Level Calibration: Equipment specific meter and Building Management System (BMS) data were used to validate that the modeled operating characteristics of the specific measures corresponded to the as operating equipment characteristics.

- Building-Level Calibration: Utility calibration was performed for the full model at the building level when equipment-specific metering and BMS data was not available.

Figure 0-1 below shows the results of measure-level calibration of laboratory air handling load profiles using comparison of the metered operating load profile to the load profile resulting from the RE's eQuest model.

Figure 0-1. Measure-Level Model Calibration Laboratory AHU

To conduct building-level calibration, modeled kWh usage and monthly peak kW were each compared to the annual electric bills and the models were adjusted iteratively to ensure that the equipment load profiles and building profiles matched annual load profiles represented in the utility bills. For full building models, definitive statistical comparison techniques based on ASHRAE Guideline 14-2002[2] were used to determine model calibration compliance before evaluation savings were calculated. These standard methods require that monthly utility data and its corresponding hourly weather data, such as regional temperature and relative humidity data from NOAA, be used to validate the as-built models.

The following two statistical indices were used per the Guideline: normalized mean bias error (NMBE) and the coefficient of variation of the root mean square error (CVRMSE). This approach characterizes how well the model correlates with the monthly reported usage from the utility, and also places constraints on the allowed variability of the model correlation across a full calendar year.

[2] ASHRAE Guideline 14-2002, *Measurement of Energy and Demand Savings*, American Society of Heating Refrigerating, and Air-Conditioning Engineers, Inc., June 27, 2002.

The REs calculated project specific values of the NMBE and CVRMSE metrics as weighted averages of the simple NMBE and CVRMSE for each energy or demand resource (electric and gas). Each weighted average was based on the relative importance of the energy source to the dominant project measure savings, and on availability of data from the utility. Per Guideline 14, the target compliance values were 5% and 15% maximum for weighted NMBE and CVRMSE respectively. Figure 0-2shows the results of utility bill model calibration. Calibrations were achieved in accordance with the ASHRAE Guideline targets.

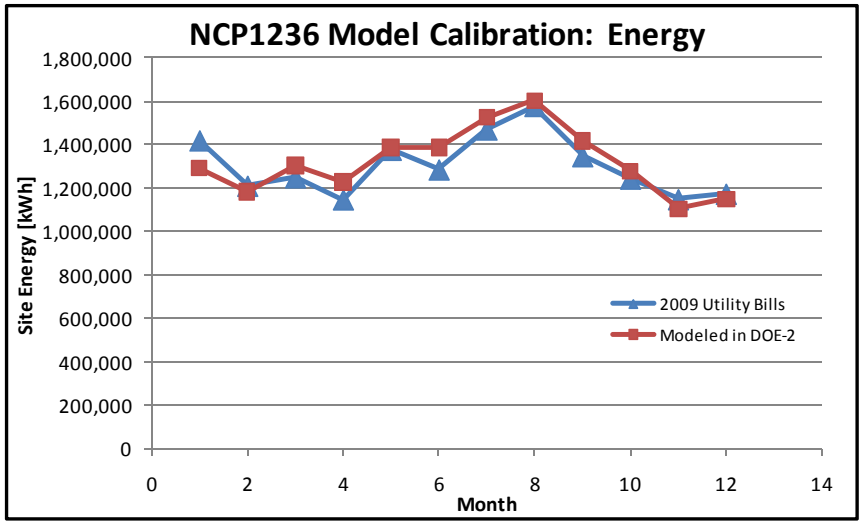


Figure 0-2. Model Calibration kWh

In three projects that used the whole building modeling, full utility bill calibration could not be completed due to either the absence of utility data for tenant meters in multifamily building or to the fact that the affected building was part of a larger campus and not individually metered. In these cases, partial utility billing analysis was used. Some examples are described below.

- In the case of multi-family buildings, a partial calibration of common area loads was completed.
- For campus meters, the RE compared the total meter use before and after the new building was added to the meter and determined whether other substantive modifications were made on campus that would impact the change in energy use..
- Where pre and post construction utility data was obtained, the site representatives were interviewed to determine other significant impacts on the site meter in the same period. If none were identified, the modeled building load was compared to the difference in the metered consumption from before and after the building was constructed.
- In other cases, the utility validation simply included a comparison of the metered consumption to the whole bill to ensure that it was not out of alignment with the billed usage.

1.9 MEASURE-LEVEL ANALYSIS

For projects with analyses based on IPMVP Option B, the measures were analyzed individually based on site collected meter data. As shown in Figure 0-3above, this approach was used for the majority of projects in the evaluation. It was applied to projects in which the individual measures could be analyzed using custom spreadsheets and a whole building simulation was not required for savings estimation. The approach included validation of the modeled energy consumption in comparison to the field metered consumption.

Operating schedules were defined for equipment based on meter data, DDC data, site observations and interviews of site personnel. Regression analysis was used to develop operating load profiles of HVAC equipment based on site specific weather data for the metering period and metered kW values under varying conditions. Figure 0-3 is an example of a regression analysis for a cooling tower. Equations derived from regression analysis were used to model the energy consumption for a typical meteorological year during the defined operating periods for that equipment.

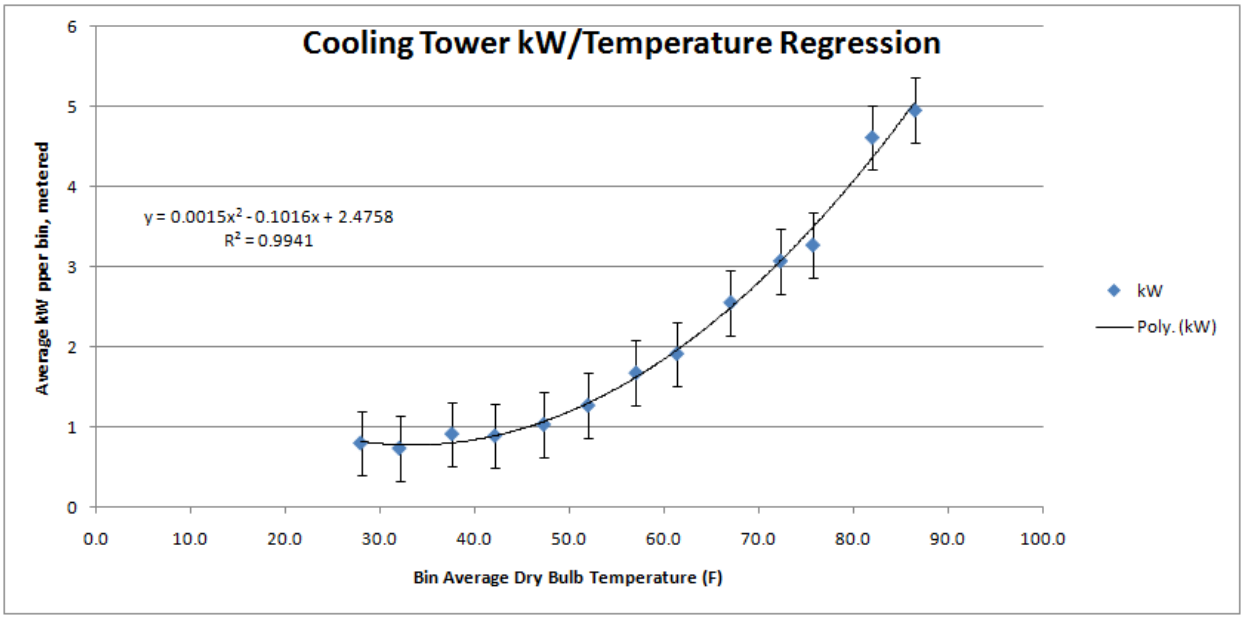


Figure 0-3. Sample Meter Based Regression Analysis

As annual load profiles were developed for the measures based on the operating schedules, regression analysis and other measure specific variables. The annual load profile was compared to the utility consumption data using two different techniques. Where Commercial Building Energy Consumption Survey (CBECS) data was available for the building type Table E6A, Electricity Consumption (kWh) Intensities by End Use for All Buildings, 2003, was used to compare the modeled percent of end use load to the national average. This was essentially a validation process; these newly constructed buildings were expected to be more efficient that the average building represented in CBECS. The process did ensure that the estimated energy use for a particular end use was not out of line with what would be reasonably expected for the building type.

In cases where no CBECS data was available, utility bill comparisons were completed. Figure 0-4 below shows an example of this type of utility data validation. In the example below the calibration process identified a problem with the peak demand estimates (originally estimated at 70% of billed peak which was not feasible given that the loads were cooling and did not operate during the winter months).

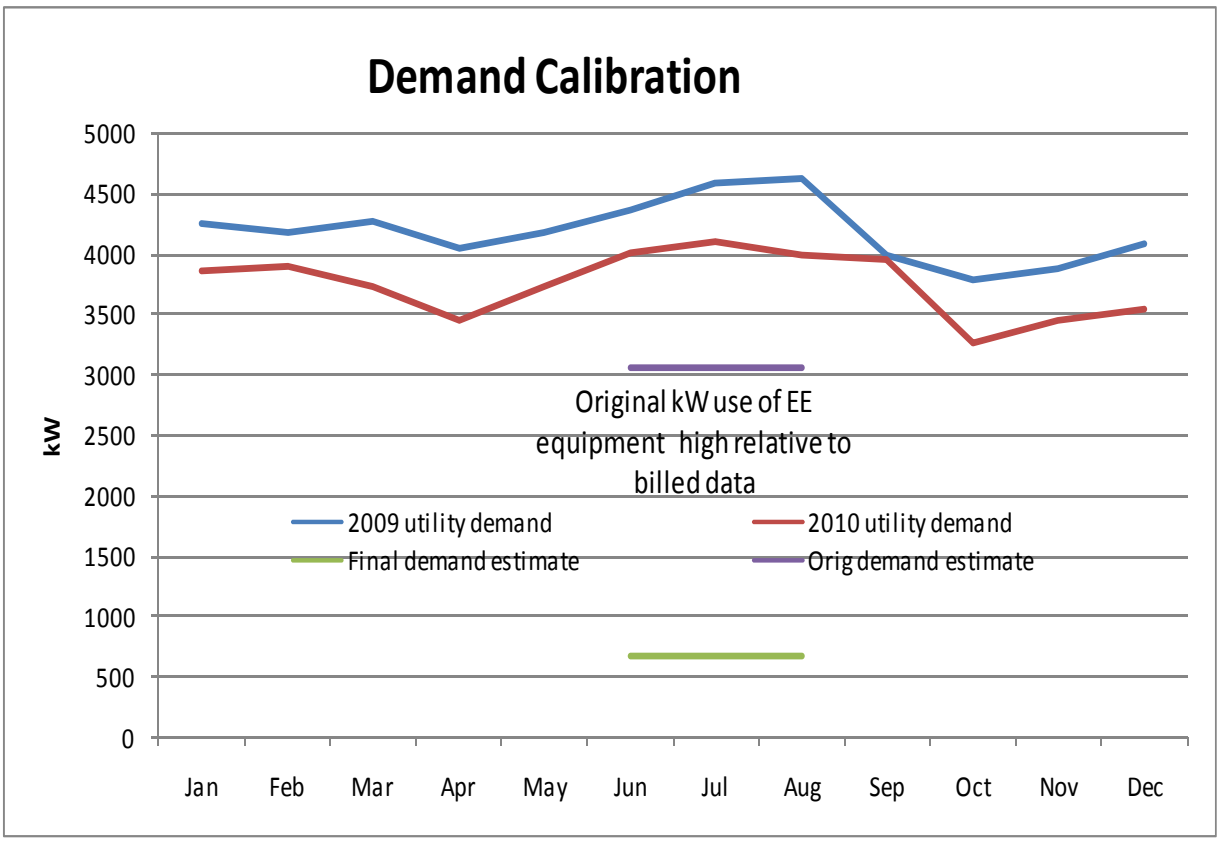


Figure 0-4. Demand Estimate Validation

In some cases the installed measures had a very low percent of the total use of the site or no utility data was available and validation of the analysis against utility data could not be completed.

The calibrated and validated models reflected the energy use of a specific year in response to typical operating characteristics and to the unique weather patterns of that year. In order to be used to develop savings estimates over the life of the measures, the models were normalized to weather data that represents a "typical" year in the building location. Typical Meteorological Year 3 (TMY3) data was used to normalize the models.

Appendix C: Survey Instruments

Appendix C: Survey Instruments

1.0 SURVEY INSTRUMENTS

Survey Instruments in this Appendix include:

Non-Participating Design Team Survey Baseline Survey (C-2 – C-16)

Non-Participating Owner Survey Baseline Survey (C-17 – C-31)

Non-Participating Design Firm Survey Market Effects/Spillover Instrument (C-32 – C-45)

Non-Participating Owner Survey Market Effects/Spillover Instrument (C-46 – C-57)

Participating Design Firm Survey (C-58 – C-79)

Participating Owner Survey (C-80 – C-100)

Appendix C: Non-Participating Design Team Survey Baseline Survey

New Construction Program (NCP) Non-Participating Design Team Survey
Baseline Survey
FINAL 08/22/2011

[INTERVIEWER: SKIP FIRST SENTENCE IF NO NAME AVAILABLE]

Hello may I please speak to **[CONTACT NAME]**?

I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. We are researching the commercial and industrial new construction and major renovation market in New York. The new construction project of yours that is the focus of this call is the **[PROJECT NAME]** project from **[YEAR]**. We are looking to speak with a design professional or architect, who had decision making authority during project design and construction in order to ask about what type of equipment was ultimately specified and about the decision-making process.

BUILT & LOCATION SCREEN
3

BL1. Was this project completed, the building built or renovated?

01	YES	
02	NO	**[GO TO BL1 TERMINATION SCRIPT]**
96	REFUSED	**[GO TO BL1 TERMINATION SCRIPT]**
97	DON'T KNOW	**[GO TO BL1 TERMINATION SCRIPT]**

BL1 TERMINATION SCRIPT:
This survey is gathering information about the decision-making for completed new construction or major renovation projects. Thank you for your time. [**TERMINATE**]

BL2. Was this project on Long Island?

01	YES	**[GO TO BL2 TERMINATION SCRIPT]**
02	NO	
96	REFUSED	**[GO TO BL2 TERMINATION SCRIPT]**
97	DON'T KNOW	**[GO TO BL2 TERMINATION SCRIPT]**

BL2 TERMINATION SCRIPT:
This survey is gathering information on the decision-making for completed new construction or major renovation in New York but not including Long Island. Thank you for your time. [**TERMINATE**]

FINDING APPROPRIATE INTERVIEWEE & SCREEN FOR NON-PARTICIPANT

As part of this evaluation effort we will be speaking to different people involved with this project to gather as much information as possible. We understand that as part of the design team you may not have all the information about decision-making or design and equipment specifications for the project, but we would like to include your perspective in our research. If you are not able to answer some of these questions or unsure about some of the project details, that is fine, we will just move on.

Q1. Are you the appropriate person in your organization to discuss issues related to your organization's decisions made on this project regarding design and equipment choices?

01	YES	**[GO TO Q5]**
02	NO	
96	REFUSED	**[TERMINATE]**

97 DON'T KNOW

Q2. Can you provide me with a contact name and phone number for a person in your organization who can speak to design and equipment choices for this project?
01 YES **[SPECIFY NAME, NUMBER]**
02 NO **[TERMINATE]**
96 REFUSED **[TERMINATE]**
97 DON'T KNOW **[TERMINATE]**

Q3. Can you transfer me to **[NEW NAME FROM Q2]**?
01 YES **[GO BACK TO INTRO]**
02 NO **[NEW NUMBER TO GENERAL CALLBACK]**
96 REFUSED **[NEW NUMBER TO GENERAL CALLBACK]**

Q5. Have you, on behalf of your organization, participated in any NYSERDA or **New York Energy $mart**℠ programs in the past four years?
01 DID NOT PARTICIPATE
02 PARTICIPATED **[GO TO TERMINATION SCRIPT FOR Q5]**
96 REFUSED **[GO TO TERMINATION SCRIPT FOR Q5]**
97 DON'T KNOW

Q5 TERMINATION SCRIPT
This particular survey concerns projects and their decision makers that did not participate in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time.

Q6. To the best of your knowledge, has your organization participated in any NYSERDA or **New York Energy $mart**℠ programs in the past four years? Please think about all projects including those that you were not involved with.
01 DID NOT PARTICIPATE
02 PARTICIPATED **[GO TO TERMINATION SCRIPT FOR Q6]**
96 REFUSED **[GO TO TERMINATION SCRIPT FOR Q6]**
97 DON'T KNOW

Q6 TERMINATION SCRIPT:
This particular survey concerns projects and their decision makers that did not participate in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time.

Q7. This survey will take about 25 minutes to complete. We can proceed now over the phone or we can schedule a more convenient time. Do you want to proceed by phone now?
01 YES, AVAILABLE
02 NO, NOT AVAILABLE **[SCHEDULE CALLBACK]**
96 REFUSED **[TERMINATE]**

DESIGN INFORMATION

We are interested in the building components installed in the **[PROJECT NAME]** project located at **[LOCATION]** and about how decisions were made regarding different aspects of the project design.

D4. First, I'm going to read you a list of factors. For each one, please tell me how important it was in the design of energy using features for this project -- very important, somewhat important, not too important, or not at all important? First… **[INSERT ITEMS]**

[READ IF NECESSARY WITH EACH ITEM] Was this factor very important, somewhat important, not too important, or not at all important in the design of energy using features for this project?

a. Initial or Construction Cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 VERY IMPORTANT
02 SOMEWHAT IMPORTANT
03 NOT TOO IMPORTANT
04 NOT AT ALL IMPORTANT
96 REFUSED
97 DON'T KNOW

D5a. Do you estimate that energy use for this project ended up being less than, greater than or equal to a code compliant building?

01 LESS
02 GREATER
03 EQUAL **[GO TO D6]**
96 REFUSED **[GO TO D6]**
97 DON'T KNOW **[GO TO D6]**

D5b. What percent [**IF D5a=01: 'less'/IF D5a=02: 'greater'**] do you estimate the project's energy use is compared to a code compliant building? **[IF DON'T KNOW, PROMPT WITH: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO D6 IF D5a=02]

D5c. Thinking about this project's energy savings beyond code, what percentage would you say is attributable to the following items? [PROGRAMMING NOTE: Percents add to less than or equal to 100.]

a. Building envelope
b. HVAC and HVAC-related motors
c. Lighting and lighting controls

[GO TO D6 IF projtype≠"multifamily"]

d. Domestic hot water system
e. Appliances

01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

D6. Were there any aspects of the design of this project that were built to better than energy code?

01 YES

02 NO
96 REFUSED
97 DON'T KNOW

WHOLE BUILDING

WB1. Was whole building analysis, such as energy modeling used to analyze this building or not?
01 YES
02 NO **[GO TO B1]**
96 REFUSED **[GO TO B1]**
97 DON'T KNOW **[GO TO B1]**

WB2. I'm going to read you a list of factors. For each one, please tell me how much influence it had on the decision to use whole building energy simulation as part of the design process – a great deal of influence, some influence, only a little influence, or no influence. First… **[INSERT ITEMS]**

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on the decision to use whole building modeling?
a. Equipment sizing
b. Energy use
c. LEED certification
d. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
e. Design team influence
   01 A GREAT DEAL
   02 SOME
   03 ONLY A LITTLE
   04 NO INFLUENCE
   96 REFUSED
   97 DON'T KNOW

WB3. Were any of the following features of the building changed as a result of the whole building modeling or not? First… **[INSERT ITEM]**
[READ IF NECESSARY] Was this changed due to the whole building modeling or not?
a. Envelope
b. Lighting
c. HVAC system efficiency
d. HVAC controls
[GO TO WB4 IF PROJTYPE≠"multifamily"]
e. Domestic Hot Water
f. Appliances
   01 YES
   02 NO
   96 REFUSED
   97 DON'T KNOW

WB4. Did the implementation of whole building modeling increase, decrease or have no effect on the energy efficiency of the project?
01 INCREASE
02 DECREASE
03 NO EFFECT
96 REFUSED

97 DON'T KNOW

BUILDING ENVELOPE

B1. I'm going to read you a list of factors. For each one, please tell me how much influence it had on what level of insulation was selected for the building – a great deal of influence, some influence, only a little influence, or no influence. First… **[INSERT ITEMS]**

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on the building's level of insulation?

a. Initial or Construction Cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE **[GO TO H1]**

B2. Was the insulating value of the building envelope better than, the same as or below energy code?

01	BETTER THAN	
02	THE SAME AS	**[GO TO B4]**
03	BELOW ENERGY CODE	**[GO TO B4]**
96	REFUSED	**[GO TO B4]**
97	DON'T KNOW	**[GO TO B4]**

B3. Was the insulating value of any of the following better than code? First… **[INSERT COMPONENT]**

[READ IF NECESSARY] Was the insulating value of this item better than code?

a. Foundation
b. Roof
c. Walls
d. Glazing

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

B4. Did the building incorporate any of the following to influence solar heat gain**? [INSERT FEATURE]**

[READ IF NECESSARY] Did the building incorporate this feature to influence solar heat gain?

a. A white roof
b. A green or vegetated roof
c. Low emissivity or Low-e coatings on the windows
d. Tinted windows

01 YES
02 NO

96 REFUSED
97 DON'T KNOW

HVAC SYSTEMS

H1. I'm going to read you a list of factors. For each one, please tell me how much influence it had on the selection of the building's HVAC system – a great deal of influence, some influence, only a little influence, or no influence? [**INSERT ITEM**]

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on the selected HVAC system?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE [**GO TO L1**]

H2. Was the HVAC system selected better than, the same as or below the energy code requirements?

01 BETTER THAN
02 THE SAME AS
03 BELOW ENERGY CODE
96 REFUSED
97 DON'T KNOW

H3. Which of the following types of equipment were included in this project's design? **[READ LIST]**

[**READ IF NECESSARY**] Was this equipment included in this project?

a. Central Chiller
b. Boiler
c. Central Air System
d. A stand alone air-conditioner unit or packaged DX Equipment
e. Heat Pumps

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

[GO TO L1 IF H3a-e≠01]

H4. For each of the following of equipment that was included in this project's design, please tell me if it was better than, the same as or below the energy code? First… **[INSERT ITEM WHERE H3=01]**

[READ IF NECESSARY] Was the equipment included in this project better than, the same as or below the energy code?

a. Central Chiller
b. Boiler

c. Central air system
d. Stand alone air-conditioner unit or packaged DX equipment
e. Heat pumps

01 BETTER THAN
02 THE SAME AS
03 BELOW ENERGY CODE
96 REFUSED
97 DON'T KNOW

[ASK H5b IF H3a = 1]

H5b. Were variable volume pumps part of the cooling system design?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

[ASK H5d IF H3b = 1]

H5d. Were variable volume pumps part of the heating system design?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

[ASK H5f IF H3c = 1]

H5f. Was variable air volume part of the air system design?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

LIGHTING

L1. I'm going to read you a list of factors. For each one, please tell me how much influence it had on the selection of the building's lighting system - a great deal of influence, some influence, only a little or no influence. **[INSERT ITEM]**

[READ IF NECESSARY] Did this factor have a great deal, some, only a little or no influence on the selection of the lighting system?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE **[GO TO W1]**

L2. Was the lighting system designed to be better than, the same as or below energy code?
01 BETTER THAN
02 THE SAME AS
03 BELOW ENERGY CODE
96 REFUSED
97 DON'T KNOW

Now I am going to ask you about the approaches to lighting design that were installed for this project.

L3. First, which of the following general lighting fixture types were installed?
[READ IF NECESSARY] Was this installed for this project?
a. Lensed Direct Fixtures **[READ IF NECESSARY: fixture has a translucent lens]**
b. Parabolic Fixtures **[READ IF NECESSARY: recessed fixture with a grid reflector]**
c. Direct/Indirect fixture **[READ IF NECESSARY: fixture has some covering over the lamps that directs light up and along the ceiling as well as allowing some light to come directly through the covering]**
d. Fluorescent Low or High–bay fixtures
e. Metal Halide Low or High–bay Fixtures
f. High Pressure Sodium Low or Hi-bay fixtures
g. Downlights
[GO TO L4a IF PROJTYPE≠"multifamily"]
h. In-unit hard wired lighting
01 YES
02 NO
96 REFUSED
97 DON'T KNOW

L4a. Which of the following lamp types makes up the majority of the lamps in this building**? [READ LIST, CODE ONE RESPONSE ONLY]**
01 T-12 lamps with electronic ballasts
02 T-8 lamps with electronic ballasts
03 High performance T-8 lamps and ballasts
04 T-5 lamps with electronic ballasts
05 Compact fluorescent lamps, or CFLs
06 Metal Halide
07 Incandescent
95 OTHER **[SPECIFY]**
96 REFUSED
97 DON'T KNOW

L4b. Which of the following were installed to control the overhead fixtures?

[READ IF NECESSARY] Was this installed to control the overhead fixtures?
a. On-off manual switches
b. Two-level switching
c. Occupancy sensors
d. Daylighting control
e. Zoned fixture control
01 YES
02 NO
96 REFUSED
97 DON'T KNOW

[IF L3h≠01, GO TO W1]

L4c. Did you install hard-wired lighting in the following rooms of all the units?

[READ IF NECESSARY: Did you install hard-wired lighting in this room?]

1. Kitchens
2. Bathrooms
3. Living areas
4. Bedrooms

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

[GO TO W1 IF L4c1-4≠01]

L4d. Were the hard-wired lighting fixtures installed in the following rooms incandescent or fluorescent fixtures?

[READ IF NECESSARY: Were the hard-wired fixtures in these rooms incandescent or fluorescent?]

1. Kitchen
2. Bathrooms
3. Living areas
4. Bedrooms

01 INCANDESCENT FIXTURES
02 FLUORESCENT FIXTURES
03 BOTH
96 REFUSED
97 DON'T KNOW

[GO TO INFL1 IF PROJTYPE≠ "multifamily"]

DOMESTIC HOT WATER

W1. I'm going to read you a list of factors, for each one, please tell me how much influence it had on the selection of the building's domestic hot water systems - a great deal of influence, some influence, only a little or no influence.

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on the selection of the hot water system?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE **[GO TO A1]**

W2. Was the Domestic Hot Water System designed to be better than, the same as or below energy code?

01 BETTER THAN
02 THE SAME AS **[GO TO W4]**
03 BELOW ENERGY CODE **[GO TO W4]**
96 REFUSED [**GO TO W4**]
97 DON'T KNOW [**GO TO W4**]

W3a. Was a premium-efficiency condensing hot water heater installed?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

W3b. Was variable speed pumping installed?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

W4. Did this project include the installation of any of the following? First… **[INSERT COMPONENT]**

[READ IF NECESSARY] Did the project include installation of this feature?

a. Low-flow shower heads
b. Faucet aerators
c. Dual flush toilets

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

W4d. Did the project include installation of any other water saving devices?

01 YES ____ **[SPECIFY]**
02 NO
96 REFUSED
97 DON'T KNOW

APPLIANCES

A1. I'm going to read you a list of factors, for each one, please tell me how much influence it had on the selection of the building's appliances - a great deal of influence, some influence, only a little or no influence. **[INSERT ITEM]**

[READ IF NECESSARY] Did this factor have a great deal, some, only a little or no influence on the selection of appliances?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 A GREAT DEAL

02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE **[GO TO INFL1]**

A2. Were ENERGY STAR ® appliances part of this project or not?
01 YES
02 NO
96 REFUSED
97 DON'T KNOW

DESIGN TEAM VERSUS CUSTOMER INFLUENCE

INFL1. We are interested in knowing how involved and influential the building owner was in the selection of the equipment for this project. Which of the following statements best describes the role of the owner in this project?
04 You chose the equipment without input from the owner.
01 You recommended the equipment and the owner agreed with the choice.
02 You provided several different equipment options and the owner chose which one they wanted included.
03 The owner knew what equipment they wanted and told you what to use or told you to use the same as in another of their buildings.
96 REFUSED
97 DON'T KNOW

INFL3. I'm going to read you a list of building or design components, for each one, please tell me how involved or influential the owner was in the decisions for the final design - a great deal of influence, some influence, only a little or no influence. First… **[INSERT ITEM]**

[**READ IF NECESSARY**] Did the owner have a great deal, some, only a little or no influence on this factor?
a. Conducting whole building analysis
b. The selected HVAC design
c. The selected lighting design
d. **[SKIP TO ST4a IF PROJTYPE≠"multifamily"]** In-unit efficiency, such as the efficiency of Domestic hot water and appliances
01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW

FIRMOGRAPHICS

ST4a. Would you characterize your organization as an architecture firm, an engineering firm or another type of organization?
01 ARCHITECTURE FIRM
02 ENGINEERING FIRM
03 BOTH

95 OTHER ____ **[SPECIFY]**
96 REFUSED
97 DON'T KNOW

ST5. Approximately how many new construction and major renovation projects per year is your organization involved with in New York (not including Long Island)?
01 _____**[RECORD NUMBER]**
96 REFUSED
97 DON'T KNOW

ST6. We would like to know the four facility types in which your firm works most frequently in its new construction and major renovation projects in New York (not including Long Island). I have a list of facility types I will go through and then I will work with you so you can identify the top four.

[WITHIN TOP FOUR]
a. _____
b. _____
c. _____
d. _____

01 Agriculture
02 Apartments or Multifamily
03 Amusement, Social, and Recreational Buildings
04 Education, such as Schools, colleges, and libraries
05 Grocery and Food Sales
06 Food Service and restaurants
07 Health Care, such as hospitals and other treatment facilities
08 Lodging, such as hotels and motels
09 Retail and Mercantile
10 Office and bank buildings
11 Non-Manufacturing Laboratories
12 Manufacturing plants and laboratories
13 Warehouse and Storage
14 Public Assembly
15 Public Order and Safety
16 Government Service Building
17 Religious Worship
18 Single Family Housing
19 Commercial – Not Specified
95 OTHER **(specify)** _____
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE

ST6e. We would like to know what share of your work are in each of these top four facility types. What percent of your firm's new construction and major renovation work in New York are projects for **[INSERT ST6a]**?
01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

ST6f. What percent of your firm's new construction and major renovation work in New York are projects for **[INSERT ST6b]**?

01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE

ST6g. What percent are projects for **[INSERT ST6c]?**

01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE

ST6h. What percent are projects for **[INSERT ST6d]?**

01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE

ST7. How many employees does your firm have? **[READ LIST]**

01 Fewer than 5
02 5 to 9
03 10 to 19
04 20 to 49
05 50 to 99
06 100 to 249
07 250 or More
96 REFUSED
97 DON'T KNOW

ST8. Is your company independent, or part of a larger company?

01 Independent
02 Part of a larger company
95 OTHER **(specify)** _____
96 REFUSED
97 DON'T KNOW

ST9b. How many offices does your firm have? **[READ LIST]**

01 One
02 2 to 5
03 6 to 10
04 11 to 20
05 More than 20
96 REFUSED
97 DON'T KNOW

CLOSING:

Finally, in order to try to minimize NYSERDA survey calls to you in the future, could you give me your name and phone number so that we can check it against our sample files in future studies?

01 YES **[RECORD NAME, PHONE]**

96 REFUSED

Those are all the questions I have for you. Thank you so much for taking the time for this interview. The information you have provided will be very valuable to NYSERDA.

Appendix C: Non-Participating Owner Survey Baseline Survey

New Construction Program (NCP) Non-Participating Owner Survey
Baseline Survey
Final 8/24/11

[INTERVIEWER: SKIP FIRST SENTENCE IF NO NAME AVAILABLE]

Hello may I please speak to **[CONTACT NAME]**?

I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. We are researching the commercial and industrial new construction and major renovation market in New York. The new construction project of yours that is the focus of this call is the [**PROJECT NAME**] project from [**YEAR**]. We are looking to speak with a building owner representative who had decision making authority during project design and construction, including facilities or operations personnel, in order to ask about what type of equipment was ultimately installed and about the decision-making process.

BUILT & LOCATION SCREEN

BL1. Was this project completed, the building built or renovated?

01	YES	
02	NO	**[GO TO BL1 TERMINATION SCRIPT]**
96	REFUSED	**[GO TO BL1 TERMINATION SCRIPT]**
97	DON'T KNOW	**[GO TO BL1 TERMINATION SCRIPT]**

BL1 TERMINATION SCRIPT:
This survey is gathering information about the decision-making for completed new construction or major renovation projects. Thank you for your time. [**TERMINATE**]

BL2. Was this project on Long Island?

01	YES	**[GO TO BL2 TERMINATION SCRIPT]**
02	NO	
96	REFUSED	**[GO TO BL2 TERMINATION SCRIPT]**
97	DON'T KNOW	**[GO TO BL2 TERMINATION SCRIPT]**

BL2 TERMINATION SCRIPT:
This survey is gathering information on the decision-making for completed new construction or major renovation in New York but not including Long Island. Thank you for your time. [**TERMINATE**]

FINDING APPROPRIATE INTERVIEWEE & SCREEN FOR NON-PARTICIPANT
As part of this evaluation effort we will be speaking to different people involved with this project to gather as much information as possible. We understand that as the building owner you may not have all the information about design and equipment for the project but we would like to include your perspective in our research. If you are not able to answer some of these questions or unsure about some of the project details, that is fine, we will just move on.

Q1. Are you the appropriate person in your organization to discuss issues related to your organization's decisions made on this project regarding design and equipment choices?

01	YES	**[GO TO Q4]**
02	NO	
96	REFUSED	**[TERMINATE]**
97	DON'T KNOW	

Q2. Can you provide me with a contact name and phone number for a person in your organization or a representative of the owner or a tenant who can speak to design and equipment choices for this project? We are NOT looking for someone on the design team, such as the architect or engineer for the project – we have a separate survey for them. We are looking for someone to speak to from the owner's perspective.

.

01	YES	**[SPECIFY NAME, NUMBER]**
02	NO	**[TERMINATE]**
96	REFUSED	**[TERMINATE]**
97	DON'T KNOW	**[TERMINATE]**

Q3. Can you transfer me to **[NEW NAME FROM Q2]**]?

01	YES	[**GO BACK TO INTRO]**
02	NO	**[NEW NUMBER TO GENERAL CB]**
96	REFUSED	**[NEW NUMBER TO GENERAL CB]**

Q4 I'd like to understand more about your involvement with design and equipment decisions for this project. Please tell me which of the following statements best describes the way in which you were involved in decision-making for this project. **[READ STATEMENTS]**

01	I was very involved with design and equipment decisions
02	I was somewhat involved but I mostly just followed the suggestions from the design team
03	I was not very or not at all involved with design and equipment decisions. The design team or others made those decisions and I just approved them
96	REFUSED
97	DON'T KNOW

Q5. Have you, on behalf of your organization, participated in any NYSERDA or **New York Energy $mart**SM programs in the past four years?

01	DID NOT PARTICIPATE	
02	PARTICIPATED	**[GO TO TERMINATION SCRIPT FOR Q5]**
96	REFUSED	**[GO TO TERMINATION SCRIPT FOR Q5]**
97	DON'T KNOW	

Q5 TERMINATION SCRIPT
This particular survey concerns projects and their decision makers that did not participate in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time.

Q6. To the best of your knowledge has your organization participated in any NYSERDA or **New York Energy $mart**SM programs in the past four years? Please think about all projects including those that you were not involved with.

01	DID NOT PARTICIPATE	
02	PARTICIPATED	**[GO TO TERMINATION SCRIPT FOR Q6]**
96	REFUSED	**[GO TO TERMINATION SCRIPT FOR Q6]**
97	DON'T KNOW	

Q6 TERMINATION SCRIPT:

This particular survey concerns projects and their decision makers that did not participate in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time.

Q7. This survey will take about 25 minutes to complete. We recognize that this is a sizeable time commitment and we can proceed now over the phone; or we can schedule a more convenient time. Do you want to proceed by phone now?

01 YES, AVAILABLE
02 NO, NOT AVAILABLE **[SCHEDULE CALLBACK]**
96 REFUSED **[TERMINATE]**

DESIGN INFORMATION

We are interested in the building components installed in the **[PROJECT NAME]** project located at **[LOCATION]** and about how decisions were made regarding different aspects of the project design.

D4. First, I'm going to read you a list of factors. For each one, please tell me how important it was in the design of energy using features for this project -- very important, somewhat important, not too important, or not at all important? First… **[INSERT ITEMS]**

[**READ IF NECESSARY WITH EACH ITEM**] Was this factor very, somewhat, not too, or not at all important in the design of energy using features for this project?

a. Initial or Construction Cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 VERY IMPORTANT
02 SOMEWHAT IMPORTANT
03 NOT TOO IMPORTANT
04 NOT AT ALL IMPORTANT
96 REFUSED
97 DON'T KNOW

D5a. Do you estimate that energy use for this project ended up being less than, greater than or equal to a code compliant building?

01 LESS
02 GREATER
03 EQUAL **[GO TO D6]**
96 REFUSED **[GO TO D6]**
97 DON'T KNOW **[GO TO D6]**

D5b. What percent **[IF D5a=01: 'less'/IF D5a=02: 'greater']** do you estimate the project's energy use is compared to a code compliant building? **[IF DON'T KNOW, PROMPT WITH: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO D6 IF D5a=02]

D5c. Thinking about this project's energy savings beyond code, what percentage would you say is attributable to the following items? **[PROGRAMMING NOTE: Percents add to less than or equal to 100.]**

a. Building envelope
b. HVAC and HVAC-related motors
c. Lighting and lighting controls

[GO TO D6 IF projtype≠"multifamily"]

d. Domestic hot water system
e. Appliances

01 _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

D6. Were there any aspects of the design of this project that were built to better than energy code?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

WHOLE BUILDING

WB1. Was whole building analysis, such as energy modeling used to analyze this building or not?

01 YES
02 NO **[GO TO B1]**
96 REFUSED **[GO TO B1]**
97 DON'T KNOW **[GO TO B1]**

WB2. I'm going to read you a list of factors. For each one, please tell me how much influence it had on your decision to use whole building energy simulation as part of the design process – a great deal of influence, some influence, only a little influence, or no influence. First… **[INSERT ITEMS]**

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on your decision to use whole building modeling?

a. Equipment sizing
b. Energy use
c. LEED certification
d. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
e. Design team influence

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW

WB3. Were any of the following features of the building changed as a result of the whole building modeling or not? First… **[INSERT ITEM]**

[READ IF NECESSARY]Was this changed due to the whole building modeling or not?

a. Envelope

b. Lighting
c. HVAC system efficiency
d. HVAC controls

[GO TO WB4 IF PROJTYPE≠"multifamily"]

e. Domestic Hot Water
f. Appliances

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

WB4. Did the implementation of whole building modeling increase, decrease or have no effect on the energy efficiency of the project?

01 INCREASE
02 DECREASE
03 NO EFFECT
96 REFUSED
97 DON'T KNOW

WB5. Is the modeled energy use higher, lower or the same as the actual energy use for the building?

01 HIGHER
02 LOWER
03 SAME
96 REFUSED
97 DON'T KNOW

BUILDING ENVELOPE

B1. I'm going to read you a list of factors. For each one, please tell me how much influence it had on your selection of the building's level of insulation – a great deal of influence, some influence, only a little influence, or no influence. First… **[INSERT ITEMS]**

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on your selection of the building's level of insulation?

a. Initial or Construction Cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE **[GO TO H1]**

B2. Was the insulating value of the building envelope better than, the same as or below energy code?

01 BETTER THAN
02 THE SAME AS **[GO TO B4]**
03 BELOW ENERGY CODE **[GO TO B4]**
96 REFUSED **[GO TO B4]**
97 DON'T KNOW **[GO TO B4]**

B3. Was the insulating value of any of the following better than code? First… **[INSERT COMPONENT]**

[READ IF NECESSARY] Was the insulating value of this item better than code?

a. Foundation
b. Roof
c. Walls
d. Glazing

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

B4. Did the building incorporate any of the following to influence solar heat gain? **[INSERT FEATURE]**

[READ IF NECESSARY] Did the building incorporate this feature to influence solar heat gain?

a. A white roof
b. A green or vegetated roof
c. Low emissivity or Low-e coatings on the windows
d. Tinted windows

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

HVAC SYSTEMS

H1. I'm going to read you a list of factors. For each one, please tell me how much influence it had on your selection of the building's HVAC system – a great deal of influence, some influence, only a little influence, or no influence? [**INSERT ITEM**]

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on your selection of the HVAC system?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE [**GO TO L1**]

H2. Was the HVAC system better than, the same as or below energy code?

01 BETTER THAN
02 THE SAME AS
03 BELOW ENERGY CODE
96 REFUSED
97 DON'T KNOW

H3. Which of the following types of equipment were included in this project? **[READ LIST]**

[**READ IF NECESSARY**] Was this equipment included in this project?

a. Central Chiller
b. Boiler
c. Central Air System
d. A stand alone air-conditioner unit or packaged DX Equipment
e. Heat Pumps

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

[GO TO L1 IF H3a-e~=01]

H4. For each of the following types of equipment that was included in this project, please tell me if the equipment was better than, the same as or below the energy code. First… **[INSERT ITEM WHERE H3=01]**

[READ IF NECESSARY] Was the equipment included in this project better than, the same as or below the energy code?

f. Central Chiller
g. Boiler
h. Central air system
i. Stand Alone Air-Conditioner Unit or packaged DX equipment
j. Heat pumps

01 BETTER THAN
02 THE SAME AS
03 BELOW ENERGY CODE
96 REFUSED
97 DON'T KNOW

LIGHTING

L1. I'm going to read you a list of factors. For each one, please tell me how much influence it had on your selection of the building's lighting system - a great deal of influence, some influence, only a little or no influence. [**INSERT ITEM**]

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on your selection of the lighting system?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED
97 DON'T KNOW
99 NOT APPLICABLE **[GO TO W1]**

L2. Was the installed lighting system better than, the same as or below energy code?
01 BETTER THAN
02 THE SAME AS
03 BELOW ENERGY CODE
96 REFUSED
97 DON'T KNOW

Now I am going to ask you about the approaches to lighting design that were installed for this project.

L3. First, which of the following general lighting fixture types were installed?

[READ IF NECESSARY] Was this installed for this project?
h. Lensed Direct Fixtures (READ IF NECESSARY: fixture has a translucent lens)
i. Parabolic Fixtures (READ IF NECESSARY: recessed fixture with a grid reflector)
j. Direct or Indirect fixtures (READ IF NECESSARY: fixture has some covering over the lamps that directs light up and along the ceiling as well as allowing some light to come directly through the covering)
k. Fluorescent Low or High–bay fixtures
l. Metal Halide Low or High–bay Fixtures
m. High Pressure Sodium Low or Hi-bay fixtures
n. Downlights
[GO TO L4a IF PROJTYPE≠"multifamily"]
h. In-unit hard wired lighting
01 YES
02 NO
96 REFUSED
97 DON'T KNOW

L4a. Which of the following lamp types makes up the <u>majority</u> of the lamps in this building? [READ LIST, CODE ONE RESPONSE ONLY]
01 T-12 lamps with electronic ballasts
02 T-8 lamps with electronic ballasts
03 High performance T-8 lamps and ballasts
04 T-5 lamps with electronic ballasts
05 Compact florescent lamps, or CFLs
06 Metal Halide
07 Incandescent
95 OTHER [SPECIFY]
96 REFUSED
97 DON'T KNOW

L4b. Which of the following were installed to control the overhead fixtures?

[**READ IF NECESSARY**] Was this installed to control the overhead fixtures?
a. On-off manual switches
b. Two-level switching
c. Occupancy sensors
d. Daylighting control
e. Zoned fixture control
01 YES

02 NO
96 REFUSED
97 DON'T KNOW

[IF L3h~=01, GO TO W1]

L4c. Did you install hard-wired lighting in the following rooms of all the units?

[READ IF NECESSARY: Did you install hard-wired lighting in this room?]

1. Kitchens
2. Bathrooms
3. Living areas
4. Bedrooms

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

[GO TO W1 IF L4c1-4≠01]

L4d. Were the hard-wired lighting fixtures installed in the following rooms incandescent or fluorescent fixtures?

[READ IF NECESSARY: Were the hard-wired fixtures in these rooms incandescent or fluorescent?]

1. Kitchen
2. Bathrooms
3. Living areas
4. Bedrooms

01 INCANDESCENT FIXTURES
02 FLUORESCENT FIXTURES
03 BOTH
96 REFUSED
97 DON'T KNOW

[GO TO INFL_S IF PROJTYPE≠ "multifamily"]

DOMESTIC HOT WATER

W1. I'm going to read you a list of factors, for each one, please tell me how much influence it had on your selection of the building's domestic hot water systems - a great deal of influence, some influence, only a little or no influence.

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on your selection of the hot water system?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance
d. Operating cost

01 A GREAT DEAL
02 SOME
03 ONLY A LITTLE
04 NO INFLUENCE
96 REFUSED

97 DON'T KNOW
99 NOT APPLICABLE **[GO TO A1]**

W2. Was the installed Domestic Hot Water System better than, the same as or below energy code?

01	BETTER THAN	
02	THE SAME AS	**[GO TO W4]**
03	BELOW ENERGY CODE	[**GO TO W4**]
96	REFUSED	[**GO TO W4**]
97	DON'T KNOW	[**GO TO W4**]

W3a. Was a premium-efficiency condensing hot water heater installed?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

W3b. Was variable speed pumping installed?

01 YES
02 NO
96 REFUSED
97 DON'T KNOW

W4. Did this project include the installation of any of the following? First… **[INSERT COMPONENT]**

[READ IF NECESSARY] Did the project include installation of this feature?

a. Low-flow shower heads
b. Faucet aerators
c. Dual flush toilets
   01 YES
   02 NO
   96 REFUSED
   97 DON'T KNOW

W4d. Did the project include installation of any other water saving devices?

03 YES **[SPECIFY]**
04 NO
96 REFUSED
97 DON'T KNOW

APPLIANCES

A1. I'm going to read you a list of factors, for each one, please tell me how much influence it had on your selection of the building's appliances - a great deal of influence, some influence, only a little or no influence. **[INSERT ITEM]**

[READ IF NECESSARY] Did this factor have a great deal, some, only a little or no influence on your selection of appliances?

a. First cost
b. Performance **[READ IF NECESSARY: meaning comfort and/or other amenity]**
c. Appearance

d. Operating cost
   01 A GREAT DEAL
   02 SOME
   03 ONLY A LITTLE
   04 NO INFLUENCE
   96 REFUSED
   97 DON'T KNOW
   99 NOT APPLICABLE **[GO TO INFL_S]**

A2. Did you provide ENERGY STAR ® appliances as part of this project or not?
   01 YES
   02 NO
   96 REFUSED
   97 DON'T KNOW

DESIGN TEAM VERSUS CUSTOMER INFLUENCE

[GO TO INFL_S2 IF DESIGN TEAM= ""]

INFL_S1. I'd like to confirm that **[DESIGN TEAM]** was the design team or architect for **[PROJECT NAME]**.

   01 YES **[SKIP TO INFL1]**
   02 NO

INFL_S2. Who was the design team or architect for this project?
   01 _____ [RECORD DESIGN TEAM]
   96 REFUSED
   97 DON'T KNOW

INFL_S3. What is the phone number and address for the design team or architect?
   01 _____ **[RECORD ADDRESS & PHONE]**
   96 REFUSED
   97 DON'T KNOW

INFL1. We are interested in knowing how influential the design team was in selecting the equipment you installed. Which of the following statements best describes the role of the design team in this project?

   01 The design team recommended the equipment and you agreed with the choice.
   02 The design team included the different equipment options, and you chose to purchase one of them.
   03 You suggested the equipment and then got a supporting opinion from the design team.
   04 You chose the equipment without input from the design team.
   96 REFUSED
   97 DON'T KNOW

INFL3. I'm going to read you a list of building or design components, for each one, please tell me how much influence the information provided by the design team had on your final decision - a great deal of influence, some influence, only a little or no influence. First… **[INSERT ITEM]**

[**READ IF NECESSARY**] Did this factor have a great deal, some, only a little or no influence on your decision?

a. Conducting whole building analysis
b. The selected HVAC design
c. The selected lighting design
d. **[SKIP TO ST1 IF PROJTYPE≠"multifamily"]** In-unit efficiency, such as the efficiency of Domestic hot water and appliances
   01 A GREAT DEAL
   02 SOME
   03 ONLY A LITTLE
   04 NO INFLUENCE
   96 REFUSED
   97 DON'T KNOW

FIRMOGRAPHICS

And finally, just a few questions about your project.

ST1. Did your project fall into any of the following categories? Please stop me when I get to the appropriate category.
   01 Agriculture
   02 Apartments or Multifamily
   03 Amusement, Social, and Recreational Buildings
   04 Education, such as Schools, colleges, and libraries
   05 Grocery and Food Sales
   06 Food Service and restaurants
   07 Health Care, such as hospitals and other treatment facilities
   08 Lodging, such as hotels and motels
   09 Retail and Mercantile
   10 Office and bank buildings
   11 Non-Manufacturing Laboratories
   12 Manufacturing plants and laboratories
   13 Warehouse and Storage
   14 Public Assembly
   15 Public Order and Safety
   16 Government Service Building
   17 Religious Worship
   95 OTHER **(specify)** _____
   96 REFUSED
   97 DON'T KNOW

ST 2. Please provide the square footage of the building in the [**PROJECT NAME**] project.
   01 _____**[RECORD SQUARE FEET]**
   96 REFUSED
   97 DON'T KNOW

ST3. What is the Principal Activity of the business operating in the new building? **[DO NOT READ. RECORD ONE ANSWER ONLY.]**
   01 Education
   02 Food Sales
   03 Food Service
   04 Health Care
   05 Lodging

06 Retail/Mercantile
07 Office
08 Public Assembly
09 Public Order and Safety
10 Religious Worship
11 Service
12 Warehouse and Storage
13 Manufacturing **(specify Industry Type)**
14 Vacant
15 Multifamily housing **[GO TO ST9a]**
95 OTHER **(specify)** _____
96 REFUSED
97 DON'T KNOW

ST7. How many employees does your firm have? **[READ LIST]**
01 Fewer than 5
02 5 to 9
03 10 to 19
04 20 to 49
05 50 to 99
06 100 to 249
07 250 or More
96 REFUSED
97 DON'T KNOW

ST8. Is your company independent, or part of a larger company?
01 Independent
02 Part of a larger company
95 OTHER **(specify)** _____
96 REFUSED
97 DON'T KNOW

[GO TO ST9b IF ST3~=15]
ST9a. How many multifamily properties does your firm have? [READ LIST]
01 One **[CONTINUE TO CLOSING]**
02 2 to 5 **[CONTINUE TO CLOSING]**
03 6 to 10 **[CONTINUE TO CLOSING]**
04 11 to 20 **[CONTINUE TO CLOSING]**
05 More than 20 **[CONTINUE TO CLOSING]**
96 REFUSED **[CONTINUE TO CLOSING]**
97 DON'T KNOW **[CONTINUE TO CLOSING]**

ST9b. How many properties does your firm have? **[READ LIST]**
01 One
02 2 to 5
03 6 to 10
04 11 to 20
05 More than 20
96 REFUSED
97 DON'T KNOW

CLOSING:
Finally, in order to try to minimize NYSERDA survey calls to you in the future, could you give me your name and phone number so that we can check it against our sample files in future studies?

01 YES **[RECORD NAME, PHONE]**
96 REFUSED

Those are all the questions I have for you. Thank you so much for taking the time for this interview. The information you have provided will be very valuable to NYSERDA.

Appendix C: Non-Participating Design Firm Survey Market Effects/Spillover Instrument

New Construction Program (NCP)
Non-Participating Design Firm Survey
MARKET EFFECTS/SPILLOVER INSTRUMENT
FINAL 11/15/2011

[SKIP FIRST SENTENCE IF NO NAME AVAILABLE]

Hello may I please speak to **[CONTACT NAME]**?

I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. We are researching the commercial and industrial new construction and major renovation market in New York to better understand general familiarity with energy efficiency programs, your firm's decisions on energy efficiency, and changes in market construction techniques in the past two years. Your firm was selected as part of a small carefully designed sample of design professionals and your feedback is very important to this research. Your responses to this survey will be kept confidential to the extent permitted by law.

BUILT & LOCATION SCREEN

BL1. Do you and your firm work on commercial or industrial new construction or major renovation projects in New York State, not including Long Island?

1.	YES	
2.	NO	**[GO TO BL1 TERMINATION SCRIPT]**
96	REFUSED	**[GO TO BL1 TERMINATION SCRIPT]**
97	DON'T KNOW	**[GO TO BL1 TERMINATION SCRIPT]**

BL1 TERMINATION SCRIPT:
This survey targets respondents who work in new construction or major renovation in New York State but outside of Long Island. Thank you for your time. **[TERMINATE]**

FINDING APPROPRIATE RESPONDENT & SCREEN FOR NON-PARTICIPANT

Q1. Are you the appropriate person in your organization to discuss issues related to your organization's decisions on design and equipment choices for commercial or industrial new construction or major renovation projects in New York State, not including Long Island?

1.	YES	**[GO TO Q4]**
2.	NO	
96	REFUSED	**[TERMINATE]**
97	DON'T KNOW	

Q2. Can you provide me with a contact name and phone number for a person in your organization who can speak to design and equipment choices for your firm's new construction or major renovation projects?

1.	YES	**[SPECIFY NAME, NUMBER]**
2.	NO	**[TERMINATE]**
96	REFUSED	**[TERMINATE]**
97	DON'T KNOW	**[TERMINATE]**

Q3. Can you transfer me to **[NEW NAME FROM Q2]**?

1.	YES	**[TRANSFERRING]**
2.	NO, NOT AVAILABLE	**[SCHEDULE CALLBACK]**

96 REFUSED **[SCHEDULE CALLBACK]**

Q4. Have you, on behalf of your organization, participated in any NYSERDA or **New York Energy $mart**SM programs in the past four years?
1. DID NOT PARTICIPATE
2. PARTICIPATED **[GO TO TERMINATION SCRIPT FOR Q4]**
96 REFUSED **[GO TO TERMINATION SCRIPT FOR Q4]**
97 DON'T KNOW

Q4 TERMINATION SCRIPT
This particular survey is for respondents who have not participated in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time. **[TERMINATE]**

Q5. To the best of your knowledge has your organization participated in any NYSERDA or **New York Energy $mart**SM programs in the past four years? Please think about all projects, including those that you were not involved with.
1. DID NOT PARTICIPATE
2. PARTICIPATED **[GO TO TERMINATION SCRIPT FOR Q5]**
96 REFUSED **[GO TO TERMINATION SCRIPT FOR Q5]**
97 DON'T KNOW

Q5 TERMINATION SCRIPT:
This particular survey is for firms that have not participated in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time. **[TERMINATE]**

Q6. This survey will take about 20 to 30 minutes to complete. We recognize that this is a sizeable time commitment and we very much appreciate your participation. We can proceed now over the phone; or we can schedule a more convenient time. Do you want to proceed by phone now?
1. YES, AVAILABLE **[GO TO AW1]**
2. NO, NOT AVAILABLE
96 REFUSED **[TERMINATE]**

Q7. I would be pleased to schedule an appointment. We can also send you a confirmation of your scheduled callback which will provide an overview of the content and will include one of the survey questions for your information and reference during the survey. Would you like to provide an email address or fax number to send this document?
1. _____[**RECORD EMAIL] [GO TO SCRIPT FOR Q7]**
2. _____[**RECORD FAX NUMBER] [GO TO SCRIPT FOR Q7]**
3. SCHEDULE APPOINTMENT WITHOUT EMAIL/FAX **[GO TO SCRIPT FOR Q7]**
96 REFUSED **[TERMINATE]**

Q7 SCRIPT:
Thank you for your time and willingness to participate. We look forward to speaking with you again soon. **[SCHEDULE CALLBACK]**

[BEGIN WITH Q8 WHEN CALLING TO COMPLETE SCHEDULED INTERVIEW]

Q8. Hello may I please speak to **[CONTACT NAME]**? I'm calling back on behalf of the New York State Energy Research and Development Authority or NYSERDA. We have scheduled an interview with you at this time about the commercial and industrial new construction and major renovation market. Are you ready to proceed with the survey?
1. YES
2. NO, NOT AVAILABLE **[SCHEDULE CALLBACK]**

96 REFUSED **[TERMINATE]**

NYSERDA AND NCP AWARENESS

AW1. Prior to this call, were you aware of any energy efficiency programs that provide assistance in order to increase the energy efficiency of commercial and industrial new construction and major renovation in New York?
1. YES
2. NO
96 REFUSED
97 DON'T KNOW

AW2. Prior to this call, were you aware of the New York State Energy Research and Development Authority (also known as NYSERDA)?
1. YES
2. NO **[GO TO M1]**
96 REFUSED **[GO TO M1]**
97 DON'T KNOW **[GO TO M1]**

AW3. Prior to this call, were you aware of NYSERDA's New Construction Program for commercial and industrial new construction and major renovations in New York?
1. YES
2. NO **[GO TO M1]**
96 REFUSED **[GO TO M1]**
97 DON'T KNOW **[GO TO M1]**

AW4. How familiar are you with NYSERDA's New Construction Program? Would you say you are…**[READ LIST]**
1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar **[GO TO M1]**
96 REFUSED **[GO TO M1]**
97 DON'T KNOW **[GO TO M1]**

AW5. Are you aware of any new construction or major renovation projects outside your firm that have been or currently are participating in NYSERDA's New Construction Program?
1. YES
2. NO
96 REFUSED
97 DON'T KNOW

AW6. Have you ever discussed the NYSERDA New Construction Program with architects, engineers or design professionals, building owners, developers or equipment providers?
1. YES
2. NO
96 REFUSED
97 DON'T KNOW

DESIGN INFORMATION: OVERALL MARKET (SPILLOVER & MARKET EFFECTS)

I would like to get your **perceptions** about the New York commercial and industrial new construction and major renovation market – where it was two years ago and where the market is currently. We are trying to gather information about everyone's **perceptions** of the market. But if you only have experience with a few projects and do not feel you have formed any perceptions about the overall market, then please feel free to provide your best answer based on your projects. We will ask you at the end of the survey if most of your responses were your perceptions of the market or if they were based on your projects only. To help you recall the time period, two years ago was summer of 2009 during a low period of the current recession.

M1. What percent of all New York commercial new construction projects do you think did not meet their relevant energy code 2 years ago? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M2. What percent do you think do not meet energy code today? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

Now I'm now going to ask you a series of questions regarding your familiarity with and use of various energy efficiency measures affecting building mechanical systems. If you are not familiar with any of these measures or systems, please just tell me that.

[FOR EACH EEMDA FROM TABLE 1, ASK M3 TO M8 IN SEQUENCE THEN GO TO NEXT EEMDA AND ASK M3 TO M8]

M3. How familiar are you with **[INSERT EEMDA FROM TABLE 1]**. Would you say you are…**[READ LIST]?**

1. Very familiar
2. Somewhat familiar
3. Not too familiar **[GO TO NEXT EEMDA]**
4. Not at all familiar **[GO TO NEXT EEMDA]**
96 REFUSED **[GO TO NEXT EEMDA]**
97 DON'T KNOW **[GO TO NEXT EEMDA]**

M4. Thinking back two years ago, how familiar would you say you were with **[EEMDA]** then? Would you say you were…**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar
96 REFUSED
97 DON'T KNOW

M5. In your opinion, over the past two years, has the availability of **[EEMDA]**… **[READ LIST]**

1. Decreased significantly
2. Decreased somewhat

3. Stayed the same
4. Increased somewhat
5. Increased significantly
96 REFUSED
97 DON'T KNOW

M6. To the best of your knowledge, approximately what percentage of all New York commercial and industrial new construction and major renovation projects currently incorporates **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M7. Please think back two years ago approximately what percentage of all New York commercial and industrial new construction and major renovation projects incorporated **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M3 FOR NEXT EEMDA/M9 IF AW1 = 02, 96, 97 OR M6<=M7 OR M6≠1]

M8. To the best of your knowledge, what percent of the energy savings from any increased incorporation of **[EEMDA]** in New York over the last 2 years can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

TABLE1. HVAC Energy Efficiency Measures and Design Approaches or Motors (EEMDA)

EEMDA	M3. Current familiarity	M4. Familiar 2 yrs ago	M5. Availability	M6. Current %	M7. % 2-yrs ago	M8. Attribution
Efficient HVAC Equipment	M3_a	M4_a	M5_a	M6_a	M7_a	M8_a
Building control systems (EMS) to optimize HVAC	M3_b	M4_b	M5_b	M6_b	M7_b	M8_b
Variable Air Volume (VAV) Systems	M3_c	M4_c	M5_c	M6_c	M7_c	M8_c
High-performance building shells	M3_d	M4_d	M5_d	M6_d	M7_d	M8_d
Premium-efficiency motors (NEMA-premium motors)	M3_e	M4_e	M5_e	M6_e	M7_e	M8_e
Variable speed	M3_f	M4_f	M5_f	M6_f	M7_f	M8_f

drives in motors						

I'm now going to ask you about your familiarity with lighting energy efficiency measures and design approaches. Again, if you are not familiar with any of these measures or design approaches, please just tell me that.

[FOR EACH EEMDA FROM TABLE 2, ASK M9 TO M14 IN SEQUENCE THEN GO TO NEXT EEMDA AND ASK M9 TO M14]

M9. Please rate your current familiarity with **[INSERT EEMDA FROM TABLE 2]**. Would you say you are…**[READ LIST]**?

1. Very familiar
2. Somewhat familiar
3. Not too familiar **[GO TO NEXT EEMDA]**
4. Not at all familiar **[GO TO NEXT EEMDA]**

96 REFUSED **[GO TO NEXT EEMDA]**

97 DON'T KNOW **[GO TO NEXT EEMDA]**

M10. Thinking back two years ago, how familiar would you say you were with **[EEMDA]** then? Would you say you were…**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar

96 REFUSED

97 DON'T KNOW

M11. In your opinion, in the past two years, has the availability of **[EEMDA]**… **[READ LIST]**

1. Decreased significantly
2. Decreased somewhat
3. Stayed the same
4. Increased somewhat
5. Increased significantly

96 REFUSED

97 DON'T KNOW

M12. To the best of your knowledge, approximately what percentage of all New York commercial and industrial new construction and major renovation projects currently incorporates **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**

96 REFUSED

97 DON'T KNOW

M13. Please think back two years ago approximately what percentage of all New York commercial and industrial new construction and major renovation projects incorporated **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**

96 REFUSED

97 DON'T KNOW

[GO TO M9 FOR NEXT EEMDA OR M15 IF AW1 = 02, 96, 97 OR M13>=M12 OR M12≠1]

M14. To the best of your knowledge, what percent of the energy savings from any increased incorporation of **[EEMDA]** over the last 2 years in New York can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

TABLE2. Lighting Energy Efficiency Measures and Design Approaches (EEMDA)

EEMDA	M9. Current familiarity	M10. Familiar 2 yrs ago	M11. Availability	M12. Current %	M13. % 2-yrs ago	M14. Attribution
Efficient lighting technologies	M9_a	M10_a	M11_a	M12_a	M13_a	M14_a
Efficient lamps and fixtures	M9_b	M10_b	M11_b	M12_b	M13_b	M14_b
Lighting occupancy sensors or controls	M9_c	M10_c	M11_c	M12_c	M13_c	M14_c
Daylighting Technologies	M9_d	M10_d	M11_d	M12_d	M13_d	M14_d

[IF proj_typenum ≠ "6", GO TO M20]

Now let's talk about domestic hot water and appliance energy efficiency measures or design approaches. Please just let me know if you are not familiar with any of the measures I ask about.

M15. To the best of your knowledge, about what percent of domestic hot water systems installed in multi-family new construction or major renovation projects are better than energy code? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M17 IF AW1 = 2, 96, 97]

M16. About what percent of the energy savings from the installation of above code domestic hot water systems in multi-family new construction and major renovation projects can reasonably be attributed to the influence of New York energy efficiency programs for multi-family new construction or major renovation projects? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M17. To the best of your knowledge, what percent of appliances installed in multi-family new construction or major renovation projects in New York are ENERGY STAR appliances?

[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M20 IF AW1 = 2, 96, 97]

M18. About what percent of the energy savings from the installation of ENERGY STAR appliances in multi-family new construction and major renovation projects can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[M19 INTENTIONALLY OMITTED]

I'm now going to ask you a series of questions regarding your familiarity with and use of various other energy efficiency measures and design approaches. As we've talked about before, if you are not familiar with any of these measures, that's fine, just let me know.

[FOR EACH EEMDA FROM TABLE 3, ASK M20 TO M25 IN SEQUENCE THEN GO TO NEXT EEMDA AND ASK M20 TO M25]

M20. Please rate your current familiarity with **[INSERT EEMDA FROM TABLE 3]**. Would you say you are ...**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar **[GO TO NEXT EEMDA]**
4. Not at all familiar **[GO TO NEXT EEMDA]**
96 REFUSED **[GO TO NEXT EEMDA]**
97 DON'T KNOW **[GO TO NEXT EEMDA]**

M21. Thinking back two years ago, how familiar would you say you were with **[EEMDA]** then? Would you say you were…**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar
96 REFUSED
97 DON'T KNOW

M22. In your opinion, over the past two years has the availability of **[EEMDA]**… **[READ LIST]**

1. Decreased significantly
2. Decreased somewhat
3. Stayed the same
4. Increased somewhat
5. Increased significantly
96 REFUSED
97 DON'T KNOW

M23. To the best of your knowledge, approximately what percentage of all New York commercial and industrial new construction and major renovation projects currently incorporates **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M24. Please think back two years ago, at that time approximately what percentage of New York's commercial and industrial new construction and major renovation projects incorporated **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M20 FOR NEXT EEMDA OR M26 IF AW1 = 02, 96, 97 OR M24>=M23 OR M23≠1]

M25. To the best of your knowledge, what percent of the energy savings from any increased incorporation of the following measures over the last 2 years can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market?

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

TABLE3. Energy Efficiency Measures and Design Approaches (EEMDA)

EEMDA	M20. Current familiarity	M21. Familiar 2 yrs ago	M22. Availability	M23. Current %	M24. % 2-yrs ago	M25. Attribution
Advanced Solar Technologies	M20_a	M21_a	M22_a	M23_a	M24_a	M25_a
Peak Load Reduction Technologies	M20_b	M21_b	M22_b	M23_b	M24_b	M25_b
Whole Building Design	M20_c	M21_c	M22_c	M23_c	M24_c	M25_c
Green Building Design	M20_d	M21_d	M22_d	M23_d	M24_d	M25_d
LEED Certification	M20_e	M21_e	M22_e	M23_e	M24_e	M25_e
Building Commissioning	M20_f	M21_f	M22_f	M23_f	M24_f	M25_f

Now I have just a couple of questions about energy usage in the commercial and industrial new construction and major renovation market in NY.

M26. How has the energy usage in newly constructed and major renovation commercial and industrial buildings in NY changed over the last 2 years? Would you say that it has…**[READ LIST]**

1. Increased
2. Decreased
3. Stayed the same **[GO TO M29]**

96 REFUSED **[GO TO M29]**
97 DON'T KNOW **[GO TO M29]**

M27. By what percent has it **[IF M26=01, "INCREASED"/IF M26=02, "DECREASED"]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M29 IF AW1 = 02, 96, 97]
M28. Of the changes in energy usage in new buildings that have occurred in the last 2 years, what percent of this change do you think is attributable to energy efficiency programs? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

Now I'd like to talk about some factors that may contribute to greater energy efficiency in new buildings in New York.

M29. [**IF Q7 = 1 or 2, READ**: You have received an e-mail or fax with a list of 8 items we'd like you to rate. Please refer to that document now. **[WAIT FOR RESPONDENT TO PULL UP E-MAIL/FAX]**]
I'm going to read you a list of 8 items. In your opinion what percent of greater energy efficiency in new or major renovation buildings can reasonably be attributed to the influence of each of the following 8 items? Please be sure that all of your percentages add up to 100%. **[READ LIST]**
- Increased availability of energy efficient products/technologies
- Increased knowledge of energy efficient construction practices
- Energy efficiency programs and efforts by the State of NY
- Higher energy prices
- increased awareness of global environmental consequences of energy use
- Increased Federal programs and promotions concerning energy efficiency
- Increased promotion of efficiency by manufacturers
- Increased promotion of efficiency by vendors, contractors or retailers.

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW
[PROGRAMMER: VERIFY THAT PERCENTS ADD TO 100%, NOT COUNTING RF & DK]

M30. Many times in decision-making we have a factor with a small level of influence but it is still required for us to make that decision, something like a flip point or tipping point. I would like you to go back to these 8 items and tell me whether or not each one is required when you decide to put greater energy efficiency into a new or rehab building. First **[INSERT ITEM] is this required or not?**
a. Availability of energy efficient products/technologies
b. Knowledge of energy efficient construction practices
c. Energy efficiency programs and efforts by State of NY
d. High energy prices

e. Concern/knowledge about global environmental consequences of energy use
f. Federal programs and promotions concerning energy efficiency
g. Promotion of efficiency by manufacturers
h. Promotion of efficiency by vendors, contractors or retailers

1 YES
2 NO
96 REFUSED
97 DON'T KNOW

M31. Finally, were most of your responses to the survey questions based on your best guess of where the commercial/industrial new construction and major renovation market is in New York or were your response based more on your experiences with your own projects?

1 THE MARKET
2 MY PROJECTS
96 REFUSED
97 DON'T KNOW

FIRMOGRAPHICS

ST4a. Would you characterize your organization as an architecture firm, an engineering firm or another type of organization?

1 ARCHITECTURE FIRM
2 ENGINEERING FIRM
95 OTHER (specify: _____)
96 REFUSED
97 DON'T KNOW

ST5. Approximately how many new construction projects per year is your organization involved with in New York (not including Long Island)?

1 [RECORD NUMBER]
96 REFUSED
97 DON'T KNOW

ST6. We would like to know the four facility types in which your firm works most frequently in its new construction projects in New York (not including Long Island). I have a list of facility types I will go through and then I will work with you so you can identify the top four. **[READ LIST]** **[WITHIN TOP FOUR]**

a. _____
b. _____
c. _____
d. _____

1 Agriculture
2 Apartments/Multifamily
3 Amusement, Social,
4 Education, Schools, colleges, libraries, and Recreational Buildings
5 Grocery/ Food Sales
6 Food Service, restaurants
7 Health Care, hospitals and other treatment facilities
8 Lodging, hotel and motel
9 Retail/Mercantile
10 Office and bank building
11 Non-Manufacturing Laboratories

12. Manufacturing plants and laboratories
13. Warehouse and Storage
14. Public Assembly
15. Public Order and Safety
16. Government Service Building
17. Religious Worship

95 OTHER (specify) _____
96 REFUSED
97 DON'T KNOW

We would like to know what share of your work are in each of these top four facility types.

e. What percent of your firm's new construction work in New York are projects for **[INSERT ST6a]**?
f. What percent of your firm's new construction work in New York are projects for **[INSERT ST6b]**?
g. What percent are projects for **[INSERT ST6c]?**
h. What percent are projects for **[INSERT ST6d]?**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[PROGRAMMER: VERIFY THAT PERCENTS ADD TO <=100%, NOT COUNTING RF & DK]

ST7. How many employees does your firm have? **[READ LIST]**

1. Fewer than 5
2. 5 to 9
3. 10 to 19
4. 20 to 49
5. 50 to 99
6. 100 to 249
7. 250 or More

96 REFUSED
97 DON'T KNOW

ST8. Is your company independent, or part of a larger company?

1. INDEPENDENT
2. PART OF A LARGER COMPANY

95 OTHER (specify) _____
96 REFUSED
97 DON'T KNOW

ST9b. How many offices does your firm have? Please stop me when I get to the appropriate category. **[READ LIST]**

1. One
2. 2 to 5
3. 6 to 10
4. 11 to 20
5. More than 20

96 REFUSED
97 DON'T KNOW

CLOSING:

Those are all the questions I have for you. Thank you so much for taking the time for this interview. The information you have provided will be very valuable to NYSERDA.

Appendix C: Non-Participating Owner Survey Market Effects/Spillover Instrument

New Construction Program (NCP)
Non-Participating Owner Survey
MARKET EFFECTS/SPILLOVER INSTRUMENT
FINAL 11/15/2011

[SKIP FIRST SENTENCE IF NO NAME AVAILABLE]

Hello may I please speak to **[CONTACT NAME]**? I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. We are researching the commercial and industrial new construction and major renovation market in New York to better understand general familiarity with energy efficiency programs, your organization's decisions on energy efficiency, and changes in market construction techniques in the past two years. Your organization was selected as part of a small carefully designed sample of building owners and developers and your feedback is very important to this research. Your responses to this survey will be kept confidential to the extent permitted by law.

BUILT & LOCATION SCREEN

BL1. Our records indicate that, sometime since 2004, your organization completed a commercial or industrial new construction or major renovation project in New York State, not including Long Island? Is this correct?

1.	YES	
2.	NO	**[GO TO BL1 TERMINATION SCRIPT]**
96	REFUSED	**[GO TO BL1 TERMINATION SCRIPT]**
97	DON'T KNOW	**[GO TO BL1 TERMINATION SCRIPT]**

BL1 TERMINATION SCRIPT:
This survey targets respondents who have completed a new construction or major renovation project in New York State but outside of Long Island. Thank you for your time. **[TERMINATE]**

FINDING APPROPRIATE RESPONDENT & SCREEN FOR NON-PARTICIPANT

Q1. Are you the appropriate person in your organization to discuss issues related to your organization's decisions on design and equipment choices for commercial or industrial new construction or major renovation projects in New York State, not including Long Island?

1.	YES	**[GO TO Q4]**
2.	NO	
96	REFUSED	**[TERMINATE]**
97	DON'T KNOW	

Q2. Can you provide me with a contact name and phone number for a person in your organization who can speak to design and equipment choices for your organization's new construction or major renovation projects?

1.	YES	**[SPECIFY NAME, NUMBER]**
2.	NO	**[TERMINATE]**
96	REFUSED	**[TERMINATE]**
97	DON'T KNOW	**[TERMINATE]**

Q3. Can you transfer me to **[NEW NAME FROM Q2]**?

1.	YES	**[TRANSFERRING]**
2.	NO, NOT AVAILABLE	**[SCHEDULE CALLBACK]**
96	REFUSED	**[SCHEDULE CALLBACK]**

Q4. Have you, on behalf of your organization, participated in any NYSERDA or **New York Energy $mart**[SM] programs in the past four years?

1. DID NOT PARTICIPATE
2. PARTICIPATED **[GO TO TERMINATION SCRIPT FOR Q4]**
96 REFUSED **[GO TO TERMINATION SCRIPT FOR Q4]**
97 DON'T KNOW

Q4 TERMINATION SCRIPT

This particular survey is for respondents who have not participated in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time. **[TERMINATE]**

Q5. To the best of your knowledge has your organization participated in any NYSERDA or **New York Energy $mart**[SM] programs in the past four years? Please think about all projects, including those that you were not involved with.

1. DID NOT PARTICIPATE
2. PARTICIPATED **[GO TO TERMINATION SCRIPT FOR Q5]**
96 REFUSED **[GO TO TERMINATION SCRIPT FOR Q5]**
97 DON'T KNOW

Q5 TERMINATION SCRIPT:

This particular survey is for organizations that have not participated in a NYSERDA program. You could be called later for other surveys being conducted with participants. Thank you for your time. **[TERMINATE]**

Q6. This survey will take about 20 to 30 minutes to complete. We recognize that this is a sizeable time commitment and we very much appreciate your participation. We can proceed now over the phone; or we can schedule a more convenient time. Do you want to proceed by phone now?

1. YES, AVAILABLE **[GO TO AW1]**
2. NO, NOT AVAILABLE
96 REFUSED **[TERMINATE]**

Q7. I would be pleased to schedule an appointment. We can also send you a confirmation of your scheduled callback which will provide an overview of the content and will include one of the survey questions for your information and reference during the survey. Would you like to provide an email address or fax number to send this document?

1. _____[**RECORD EMAIL] [GO TO SCRIPT FOR Q7]**
2. _____[**RECORD FAX NUMBER] [GO TO SCRIPT FOR Q7]**
3. SCHEDULE APPOINTMENT WITHOUT EMAIL/FAX **[GO TO SCRIPT FOR Q7]**
96 REFUSED **[TERMINATE]**

Q7 SCRIPT:

Thank you for your time and willingness to participate. We look forward to speaking with you again soon. **[SCHEDULE CALLBACK]**

[BEGIN WITH Q8 WHEN CALLING TO COMPLETE SCHEDULED INTERVIEW]

Q8. Hello may I please speak to **[CONTACT NAME]**? I'm calling back on behalf of the New York State Energy Research and Development Authority or NYSERDA. We have scheduled an interview with you at this time about the commercial and industrial new construction and major renovation market. Are you ready to proceed with the survey?

1. YES
2. NO, NOT AVAILABLE **[SCHEDULE CALLBACK]**
96 REFUSED **[TERMINATE]**

NYSERDA AND NCP AWARENESS

AW1. Prior to this call, were you aware of any energy efficiency programs that provide assistance in order to increase the energy efficiency of commercial and industrial new construction and major renovation in New York?
1. YES
2. NO
96 REFUSED
97 DON'T KNOW

AW2. Prior to this call, were you aware of the New York State Energy Research and Development Authority (also known as NYSERDA)?
1. YES
2. NO **[GO TO M1]**
96 REFUSED **[GO TO M1]**
97 DON'T KNOW **[GO TO M1]**

AW3. Prior to this call, were you aware of NYSERDA's New Construction Program for commercial and industrial new construction and major renovations in New York?
1. YES
2. NO **[GO TO M1]**
96 REFUSED **[GO TO M1]**
97 DON'T KNOW **[GO TO M1]**

AW4. How familiar are you with NYSERDA's New Construction Program? Would you say you are...**[READ LIST]**
1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar **[GO TO M1]**
96 REFUSED **[GO TO M1]**
97 DON'T KNOW **[GO TO M1]**

AW5. Are you aware of any new construction or major renovation projects outside your organization that have been or currently are participating in NYSERDA's New Construction Program?
1. YES
2. NO
96 REFUSED
97 DON'T KNOW

AW6. Have you ever discussed the NYSERDA New Construction Program with architects, engineers or design professionals, building owners, developers or equipment providers?
1. YES
2. NO
96 REFUSED
97 DON'T KNOW

DESIGN INFORMATION: OVERALL MARKET (SPILLOVER & MARKET EFFECTS)

I would like to get your **perceptions** about the New York commercial and industrial new construction and major renovation market – where it was two years ago and where the market is currently. We are trying to gather information about everyone's **perceptions** of the market. But if you only have experience with

a few projects and do not feel you have formed any perceptions about the overall market, then please feel free to provide your best answer based on your projects. We will ask you at the end of the survey if most of your responses were your perceptions of the market or if they were based on your projects only. To help you recall the time period, two years ago was summer of 2009 during a low period of the current recession.

M1. What percent of all New York commercial new construction projects do you think did not meet their relevant energy code 2 years ago? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M2. What percent do you think do not meet energy code today? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

Now I'm now going to ask you a series of questions regarding your familiarity with and use of various energy efficiency measures affecting building mechanical systems. If you are not familiar with any of these measures or systems, please just tell me that.

[FOR EACH EEMDA FROM TABLE 1, ASK M3 TO M8 IN SEQUENCE THEN GO TO NEXT EEMDA AND ASK M3 TO M8]

M3. How familiar are you with **[INSERT EEMDA FROM TABLE 1]**. Would you say you are ...**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar **[GO TO NEXT EEMDA]**
4. Not at all familiar **[GO TO NEXT EEMDA]**
96 REFUSED **[GO TO NEXT EEMDA]**
97 DON'T KNOW **[GO TO NEXT EEMDA]**

M4. Thinking back two years ago, how familiar would you say you were with **[EEMDA]** then? Would you say you were…**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar
96 REFUSED
97 DON'T KNOW

M5. In your opinion, over the past two years, has the availability of **[EEMDA]**… **[READ LIST]**

1. Decreased significantly
2. Decreased somewhat
3. Stayed the same
4. Increased somewhat
5. Increased significantly

96 REFUSED
97 DON'T KNOW

M6. To the best of your knowledge, approximately what percentage of all New York commercial and industrial new construction and major renovation projects currently incorporates **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M7. Please think back two years ago approximately what percentage of all New York commercial and industrial new construction and major renovation projects incorporated **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M3 FOR NEXT EEMDA/M9 IF AW1 = 02, 96, 97 OR M6<=M7 OR M6≠1]

M8. To the best of your knowledge, what percent of the energy savings from any increased incorporation of **[EEMDA]** in New York over the last 2 years can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

TABLE1. HVAC Energy Efficiency Measures and Design Approaches or Motors (EEMDA)

EEMDA	M3. Current familiarity	M4. Familiar 2 yrs ago	M5. Availability	M6. Current %	M7. % 2-yrs ago	M8. Attribution
Efficient HVAC Equipment	M3_a	M4_a	M5_a	M6_a	M7_a	M8_a
Building control systems (EMS) to optimize HVAC	M3_b	M4_b	M5_b	M6_b	M7_b	M8_b
Variable Air Volume (VAV) Systems	M3_c	M4_c	M5_c	M6_c	M7_c	M8_c
High-performance building shells	M3_d	M4_d	M5_d	M6_d	M7_d	M8_d
Premium-efficiency motors (NEMA-premium motors)	M3_e	M4_e	M5_e	M6_e	M7_e	M8_e
Variable speed drives in motors	M3_f	M4_f	M5_f	M6_f	M7_f	M8_f

I'm now going to ask you about your familiarity with lighting energy efficiency measures and design approaches. Again, if you are not familiar with any of these measures or design approaches, please just tell me that.

[FOR EACH EEMDA FROM TABLE 2, ASK M9 TO M14 IN SEQUENCE THEN GO TO NEXT EEMDA AND ASK M9 TO M14]

M9. Please rate your current familiarity with **[INSERT EEMDA FROM TABLE 2]**. Would you say you are...**[READ LIST]**
1. Very familiar
2. Somewhat familiar
3. Not too familiar **[GO TO NEXT EEMDA]**
4. Not at all familiar **[GO TO NEXT EEMDA]**
96 REFUSED **[GO TO NEXT EEMDA]**
97 DON'T KNOW **[GO TO NEXT EEMDA]**

M10. Thinking back two years ago, how familiar would you say you were with **[EEMDA]** then? Would you say you were…**[READ LIST]**
1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar
96 REFUSED
97 DON'T KNOW

M11. In your opinion, in the past two years, has the availability of **[EEMDA]**… **[READ LIST]**
1. Decreased significantly
2. Decreased somewhat
3. Stayed the same
4. Increased somewhat
5. Increased significantly
96 REFUSED
97 DON'T KNOW

M12. To the best of your knowledge, approximately what percentage of all New York commercial and industrial new construction and major renovation projects currently incorporates **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M13. Please think back two years ago approximately what percentage of all New York commercial and industrial new construction and major renovation projects incorporated **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**
1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M9 FOR NEXT EEMDA OR M15 IF AW1 = 02, 96, 97 OR M13>=M12 OR M12≠1]

M14. To the best of your knowledge, what percent of the energy savings from any increased incorporation of **[EEMDA]** over the last 2 years in New York can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

TABLE2. Lighting Energy Efficiency Measures and Design Approaches (EEMDA)

EEMDA	M9. Current familiarity	M10. Familiar 2 yrs ago	M11. Availability	M12. Current %	M13. % 2-yrs ago	M14. Attribution
Efficient lighting technologies	M9_a	M10_a	M11_a	M12_a	M13_a	M14_a
Efficient lamps and fixtures	M9_b	M10_b	M11_b	M12_b	M13_b	M14_b
Lighting occupancy sensors or controls	M9_c	M10_c	M11_c	M12_c	M13_c	M14_c
Daylighting Technologies	M9_d	M10_d	M11_d	M12_d	M13_d	M14_d

[IF proj_typenum ≠ "6", GO TO M20]

Now let's talk about domestic hot water and appliance energy efficiency measures or design approaches. Please just let me know if you are not familiar with any of the measures I ask about.

M15. To the best of your knowledge, about what percent of domestic hot water systems installed in multi-family new construction or major renovation projects are better than energy code? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[SKIP TO M17 IF AW1 = 02, 96, 97]

M16. About what percent of the energy savings from the installation of above code domestic hot water systems in multi-family new construction and major renovation projects can reasonably be attributed to the influence of New York energy efficiency programs for multi-family new construction or major renovation projects? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M17. To the best of your knowledge, what percent of appliances installed in multi-family new construction or major renovation projects in New York are ENERGY STAR appliances? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M20 IF AW1 = 02, 96, 97]

M18. About what percent of the energy savings from the installation of ENERGY STAR appliances in multi-family new construction and major renovation projects can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[NOTE: M19 INTENTIONALLY OMITTED]

I'm now going to ask you a series of questions regarding your familiarity with and use of various other energy efficiency measures and design approaches. As we've talked about before, if you are not familiar with any of these measures, that's fine, just let me know.

[FOR EACH EEMDA FROM TABLE 3, ASK M20 TO M25 IN SEQUENCE THEN GO TO NEXT EEMDA AND ASK M20 TO M25]

M20. Please rate your current familiarity with **[INSERT EEMDA FROM TABLE 3]**. Would you say you are…**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar **[GO TO NEXT EEMDA]**
4. Not at all familiar **[GO TO NEXT EEMDA]**
96 REFUSED **[GO TO NEXT EEMDA]**
97 DON'T KNOW **[GO TO NEXT EEMDA]**

M21. Thinking back two years ago, how familiar would you say you were with **[EEMDA]** then? Would you say you were…**[READ LIST]**

1. Very familiar
2. Somewhat familiar
3. Not too familiar
4. Not at all familiar
96 REFUSED
97 DON'T KNOW

M22. In your opinion, over the past two years has the availability of **[EEMDA]**… **[READ LIST]**

1. Decreased significantly
2. Decreased somewhat
3. Stayed the same
4. Increased somewhat
5. Increased significantly
96 REFUSED
97 DON'T KNOW

M23. To the best of your knowledge, approximately what percentage of all New York commercial and industrial new construction and major renovation projects currently incorporates **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

M24. Please think back two years ago, at that time approximately what percentage of New York's commercial and industrial new construction and major renovation projects incorporated **[EEMDA]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M20 FOR NEXT EEMDA OR M26 IF AW1 = 02, 96, 97 OR M24>=M23 OR M23≠1]

M25. To the best of your knowledge, what percent of the energy savings from any increased incorporation of the following measures over the last 2 years can reasonably be attributed to the influence of New York energy efficiency programs targeted at the commercial and industrial new construction or major renovation market?

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

TABLE3. Energy Efficiency Measures and Design Approaches (EEMDA)

EEMDA	M20. Current familiarity	M21. Familiar 2 yrs ago	M22. Availability	M23. Current %	M24. % 2-yrs ago	M25. Attribution
Advanced Solar Technologies	M20_a	M21_a	M22_a	M23_a	M24_a	M25_a
Peak Load Reduction Technologies	M20_b	M21_b	M22_b	M23_b	M24_b	M25_b
Whole Building Design	M20_c	M21_c	M22_c	M23_c	M24_c	M25_c
Green Building Design	M20_d	M21_d	M22_d	M23_d	M24_d	M25_d
LEED Certification	M20_e	M21_e	M22_e	M23_e	M24_e	M25_e
Building Commissioning	M20_f	M21_f	M22_f	M23_f	M24_f	M25_f

Now I have just a couple of questions about energy usage in the commercial and industrial new construction and major renovation market in NY.

M26. How has the energy usage in newly constructed and major renovation commercial and industrial buildings in NY changed over the last 2 years? Would you say that it has…**[READ LIST]**

1. Increased
2. Decreased
3. Stayed the same **[GO TO M29]**
96 REFUSED **[GO TO M29]**
97 DON'T KNOW **[GO TO M29]**

M27. By what percent has it **[IF M26=01, "INCREASED"/IF M26=02, "DECREASED"]**? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[GO TO M29 IF AW1 = 02, 96, 97]

M28. Of the changes in energy usage in new buildings that have occurred in the last 2 years, what percent of this change do you think is attributable to energy efficiency programs? **[PROMPT IF NECESSARY: A ROUGH GUESS IS ACCEPTABLE AS WE REALIZE FEW INDIVIDUALS CAN ANSWER THIS WITH GREAT CERTAINTY.]**

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

Now I'd like to talk about some factors that may contribute to greater energy efficiency in new buildings in New York.

M29. [**IF Q7 = 1 or 2, READ**: You have received an e-mail or fax with a list of 8 items we'd like you to rate. Please refer to that document now. **[WAIT FOR RESPONDENT TO PULL UP E-MAIL/FAX]**]

I'm going to read you a list of 8 items. In your opinion what percent of greater energy efficiency in new or major renovation buildings can reasonably be attributed to the influence of each of the following 8 items? Please be sure that all of your percentages add up to 100%. **[READ LIST]**

- Increased availability of energy efficient products/technologies
- Increased knowledge of energy efficient construction practices
- Energy efficiency programs and efforts by the State of NY
- Higher energy prices
- increased awareness of global environmental consequences of energy use
- Increased Federal programs and promotions concerning energy efficiency
- Increased promotion of efficiency by manufacturers
- Increased promotion of efficiency by vendors, contractors or retailers.

1. _____**[RECORD PERCENT]**
96 REFUSED
97 DON'T KNOW

[PROGRAMMER: VERIFY THAT PERCENTS ADD TO 100%, NOT COUNTING RF & DK]

M30. Many times in decision-making we have a factor with a small level of influence but it is still required for us to make that decision, something like a flip point or tipping point. I would like you to go back to these 8 items and tell me whether or not each one is required when you decide to put greater energy efficiency into a new or rehab building. First **[INSERT ITEM] is this required or not?**

i. Availability of energy efficient products/technologies
j. Knowledge of energy efficient construction practices
k. Energy efficiency programs and efforts by State of NY
l. High energy prices
m. Concern/knowledge about global environmental consequences of energy use
n. Federal programs and promotions concerning energy efficiency

o. Promotion of efficiency by manufacturers
p. Promotion of efficiency by vendors, contractors or retailers

1. YES
2. NO
96 REFUSED
97 DON'T KNOW

M31. Finally, were most of your responses to the survey questions based on your best guess of where the commercial/industrial new construction and major renovation market is in New York or were your responses based more on your experiences with your own projects?

1. THE MARKET
2. MY PROJECTS
96 REFUSED
97 DON'T KNOW

CLOSING:
Those are all the questions I have for you. Thank you so much for taking the time for this interview. The information you have provided will be very valuable to NYSERDA.

Appendix C: Participating Design Firm Survey

Project Name:

Project Number:

Contact Name:

Project Contact Phone:

Interviewer:

Date of interview:

NEW CONSTRUCTION PROGRAM (NCP) PARTICIPATING DESIGN FIRM SURVEY

Each instrument will be customized by the lead engineer for the site's evaluation during the development of the site-specific M&V plan. All of the program/file information to be used in the interview as indicated within this instrument will be completed by the lead engineer prior to the interview.

DM1-3 Not Applicable

DESIGN INFORMATION: ACTUAL AND AS WOULD HAVE OCCURRED WITHOUT NYSERDA'S NCP

[Prior to calling, review program records for the project. In the table below under "Program Records," check off each measure/design category for each energy efficiency measure/design group that the files indicate were incorporated.]

Measure	Program Records
Whole Building Design	❒
LEED Certification/Green Building Design	❒
Building shell measures	❒
High performance window glazing (low-E)	❒
Building Commissioning	❒
Peak Load Reduction Technologies	❒
High efficiency lighting fixtures/LPD reduction	❒
Lighting occupancy sensors or other automatic controls	❒
Daylighting Technologies	❒

Premium efficiency (NEMA-premium) motors or motors w/ variable speed drives	❒
Premium efficiency HVAC equipment including rooftop units, chillers, heat pumps etc.	❒
Premium Efficiency heating equipment	❒
Building control systems (EMS) to optimize HVAC	❒
Variable Air Volume (VAV) Systems	❒
AHU/RTU/MAU Heat Recovery	❒
Economizers (beyond code)	❒
Ground Source Heat Pump System	❒
Other:	

D1. In what year was the construction permit application filed for this building?

D2a. To which energy standard or code did you design the building?

D2b. If this standard was different from the New York State energy code, why did you choose to design to this standard?

D3a. Did this project's participation in the New Construction Program affect the building design you recommended?

1. Yes [CONTINUE TO D3b]
2. No [CONTINUE TO D5]

D3b. What affect did the program have on the building design?

D4 Not Applicable

D5. Please estimate the project performance relative to code that this building would have achieved overall without NYSERDA.

_____ %

D6. Estimate the final overall project performance relative to code.

_____ %

D7. Not Used

D8. Before participating in the New Construction Program, were you planning to exceed code for the _____ *[component]*? [ONLY ASK D8f and D8g IF PROJECT IS RESIDENTIAL.]

Component	Yes	No	
a) Envelope	❒	❒	[IF NO, SKIP BUILDING ENVELOPE SECTION EXCEPT ASK B7a OF ALL]
b) Lighting	❒	❒	[If No, SKIP LIGHTING SECTION EXCEPT ASK L6a OF ALL]
c) HVAC system efficiency	❒	❒	[IF d) AND e) = NO, SKIP HVAC SECTION EXCEPT ASK H6a OF ALL]
d) HVAC Controls	❒	❒	[IF d) AND e) = NO, SKIP HVAC SECTION EXCEPT ASK H6a OF ALL]
e) Domestic Hot Water	❒	❒	[SKIP DOMESTIC HOT WATER SECTION]
f) Appliances	❒	❒	[SKIP APPLIANCES SECTION]

D9a. Were there other areas where you planned to exceed code prior to program participation?

1. Yes [CONTINUE TO D9b]
2. No [SKIP D9b]

D9b. What were these?

_____

Customize the remainder of this section (as follows) to reflect the specific above code measures installed in the project. Make sure to provide respondent the opportunity to discuss other measures incorporated that were not part of the package included in NCP. Note the total percent savings at beginning of each building component section and focus on areas with the most savings first.

[ASK WHOLE BUILDING SECTION OF ALL]

Whole Building

WB1a. Before working with the New Construction Program, what was the original intent for the building design?

WB1b. How did it change and who influenced these changes?

WB2. Was whole building analysis, such as energy modeling used to analyze efficiency measures for this building?

___Yes ___No

[IF NO, SKIP REMAINING WHOLE BUILDING SECTION.]

WB3. Would the project have included whole building modeling without the assistance of NYSERDA's New Construction Program?

WB4. What impact did the whole building modeling have on the final level of efficiency of the project?

WB5a. Did the modeling result in measures being added to or removed from the project?

___Yes ___No

[IF NO, SKIP WB5b]

WB5b. What was changed due to the whole building modeling?

WB6. What role did the modeling firm play on the project team? With whom did they primarily interact?

WB7. Did you receive information from the building model which caused your design team to reevaluate planned approaches to the building?

WB8. Not applicable

Building Envelope

B1. Percent of Savings attributable to envelop _____ *Review Engineers records this information during survey development*

B2. What was the primary driver for your envelope design [*Record response and then check which of the following were in the response.*]

_____

_____

1. __ First Cost
2. __ Performance (comfort, amenity)
3. __ Appearance
4. __ Operating Cost

B3. What assembly type and components were considered for the following building envelope components? *Fill in responses below. If R/U value is not known by respondent, review engineer can estimate value from assembly and component responses.*

1. Foundation – Describe Foundation and Components

_____

_____

1a Foundation R-value _____

2. Roof – Describe Roof Assembly and Components
   _____
   _____

   2a. Roof R-value _____

3 Walls – Describe Wall Assembly and Components
   _____
   _____

   3a. Wall R-value _____

4. Glazing – Describe Window Assembly _____

   4a Glazing U-value _____

B4. How does this building's overall average R-value compare with what you might have designed without the assistance of the New Construction Program?

B5a. Did the building glazing or roof incorporate any special features to influence solar heat gain?

___Yes ___No

[IF "NO" SKIP B5b.]

B5b. Please describe these features.

B6. If the installed building envelope is different from the design, why was the final decision for the installed building envelope made for this project?

[ASK OF ALL]

B7a. Has your approach to building envelope design for this type of building changed since this project?

___Yes ___No

[IF "NO" SKIP B7b.]

B7b. How has it changed?

HVAC systems and controls

H1. Percent of Savings attributable to HVAC (including HVAC related motors) _____ *Review Engineers records this information during survey development*

H2. What was the primary driver for your recommendation in the selection of the HVAC system? [*Record response and then check which of the following were in the response.*]

_____

_____

1. __ First Cost
2. __ Performance (comfort, amenity)
3. __ Appearance
4. __ Operating Cost

H3. Now I am going to ask you about the approaches to HVAC that might have been considered for this project. Which of the following approaches were considered during design and/or construction? *Review engineer tailors survey to include the options that might apply during survey development then completes the following table during interview.*

1. ____ Central Chiller

[IF CENTRAL CHILLER WAS NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

1a. ____ Air Cooled Chiller

1b. ____ Water Cooled Chiller

1c. ____ Premium Efficiency Chillers

1d. ____ Variable Speed chilled water pumping

1e. ____ Chilled water reset

1f. ____ Premium efficiency pumps

[IF WATER COOLED CHILLER NOT CONSIDERED, SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

1g. ____ Condenser water reset

1h. ____ Variable speed cooling tower fans

1i. ____ Water side economizer

1j. ____ Other – describe:

2. ____ Central Boiler

[IF CENTRAL BOILER WAS NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

2a. _____ Fuel Type *indicate fuel type*

2b. ____ Premium Efficiency Condensing Boiler

2c. ____ Variable Speed Pumping

2d. ____ Premium Efficient Pumps

2e. ____ Temperature reset or other control strategies

3. ____ Central Air System without DX

[IF CENTRAL SYSTEMS WERE NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

3a. ____ Variable Speed Fans

3b. ____ Variable Air Volume System

3c. ____ Premium Efficiency Motors

3d. ____ Economizer

3e. ____ Demand Controlled Ventilation

3f. ____ Occupancy Based Control

3g. ____ Energy Recovery

3 h. ____ Other – describe:

4. ____ Packaged DX Equipment

[IF ROOF TOP DX SYSTEMS WERE NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

4a. ____ Variable Speed Fans

4b. ____ Variable Air Volume System

4c. ____ Premium Efficiency Motors

4d. ____ Economizer

4e. ____ Demand Controlled Ventilation

4f. ____ Occupancy Based Control

4g. ____ Other – describe:

5. ____ Heat Pumps

[IF HEAT PUMPS WERE NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

5a. ____ Electric

5b. ____ Water Source

5c. ____ Geothermal

5d. ____ Premium Efficiency Equipment

[IF ELECTRIC ONLY, SKIP TO H4]

5e. ____ Variable flow pumping

6. ____ Other: describe

H4. Not Used

H5. How does the building's HVAC system efficiency compare to what you would have designed without the assistance of the New Construction Program?

[ASK OF ALL]

H6a. Has your approach to HVAC system selection and design changed since this project?

___Yes ___No

[IF NO, SKIP TO NEXT APPLICABLE SECTION]

H6b. How has it changed?

Lighting

L1. Percent of Savings attributable to Lighting (including controls) _____ *Review Engineers records this information during survey development*

L2. What was the primary driver for your recommendation in the selection of the Lighting system? [*Record response and then check which of the following were in the response.*]

_____

_____

1. __ First Cost
2. __ Performance (comfort, amenity)
3. __ Appearance
4. __ Operating Cost

L3. Now I am going to ask you about the approaches to lighting design that might have been considered for this project. Which of the following approaches were considered during design and/or construction? *Review engineer tailors survey to include the options that might apply during survey development then completes the following table during interview.*

1. ____ Overhead Fluorescent Fixtures
   - 1a. ____ Lensed Direct Fixtures
   - 1b. ____ Parabolic Fixtures
   - 1c. ____ Direct/Indirect fixtures
   - 1d. ____ T-12 lamps with electronic ballasts
   - 1e. ____ T-8 lamps with electronic ballasts
   - 1f. ____ High performance T-8 lamps and ballasts
   - 1g. ____ T5 lamps
   - 1h. ____ Bi-level switching
   - 1i. ____ Occupancy sensors
   - 1j. ____ Daylighting control

2. ____ Task Lighting
   - 2a. ____ Furniture mounted

2b. ____ Occupant Provided

2c. ____ Incandescent lamps

2d. ____ Compact fluorescent lamps

3. ____ Recessed Cans

3a. ____ Incandescent

3b. ____ Fluorescent

3c. ____ Dimming

4. ____ Track

4a. ____ Incandescent

4b. ____ Fluorescent

4c. ____ Dimming

5. ____ Decorative, display, accent or other special lighting

5a. ____ Incandescent

5b. ____ Fluorescent

5c. ____ Other: describe

5d. ____ Dimming

[ASK 6 FOR RESIDENTIAL ONLY, SKIP TO L4. IF NON-RESIDENTIAL]

6. ____ In-unit hard wired lighting

[IF IN-UNIT LIGHTING WAS CONSIDERED, ASK WHICH LOCATIONS AND WHICH FIXTURE TYPE IN EACH LOCATION]

6a. ____ Kitchens

6ai. ____ Incandescent

6aii. ____ Fluorescent

6b. ____ Bathrooms

6bi. ____ Incandescent

6bii. ____ Fluorescent

6c. ____ Living areas

6ci. ____ Incandescent

6cii. ____ Fluorescent

6d. ____ Bedrooms

6di. ____ Incandescent

6dii. ____ Fluorescent

L4. Not Used

L5a. How does the lighting power density of the installed lighting system compare to what you would have designed without the assistance of the New Construction Program?

L5b. Please estimate the percent improvement in the Lighting Power Density attributable to the assistance of the New Construction Program.

[ASK OF ALL]

L6a. Has your approach to lighting changed since this project?

___Yes ___No

[IF NO, SKIP TO NEXT APPLICABLE SECTION]

L6b. How has it changed?

Refrigeration & Other Technologies

[*Lead engineer is to develop questions similar to the above for building envelope, HVAC, and lighting and customize these for refrigeration or other measures.*]

[ASK DOMESTIC HOT WATER AND APPLIANCES QUESTIONS ONLY WHERE APPLICABLE ON RESIDENTIAL PROJECTS]

Domestic hot water

W1. Percent of Savings attributable to domestic hot water _____ *Review Engineers records this information during survey development*

W2a. Did you consider other approaches for domestic water prior to working with NYSERDA?

___Yes ___No

[IF NO, SKIP TO W2]

W2b. Can you please tell me what other options were considered?

W3. Why was the installed system selected?

W4. Were you planning to include water saving devices on this project prior to participating in the New Construction Program?

Residential only

Appliances

A1. Percent of Savings attributable to appliances _____ *Review Engineers records this information during survey development*

A2. Were you considering recommending ENERGY STAR® appliances prior to working with NYSERDA?

___Yes ___No

A3. Not applicable

COMPARATIVE SELF-REPORT FREE-RIDERSHIP AND SPILLOVER

FR1. *Based on responses to questions above, fill in a "0 to 4"score indicating the extent to which respondent was already planning to incorporate the energy efficiency measures/designs. DO NOT ASK RESPONDENT DIRECTLY. "0" indicates that respondent had no plans at all; "4" indicates that respondent had documented plans and had budgeted for all of the efficiency measures/designs*

0 1 2 3 4

(No plans) (Documented plans/budget)

FR2. Not Used

FR3. Which facet of the New Construction Program had the greatest impact on your decision to incorporate the high efficiency measures/designs at the site? *Link discussion in FR2 on specific measures to their influencing component of the NCP.*

Based on response to FR3, fill in a "0 to 4"score indicating the extent to which the program influenced the decision to incorporate high efficiency measures/designs. DO NOT ASK RESPONDENT DIRECTLY. "0" indicates that the program had no influence; "4" indicates that the program was the primary reason that high efficiency measures were incorporated.

0 1 2 3 4

(No program influence) (Program was primary influence)

FR4. On a scale of 0 to 4, where 0 = "not at all important" and 4 = "very important"…

Please indicate how important the New Construction Program (including its financial and technical assistance) was in your decision to incorporate measures/designs of the efficiency level you incorporated at this site?

0 1 2 3 4

(Not at all important) (Very important)

FR5. Not Used

FR6. Not Used

FR7. Most new equipment and design strategies have to meet current energy standards. But let's just focus on the fact that some of your new equipment and design strategies have <u>even higher efficiencies than standard new equipment/designs</u>, and this new higher efficiency equipment/design provides extra energy savings….

Overall, <u>across all measures/designs</u>, what percent of these <u>extra energy savings</u> would have been achieved anyway, even if the New Construction Program did not exist. Please provide a lower and upper bound, and then your best estimate.

[If needed for clarification] For example, 50% means that half of the extra savings from the high efficiency equipment would have been achieved anyway. Remember, I'm asking only about the extra savings from incorporating high efficiency equipment instead of standard efficiency equipment/designs.

Lower bound → _____ % Upper bound → _____ % Best estimate → _____ %

INSIDE SPILLOVER

ISO1. Did your experience with the New Construction Program in any way influence you to incorporate additional natural gas or electric energy efficiency measures or designs <u>at this site</u> that did not go through the New Construction Program or any other NYSERDA programs? (*i.e.*, measures/designs that would not have been incorporated without the influence of the program)?

- o No → [SKIP TO NEXT SECTION ON OUTSIDE SPILLOVER]
- o Yes→ [CONTINUE TO QUESTION ISO2]
- o Don't know → [SKIP TO NEXT SECTION ON OUTSIDE SPILLOVER]

ISO2. [IF ISO1 = "YES"] Please briefly <u>describe how</u> the New Construction Program has influenced your decisions to incorporate additional high-efficiency measures or designs at this site. (Identify the types of measures/designs affected.) *[Probe to ensure electric spillover and natural gas spillover are both addressed. Probe for the relative energy savings from the participating project, i.e., the following question]*

ISO3. [IF ISO2 DESCRIBES ELECTRIC SAVINGS] The program estimated the **electric** energy savings from the project we have been discussing that was assisted by NCP to be _____ [*program ex ante electric savings*]. Would you estimate the **electric** energy savings from these <u>extra</u> measures/designs to be <u>less than</u>, <u>similar to</u>, or <u>more than</u> the energy savings from the energy efficiency **electric** measures/designs incorporated through the New Construction Program?

- o Less than the NCP project → About what percentage of the savings from the NCP project? *[Enter a number less than 100%]* ____%

- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project?

  [Enter a number greater than 100%] ____%

ISO3b. Please describe the electric saving items that were incorporated into your new **[*or addition to your*]** building that were influenced by your NCP participation.

ISO4. [IF ISO2 DESCRIBES GAS SAVINGS] The program estimated the **natural gas** energy savings from the project we have been discussing that was assisted by NCP to be _____ [*program ex ante savings]*. Would you estimate the **natural gas** energy savings from these extra measures/designs to be less than, similar to, or more than the energy savings from the energy efficiency measures/designs incorporated through the New Construction Program?

- o Less than the NCP project → About what percentage of the savings from the NCP project? *[Enter a number less than 100%]* ____%
- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project?

  [Enter a number greater than 100%] ____%

ISO4b. Please describe the natural gas saving items that were incorporated into your new **[*or addition to your*]** building that were influenced by your NCP participation.

ISO5. To the best of your knowledge, what share of the savings from these extra measures/designs can reasonably be attributed to the influence of the New Construction Program?

Interviewer may be able to complete this based on response to ISO2-4, or at least use ISO2-4 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question

_____% of electric savings [100% or less]

_____% of gas savings [100% or less]

OUTSIDE SPILLOVER

OSO1. Did your company recommend any additional energy efficiency (natural gas or electric) measures or designs at other facilities in New York (excluding Long Island)?

- o No → [SKIP TO NEXT SECTION]
- o Yes → [ASK QUESTION OSO2.]
- o Don't know → [SKIP TO NEXT SECTION]

OSO2. Did your experience with the New Construction Program in any way influence you to incorporate additional energy efficiency measures or designs at other facilities in New York (excluding Long Island) that did not participate in the New Construction Program beyond what you would have done otherwise? (Don't include projects that participated in any NYSERDA program.)

- o No → [SKIP TO NEXT SECTION]
- o Yes → About how many other facilities were influenced (that did not participate in NYSERDA programs)? _____
- o Don't know → [SKIP TO NEXT SECTION]

OSO3. [IF OSO1 AND OSO2 = "YES"] Please briefly describe how the New Construction Program has influenced your decisions to incorporate additional high-efficiency measures or designs at other facilities in New York (excluding Long Island) that did not participate in the New Construction Program. Identify the types of measures/designs affected.

OSO4. [IF OSO3 INCLUDES ELECTRIC MEASURES] On average, would you estimate the **electric** energy savings from these other non-program facilities to be less than, similar to, or more than the _____ *[program ex ante savings]* **electric** energy savings from the energy efficiency measures/designs incorporated through the New Construction Program project?

[e.g., if the same measures were implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings "on average" not in aggregate across the many buildings that might be affected]

- o Less than the NCP project → About what percentage of the savings from the NCP project? [Enter a number less than 100%] ____%
- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project? [Enter a number greater than 100%] ____%

OSO4b.Please describe the electric saving items that were incorporated into these other building(s) that were influenced by your NCP participation.

OSO5. [IF OSO3 INCLUDES GAS MEASURES] On average, would you estimate the **natural gas** energy savings from these other non-program facilities to be less than, similar to, or more than the _____ *[program ex ante savings]* **natural gas** energy savings from the energy efficiency measures/designs incorporated through the New Construction Program project?

[e.g., if the same measures were implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings "on average" not in aggregate across the many buildings that might be affected]

- o Less than the NCP project → About what percentage of the savings from the NCP project? [Enter a number less than 100%] ____%

- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project?

  [Enter a number greater than 100%] ____%

OSO5b. Please describe the natural gas saving items that were incorporated into these other building(s) that were influenced by your NCP participation.

OSO6. To the best of your knowledge, what share of the savings from energy efficiency measures/designs at these non-program facilities can reasonably be attributed to the influence of the New Construction Program?

Interviewer may be able to complete this based on response to OSO4 and OSO5, or at least use them to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question

_____% of electric savings [100% or less]

_____% of natural gas savings [100% or less]

CUSTOMER VS DESIGN TEAM INFLUENCE

Infl1a. Not Applicable

Inf1b. We are interested in knowing how influential _____ *[owner]* was in selecting the efficient equipment you installed. Which of the following statements best describes the role of _____ *[owner]*?

1. We recommended the efficient equipment and *[owner]* agreed with the choice
2. We included the efficient equipment as an option, and *[owner]* chose to purchase them
3. _____ *[owner]* suggested the efficient equipment and then got a supporting opinion from us.
4. _____*[owner]* chose the energy efficient equipment without input from us.
5. Don't know/refused

Inf2. I'd like to confirm the contact information I have for the primary individual you worked with at ____ *[owner]*?

Complete from program files prior to interview. [IF DIFFERENT, THEN OBTAIN TITLE, NAME, PHONE NUMBER, EMAIL ADDRESS OF DESIGN FIRM PRIMARY CONTACT]

_____

Title *Name* *Phone* *Email*

Inf3. On the scale of 0 to 4, with 0 being no influence and 4 being very influential, how influential was the information you provided by the ____ *[owner]* in the decision to install the efficiency measures incorporated in this project?

Infl3a. Whole building

0 1 2 3 4

(Not influential) (Very influential)

Infl3b. HVAC

0 1 2 3 4

(Not influential) (Very influential)

Infl3c. Lighting

0 1 2 3 4

(Not influential) (Very influential)

Infl3d. Other (*Review Engineer Specify*)

0 1 2 3 4

(Not influential) (Very influential)

Infl3e. In-unit Efficiency [RESIDENTIAL ONLY]

0 1 2 3 4

(Not influential) (Very influential)

Inf4. Was there anyone else who significantly influenced the installed levels of efficiency in the building?

1. No _____
2. Yes _____

[IF YES] Who was this and in what capacity where they involved with this project?

DESIGN INFORMATION: OVERALL MARKET

I have only 2 shorter topic areas to cover and then we will be finished with this interview.

I am now going to quickly run through building design components and would like your inputon where the market has been over the last 2 years, and then where the market is currently. This will then be followed by how much influence you think NYSERDA has had in changes in the market for commercial new construction.

M1. What proportion of commercial/industrial new construction projects do you think did not meet their relevant energy code 2 years ago? _____%

M2. What proportion do you think do not meet energy code today? _____%

M3. On average, what would you say was the typical overall R-value for commercial/industrial new construction projects 2 years ago?

M3a. Roof: _____

M3b. Walls: _____

M4. What do you think is the typical R-value today in new construction?

M4a. Roof: _____

M4b. Walls: _____

M5. Please describe what you think was the typical HVAC system for commercial/industrial new construction projects 2 years ago?

M5a.	Central Plant (Chiller/Boiler):	1.	Standard efficiency _____
		2.	High efficiency _____
M5b.	Roof Top DX Unit:	1.	Standard efficiency _____
		2.	High efficiency _____
M5c.	Electric/Air Source Heat Pump:	1.	Standard efficiency _____
		2.	High efficiency _____
M5d.	Water Source Heat Pump:	1.	Standard efficiency _____
		2.	High efficiency _____

M5e. Other: _____

M5f. Don't know: _____

M6. What do you think is the typical HVAC system today in new construction?

M6a.	Central Plant (Chiller/Boiler):	1.	Standard efficiency _____
		2.	High efficiency _____
M6b.	Roof Top DX Unit:	1.	Standard efficiency _____
		2.	High efficiency _____
M6c.	Electric/Air Source Heat Pump:	1.	Standard efficiency _____

2. High efficiency _____

M6d. Water Source Heat Pump: 1. Standard efficiency _____

2. High efficiency _____

M6e. Other: _____

M6f. Don't know: _____

M7. Please describe what you think was the typical lighting system for commercial/industrial new construction projects 2 years ago?

M7a. Lamps : 1. ____ Incandescent _____
2. ____ Metal Halide _____
3. ____ T12
4. ____ T8
5. ____ High Performance T8
6. ____ T5
7. ____ Compact Fluorescent

M7b. Fixture Types: 1. ____ Parabolic
2. ____ Lensed Direct
3. ____ Direct/Indirect
4. ____ Recessed Cans
5. ____ Other _____

M7c. Controls: 1. ____ Occupancy Sensors
2. ____ Bi-level Switching
3. ____ Daylighting with automatic controls
4. ____ Other _____

M8. What do you think is the typical lighting system today in new construction?

M8a. Lamps : 1. ____ Incandescent _____
2. ____ Metal Halide _____
3. ____ T12
4. ____ T8
5. ____ High Performance T8
6. ____ T5
7. ____ Compact Fluorescent

M8b. Fixture Types: 1. ____ Parabolic
2. ____ Lensed Direct

3. ____ Direct/Indirect
4. ____ Recessed Cans
5. ____ Other _____

M8c. Controls:
1. ____ Occupancy Sensors
2. ____ Bi-level Switching
3. ____ Daylighting with automatic controls
4. ____ Other _____

M9. In general, for commercial new construction, how has the energy usage changed over the last 2 years?

1. ____ Increased?
2. ____ Decreased?

M9b. By what percent? ____%

M10. Not Used

M11. Of the factors influencing the changing energy usage in new buildings, what percent influence do you think NYSERDA's New Construction Program has had? ____%

FIRMOGRAPHICS

[Lead engineer to complete the following prior to the interview as they have information. Then ask the questions to complete all the questions in this section.]

ST1-3 Not Applicable

ST4a. How would you characterize your business/organization? **[Check one]**

1. ___ Architecture Firm
2. ___ Engineering Firm
3. ___ Other – describe _____

ST5. Approximately how many new construction projects per year is your organization involved with in New York (excluding Long Island)? [Check one]

1. ___ One
2. ___ 2 - 5
3. ___ 6 - 10
4. ___ 11 - 20
5. ___ More than 20

ST6. In terms of the new construction projects your firm is involved with in New York (excluding Long Island), what are the ***four*** building types in which you work most frequently? *Circle the predominant types below, then ask percent*

For each of those four building types, approximately what share of your work is associated with each building type? [Record percents]

1. ___ % Agriculture
2. ___% Apartments/Multifamily
3. ___% Amusement, Social,
4. ___% Education, Schools, colleges, libraries, and Recreational Buildings
5. ___% Laboratories (nonmanufacturing owned)
6. ___% Public Assembly
7. ___% Office and bank building
8. ___% Food Service, restaurants
9. ___% Public Order and Safety
10. ___% Government Service Building
11. ___% Religious Worship
12. ___% Grocery / food sales
13. ___% Service
14. ___% Health Care, hospitals and other health treatment
15. ___% Warehouse and Storage (excluding manufacturer owned)
16. ___% Water / wastewater
17. ___% Lodging, Hotel, Motel
18. ___% Mercantile/Retail
19. ___% Manufacturing plants, warehouse, laboratories (Identify Industry Type_____(e.g., chemical, food, paper, etc.)
20. ___% Other, miscellaneous nonresidential building

ST7. How many employees does your firm have?

[1] Fewer than 5

[2] 5 to 9

[3] 10 to 19

[4] 20 to 49

[5] 50 to 99

[6] 100 to 249

[7] 250 or More

-98 Don't know [DON'T READ]

-99 Refused [DON'T READ]

ST8. Is your company independent, or part of a larger company?

[1] Independent

[2] Part of a larger company

[3] Other (specify) _____

-98 Don't know [DON'T READ]

-99 Refused [DON'T READ]

ST9. How many locations/establishments/multifamily properties [ASK AS IS RELEVANT] does your firm have?

[1] One

[2] 2 to 5

[3] 6 to 10

[4] 11 to 20

[5] More than 20

-98 Don't know [DON'T READ]

-99 Refused [DON'T READ]

Appendix C: Participating Owner Survey

Project Name:

Project Number:

Contact Name:

Project Contact Phone:

Interviewer:

Date of interview:

NEW CONSTRUCTION PROGRAM (NCP) PARTICIPATING OWNER SURVEY

Each instrument will be customized by the lead engineer for that site's evaluation during the development of the site-specific M&V plan. All of the program/file information to be used in the interview as indicated within this instrument will be completed by the lead engineer prior to the interview.

[IF PROJECT IS IN CENSUS STRATUM ASK DM1 – DM3, OTHERWISE PROCEED TO NEXT SECTION.]

DECISION-MAKERS (FOR ADDITIONAL INTERVIEWS)

DM1. Generally, how are decisions related to building design made at your firm? I'm going to read a list of decision descriptions, and I would like to know which statement best describes how each decision is made at your firm.

1. A committee which I chair has final say in the decision. [SKIP TO DM2.]
2. The decision is completely a committee decision. [SKIP TO DM2.]
3. Someone else makes the technical recommendations but I have the final financial or contracting authority. [SKIP TO DM2.]
4. I make the recommendations but others have the financial or contracting authority. [SKIP TO DM2.]
5. I make recommendations and the corporate office elsewhere makes the decision, but my recommendations are normally followed. [SKIP TO DM2.]
6. I make recommendations but the corporate office always makes their own decisions, sometimes with little regard to my recommendations. [SKIP TO DM2.]
7. There are multiple groups and decision points that must be passed that are more complicated than these other statements. → ***Ask DM1b***

DM1b. Describe the decision-making process. *[Open-ended]*

DM2. Who played key roles in the decision-making process?

[Obtain titles, names, phone numbers, email addresses][Ensure you have all the people that correspond to the response in DM1. Inquire who is on the committee for committee decisions, who in the corporate office if they have input into the decisions, who is/are the financial and contracting authorities if they are involved.]

Title	*Name*	*Phone*	*Email*	*DM3 Score*
Title	*Name*	*Phone*	*Email*	*DM3 Score*
Title	*Name*	*Phone*	*Email*	*DM3 Score*
Title	*Name*	*Phone*	*Email*	*DM3 Score*

DM3. On the scale of 0 to 4, with 0 being no influence and 4 being very influential, how influential was each person in the decision making process? *[Recite the name(s) obtained in the previous question. Enter score above as indicated.]*

[ADMINSITER THE REMAINDER OF THIS SURVEY TO ALL PARTICIPANT OWNER INTERVIEWEES: CENSUS STRATUM, NON-CENSUS STRATUM, AND ADDITIONAL DECISION MAKERS IDENTIFIED FOR CENSUS STRATUM.]

DESIGN INFORMATION: ACTUAL AND AS WOULD HAVE OCCURRED WITHOUT NYSERDA'S NCP

[Prior to calling, review program records for the project. In the table below under "Program Records," check off each measure/design category for each energy efficiency measure/design group that the files indicate were incorporated.]

Measure	**Program Records**
Whole Building Design	❒
LEED Certification/Green Building Design	❒
Building shell measures	❒
High performance window glazing (low-E)	❒
Building Commissioning	❒
Peak Load Reduction Technologies	❒
High efficiency lighting fixtures/LPD reduction	❒
Lighting occupancy sensors or other automatic controls	❒

Daylighting Technologies	❒
Premium efficiency (NEMA-premium) motors or motors w/ variable speed drives	❒
Premium efficiency HVAC equipment including rooftop units, chillers, heat pumps etc.	❒
Premium Efficiency heating equipment	❒
Building control systems (EMS) to optimize HVAC	❒
Variable Air Volume (VAV) Systems	❒
AHU/RTU/MAU Heat Recovery	❒
Economizers (beyond code)	❒
Ground Source Heat Pump System	❒
Other:	

D1 – D3 Not Applicable

D4. Did your participation in the New Construction Program affect the building design relative to meeting or to exceeding the code requirements?

D5. Please estimate the project performance relative to code that you would have achieved overall without NYSERDA.

_____ %

D6. Estimate the final overall project performance relative to code.

_____ %

D7. Not used.

D8. Before participating in the New Construction Program, were you planning to exceed code for the _____ *[component]*? [ONLY ASK D8E AND D8F IF PROJECT IS RESIDENTIAL.]

Component	**Yes**	**No**	
a) Envelope	❒	❒	[IF NO, SKIP BUILDING ENVELOPE SECTION EXCEPT ASK B7a OF ALL]
b) Lighting	❒	❒	[If No, SKIP LIGHTING SECTION EXCEPT ASK L6a OF ALL]
c) HVAC system efficiency	❒	❒	[IF d) AND e) = NO, SKIP HVAC SECTION

		EXCEPT ASK H6a OF ALL]
d) HVAC Controls	❒	❒ [IF d) AND e) = NO, SKIP HVAC SECTION EXCEPT ASK H6a OF ALL]
e) Domestic Hot Water	❒	❒ [SKIP DOMESTIC HOT WATER SECTION]
f) Appliances	❒	❒ [SKIP APPLIANCES SECTION]

D9a. Were there other areas where you planned to exceed code prior to program participation?

1. YES [CONTINUE TO D9b]
2. NO [SKIP D9b]

D9b. What were these?

Customize the following portion of this section to reflect the specific above code measures installed in the project. Provide respondent with the opportunity to discuss other measures incorporated that were not part of the NCP package. Note the total percent savings at beginning of each building component section and focus on areas with the most savings first.

[ASK WHOLE BUILDING SECTION OF ALL]

Whole Building

WB1. Before working with the New Construction Program, what was the original intent for the building design?

WB1a. How did it change and who influenced these changes?

WB2. Was whole building analysis, such as energy modeling used to analyze efficiency measures for this building?

___Yes ___No

[IF "NO" SKIP REMAINING WHOLE BUILDING SECTION.]

WB3. Would the project have included whole building modeling without the assistance of NYSERDA's New Construction Program?

WB4. What impact did the whole building modeling have on the final level of efficiency of the project?

WB5a. Did the modeling result in measures being added to or removed from the project?

___Yes ___No

[IF NO, SKIP WB5b]

WB5b. What was changed due to the whole building modeling?

WB6. What role did the modeling firm play on the project team? With whom did they primarily interact?

WB7. Did you receive information from the building model which caused your design team to reevaluate planned approaches to the building?

WB8. Do you perceive that the modeled energy use and the actual energy use for the building are similar or are different?

Building Envelope

B1. Percent of Savings attributable to envelope _____ *Review Engineers records this information during survey development*

B2. What was the primary driver for envelope selection? [*Record response and then check which of the following were in the response.*]

_____

_____

5. __ First Cost
6. __ Performance (comfort, amenity)
7. __ Appearance
8. __ Operating Cost

B3. What assembly type and components were considered for the following building envelope components? *Fill in responses below. Then ask R/U value if not given.*

1. Foundation – Describe Foundation and Components _____

_____

1a Foundation R-value _____

2. Roof – Describe Roof Assembly and Components

_____

_____

2a. Roof R-value _____

3 Walls – Describe Wall Assembly and Components

_____

_____

3a. Wall R-value _____

4. Glazing – Describe Window Assembly _____

4a Glazing U-value _____

B4. How does this building's overall average R-value compare with what you might have installed without the assistance of the New Construction Program?

B5a. Did the building glazing or roof incorporate any special features to influence solar heat gain?

___Yes ___No

[IF "NO" SKIP B5b.]

B5b. Please describe.

B6. Why was the final decision for the installed building envelope made?

[ASK OF ALL]

B7a. Has your approach to building envelope construction changed since this project?

___Yes ___No

[IF "NO" SKIP B7b.]

B7b. How has it changed?

HVAC systems and controls

H1. Percent of Savings attributable to HVAC (including HVAC related motors) _____ *Review Engineers records this information during survey development*

H2. What was the main concern in selecting the HVAC system? [*Record response and then check which of the following were in the response.*]

_____

_____

5. __ First Cost
6. __ Performance (comfort, amenity)
7. __ Appearance
8. __ Operating Cost

H3. Now I am going to ask you about the approaches to HVAC that might have been considered for this project. Which of the following approaches were considered during design and/or construction? *Review engineer tailors survey to include the options that might apply during survey development then completes the following table during interview.*

1. ____ Central Chiller

[IF CENTRAL CHILLER WAS NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

1a. ____ Air Cooled Chiller

1b. ____ Water Cooled Chiller

1c. ____ Premium Efficiency Chillers

1d. ____ Variable Speed chilled water pumping

1e. ____ Chilled water reset

1f. ____ Premium efficiency pumps

[IF WATER COOLED CHILLER NOT CONSIDERED, SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

1g. ____ Condenser water reset

1h. ____ Variable speed cooling tower fans

1i. ____ Water side economizer

1j. ____ Other – describe:

2. ____ Central Boiler

[IF CENTRAL BOILER WAS NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

2a. _____ Fuel Type *indicate fuel type*

2b. ____ Premium Efficiency Condensing Boiler

2c. ____ Variable Speed Pumping

2d. ____ Premium Efficient Pumps

2e. ____ Temperature reset or other control strategies

3. ____ Central Air System without DX

[IF CENTRAL SYSTEMS WERE NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

3a. ____ Variable Speed Fans

3b. ____ Variable Air Volume System

3c. ____ Premium Efficiency Motors

3d. ____ Economizer

3e. ____ Demand Controlled Ventilation

3f. ____ Occupancy Based Control

3g. ____ Energy Recovery

3 h. ____ Other – describe:

4. ____ Packaged DX Equipment

[IF ROOF TOP DX SYSTEMS WERE NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

4a. ____ Variable Speed Fans

4b. ____ Variable Air Volume System

4c. ____ Premium Efficiency Motors

4d. ____ Economizer

4e. ____ Demand Controlled Ventilation

4f. ____ Occupancy Based Control

4g. ____ Other – describe:

5. ____ Heat Pumps

[IF HEAT PUMPS WERE NOT CONSIDERED SKIP TO NEXT APPLICABLE EQUIPMENT TYPE]

5a. ____ Electric

5b. ____ Water Source

5c. ____ Geothermal

5d. ____ Premium Efficiency Equipment

[IF ELECTRIC ONLY, SKIP TO H4]

5e. ____ Variable flow pumping

6. ____ Other: describe

H4. Not used.

H5. How does the building's HVAC system efficiency compare to what you would have installed without the assistance of the New Construction Program?

[ASK OF ALL]

H6a. Has your approach to HVAC system selection and design changed since this project?

___Yes ___No

[IF NO, SKIP TO NEXT APPLICABLE SECTION]

H6b. How has it changed?

Lighting

L1. Percent of Savings attributable to Lighting (including controls) _____ *Review Engineers records this information during survey development*

L2. What was the main concern in selecting the lighting system? [*Record response and then check which of the following were in the response.*]

_____

_____

1. __ First Cost
2. __ Performance
3. __ Appearance
4. __ Operating Cost

L3. Now I am going to ask you about the approaches to lighting design that might have been considered for this project. Which of the following approaches were considered during design and/or construction? *Review engineer tailors survey to include the options that might apply during survey development then completes the following table during interview.*

4. ____ Overhead Fluorescent Fixtures
   - 1a. ____ Lensed Direct Fixtures
   - 1b. ____ Parabolic Fixtures
   - 1c. ____ Direct/Indirect fixtures
   - 1d. ____ T-12 lamps with electronic ballasts
   - 1e. ____ T-8 lamps with electronic ballasts
   - 1f. ____ High performance T-8 lamps and ballasts
   - 1g. ____ T5 lamps
   - 1h. ____ Bi-level switching
   - 1i. ____ Occupancy sensors
   - 1j. ____ Daylighting control

5. ____ Task Lighting
   - 2a. ____ Furniture mounted
   - 2b. ____ Occupant Provided
   - 2c. ____ Incandescent lamps
   - 2d. ____ Compact fluorescent lamps

6. ____ Recessed Cans
   - 3a. ____ Incandescent
   - 3b. ____ Fluorescent
   - 3c. ____ Dimming

4. ____ Track
   - 4a. ____ Incandescent
   - 4b. ____ Fluorescent
   - 4c. ____ Dimming

5. ____ Decorative, display, accent or other special lighting
   - 5a. ____ Incandescent
   - 5b. ____ Fluorescent
   - 5c. ____ Other: describe
   - 5d. ____ Dimming

[ASK 6 FOR RESIDENTIAL ONLY, SKIP TO L4. IF NON-RESIDENTIAL]

6. ____ In-unit hard wired lighting

[IF IN-UNIT LIGHTING WAS CONSIDERED, ASK WHICH LOCATIONS AND WHICH FIXTURE TYPE IN EACH LOCATION]

6a. ____ Kitchens
   - 6ai. ____ Incandescent
   - 6aii. ____ Fluorescent

6b. ____ Bathrooms
   - 6bi. ____ Incandescent
   - 6bii. ____ Fluorescent

6c. ____ Living areas
   - 6ci. ____ Incandescent
   - 6cii. ____ Fluorescent

6d. ____ Bedrooms
   - 6di. ____ Incandescent
   - 6dii. ____ Fluorescent

L4. Not used

L5a. Not used

L5b. Not used

[ASK OF ALL]

L6a. Has your approach to lighting changed since this project?

___Yes ___No

[IF NO, SKIP TO NEXT APPLICABLE SECTION]

L6b. How has it changed?

Refrigeration & Other Technologies

[*Lead engineer is to develop questions similar to the above for building envelope, HVAC, and lighting and customize these for the installed measures.*]

[ASK DOMESTIC HOT WATER AND APPLIANCES QUESTIONS ONLY WHERE APPLICABLE ON RESIDENTIAL PROJECTS]

Domestic hot water

W1. Percent of Savings attributable to domestic hot water system _____ *Review Engineers records this information during survey development*

W2a. Did you consider other approaches for domestic water prior to working with NYSERDA?

___Yes ___No

[IF NO, SKIP TO W2]

W2b. Can you please tell me what other options were considered?

W3. Why was the installed system selected?

W4. Were you planning to install water saving devices on this project prior to participating in the New Construction Program?

Residential only

Appliances

A1. Percent of Savings attributable to appliances _____ *Review Engineers records this information during survey development*

A2. Were you considering providing ENERGY STAR® appliances prior to working with NYSERDA?

___Yes ___No

A3. Why did you decide to install ENERGY STAR® appliances?

COMPARATIVE SELF-REPORT FREE-RIDERSHIP AND SPILLOVER

FR1. *Based on responses to questions above, fill in a "0 to 4"score indicating the extent to which respondent was already planning to incorporate the energy efficiency measures/designs. DO NOT ASK RESPONDENT DIRECTLY. "0" indicates that respondent had no plans at all; "4" indicates that respondent had documented plans and had budgeted for all of the efficiency measures/designs.*

0 1 2 3 4

(No plans) (Documented plans/budget)

FR2. Not used.

FR3. Which facet of the New Construction Program had the greatest impact on your decision to incorporate the high efficiency measures/designs at the site? *Link discussion in FR2 on specific measures to their influencing component of the NCP.*

Based on response to FR3, fill in a "0 to 4"score indicating the extent to which the program influenced the decision to incorporate high efficiency measures/designs. DO NOT ASK RESPONDENT DIRECTLY. "0" indicates that the program had no influence; "4" indicates that the program was the primary reason that high efficiency measures were incorporated.

0 1 2 3 4

(No program influence) (Program was primary influence)

FR4. On a scale of 0 to 4, where 0 = "not at all important" and 4 = "very important"…

Please indicate how important the New Construction Program (including its financial and technical assistance) was in your decision to incorporate measures/designs of the efficiency level you incorporated at this site?

0 1 2 3 4

(Not at all important) (Very important)

FR5. Not used.

FR6. Not used.

FR7: Most new equipment and design strategies have to meet current energy standards. But let's just focus on the fact that some of your new equipment and design strategies have <u>even higher efficiencies than standard new equipment/designs</u>, and this new higher efficiency equipment/design provides extra energy savings….

Overall, <u>across all measures/designs</u>, what percent of these <u>extra energy savings</u> would have been achieved anyway, even if the New Construction Program did not exist? Please provide a lower and upper bound, and then your best estimate.

[If needed for clarification] For example, 50% means that half of the extra savings from the high efficiency equipment would have been achieved anyway. Remember, I'm asking only about the extra savings from incorporating high efficiency equipment instead of standard efficiency equipment/designs.

Lower bound → _____ % Upper bound → _____ % Best estimate → _____ %

INSIDE SPILLOVER

ISO1. Did your experience with the New Construction Program in any way influence you to incorporate additional natural gas or electric energy efficiency measures or designs at this site that did not go through the New Construction Program or any other NYSERDA programs? (*i.e.*, measures/designs that would not have been incorporated without the influence of the program)?

- o NO → [Skip to next section on outside spillover]
- o YES→ [Continue to Question ISO2]
- o Don't know → [Skip to next section on outside spillover]]

ISO2. [*If ISO1 = "YES"*] Please briefly describe how the New Construction Program has influenced your decisions to incorporate additional high-efficiency measures or designs at this site. (Identify the types of measures/designs affected.) *[Probe to ensure electric spillover and natural gas spillover are both addressed. Probe for the relative energy savings from the participating project, i.e., the following question]*

ISO3. [IF ISO2 DESCRIBES ELECTRIC SAVINGS] The program estimated your **electricity** energy savings from the project we have been discussing that was assisted by NCP to be _____ [*program ex ante electric savings*. Would you estimate the **electricity** energy savings from these extra measures/designs to be less than, similar to, or more than the energy savings from the energy efficiency **electric** measures/designs incorporated through the New Construction Program?

- o Less than the NCP project → About what percentage of the savings from the NCP project? *[Enter a number less than 100%]* ____%
- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project?

  [Enter a number greater than 100%] ____%

ISO3b. Please describe the electric saving items that were incorporated into your new **[*or addition to your*]** building that were influenced by your NCP participation.

ISO4. [IF ISO2 DESCRIBES GAS SAVINGS] The program estimated your **natural gas** energy savings from the project we have been discussing that was assisted by NCP to be _____ [*program ex ante savings]*. Would you estimate the **natural gas** energy savings from these extra measures/designs to be less than, similar to, or more than the energy savings from the energy efficiency measures/designs incorporated through the New Construction Program?

- o Less than the NCP project → About what percentage of the savings from the NCP project? *[Enter a number less than 100%]* ____%
- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project?

[Enter a number greater than 100%] ____%

ISO4b. Please describe the natural gas saving items that were incorporated into your new **[*or addition to your*]** building that were influenced by your NCP participation.

ISO5. To the best of your knowledge, what share of the savings from these extra measures/designs can reasonably be attributed to the influence of the New Construction Program?

[Interviewer may be able to complete this based on response to ISO2-4, or at least use ISO2-4 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question]

_____% of electric savings [100% or less]

_____% of gas savings [100% or less]

OUTSIDE SPILLOVER

OSO1. Did your company implement any additional energy efficiency (natural gas or electric) measures or designs at other facilities in New York (excluding Long Island)?

- o NO → [SKIP TO NEXT SECTION]
- o YES → [ASK QUESTION OSO1A.]
- o Don't know → [SKIP TO NEXT SECTION]

OSO2. Did your experience with the New Construction Program in any way influence you to incorporate additional energy efficiency measures or designs <u>at other facilities in New York (excluding Long Island) that did not participate in the New Construction Program</u> beyond what you would have done otherwise? (Don't include projects that participated in any NYSERDA program.)

- o NO → [SKIP TO NEXT SECTION]
- o YES → About how many other facilities were influenced (that did not participate in NYSERDA programs)? _____
- o Don't know → [SKIP TO NEXT SECTION]

OSO3. [IF OSO1 AND OSO2 = "YES"] Please briefly <u>describe how</u> the New Construction Program has influenced your decisions to incorporate additional high-efficiency measures or designs <u>at other facilities in New York (excluding Long Island)</u> that did not participate in the New Construction Program. Identify the types of measures/designs affected.

OSO4. [IF OSO3 INCLUDES ELECTRIC MEASURES] On average, would you estimate the **electricity** energy savings from these other non-program facilities to be less than, similar to, or more than the _____ *[program ex ante savings]* **electricity** energy savings from the energy efficiency measures/designs incorporated through the New Construction Program project?

[e.g., if the same measures were implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings "on average" not in aggregate across the many buildings that might be affected]

- o Less than the NCP project → About what percentage of the savings from the NCP project? [Enter a number less than 100%] ____%
- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project? [Enter a number greater than 100%] ____%

OSO4b. Please describe the electric saving items that were incorporated into these other building(s) that were influenced by your NCP participation.

OSO5. [IF OSO3 INCLUDES GAS MEASURES] On average, would you estimate the **natural gas** energy savings from these other non-program facilities to be less than, similar to, or more than the _____ *[program ex ante savings]* **natural gas** energy savings from the energy efficiency measures/designs incorporated through the New Construction Program project?

[e.g., if the same measures were implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings "on average" not in aggregate across the many buildings that might be affected]

- o Less than the NCP project → About what percentage of the savings from the NCP project? [Enter a number less than 100%] ____%
- o About the same savings as the NCP project
- o More than the NCP project → About what percentage of savings from the NCP project? [Enter a number greater than 100%] ____%

OSO5b. Please describe the natural gas saving items that were incorporated into these other building(s) that were influenced by your NCP participation.

OSO6. To the best of your knowledge, what share of the savings from energy efficiency measures/designs at these non-program facilities can reasonably be attributed to the influence of the New Construction Program?

Interviewer may be able to complete this based on response to OSO1b, or at least use OSO1b to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question

_____% of electric savings [100% or less]

_____% of natural gas savings [100% or less]

DESIGN TEAM VERSUS CUSTOMER INFLUENCE

Inf1. We are interested in knowing how influential ____ *[design team]* was in selecting the efficient equipment you installed. Which of the following statements best describes the role of ____*[design team]*?

1. ____ *[design team]* recommended the efficient equipment and you agreed with the choice
2. ____ *[design team]* included the efficient equipment as an option, and you chose to purchase them
3. You suggested the efficient equipment and then got a supporting opinion from ___ *[design team]*
4. You chose the energy efficient equipment without input from ____ *[design team]*
5. Don't know/refused

Inf2. I'd like to confirm the contact information I have for the primary individual you work with at ____ *[design team]*?

Complete from program files prior to interview.

Obtain titles, names, phone numbers, email addresses

_____

Title *Name* *Phone* *Email*

Inf3. On the scale of 0 to 4, with 0 being no influence and 4 being very influential, how influential was the information provided by the ____ *[design team]* in your decision to install the measure?

0 1 2 3 4

(Not influential) (Very influential)

Infl3a. Whole building

0 1 2 3 4

(Not influential) (Very influential)

Infl3b. HVAC

0 1 2 3 4

(Not influential) (Very influential)

Infl3c. Lighting

0 1 2 3 4

(Not influential) (Very influential)

Infl3d. Other (*Review Engineer Specify*)

0 1 2 3 4

(Not influential) (Very influential)

Infl3e. In-unit Efficiency [RESIDENTIAL ONLY]

0 1 2 3 4

(Not influential) (Very influential)

Inf4. Was there anyone else who significantly influenced the installed levels of efficiency in the building?

3. No _____
4. Yes _____

[IF YES] Who was this and in what capacity where they involved with this project?

DESIGN INFORMATION: OVERALL MARKET

I have only 2 shorter topic areas to cover and then we will be finished with this interview.

I am now going to quickly run through building design components and would like your best guess on where the market has been over the last 2 years, and then where the market is currently. This will then be followed by how much influence you think NYSERDA has had in changes in the market for commercial new construction.

M1. What proportion of commercial/industrial new construction projects do you think did not meet their relevant energy code 2 years ago? _____%

M2. What proportion do you think do not meet energy code today? _____%

M3-8 Not Used

M9. In general, for commercial new construction how has the energy usage changed over the last 2 years? Gone up or gone down?

3. ____ Increased?
4. ____ Decreased?

M9b. By what percent? ____%

M10. Not used.

M11. Of the factors influencing the changing energy usage in new buildings, what percent influence do you think NYSERDA's New Construction Program has had? ____%

FIRMOGRAPHICS

[Lead engineer to complete the following prior to the interview as they have information. Then ask the questions to complete all the questions in this section.]

ST 1 Building Type_____ (confirm building type)

Amusement, Social and Recreational Bldgs

Apartments

Capitols/Court Houses/City Halls

Dormitories

Hospitals and Other Health Treatment

Hotels and Motels

Houses of Worship

Laboratories (Manufacturer owned)

Libraries and Museums

Manufacturing and Processing Plants

Miscellaneous Nonresidential Buildings

Office and Bank Buildings

One-family Houses

Other Government Service Buildings

Other Religious Buildings

Parking Garages and Automotive Services

Schools and Colleges

Space Facilities

Stores and Restaurants

Warehouses (excl. manufacturer owned)

ST 2 Square Footage _____ (confirm building gross sq ft)

ST3. What is the Principal Activity of the business operating in the new building? [RECORD ALL THAT APPLY]

[1] Education

[2] Food Sales

[3] Food Service

[4] Health Care

[5] Lodging

[6] Retail/Mercantile

[7] Office

[8] Public Assembly

[9] Public Order and Safety

[10] Religious Worship

[11] Service

[12] Warehouse and Storage

[13] Manufacturing (Identify Industry Type e.g., chemical, food, paper, etc.)

[14] Vacant

[15] Other (specify) _____

[16] Multifamily housing [SKIP ST4 AND ST5]

-98 Don't know [DON'T READ]

-99 Refused [DON'T READ]

ST4-6 Not Applicable

ST7. How many employees does your firm have?

[1] Fewer than 5

[2] 5 to 9

[3] 10 to 19

[4] 20 to 49

[5] 50 to 99

[6] 100 to 249

[7] 250 or More

-98 Don't know [DON'T READ]

-99 Refused [DON'T READ]

ST8. Is your company independent, or part of a larger company?

[1] Independent

[2] Part of a larger company

[3] Other (specify) _____

-98 Don't know [DON'T READ]

-99 Refused [DON'T READ]

ST9. How many locations/establishments/multifamily properties [ASK AS IS RELEVANT] does your firm have?

[1] One

[2] 2 to 5

[3] 6 to 10

[4] 11 to 20

[5] More than 20

-98 Don't know [DON’T READ]

-99 Refused [DON’T READ]

Appendix D: Sampling Memos

Appendix D: Sampling Memos

This appendix includes:

Megdal & Associates

M E M O R A N D U M

To: Cherie Gregoire, NYSERDA Energy Analysis and the Evaluation Staff of the New York Department of Public Service (DPS)

From: Kathryn Parlin, WHEC; Jennifer Chiodo, Cx Associates, LLC. and Lori Megdal, Megdal & Associates, LLC

Subject: Sampling Design for Impact Evaluation Site Visits of the 2007-2008 NCP Participants

Date: November 16, 2009

The purpose of this memo is to provide an explanation of the sampling process used to develop the list of projects to include in the on-site survey for the impact evaluation of NYSERDA's New Construction Program (NCP), and to discuss the results of that process and the analyses undertaken to verify that the sample is reasonably representative of NCP's 2007 and 2008 activity. The first section describes the overall framework for the analysis. The second and third sections provide a brief summary of the projects and categories and describe the sampling analysis process and the issues that arose. The fourth section summarizes the resulting sample in the context of the overall sampling objectives.

Overview

The first step in the sampling process was to conduct a review of the program-level data.

There were a total of 236 projects with installed measures during 2007 and 2008. Of these measures, 100 projects represent less than 3% of the total annual kWh savings and these projects were removed from the sampling process as explained below.

The participant sampling for the NCP impact evaluation was designed to address the specific characteristics of the program. The primary sampling unit is the project, and all measures installed as part of the select projects will be reviewed. This approach allows the evaluators to analyze the project comprehensively and consider interactive effects between measures or groups of measures.

Stratified ratio sampling was selected since it allows for efficient sampling design and generally requires a lower sample size for a targeted level of precision.[3] The precision/confidence target of 90/10 for the program as a whole is specified in the evaluation plan.

The size of the project in terms of energy savings tends to be a major contributor to the variability of the realization rate. Large projects tend to be more complex and also account for a high percentage of the

[3] The stratified ratio estimate (SRE) method produces a more efficient sample as long as the correlation between the program claimed and verified savings is 0.50 or greater, which is typically the case when estimating realization rates.

total program savings. Consequently, the size of the project (energy savings) was selected as the primary stratification variable and a census of the largest projects will be included in the sample.

While the evaluation is primarily designed to verify the electric savings, there are also substantial gas savings associated with this program. The savings for these non-electric measures are most often not related to the electric savings, *i.e.*, projects with large electric savings may have little or no gas savings and *vice verse*. Including gas projects in the sample will allow for the estimation of the realization rate for both the electric and gas savings. Specifying a separate sample of gas projects was not included in the Work Plan given the extent to which that would increase the sample size substantially, resulting in a large increase in the budget.

In addition, the NCP includes projects that are located both in the upstate and downstate regions. In this program, downstate projects tend to be larger and more complex than upstate projects. For many other programs, the evaluation plan includes a process for estimating the realization rates for each region. However, the NCP evaluation is based on expensive on-site analyses and it would be cost-prohibitive to increase the sample size sufficiently to estimate the realization rate separately by region.

Even with these constraints, the sample can designed to reflect the population in terms of gas projects and upstate/downstate activity. Consequently, the evaluation team decided to stratify on these variables to ensure that gas projects and regions are represented in the sample without requiring a specific precision/confidence target by subgroup. This approach ensures that the results can be generalized to the program as a whole, but will not require increasing the sample size.

Two other possibilities were also considered for stratification, *i.e.*, major measure group and type of project (pre-qualified, custom and whole building). If the size stratified sample was dominated by a single type of measure or project, then the result could be biased if uncertainty varies according to the type of measure or project. For example, pre-qualified projects consist of prescriptive measures with deemed savings, and thus these projects may have a different realization rate than custom measures with project-specific analyses. However, the differences in realization rates between the groups would have to be substantial and the sample heavily weighted toward a specific measure or type of project to have a major impact on the results. In addition, incorporating these variables to the stratification scheme would result in a highly complex sample design that would be difficult to implement. Consequently, the evaluation team decided to review the sample after selection to assess whether the sample is reasonably representative of the population in these two respects.

With regard to the allocation of the population and the sample to the strata, the *2004 California Evaluation Framework* provides a clear and defensible approach to developing an efficient sample. The Framework recommends establishing cut offs and sample sizes such that the sample sizes within each stratum are equal.[4] This approach was employed for the NCP sample design.

The specifics of the sampling plan were established after a review of the data and are based on the following guidelines:

- Sampling is based on stratified ratio estimation.
- The sample size is designed to achieve a target confidence/precision level of 90/10 for the program as a whole.
- Stratification by size is based on the annual kWh savings.

[4] The Framework recommends model-based stratification to construct the strata. This approach produces optimal sample designs for SRE sampling. (See Särndal, Swensson, et. al., *Model Assisted Survey Sampling*, Springer-Verlag, New York, 1992, pages 252 to 255, and the California Framework referenced in the following footnote, page 328.)

- A census of the largest projects will be reviewed.
- The cut offs for the strata and sample sizes within each stratum will be determined according to the methodology presented in the *2004 California Evaluation Framework.*[5]
- The sample will be allocated to major subgroups (such as region) on a proportional basis according to the distribution of projects in the subgroups, in order to ensure that the sample accurately reflects the program activity. In this case, the major subgroups will be region (upstate and downstate) and projects with gas savings. The sample will not be designed to develop savings estimates separately for each subgroup at the 90/10 confidence/precision target.
- The sample will be reviewed to verify that projects with savings from all major measure groups are represented in the sample, as well as that the three project types (pre-qualified, custom and whole building) are represented.

Summary of Projects

The stratification of the projects by size is described in Table 1 below. The cut-off points were established as consistent with the process laid out in the *2004 California Evaluation Framework* cited above.[6] Table 1 shows the number of projects, total kWh savings and minimum and maximum kWh savings by project for each stratum. The stratum of very small projects consists of 100 projects that make up a total of 3% of the total program annual energy savings, were excluded from the sample, since verifying these smaller projects would require resources while not contributing to reducing the uncertainty in the realization rate estimates.

Table 1: Projects and Savings by Size Stratum

Stratum	Sampling Method	# of Projects	kWh Savings	% of Total kWh Savings	Min kWh	Max kWh
0	None	100	2,471,105	3%	0	72,625
1	Random	94	18,622,078	22%	73,105	452,674
2	Random	32	23,641,191	29%	456,608	1,049,706
3	Census	10	38,206,469	46%	1,056,600	17,602,951

Overall, the downstate region accounted for 20% of the projects and 40% of the savings. For the projects in the strata designated for random sampling, the average project size (in terms of annual kWh) is approximately the same for the upstate and downstate regions.[7] In addition, 39 projects were found to have gas MMBtu savings, including 23 projects in strata 1 and 2, and one project in the census stratum.

[5] TecMarket Works, et. al. *The California Evaluation Framework.* Project Number: K2033910. Prepared for the California Public Utilities Commission and the Project Advisory Group. June, 2004. Pages 327 to 339 and 361 to 384.

[6] Stratified ratio estimation was used with a gamma of 0.8.

[7] Downstate projects are disproportionately represented among the large projects, which explains why the downstate projects are 20% of projects and 40% of savings but the downstate and upstate projects in strata 1 and 2 have a similar average project size.

Table 2: Projects and Savings by Region

	All Projects		Projects in Strata 1 through 3	
Region	# of Projects	MWh Savings	# of Projects	MWh Savings
Upstate	190	49,915	110	47,783
Downstate	46	33,026	26	32,686
Totals	236	82,941	136	80,470

Determining the Sample Size

The final sample size was determined by reviewing the savings in the strata, the known precision levels for the very small and census strata, and working backward to determine the required target precision for the random sample required to meet the 90/10 confidence/precision level for the program.

Table 3: Precision Target by Sampling Group

Stratum	kWh Savings	% of Savings	Target Precision at the 90% Confidence Level
No Sample	2,471,105	3.0%	1.00
Random Sample	42,263,269	51.0%	0.19
Census	38,206,469	46.1%	0.00
Totals	**82,940,843**		**0.100**

Assuming an error ratio of 0.70 and applying the finite population correction factor, the required sample size is 30 for the random sample, as shown below.

$$n_0 = \left(\frac{er \times z}{D}\right)^2 = \left(\frac{0.7 \times 1.645}{0.187}\right)^2 = 38$$

$$n = \frac{n_0}{1 + \frac{n_0}{N}} = 38 \times \frac{1}{1 + \frac{38}{126}} = 30$$

Where

n_0 is the initial sample size (without the finite population correction factor)

z is 1.645 for the 90% confidence level

er is the error ratio, estimated to be a maximum of 0.70

D is the desired relative precision, as determined by the analysis shown in Table 3 above

N is the total number of projects in the two random sample strata

n is the desired sample size incorporating the finite population correction factor

The census stratum contains 10 projects, for a total sample size of 40. As is consistent with the methodology laid out in the *2004 California Evaluation Framework*, equal sample sizes of 15 were assigned to the first and second stratum. The sampling process also included selecting projects with gas savings and by region roughly in proportion to their prevalence in the population of 2007/2008 projects for the two strata requiring random sampling, as shown in Table 4 below.[8]

Table 4: Sample Sizes by Region and Gas Projects

Stratum	Region	Gas	Total # of Projects	% of Total	# Projects in Sample	% of Sample
1	Upstate	Yes	19	20%	3	20%
1	Upstate	No	62	66%	9	60%
1	Downstate	Yes	2	2%	1	7%
1	Downstate	No	11	12%	2	13%
	Subtotal		94		15	
2	Upstate	Yes	2	6%	1	7%
2	Upstate	No	21	66%	10	67%
2	Downstate	Yes	0	0%	0	0%
2	Downstate	No	9	28%	4	27%
	Subtotal		**32**		**15**	

Sample Selection

The random selection was conducted and the results assessed to determine whether the sample is reasonably representative of the population by other major indicators. The assessment of the sample covered three areas:

11. How do the sampled savings in each stratum compare to the total savings?
12. Were all major measure groups included in the sample?
13. Does the sample include pre-qualified, custom and whole building projects?

As discussed earlier in this memo, the expectation was not that the sample and the population would be perfectly matched by measure group or type of project, but rather that the sample would include a range of measure groups and project types.

Projects and Savings by Stratum

As can be seen in Table 5, the distribution of projects and savings by stratum looks reasonable. The sample includes about 63%, 60% and 79% of the MWh, kW summer peak and gas MMBtu savings, respectively.

[8] Some projects with gas savings also included measure(s) that resulted in additional gas use. This outcome may reflect fuel switching or other electric impacts that result in increased gas use. Of the 23 projects in strata 1 and 2 with gas savings, five (5) projects also had additional gas use. For the purposes of sample, only the gas savings were considered. However, two (2) of the five projects with additional gas use were included in the final sample.

Table 5: Comparison of Sample and Population by Stratum

Stratum	# of Projects	# of Projects in Sample	Total MWh	Sample MWh	Total Summer kW	Sample Summer kW	Total Gas MMBtu Savings
0	100	0	2,471	0	1,059	0	3,738
1	94	15	18,622	2,704	6,187	1,121	85,976
2	32	15	23,641	10,977	6,236	3,142	3,837
3	10	10	38,206	38,206	9,286	9,286	15,947
Totals	**236**	**40**	**82,941**	**51,887**	**22,769**	**13,550**	**109,499**
% in Sample		**17%**		**63%**		**60%**	

Projects and Savings by Major Measure Group

Since the large projects are to be reviewed on a census basis, we are primarily interested in ensuring that the savings for the randomly selected strata reflect a range of the types of measures installed through the program. Table 6 shows the distribution of savings by measure group for electric energy, kW demand and gas savings.

Table 6: Strata 1 and 2 Projects and Savings by Major Measure Group

Measure Category	# of Records[9]	Total MWh	Sample MWh	% in Sample	Total kW Sum	Sample kW Sum	% in Sample	Total Gas MMBtu Savings	Sample Gas MMBtu Savings	% in Sample
Lighting	58	11,026	3,076	28%	2,498	633	25%	4,668	32	**1%**
HVAC	49	11,360	3,987	35%	4,837	1,860	38%	8,666	708	**8%**
Motors	115	8,508	1,766	21%	1,212	297	25%	1,569	330	21%
Shell	9	1,312	285	22%	591	180	30%	4,909	1,223	25%
Whole Building	8	8,551	4,153	49%	2,988	1,172	39%	68,941	67,245	98%
Other	14	1,507	414	27%	297	122	41%	1,060	508	48%
Totals	**253**	**42,263**	**13,681**	**32%**	**12,423**	**4,263**	**34%**	**89,813**	**70,045**	**78%**

This analysis suggests that the sample covers a wide range of measures for the electric savings. However, two major measure groups, lighting and HVAC, are seriously underrepresented among the projects with gas savings and whole building savings are overrepresented. A further review of the program data indicates that there are a number of gas projects with savings from lighting and HVAC and these savings are unlikely to be sufficiently evaluated with the selected sample. Since whole building projects tends to cover a variety of measures and whole building savings represent a large majority of the total gas savings, overrepresentation of this type of project would not be expected to introduce bias to the results.

[9] The number of records reflects the total number of measures in the database provided by NYSERDA for projects in strata 1 and 2. It does not reflect the number of projects.

Consequently, a supplemental project with lighting and/or HVAC gas savings was randomly selected from the project list and added to the sample. The selected project had gas savings associated with both measure types. An updated table including this project is included below. While the percentage of gas savings for HVAC and lighting measures is much more in line with the population, the impact to the distribution of electric savings is small.

Table 7: Strata 1 and 2 Projects and Savings by Major Measure Group with Supplemental Project

Measure Category	# of Records	Total MWh	Sample MWh	% in Sample	Total kW Sum	Sample kW Sum	% in Sample	Total Gas MMBtu Savings	Sample Gas MMBtu Savings	% in Sample
Lighting	59	11,026	3,227	29%	2,498	659	26%	4,668	1,341	29%
HVAC	54	11,360	4,230	37%	4,837	2,063	43%	8,666	2,322	27%
Motors	115	8,508	1,766	21%	1,212	297	25%	1,569	330	21%
Shell	11	1,312	296	23%	591	181	31%	4,909	1,237	25%
Whole Building	8	8,551	4,153	49%	2,988	1,172	39%	68,941	67,245	98%
Other	15	1,507	424	28%	297	122	41%	1,060	597	56%
Totals	**262**	**42,263**	**14,095**	**33%**	**12,423**	**4,493**	**36%**	**89,813**	**73,071**	**81%**

Projects and Savings by Project Type

The distribution of projects and savings by project type for the adjusted sample with the supplemental project is presented below in Table 8. This analysis suggests that the sample include a reasonable selection of pre-qualified, custom and whole building projects.[10]

Table 8: Strata 1 and 2 Projects and Savings by Project Type with Supplemental Project

Project Type	# of Projects	# of Projects in Sample	Total MWh	Sample MWh	% in Sample	Total kW Sum	Sample kW Sum	% in Sample
Pre-Qualified	30	7	10,122	2,134	21%	2,248	717	32%
Custom	56	12	17,286	5,387	31%	5,251	1,821	35%
Whole Building	40	12	14,855	6,574	44%	4,924	1,955	40%
Totals	**126**	**31**	**42,263**	**14,095**	**33%**	**12,423**	**4,493**	**36%**

[10] Table 8 includes only the electric savings. The projects with gas savings are predominantly whole building projects and the "pre-qualified" designation does not apply to gas measures. Consequently, this analysis was not meaningful for these projects.

Conclusion

The final sample size for the on-site survey to be conducted as part of the NCP impact evaluation is 41 projects, consisting of 16 in the small stratum, 15 in the medium stratum and all 10 projects in the large stratum.[11] A supplemental project was added to the initial sample size of 40 to allow for a more complete review of projects with gas savings related to lighting and HVAC measures. The inclusion of this project had virtually no impact on the distribution of the electric savings.

The sample is designed to meet the 90/10 confidence/precision target for the entire program. In addition, the sample was stratified by region and by fuel type to ensure that the sample properly reflects the population for these critical subgroups. The sample also includes a wide range of measures and project types, suggesting that it will not be biased due to the overrepresentation of specific measures or project types.

NCP impact evaluation Champion: Jennifer Chiodo, Cx Associates, LLC

NCP impact participant sample design and sampling: Kathryn Parlin, West Hill Energy & Computing, Inc.

[11] Three of the 10 census stratum projects were part of the 2008-2009 impact evaluation of NYSERDA's Largest Savers. The on-site measurements, monitoring and evaluation of these sites from that evaluation will be included for this program year-specific evaluation study. No additional site visits are planned for these three sites.

Megdal & Associates

M E M O R A N D U M

To: Judeen Byrne, NYSERDA Energy Analysis and the Evaluation Staff of the New York Department of Public Service (DPS)

From: Kathryn Parlin, WHEC; Jennifer Chiodo, Cx Associates, LLC.; and Lori Megdal, Megdal & Associates, LLC

Subject: Sampling Design for NCP Non-Participant Surveys

Date: August 10, 2010; Finalized May 11, 2011

The purpose of this memo is to provide an explanation of the sampling process used to develop the list of projects and design firms to include in the non-participant survey component of the impact evaluation of NYSERDA's New Construction Program (NCP). The first section describes the overall framework for the analysis. The second and third sections cover developing the sampling frame and selecting the sample of non-participating projects. The fourth section describes how the sample of non-participating projects will be used to generate the non-participating building owner and design firm samples. The fifth section discusses the analysis of formerly-participating design firms, and is followed by the conclusion.

Overview

The NCP evaluation plan calls for surveys of three categories of non-participants:

- non-participating building owners
- non-participating design firms
- formerly-participating design firms

The first two surveys are designed to develop estimates of non-participant spillover, provide data for a pilot study of market effects versus spillover, and provide a reality check on project-specific baselines for the NCP participant on-site sample. The Dodge Players' database[12] of permitted projects was used as the sample frame for these surveys. This database was also used to construct the sample frame for the recent NCP market characterization study,[13] and the processes and stratification from this study were adopted to the extent possible. A stratified random sample of Dodge database projects was selected, and the building owners, architects and engineers for each chosen project were compiled to generate the list of potential survey participants.

[12] The McGraw-Hill Construction (Dodge) Players' Database is referred to in this memo as the Dodge Players database or Dodge database since only one Dodge database was used for this work.

[13] *New Construction Program Market Characterization and Assessment, Final Report*, Prepared for NYSERDA by Summit Blue Consulting, LCC. Project Number 9875. August, 2008.

For the sample of formerly-participating design firms, an initial analysis of NYSERDA's database of all enrolled NCP projects was conducted to assess the feasibility of pursuing this subset of participants. The original concept was that higher spillover may be found among design firms who worked extensively with the NCP and then chose to leave the program. This initial analysis indicated that there is an insufficient number of formerly-participating designs to make it worthwhile to continue with this approach, as explained in more detail below.

Sample Frame for Non-Participating Projects

The first step in the sampling process was to construct the non-participant sample frame from the Dodge database. The Dodge database covers projects receiving permits from 2004 to 2009. The preparation of the Dodge database required two steps: 1) ineligible and likely non-completes were removed from the database, and 2) NCP participating projects were eliminated to establish the non-participant sample frame. This data cleaning process was conducted by APPRISE.

Given the goals of the survey, the Impact Evaluation Team is only interested in completed projects and projects that would have been eligible to received incentives under the NCP program. Projects with a status of "permit" were eliminated, since these projects are unlikely to have reached completion. In addition, projects that would be ineligible for NCP incentives were removed prior to the participant matching for four reasons[14]:

- Project Type – Dodge New Construction Reports include a number of project types that would not be eligible for NCP incentives. These included airports (non-building), bridges, communication systems, dams and reservoirs, gas systems, miscellaneous non-building construction, power/heat/cooling plans, river/harbor/flood control, sewage and waste disposal systems, streets and highways, and water supply systems.
- Geography – Projects that were in Nassau County and Suffolk County (Long Island Power Authority territory) were excluded given that LIPA does not participate in the SBC.
- NYC Buildings - Since NYC government buildings also do not participate in the SBC, all NYC government building projects were excluded.
- Duplicates – The Dodge frame had some duplicate records.

All projects in NYSERDA's database of enrolled projects were removed from the Dodge database. In order to compare the participating projects, the project (building) name and address within each zip code and within each city were compared. The next step was to compare the owners, architects, and engineers for each matched project to see if they are the same as the owners, architects, or engineers in the participants list. When the owners, architects, or engineers match the participant list, the Dodge project was assumed to be a participating project and was eliminated from the non-participant sample frame.

Selecting the Sample of Non-Participating Projects

A stratified random sample of non-participating projects was selected. The sample frame was stratified based on the business type and the size of the projects (in terms of construction value). The business type stratification with the number of projects and the construction value is shown below in Table 1.

[14] The same screening process was used for the 2008 MCA report.

Table 9: Number of Projects and Construction Value by Business Type

Business Type	# of Projects	Construction Value (x $1,000)	% of Projects	% of Construction Value
Commercial	1,767	11,501,521	33%	31%
Education	508	3,341,330	9%	9%
Government/Nonprofit	621	4,283,465	12%	12%
Healthcare	398	2,892,263	7%	8%
Manufacturing	109	5,251,981	2%	14%
Multifamily	1,996	9,515,567	37%	26%
Totals	5,399	36,786,127		

This analysis indicates that the bulk of the new construction activity occurs in the general commercial and multifamily sectors.

The size strata were defined to be consistent with the recent MCA study. As was done in that study, the very small projects (with construction value below $1 million) were excluded from the sample since they represent a small share of the total new construction market and are not representative of most projects that participate in the NCP, which tend to be larger construction projects. The definitions of the strata are described below:

- Large/moderate[15] – Projects of $15 million or more in new construction value
- Small – Projects with $1 million to less than $15 million in new construction value

Table 10 shows the number of projects and construction value by business type and size. Overall, the construction value is fairly evenly divided between the small and large projects. The exception is the education category, which seems to be predominantly composed of many smaller projects.

Table 10: Number of Projects and Construction Value by Business Type and Size

	# Projects in Non-Participant Population			Construction Value (x $1,000,000)		
Business Type	**All**	**Small**	**Large**	**All**	**Small**	**Large**
Commercial	1,767	1,672	95	11,502	5,218	6,283
Education	508	463	45	8,062	6,283	1,779
Government/ Nonprofit	621	581	40	3,341	1,779	1,562
Healthcare	398	354	44	3,324	1,562	1,762
Manufacturing	109	96	13	4,283	1,762	2,521
Multifamily	1,996	1,902	94	3,879	2,521	1,358
Totals	5,399	5,068	331	34,392	19,126	15,266

[15] In the MCA study, the large and moderate categories were separate, with large projects identified as those with construction value of $50 million or more. Given the goals and size of the sample frame for the non-participant impact survey, it was decided to combine these two categories.

The evaluation plan specifies sample sizes of 75 for the non-participant building owners and design firms, based on meeting the confidence/precision target of 90/10 based on the formula for estimating proportions and allowing for some leeway. The sample was allocated to the business types proportionally based on construction value, with oversampling for the education and healthcare sectors to improve the sample size used to verify baselines for the participant on-site surveys.[16] Within each business type, the sample will be evenly divided between large and small projects. If the sample frame is insufficient to produce the required number of completed surveys for the large projects, the sample will be completed with smaller projects in the same business type.[17] This process resulted in a sample size of 74. The results of the sample allocation are presented in Table 11 below.

Table 11: Sample Sizes by Business Type

Business Type	# Projects in Non-Participant Population	Total Construction Value	% of Projects	# of Construction Value	# in Non-Participant Sample
Commercial	1,767	11,501,521	33%	31%	22
Education	508	3,341,330	9%	9%	8
Government/Nonprofit	621	4,283,465	12%	12%	8
Healthcare	398	2,892,263	7%	8%	8
Manufacturing	109	5,251,981	2%	14%	10
Multifamily	1,996	9,515,567	37%	26%	18
Totals	5,399	36,786,127			74

Sample of Non-Participating Building Owners and Design Firms

The evaluation plan calls for two separate surveys, one of non-participating buildings owner and one of non-participating design firms. The process above results in a sample frame of non-participating projects. The sample of 74 building owners is simply the list of building owners associated with these projects.

Non-participating design firms, however, may be more complicated to identify. The Dodge database was screened to remove all projects that enrolled in the NCP. However, it is theoretically possible that a NCP participating design firm may also have contributed to a project included in the non-participant sample frame. For this reason, the list of design firms associated with the randomly selected non-participating projects will be compared to NYSERDA program records to verify that they are actually non-participants and 74 design firms will be included in the sample, with the same distribution by business type and size as developed for the non-participating projects.

Formerly-Participating Design Firms

In the evaluation plan, the Impact Evaluation Team expressed the intention to conduct a survey of formerly-participating design firms to improve the estimate of non-participant spillover. The assumption was that these firms learned about energy efficient design through the NYSERDA NCP and then

[16] Two projects were added to each of these two categories.

[17] This situation may arise in the manufacturing sector, which has only 13 projects in the large category. It may also be possible to add projects with a status of "permit" to the sample list and identify completed projects as part of the survey.

continued to apply this knowledge to other projects even after making the decision to discontinue participation in the program.

Formerly-participating design firms were defined as firms who completed at least one project through NCP prior to 2007 and did not have any subsequent completions. The NYSERDA database of NCP completed projects was analyzed to identify this subset of participants. This analysis identified 158 formerly-participating design firms, and fourteen (14) of these firms completed projects with no recorded electric savings (energy or demand savings). The disposition of the 144 remaining projects is described below in Table 12.

Table 12: Formerly-Participating Design Firms by Number of Completed Projects

Number of Completed Projects	# of Formerly-Participating Design Firms	% of Formerly-Participating Firms
1	118	82%
2	18	13%
3	4	3%
4	2	1%
6	2	1%
Total	144	

This analysis shows that the formerly-participating firms completed very few projects with the program. Since the actual level of program activity seems to be insufficient to generate the type of behavioral change that was originally envisioned, the Impact Evaluation Team decided not to pursue the survey of formerly-participating design firms.

Conclusion

A stratified, random sample of non-participating projects will be selected from the Dodge database and the building owners and design firms associated with the projects will be surveyed. The sample is designed to meet the 90/10 confidence/precision target for the entire program. The sample was stratified by building type and size (construction value) to reflect the new construction market as represented in the Dodge database. The sample sizes for two business types (education and healthcare) were increased to allow for a sufficient number of completed surveys to provide insight into the baseline practices to support the NCP on-site survey.

The overall sample size was 74 for each survey, as is consistent with the NCP evaluation plan. The sample sizes were allocated proportionally to the building types based on construction value, and then divided equally between large and small projects within each building type, which is roughly proportional to the distribution of construction values overall and within each business type (except education). The building owners and design firms associated with these non-participating projects will be surveyed, and the list of design firms will be checked against the NYSERDA program records to ensure that they are actually non-participants.

The Impact Evaluation Team analyzed the NYSERDA program database to assess the activity associated with formerly-participating design firms and concluded that conducting a survey of these firms to assess non-participant spillover is not likely to produce results due to the low level of program activity among the formerly-participating firms.

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Appendix E: Example Gross & Modeled Partial Net Methods

Example Project

The following example project analysis does not represent an actual project in the sample population. The project evaluation occurs in two stages and 7 steps as follows:

Evaluation of Project Gross Savings

1. Determine as-built and operating conditions
2. Develop calibrated as-built model
3. Develop code baseline model
4. Calculate gross savings

Evaluation of Project Net Savings

5. Develop project specific baseline from participant surveys and triangulation call
6. Run project-specific baseline model
7. Calculate modeled partial net savings

This project includes a high efficiency building envelope, efficient HVAC equipment and control strategies and efficient lighting equipment and control strategies. It is a good example of one of a relatively simple "whole building" type project relative to many of the "whole building" type projects analyzed in this evaluation. This project does not include inside spillover (ISO). Since ISO was relatively rare, we do not include it in the example. ISO savings are included in the calibrated as-built model and must be netted out of the gross savings where they occur.

EVALUATION OF PROJECT GROSS SAVINGS

Step 1: Determine As-built and operating conditions

Conduct On-site Metering

- Meter three high efficiency roof top air conditioning units
- Data log lighting systems:
  - Dimming light intensity and amperage
  - On/Off operation for representative sample of all affected non-dimmed spaces
    - Occupancy controlled
    - Switch controlled

Collect other project data

- Program files, TA study
- As-built plans
- On site fixture counts and equipment inspection
- Building operating schedule
- Manufacturer data for installed equipment
- Utility billing data

Step 2: Develop the Calibrated As-built Model

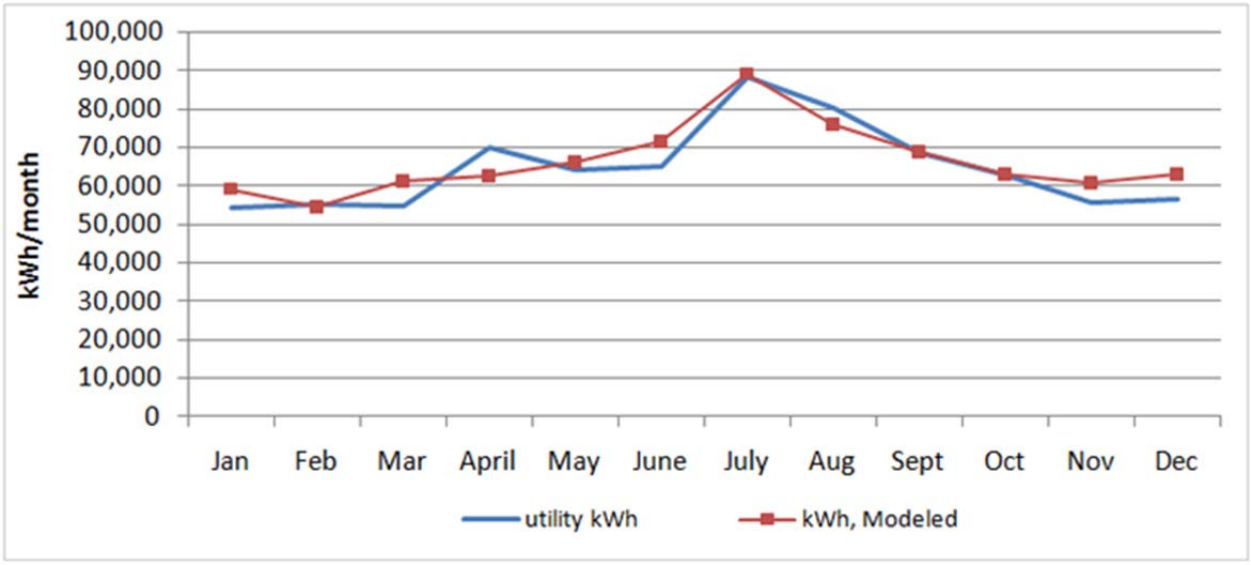
Create As-Built Model

- eQuest Model
  - Input Building geometry, construction characteristics & schedules
  - Equipment meter data and operating schedule survey information used to set schedules
  - Input Measures
    - Efficient Envelope
    - HVAC efficiency, drives and controls
    - Lighting efficiency, occupancy and day lighting control
  - Initial Weather File – local 2010 NOAA data
    - 2010 year with utility data

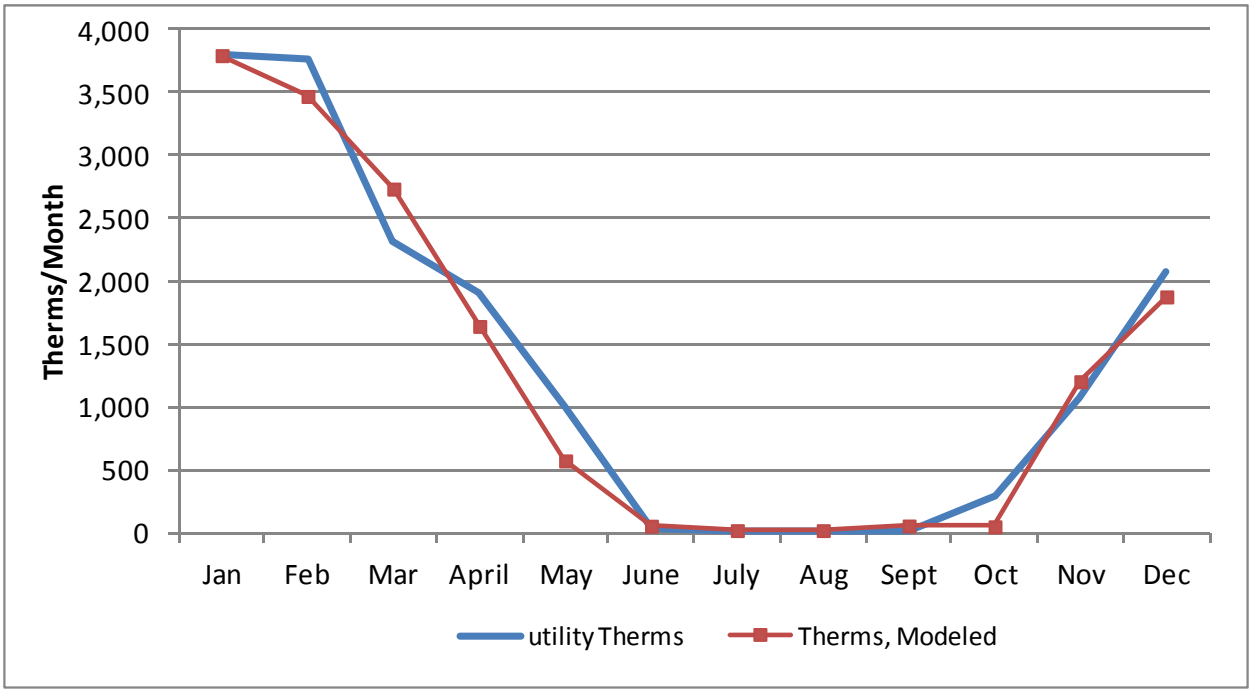
IPMVP Option D - Model Calibration

- Calibrate modeled equipment loads to metered equipment loads
  - Verify modeled kW for HVAC corresponds to metered value under same conditions
  - Adjust loads to calibrate
- Calibrate modeled whole building load to actual utility use
  - Monthly
  - Annual
  - kWh, kW, fossil fuel
- The following pages show the model calibration results in graphic and tabular formats

Model kWh Calibration Results



Model Gas Calibration



Model Calibration ASHRAE Std 14 Results

Calculated:	kWh	kW*	Therms
CVRMSE	7%	NA	18%
NMBE	-3%	NA	5%
weight	*0.5*	*0*	*0.5*

* No utility kW data provided

	Project Weighted	Target
CVRMSE	13%	15%
NMBE	4%	5%

Calibrated Model Energy Use *Step 2 Results*

- 2010 modeled usage closely matched 2010 billed usage
  - Normalize to typical weather
  - TMY3 normalized as-built and operating annual Use

    800,000 kWh

    1,500 MMBTU
  - This calibrated model closely simulates the actual energy use of the building and installed measures for a “typical” year.

Step 3: Develop Code Baseline Model

Code Baseline Model

- Set each parameter in calibrated as-built model to code baseline
- Code baseline for the measures is shown in the table below

Code Baseline Measure Parameters

Measure Type	Efficient Measure	Code Baseline
Envelope	Walls and Window R-value above code	Code R-values
HVAC Efficiency	High Efficiency Rooftop units	Code efficiency
HVAC Controls	VFDs, Dual enthalpy economizers, Demand control ventilation	Inlet vane capacity control, Dry bulb economizer, no occupancy based vent control
Lighting Efficiency	Efficient LPD	Code LPD
Lighting Controls	Occupancy sensors and day-lighting	Occupancy sensors in large areas only

- Run model permutation for each measure or measure group
- Final run is code model

Modeled Code Baseline Energy Use *Step 3 Results*

- Code model energy consumption

1,000,000 kWh

1,850 MMBTU Gas

Step 4: Calculate Gross Savings

	Evaluated Code Baseline	Evaluated As-Built Energy Use	Evaluated Gross Savings
	Step 3	*Step 2*	*Step 4*
Elec (kWh)	**1,000,000**	**800,000**	**200,000**
Gas (MMBTU)	**1,850**	**1,500**	**350**

Gross Savings Determination *Step 4 Results*

200,000 kWh

350 MMBTU Gas

MODELED PARTIAL NET SAVINGS

Step 5: Determine Project Specific Baseline

Project Specific Baseline

- Interviews conducted with owner & design team
- Tabulated survey results
  - Clear agreement on technology/approach baseline in most instances
  - For HVAC owner indicated engineer made decisions
- Triangulation teleconference results in the following project specific baseline measure parameters (shown in the far right column in the table below)

Example Measure Parameters

Measure Type	Efficient Measure	Code Baseline	Project Specific Baseline
Envelope	Walls and Window R-value above code	Code R-values	Code R-values
HVAC Efficiency	High Efficiency Rooftop Units	Code efficiency	Code efficiency
HVAC Controls	VFDs, Dual enthalpy economizers, Demand control ventilation	Inlet vane capacity control, Dry bulb economizer, no occupancy based vent control	VFDs, Dry bulb economizer, no occupancy based vent
Lighting Efficiency	Efficient LPD	Code LPD	LPD based on Standard T-8 technology substituted for the installed HP T-8 fixtures.
Lighting Controls	Occupancy sensors and day-lighting	Occupancy sensors in large areas only	Occupancy sensors in large areas and offices

Step 6: Develop Project-specific Baseline Model

Example: Project-specific Baseline Model

- Set each parameter in calibrated as-built model to project-specific baseline
- Run model permutation for each measure or measure group
- Final run is project-specific baseline model

Project-specific Baseline Model *Step 6 Results*

- Project Specific Baseline model

880,000 kWh

2,000 MMBTU Gas

Step 7: Calculate Modeled Partial Net Savings

	Project Specific BL Model kWh	As Built Model kWh	Modeled Partial Net Savings
	Step 6	*Step 2*	*Step 7*
Elec (kWh)	**880,000**	**800,000**	**80,000**
Gas (MMBTU)	**2,000**	**1,800**	**200**

Modeled Partial Net Savings *Step 7 Results*

80,000 kWh

200 MMBTU Gas