NYSERDA 2009 – 2010 Industrial and Process Efficiency Program Impact Evaluation Report --- Final ---

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Prepared for

The New York State

Energy Research and Development Authority

Judeen Byrne, Project Manager

Prepared by:

Megdal & Associates Impact Evaluation Team

Jonathan B. Maxwell, PE, Principal Investigator, ERS

Betsy Ricker, ERS

With Team Members

Lori Lewis, Megdal & Associates

Kathryn Parlin, West Hill Energy & Computing

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NOTICE

ABSTRACT

NYSERDA's Industrial and Process Efficiency Program (Program) provides technical support and energy efficiency information to manufacturing, agricultural, mining, wastewater, and data center customers. It is funded through the Energy Efficiency Portfolio Standard. This report describes an impact evaluation of the Program completed projects for the period from September 2008 through June 2010.

Engineers visited thirty-six participant sites and completed site-specific measurement and verification at each to assess the proportion of savings being realized compared to the Program-reported savings recorded by NYSERDA. Engineers interviewed participating decision-makers and survey professionals interviewed the projects' vendors to assess free ridership. Due to the relative youth of this program, spillover was not polled directly with participants, but was based on previous evaluations similar to the one performed.

The presented results of the Program include estimates of the realization rates of installed measures by fuel types, and free ridership, spillover to determine the net-to-gross ratio. The evaluation found realization rates of 0.89 and 1.01 for electric energy and demand efficiency impact, respectively, and 1.14 for natural gas. Attribution analysis found a 34% free ridership. With spillover effects the overall net-to-gross factor is 1.04. Quantified non-energy impacts were found to be 6% of the retail value of the energy saved. The report concludes with recommendations regarding future program operation and future evaluation activities.

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GLOSSARY OF TERMS

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

census – All individuals in a group. In evaluations of energy efficiency programs census typically refers to all projects in a stratum of program projects.

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

contact rate – One of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR.[1] The contact rate includes all outcomes where an eligible respondent was reached and the interview attempted divided by these plus those not contacted. The three contact rate outcomes are completes, refusals, and break-offs (the numerator of the contact rate).

cooperation rate – One of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR.[2] The proportion of all cases interviewed of all eligible units ever contacted. Those contacted (the denominator) include completes, refusals, and break-offs.[3]

error ratio – In energy efficiency evaluation, the error ratio is a measure of the degree of variance between the reported savings estimates and the evaluated estimates. For a sample, the error ratio is:

$$er = \frac{\sqrt{\sum_{i=1}^{n} w_i \frac{e_i^2}{x_i^\gamma} \sum_{i=1}^{n} w_i x_i^\gamma}}{\sum_{i=1}^{n} w_i y_i}$$

where,

n is the sample size

w_i is the population expansion weight associated with each sample point i

x_i is the program reported savings for each sample point i

y_i is the evaluated gross savings for each sample point i, the constant gamma, $\gamma = 0.8$ (typically), and the error for each sample point $e_i = y_i - bx_i$, where b is the program realization rate

evaluated gross savings – The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated, as calculated by program evaluators.

evaluated net savings – The total change in load that is attributable to an energy efficiency program, as calculated by program evaluators. This change in load may include, implicitly or explicitly, the effects of free drivers, free riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand.

free rider, free ridership (FR) – 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.

net to gross, net-to-gross ratio (NTG, NTGR) – The relationship between net energy and/or demand savings, where net is measured as what would have occurred without the program, what would have occurred naturally,

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1 American Association for Public Opinion Research, *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys,* 2011. The rates presented here have multiple and more-specific categories and definitions. This document is available on AAPOR website: www.aapor.org.

2 Ibid.

3 Ibid.

and gross savings (often evaluated savings). The NTGR is a factor represented as the ratio of net savings actually attributable to the program divided by program gross savings. For NYSERDA programs the NTGR is defined as 1 minus free ridership plus spillover ($1 - FR + SO$).

outreach contractor – Consultant hired by NYSERDA to provide program outreach to customers, service providers, and stakeholders.

population expansion weight – The total number of units in a population divided by the number of units in the sample.

realization rate (RR) – The ratio of the evaluated gross savings to the program's reported savings. The RR represents the percent of program-estimated savings that the evaluator 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)

$kWh_{program}$ is the kWh savings claimed by program

refusal rate – One of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR).[4] The proportion of all cases in which an eligible respondent refuses to be interviewed, or breaks-off an interview, of all potentially eligible cases.

relative precision – Relative precision reflects the variation due to sampling as compared to the magnitude of the mean of the variable being estimated. It is a normalized expression of a sample's standard deviation from its mean. It represents only sampling precision, which is one of the contributors to reliability and rigor, and should be used solely in the context of sampling precision when discussing evaluation results.

Relative precision is calculated as shown below. It must be expressed for a specified confidence level. The relative precision (rp) of an estimate at 90% confidence is given below:

$$rp = 1.645 \frac{sd(\mu)}{\mu}$$

where,

μ is the mean of the variable of interest

sd(μ) is the standard deviation of μ

1.645 is the *z* critical value for the 90% confidence interval

For the 90% confidence interval, the error bound is set at 1.645 standard deviations from the mean. The magnitude of the *z* critical value varies depending on the level of confidence required.

response rate – One of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research.[5] The response rate estimates the fraction of all eligible working numbers where a request for an interview was made. The denominator of this ratio is the inclusion of all possible components where a request for an interview could be attempted. More specifically, the response rate is the number of completed interviews divided by the sum of completes, refusals, break-offs, not contacted, and the figure estimated for unknown eligibility.

4 Ibid.

5 Ibid.

$$Response\ rate = \frac{Completes}{Completes + refusals + break\text{-}offs + not\ contacted + (e \times unknown\ eligibility)}$$

where,

e = the estimated eligibility rate of the study (determined from the eligibility rate for those that completed the eligibility screen)

spillover (SO) – 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 technical assistance 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. Sometimes spillover is referred to as “free drivership” or as “market effects.” Market effects are program-induced impacts or program-induced changes in the market. Market effects include impacts over time. These market effects may be current or may occur after a program ends. When market effects occur after a program ends, they are referred to as “momentum” effects or as “post-program market effects.” Spillover is often a narrower definition because it does not include impacts that accrue due to program-induced market structure change and seldom look for effects that occur well after program intervention or effects that occur after a program ends. This evaluation addresses participant inside spillover (ISO), participant outside spillover (OSO), and non-participant spillover (NPSO) but not the broader definition of program effects within market effects.

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, such as when, due to the program, participants add efficiency measures to the same building where program measures were installed but did not participate in the program for these measures.

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. This can occur when a firm installs energy efficiency measures they learned about through the program at another of their sites without having that other site participate in a NYSERDA program. Outside spillover is also generated when participating vendors install or sell energy efficiency to non-participating sites because of their experience with the program.[6]

non-participant spillover - The reduction in energy consumption and/or demand from measures installed and actions taken at non-participating sites due to the program but not participating in the program and not induced by program participating vendors. These actions could be program-induced decision-making of non-participating building owners or encouraged by nonparticipating vendors or contractors because of the influence of the program.

stratified ratio estimator (SRE) – An efficient sampling design combining stratified sample design with a ratio estimator. It’s most advantageous when the population has a large coefficient of variation, which occurs, for example, when a substantial portion of the projects have small savings, and a small number of projects have very large savings. 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.

summer coincident peak demand period – For this evaluation NYSERDA defined the summer coincident peak demand period as the hours between noon and 6 p.m. on non-holiday weekdays during June, July, and August. NYSERDA reports the demand savings as the average reduction in electric demand during the summer coincident peak demand period.

within-site sampling – When the quantity of uniquely controlled lighting circuits (or motors or other installed units) to be evaluated at a site is large, engineers will meter a sample of them. Within-site sampling refers to the process. In this evaluation the default within-site sample design targets ±20% relative precision at 80% confidence.

[6] This definition is one that NYSERDA has used throughout its history with energy efficiency programs. There may be other states where the latter circumstance of participating vendors influencing non-participating sites is defined as a type of non-participant spillover.

CONTENTS

TABLES X

FIGURES X

EXECUTIVE SUMMARY ES-1
Realization Rates ES-2
Net-to-Gross ES-3
Non-Energy and Other-Energy Impacts ES-4

SECTION 1: INTRODUCTION 1-1
1.1 Program Background 1-1
1.2 Industrial and Process Efficiency Evaluation Objectives 1-2
1.3 Report Format 1-2

SECTION 2: EVALUATION METHODOLOGY 2-1
2.1 Overall Approach 2-1
2.1.1 Data Sources 2-1
2.2 Sample Design 2-2
2.3 Realization Rate 2-4
2.3.2 Baseline 2-4
2.3.4 Calculation of the Realization Rate 2-6
2.4 Net-to-Gross Savings 2-7
2.4.1 Methodology for Free Ridership and Participant Spillover 2-7
2.4.2 Survey Method for Net-to-Gross Data Collection and Sample Disposition for the Surveys 2-10
2.5 Evaluated Net Savings 2-12
2.6 Secondary Energy Impact 2-12
2.7 Non-Energy Impact 2-12

SECTION 3: RESULTS 3-1
3.1 Realization Rate 3-1
3.1.1 Measurement and Verification Site Recruitment 3-1
3.1.2 Site-Specific Energy Savings and Realization Rates 3-1
3.1.3 Site-Specific Reasons for Energy Savings Realization Rate Deviations from 1.0 3-4
3.1.4 Program Measurement and Verification 3-5
3.1.5 Program-Level Realization Rates 3-6
3.1.6 Realization Rate Summary 3-8
3.2 Net-to-Gross Savings 3-8
3.2.1 Free Ridership 3-8
3.2.2 Spillover 3-10
3.2.3 Net-to-Gross Ratio 3-12
3.3 Secondary Energy Impact 3-13
3.4 Evaluated Net Savings 3-13
3.5 Non-Energy Impact 3-14

SECTION 4: PRE-INSTALLATION REVIEW -- EVALUATION INVOLVEMENT 4-1

SECTION 5: CONCLUSIONS AND RECOMMENDATIONS 5-1
5.1 Conclusions 5-1
5.2 Recommendations 5-2

APPENDIX A: SAMPLING DESIGN FOR IPE M&V AND NET-TO-GROSS PARTICIPANT SURVEYS

APPENDIX B: NYSERDA INDUSTRIAL PROCESS EFFICIENCY BASELINE DETERMINATION METHODOLOGY FOR PROGRAM EVALUATION

APPENDIX C: RIGOR ASSIGNMENT FOR THE ON-SITE M&V

APPENDIX D: MEASURE RETENTION AND LIFE POLICY

APPENDIX E: TWO EXAMPLES OF CASES WORKING THROUGH THE FREE RIDERSHIP ALGORITHM

APPENDIX F: IPE PARTICIPATING OWNER SURVEY

APPENDIX G: IPE PARTICIPATING VENDOR SURVEY

TABLES

Table ES-1. Survey Periods ES-2
Table ES-2. Electricity Realization Rate Results Summary ES-3
Table ES-3. Natural Gas Realization Rate Results Summary......ES-3
Table ES-4. Current Free Ridership, Inside Spillover, and Outside Spillover Estimates ES-3
Table ES-5. Non-Energy Impacts – Summary of Results ES-4
Table ES-6. Electric Program Secondary Energy Impacts – Summary of Results......ES-4
Table ES-7. Evaluated Net Savings for Electric Program Projects through June 30, 2010 ......ES-5
Table ES-8. Evaluated Net Savings for Natural Gas Program Projects through June 30, 2010 ......ES-5
Table 2-1. Upstate Projects and Savings by Stratum 2-3
Table 2-2. Downstate Projects and Savings by Stratum 2-4
Table 2-3. Sample Disposition for the Industrial and Process Efficiency Net-to-Gross Survey of Participating Building Owners and Vendors......2-11
Table 3-1. Realization Rate Results Summary, Electricity, by Region and Size......3-6
Table 3-2. Realization Rate Results Summary, Summer Coincident Peak Demand Savings......3-7
Table 3-3. Realization Rate Results Summary, Natural Gas Efficiency......3-7
Table 3-4. Average Direct Free Ridership for End Users and Vendors......3-8
Table 3-5. Distribution for Direct Free Ridership for End Users and Vendors 3-9
Table 3-6. Average of Direct Free Rider Estimates, Adjusted for Consistency 3-9
Table 3-7. Site Weighted Free Ridership for Each of the Three Types of Sites......3-10
Table 3-8. Summary of NYSERDA's C&I Participant Spillover Rates from Other Relevant Evaluations 3-11
Table 3-9. Electric Program Secondary Energy Impacts – Summary of Results......3-13
Table 3-10. Evaluated Net Savings for Electric Program Projects through June 30, 2010......3-13
Table 3-11. Evaluated Net Impacts for Natural Gas Program Projects through June 30, 2010 3-14
Table 3-12. Non-Energy Impacts Description 3-15
Table 3-13. Non-Energy Impact – Summary of Results......3-16

FIGURES

Figure 2-1. Schematic of the Enhanced Self-Report Components and How They Are Combined to Estimate Free Ridership for Industrial and Process Efficiency 2-8
Figure 3-1. On-Site Measurement and Verification Measure Type Summary 3-1
Figure 3-2. Reported and Evaluated Electric Energy Savings......3-2
Figure 3-3. Reported and Evaluated Electric Peak Demand Savings 3-3
Figure 3-4. Reported and Evaluated Fossil Fuel Savings 3-4
Figure 3-5. Reasons Evaluated Savings Deviated from Study Estimates 3-5
Figure 3-6. Bar Graph Depicting the Rates within the Program's Net-to-Gross Ratio......3-12

EXECUTIVE SUMMARY

In 2007 the New York Public Service Commission observed that statewide annual electricity use was expected to increase by nearly 13% by 2015 and declared a goal to reduce use by 15% compared to 2015 projections. The Commission set a goal to reduce natural gas use by a comparable amount.[7] Recognizing that historic levels of investment in the state were insufficient to achieve these goals, the Commission ordered establishment of the Energy Efficiency Portfolio Standard (EEPS) in 2008 and expressly directed NYSERDA to increase energy efficiency efforts in the industrial sector. The New York State Energy Research and Development Authority (NYSERDA) created the EEPS-funded Industrial and Process Efficiency Program in 2009 in response to this direction.

PROGRAM BACKGROUND

NYSERDA's Industrial and Process Efficiency Program (Program) supports manufacturers and data centers as they improve the energy efficiency of their operations. All electric and natural gas distribution customers in the manufacturing, agricultural, mining, wastewater, and data center industries that pay the New York System Benefits Charge (SBC) are eligible for Program support.

Incentives are calculated, when appropriate, based on a reduction in energy usage per unit of production or workload. Projects may include those that increase productivity and capacity, enhance reliability, and/or increase uptime. Eligible facilities also may apply for incentives for non-process measures. Incentives are available for both electric and natural gas projects for the custom and site-specific use of commercially available technology. Both existing and new facilities are eligible to participate to develop large unique energy efficiency projects. The Program is relatively new, with the first 26 projects completed in 2009, and an additional 44 completed in the first six months of 2010. The majority of projects in the first two program years were lighting and compressed air upgrades. As the program matures, the complexity of the projects is expected to increase to include more custom and process-specific energy efficiency measures. The Program requires that the participant conduct pre-installation measurement of equipment performance on larger projects to demonstrate savings potential and then measure post-installation equipment performance to ensure the program is garnering expected savings.

EVALUATION OBJECTIVES

The primary objective of this impact evaluation was to determine the electric and fossil fuel savings attributable to the Program for projects completed from Program inception in early 2009 through June 30, 2010. The evaluation was designed to estimate the realization rate (RR), i.e., the ratio of the evaluated savings to the NYSERDA's program-reported savings; and to develop estimates of net-to-gross (NTG) components of free riders (FR) and participant spillover (SO), which when combined are called the net-to-gross ratio (NTGR).

Program reported savings were multiplied by the RR to calculate the evaluated gross savings; then evaluated gross savings were multiplied by the NTGR to calculate evaluated net savings. This report presents the results for the first phase of a two-phase evaluation plan.

RESEARCH APPROACH

The Impact Evaluation Team developed separate RRs for electric energy (kWh/yr), electric demand (kW), and natural gas (MMBtu/yr) savings. A single NTGR was calculated and applied across all the evaluated gross adjusted results to determine net savings.

Measurement & verification (M&V) and NTG sample sizes were designed to meet the 90/10 confidence/precision target for each of upstate, downstate, and statewide annual electricity savings. The sample was stratified by the magnitude of reported electric energy savings.

The components of the evaluation are described below:

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[7] Case 07-M-0548 - Proceeding on Motion of the Commission Regarding an Energy Efficiency Portfolio Standard. Order Instituting Proceeding. Issued and Effective May 16, 2007.

1. On-site M&V was conducted at 36 facilities. The RR was calculated based on the information gathered and analyses performed during this M&V. The evaluation engineers developed each site-specific scope of work to leverage any program M&V activities. The on-site evaluation M&V also determined non-energy impacts such as operations and maintenance savings, production savings, and water use savings.
2. On-site and telephone surveys were administered to facility decision-makers for the projects included in the M&V sample to develop inputs into the estimate of free ridership. Surveys were implemented for 33 of the 36 projects where on-site M&V was performed. Decision-maker interviews could not be secured for three of the projects.
3. A telephone survey with vendors associated with the projects in the on-site M&V sample was conducted to provide additional input into the estimate of FR for the sampled projects. Evaluators completed interviews with vendors for 35 projects.

Since the Program is new and it takes time for participants and market actors to absorb and act upon the new information disseminated through the program, it is likely that estimating spillover from primary data collection would underestimate the actual impacts of the Program. Consequently, developing a current estimate of SO was not part of the evaluation design. Instead, participant SO estimates were taken from prior NYSERDA evaluations to ensure a balanced and unbiased estimate of the NTGR.[8] Table ES-1 presents the general timeline of the on-site and survey activities.

Table ES-1. Survey Periods

Survey Type	Date Range
Site M&V & on-site survey	June 2011 to December 2011
Vendor surveys	November and December 2011

RESULTS

Evaluators analyzed the impact of the program on participants' energy use and on non-energy aspects of their operations.

Realization Rates

Tables ES-2 and ES-3 present the summary of the RR results for electricity and natural gas. The statewide RR for electric energy savings for projects completed during the evaluation period is 0.89, with 4.9% relative precision at 90% confidence. The summer coincident peak demand reduction RR overall is 1.01 with 35.1% relative precision at 90% confidence. The estimate of relative precision for the demand savings is only marginally informative given that the Program did not require applicants to calculate peak demand savings until the latter part of the evaluation period. NYSERDA does not have a peak demand savings target for the Program. The natural gas RR of 1.14 has no sampling error and is based on a census of natural gas projects, as only two projects claimed natural gas savings and both were evaluated.

[8] The body of the report includes a detailed discussion for the choices made regarding the spillover estimate.

Table ES-2. Electricity Realization Rate Results Summary

Studies	Total Number of Projects (N)	Number of Completed Sites in RR Sample (n)	Electric Energy		Summer Coincident Peak Demand	
			RR	RR Relative Precision	RR	RR Relative Precision
Upstate	58	26	0.86	5.9%	0.98	41.4%
Downstate	10	10	1.22	0.0%a	1.41	0.0%a
Program total	70	36	0.89b	4.9%	1.01b	35.1%

[a]Census, so no ampling uncertainty (i.e., perfect precision)

[b]The table results are for the retrospective evaluation. The prospective RRs to apply to Program savings after June 2010 are 0.95 on electric energy and 1.08 on demand. They were calculated by excluding one outlier project not expected to represent future activity.

Table ES-3. Natural Gas Realization Rate Results Summary

Region	Total Number of Projects (N)	Number of Completed Sites in RR Sample (n)	Natural Gas Efficiency	
			RR	RR Relative Precision (census, so no sampling uncertainty)
Upstate	1	1	1.09	0.0%
Downstate	1	1	1.15	0.0%
Program total	2	2	1.14	0.0%

The most common reasons for deviations in savings were differences in operating parameters (e.g. operating hours), production rates, calculation methodology, equipment efficiencies, and analysis parameters.

Net-to-Gross

The NTG telephone surveys were of the end users and the project vendors selected for the M&V on-site survey. Table ES-4 lists the FR developed for the current evaluation and the inside spillover (ISO), outside spillover (OSO), and non-participant SO (NPSO) components leveraged from other NYSERDA research.

Table ES-4. Current Free Ridership, Inside Spillover, and Outside Spillover Estimates

Attribution Variable	Factor
Free ridership	0.34
Inside spillover	0.04
Outside spillover	0.19
Non-participant spillover	0.15
Calculation	NTG = 1 – FR + ISO + OSO + NPSO = 1 – 0.34 + 0.04 + 0.19 + 0.15
Net-to-gross ratio	1.04a

[a]The table results are for the retrospective evaluation. The prospective NTGR recommended for Program savings after June 2010 is 0.90.

Non-Energy and Other-Energy Impacts

As part of the on-site survey, evaluators identified non-energy impacts (NEIs) that were material and quantifiable for 14 of the 36 projects in the M&V sample. Table ES-5 summarizes the findings expressed in terms of dollars of NEIs per MWh or MMBtu of reported first-year savings. Most of the NEIs are associated with measures that reduce operations and maintenance costs. The total program NEI is just under $190,000 per year for the population. This represents about 6% of the retail value of the annual energy savings resulting from implemented Program measures.

Table ES-5. Non-Energy Impacts – Summary of Results

NEIs - Projects with Reported Electric Savings	Value of NEIs $/MWh of Reported Savings	Total Annual Program NEI
Upstate	$4.81	$155,473
Downstate	$8.31	$20,538
Total	$5.09	$176,011
NEIs - Projects with Reported Natural Gas Savings	**Value of NEIs $/MMBtu of Reported Savings**	**Total Program Annual NEI**
Total	$3.37	**$12,370**
NEIs – All		**Total Program Annual NEI**
Total program		$188,381

Evaluators also assessed the "secondary" or indirect impact of electric program measures on fossil fuel energy use and of natural gas program measures on electricity and non-natural gas fossil fuel energy use. The Program did not report such impact. Table ES-6 shows the results of this secondary fuel source impact evaluation on electric program projects. Secondary natural gas impacts, largely due to heating penalties associated with lighting efficiency projects, are expressed as a function of reported MWh of electric savings and for the program overall. One electric program project is significantly reducing on-site coal use. These savings are not believed to be representative of typical projects and therefore a separate MMBtu/MWh ratio for coal was not developed. The two projects funded through the natural gas program had no reported or evaluated secondary energy effects.

Table ES-6. Electric Program Secondary Energy Impacts – Summary of Results

Non-Reported Fuel Impacts	MMBtu/MWh of Reported Savings	Evaluated Gross Secondary Impact (MMBtu/yr)
Natural gas	(0.33)	(11,572)
Coal	N/A	19,599

Evaluated Net Savings

Tables ES-7 and ES-8 summarize the overall evaluated net savings for electricity and natural gas by program.

Table ES-7. Evaluated Net Savings for Electric Program Projects through June 30, 2010

Parameter	Program Reported Savings	Realization Rate	Evaluated Gross Electric Savings	Evaluated Gross Savings on Secondary Energy Sources	Evaluated Gross Savings	NTGR	Evaluated Net Savings
Electric energy (MWh/yr)	34,794	0.89	30,967	N/A	30,967	1.04	32,206
Summer coincident peak demand (MW)	4.0	1.01	4.0	N/A	4.0	1. 04	4.2
Natural gas (MMBtu/yr)	0	N/A	0	(11,572)	(11,572)	1. 04	(12,035)
Other fossil fuel (MMBtu/yr)	0	N/A	0	19,599	19,599	1. 04	20,383

Table ES-8. Evaluated Net Savings for Natural Gas Program Projects through June 30, 2010

Parameter	Program Reported Savings	Realization Rate	Evaluated Gross Natural Gas Savings	Evaluated Gross Savings on Secondary Energy Sources	Evaluated Gross Savings	NTGR	Evaluated Net Savings
Natural gas (MMBtu/yr)	3,672	1.14	4,186	0	4,186	1.04	4,353

PRE-INSTALLATION REVIEW -- EVALUATION INVOLVEMENT

In addition to the traditional post-installation M&V of projects completed through June 30, 2010, the Impact Evaluation Team has worked and continues to work with program staff on selected large projects that will be completed in 2012 or later to ensure that program-funded project M&V activities are properly designed for both program and evaluation purposes, as appropriate. Through this ongoing process evaluators and program staff have the opportunity to review projects prior to implementation to encourage consistency in baseline definition, methodology, and data collection for the Program's largest projects.

RECOMMENDATIONS

The principal goal of the evaluation was to analyze the energy savings associated with Program projects completed from program inception in 2009 through June 30, 2010. During this effort, the Impact Evaluation Team also observed opportunities to improve operation and savings estimation in the future to hopefully narrow the variation in RRs. Key recommendations are discussed below.

Program Recommendations

- **Institute a longer Program M&V period on the Program's larger energy savers** – In several instances reported savings deviated from evaluated savings due only to differences in the duration of pre- and post-installation measurement performed at the site. Increasing the M&V duration enables better assessment of measure long-term savings, especially for process-driven measures for which the savings are highly dependent on fluctuations in production.

- **Systematically collect supporting spreadsheets, models and data from technical assistance providers –** The evaluation benefited greatly from the receipt of technical assistance provider spreadsheets and metered data on a number of projects. Much of this data was collected by program staff on behalf of the Impact Evaluation Team as needs were noted for specific projects. During this process both program and evaluation staff agreed that having program staff routinely gather and retain this data in its original format would facilitate program staff review of projects as well as future evaluations. If this comprehensive compilation of records for all projects is impossibly unwieldy, at least do it for the largest projects, such as those with incentives in excess of $250,000.
- **Apply a common algorithm for tracking demand savings –** The high variance in the peak demand savings realized by the Program stem from inconsistencies in algorithms and requirements regarding peak demand calculations. Evaluators recommend that program staff consider requiring that peak demand be calculated in a consistent fashion across projects.[9]
- **Incorporate heating, ventilation, and air conditioning interactive effects into lighting analysis where significant impacts are likely** – The evaluation results showed that the heating and cooling effects of reduced lighting load and run-time hours can be significant, especially in facilities such as data centers with high cooling loads. Evaluators recommend that the Program reporting these and other secondary fuel impacts.
- **Create and Track Premise IDs** – During the evaluator's population frame development process, time was required to manually screen the population for recent marketing department, FlexTech impact evaluation, process evaluation, and market characterization research contacts with Program representatives, to check for multiple staged projects at a single site, and to identify multi-site projects. Site names, addresses, and contact names were used in lieu of a common premise identifier. While this was a manageable exercise for the Phase 1 population size of 70 projects, the exercise will be more daunting as the program expands in the future. To help evaluators and likely aid program administrators as well, evaluators recommend that NYSERDA establish unique premise IDs that are constant across programs and that remain constant for a facility in the event of name changes or other turnover. The use of premise IDs is not uncommon in the utility environment, whereby a portion of each customer's account number can be the unique premise ID number, and the suffix of the number is the only thing that changes with alterations in account ownership. It is conceivable that NYSERDA could use the utility companies' premise IDs.
- **Increase Impact Evaluation Team involvement in pre-installation project review** – The evaluation team's involvement in pre-installation program review has resulted in adjusted savings estimates and consistency between evaluation and program M&V metering and agreement in baseline definitions. Program and evaluation staff should actively work together to ensure more systematic involvement of the Impact Evaluation Team in pre-installation program review and increase the number of projects.
- **Include a mechanism to monitor changes in program reported savings** – Once a project's savings are reported, they are eligible for evaluation. Some participants complete large projects in multiple stages that span many years. As currently operated, program administrators can either create a new project record for each stage or can modify existing project records to increase the associated savings and incentive values and change project completion dates, among other fields, as new measures are finished. The latter approach causes unusual and significant challenges to evaluation. Projects in this evaluation could reappear in the next evaluation with different values. Any analysis of program performance over a period of time based on tracking data would be flawed. The evaluation team recommends that each phase of the project that has a unique completion date have a unique tracking record.
- **Use 0.95 as the prospective realization rate for electric energy savings and 1.08 for demand savings –** The overall electric energy (kWh) RR is 0.89, the electric demand (kW) RR is 1.01, and the natural gas

[9] This evaluation calculated demand impact based on the average load during all summer weekday non-holiday afternoons. In the next evaluation cycle the definition is expected to be that specified in the *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, Residential, Multi-Family, and Commercial/Industrial Measures,* prepared for the New York Department of Public Service by TecMarket Works, October 15, 2010, p. 8: "The Program Administrators (PAs) should calculate coincident peak demand savings based on the hottest summer non-holiday weekday during the hour ending at 5 p.m."

(MMBtu) RR is 1.14. These are the findings applicable to this retrospective evaluation of projects completed from program launch through June 2010. NYSERDA also applies an RR when reporting savings for current projects. The retrospective natural gas realization rate is appropriate for use for this purpose as well. However, the evaluated outlier project is not likely to be representative of any future project and its performance materially affected the electric RRs. Evaluators recommend that NYSERDA apply this evaluation's electric energy RR absent the outlier of 0.94 and the demand RR absent the outlier of 1.08 for prospective use.

- **Use 0.90 as the prospective NTGR –** Evaluators expect spillover to decline as more of the Program's savings as associated with large unique projects that do not lend themselves to technology transfer, which is a major factor in spillover. For this reason evaluators recommend using a lower prospective NTGR than the value computed for the Phase 1 projects in this evaluation.

Evaluation Recommendations

- **Conduct in-depth primary research on participant SO** – Direct assessment of participant SO through survey research is the preferred method of calculating this factor. Evaluators believe that enough time will have passed by the time that the next phase of evaluation occurs to merit direct surveying of participants to calculate SO. It is planned for Phase 2. In the event that responses indicate significant spillover, use enhanced techniques to validate responses.
- **Reassess NEIs in the next evaluation** – The evaluation of this project sample found moderately significant quantifiable NEIs, valued at 6% of the retail value of the energy savings. Discussion with customers and service providers during our pre-installation evaluation work suggests that some of the major process measures in the Program pipeline will substantively affect customers' product quality, speed of production, and business retention and thus have significant NEIs. Based on these conversations and on the expected increase in the proportion of such projects in the Program portfolio overall, evaluators recommend investigating NEIs in the next evaluation.

Section 1:

INTRODUCTION

The New York Public Service Commission established the Energy Efficiency Portfolio Standard (EEPS) to fund energy efficiency assistance in New York. Customers of Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric and Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid, Orange and Rockland Utilities, Rochester Gas and Electric Corporation, Corning Natural Gas Corporation, KeySpan Gas East Corporation d/b/a National Grid, Brooklyn Union Gas Company d/b/a National Grid NY, and National Fuel Gas Distribution Corporation fund EEPS through payment of the System Benefits Charge (SBC) on utility bills.

The New York State Energy Research and Development Authority (NYSERDA), a public benefit corporation established in 1975, began administering EEPS programs in 2009. NYSERDA's Industrial and Process Efficiency Program (Program) is available to electric and natural gas distribution customers in the manufacturing, agricultural, mining, wastewater, and data center industries that pay into the SBC.

1.1 PROGRAM BACKGROUND

The Program is available to the manufacturing sector in New York and targets key industries such as chemicals and pharmaceuticals, primary metals, non-metallic minerals, pulp and paper, automotive, computers and electronics, food processing, and forest products. It includes manufacturing facilities or support operations such as warehousing and distribution sites. Mining and extraction as well as water and wastewater are also included.

Data centers are part of this program and are found in nearly every sector. Key target sectors for data centers include financial services, technology services, cable and telecommunications, insurance and medical, and colleges and universities.

The Program's goal is to help manufacturers and data centers improve the energy efficiency of their operations. Incentives are calculated, when appropriate, based on a reduction in energy usage per unit of production or workload. Projects may include those that increase productivity and capacity, enhance reliability, and/or increase uptime. Incentives are available for both electric and natural gas[10] projects for the custom and site-specific use of commercially available technology and are based on one year's energy savings from installed projects. The Program requires that larger project applicants execute measurement and verification (M&V).[11] Both existing and new facilities are eligible to participate.

NYSERDA Program staff and a team of Vertical Outreach contractors work with stakeholders and eligible customers to bring projects into the Program. The Program focuses on projects that reduce electric energy use per unit of production. Non-process measures are eligible as well. The Vertical Outreach contractors specialize in the industrial sector and data centers and help customers through the process.

The Program is relatively new, with the first 26 projects being completed in 2009, and an additional 44 completed in the first six months of 2010. The majority of the 70 projects were for lighting and compressed air. These are relatively straightforward technologies with short project-lead times, making them good candidates for the Program as it develops customer relationships and market traction. As the program matures, the complexity of the projects is expected to increase to include more custom and process-specific efficiency measures, making the lighting and compressed air projects included in this evaluation less typical of measures included in the Program moving forward.

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[10] Initial EEPS "fast track" funding was for measures that save electricity. On August 24, 2009, the New York Department of Public Service (DPS) ordered that funding for natural gas efficiency be added to the program. Program activity started in April 2010 once the operating plan was submitted and the natural gas utility companies started collecting the charge.

[11] The Program generally requires participants to perform M&V for up to one year after installation for projects expected to save over 1,000,000 kWh/yr for lighting or 500,000 kWh/yr for other technologies. This requirement is independent of evaluation.

1.2 INDUSTRIAL AND PROCESS EFFICIENCY EVALUATION OBJECTIVES

The primary objective of the Industrial Process and Efficiency Program Impact Assessment was to determine the gross and net electric and fossil fuel savings associated with Program-funded projects completed from program start in early 2009 through June 30, 2010.

This evaluation was designed to calculate savings by applying to the program reported savings, two factors:, the realization rate (RR), and the net to gross ratio (NTGR).: The RR is the ratio of the evaluated gross savings to the program-reported savings; the NTGR, accounts for the influence of customer decision-making on savings through the estimation of free ridership (FR) and participant spillover (SO). The program's evaluated net savings is the product of the program reported savings, the RR, and the NTGR.

A targeted study of non-energy impacts (NEIs) associated with these projects was also conducted, as were pre-installation reviews by evaluators for selected large complex process-oriented projects expected to be implemented in 2012 or later.

The evaluation started in late 2010 and was completed in 2012.

This is phase one of a two-phase evaluation The first was scheduled for 2011 to allow a sufficient number of projects to be completed and accumulate post-retrofit performance and still give regulators and program staff early feedback on this new program's performance. Because the first evaluation cycle covered relatively few projects compared to the program's 15x15 goal savings, NYSERDA plans to fund a second evaluation cycle in 2012. The second cycle generally will follow the same model as the first, with three potential changes: (1) the sample design will account for the cohort of projects that received pre-installation evaluator involvement prior to reporting program savings, (2) some medium and large projects may be evaluated using both pre- and post-retrofit measurements, and (3) the scope of research will include participant SO.

1.3 REPORT FORMAT

The Impact Evaluation Team prepared a results presentation as the evaluation process neared its conclusion. The primary intent of this presentation was to give feedback to program staff regarding opportunities to improve program operations. This comprehensive impact evaluation report presents the evaluated gross- and net savings. The balance of this report is organized as follows:

- Section 2 provides details on the evaluation approach and methodology, including the sample design.
- Section 3 presents the evaluation results.
- Section 4 contains conclusions and recommendations to program staff.
- Report appendices follow Section 4

Section 2:

EVALUATION METHODOLOGY

This section describes the methods used to estimate evaluated gross and net savings and Non Energy Impacts (NEIs) for the Program. The discussion covers the overall approach, the sample design, the net-to-gross (NTG) analysis, and the calculation of total evaluated program savings.

2.1 OVERALL APPROACH

During 2011, the Impact Evaluation Team conducted a retrospective evaluation of a sample of the projects completed in 2009 and early 2010 using on-site measurement and verification (M&V) and enhanced NTG measurement techniques. The realization rate (RR) and net-to-gross (NTG) survey were sample based, with the results extrapolated to all projects in the population.

The Team developed two factors – RR and net-to-gross ratio (NTGR) – to arrive at the final savings attributable to the Program. The two factors were developed from data collected during on-site M&V, two NTG surveys, and previous studies:

1. On-site M&V was conducted at 36 facilities. The RR was calculated based on the information gathered and analyses performed during this M&V. The on-site M&V also included non-energy impacts such as operations and maintenance savings, production savings, and water use savings.
2. On-site and telephone surveys were administered to facility decision-makers for the projects included in the M&V sample to develop inputs into the estimate of FR. Surveys were implemented for 33 of the 36 projects where on-site M&V was performed. Decision-maker interviews could not be secured for three of the projects.
3. A telephone survey with vendors associated with the projects in the on-site M&V sample was conducted to provide additional input into the estimate of free ridership (FR) for the sampled projects. Evaluators completed interviews with vendors for 35 projects.

Since the Program is new and it takes time for participants and market actors to absorb and act upon the information disseminated through the program, it is likely that estimating participant spillover (SO) from primary data collection would underestimate the actual impacts of the program. Consequently, developing a current estimate of SO was not part of the evaluation design. Instead, SO estimates were taken from prior NYSERDA evaluations to ensure a balanced and unbiased estimate of the net-to-gross ratio (NTGR).

On-site M&V and surveys were conducted from July through December 2011. The vendor surveys were implemented during November and December 2011. NEIs such as operations and maintenance savings, production savings, and water-use savings were also assessed during the on-site M&V.

In addition to the traditional post-installation M&V of projects completed through June 30, 2010, the Impact Evaluation Team worked with program staff on selected large projects that will be completed in 2012 or later to afford evaluators and program staff the opportunity to review projects prior to implementation and encourage consistency in M&V baseline definition, methodology, and data collection.

2.1.1 Data Sources

The Impact Evaluation Team issued two data requests to NYSERDA. The first request was for tracking data to be used to design the sample. Key data included tracking ID and other customer identifying information, location, status, savings, and measure descriptors for each project. Upon receipt, the information was reviewed and the database's relevant fields were consolidated to develop the appropriate inputs for evaluation project sampling.

Once the sample was drawn, a second data request was made for the following information from each sampled project:

- Project-level information, including address, contact information for the site owner and engineer, type of project (custom, design/build), and type of business.

- Measure-level information (in easily readable electronic format), such as a description of the measure, quantity recommended, energy savings (electric, natural gas, and other fuels), demand savings, measure life, and installation costs.
- Pre- and post-retrofit production data.
- Firmographics including the size of the firms, the number of employees, the fuels used for major end uses, and the types of major electric and natural gas end uses. According to NYSERDA staff, this information is likely to be found in the study reports.
- Emails and related communications about the project archived by program staff, Vertical Outreach contractors, and other parties.
- Utility consumption data from third-party sources for the pre- and post-retrofit periods for the projects selected for site visits.
- Supporting implemented measure details including description and analysis.
- Excel workbooks, building and system simulation input files, and other documentation of savings calculations developed by applicants and review contractors.

2.2 SAMPLE DESIGN

The general approach to sampling for the on-site, participant NTG and vendor NTG is discussed below. A detailed sampling plan was presented in a separate memo and provided to NYSERDA and the New York Department of Public Service (DPS) for review. This memo is attached as Appendix A.

The population was defined as all Program projects[12] with a current status of "installed" and a current status date from the beginning of program implementation in 2009 through June 30, 2010 in the tracking system at the time of the data extraction: August 9, 2010.[13] (The first project application was received on September 10, 2008; the first project was completed on February 25, 2009.) This end date of June 30, 2010 was chosen to be as late as possible and still allow time for meaningful accumulation of post-retrofit billing, production, and other performance data.

Seventy-one Program projects met the above criteria. One upstate project reported no savings and was excluded, reducing the sampling frame to 70 projects, of which 65 received Energy Efficiency Portfolio Standard (EEPS) electric funding, two received EEPS natural gas funding, and three received System Benefit Charge (SBC) funding.[14] One natural gas project reported both electric and natural gas savings and was funded by both EEPS electric and EEPS natural gas. After the sample design had been completed and the strata defined, one project was removed from the upstate census strata because the phased nature of the project meant that by the time the evaluation occurred, additional changes had already been made to the facility that would make the original project difficult to evaluate.

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[12] In this evaluation the term "project" is used to describe a single measure or group of measures recorded in NYSERDA's program tracking system under a unique project number. In some cases groups of disparate and physically unrelated measures were grouped together as a single NYSERDA project for administration. Conversely, NYSERDA administrators split some multiple-stage projects that span multiple years into multiple project numbers. Also note if installed measures' savings were included in NYSERDA's installed savings count they were subject to evaluation.

[13] Three of the projects that met this criteria were multi-stage projects for which some but not all measures were completed. The reported savings corresponded to the savings for completed measures only.

[14] The three SBC projects were encumbered prior to EEPS as part of the Existing Facilities Program, but the development period meant that the handling of them was substantively provided by the Industrial and Process Efficiency Program and the completion dates were after the beginning of EEPS. All were air compressor projects of between 300,000 and 550,000 kWh/yr in savings. The projects were in the sample frame and used in development of the realization rates, but they are not part of the EEPS-funded population and for net impact calculation and reporting, the savings was excluded. Since the SBC projects were treated in the same fashion as EEPS projects, including them in the sample for estimating realization rates and net effects would not be expected to introduce bias into the results.

Since natural gas savings were claimed for only two projects, both were evaluated to estimate the RR for natural gas. The data center projects were also put in a dedicated census stratum due to anticipated future growth of projects in that segment.

For the other electric projects, two samples were drawn for the impact evaluation: one for the upstate region and one for downstate. The primary sampling unit was the project, and the sample frame was stratified by size, defined according to the annual electrical energy savings.

The sample was designed to determine the electric RRs for the upstate and downstate regions separately at the 90/10 confidence/precision level. Sample sizes were chosen using stratified ratio estimation (SRE), assuming an error ratio of 0.60. This relatively high error ratio was assumed because this was a new program with complex and unique industrial measures expected, which evaluators anticipated would lead to a greater than average variation in RRs.

Tables 2-1 and 2-2 show the distribution of projects and savings into the size strata. Break points between strata were defined using the SRE method as described in the California Evaluation Framework.[15] The stratum boundaries are indicated by the minimum and maximum annual project savings for each stratum shown in the table. The sample was allocated evenly to the strata. However, in some cases the number of projects was less than the allocated sample size for some strata in the upstate region. These strata were designated as census, i.e., all of the projects in the stratum were included in the sample.

The downstate population included only 11 projects, of which the smallest energy saver was relatively inconsequential (less than 5% of reported savings). As a result, this project was removed from the sample. All of the other projects, including seven projects with reported electric savings, one natural gas project, and both data center projects, were evaluated.

Table 2-1. Upstate Projects and Savings by Stratum

Stratum		Sampling Method	# of Projects	kWh Savings	% of Total kWh Savings	Min kWh	Max kWh	Sample Size
0	Natural gas	Census[1]	1	0	0%	0	0	1
1	Small	Random	30	5,894,794	18%	46,810	314,788	8
2	Medium	Random	14	6,716,915	20%	330,508	837,074	8
3	Large	Census	7	8,520,511	25%	870,000	1,689,054	7
4	Very large	Census[2]	3	11,884,797	35%	2,309,504	5,355,067	2
5	Data center	Census	3	589,800	2%	63,275	441,487	3
Total			58	33,607,403	100%	0	5,355,067	30

[1] NYSERDA's tracking database indicated one project with reported electric savings of 586 kWh in this stratum. This was actually the MMBtu savings for this natural gas efficiency project. The 586 kWh has been corrected to 0 kWh of savings in this table.

[2] After the sample design had been completed and the strata defined, one project was removed from upstate census strata 4 because the phased nature of the project meant that additional changes had already been made to the facility that would make the original project difficult to evaluate. The other two projects in this stratum were verified.

[15] 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, 327 to 339 and 361 to 384.

Table 2-2. Downstate Projects and Savings by Stratum

Stratum		Sampling Method	# of Projects	kWh Savings	% of Total kWh Savings	Min kWh	Max kWh	Sample Size
0	Natural gas	Census	1	23,651	1%	0	0	1
1	Small	Excluded	2	95,000	4%	23,651	95,000	0
2-4	Med-very large	Census	7	1,688,770	68%	127,816	424,016	7
5	Data center	Census	2	664,055	27%	67,668	596,387	2
Total			12	2,471,476	100%	0	596,387	10

The final sample represents over half of the participants and over 85% of the population's reported savings.

2.3 REALIZATION RATE

The RR is the ratio of evaluated energy savings to the Program's reported savings at the time of evaluation.[16] 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.

2.3.1 Program Measurement and Verification

Evaluation M&V leveraged data collected during program-required M&V for applicable projects. When evaluation M&V accuracy requirements exceeded what the Program had already required and funded independent of the evaluation, or in instances where program M&V was not performed, spot and short-term metering was conducted to supplement available data. Analysts designed M&V plans around equipment metering. Engineers used the International Performance Measurement and Verification Protocol (IPMVP) framework to develop M&V plans, as is discussed below.[17]

2.3.2 Baseline

Baseline definition is important for industrial process projects and can be challenging to determine. There is no code or code analog for minimum efficiency associated with most industrial projects. Applications can be unique, with no obvious standard practice. Projects often are associated with expanding plant or data center processing capacity.

The Impact Evaluation Team developed a protocol for defining baseline and solicited the input of program staff prior to the finalization of the baseline's definition.[18] The protocol is included with this report as Appendix B. The key principles include normalizing savings per unit production, using long-term post-retrofit production rates as the basis for both pre- and post-retrofit energy use and defining the baseline as the least efficient alternative that the customer would reasonably have considered technically and economically. Evaluators used the guidance in this memo to verify and define project baselines, especially for process efficiency and capacity increase projects.

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[16] The program reports savings after installation. For projects subject to program-directed M&V, the savings is subject to revision up to a year or more after applicants complete M&V. In one instance a census stratum project was evaluated based on reported savings that potentially was subject to later such adjustment. This anomaly does not affect the evaluated net impact but could cause the evaluation RRs to not reflect the correct value relative to the final post-M&V adjusted reported savings.

[17] The *International Performance Measurement and Verification Protocol* (IPMVP) defines methods of performing M&V for energy efficiency-related projects in four "options." The options are described in detail in the protocol available at www.evo-world.org.

[18] *NYSERDA Industrial and Process Efficiency Baseline Determination Methodology for Program Evaluation, Final* 2/12/2010, Jon Maxwell, ERS and Megdal & Associates Impact Evaluation Team, prepared for Cherie Gregoire, NYSERDA Energy Analysis.

2.3.3 Measurement and Verification Site Work

The Impact Evaluation Team collected program tracking data from the implementation team, conducted independent surveys, and installed meters to collect independent data. The metering requirements were defined by the engineers in the M&V plans in accordance with IPMVP terminology. Where possible, site engineers estimated and considered measurement error and other sources of engineering uncertainty.

Sampled participants were subject to one of three levels of evaluation to determine the Program gross savings RR:

1. Verification-level rigor only – Inspection or review-only verification, for the smallest savers or those whose savings were seasonally dependent and for which metering was not possible during the evaluation period (planned as 3% of evaluated projects, 8% actual).
2. Basic rigor – IPMVP Option A-level analysis if the project delivers moderate savings and the evaluation engineer finds that the implementation-side M&V was conducted in a sufficiently rigorous and objective manner to permit leveraging the data. An analysis based on production-normalized billing analysis would typically be in this level of rigor (45% planned, 10% actual).
3. Enhanced rigor – IPMVP Option B-level analysis, for all large savings projects in the sample and for moderate savings projects that lacked prior evaluation-grade analysis through the Program. This level of rigor typically includes modeling of the process or building, calibrated against field measurement of specific equipment (52% planned, 82% actual).

The evaluation manager determined the level of rigor to assign to each project with consideration of the complexity of the analysis, the magnitude of savings, and overall budget available using the same decision-making process as described in the memorandum, Rigor Assignment for the On-Site M&V.[19] This document is included as Appendix C.

The final disposition was 8% verification, 10% basic, and 82% enhanced. The number of verification rigor projects increased compared to the plan because three projects instead of one could not be metered (measures/equipment out of season and a customer uncomfortable with logging). The number of basic rigor projects decreased, and the number of enhanced rigor projects increased without negative budget ramifications because the engineering teams were able to execute an enhanced level of rigor for an unexpectedly large number of lighting projects for the same level of effort that was allocated for industrial process measure evaluation at a basic level of rigor.

For the basic and enhanced rigor projects, the lead engineer drafted a site-specific M&V plan using the NYSERDA and DPS-approved M&V template and available project-level data. Each M&V plan identified on-site metering needs and the planned analysis method. Plan development required contacting the participant to ensure their willingness and ability to support the evaluation work and checking NYSERDA contact lists for recent prior contacts.[20] The approach either replicated the method used in the program application or used a different approach, depending on whether the evaluator concluded another method was more appropriate for post-retrofit based evaluator-grade rigor. The evaluation approach was sensitive to customer inconvenience and their perceptions regarding prior M&V already supported. Subsequently the on-site data collection was conducted. The data from the evaluator's M&V work was used to develop a project- or measure-level evaluated ex post savings estimate. The evaluator then compared the evaluated savings with the documented ex ante savings for that project or measure to determine the RR.

During the evaluation one project was identified that had complexities associated with measure retention. The project ultimately was not part of the evaluated sample but having to face the issue in both this program's

[19] From Jon Maxwell, Satyen Moran, ERS; Kathryn Parlin, WHEC; and Lori Megdal, Megdal & Associates, LLC, to Judeen Byrne, NYSERDA Energy Analysis and the Evaluation Staff of the New York Department of Public Service (DPS), November 16, 2010 revised February 21, 2011.

[20] As the evaluators were developing the population frame, extra time was required to manually screen the population for recent marketing department, FlexTech impact evaluation, process evaluation, and market characterization research contacts with Program representatives, to check for multiple staged projects at a single site, and to identify multi-site projects. Site names, addresses and contact names were used in lieu of a common premise identifier. While this was a manageable exercise for the Phase I population size of 70 projects the exercise will be more daunting as the program expands and will be unwieldy in the future.

evaluation and that of the concurrent Existing Facilities impact evaluation led to the establishment of a general evaluation and retention policy, described in Appendix D.[21]

2.3.4 Calculation of the Realization Rate

The goal of the calculations is to estimate overall RR for the Program. As presented in the glossary, for an individual project the electric energy realization rate is:

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

where,

$kWh_{evaluation}$ = Evaluation M&V kWh savings (by evaluation M&V contractor)

$kWh_{program}$ = kWh savings claimed by program

Similar formulas apply for demand and fossil fuel (MMBtu) realization rate calculation.

Program-level RR calculation is more complicated. In statistics the RR term for a sample is considered the ratio estimator and given the symbol b, as shown in the equation below. The RR or b is the ratio of the evaluated gross savings (numerator) to the program-reported savings (denominator).

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

where,

b = Realization rate (ratio estimator)

i = Project number (e.g. project 1, project 2, project 3,… to project n)

n = Total number of verified projects

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

y_i = Evaluated gross (verified) savings for project *i*

x_i = Program reported savings for project *i*

The program-reported savings for each project in the sample is known at the beginning of the evaluation and denoted x_i. Based on the sample design each evaluated project effectively represents itself and, if it is not a census project, also other projects not in the sample. The expansion weight w_i represents this factor. A w of 5.0 for example means that for every evaluated project in the sample, there is a total of 5.0 projects in the population that are of the same type. In this evaluation the type is defined by the unique geographic location (upstate or downstate) and size combination, or stratum. The product of the reported savings and the expansion weight for each sampled project, summed for all projects in the sample, constitutes the denominator of the program-level RR formula.

The evaluation engineers independently estimated savings for each project based on site M&V. This was the single biggest effort in the impact evaluation. The evaluated gross savings for each project is indicated as y_i in the equation below. As with the program reported savings, the evaluated gross savings is multiplied by the expansion weight and the products are summed for the sample, with the result being the numerator of the program-level RR formula.

The basis for these calculations and the method for calculating the variance are provided in *The California Evaluation Framework.*[22]

[21] Memorandum from Jon Maxwell, ERS, to Judeen Byrne and Helen Kim, NYSERDA, Measure Retention and Life Policy, October 28, 2011.

2.4 NET-TO-GROSS SAVINGS

NTG research examines the influence of the Program and project on decision-making to ascertain savings that are due to the Program's influence versus that which would have occurred anyway, i.e., naturally occurring efficiency.

2.4.1 Methodology for Free Ridership and Participant Spillover

The Net-to-Gross Ratio (NTGR), the adjustment factor to derive net savings from the Program, is comprised of two primary components:

1. Free ridership (FR) – The proportion of the savings that participants would have adopted within the same time frame without the influence of the Program.
2. Spillover (SO) – Additional efficiency actions that are taken due to what participants learned or experienced through the Program. SO estimates are developed for all the market actors that could be affected, whether these are participants or not and whether it occurs at the program facility or another facility. Inside SO (ISO) occurs when energy saving actions are taken at the same site by participants but are not done as part of the Program. Outside SO (OSO) occurs when energy saving actions are taken by participating end users or participating vendors at sites that are not part of program participation. There is also non-participating SO (NPSO) for savings resulting from actions taken due to the Program, but not through the Program, as the Program affects decision-making throughout the market.

Free Ridership Methods

Participant FR data was collected through telephone surveys (self-reporting) with participating building owners, participating vendors, and, when known, the firms additional key decision-makers. A schematic of the enhanced self-report approach used for this evaluation is provided in Figure 2-1, which shows each of the components and process flow.

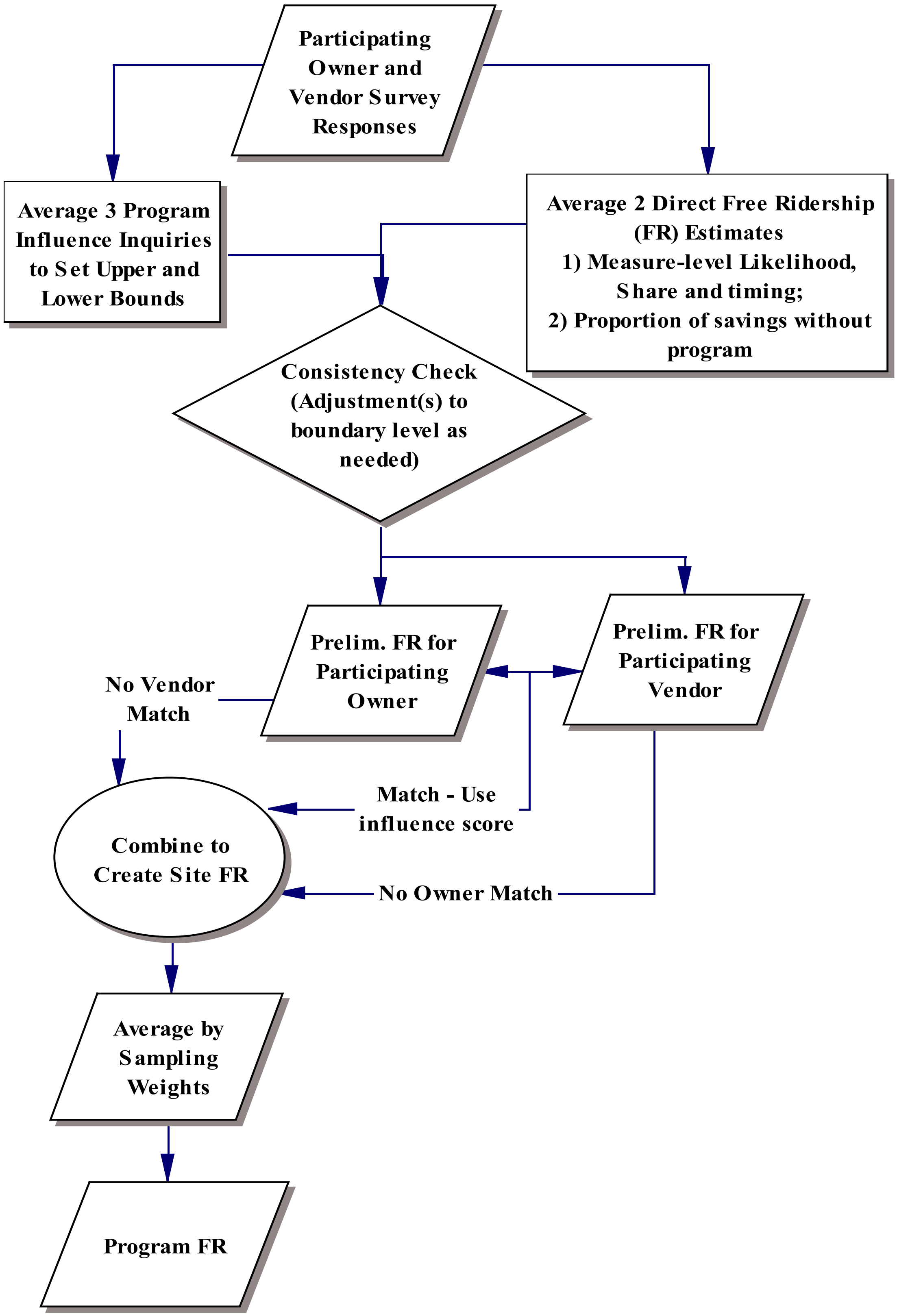
There are two initial FR estimates, referred to as the direct FR measurements, developed by site from each participating end user, any additional decision-maker, and participating vendors that completed the telephone survey. These two direct FR measurements are described below:

- The first direct FR estimate is derived from three survey questions. These ask about the likelihood of each measure being installed without the Program, the share of measures that would have been adopted for applicable measures (such as lighting), and when (timing) the measures would have been installed.
- The second direct FR estimate is from a survey question asking the participant to estimate, across all measures, the proportion of the total savings that would have been achieved without the Program.

These two estimates are averaged to develop a preliminary FR estimate for each participating site. This is represented by the rectangle in the second row on the right side of the schematic of the FR algorithm (Figure 2-1). (Appendix E uses actual survey data from two cases to go through the algorithm step by step.)

[22] 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, 327 to 339 and 361 to 384.

Figure 2-1. Schematic of the Enhanced Self-Report Components and How They Are Combined to Estimate Free Ridership for Industrial and Process Efficiency



A consistency check is performed by comparing the direct FR estimates developed through the above process to an average of responses to three questions regarding the influence of the Program.[23] The three survey questions that comprise the consistency check inquire about 1) plans for high efficiency prior to program participation, 2) the influence of the Program, and 3) the respondents' stated importance of the Program.[24] 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 based on the program influence questions, the final FR estimate for that site is adjusted upward or downward to the edge of those bounds according to the influence score. The consistency check and adjustment are shown in the diamond in the middle of the FR algorithm graphic above.

One significant improvement in the FR method was made in this evaluation as compared to prior NYSERDA evaluations. Previously the end user FR rates were averaged (savings weighted), and the vendor FR was averaged. Then these two figures were averaged to produce the program's FR rate. In reality the relationships between end users and vendors vary significantly. At one end, there may not be a vendor, i.e., the customer chooses what they want and just orders it; at the other end, the vendor may sell the customer on a specific technology, potentially using the Program to help sell the idea of making the change, and the customer relies totally on the vendor.

This evaluation asked a survey question regarding this relationship in the decision-making. Sites with end user and vendor FR estimates were combined site by site by weighting the end user and vendor FR factors based upon a proportional influence score derived from the survey inquiry. This approach should result in a higher level of rigor for the FR estimate than has been attained in prior evaluations.

Spillover Method

Spillover is commonly divided into two research components based on the affected market sectors, i.e., participant (including inside spillover (ISO) and outside spillover (OSO)[25]) and non-participant spillover. Distinct methods have been developed to estimate SO for these two, very different parts of the market.

For non-participants, NYSERDA historically has not evaluated NPSO for individual programs, as it offers many C&I programs that affect the C&I market interactively. Double counting or gaps would occur if a non-participant study was attempted program by program. Therefore, NYSERDA has a standing policy to use the results from a single C&I market study to measure NPSO that collectively is applicable for all major C&I programs. This method has been applied to multiple recent evaluations of SBC programs. The last such study was completed in 2007. A new evaluation to update this estimate began in early 2012 and is currently in progress.

Estimating participant SO for this Program is complicated on a number of levels. As the Program was in the early stages of implementation when the evaluation design was developed, the Impact Evaluation Team concluded that the evaluation time frame did not allow sufficient time lag for participant spillover effects to be measured at its long-term rate.

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[23] Over 20 years of experience in estimating self-report FR for energy efficiency program evaluation has set standards for quality 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 for construct validity to obtain a rigorous FR estimate over the need for sampling precision.

[24]The average of these influence scores by site and for each respondent is represented in Figure 2-1 by the left rectangle in the second row.

[25] **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, such as when, due to the program, participants add efficiency measures to the same building where program measures were installed but did not participate in the program for these measures.

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. This can occur when a firm installs energy efficiency measures they learned about through the program at another of their sites without having that other site participate in a NYSERDA program. Outside spillover is also generated when participating vendors install or sell energy efficiency to non-participating sites because of their experience with the program.

The Impact Evaluation Team carefully considered the possible approaches to estimating participant inside and outside SO for the Program's Phase 1 projects. The Team developed an evaluation work plan that called for applying the participant SO rate as developed through the latest evaluations for NYSERDA's C/I programs. This strategy was selected as the SO rates would be based on direct research in the New York market and similar programs implemented by NYSERDA. Although the Program) was launched in 2009, its roots are in the Commercial/Industrial Performance Program (CIPP) and the evaluators that with respect to spillover effects, Program projects completed in the Phase 1 evaluation timeframe are similar to the projects completed for the CIPP(since only a few major process upgrade projects were completed by June 2010. However, there is a potential issue in that these studies are not current and often the magnitude of the participant SO is substantial. Another issue is that these early projects are not expected to be representative of the Program's targeted large and often process-focused projects.

A second reasonable alternative strategy could be to apply a default value. The NY DPS has adopted a policy of applying a default NTGR value of 0.90 as a placeholder for EEPS programs that have not yet received an evaluation. Since one component of the NTGR could not be reliably evaluated from primary data and a second component is based on dated research, the default NTGR that encompasses both FR and SO could be a plausible solution. This approach also has the advantage of being straightforward and consistent with the DPS policy. A potential drawback is that it does not make use of the Program and NYSERDA C/I NTG research. In addition, assigning an NTGR of less than 1.0 effectively assumes that free ridership is higher than spillover, which is counter to the findings of similar projects in previous evaluations of NYSERDA's C/I programs.

After considering both approaches and also a third option of assigning a neutral NTGR of 1.0, the Impact Evaluation Team chose to use the approach of estimating participant SO from similar and precursor programs.

2.4.2 Survey Method for Net-to-Gross Data Collection and Sample Disposition for the Surveys

Two surveys provided data for the FR estimation described in the prior subsection:

1. A survey of participating building owners and associated decision-makers was conducted by the lead engineers for projects in the M&V sample. The questionnaire is included in this report as Appendix F.
2. A telephone survey of participating vendors was administered by a social scientist. The questionnaire is included in this report as Appendix G.

The lead engineers interviewed participating customers and asked a battery of FR questions as well as analysis inquiries needed for evaluating savings and NEI research. For census-strata projects, interviewers repeated the FR component of the questionnaire with additional decision-makers associated with the project when possible. The survey of participating vendors only contained inquiries related to the FR estimation task.

The Program funds more large custom projects than many other NYSERDA programs. The complexity and greater savings per project means that NYSERDA Program staff can and must spend more time with customers on each project. If handled well, this leads to better long-term working relationships than are often found in the more anonymous prescriptive incentive programs. This may have contributed to the Impact Evaluation Team's ability to obtain high response and cooperation rates. The sample dispositions for the surveys are provided in Table 2-3. The response and cooperation rates were 84.6% and 86.8%, respectively, for building owners and 92% and 100% for participating vendors.

Table 2-3. Sample Disposition for the Industrial and Process Efficiency Net-to-Gross Survey of Participating Building Owners and Vendors

		Number of Participating Building Owners	Percentage of Participating Building Owners	Number of Sites for Participating Vendor Interviews	Percentage of Sites for Participating Vendor Interviews
Total sample size		39a	100.0%	26	100.0%
Excluded Sample	Not working/unusable number	0	0%	0	0%
Not contacted	Respondent never available	1	2.6%	1	3.8%
	Answering machine	0	0.0%	1	3.8%
	Call back/left 800#	0	0.0%	0	0.0%
	Never contacted	0	0.0%	0	0.0%
Unknown eligibility	No answer/busy	0	0.0%	0	0.0%
	Records not yet called/scr. not complete	0	0.0%	0	0.0%
Not eligible	Not eligible/not qualified	0	0.0%	0	0.0%
Refused/	Refused	5	12.8%	0	0.0%
Break-off	Break-off	0	0.0%	0	0.0%
Completed interviews[1]		33	84.6%	24	92.3%
Contact rate = [Bldg owner (33+5)/(33+5+1) = 97.4%]			97.4%		92.3%
Cooperation rate = [Bldg owner (33)/(33+5) = 86.8%]			86.8%		100.0%
Response rate = [Bldg owner (33/38)×(38/39) = 84.6%]			84.6%		92.3%

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

[a] Additional decision-makers were identified for seven of eighteen census sites. Attempts were made to reach all seven. Surveys implemented with additional decision-makers for two sites.

[1] One project with two distinct sites and decision-makers. Surveys implemented with both decision-makers for this project. This is counted as just one project in this table.

2.5 EVALUATED NET SAVINGS

Evaluated net savings measures the program savings after adjusting for the RR and the NTGR. The formula is:

$$Evaluated\ net\ savings_{primary\ energy\ source} = Program\ reported\ savings\ \times\ RR\ \times\ NTGR$$

2.6 SECONDARY ENERGY IMPACT

Site-specific evaluated gross energy impact analysis included consideration of the impacts of the projects on energy sources other than those that formed the basis of the incentive. Because there were no corresponding reported savings estimates, the impact was calculated directly without the use of a ratio estimator. Otherwise the secondary energy impact calculation method was the same as described in Section 2.3.

$$Evaluated\ net\ savings_{secondary\ energy\ source} = Evaluated\ gross\ savings_{secondary}\ \times\ NTGR$$

2.7 NON-ENERGY IMPACT

The evaluation included analysis of non-energy benefits and costs to the customer that resulted from the implementation of the measures. The sample for the NEI evaluation component was the same as that for the evaluation on-site M&V. The engineer responsible for the site visit also asked NEI questions and estimated NEIs for installed measures. An extensive battery of NEI questions was incorporated into the on-site survey instrument. Evaluators anticipated that NEIs would include the following:

- Maintenance labor and materials savings
- Labor savings associated with productivity gains (e.g., the process is faster and eliminates a shift)
- Increased sales associated with faster production (e.g., more paper per hour with the same hr/yr)
- Increased sales associated with producing higher quality products

Evaluators quantified the NEIs for projects whenever possible. In the aggregate analysis, the dollar value of the NEIs was normalized per MWh/yr or per MMBtu/yr or first-year reported savings on the project. The analysis did not attempt to quantify non-participant NEIs.

Section 3:

RESULTS

This section presents the analysis results by each major element: realization rate (RR), evaluated net to gross (NTG), and non-energy impacts (NEI).

3.1 REALIZATION RATE

RR measures the variance between the Program's reported savings and the evaluated savings. It is defined as the evaluated savings divided by the Program's reported savings.

3.1.1 Measurement and Verification Site Recruitment

Engineers performed site-specific measurement & verification (M&V) on 36 of the 40 sampled projects to determine the RR, as described in Section 2.

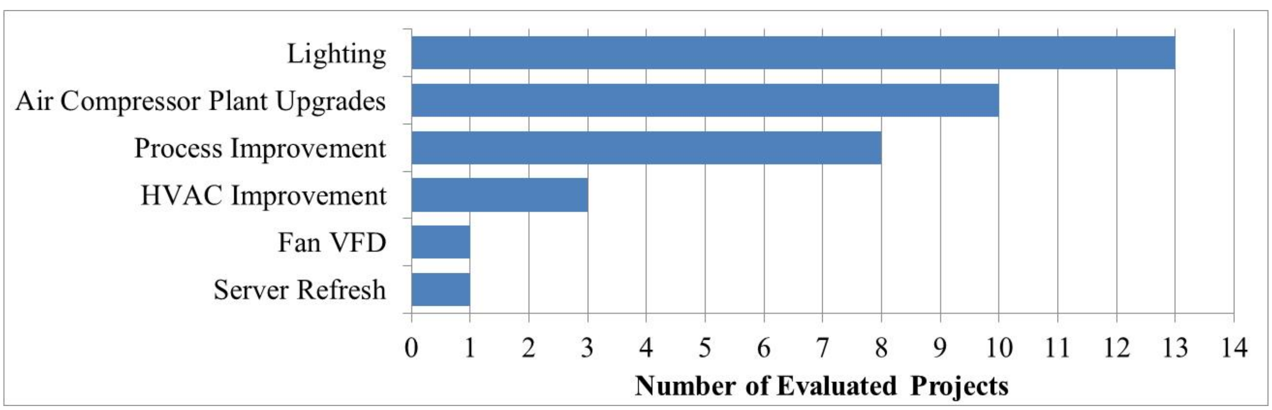
M&V was not implemented for three projects due to refusal or non-response. Engineers determined that a fourth project could not be evaluated; the funded project was phase five of a seven-phase project. The participating customer was installing phases six and seven during the evaluation period, which meant that short-term metering could not capture representative post-retrofit performance. It is recommended that this project be evaluated in the next evaluation for the Program.

All four of the dropped sites were part of census strata, which means they were irreplaceable in the sample. Additionally, given the small number of non-responders and the nature of the reasons for dropping these sites[26], the Impact Evaluation Team determined that it was inappropriate to account for non-response bias in weighting the sample RR results.

3.1.2 Site-Specific Energy Savings and Realization Rates

Figure 3-1 tabulates measure types reflecting the technologies investigated on-site. Lighting efficiency was the most common measure evaluated, followed by air compressor plant upgrade measures and process improvement measures. Server refresh, the systematic replacement of computer servers before physical failure, and the upgrade of a fan from constant to variable speed control were the least common measures, occurring once each.

Figure 3-1. On-Site Measurement and Verification Measure Type Summary



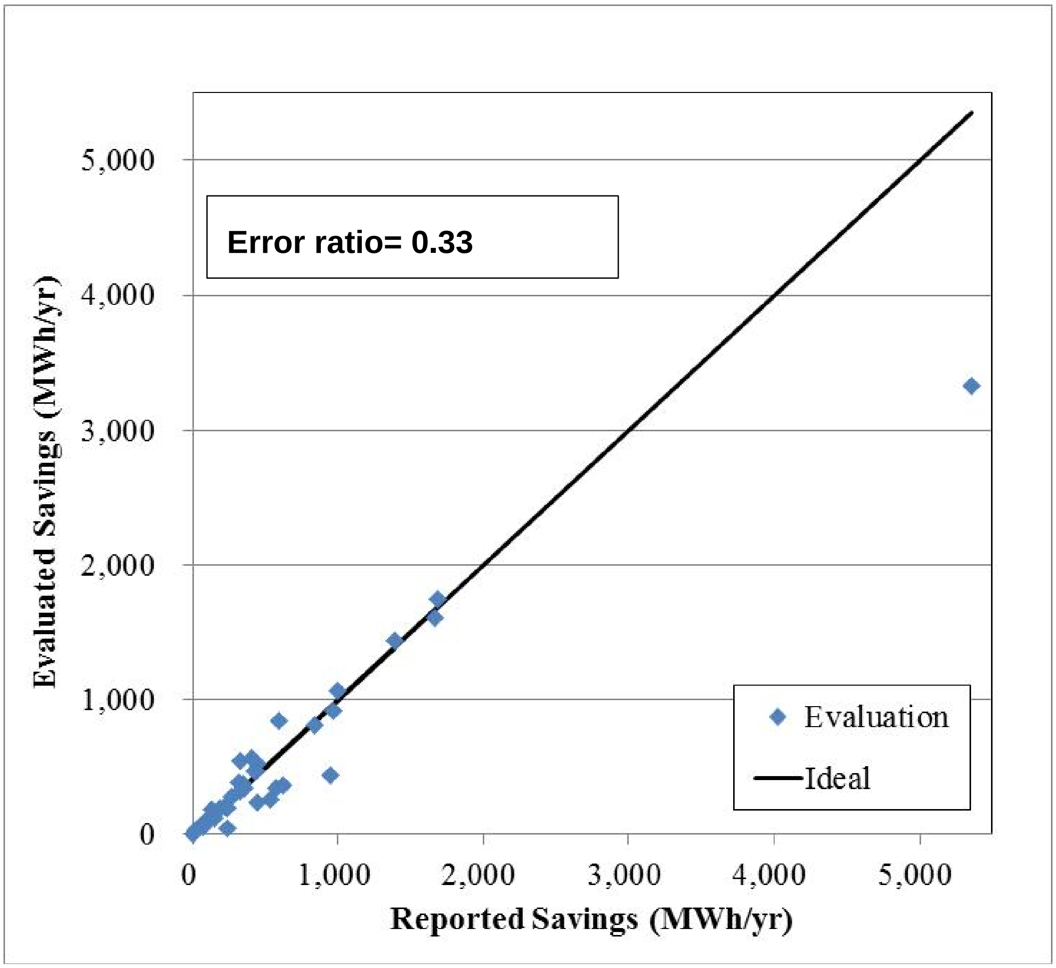
For the population, 38% of the electric energy savings was associated with technologies also found in the commercial market: Lighting, HVAC, and non-process VFDs. An additional 40% of the savings was for

[26] One customer was unresponsive to requests, two refused evaluation due to poor timing relative to the process cycle and staff availability, and one multi-phased project was in the midst of installing the subsequent phase at the time of evaluation.

compressed air system upgrades. Most such incentives funded VFD-controlled compressors. Process measures contributed 21% of the savings. Data on committed projects not yet completed indicates that process-related projects will contribute a significantly greater share of savings in the future.

Figures 3-2 and 3-3 illustrate the evaluated annual electric energy and summer coincident peak demand[27] savings compared with that reported by the Program. Ideally, the evaluated savings would always match the program savings. This ideal is shown as a solid black line on the charts. Actual findings are plotted as points on the graphs. A pattern of points below the ideal line suggests an RR of less than one; points above the line suggest an RR greater than 1. The error ratio measures the amount of scatter in the point distribution. The higher the error ratio, the greater the amount of scatter between points. The error ratio assumed for estimating sample sizes was 0.6.

Figure 3-2. Reported and Evaluated Electric Energy Savings

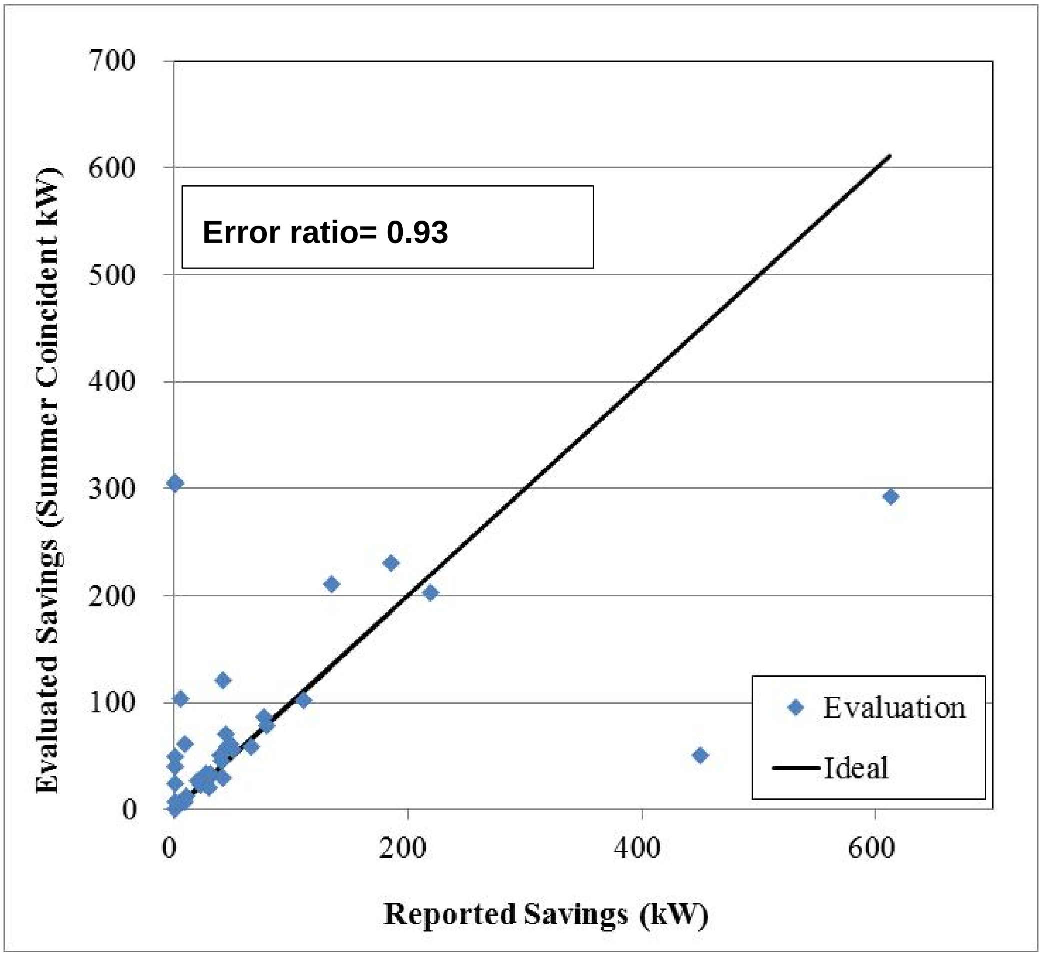


The electricity savings error ratio was calculated to be 0.33. This is much lower than the 0.6 error ratio that was assumed in estimating the sample size, indicating less scatter in the point distribution than was assumed when estimating sample sizes, and meaning that the evaluation was able to attain better sampling precision than originally anticipated.

[27] For this evaluation NYSERDA defined the summer coincident peak demand period as the hours between noon and 6 p.m. on non-holiday weekdays during June, July, and August. NYSERDA reports the demand savings as the average reduction in electric demand during the summer coincident peak demand period. For reference see Reporting Coincident Peak Period Demand Reduction-INTERIM DRAFT memorandum from Dakers Gowans, Nexant to Cherie Gregoire, NYSERDA, May 11, 2006.

One site represented more than 15% of total electric savings reported by the Program, making it the single largest saver reported. This project is indicated in the far right corner of the graph above. About two-thirds of the reduction in this project's evaluated savings compared to the program reported savings is due to evaluators' finding that some of the saved electricity is supplied by an on-site coal-fired power plant and does not reduce utility grid load. Evaluators reduced the evaluated electricity savings accordingly and credited the program with this coal savings in Section 3.3 of this report.

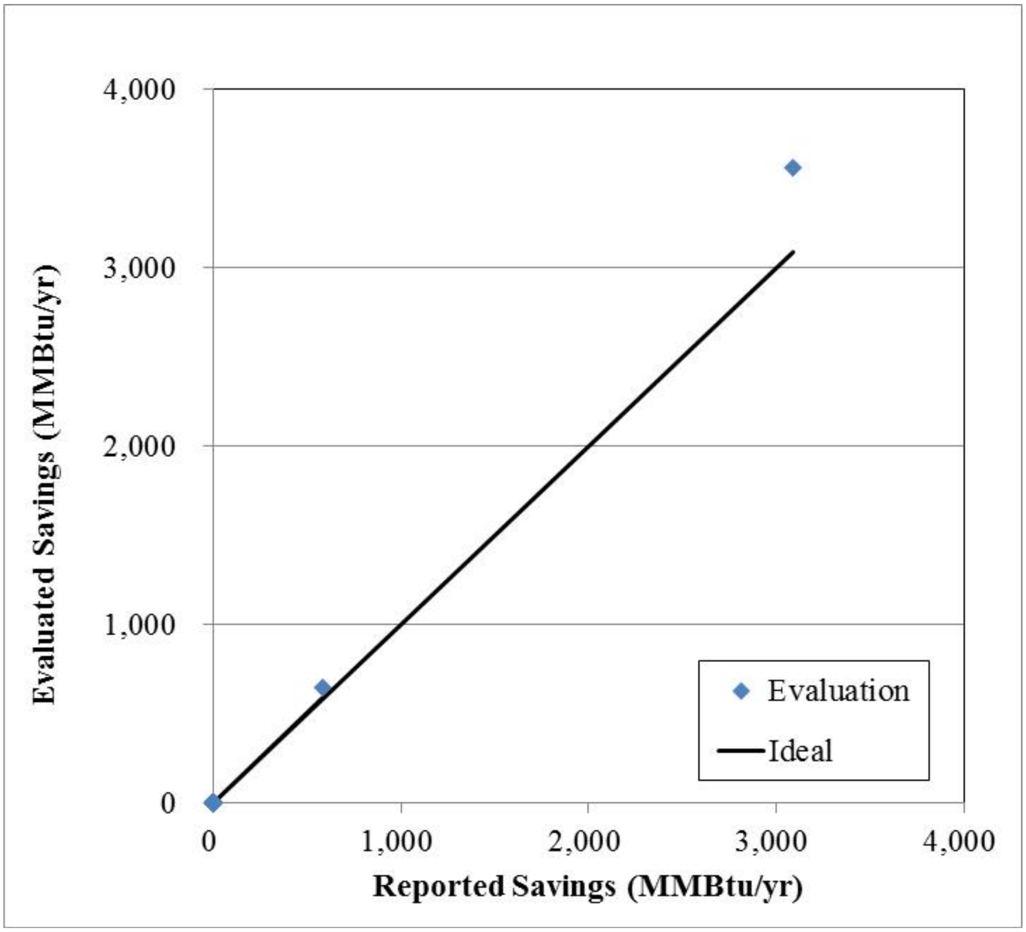
Figure 3-3. Reported and Evaluated Electric Peak Demand Savings



Evaluators found that the level of rigor used by applicants to estimate demand savings varied widely and generally was lower than that used to calculate energy savings. Also the peak demand savings basis varied between projects. Additionally, the Program did not begin requiring peak demand savings calculations until the latter part of the period under evaluation. Reported program savings estimate demand savings based on many different definitions: average billed demand savings over 12 months, cumulative billed demand savings per year, super-peak demand savings, and summer demand savings. Evaluation analysts calculated project-specific peak demand savings for the sample using the summer coincident peak demand period definition and used this demand estimate as the evaluated peak demand. The variability in the program peak demand calculation methodologies and reporting strategies explains the spread in the evaluated vs. reported savings in Figure 3-3.

Figure 3-4 shows the same relationship of program reported and evaluated savings for fossil fuel efficiency measures.

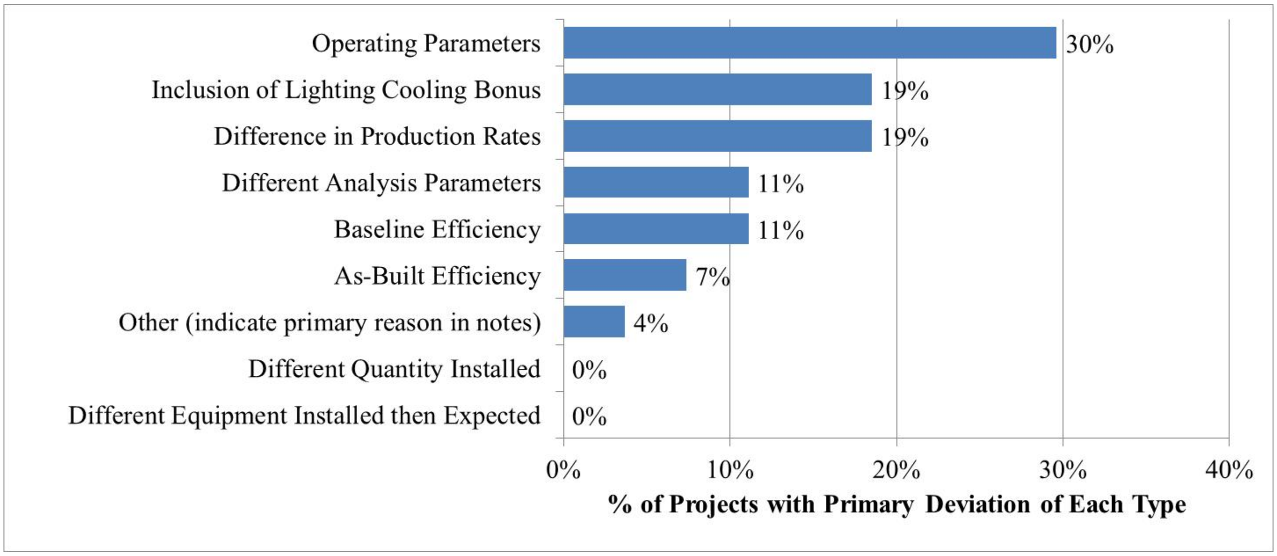
Figure 3-4. Reported and Evaluated Fossil Fuel Savings



3.1.3 Site-Specific Reasons for Energy Savings Realization Rate Deviations from 1.0

Of the 36 projects that received on-site M&V, evaluators calculated annual kWh savings that deviated from the study-estimated energy savings by more than +/-10% for 20 of the projects. For each of these projects the study's lead evaluation engineer categorized up to two major reason(s) for such deviation; in seven instances the engineer chose two reasons. The chart in Figure 3-5 illustrates the major reasons for the evaluation results to deviate more than +/-10% when compared with the program reported savings as recorded in NYSERDA's tracking system. Percentages are shown relative to the 20 projects in which significant deviation was observed. These percentages are not weighted on savings.

Figure 3-5. Reasons Evaluated Savings Deviated from Study Estimates



Some of the reasons for discrepancies between verified and program savings are described below.

- Operating parameters (e.g., schedules, hours per year, compressed air system pressures) between predicted and evaluated calculations were found to differ. Some of the differences were due to the different time periods between evaluation and program review; others were due to the difference in data collected or data collection duration.
- Production rates (e.g., higher or lower than expected production after measure installation) varied from the original estimates.
- Calculation methodology (e.g., the inclusion of a cooling bonus on lighting efficiency projects in evaluation savings) was modified by evaluators.
- Analysis parameters (e.g., efficiencies of equipment serving measure systems) or the baseline and as-built equipment efficiencies did not agree.

The evaluation found that equipment quantities, type, make, and model were consistent between program documents and evaluation inspection. This finding reflects a high level of rigor on the part of program staff and technical assistance providers during the post-installation review step of the program.

3.1.4 Program Measurement and Verification

The Program requires M&V for all lighting projects with reported savings of more than 1,000,000 kWh per year and all other projects with reported savings greater than 500,000 kWh per year. Evaluators identified 10 projects of the 36 evaluated that also received program M&V.

It appears that projects analyzed during program M&V accurately captured the project savings more often than those projects not subject to program M&V. Comparing the percentage of projects that deviated from program savings by 10% or more, there were 40% (4 of 10) of projects with program M&V fell into this category as compared to 56% (20 of 36) of projects that did not go through the program M&V process. While the sample size is small and the results may not be statistically significant at the 90% confidence level, this finding suggests that program M&V is having a positive effect on improving the accuracy of program savings. Evaluators also observed that projects with longer (three to four months) program M&V periods tended to more accurately project baseline and as-built savings than those with shorter M&V periods (four weeks or less).

3.1.5 Program-Level Realization Rates

Tables 3-1 and 3-2 present the summary of the RR estimates for electricity savings, by strata and program. The RRs are reported separately by region of the state. The statewide RRs are 0.89 on annual electric energy, 1.01 on summer peak coincident demand, and 1.14 on annual natural gas energy.

Relative precision is 4.9% on annual electric energy, and 35.1% on summer peak coincident demand. There is no sampling uncertainty on natural gas, as both projects were evaluated.

Table 3-1. Realization Rate Results Summary, Electricity, by Region and Size

Stratum		Sample Size Range (Annual kWh)		Population (N)	Number of Completed Sites in Sample (n)	Realization Rate	Relative Precision
Upstate							
0	Natural gas savings only	-	-	1	1	N/A	
1	Small	85,480	327,493	30	8	1.03	
2	Medium	354,072	837,074	14	8	0.78	
3	Large	947,011	1,689,054	7	6	0.94	
4	Very large	5,355,067	5,355,067	3	1	0.62	
5	Data centers	63,275	441,487	3	2	1.16	
	Total			58	26	0.86	5.9%
Downstate							
0-1	Natural gas & small	23,651	23,651	2	1	1.74	
2-4	Medium/large/very large	127,816	424,016	7	7	1.23	
5	Data centers	67,668	596,387	2	2	0.84	
	Total			11	10	1.22	0.0%a
Program Totals							
Total				**69**	**36**	**0.89**	**4.9%**
Total without upstate stratum 4					**35**	**0.95**	**N/A**

[a]Census attempt so no sampling uncertainty.

The sampled site in upstate stratum 4 is the single largest saver in the population and considered an outlier due to its size and unique technical characteristics. Because it is an outlier, the expansion weight for upstate stratum 4 remained at 1.0 and was not adjusted upward due to the nonresponse of the other two participants in the census stratum.

The presentation of program-level results and recommendations has been framed with consideration to overall program performance both including and excluding this project in the evaluation result; without this site, the RR for the Program increases to 0.95.

The sample design placed data center measures in their own upstate and downstate strata so that evaluators could ensure examination of this unique sub-segment of the Program population to determine if such projects, expected to be a significant contributor to future energy savings, have characteristic differences in performance from other Program projects. The results suggest that differences are moderately significant. The four data center projects[28] together have a better-than-average 1.13 RR. They also have relatively low variance between evaluated and reported savings. The two data center lighting projects have an RR of 1.31. The high RR is driven not just by lighting energy savings, but also by savings in cooling energy. The two server refresh projects are smaller projects than the Program average and have a 0.92 RR. The high RR for the data center projects is driven by the savings of the two lighting projects.

Table 3-2 shows the RRs and relative precision for summer peak demand savings.

Table 3-2. Realization Rate Results Summary, Summer Coincident Peak Demand Savings

Stratum	Realization Rate	Relative Precision
Upstate		
Total (strata 0 through 5)	0.98	41.4%
Total without stratum 4 (very large project)	1.07	N/A
Downstate		
Total (strata 0 through 5)	1.41	0.0%a
Total Program		
Total	1.01	35.1%
Total without stratum 4 (very large project)	1.08	N/A

[a]Census attempt so no sampling uncertainty.

The relative precision in the peak demand result is higher than expected and indicates a high variation in the evaluated peak demand results. Evaluators expect that this variation stems from the Program not originally collecting demand information and inconsistencies in the Program's approach to claiming and calculating peak demand.

Table 3-3 shows the overall natural gas RRs and relative precision for those projects where natural gas impacts were claimed by the Program. Since only two projects claimed natural gas savings and both projects were verified, there is no sampling or sampling error, and the relative precision is 0%.

Table 3-3. Realization Rate Results Summary, Natural Gas Efficiency

Region	Sample Size (Annual MMBtu)	Population (N)	Number of Completed Sites in Sample (n)	Natural Gas Efficiency	
				RR	No Sampling (i.e., perfect sampling precision)
Upstate	586	1	1	1.09	0.0%
Downstate	3,086	1	1	1.15	0.0%
Total	3,672	2	2	1.14	0.0%

[28] The data center strata projects were for a lighting efficiency upgrade, lighting controls upgrade (classified as a HVAC controls upgrade in program tracking), and two server refresh projects, all in data centers.

The evaluated gas savings are higher than reported mainly because the evaluated savings per unit production was similar to that in the Program estimate, and actual production rates were greater than predicted for the two projects.

3.1.6 Realization Rate Summary

The key RR analysis findings are as follows:

- The overall evaluated electric energy RR is 0.89.
- The overall summer coincident peak demand RR is 1.01.
- The natural gas efficiency measures RR is 1.14.
- Evaluators found that differences in operating parameters, calculation methods, production rates, analysis study parameters, and equipment efficiencies were the largest contributors to the deviations observed between the evaluation and Program reported results.

3.2 NET-TO-GROSS SAVINGS

This section covers the components of the impact evaluation that are required to produce the free ridership (FR) and spillover (SO) rates, and net-to-gross ratio (NTGR).

3.2.1 Free Ridership

Survey responses were used to estimate FR according to the algorithm and procedure described in the evaluation methodology sections for FR (Section 2.3) and SO Section 2.4). This method is based on multiple inquiries and consistency checks in order to support construct validity for measuring this concept of what would have occurred without the Program, a circumstance that individuals do not actually experience. Appendix E presents two actual cases as examples and goes through the FR algorithm and its schematic step-by-step.

Two market actors contribute the primary inputs for the direct FR measurements at the site level: end users and vendors. These are the estimates averaged in the right square in the second row of the algorithm graphic (Figure 2-1), referred to as first direct FR and second direct FR and using survey inquiries. The average across sites for the first estimate is 34% from end users and 17% from vendors, as shown in Table 3-4. The second direct FR estimate averaged is 45% for end users and 32% for vendors.

Table 3-4. Average Direct Free Ridership for End Users and Vendors

	First Direct FR (Likelihood & share & timing)	Second Direct FR (Best estimate)
End users (n = 33)	34%	45%
Vendors (n = 21)	17%	32%

The distribution for the first direct FR estimate is fairly polarized for end users, with 36% of the end users reporting 0% FR and 24% reporting 100% FR. The median is 19%. The vendors had a low FR tendency, with 70% reporting no FR and only 5% reporting full FR.

The second direct FR distributions reflect similar patterns; 21% end users reported, 0% FR, and 21% reported 100% FR, and the median is 30%. For vendors, 33% report 0% FR and 19% report 100% FR. The median is 10% (see Table 3-5.).

Table 3-5. Distribution for Direct Free Ridership for End Users and Vendors

	First Direct FR Estimate			Second Direct FR Estimate		
	Median (Likelihood & share & timing)	0% FR (Likelihood & share & timing)	100% FR (Likelihood & share & timing)	Median (Best estimate)	0% FR (Best estimate)	100% FR (Best estimate)
End users (n = 33)	19%	36%	24%	30%	21%	21%
Vendors (n = 21)	0%	70%	5%	10%	33%	19%

The two direct FR estimates are averaged by site and by market actor. This estimate is then compared to the site average by market actor for the three program influence questions. This provides a preliminary site FR by market actors adjusted for consistency checks (the application of FR bounds based upon program influence scores). If the respondent's preliminary FR estimate fell below the lower or above the upper bounds of FR based on their average influence score, the final FR estimate for that site from that respondent was adjusted upward or downward to the edge of those bounds. The average of the two direct FR measurements for end users was 39%; after the consistency adjustments, it was 40%. Six percent were adjusted downward, and 12% were adjusted upward. The vendors' average of the two direct FR estimates was 25%; after the consistency adjustments their preliminary FR was 20%. Table 3-6 presents this information.

Table 3-6. Average of Direct Free Rider Estimates, Adjusted for Consistency

	Average of Two Direct FR Estimates	Percentage That Were Inconsistent & Were Adjusted Downward	Percentage That Were Inconsistent & Were Adjusted Upward	Preliminary FR
End users (n = 33)	39%	6%	12%	40%
Vendors (n = 21)	25%	14%	0%	20%

Multiple inquiries used in the step-by-step algorithm individually fall close to the percentages found overall at the end of the algorithm. One example is that one quarter of the surveyed end users claimed that high efficiency equipment and designs were fully specified and explicitly selected or incorporated into the project budget prior to their participation in the Program. More than one-third (14) said that program participation did not influence the type, amount, or level of efficiency of the measures that were installed. Nearly one-third (11) estimated that 75% or more of the energy savings would have been achieved even if the Program had not existed.

Most of the steps of the FR algorithm are performed at the site level for end users and for vendors. The last stage of the FR algorithm is combining the preliminary site FR estimates from 1) matched building owners and vendors, 2) those with only end user respondents, and 3) those with only vendor input. The site FR rates from these three groups are 21%, 55%, and 41%, respectively. The FR from combining these estimates is 34% derived from site FR rates, as shown in Table 3-7.

Table 3-7. Site Weighted Free Ridership for Each of the Three Types of Sites

Groups by Available FR Data	Free Ridership Estimate	Number of Sites
Sites with only end user interviews	55%	14
Sites with matched end user and vendor responses	21%	19
Sites with only vendor interviewees	41%	2
Overall program	**34%**	**35a**

[a] There were two respondents for each site with a matched participating end user and their vendor. There were end user sites with no matching vendor interview and two vendor interviews with no matching end user interview.

3.2.2 Spillover

Nonparticipant spillover. NYSERDA uses an estimate developed at the portfolio level for NPSO, as the influence of NYSERDA programs serving the C/I sectors can easily overlap with one another and be interactive in the marketplace (making it difficult for respondents to differentiate the impacts from individual C&I programs). NYSERDA conducted a commercial/industrial (C/I) NPSO study applicable to C/I programs in 2005 and 2007. The most recent such evaluation in 2007 produced an estimate of 15%.[29] While actual NPSO for an individual program may be greater or lesser than the portfolio estimate it is expected that in general the overall effect should be representative.

Participant spillover (including inside spillover (ISO) and outside spillover (OSO)). As specified in the evaluation design, the Impact Evaluation Team reviewed participant SO from the Commercial/Industrial Performance Program (CIPP), which was one of the precursor programs to the Industrial and Process Efficiency Program ("the Program") and the Existing Facilities Program (EFP). While the Program is technically a new initiative by NYSERDA, it benefits from the technical expertise, implementation experience, and base of knowledge developed by NYSERDA's CIPP and EFP staff.

Participant SO from previous evaluations are presented in Table 3-8. A range of NYSERDA C/I programs are included in the table for context, and the studies are listed in order of relevance to the Program. CIPP is particularly similar to the Program in this first phase of evaluation because some of the projects actually started as CIPP (now EF) projects, and because the measure mix is not entirely different than CIPP. The other studies listed reflect programs with similar projects and measures to those included in this evaluation of the Program. About 25% of the Program Phase 1 funded projects were lighting, almost as many were air compressor VFD installations. Only a few major process upgrade projects were completed by June 2010. This will likely not hold true for the next phase of evaluated program participants.

[29] NYSERDA *Commercial and Industrial Market Effects Evaluation, Final Report*, submitted by Summit Blue Consulting LLC and Quantec, LLC., October 2007.

Table 3-8. Summary of NYSERDA's C&I Participant Spillover Rates from Other Relevant Evaluations

Row ID	NYSERDA C&I Evaluation Study	ISO Rate	OSO Rate	Total Participant SO
1	NYSERDA (2007) *Commercial and Industrial Performance Program Market Characterization, Market Assessment and Causality Evaluation*, May. Submitted by Summit Blue Consulting LLC and Quantec.	4%	40%	45%
2	NYSERDA (2005) *Commercial/Industrial Performance Program Market Characterization, Market Assessment and Causality Evaluaiton*, Final Report. March. Submitted by Summit Blue Consulting LLC and Quantec.	6%	19%	25%
3	NYSERDA (2012) Impact Evaluation NYSERDA 2007-2009 FlexTech Program, Final Report. March. Submitted by Megdal & Associates, LLC and ERS.	4%	30%	34%
4	NYSERDA (2007) Technical Assistence Market Characterization, Market Assessment and Causality Evaluation, Final Report. May. Submitted by Summit Blue Consulting LLC and Quantec.	11%	19%	30%
5	NYSERDA (2005) Technical Assistence Market Characterization, Market Assessment and Causality Evaluation, Final Report. February. Submitted by Summit Blue Consulting LLC and Quantec.	7%	28%	35%
6	NYSERDA (2005) Smart Equipment Choice Market Characterization, Market Assessment and Causality Evaluation, Final Report. March. Submitted by Summit Blue Consulting LLC and Quantec.	9%	22%	31%
	Minimum	4%	19%	25%
	Maximum	11%	40%	45%

The statewide default NTGR for EEPS planning and programs without evaluations is 0.90. The Program FR is 34% and NPSO is 15% (from the 2007 NYSERDA NPSO study). Considering that the Program is an outgrowth of CIPP and applying the default NTGR of 0.90 suggests a participant SO rate of 9% (0.90 – (1.00 - 0.34 + 0.15) = 0.09), which when compared to CIPP evaluations appears to understate participant SO, the Impact Evaluation Team recommended basing participant SO values on earlier studies.

The Impact Evaluation Team recommends using a participant ISO of 4%, which is the lowest value from the evaluations listed in Table 3-8. The low ISO value was selected since the Program is targeting larger customers and projects and is focusing on establishing long-term relationships with end users. These factors make it more likely to have a low ISO rate since these participants will be likely to take advantage of program services and incentives and measures will be installed through the Program rather than independently by the participant. In this respect, the ISO rate would be expected to be lower for the industrial process projects than for other programs with more prescriptive or smaller projects.

Regarding OSO, the 2007 evaluation of CIPP (for program years 2005 and 2006) estimated an OSO of 40%, and 2005 evaluation found an OSO of 19%, an average OSO rate of 30%. This value is very similar to the most recent FlexTech Program impact evaluation, which included projects, customers and measures similar to those in the CIPP. While CIPP was the predecessor program and it served over 100 industrial customers, there was concern regarding its relevance to this industrial-only program regarding spillover specifically. Evaluators considered this. As noted in Section 4.1.2, 38% of Program savings was for commercial technologies—lighting, HVAC, and non-process VFDs—and an additional 40% of the savings was for compressed air system upgrades, mostly VFD-controlled compressors. Such "balance of plant" measures are not commercial, but they have similar characteristics to commercial projects that are relevant to spillover: The efficiency solutions are not unique, they are applicable to many facilities; and they are provided by a mature distributor network that practices technology transfer. Given this measure profile for Phase 1 period projects, evaluators believe that the CIPP findings are relevant for comparison.

As CIPP is the closest to the Program and the 2005 evaluation was conducted earlier in the CIPP implementation cycle, the Impact Evaluation Team recommends the use of the 19% OSO from the 2005 evaluation. Although this evaluation is dated, this value is also the lowest OSO found in the range of evaluations presented in Table 3-8, suggesting that adopting this estimate of OSO would be unlikely to overstate SO. Choosing a value at the low end of the OSO range also is prudent due to the greater presence of EEPS programs in the market than existed five years ago. Some former OSO projects are likely now program-funded projects. The Impact Evaluation Team concluded that an OSO of 19% is an appropriate value to apply in the absence of direct and current research.

Using these SO values, the total NTGR is 1.04 (1 - 0.34 + 0.15 + 0.19 + 0.04).

Evaluators speculate that future Program participant spillover is likely to differ materially from the values assumed in this evaluation because unique process measures are contributing a greater share of the savings as the Program evolves. One would expect vendor-driven spillover to lessen as technology transfer opportunities decline. Therefore evaluators do not recommend using these estimates prospectively, only retrospectively to cover the Phase 1 evaluation. Primary research on the Program participant SO is planned to be an early activity in the next round phase of evaluation. Moving the schedule ahead on the next evaluation and adjusting the savings retrospectively based on the results of the next evaluation could be one approach to alleviating concerns about the validity of the SO estimate.

3.2.3 Net-to-Gross Ratio

The FR and SO rates are combined to produce an NTGR that is applied to evaluated gross savings to produce net savings. Figure 3-6 presents bar graphs displaying -34% for FR, 4% for ISO, 19% for OSO, and 15% for NPSO.

Figure 3-6. Bar Graph Depicting the Rates within the Program's Net-to-Gross Ratio

The NTGR is one minus the FR rate plus the SO rates that include participant ISO, participant OSO, and NPSO. The NTGR for the Program = 1.04.

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

$$NTGR = 1 - 0.34 + (0.04 + 0.19 + 0.15) = 1.04$$

3.3 SECONDARY ENERGY IMPACT

Most projects reported savings associated with a single energy source, either electricity or natural gas. Evaluation engineers also calculated other recurring fuel impacts due to interactive effects between energy-using systems in their assessments. All unreported interactive effects addressed by evaluators were natural gas impacts due to heating penalties associated with lighting efficiency projects. There were nine such evaluated projects. Evaluators calculated this secondary impact and expressed it as a function of reported MWh of electric savings. This analysis of secondary impacts is reported separately in this Section. Combining these secondary negative effects throughout would have obscured the positive natural gas savings results of the primarily natural gas projects.

One project has evaluated coal savings associated with an on-site electric power plant and an electricity-saving measure; this also is a type of secondary effect. These savings (see Table 3-9) were not considered to be representative of typical projects; therefore an MMBtu/MWh ratio for coal or other fuels was not developed. The coal impact is included in this section because, absent Program-reported impact, it is impossible to express the evaluation findings in terms of an RR.

Table 3-9. Electric Program Secondary Energy Impacts – Summary of Results

Non-Reported Fuel Impacts	MMBtu/MWh of Reported Savings	Evaluated Gross Impact (MMBtu/yr)
Natural gas	(0.33)	(11,572)
Coal	N/A	19,599

The (11,572) MMBtu natural gas penalty exceeds the 4,187 MMBtu evaluated gross natural gas impact, which can be explained by the fact that the program evaluation period included over 34,000 annual MWh of electric project savings and less than 3,700 annual MMBtu of reported savings from two small natural gas program projects.

The generalized ratio of -0.33 MMBtu/MWh ratio in secondary energy impact due to interactive effects indicates that this factor will become much less significant as the program develops more natural gas efficiency projects in the future.

The other secondary impact is reduced coal usage. The savings from one energy efficiency project does not result in electric savings to the grid, but rather reduces the electricity needed from on-site generation. The electricity on site is generated by a coal plant; the benefit resulting from this energy efficiency project is 19,599 MMBtu/yr in coal savings.

3.4 EVALUATED NET SAVINGS

The net savings calculations combine the results of the three prior sections on RR and NTG into overall program savings. Tables 3-10 and 3-11 summarize the Program's overall savings.

Table 3-10. Evaluated Net Savings for Electric Program Projects through June 30, 2010

Parameter	Program Reported Savings	Realization Rate	Evaluated Gross Electric Savings	Evaluated Gross Savings on Secondary Energy Sources	Evaluated Gross Savings	NTGR	Evaluated Net Savings
Electric energy (MWh/yr)	34,794	0.89	30,967	N/A	30,967	1.04	32,206
Summer coincident peak demand (MW)	4.0	1.01	4.0	N/A	4.0	1.04	4.2
Natural gas (MMBtu/yr)	0	N/A	0	(11,572)	(11,572)	1.04	(12,035)
Other fossil fuel (MMBtu/yr)	0	N/A	0	19,599	19,599	1.04	20,383

Table 3-11. Evaluated Net Impacts for Natural Gas Program Projects through June 30, 2010

Parameter	Program Reported Savings	Realization Rate	Evaluated Gross Natural Gas Savings	Evaluated Gross Savings on Secondary Energy Sources	Evaluated Gross Savings	NTGR	Evaluated Net Savings
Natural gas (MMBtu/yr)	3,672	1.14	4,186	0	4,186	1.04	4,353

3.5 NON-ENERGY IMPACT

The interview questionnaire included a battery of questions prepared to determine non-energy impacts associated with the sampled projects. Fourteen of the 36 projects reported quantifiable NEIs. Of the sites reporting NEIs, the majority had undergone lighting and compressed air plant upgrades that resulted in reduced maintenance costs. One of these sites resulted in increased non-energy related costs (increased maintenance costs), while all others resulted in non-energy related savings. Table 3-12 shows the NEIs by project. The maintenance cost impacts for each of these projects were determined as follows:

$$Site\ reported\ hr/month\ O\&M\ savings\ \times\ Site\ reported\ O\&M\ labor\ rate\ (\$/hr)\ \times\ 12\ months\ per\ year$$

Custom algorithms were applied where needed to sites with O&M practices that differed from the equation shown above.

Table 3-12. Non-Energy Impacts Description

Project ID	Project Description	Non-Energy Impacts ($/year)	Non-Energy Impact Description
2	Manufacturing efficiency process	$6,370	Decreased O&M costs
15	Lighting	$2,400	Decreased O&M costs (10 hr/month less maintenance time)
16	Lighting controls	($5,340)	Increased O&M costs (3–4 more hr/month maintenance time)
17	Lighting	$4,320	Decreased O&M costs (20 hr/month less maintenance time)
18	Lighting	$840	Decreased O&M costs (19 hr/month less maintenance time)
19	Air compressor – VFDs	$720	Decreased O&M costs (3 hr/month less maintenance time)
20	Air compressor- VFDs	$16,900	Decreased O&M costs (5 hr/month less maintenance time)
21	Server refresh	$12,000	Decreased maintenance costs of $300/server/yr
22	Lighting	$1,200	Decreased O&M costs (5 hr/month less maintenance time)
25	Lighting	$540	Decreased O&M costs (2–4 hr/month less maintenance time)
27	Lighting	$2,880	Decreased O&M costs (8 hr/month less maintenance time)
29	Lighting	$26,000	Decreased O&M costs (10 hr/week less maintenance time)
33	Capacity increase	$6,000	Reduced maintenance costs to replace oil in baseline system every 4 months

Table 3-13 summarizes the total program NEI and expresses it in normalized fashion, in terms of dollars of NEIs per MWh of reported electricity savings, or per MMBtu of reported natural gas savings.

Table 3-13. Non-Energy Impact – Summary of Results

Non-Energy Impacts – Projects with Reported Electric Savings	**$/MWh of Reported Savings**	**Annual Impacts ($/yr)**
Upstate	$4.81	$155,473
Downstate	$8.31	$20,538
Program total	$5.09	$176,011
Non-Energy Impacts – Projects with Reported Natural Gas Savings	**$/MMBtu of Reported Savings**	**Annual Impacts ($/yr)**
Program total	$3.37	$12,370
Non-Energy Impacts – Total		**Annual Impacts ($/yr)**
Program total		$188,381

Quantifiable non-energy impacts amount to just under $190,000 per year. This represents 6.2% of the retail value of the annual energy savings resulting from the implemented projects.[30] Unquantifiable non-energy impacts were also identified. The most common non-energy impact was due to changes in operations and maintenance costs. Lighting system and compressed air system upgrades accounted for 11 of the 14 projects where non-energy impacts were identified. Only two process improvement projects indicated non-energy impacts; both of these projects saved operations and maintenance costs. Other sites noted improvements in the quality of the working space (e.g., improvements in light quality), and several projects indicated that increases in production were made possible with the equipment. However, none of these sites could quantify the impact of these changes.

Two natural gas efficiency projects indicated non-energy impacts. Both of these projects were process improvements where operations and maintenance savings were achieved. Evaluators anticipate that the value of NEIs will increase as the proportion of process-oriented projects increases.

[30] Based on $0.086 /kWh and $8.62 /MMBtu of natural gas, the New York 12-month average rates paid by industrial customers, as calculated from data by U.S. Energy Information Agency's *Electric Power Monthly* and *Natural Gas Navigator*, and cited by NYSERDA at www.nyserda.ny.gov/Program-Areas/Energy-Data-and-Prices-Planning-and-Policy/Energy-Prices-Supplies-and-Weather-Data.aspx, March, 2012.

Section 4:

PRE-INSTALLATION REVIEW -- EVALUATION INVOLVEMENT

During the 2011 evaluation period the Impact Evaluation Team worked with program staff on projects that will be completed in 2012 or later to 1) ensure that program-funded project measurement & verification (M&V) activities are properly designed for both program and evaluation purposes, 2) characterize the baseline condition, and 3) provide an early review of program calculations. The goal was to increase consistency between Program and evaluation in M&V baseline definition, methodology, and data collection.

Early project involvement by evaluators targeted projects with large savings (more than 1,000,000 kWh/year or 20,000 MMBtu/yr) that involved process changes, process-specific baseline definition, controls upgrades, and any concerns with overlap between free ridership and baseline definitions. Activities included regularly scheduled meetings with program staff, teleconferences with project developers and NYSERDA's technical review contractors, site visits on an ad hoc basis, and writing evaluation M&V assessment reports.

Projects receiving evaluator pre-installation review are likely to become a separate stratum when the sampling for Phase Two of evaluation is conducted.

As of March 2012, the Impact Evaluation Team was actively involved in nine project reviews (also referred to as pre-installation reviews) projects. Evaluators performed reviews of program documents and technical assistance calculations on all nine projects and executed site visits at five sites. Program staff estimates that the pre-installation reviews have covered eight of the ten largest savings applications that are expected to be installed but the work is not yet complete. The other two largest projects are straightforward and have not warranted the expense of pre-installation reviews.

These pre-installation reviews have resulted in adjustments in calculated savings and the addition of data points that enhanced the level of rigor of Program-required M&V. It has led to early baseline research to encourage consistency between program and evaluation baseline definitions. Pre-installation reviews have helped evaluators by allowing the evaluation engineers to inspect equipment in its pre-retrofit state, interview participants near the time of project installation to better estimate baseline, and increase depth of engagement with Program facilitators. Evaluators hope the process also has helped Program staff.

None of the nine projects had been completed or subject to post-retrofit evaluation as of March 2012. Evaluators do not yet have the data to quantitatively assess the impact of the team's pre-installation involvement. However, experiences worth sharing include the following:

- The evaluator pre-installation scope of activities was originally planned to be baseline characterization and pre-installation metering. Evaluator review of applicant savings calculations was not intended to be part of the pre-installation review scope. It became apparent as early as the first project review that such calculation review would and should be included in the scope. In one instance evaluator review led to the recommendation that the NYSERDA Technical Review contractor adjust their ex ante savings calculations so that the savings decreased by about 7,000,000 kWh/yr. A small fraction of that adjustment was associated with baseline characterization. The rest was associated with a more general review and reconsideration of assumptions. Post- installation Program and evaluation M&V will reveal if the advice was sound.
- Conversely, evaluators originally expected to directly perform pre-installation metering when the evaluation team wanted to collect data that the applicant or program team was unwilling to fund or for which they did not have metering equipment. While the option stands, for every project so far this either has not been necessary or has not been possible due to customer sensitivities. The evaluation team has tried to infringe on the customers as little as possible during the sensitive period before project installation, and the program team has been supportive in meeting the evaluators' expanded data requests. Both Program staff and their contractors have been extremely cooperative in this regard.
- The level of pre-installation involvement by engineers must be flexible and is affected by timing. There was one large complex project that would have been a good candidate for comprehensive pre-installation activities, but the applicant did not bring the project to NYSERDA until it was virtually ready for

installation. This limited evaluators' scope to baseline and algorithm assessment without the opportunity to influence pre-installation metering.

- The extent to which the evaluation team can determine the baseline in advance of project completion is limited. Specifically, the evaluation team can assess existing conditions, determine if the project is a retrofit or new construction and, through interviews with applicants and vendors, determine the *baseline type of equipment* that constitutes the least efficient commonly used baseline solution. However, evaluators cannot definitively determine or affirm the *baseline energy use* because post-installation hours of use and loading is unknown. This has highlighted the challenges of accurately trying to capture the "true" energy savings and in turn validates the pre-installation approach.
- Program staff have reported that the process has been educational and that they are, in at least selected instances, applying the logic used to characterize the projected energy savings in the reviewed projects to other projects.
- There have been multiple instances whereby the evaluators and Program staff started the review process with different baseline characterizations for a measure. The resulting discussion has been reasonably collaborative and has resulted in both evaluators and the Program changing baseline characterization after discussion and presentation of additional data. The evaluators are not aware of any instance where the Program rejected the evaluator's final baseline definition. .
- The baseline definition logic flowchart in Appendix B has been helpful for all.

In the future, the evaluation team intends to compare the realization rates of those projects with pre-installation involvement to those without it to help determine the overall effectiveness of this approach in terms of producing accurate savings estimates.

Section 5:

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Engineers performed verification, basic, and enhanced level on-site M&V to determine the savings realization rates (RRs) for 36 sampled sites. During on-site visits, surveys were implemented at 33 sites to determine participant free ridership (FR) and non-energy impacts (NEIs). Separately, telephone interviews with vendors were conducted for 35 projects to assess the Program's FR. The participant and vendor FR data were compiled to determine the overall FR for the Program. Program spillover (SO) was estimated based on previous studies of similar NYSERDA programs, and Program evaluated net impacts were determined by applying an NTGR that was developed from the compiled FR data and SO from recent relevant NYSERDA commercial and industrial evaluations. Based on these surveys and site M&V, the Impact Evaluation Team offers the following conclusions:

- The evaluation found Phase 1 realization rates of 0.89 and 1.01 for electric energy and demand efficiency impact, respectively, and 1.14 for natural gas. The prospective RRs to apply to Program savings after June 2010 were calculated to be 0.95 on electric energy and 1.08 on demand. The prospective RR for natural gas is unchanged.
- The overall program FR is 0.34. Spillover was selected using previous reports. Inside spillover was determined to be 4%. Outside spillover was selected as 19%, and the most recent non-participant spillover is 15%. The total net-to-gross ratio was calculated to be 1.04. A lower NTGR of 0.90 is recommended for projects completed after June 2010.
- Lighting and compressor measures represented the majority of projects in the evaluation sample. There were fewer process measures than are anticipated for future program years.
- Two of the four data center projects were actually lighting retrofits at data center facilities. The other two projects were server refresh measures. There was no characteristic difference between data centers and the remainder of the sample. This is not necessarily expected to hold true in coming program years.
- Projects that received program mandated M&V showed deviations in savings greater than +/-10% in 4 out of 10 projects. The overall average for all sampled projects was for deviations in savings greater than +/-10% for every 5.6 out of 10 projects. Projects receiving program M&V more accurately captured actual savings than those not receiving program M&V[31].
- The most common reason for deviations in savings were differences in operating parameters (30% of on-site M&V projects), production rates (19%), calculation methodology (19%), equipment efficiencies (18%), and analysis parameters (11%).
- Equipment quantities, type, make, and model were consistent between program documents and evaluation inspection, reflecting a high level of rigor on the part of program staff and technical assistance providers during post-installation review.
- Quantifiable NEIs represented 6.2% of the total cost impacts associated with the sampled projects. However, unquantifiable NEIs were identified, and NEIs are anticipated to increase in future program years as more process projects are completed.

[31] In reaching this conclusion each sampled site was treated equally; this result is not statistically representative.

5.2 RECOMMENDATIONS

The principal goal of the assessment was to analyze the energy savings associated with program projects completed in from program inception in 2009 through June 30, 2010. During this effort, the Impact Evaluation Team also observed opportunities to improve operation and savings estimation in the future to hopefully narrow the variation in RRs. Key recommendations include the following:

Program Recommendations

- **Institute a longer Program M&V period on the Program's larger energy savers** – In several instances reported savings deviated from evaluated savings due only to differences in the duration of pre- and post-installation measurement performed at the site. Increasing the M&V duration enables better assessment of measure long-term savings, especially for process-driven measures for which the savings are highly dependent on fluctuations in production.
- **Systematically collect supporting spreadsheets, models and data from technical assistance providers –** The evaluation benefited greatly from the receipt of technical assistance provider spreadsheets and metered data on a number of projects. Much of this data was collected by program staff on behalf of the Impact Evaluation Team as needs were noted for specific projects. During this process both program and evaluation staff agreed that having program staff routinely gather and retain this data in its original format would facilitate program staff review of projects as well as future evaluations. If this comprehensive compilation of records for all projects is impossibly unwieldy, at least do it for the largest projects, such as those with incentives in excess of $250,000.
- **Apply a common algorithm for tracking demand savings –** The high variance in the peak demand savings realized by the Program stem from inconsistencies in algorithms and requirements regarding peak demand calculations. Evaluators recommend that program staff consider requiring that peak demand be calculated in a consistent fashion across projects.[32]
- **Incorporate heating, ventilation, and air conditioning interactive effects into lighting analysis where significant impacts are likely** – The evaluation results showed that the heating and cooling effects of reduced lighting load and run-time hours can be significant, especially in facilities such as data centers with high cooling loads. Evaluators recommend that the Program reporting these and other secondary fuel impacts.
- **Create and Track Premise IDs** – During the evaluator's population frame development process, time was required to manually screen the population for recent marketing department, FlexTech impact evaluation, process evaluation, and market characterization research contacts with Program representatives, to check for multiple staged projects at a single site, and to identify multi-site projects. Site names, addresses, and contact names were used in lieu of a common premise identifier. While this was a manageable exercise for the Phase 1 population size of 70 projects, the exercise will be more daunting as the program expands in the future. To help evaluators and likely aid program administrators as well, evaluators recommend that NYSERDA establish unique premise IDs that are constant across programs and that remain constant for a facility in the event of name changes or other turnover. The use of premise IDs is not uncommon in the utility environment, whereby a portion of each customer's account number can be the unique premise ID number, and the suffix of the number is the only thing that changes with alterations in account ownership. It is conceivable that NYSERDA could use the utility companies' premise IDs.
- **Increase Impact Evaluation Team involvement in pre-installation project review** – The evaluation team's involvement in pre-installation program review has resulted in adjusted savings estimates and consistency between evaluation and program M&V metering and agreement in baseline definitions.

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[32] This evaluation calculated demand impact based on the average load during all summer weekday non-holiday afternoons. In the next evaluation cycle the definition is expected to be that specified in the *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, Residential, Multi-Family, and Commercial/Industrial Measures,* prepared for the New York Department of Public Service by TecMarket Works, October 15, 2010, p. 8: "The Program Administrators (PAs) should calculate coincident peak demand savings based on the hottest summer non-holiday weekday during the hour ending at 5 p.m."

Program and evaluation staff should actively work together to ensure more systematic involvement of the Impact Evaluation Team in pre-installation program review and increase the number of projects.

- **Include a mechanism to monitor changes in program reported savings** – Once a project's savings are reported, they are eligible for evaluation. Some participants complete large projects in multiple stages that span many years. As currently operated, program administrators can either create a new project record for each stage or can modify existing project records to increase the associated savings and incentive values and change project completion dates, among other fields, as new measures are finished. The latter approach causes unusual and significant challenges to evaluation. Projects in this evaluation could reappear in the next evaluation with different values. Any analysis of program performance over a period of time based on tracking data would be flawed. The evaluation team recommends that each phase of the project that has a unique completion date have a unique tracking record.
- **Use 0.95 as the prospective realization rate for electric energy savings and 1.08 for demand savings –** The overall electric energy (kWh) RR is 0.89, the electric demand (kW) RR is 1.01, and the natural gas (MMBtu) RR is 1.14. These are the findings applicable to this retrospective evaluation of projects completed from program launch through June 2010. NYSERDA also applies an RR when reporting savings for current projects. The retrospective natural gas realization rate is appropriate for use for this purpose as well. However, the evaluated outlier project is not likely to be representative of any future project and its performance materially affected the electric RRs. Evaluators recommend that NYSERDA apply this evaluation's electric energy RR absent the outlier of 0.94 and the demand RR absent the outlier of 1.08 for prospective use.
- **Use 0.90 as the prospective NTGR –** Evaluators expect spillover to decline as more of the Program's savings as associated with large unique projects that do not lend themselves to technology transfer, which is a major factor in spillover. For this reason evaluators recommend using a lower prospective NTGR than the value used for the Phase 1 projects in this evaluation.

Evaluation Recommendations

- **Conduct in-depth primary research on participant SO** – Direct assessment of participant SO through survey research is the preferred method of calculating this factor. Evaluators believe that enough time will have passed by the time that the next phase of evaluation occurs to merit direct surveying of participants to calculate SO. It is planned for Phase 2. In the event that responses indicate significant spillover, use enhanced techniques to validate responses.
- **Reassess NEIs in the next evaluation** – The evaluation of this project sample found moderately significant quantifiable NEIs, valued at 6% of the retail value of the energy savings. Discussion with customers and service providers during our pre-installation evaluation work suggests that some of the major process measures in the Program pipeline will substantively affect customers' product quality, speed of production, and business retention and thus have significant NEIs. Based on these conversations and on the expected increase in the proportion of such projects in the Program portfolio overall, evaluators recommend investigating NEIs in the next evaluation.

Appendix A
Sampling Design for IPE M&V and Net-to-Gross Participant Surveys

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: Jon Maxwell, ERS; Kathryn Parlin, WHEC; and Lori Megdal, Megdal & Associates, LLC

Subject: Sampling Design for IPE Measurement & Verification and Net-to-Gross Participant Surveys

Date: May 14, 2011

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 verification and telephone surveys for NYSERDA's Industrial Process Efficiency (IPE) Program 2011 impact evaluation. The first section describes the overall framework for the analysis. The second section covers the development of the sampling frame. The third through fifth sections cover sample design. The final section summarizes the sampling process.

Overview

The IPE evaluation plan calls for three surveys:

1. A site-visit-based measurement & verification (M&V) survey to determine realization rates (RRs) for gross savings
2. A telephone survey of participating customers associated with the RR sample to determine free ridership. In some cases these interviews will be conducted in-person at the time of the M&V site visits.
3. A telephone survey of vendors/energy service companies (ESCOs) associated with projects included in the RR sample to support free ridership analysis.

The sample design is based on the stratified ratio estimation (SRE) to select a sample of projects for the verification survey based on reported program savings and an estimated error ratio.

The Impact Evaluation Team will collect data to estimate free ridership associated with the same projects selected for the verification survey. This is efficient and will reduce survey fatigue because it uses the same sample for M&V and attribution and it reduces the necessary number of times evaluators must contact participants. As specified in the Work Plan, only free ridership will be addressed in the first evaluation cycle. Since this program is just ramping up, there has not yet been a sufficient time lag to allow spillover to develop. Spillover will be assessed in the second evaluation cycle.

The free ridership research will include interviews with vendors and ESCOs associated with the projects. NYSERDA's CATI survey contractor will conduct these interviews. Evaluators will identify the vendors during review of project materials when preparing for M&V, thus the vendor interviews will not require sampling separately. Conducting surveys for both the participating customers and vendors/ESCOs for the same projects allows the Impact Evaluation Team to gain insight into how the project is viewed from these multiple perspectives. When the Impact Evaluation Team has been on-site and has first-hand knowledge of the actual installations, this approach provides useful validation of the self-reported net effects. While the sampling process is not designed to develop a representative sample of the more commonly used and larger ESCOs or vendors, the advantages of the proposed approach in allowing a more in-depth review of specific projects outweigh the disadvantages. In addition, the sample represents over half of the participants and over 85% of the population's reported savings, as discussed below, indicating that the results of the proposed approach will adequately represent the program population.

Sample Frame for the Verification Survey

The first step in the sampling process for the 2011 evaluation was to construct the sample frame from project data. The Megdal Impact Evaluation team provided a data request to NYSERDA's Energy Analysis group, who forwarded it to NYSERDA IPE program staff for fulfillment. The request specified the need for the following fields:

- Tracking ID
- Status
- Customer name
- Location (up/downstate)
- Structure type (data center/mfg)
- Funding source (EEPS, SBC, EEPS Gas)
- Completion date
- Outreach consultant
- Reported energy savings for each energy source with units noted if they are other than kWh/yr, kW, and MMBtu/yr

Other data such as contact information, milestone dates, utility company, and measure description also were requested for later use but not needed for sampling. Upon receipt ERS reviewed and cleaned the NYSERDA database's relevant fields. Only minor data cleaning was needed.

The population was defined as all IPE projects with "Current Project Status" of "Complete" and a "Current Project Status Date" from the beginning of program implementation through June 30, 2010 in the tracking system at the time of the data extraction, August 9, 2010.[1] (The first project application was received on September 10, 2008; the first project was completed on February 25, 2009.) This end date of June 30, 2010 was chosen to be as late as possible and still allow time for meaningful accumulation of post-retrofit billing, production, and other performance data. Seventy-one IPE projects met this criteria and constituted the sampling frame.

[1] Three projects that met this criteria were multi-stage projects for which some but not all measures were complete. The reported savings corresponded to the savings for completed measures only.

Sample Selection for the Verification Survey

The primary sampling unit for the verification survey is the project.

Before defining the sampling frame, evaluators set aside five data center projects and two projects that save natural gas from the population to ensure evaluation during the first cycle. Data center projects are technologically different from other industrial customers' projects and their market dynamics differ enough that the IPE program tracks them separately. Such projects are expected to grow in frequency and savings per project. Likewise, projects that save natural gas are underrepresented compared to future activity levels. Evaluators will report the realization rates for these types of projects separately.

The sample frame of electric projects was stratified by upstate and downstate region for the purpose of estimating realization rates to meet the 90/10 confidence precision target for each region. NYSERDA defines the downstate region as the territory served by Con Edison for electricity and by Con Edison, Keyspan Energy Delivery Long Island and Keyspan Energy Delivery New York for natural gas.[2] The upstate region is the rest of the state. Efficient sample sizes were chosen using stratified ratio estimation (SRE), assuming an error ratio of 0.60.

Tables 1 and 2 below show the distribution of projects and savings into the size strata. Break points between strata were defined using the SRE method as described in the California Evaluation Framework.[3] The sample was allocated evenly to the strata. However, in some cases the number of projects in the strata was so small, it was less than the allocated sample size. Consequently, these strata were designated as census, i.e., all of the projects in the stratum are included in the sample. The downstate population was only twelve projects, of which the two smallest energy savers were so relatively inconsequential (less than 5% of reported savings) that the most efficient approach was to select the biggest ten savers. One upstate project reported no savings and was excluded.

Table 1: Upstate Projects and Savings by Size Stratum

Stratum	Sampling Method	# of Projects	kWh Savings	% of Total kWh Savings	Min kWh	Max kWh	Sample Size
Natural Gas	Census	1	586	0%	586	586	1
Data Center	Census	3	589,800	2%	63,275	441,487	3
1	Random	30	5,894,794	18%	46,810	314,788	8
2	Random	14	6,716,915	20%	330,508	837,074	8
3	Census	7	8,520,511	25%	870,000	1,689,054	7
4	Census	3	11,884,797	35%	2,309,504	5,355,067	3
Total		58	33,607,403	100%	586	5,355,067	30

Table 2: Downstate Projects and Savings by Size Stratum

Stratum	Sampling Method	# of Projects	kWh Savings	% of Total kWh Savings	Min kWh	Max kWh	Sample Size

[2] There were no Keyspan natural gas projects in the population.

[3] 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.

Natural Gas	Census	1	0	0%	0	0	1
Data Center	Census	2	664,055	27%	67,668	596,387	2
1	Small excluded	2	118,651	5%	23,651	95,000	0
2	Census	7	1,688,770	68%	127,816	424,016	7
Total		12	2,471,476	100%	0	596,387	10

Table 3 summarizes population of projects and sample size for the first evaluation cycle.

Table 3: Sample Summary

IPE Evaluation Component	Total Number of Projects			Sample Size		
	Upstate	**Down-state**	**Total**	**Upstate**	**Down-state**	**Total**
Natural gas	1	1	2	1	1	2
Data center	3	2	5	3	2	5
Electric – random strata	44	0	44	16	0	16
Electric – small excluded	0	2	2	0	0	0
Electric – census	10	7	17	10	7	17
Total	**58**	**12**	**70**	**30**	**10**	**40**

Sample Selection for Participant Telephone Survey

Free ridership will be estimated based on self-reported data. For efficiency and to avoid survey fatigue, the Impact Evaluation Team will collect data to estimate free ridership from the participating customers associated with the projects selected for the verification survey.

The survey may require interviewing multiple decision-makers associated with each project. For the twenty projects with the largest reported savings (the threshold is expected to be near 700,000 kWh/yr), evaluators will expand the self-report approach by implementing a project-specific investigation into free ridership to assess the other equipment found on-site and gain some insight into the standard practice at each facility for replacement of equipment on failure and early replacement of substandard equipment. This approach will provide concrete evidence of the site-specific baseline for the purchase of efficient equipment. The aggregate result of these multiple levels of effort will be a free ridership estimated for each sampled project based on participant information.

Sample Selection for the Vendor/ESCO Telephone Survey

NYSERDA program staff tracks vendors associated with each project. The evaluation engineers responsible for reviewing project files and talking with the participant also will identify the vendors and ESCOs associated with each project included in the verification survey. The information will be combined and provided to APPRISE for a telephone-based survey by computer-assisted telephone interviewing (CATI) center professionals.

It is expected that the vendor/ESCO sample will be smaller than the forty projects in the verification survey due to firms supporting multiple projects in the sample.

Conclusion

The primary sample unit for all of the surveys is the project. A census of the two projects with natural gas savings and the five data center projects will be verified. A sample of completed IPE projects that save electricity and are not data centers will be selected from the completed projects recorded in NYSERDA's program database for the verification survey to estimate the realization rates for gross savings. The sample design was based on the SRE method. The sample frame was stratified by fuel source (electric v. natural gas) and by region (upstate v. downstate). The total sample sizes for electric savings are thirty upstate projects and ten downstate projects, for a total of forty. The sample is designed to meet the 90/10 confidence/precision target for both upstate and downstate electric savings and exceed it for the entire program.

The same sample as selected for the verification survey will be used to estimate net-to-gross ratios. Telephone surveys of the participants (focused on the decision-makers) and vendors/ESCO's associated with the selected projects will conducted.

IPE impact evaluation Champion: Jon Maxwell, ERS

IPE impact participant sample design and sampling: Jon Maxwell, ERS and Kathryn Parlin, West Hill Energy & Computing, Inc.

Appendix B
NYSERDA Industrial Process Efficiency Baseline Determination Methodology for Program Evaluation

NYSERDA Industrial Process Efficiency Baseline Determination Methodology for Program Evaluation

--- Final 2/12/2010 ---

by

Jon Maxwell, ERS

and Megdal & Associates Impact Evaluation Team

prepared for

Cherie Gregoire, NYSERDA Energy Analysis

Section 1:

OBJECTIVE

NYSERDA's Industrial Process Efficiency (IPE) program helps New York manufacturers and data centers improve their operations to reduce energy use per unit production. Most studies and projects funded through this program will face the issue of defining baseline energy use and efficiency for their project. Often the project will be unique, there will be no legislated code or standard that specifies minimum efficiency, and there will no known prior research on common practice.

The objective of this document is to establish a standard procedure by which evaluators will define baseline energy use for manufacturing and data center projects, and to do so early in the program's implementation so that Program staff can use the same procedure or at least be aware of the standard against which their projects will be evaluated when calculating energy savings for incentive calculation and reporting purposes.

Baseline is a complex idea that can be hard to separate from free ridership, measure life, and other factors. This report describes the scope and limitations of the NYSERDA baseline determination process in Section 2. In Section 3 we define terms later used in the core Section 4, the baseline determination process itself. Section 4 is largely a logic flowchart with accompanying explanatory text.

Section 2:

APPROACH AND SCOPE

The intent of this document is to offer a procedure for defining baseline. It does not attempt to specify the actual baseline values, applicable codes or standards, or appropriate technology baselines for any particular type of project.

The underlying principle for defining baseline is straightforward: *The baseline is the least efficient option specific to a particular facility and application that the customer technically and economically would have reasonably considered to deliver the post-retrofit level of production.* Application of this concept can be complicated. This memorandum provides guidance in interpreting this statement for a variety of circumstances.

Because the concept of baseline can be hard to separate from related issues, the approach scope of the definition process needs constraints. For NYSERDA we use the following scope guidelines:

Free Ridership. In many cases what could or would have been done in the absence of the NYSERDA program is not readily apparent. Baseline definition will help evaluators determine the least efficient approach that reasonably *could* have been taken. Free ridership research will determine the difference between what *would* have happened versus what *could* have happened. To the extent that any of this interpretation is discretionary, evaluators will assess the difference as part of free ridership rather than elevating the baseline. For example, a customer could, as a matter of corporate policy, always practice a certain higher level of efficiency than some competitors. This reflects free ridership, not a high baseline.

Measure Savings Over Time. The IPE evaluation will follow NYSERDA precedent and will not evaluate measures according to “dual” baselines; that is, the baseline and post-retrofit energy use and measure savings will be estimated as being constant for all years of the measure life. In the event that a measure is removed or otherwise fails early, the life for that particular project will be reduced accordingly and remaining year savings will be zero.

Some Measures Increase Production Levels. The baseline for measures that increase production must account for alternative actions that could have been taken to otherwise increase production. Existing conditions and production methods in place should be considered when defining baseline for the added production but are not always the basis of it.

Who Defines Baseline? While the evaluators and implementer may work together for baseline determination on large complex processes, the burden for researching and defending the baseline rests with the implementation team.

Definitions

Post-Retrofit Production Level	Post-retrofit production level is the evaluator's judgment of long term expected production rates for the facility after the retrofit is completed. This level often is the production level measured in the year or two after installation, but it could be adjusted from this value based on pre-retrofit data or on forecasts of future production levels. It does not necessarily equate to production levels immediately before or after the retrofit.
Baseline System Configuration	Baseline system configuration is the least efficient system that the customer realistically could have used for the specific application to deliver the post-retrofit production level.
Baseline Energy Use	Baseline energy use is the amount of energy needed to meet the post-retrofit production level with the baseline system configuration.
Application	Application is defined by the combination of (a) the customer's industry type, (b) the particular process affected by the project, (c) the equipment itself, and (d) site. For example, adding insulation on refrigerant lines in the wine industry is a different application than adding insulation to a wine storage tank at the same site. It also is a different application than adding insulation to refrigerant lines at a refrigerated storage warehouse. NYSERDA intends to establish baseline efficiency on a site/process specific basis to the extent possible.

Minimum Commonly Used Efficiency

Minimum commonly used efficiency is the minimum efficiency that a reasonable person would choose to install for a particular application. It should be used for baseline determination.

It is never worse than minimum available efficiency but can be better, if there are minimum efficiency solutions that theoretically are possible but as a practical matter a reasonable person would not use for the particular application. For example, there may be circumstances where the least efficient technology is not the least expensive option for a customer. In such cases, it usually is unreasonable to assume that the higher cost approach is the baseline, even if it is less efficient.[1]

It is never better than standard practice but can be worse, if there are a measurable number of market actors that install less than the predominant/standard practice level of efficiency.

There should be evidence that it is an approach currently used in industry for the type of application under consideration.

[1] As an example: A customer has an older 70% efficient boiler that needs to be rebuilt/re-tubed or replaced. If rebuilt, the resulting efficiency will be 75%. A new minimum efficiency new boiler is 80%. The customer receives NYSERDA funding to buy a new 86% efficiency boiler. It turns out that a rebuild would cost more than replacement. In that case the baseline efficiency is an 80% efficient new boiler, not the 75% rebuilt one.

Individual customer policies and purchasing practices should be considered. Regional practices may be applicable as well.

Production Energy Use Intensity (EUI)

Energy use per unit production

Baseline EUI = Baseline Energy Use / Post-Retrofit Production

Post-Retrofit EUI = Post-Retrofit Energy Use / Post-Retrofit Production

Energy Impact

The difference in energy use between what would have been used by the baseline system configuration and the installed system at the post-retrofit production level.

Annual Energy Impact	=	Post-Retrofit Production Level	x	(	Baseline EUI	-	Post-Retrofit EUI	)
(Energy/Yr)		*(Units/Yr)*			*(Energy/Unit)*		*(Energy/Unit)*	

Section 3:

HOW TO DETERMINE BASELINE EFFICIENCY

The objective of the procedure is to guide the evaluator and program staff in determining the baseline system configuration, that is, the least efficient system that the customer realistically could have used for the specific application to deliver the baseline production level. The underlying premise is that baseline determination is unique to each project, and that decision-making is complex and customized for each.

This section explains the process of how to determine system configuration and in turn baseline efficiency and production EUI, with special consideration to measures that increase production levels.

The logic flow chart in Figure 4-1 together with the definitions in Section 3 guides the decision-making process.

Retrofit. The first consideration is the same as with traditional commercial and non-process industrial projects: Is the project a retrofit, new construction, failure replacement, process expansion, or major process change? To be a retrofit, the project must satisfy the following criteria:

1. It replaces old working equipment;
2. That old equipment was not otherwise going to be replaced in the near future;
3. It does not increase overall plant production

If these two conditions are met, the baseline is defined by the pre-retrofit conditions. Evaluators may require that the application demonstrate the applicability of the criteria. Interviews with site personnel expressing intent are necessary but not necessarily sufficient evidence. For example, if the project claims that the equipment was working and not going to be replaced in the near future and yet was very old for its type, the project may need to demonstrate why it was reasonable to assume that the equipment was expected to have a long future life and not be replaced in the near future in spite of its age. Possible ways to do this are to copy maintenance records showing that a 25-year old boiler, normally considered near the end of its life, had had its tubes replaced in the last five years and recent boiler efficiency test data that showed good combustion efficiency.

If equipment is in good operating condition but external circumstances drive its replacement, new emissions regulations, for example, the replacement will be considered new construction unless the applicant demonstrates that there was a reasonable way to comply with the new requirements through modification rather than replacement. If so, the modification alternative will be the theoretical baseline.

New Construction and Failure Replacement. If the project does not meet either criteria #1 or #2 above, then it is either new construction or change out replacement due to equipment failure. The two are treated the same in terms of baseline definition. The next step is to determine new construction/failure replacement baseline. The different bases are as follows, in order of priority:

1. Applicable code or standard
2. Minimum commonly used efficiency for the application
3. Custom-developed baseline
4. Existing Process (on-site or at other applicant owned site)

Some codes and standards apply to industrial process projects. The Energy Policy Act (EPAct) specifies selected minimum motor and refrigeration equipment efficiency standards. ASHRAE and the NY ECCC for buildings may affect insulation practices for a facility. OSHA ventilation standards may apply. An applicable code or standard is the preferred basis for defining baseline.

In the event that no code applies and the system being installed is not unique to the customer, then "minimum commonly used" efficiency standard is the preferred choice. Many refrigeration and compressed air systems, crushing, conveying, process heating, pumping, and other industrial processes are common to many facilities. If the technical reviewer can document a minimum commonly used standard for the application, that standard should be used.

The minimum commonly used basis is application-specific. For example, it may be that the market offers a low cfm/kW and throttle-modulation air compressor of the right size, but if it is not an option commonly or realistically used for the particular application, it is not the baseline.

If the minimum commonly used basis is inappropriate or impossible to determine, the next alternative is a custom-developed application-specific baseline. If the data or research already are available, or if the project itself conducts such research, a project-specific baseline may be used.

The last and default option for new construction projects is to use the existing process as the baseline.

In all cases program staff are responsible for requiring applicants to demonstrate the appropriateness of the baseline. Evaluators may verify it.

Increased Production and Major Process Change Measures. Projects that increase production and projects that change the fundamental way in which the product is made are treated the same for the purposes of baseline definition,. There are two additional key factors to consider for such projects: Energy use per unit production, and alternative approaches to meet production.

Energy use per unit production, or production energy use intensity (EUI), is the basis for measuring energy efficiency improvements in such projects. For increased production and major process change measures the applicant must compute the baseline and post-retrofit EUIs and multiply them by the annual baseline production level (as determined per the definitions) to estimate normalized energy use before and after the retrofit.

Alternative approaches to increase production may be necessary to assess instead of just pre-retrofit conditions to define baseline. The guiding principle in determining baseline EUI for productivity increasing projects is that it should be based on what the applicant otherwise could have done to increase production without the program-funded action(s). If the applicant could have increased production using existing methods, such as by increasing operating hours, by increasing the processing season, or by activating other similar equipment as already was in place, and it would not have fundamentally changed the process EUI, then pre-retrofit EUI can be the baseline EUI.

If on the other hand the plant's equipment was at capacity then the project represents a market opportunity. Baseline definition must consider how else the plant, the larger corporation, or the industry as a whole would otherwise have met production needs absent the funded project. If none of those options can be determined, the default is pre-retrofit EUI. The flowchart guides the decision-making process.

Figure 4-1 Baseline EUI Logic Flow Chart

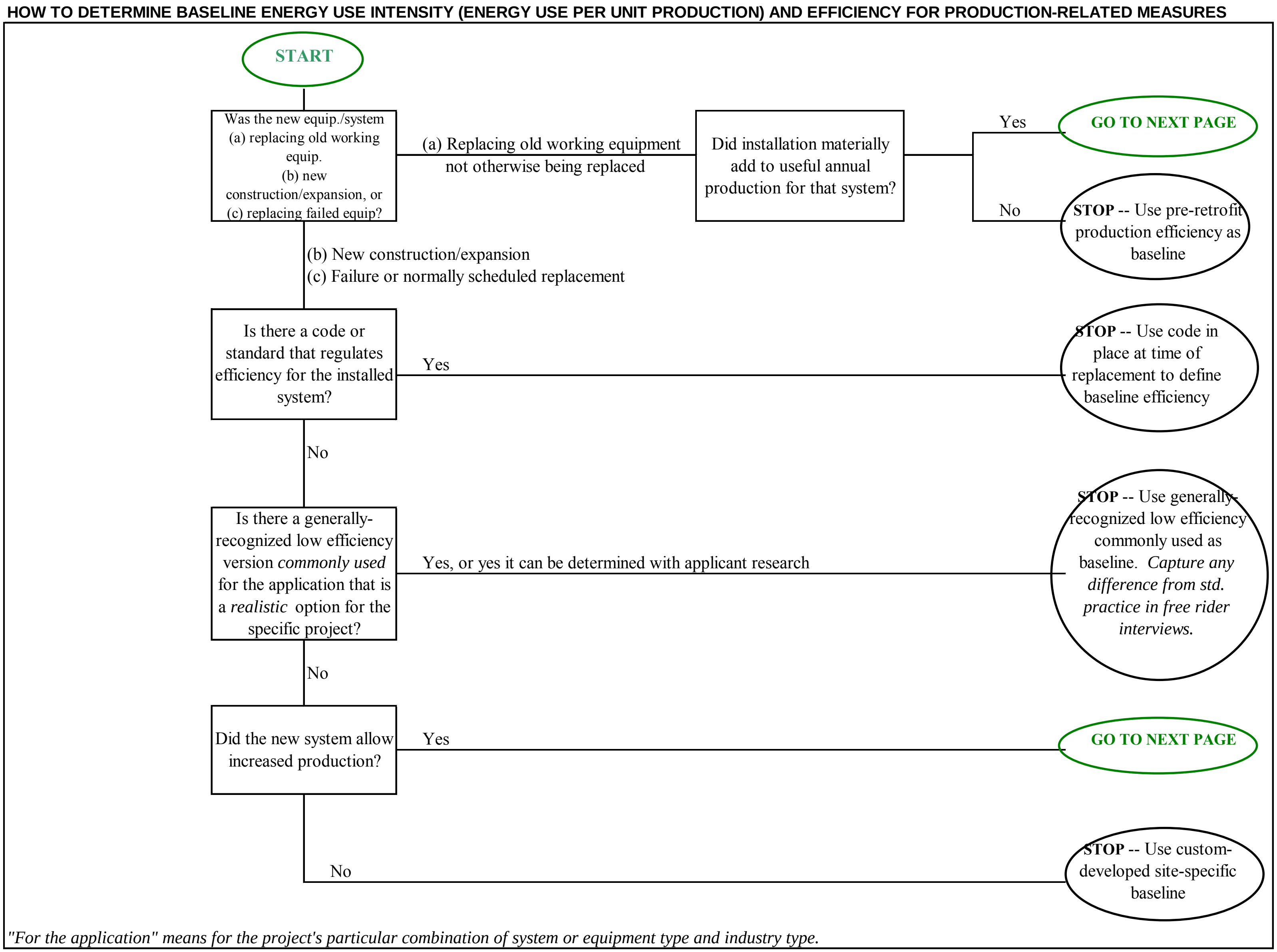
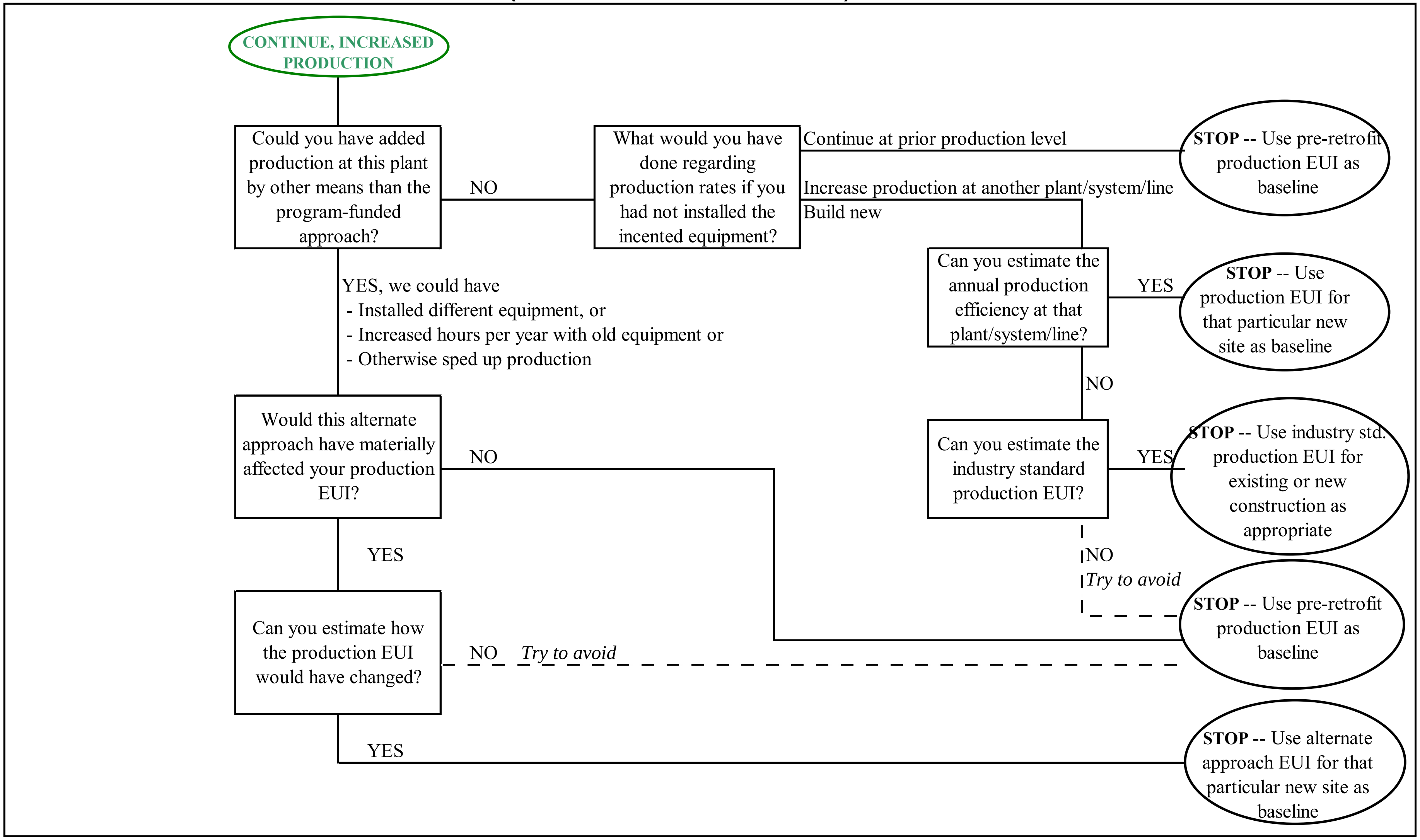


Figure 4-1 Baseline EUI Logic Flow Chart (continued)

HOW TO DETERMINE BASELINE ENERGY USE INTENSITY (ENERGY USE PER UNIT PRODUCTION) AND EFFICIENCY FOR PRODUCTION-RELATED MEASURES



Appendix C
Rigor Assignment for the On-Site M&V

Megdal & Associates **M E M O R A N D U M**

To: Judeen Byrne, NYSERDA Energy Analysis

From: Jon Maxwell, ERS

Subject: **Rigor Assignment for the On-Site M&V**

Date: November 16, 2010, revised September 24, 2012

This memorandum describes the process by which the engineering program evaluation "champion" assigns the "level of rigor" and IPMVP options to apply to each sampled project for site-specific measurement & verification.[1] The objective of the exercise is to maximize the value of engineering resources and deploy effort where evaluators can achieve the greatest reductions in measurement uncertainty in the final weighted results.

For quality control, consistency and ensuring maximum accuracy within the evaluation budget, a decision-making structure has been created for assigning rigor level for each site. These decision criteria are described in this memorandum. In assigning rigor, the champion is making decisions based on quantitative information from the program as well as consideration of qualitative factors. This combination makes the assignment process an art requiring an experienced evaluation engineer.

There are general steps that provide the logic for this decision-making process. The logic applies equally for all program evaluations with projects being evaluated at various levels of rigor. These include the program impact evaluations for Flexible Technical Assistance (FlexTech), Existing Facilities Program (EFP), and Industrial Process Efficiency (IPE).[2] Each bulleted step starts with a sentence or paragraph that generally describes the activity. Following the general description is an example of how this process was conducted for the Industrial and Process Efficiency evaluation.

1. Review the original estimates of the number of projects to be evaluated at each level of rigor. This is initially specified in the Work Plan but then is reviewed and revised after the program data for Industrial and Process Efficiency is examined and the sample design is finalized.

---

[1] The enhanced, basic, and verification levels of rigor are defined in the *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals*, April 2006. The impact evaluation team added a fourth level of rigor, "Verification with Spot Metering" that is between the levels of complexity of "Basic" and "Simple Verification." The chief distinction between Basic and Verification with Spot Metering is that Basic includes logging of equipment performance over time and requires two site visits, whereas fVerification with Spot Metering only requires instantaneous measurement or logging for a matter of hours during a single visit. Simple Verification typically does not involve any metering. The IPMVP Options are described in the *International Performance Measurement and Verification Protocol*.

[2] It does not apply to evaluation of NCP, an otherwise similar large commercial program with site-level M&V, because evaluators conducted all M&V for that project at the same highest level of rigor.

The Industrial and Process Efficiency Work Plan specified the following levels of rigor, based on a preliminary required sample of 40:

Level of Rigor	*%Projects*
Enhanced / IPMVP Option B	*52%*
For all large savings projects in the sample and for moderate savings projects that lacked prior evaluation-grade analysis through the Program. This level of rigor typically includes modeling of the process or building, calibrated against field measurement of specific equipment	
Basic / IPMVP Option A	*45%*
If the project delivers moderate savings and the evaluation engineer finds that the implementation-side M&V was conducted in a sufficiently rigorous and objective manner to permit leveraging the data. An analysis based on billing analysis would typically be in this level of rigor	
Verification with Spot Metering / IPMVP Option A	*3%*
Inspection or review-only verification, for the smallest savers or those whose savings were seasonally dependent and for which metering was not possible during the evaluation period	
Total	*100%*

The final sampling design resulted in a sample of 40 and was expected to result in 90% confidence and 10% relative precision. The distribution planned after the sampling design was kept the same for the sampled sites.

2. Assign budgets equivalent to the lowest level of rigor for all projects that should not require vigorous M&V for "non-field" related reasons such as prior evaluation-grade M&V having been conducted.

   In Industrial and Process Efficiency evaluation this applies to three projects (8%) for which:

   a. The relevant equipment could not be run out of season (2)

   b. The customer was uncomfortable with logging (1)

   In other evaluations this classification also included previously evaluated projects

3. Assign "enhanced" level of rigor to the largest savings projects.

   All the large projects with savings greater than 500,000 kWh (12) were assigned the enhanced level rigor.

4. Assign the remaining enhanced rigor sites in the budget based on consideration of project size, technological complexity, and presence of multiple types of measures.

   In Industrial and Process Efficiency, the projects targeted for enhanced rigor included measures with central cooling, lighting, motors, and VFDs. The originally expected assignment was for nine (9) such projects but relatively inexpensive IPMVP Option B M&V required for the project measures, the technical need to perform more enhanced than basic study on other measures, and available funding ultimately resulted in 18 such assignments in addition to the 12 enhanced largest projects, for a total of 82% at enhanced rigor.

5. Split the remainder of the sample sites between Basic and Verification with Spot Metering primarily based the technological complexity for measurement. The second consideration is the measure reported savings.

   Simplified methods such as billing analysis were able to produce estimates with low measurement uncertainty for the four (4) relatively low savings remaining projects, 10% of the projects.

6. Fine tune the allocations as lead engineers work through development of the site-specific M&V plans and budgets.

Appendix D
Measure Retention and Life Policy

ENERGY & RESOURCE SOLUTIONS
120 Water Street, Suite 350
North Andover, MA 01845

Texas Regional Office:
710 Park Place
College Station, TX 77840

MA Phone: (978) 521-2550
TX Phone: (979) 696-5465
Web: www.ers-inc.com
jmaxwell@ers-inc.com

M E M O R A N D U M

DATE: October 28, 2011

TO: Judeen Byrne

FROM: Jon Maxwell

CC: Lori Megdal, Helen Kim

SUBJECT: **MEASURE RETENTION AND LIFE POLICY**

This memorandum describes how impact evaluators will calculate and report measure gross annual savings for measures associated with equipment that was funded by NYSERDA, was known to have been installed and operated, and was removed by the time that evaluation field staff perform measurement and verification. It also describes the theoretical basis for using the approach and includes industry references.

Approach Summary

If evaluators determine that program-funded equipment was installed and operated for at least a year after installation, the estimated annual savings will be based on the theoretical condition that the fixtures/motors/AHUs and other removed equipment all remain in place and operational. There will be no discount to savings due to lack of measure retention, since the measure life factors used by NYSERDA and the NY DPS in reporting lifetime savings already account for retention.

Basis

NYSERDA needs two key energy-related parameters to estimate the direct impact of efficiency programs on the New York electric grid and on emissions: (1) The measure's annual savings, e.g. kWh/yr or MMBtu/yr, and (2) Number of years the measure saves energy.[1]

The number of years of savings estimates often depends on secondary research. Most of the research conducted by the energy efficiency evaluation community reports measure life in terms of the Effective Useful Life (EUL). EUL is defined as the technical equipment life, less a downward

[1] Other variables such as geographic location of the measure, time of day of savings, and fossil fuels involved affect impact but not relevant to this discussion.

adjustment factor for measure retention. The measure retention factor is defined as "the proportion of measures retained in place and that are operable." It is a value equal to or less than 1.0. Attachment A provides fuller definitions and citations regarding EUL, technical equipment life, and retention.

Because the EUL already includes a discount for measure retention, evaluators assessing the impact of a particular measure that is considered a representative of the population should not discount the evaluated measure's savings for retention related factors. Otherwise the program's lifetime impact will be penalized twice for the same factor.

Furthermore, the program's first year impact would be inappropriately stated.

Example

A customer installed 1,000 fixtures that were projected to save 100 watts each for 1,000 hours per year, for a total savings of 100,000 kWh/yr. An evaluator visits the site, conducts measurement & verification (M&V), and concludes that the demand savings per fixture and annual hours are exactly correct, but also finds that 100 of the fixtures were removed 18 months after installation due to a gut rehabilitation of one area. The fixtures have a 15-year EUL. Portfolio-level analysis uses lifetime benefit-cost models using EULs. The evaluator could calculate the project realization rate (RR) three different ways:

0.90 RR, based on the observed condition that the measure is saving 90% of the expected amount.

0.91 RR, based on the weighted average savings expected over the EUL period (100% savings for 1.5 years and 90% savings for 13.5 years = equivalent of 91% savings over 15 years).

1.00 RR, based on the judgment that the project initially saved 100% of the expected amount, and that the later reduction in savings is due to retention issues and should not be considered.

The third option is most accurate in the NYSERDA framework

This project is part of a sample. Some participants will remove fixtures after just a few years; others will remove them after twenty years; some will leave them in place until mechanical failure. Over a large population the mean time to replace is expected to be 15 years. This particular facility selected for evaluation happened to be one that replaced the fixtures earlier than average.

If nine other identical lighting projects are evaluated and all of them have a 1.00 RR and no fixtures were removed, then the correct program level result is 1,000,000 kWh/yr savings for a 15-year EUL. The first project simply happened to catch a very early retention-related issue. There is no way for an evaluator to identify that other projects may remain in place for 16 or 20 years and offset the early retention of this project. Overall one would expect in theory that the 9,900 fixtures still in place would remain in place saving energy for an average of 15.15 years.

Assigning a 1.0 RR will also result in the correct estimate of "first year savings," which was in fact 100,000 kWh.

Attachment A: Measure Life Terminology and Definitions

This attachments lists key evaluation guidelines and protocols documents that address measure life and describes how each defines life-related terms. The list starts with the California Protocols, which generally is regarded as a definitive guide in the energy efficiency program evaluation community, and follows with other documents in chronological order of publication.

In summary, all define Effective Useful Life or a parallel term as being the median life of a measure after discounting for retention.

(1) *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals*, Prepared for the California Public Utilities Commission by the TecMarket Works Team, April 2006

The California Protocols defines measure life as follows (p. 105):

"The Effective Useful Life (EUL) Evaluation Protocol… should be used to establish the period of time over which energy savings will be counted or credited for all measures that have claimed savings…. Effective useful life (EUL) is the estimate of the median number of years that the measures installed under the program are still in place and operable (retained)."

From Appendix B: Glossary:

> "ENGINEERING USEFUL LIFE - An engineering estimate of the number of years that a piece of equipment will operate if properly maintained.
>
> EFFECTIVE USEFUL LIFE (EUL) - An estimate of the median number of years that the measures installed under a program are still in place and operable."
>
> RETENTION (MEASURE) - The degree to which measures are retained in use after they are installed.
>
> PERFORMANCE DEGRADATION - Any over time savings degradation (or increases compared to standard efficiency operation) that includes both (1) technical operational characteristics of the measures, including operating conditions and product design, and (2) human interaction components and behavioral measures."

(2) *California Database for Energy Efficient Resources (1998 – present)*

The California Database for Energy Efficient Resources uses EUL as its label for life data.

(3) *The California Evaluation Framework* , Prepared for the California Public Utilities Commission and the Project Advisory Group by TecMarket Works and team members, June 2004.

The 2004 California Evaluation Framework quotes the 1999 *CADMAC Measurement and Evaluation Protocols* and uses the same definition of EUL. It uses the term "measure life" in lieu of the Protocols' "engineering useful life." In the Framework, "persistence of energy savings" unfortunately combines the measure and savings persistence factors: "a combination of measure retention, measure installations retained versus those that have failed or that have been removed, and the incremental technical degradation (the difference between the technical degradation of the efficient equipment versus the degradation of standard equipment)." This combining of concepts is problematic given that EUL accounts for one type of persistence but not the other.

(4) *Measure Life Study,* prepared for The Massachusetts Joint Utilities, Energy & Resource Solutions, November 17, 2005.

The Joint Utilities-sponsored *Measure Life Study* defines measure life and provides estimates of it for several dozen energy efficiency measures. The set of definitions was developed through consensus calls with the client utilities. It also cites prior California work from the CALMAC database by its MAESTRO group. The key relevant excerpt is on p. 1-2 of the Study:

> "**Measure Life:** The median number of years that a measure is installed and operational. This definition implicitly includes equipment life and *measure* persistence, but not *savings* persistence (see definition below).
>
> - Equipment life is the number of years installed equipment will operate until failure.
> - Measure persistence takes into account business turnover, early retirement of the installed equipment, and any other reason the measure would be removed or discontinued.
>
> In addition, this definition conforms in letter or in spirit with the definition of measure life used by most national utilities.
>
> **Persistence:** Savings persistence is the percent change in expected savings due to changed operating hours, changed process operation and/or degradation in equipment efficiency relative to the baseline efficiency option."

In these documents "Measure life" is analogous to EUL used elsewhere and "measure persistence" is analogous to retention. "Savings persistence" is almost analogous to the Protocols' performance degradation

(5) *Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, Prepared for The New England State Program Working Group (SPWG) For use as an Energy Efficiency Measures/Programs Reference Document,* for the ISO Forward Capacity Market (FCM), June 2007.

This *Measure Life Report* cites the ERS report and the ERS set of definitions. The Northeast Energy Efficiency Partnership maintains this document in its current library.

(6) *Model Energy Effi ciency Program Impact Evaluation Guide: A Resource of the National Action Plan for Energy Efficiency*, Schiller Consulting, November 2007

The NAPEE Model Energy Impact Program Evaluation Guide quotes the same EUL and persistence definitions as the California Evaluation Framework.

(7) *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs* (2008, 2010, and 2011)

The 2008 Selected Residential and Small Commercial Measures document provides guidance to use EUL when calculating lifecycle savings. The 2010 Residential, Multi-Family, and Commercial/Industrial Measures defers to the then-forthcoming Appendix M. In Appendix M, measure life discussion is based on EULs, as opposed to measure technical life or equipment life.

Appendix E

Two Examples of Cases Working Through the FR Algorithm

TWO EXAMPLES OF CASES WORKING THROUGH THE FR ALGORITHM

This appendix provides tables with actual survey responses and algorithm outputs for two cases to demonstrate the application of the FR (FR) algorithm discussed and presented graphically in the report's section on net-to-gross (NTG) methodology. To aid in the reading of this appendix, the next page repeats the graphic of the algorithm in Figure E-1. The remainder of the appendix details the results of the Program FR analysis. More descriptions of the variables and algorithm can be found in the main body of the report.

One of the two example cases selected illustrates adjustment due to a consistency check and the other does not. One has a matched building owner and vendor and the other has only data from a vendor. These are two of the major algorithm decision points.

Step 1: First Direct Free Ridership Estimate

There are two initial FR estimates (direct estimates) developed by site for each participating building owner and participating vendor referred to as the direct FR measurements. The first element of the first estimate is based upon the likelihood of each measure being installed. The second element reflects the proportion of that equipment (such as lighting) that would have been adopted without the Program. The third element is timing. The key issue is when the participant would have incorporated a similar measure or design, i.e., did the Program impact when the efficiency measure was installed. This factor adjusts FR for participants who installed measures earlier due to participation in the Program, as described below.

- If the participant would have installed the measure within one year, the direct measurement of FR described above is left unadjusted.
- If the participant would have eventually installed the measure, but not for five years or more, direct FR is multiplied by zero, indicating that the participant is not a free rider.
- Proportional adjustments are made for responses between one and five years.

Likelihood and share questions are asked for each measure. Timing is asked for the overall project. The survey questions on likelihood, share, and timing are provided in Table E-1 below.

Figure E-1. Schematic of the Survey Responses and How They Are Combined to Estimate Free Ridership for Industrial and Process Efficiency

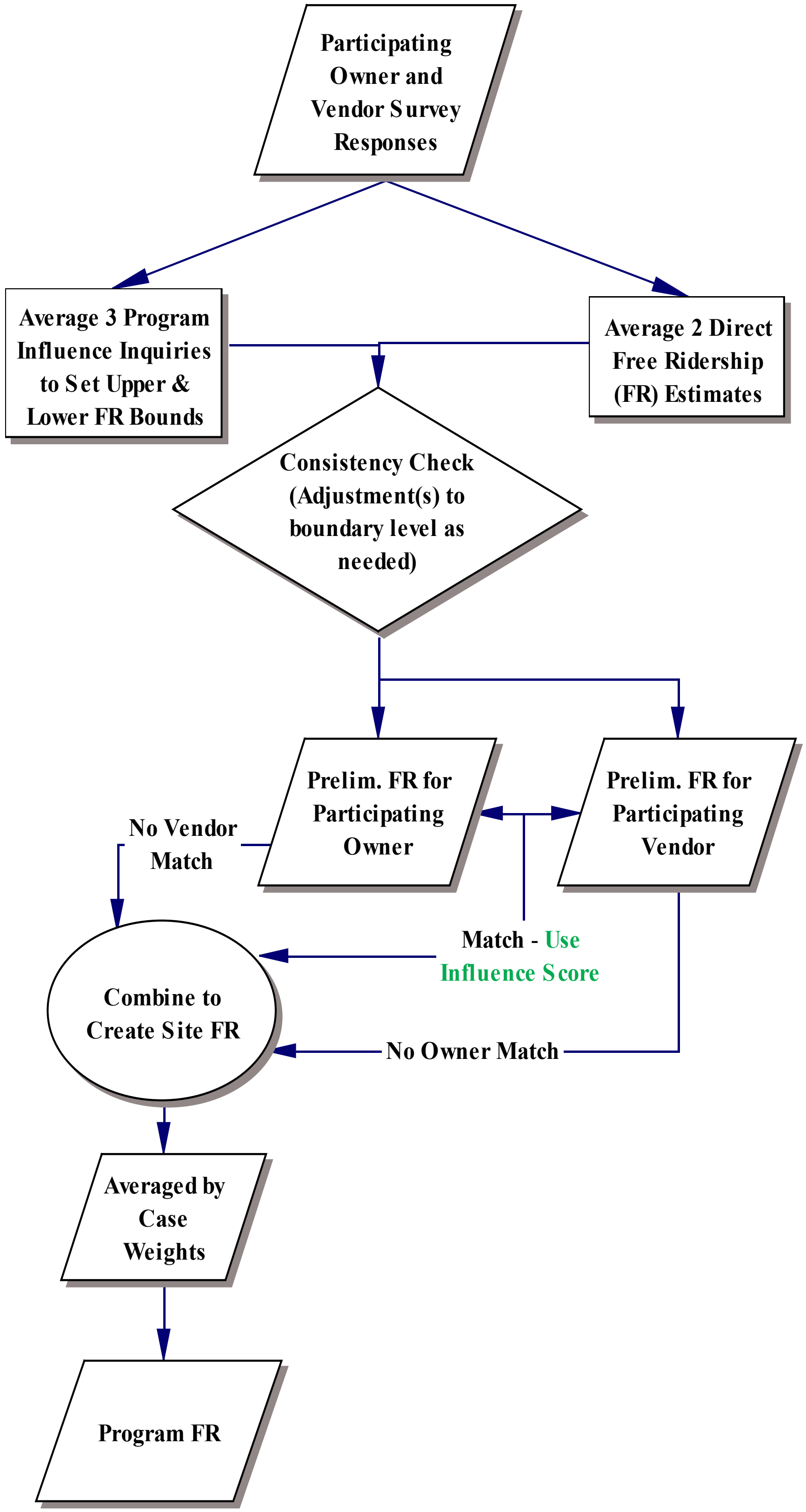


Table E-1. First Direct Free Ridership Likelihood, Share, and Timing Questions with Factor Calculations

Survey Question #	Survey Question	Factor, Where Applicable
FR7	What is the likelihood that you would have incorporated [measure] with the *same high level of efficiency* if you had not received finanancial/technical assistance from the Program?	Likelihood by measure
FR8	What percentage of this high efficiency [measure] would you have incorporated if you had not received finanancial/ technical assistance from the IPE Program?	Share by measure
FR1/ FR1a	In your opinion, did the financial and/or technical assistance that you received through the program cause you to undertake this project earlier than you would have without the Program? About how much earlier [in number of years]?	Timing factor: Less than or equal to 1 = 1.0 More than 1 year and less than 2 years = 0.75 More than 2 years and less than 3 years = 0.5 More than 3 years and less than 5 years = 0.25 More than 5 years = 0
First direct FR estimate		$[(FR7 \times FR8) \times Savings\ weighted\ across\ measures] \times Timing\ factor$

Table E-2 shows how the measure-level initial FR is used to derive direct FR1 for the three respondents in the examples.

Table E-2. First Direct Free Ridership Example Calculation

S: = Survey Question	Example 1 Owner Responses	Example 1 Vendor Responses	Example 2 Vendor Responses
S: Likelihood Measure 1 would have been adopted without Program (FR7)	0.5	0.5	0
S: Share of measure 1 that would have been installed without the Program (FR8)	0.4	0.5	0
S: Timing factor	--	1.0 (less than or equal to 1 year)	--
$First\ direct\ FR = FR7 \times FR8 \times Timing\ factor^1$	0.2	0.25	0

[1] Timing was not given for owner in example 1 or vendor in example 2. In these cases the savings weighted initial FR was used for the first direct FR.

The examples are of single-measure projects. If the project consists of multiple measures, then the likelihood and share proportions are multiplied calculations completed for each measure and then savings-weighted to obtain a calculation across measures. The timing factor is then applied to calculate the project overall first direct FR estimate by site by market actor.

Step 2: Second Direct Free Ridership Estimate

The second direct FR uses survey inquiries that ask the participant to directly estimate, across all measures, the proportion of the total savings that would have been achieved without the Program. The participants are also asked to estimate the upper and lower bounds for their estimate. This "best" estimate is the second direct FR estimate. Table E-3 shows the responses for these questions and the second direct FR for the examples. Example 1's owner had a second direct FR best estimate of 20%, example 1's vendor had a best estimate of 30%, and example 2's vendor had a best estimate of 100%.

Table E-3. Second Direct Free Ridership Example Calculation

S: = Survey Question	Example 1 Owner Responses	Example 1 Vendor Responses	Example 2 Vendor Responses
S: Best estimate of savings without Program second direct FR	0.2	0.3	1
S: Highest estimate of savings without Progrm	0.2	0.4	1
S: Lowest estimate of savings without Program	0.15	0.2	1

Step 3: Average Direct Free Ridership Estimates

The two direct FR estimates are averaged to develop a preliminary FR estimate for each participating site per respondent. The preliminary FR is 20% for the example 1 owner, 28% for the example 1 vendor, and 50% for the example 2 vendor as shown in Table E-4.

Table E-4. Averaging Direct FR1 and Direct FR2 Equals the Preliminary FR

	Example 1 Owner	Example 1 Vendor	Example 2 Vendor
First direct FR	0.2	0.25	0
Second direct FR	0.2	0.3	1
Preliminary FR	0.2	0.28	0.5

Step 4: Calculate of Free Ridership Bounds

As illustrated in Figure E-1, a consistency check is performed by comparing the preliminary FR estimates developed through the above described process to an average of responses to three questions regarding the influence of the Program.[1] The three survey questions that comprise the consistency check inquire about plans for high efficiency prior to Program participation, influence of the Program, and the respondents' stated importance of the Program. The questions and scoring are as follows and as displayed in Table E-5.

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[1] Over 20 years of experience in estimating self-report FR for energy efficiency program evaluation has set standards for quality 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. This is more important to obtaining a rigorous FR estimate than sampling precision.

1. **Prior plans** – The participant is asked if they had any prior plans to install similar high efficiency measures as the measures received through IPE. If so, they are asked to describe their plans for energy efficient installations made prior to participating in the Program. The interviewer then assigns a score for this level of planning that ranges from zero (indicating no plans) to four (indicating that the high efficiency equipment was selected and budgeted).
2. **Program influence –** Participants were asked if the IPE Program influenced the type, number, or efficiency of measures installed. Those respondents who answered in the affirmative were asked to describe the Program's influence on the decision to install high efficiency measures. The interviewer then rated the response from zero (indicating the Program had no influence) to four (indicating the Program was the primary reason that high efficiency equipment was installed).
3. **Program importance** – The participant was directly asked to rate the importance of the Program in their decision to install high efficiency measures on a scale of zero (indicating the Program was not at all important in the decision to install high efficiency equipment) to four (indicating the Program was very important in that decision).

Table E-5. Planning and Influence Questions for FR Adjustments

Survey Question #	Survey Question	Valid Responses	Factor, Where Applicable
FR3	Could you please describe any plans that you had to incorporate the measures prior to participating in the Industrial Process Efficiency Program?	Verbatim with score recorded by interviewer based upon the following guidelines:	Planning score is inverted prior to being used as 1st of 3 influence scores
		0 = No plans for high-efficiency equipment; respondent may have considered alternative technology options, but did not explicitly consider high efficiency.	
		1 = Initial steps toward consideration of high efficiency such as requesting information on or discussing, in general, high efficiency with vendors or contractors.	
		2 = In-depth discussion or consideration of specific types of high efficiency equipment (e.g., lighting, HVAC, appliances), including their positive or negative attributes and costs.	
		3 = Identification of specific equipment manufacturers and models, including assessment of their relative costs and performance characteristics.	
		4 = High efficiency equipment and designs fully specified and explicitly selected or incorporated into project budget.	
FR5	Please briefly describe how the Industrial Process Efficiency Program influenced your decision to incorporate high efficiency measures at this site. Include which part or feature of the Industrial Process Efficiency Program (if any) had the greatest impact on your decision to incorporate the high efficiency measures at this site.	Verbatim with score recorded by interviewer based upon the following guidelines:	2nd of 3 influence scores
		0 = No influence on the decision to install high-efficiency equipment. All equipment would have been installed at the same efficiencies even without the Program.	
		1 = Program helped in making final decision on equipment that had already been thoroughly considered.	
		2 = Program lent credibility to the decision to invest in high efficiency and/or it provided information that helped expand the quantity, scope, or efficiency of the equipment.	
		3 = Program identified a significant number of specific high efficiency options that were installed but that had not previously been considered and/or Program was a major driver behind a significant increase in the quanitity, scope, or efficiency of high-efficiency equipment.	
		4 = Program was the primary reason that high efficiency equipment was installed in the project.	

Survey Question #	Survey Question	Valid Responses	Factor, Where Applicable
FR6	On a scale of 0 to 4, where 0 is “not at all important” and 4 is “very important,” please indicate how important the IPE Program (including its financial and technical assistance) was in the decision to incorporate high efficiency measures at this site.	0 Not at all important	3rd of 3 influence scores
		1 Slightly important	
		2 Somewhat important	
		3 Important	
		4 Very Important	

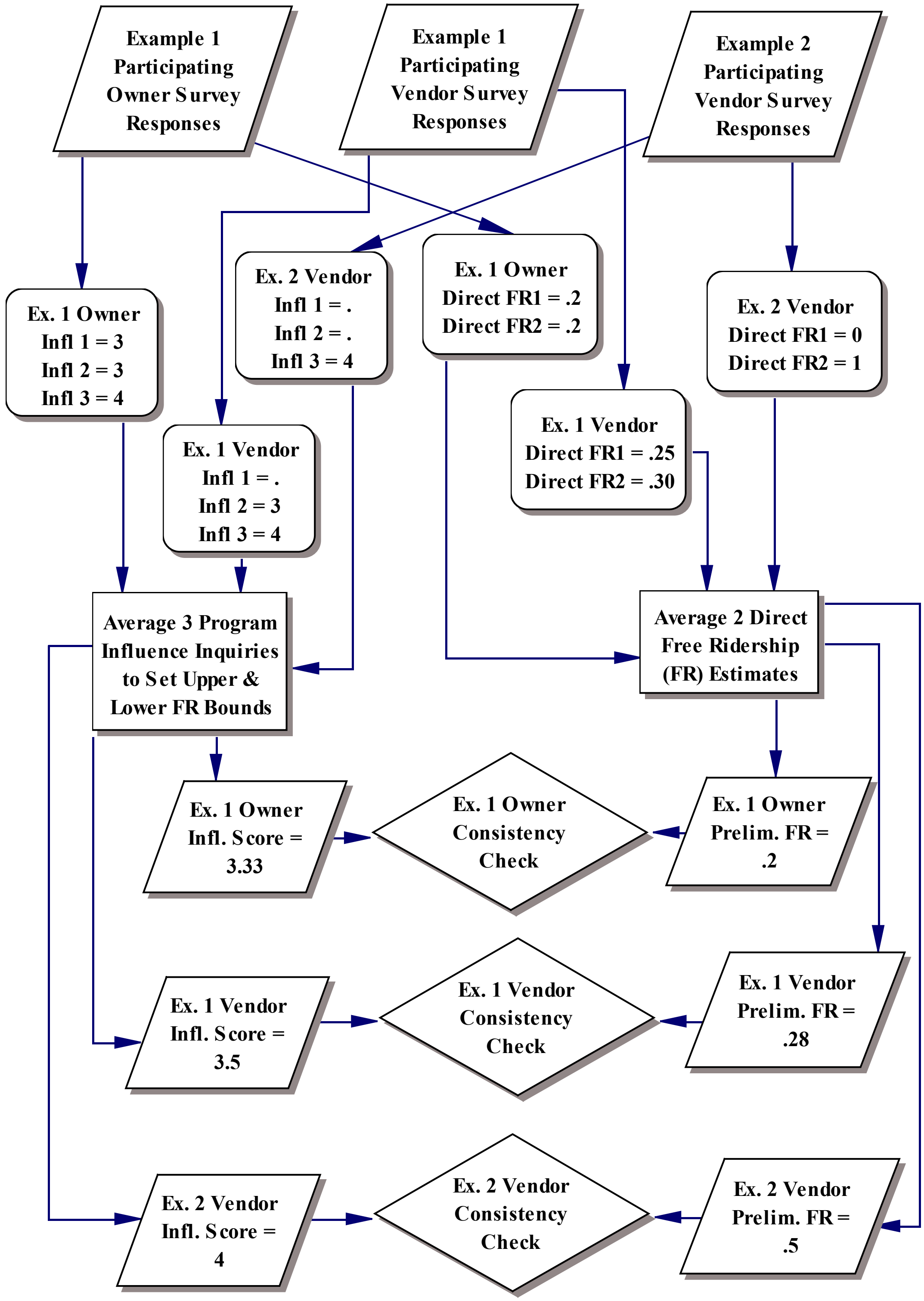
Responses for these three influence questions are provided for the case examples below in Table E-6 along with the average of the three scores.

Table E-6. Influence Survey Questions and Average Influence Score

S: = Survey Question	Example 1 Owner	Example 1 Vendor	Example 2 Vendor
FR3 on prior planning (Response then inverted prior to average)	3	Missing	Missing
FR5 influence on decision-making	3	3	Missing
FR6 importance score	4	4	4
Average influence score	3.33	3.5	4

Figure E-2 illustrates how each of the steps described above are applied through the FR algorithm schematic to derive the direct FR rates, direct FR averages, and average influence scores.

Figure E-2. Schematic of the Enhanced Self-Report Components and How They Are Combined to Estimate Free Ridership for Industrial and Process Efficiency – Part 1



Note: A period (.) indicates no data.

The average program influence score was converted into an upper and lower bound range of plausible FR values. These are provided in Table E-7. A few of the lower and upper bound range for FR are as follows:

- If the average influence score is 0.33 or less then the lower bound is 75% FR and the upper bound is 100%.
- If the average influence score is 1.33 then the lower bound is 55% FR and the upper bound is 95%.
- If the average influence score is 2.5 then the lower bound is 5% FR and the upper bound is 55%.
- If the average influence score is 4.0 then the lower bound is 0% FR and the upper bound is 25%.

Table E-7. Conversion Table for Average Influence Scores

Position #	Average Program Influence Score	Lower Bound Direct FR Value	Upper Bound Direct FR Value
0-1	0.00-0.33	75%	100%
2	0.50	70%	100%
3	0.67	65%	100%
4	1.00	60%	100%
5	1.33	55%	95%
6	1.50	35%	85%
7	1.67	30%	80%
8	2.00	25%	75%
9	2.33	20%	70%
10	2.50	5%	55%
11	2.67	3%	50%
12	3.00	0%	45%
13	3.33	0%	40%
14	3.50	0%	35%
15	3.67	0%	30%
16	4.00	0%	25%

Step 5: Consistency Check – Limit Free Ridership Estimate to Bounds

If the participant's preliminary FR estimate falls below the lower or above the upper bounds of FR based on their average influence score, the final FR estimate for that site from that respondent is adjusted upward or downward to the edge of those bounds. In the examples, the preliminary FR for example 1's owner is consistent with his/her average influence score and so is the preliminary FR for example 1's vendor. The vendor preliminary FR for example 2 is 0.5 and the average influence score is 4. These are inconsistent (the preliminary FR is 50% while the three influence questions all have the highest scores possible). Using the conversion table for the upper and lower bounds creates the adjusted FR to be 0.25, the upper bound for an FR with the highest possible influence scores (4.0).

Step 6: Combine Owner and Vendor-Based Estimates

The next step is to derive an FR estimate for each site, combining FRs across owners and vendors when both could be interviewed for the site. One significant improvement in the FR method was made in this evaluation as compared to prior NYSERDA evaluations. Previously the end user FR rates were averaged (savings weighted) and the vendor FR was averaged. Then these two averages were averaged together to produce the program's FR rate. The implication of a simple average of the end user and vendor FR estimates is that they carry equal weight. In reality the relationships between end users and vendors vary significantly. At one extreme, there may not be a vendor, i.e., the customer chooses what they want and just orders it; at the other end, the vendor may sell the customer on specific technology, potentially using the Program to help sell the idea of making the changes, and the customer relies totally on the vendor.

This evaluation asks a survey question regarding this relationship in the decision-making. Customer influence percentages are assigned from 0% to 100% in 25% increments. The customer versus vendor responses and the assigned percent customer influence is provided in Table E-8.

Table E-8. Customer versus Vendor Influence

Survey Question #	Survey Question	Responses	Customer Influence Percentage
INF1	We are interested in knowing how influential the customer at [site] was in selecting the efficiency/demand measure installed. Which of the following statements best describes the role of the customer for the decisions involving the greatest energy/demand savings?	1. The customer knew what equipment they wanted and its price and planned for this equipment and then you agreed with the choice.	100%
		2. The customer knew the equipment they wanted but needed confirmation on their choice and the cost for obtaining and installing that equipment. You provided the information the customer still needed for the decision.	75%
		3. The customer generally wanted energy efficiency/demand savings and you provided information and recommendations that enabled this equipment to be installed.	50%
		4. You suggested the energy/demand saving measure and then got a supporting opinion from the customer.	25%
		5. You chose the energy/demand saving measure without input from the customer and then the customer followed your recommendation.	0%
Vendor influence is 1 – customer influence.			

Sites with end user and vendor FR estimates are combined site by site by weighting the end user and vendor FR factors based upon a proportional influence score derived from the survey inquiry. This approach should result in a higher level of rigor for the FR estimate than the prior evaluation.

Table E-9 details the decision influence responses and the site FRs for the two examples. The vendor in example 1 provided a response of four to the customer influence question which creates a weighting of 75% of the vendor’s FR and 25% of the end user’s FR for that site. The sites FRs are then 26% for example 1 and 25% for example 2 (the vendor's FR estimate).

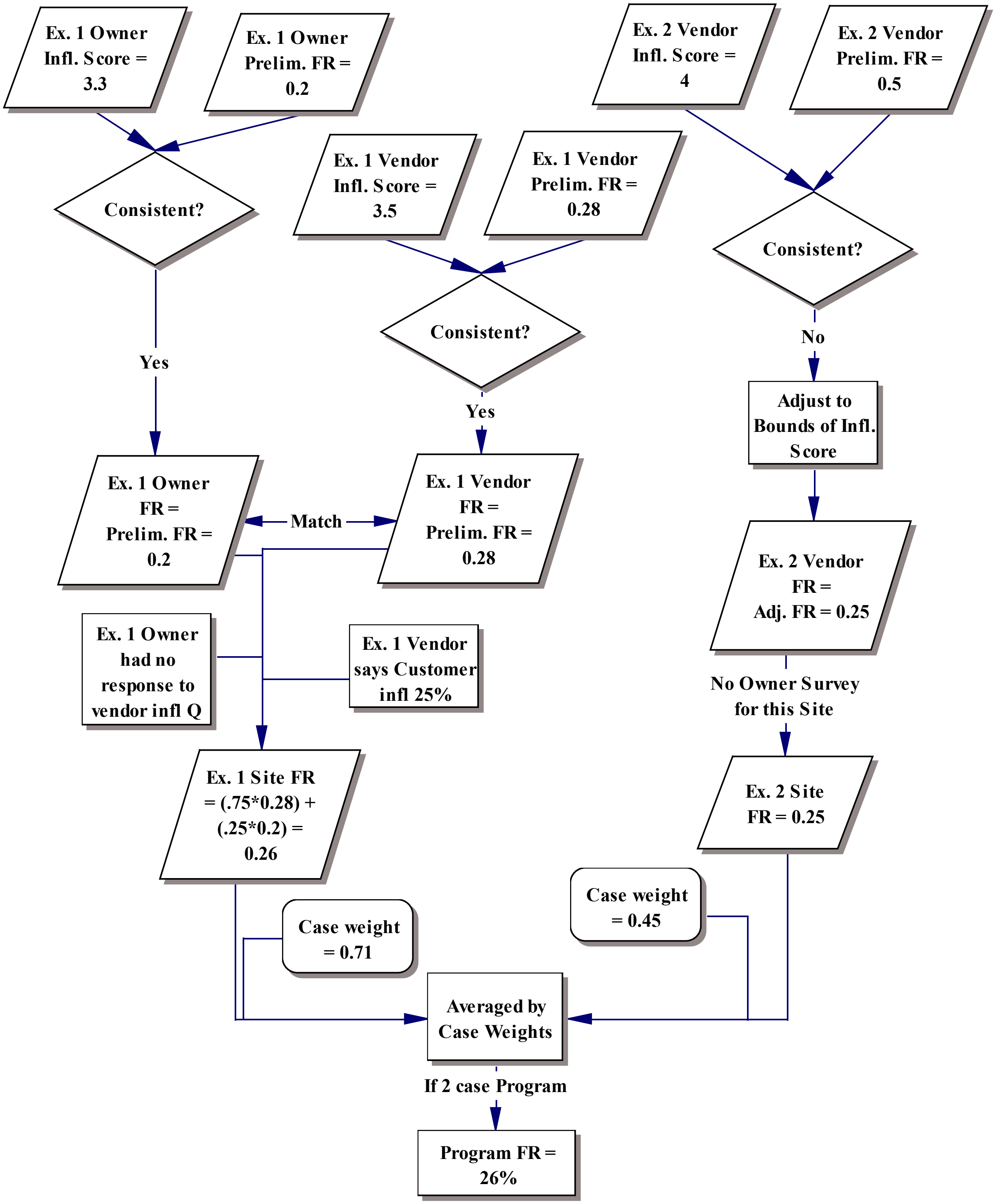
Table E-9. Extent of Market Actor Influence on Decision to Install

S: = Survey Question Extent of Market Actor Influence on Decision to Install	Example 1 Owner Response	Example 1 Vendor Response	Example 2 Vendor Response
S: Customer influence score (survey response)	--	4	5
Preliminary/adjusted FR	.20	.28	25%
Site FR	26%a		25%
$Site\ FR\ =\ (0.2 \times .25) + (0.28 \times .75)\ =\ 26\%$			

Step 7: Calculate Program-Level Free Ridership from Site-Level Estimates

These last steps in the FR algorithm are shown within the FR algorithm schematic for the two examples in Figure E-3. If the program only had these two participants then the program FR is the savings case weighted average across the two site FRs. Example 1 has a case weight of 0.71 and example 2 has a weight of 0.45. The Program-level FR from the two examples is then 26%.

Figure E-3. Schematic of Survey Responses and How They Are Combined to Estimate Free Ridership for Industrial and Process Efficiency – Part 2



Appendix F
Industrial Process Efficiency
Participating Owner Survey

NYSERDA Industrial Process Efficiency Program

Participating Owner Survey

FIELD VERSION FOR ENGINEERS (Final)

INTRODUCTIONS

Project Name:	____________________
Project ID Number:	____________________
Respondent Name:	____________________
Phone:	____________________
Interview Date:	____________________
Interviewer Name:	____________________

ASK TO SPEAK WITH NAMED SAMPLE CONTACT. WHEN PERSON COMES TO THE PHONE OR IF PERSON ANSWERING PHONE ASKS WHAT THIS IS ABOUT, READ:

Hello my name is __________ and I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. Our records indicate that the project at **[DESCRIPTION AND LOCATION]** participated in the NYSERDA Industrial Process Efficiency (IPE) Program. We are researching to assess the program's accomplishments and to improve services. NYSERDA sent you a letter recently telling you that we would be calling and explaining the research we are doing. Your firm was selected as part of a small carefully designed sample of participating customers and your feedback is very important to this research. Your responses to this survey will be kept confidential to the extent permitted by law.

SCR1. Our records show that your company installed energy efficiency measures sometime during [year]. Do you recall your company having participated in NYSERDA's Industrial Process Efficiency Program?

1 YES **[CONTINUE]**

2 NO **[ASK FOR KNOWLEDGEABLE CONTACT]**

[IF STILL NOT AWARE THANK AND TERMINATE]

-96 REFUSED **[THANK AND TERMINATE]**

-97 DON'T KNOW → **[ASK FOR KNOWLEDGEABLE CONTACT]**

[IF STILL NOT AWARE THANK AND TERMINATE]

SCR2. I'd like to speak to the person in the company who was responsible for selecting the energy efficiency measures that were installed. Would that be you?

1 YES **[CONTINUE]**

2 NO **[ASK FOR ALTERNATIVE KNOWLEDGEABLE CONTACT]**

-96 REFUSED **[THANK AND TERMINATE]**

-97 DON'T KNOW **[ASK FOR ALTERNATIVE KNOWLEDGEABLE CONTACT]**

[IF NO] Who at your company can best speak about the energy efficiency measures that were installed with your participation in the IPE program?

[RECORD THE NAME AND NUMBER OF THE NEW CONTACT PERSON BELOW, AND THEN FOLLOW UP WITH HIM OR HER.]

1. **NEW CONTACT NAME AND PHONE NUMBER:**

Name: ____

Phone: (___) _______________________ Extension: ___________

[ONCE CORRECT PERSON IS CONTACTED, REINTRODUCE AND CONTINUE.]

[PLEASE DOCUMENT CONTACTS. LOG IN CONTACTS DATABASE AS APPROPRIATE.]

As a part of this study, we will be conducting a site visit to collect additional data for the installed energy efficiency measures.

During the site visit we will verify the installed equipment, understand the current and pre-retrofit operation, and install loggers to get the usage profiles.

The data we collect will be used to calculate the energy savings for the installed measures. These savings values will be compared with the pre-installation (pre-retrofit) estimated to assess the amount of actual savings realized. These results along with all the results from all the other sampled sites will be projected for the entire program to assess how the overall program is doing.

PROJECT SPECIFIC REVIEW

[ENGINEER DELETES ROWS THAT ARE NOT APPLICABLE GIVEN PROJECT REVIEW PRIOR TO INITIAL CALL.]

Ask question Q1 for all the measures included in the project and record the answers in table provided after question Q2.

Q1. Our records indicate that this project included **[MEASURE]**. Are these records correct?

1. YES **[ASK Q1 FOR NEXT MEASURE]**
2. NO **[ASK Q1 FOR NEXT MEASURE]**
-96. Don't know **[ASK Q1 FOR NEXT MEASURE]**
-97. Refused **[ASK Q1 FOR NEXT MEASURE]**

Q2. Were there other measures installed through the program that I have not listed?

1. YES **[Record the measures in the following table]**
2. NO **[SKIP TO REP1.]**
-96. Don't know **[SKIP TO REP1.]**
-97. Refused **[SKIP TO REP1.]**

[DATABASE] Program Savings Estimates *(complete 2nd & 3rd columns in advance of interview)*

Measure Category	Measure Description	**Program Energy Savings Estimate** (kWh/yr or therms/yr)	**Q1** 1=yes 2=no 96=don't know 97=refused
a Air Compressor- Motors			
b Air Compressor- Tank			
c Air Compressor- VFDs			
d Capacity Increase			
e HVAC- Chiller			
f HVAC-Controls			
g Lighting			
h Manufacturing Efficiency Process			
i Process Improvement			
j Server Refresh			
k VFDs			
l *Write in category for other, or repeated category measure*			
m			
n			

[INCLUDE THESE MEASURES IN ALL FUTURE MEASURE-SPECIFIC QUESTIONS: REP1, REP2, FR2, FR3, FR7, AND FR8]

EARLY REPLACEMENT versus RETROFIT

[ENGINEER DELETES ROWS THAT ARE NOT APPLICABLE GIVEN PROJECT REVIEW PRIOR TO INITIAL CALL, THEN ADD ANY MEASURES DISCOVERED IN Q2.]

[FOR EACH RECOMMENDED MEASURE FROM SAMPLE FILE AND Q2, ASK REP1 AND REP2 IN SEQUENCE THEN GO TO NEXT MEASURE AND ASK REP1 AND REP2 IN SEQUENCE]

[FORMAT FOR REP2 INSTALLED DATE RESPONSE SHOULD BE MMYY.]

[IF MORE THAN 5 MEASURES, PRIORITIZE BY *EX ANTE* SAVINGS AND ONLY ASK ABOUT THE 1ST 5 MEASURES.]

[DO NOT ASK REP1-REP2 FOR PROCESS IMPROVEMENT.]

REP1. To the best of your recollection, how old was **[MEASURE]** that you replaced through the program? **[FOR EACH APPLICABLE MEASURE, RECORD: 1) AGE IN YEARS OR 2) ORIGINAL INSTALL DATE]**

Prior Equipment for Measure	Age (Years) -	OR	Original Install Date	Reasons for Replacement
GAS MEASURES				
Air Compressor- Motors	REP1_a1 ___		REP1_a2 _____	REP2_a _____
Air Compressor- Tank	REP1_b1 ___		REP1_b2 _____	REP2_b _____
Air Compressor- VFDs	REP1_c1 ___		REP1_c2 _____	REP2_c _____
Capacity Increase	REP1_d1 ___		REP1_d2 _____	REP2_d _____
HVAC- Chiller	REP1_e1 ___		REP1_e2 _____	REP2_e _____
HVAC-Controls	REP1_f1 ___		REP1_f2 _____	REP2_f _____
Lighting	REP1_g1 ___		REP1_g2 _____	REP2_g _____
Manufacturing Efficiency Process	REP1_h1 ___		REP1_h2 _____	REP2_h _____
Process Improvement	REP1_i1 ___		REP1_i2 _____	REP2_i _____

Server Refresh	REP1_j1 ___		REP1_j2 _____	REP2_j _____
VFDs	REP1_k1 ___		REP1_k2 _____	REP2_k _____
Other1	REP1_l1 ___		REP1_l2 _____	REP2_l _____
Other2	REP1_m1 ___		REP1_m2 _____	REP2_m _____
Other3	REP1_n1 ___		REP1_n2 _____	REP2_n _____

REP2. Which of the following BEST describes your decision to replace **[MEASURE]**?

1. It was working but not as efficiently as newer models.
2. It was working but we needed a larger/smaller system.
3. It was working but old and would probably need to be replaced in the next couple of years anyway.
4. It required frequent maintenance.
5. It was not working.

-96. Don't know

-97. Refused

FREE-RIDERSHIP

FR1. In your opinion, did the financial and/or technical assistance that you received through the program cause you to undertake this project earlier than you would have without the Program?

1. NO ➔ **[SKIP TO FR2]**
2. YES, EARLIER ➔ **[SKIP TO FR1a]**

-96. Don't know ➔ **[SKIP TO FR2]**

-97. Refused ➔ **[SKIP TO FR2]**

FR1a. About how much earlier?

_________ (number of years)

-96. Don't know

-97. Refused

[ENGINEER DELETES ROWS THAT ARE NOT APPLICABLE GIVEN PROJECT REVIEW PRIOR TO INITIAL CALL, THEN ADD ANY MEASURES DISCOVERED IN Q2.]

[ASK THE FOLLOWING FOR EACH MEASURE MENTIONED IN Q1 OR Q2]

FR2. Prior to participating in the Industrial Process Efficiency Program, were you planning to incorporate **[MEASURE]**?

1. NO ➔ **[ASK FR2 FOR NEXT MEASURE]**

2. YES ➔ **[ASK FR2 FOR NEXT MEASURE]**
-96. Don't know ➔ **[ASK FR2 FOR NEXT MEASURE]**
-97. Refused ➔ **[ASK FR2 FOR NEXT MEASURE]**

[IF "YES" TO ANY FR2 THEN ASK FR3. IF ALL FR2 ARE "NO" SKIP TO FR4]

Measure		**FR2 Response Code**
Air Compressor- Motors	FR2_a	
Air Compressor- Tank	FR2_b	
Air Compressor- VFDs	FR2_c	
Capacity Increase	FR2_d	
HVAC- Chiller	FR2_e	
HVAC-Controls	FR2_f	
Lighting	FR2_g	
Manufacturing Efficiency Process	FR2_h	
Process Improvement	FR2_i	
Server Refresh	FR2_j	
VFDs	FR2_k	
Other1	FR2_l	
Other2	FR2_m	
Other3	FR2_n	

FR3. Could you please describe any plans that you had to incorporate the measures prior to participating in the Industrial Process Efficiency Program? **[PROBE FOR EQUIPMENT TYPE, TIMING, QUANTITY, AND EFFICIENCY, AS WELL AS PRIOR BUDGETING.]**

[BASED ON RESPONSE TO FR3, FILL IN A "0 TO 4"SCORE INDICATING THE EXTENT TO WHICH RESPONDENT WAS ALREADY PLANNING TO INCORPORATE THE ENERGY EFFICIENCY MEASURES. 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.]

(No plans) (Documented plans/budget)

0 1 2 3 4

[GUIDELINES FOR ASSIGNING HIGH EFFICIENCY PROJECT PLANNING SCORE]

Score	**Extent of Planning**
0	No plans for high efficiency equipment; respondent may have

	considered alternative technology options, but did not explicitly consider high efficiency.
1	Initial steps toward consideration of high efficiency such as requesting information on or discussing, in general, high efficiency options with vendors or contractors.
2	In-depth discussion or consideration of specific types of high efficiency equipment (e.g., lighting, HVAC, appliances), including their positive and negative attributes and costs.
3	Identification of specific equipment manufacturers and models, including assessment of their relative costs and performance characteristics.
4	High efficiency equipment and designs fully specified and explicitly selected or incorporated into project budget.

FR4. Thinking about the measures you incorporated at this site, did your participation in the Industrial Process Efficiency Program influence the type or amount of measures you selected or their efficiency levels?

1. NO ➔ (equipment would have been incorporated at the same high efficiencies) **[SKIP TO FR6]**
2. YES ➔ **[GO TO FR5]**

-96. Don't know ➔ **[SKIP TO FR6]**

-97. Refused ➔ **[SKIP TO FR6]**

FR5. Please briefly describe how the Industrial Process Efficiency Program influenced your decision to incorporate high efficiency measures at this site. Include which part or feature of the Industrial Process Efficiency Program (if any) had the greatest impact on your decision to incorporate the high efficiency measures at the site. **[PROBE FOR SPECIFIC MEASURES.]**

[IF THIS QUESTION HAS BEEN ANSWERED IN QUESTION FR3 (REGARDING PRIOR PLANS), THEN PROBE FOR ADDITIONAL DETAILS ON THE PROGRAM'S INFLUENCE ON QUANTITY AND EFFICIENCY LEVEL.]

[BASED ON RESPONSE TO FR5 FILL IN A "0 TO 4"SCORE INDICATING THE EXTENT TO WHICH THE PROGRAM INFLUENCED THE DECISION TO INCORPORATE HIGH EFFICIENCY MEASURES. 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.]

(No program influence) (Program was primary influence)

0 1 2 3 4

[GUIDELINES FOR ASSIGNING PROGRAM INFLUENCE SCORE]

Score	**Characterization of Program Influence**
0	No influence on the decision to install high efficiency equipment. All equipment would have been installed at the same efficiencies even without the program.

1	Program helped in making final decision on equipment that had already been thoroughly considered.
2	Program lent credibility to the decision to invest in high efficiency and/or it provided information that helped expand the quantity, scope, or efficiency of the equipment.
3	Program identified a significant number of specific high efficiency options that were installed but that had not previously been considered and/or program was a major driver behind a significant increase in the quantity, scope, or efficiency of high efficiency equipment.
4	Program was the primary reason that high efficiency equipment was installed in the project.

FR6. On a scale of 0 to 4, where 0 = "not at all important" and 4 = "very important"… Please indicate how important the IPE Program (including its financial and technical assistance) was in the decision to incorporate high efficiency measures at this site.

(Not at all important) (Very important)

0 1 2 3 4

[ASK THE FOLLOWING QUESTIONS FOR EACH MEASURE CATEGORY BELOW. IF PREVIOUS OPEN-ENDED QUESTIONS HAVE PROVIDED THE NECESSARY INFORMATION, INTERVIEWER MAY SKIP THE QUESTION. BY THE END OF THE INTERVIEW, INTERVIEWER SHOULD BE ABLE TO POPULATE THE TABLE BELOW WITH EITHER A "LIKELIHOOD" OR "SHARE OF MEASURES" FOR EACH RELEVANT MEASURE CATEGORY]

Next I'd like to try to quantify the impact of the Industrial Process Efficiency Program. You've already provided **[SOME/MOST]** of the information that I'm looking for. Let me ask about the **[MEASURE]**.

- **[BASED ON EARLIER RESPONSES, ASK EITHER THE "LIKELIHOOD" QUESTION OR THE "SHARE OF MEASURES" QUESTION, WHICHEVER IS MORE APPROPRIATE.**
- **FOR EXAMPLE, IF RESPONDENT INCORPORATED A SINGLE CHILLER, THEN THE "LIKELIHOOD" QUESTION MAY BE MOST APPROPRIATE; IF THEY INCORPORATED MULTIPLE MEASURES OF VARIOUS TYPES/SIZES, THEN THE "SHARE OF MEASURES" MAY BE MORE APPROPRIATE. SOME RESPONDENTS MAY BE ABLE TO OFFER VALID RESPONSES TO BOTH QUESTIONS.**
- **IF YOU ARE UNCERTAIN, ASK BOTH QUESTIONS. IF RESPONDENT CAN PROVIDE A RESPONSE TO EACH, THEN RECORD BOTH RESPONSES]**

FR7. **[LIKELIHOOD]** What is the likelihood that you would have incorporated **[MEASURE]** with the <u>same high level of efficiency</u> if it you had not received financial/technical assistance from the program?

1. Definitely would NOT have incorporated measure of the same high level of efficiency

2. MAY HAVE incorporated measure of the same high level of efficiency, even without the program ➔ about what percent likelihood? _____%
3. Definitely WOULD have incorporated measure of the same high level of efficiency anyway

-96. Don't know

-97. Refused

FR8. **[SHARE OF MEASURES] [ASK IF RECEIVED SUPPORT FOR MULTIPLE MEASURES/DESIGNS AND MIGHT HAVE DONE SOME BUT NOT ALL.]**

What percentage of this high efficiency **[MEASURE]** would you have incorporated if you had not received financial/technical assistance from the IPE Program? **[IF NECESSARY, OR IF THE FLOW OF THE INTERVIEW DICTATES, YOU MAY DERIVE THIS VALUE BY ASKING 1) THE SHARE OF MEASURES THAT WOULD HAVE BEEN INCORPORATED (AT ANY EFFICIENCY) AND 2) THE SHARE OF INCORPORATED MEASURES THAT WOULD HAVE BEEN HIGH EFFICIENCY. THE VALUE IN THE TABLE BELOW FOR QUESTION FR WOULD BE THE PRODUCT OF THESE TWO VALUES.]**

[FILL IN EITHER THE "LIKELIHOOD" VALUE OR THE "SHARE OF MEASURES" VALUE OR BOTH VALUES FOR EACH RELEVANT MEASURE CATEGORY. THAT WOULD HAVE BEEN INCORPORATED (AT HIGH EFFICIENCY) WITHOUT THE COMMERCIAL AND INDUSTRIAL PROGRAM				
Measure Name	**Likelihood FR7**		**Share FR8**	
Air Compressor- Motors	FR7_a %___	and/or	FR8_a %___	
Air Compressor- Tank	FR7_b %___	and/or	FR8_b %___	
Air Compressor- VFDs	FR7_c %___	and/or	FR8_c %___	
Capacity Increase	FR7_d %___	and/or	FR8_d %___	
HVAC- Chiller	FR7_e %___	and/or	FR8_e %___	
HVAC-Controls	FR7_f %___	and/or	FR8_f %___	
Lighting	FR7_g %___	and/or	FR8_g %___	
Manufacturing Efficiency Process	FR7_h %___	and/or	FR8_h %___	
Process Improvement	FR7_i %___	and/or	FR8_i %___	
Server Refresh	FR7_j %___	and/or	FR8_j %___	
VFDs	FR7_k %___	and/or	FR8_k %___	
Other1	FR7_l %___	and/or	FR8_l %___	
Other2	FR7_m %___	and/or	FR8_m %___	
Other3	FR7_n %___	and/or	FR8_n %___	

FR9. 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 strategies have even higher efficiencies than standard new equipment, and this new higher efficiency equipment provides extra energy savings…

Overall, across all these efficient measures, such as heat recovery, what percent of these extra energy savings would have been achieved anyway, even if the Industrial Process Efficiency 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.

Lower bound ➔ ____ % Upper bound ➔ ____ % Best estimate ➔ ____%

FR10. Overall what percent of the generation would have been achieved anyway, even if the Industrial Process Efficiency or its predecessor programs did not exist? Again, 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.

Lower bound ➔ ____ % Upper bound ➔ ____ % Best estimate ➔ ____%

N. NON-ENERGY IMPACTS

[IF NO HIGH EFFICIENCY LIGHTING MEASURES SKIP TO N8]

[Change in lighting servicing costs are a transfer payment for benefit/cost but a benefit to customers whose measurement could be useful for program implementation]

N1. Do you pay for a service that maintains your lighting equipment?

1. YES
2. NO ➔ **[SKIP TO N5]**

-96. Don't know ➔ **[SKIP TO N5]**

-97. Refused ➔ **[SKIP TO N5]**

N2. Has what you are paying to maintain your lighting equipment changed because of this project?

1. YES
2. NO **[SKIP TO N8]**

-98 Don't know **[SKIP TO N8]**

-99 Refused **[SKIP TO N8]**

N3. Are you being charged more or less now?

1. MORE
2. SAME **[SKIP TO N8]**
3. LESS

-98 Don't know **[SKIP TO N8]**

`-99 Refused **[SKIP TO N8]**

N4. How much [MORE/LESS] in dollars per month? _______ **[SKIP TO N8]**

-98 Don't know **[SKIP TO N8]**

-99 Refused **[SKIP TO N8]**

N5. Has the number of hours needed to maintain the lighting equipment changed due to the project?

1. YES
2. NO ➔ **[SKIP TO N8]**

-96. Don't know ➔ **[SKIP TO N8]**

-97. Refused ➔ **[SKIP TO N8]**

N6. Is the number of hours more or fewer than before this project?

1. MORE
2. SAME ➔ **[SKIP TO N8]**
3. FEWER

-96. Don't know ➔ **[SKIP TO N8]**

-97. Refused ➔ **[SKIP TO N8]**

N7. About how many **[MORE/FEWER]** hours per month? ______

-96. Don't know

-97. Refused

N8. What does your organization use as an hourly labor rate for O&M staff for internal budgeting?

$ ______ /hr

-96. Don't know

-97. Refused

OVERALL OPERATIONS & MAINTENANCE EXPENSES (excluding lighting)

N9. Have the number of hours for operations and maintenance (O&M), excluding lighting, changed because of this project?

1. YES
2. NO ➔ **[SKIP TO N13]**

-96. Don't know ➔ **[SKIP TO N13]**

-97. Refused ➔ **[SKIP TO N13]**

N10. Are you spending more or fewer hours per month for O&M than you spent before this project?

1. MORE
2. SAME **[SKIP TO N13]**
3. FEWER

-96. Don't know **[SKIP TO N13]**

-97. Refused **[SKIP TO N13]**

N11. About how many **[MORE/FEWER]** hours are you spending per month than before the project?

____

-96. Don't know

-97. Refused

If responses are for individual measure, record the responses in the table below:

Measure Name	Response for N9	Response for N10	Response for N11
Air Compressor- Motors			
Air Compressor- Tank			
Air Compressor- VFDs			
Capacity Increase			
HVAC- Chiller			
HVAC-Controls			
Lighting			
Manufacturing Efficiency Process			
Process Improvement			
Server Refresh			
VFDs			
Other1			
Other2			
Other3			

N12. *Deleted. Addressed in N8. Numbering retained for consistency with EF questionnaire.*

PRODUCTIVITY

N13. Has throughput changed because of this project? Throughput is defined as a measure of output per unit of labor input.

If necessary give examples such as eliminating a shift while maintaining production, or producing a higher quality product that increases revenues but does not require more labor or energy to produce, once the investment was made.

1. YES

2. NO ➔ **[SKIP TO N17]**

-96. Don't know ➔ **[SKIP TO N17]**

-97. Refused ➔ **[SKIP TO N17]**

N14. Is your throughput higher or lower than before this project?

1. HIGHER
2. SAME ➔ **[SKIP TO N17]**
3. LOWER
-96. Don't know ➔ **[SKIP TO N17]**
-97. Refused ➔ **[SKIP TO N17]**

N15. Has the program induced change in throughput changed your firm's net revenues?

1. YES
2. NO ➔ **[SKIP TO N17]**
-96. Don't know ➔ **[SKIP TO N17]**
-97. Refused ➔ **[SKIP TO N17]**

N16. Approximately how much has your revenue [INCREASED/DECREASED] per month due to your program participation? ______

-96. Don't know
-97. Refused

WATER AND WASTEWATER EXPENSES

N17. Have your monthly costs for acquiring water or treating or disposing of wastewater changed because of this project?

1. YES
2. NO ➔ **[SKIP TO N20]**
-96. Don't know ➔ **[SKIP TO N20]**
-97. Refused ➔ **[SKIP TO N20]**

N18. Are you spending more or less per month than you were before this project?

1. MORE
2. SAME **[SKIP TO N20]**
3. LESS
-96. Don't know ➔ **[SKIP TO N20]**
-97. Refused ➔ **[SKIP TO N20]**

N19. About how much **[MORE/LESS]** are you spending in dollars per month than you were before this project? ______

-96. Don't know
-97. Refused

MATERIALS, WASTE AND WASTE HANDLING (NON-WATER OR WASTEWATER) EXPENSES

N20. Have your monthly costs for buying raw materials or handling scrap and waste other than water changed because of this project?

1. YES
2. NO ➔ **[SKIP TO N23]**
-96. Don't know ➔ **[SKIP TO N23]**
-97. Refused ➔ **[SKIP TO N23]**

N21. Are you spending more or less per month than you were before this project?

1. MORE
2. SAME **[SKIP TO N23]**
3. LESS
-96. Don't know ➔ **[SKIP TO N23]**
-97. Refused ➔ **[SKIP TO N23]**

N22. About how much **[MORE/LESS]** are you spending in dollars per month than you were before this project? ______

-96. Don't know
-97. Refused

IMPACTS THROUGH INDUCED CHANGES IN ELECTRIC RATE

[CHANGE IN ENERGY PAYMENTS DUE TO CHANGES IN ELECTRIC RATES ARE A TRANSFER PAYMENT FOR B/C BUT A BENEFIT TO CUSTOMERS WHOSE MEASUREMENT COULD BE USEFUL FOR PROGRAM IMPLEMENTATION)]

N23. Did your firm change its electric rate, the rate at which the firm pays for each energy and demand used because of the IPE Project?

1. YES
2. NO ➔ **[SKIP TO N26]**
-96. Don't know ➔ **[SKIP TO N26]**
-97. Refused ➔ **[SKIP TO N26]**

N24. Did what you pay in electricity costs per kWh increase or decrease?

1. INCREASE
2. DECREASE

N25. Approximately how many **[MORE/LESS]** dollars does your firm pay in electricity charges per month due to just this change in electric rate *(i.e.*, the change in the rate caused by your participation but not the change in usage due to the project)?

$_________ per month

-96. Don't know
-97. Refused

IMPACTS THROUGH INDUCED CHANGES IN NATURAL GAS RATE

ONLY ASK FOR PROJECTS THAT SAVED NATURAL GAS. OTHERWISE SKIP TO D1.

N26. Did your firm change its natural gas rate because of the IPE Project?

1. YES
2. NO ➔ **[SKIP TO D1]**

-96. Don't know ➔ **[SKIP TO D1]**

-97. Refused ➔ **[SKIP TO D1]**

N27. Did what you pay in for natural gas per therm increase or decrease?

1. INCREASE
2. DECREASE

N28. Approximately how many **[MORE/LESS]** dollars does your firm pay per month due to just this change in natural gas rate *(i.e.*, the change in the rate caused by your participation but not the change in usage due to the project)?

$________ per month

-96. Don't know

-97. Refused

DECISION-MAKERS (FOR ADDITIONAL INTERVIEWS)

[IF PROJECT IS IN CENSUS STRATUM ASK DM9 – DM11, OTHERWISE PROCEED TO NEXT SECTION.]

DM9a. Generally, how are decisions 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 DM10.]**
2. The decision is completely a committee decision. **[SKIP TO DM10.]**
3. Someone else makes the technical recommendations but I have the final financial or contracting authority. **[SKIP TO DM10.]**
4. I make the recommendations but others have the financial or contracting authority. **[SKIP TO DM10.]**
5. I make recommendations and the corporate office elsewhere makes the decision, but my recommendations are normally followed. **[SKIP TO DM10.]**
6. I make recommendations but the corporate office always makes their own decisions, sometimes with little regard to my recommendations. **[SKIP TO DM10.]**
7. There are multiple groups and decision points that must be passed that are more complicated than these other statements. → ***Ask DM9b***

DM9b. Describe the decision-making process. ***[Open-ended]***

DM10. 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	DM11 Score
Title	*Name*	*Phone*	*Email*	*DM11 Score*
Title	*Name*	*Phone*	*Email*	*DM11 Score*
Title	*Name*	*Phone*	*Email*	*DM11 Score*

DM11. 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.]***

FIRMOGRAPHICS

ST1. What is the principal product manufactured at this facility?

AFTER INTERVIEW COMPLETION LOOK UP 4-DIGIT 2007 NAICS NUMBER. FOR DATA CENTERS AND RELATED SITES, ENTER 5415, EVEN IF THE DATA CENTER IS PART OF A COMMERCIAL ENTERPRISE THAT WOULD FALL UNDER A DIFFERENT CLASSIFICATION.

___ ___ ___ ___

www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007

(Deleted all EF firmographic questions).

THANK YOU FOR YOUR TIME!

Appendix G
Industrial Process Efficiency
Participating Vendor Survey

NYSERDA Industrial Process Efficiency Program
Impact Evaluation 2011 Participating Vendor Survey
FINAL *10/26/11*

Hello may I please speak to **[NAME1]**? I'm calling on behalf of the New York State Energy Research and Development Authority (or NYSERDA). We are conducting research for NYSERDA's Industrial and Process Efficiency Program (IPE).

[IF INTRO = INTRO 1, READ INTRO1, ELSE SKIP TO INSTRUCTIONS BEFORE INTRO2]

INTRO 1

Our records have **[COMPANY]** listed as the vendor for the Program's project at **[SITE]** and indicate that you may be the best contact at your firm for this project. I'd like to ask you some questions regarding the decision-making process for this project or projects similar to this one.

[READ IF NECESSARY: We are researching a small carefully designed sample of projects that participated in the NYSERDA Industrial and Process Efficiency Program. Because we are only talking to a few people, your participation in this evaluation is very important to us. The information you provide will be used to assess program accomplishments and improve NYSERDA's programs. Your responses will be kept confidential to the extent permitted by law.**]**

[GO TO Q1]

[IF INTRO = INTRO 2, READ INTRO 2]

INTRO 2

We would like to conduct interviews regarding the decision-making process for the following projects:

[READ MULTIPLE SITE LISTINGS]

Our records have **[COMPANY]** listed as the vendor for these projects and indicate that you may be the best contact at your firm regarding these projects. I'd like to ask you some questions regarding the decision-making process for these projects or projects similar to these.

[READ IF NECESSARY: We are researching a small carefully designed sample of projects that participated in the NYSERDA Industrial and Process Efficiency Program. Because we are only talking to a few people, your participation in this evaluation is very important to us. The information you provide will be used to assess program accomplishments and improve NYSERDA's programs. Your responses will be kept confidential to the extent permitted by law.**]**

[GO TO Q1]

SECTION: SCR – SCREENER QUESTIONS

Q1. Are you the appropriate person to discuss issues related to the Industrial and Process Efficiency project at **[IF INTRO = INTRO 1 INSERT "**this site**", IF INTRO = INTRO 2 INSERT "**these sites**"]**?

1. YES **[SKIP TO SCR1]**
2. NO, NOT CORRECT RESPONDENT
96. REFUSED
97. DON'T KNOW

Q2. Can you provide me with a contact name and phone number for a person who can speak about the project at **[SITE]**? **[REPEAT FOR ALL MULTIPLE SITES]**

1. YES **[RECORD NAME AND PHONE NUMBER]**
2. NO **[TERMINATE]**
96. REFUSED **[TERMINATE]**
97. DON'T KNOW **[TERMINATE]**

[IF Q2=1. CONTACT THIS PERSON, REPEAT INITIAL INTRODUCTION]

SCR1. This survey will take about **[IF VENDOR HAS ONLY 1 SITE, INSERT "**10**"; IF VENDOR HAS 2 SITES, INSERT "**10 TO 15**"; IF VENDOR HAS 3 SITES, INSERT "**15**"]** minutes to complete. Can we discuss **[IF INTRO = INTRO 1 INSERT "**this project**", IF INTRO = INTRO 2 INSERT "**these projects**"]** now, or can we schedule a time when I can call you back?

1. CAN DISCUSS NOW **[GO TO SECTION FR]**
2. SCHEDULE CALL BACK **[RECORD CALLBACK DATE AND TIME]**
96. REFUSED **[READ: "**Because we are only talking to a few people, your participation in this evaluation is very important to us. The information you provide will be used to assess program accomplishments and improve NYSERDA's programs. Can we continue?**" IF RESPONDENT REFUSES, THANK AND TERMINATE]**

[CONDUCT AN ENTIRE SURVEY FOR THE FIRST SITE, OR ONLY SITE, FOR A VENDOR]

[CONDUCT SURVEY FR1-FR10c AND INF1 FOR EACH ADDITIONAL SITE]

SECTION: FR – FREE RIDERSHIP

Our records indicate that this Program project at **[SITE]** included the following measures: **[READ MEASURE NAMES]**

FR1. Prior to participating in the Industrial and Process Efficiency Program, were there plans to install any of the adopted energy efficiency equipment or action at this customer's facility?

1. YES
2. NO **[SKIP TO FR3]**
96. REFUSED **[SKIP TO FR3]**
97. DON'T KNOW **[SKIP TO FR3]**

FR2. Could you please describe any plans that your customer had to incorporate the adopted measures prior to participating in the Industrial and Process Efficiency Program?

1. **[NOTES FROM VERBATIM]**
96. REFUSED
97. DON'T KNOW

[IF RESPONDENT PROVIDED VERBATIM ANSWER FOR FR2, BASED ON RESPONSE FILL IN FR2a WITH A "0 TO 4" SCORE INDICATING THE EXTENT TO WHICH RESPONDENT WAS ALREADY PLANNING TO INCORPORATE THE MEASURES. DO NOT ASK RESPONDENT TO SCORE DIRECTLY. "0" INDICATES THAT RESPONDENT HAD NO PLANS AT ALL; "4" INDICATES THAT RESPONDENT HAD DOCUMENTED PLANS AND HAD BUDGETED FOR ALL OF THE MEASURES.]

FR2a

[NO PLANS] **[DOCUMENTED PLANS/BUDGET]**

0 1 2 3 4

[FULL GUIDELINES FOR ASSIGNING HIGH-EFFICIENCY PROJECT PLANNING SCORE]

SCORE	EXTENT OF PLANNING
0	NO PLANS FOR HIGH EFFICIENCY EQUIPMENT OR ACTIONS; RESPONDENT MAY HAVE CONSIDERED ALTERNATIVE TECHNOLOGY OPTIONS, BUT DID NOT EXPLICITLY CONSIDER HIGH EFFICIENCY.
1	INITIAL STEPS TOWARD CONSIDERATION OF HIGH EFFICIENCY SUCH AS REQUESTING INFORMATION ON OR DISCUSSING, IN GENERAL, HIGH EFFICIENCY OPTIONS WITH VENDORS OR CONTRACTORS.
2	IN-DEPTH DISCUSSION OR CONSIDERATION OF SPECIFIC TYPES OF HIGH EFFICIENCY EQUIPMENT (*E.G.*, LIGHTING, HVAC, APPLIANCES, INTERVAL METER), INCLUDING THEIR POSITIVE AND NEGATIVE ATTRIBUTES AND COSTS.
3	IDENTIFICATION OF SPECIFIC EQUIPMENT MANUFACTURERS AND MODELS, INCLUDING ASSESSMENT OF THEIR RELATIVE COSTS AND PERFORMANCE CHARACTERISTICS.
4	HIGH EFFICIENCY EQUIPMENT AND DESIGNS FULLY SPECIFIED AND EXPLICITLY SELECTED OR INCORPORATED INTO PROJECT BUDGET.

FR3. Do you think the Industrial and Process Efficiency Program or its assistance caused the customer to undertake this project earlier than they would have without the program?

1. YES
2. NO **[SKIP TO FR5]**
96. REFUSED **[SKIP TO FR5]**
97. DON’T KNOW **[SKIP TO FR5]**

FR4. How much earlier?

1. **[RECORD NUMBER OF MONTHS]**
2. **[RECORD NUMBER OF YEARS]**
96. REFUSED
97. DON’T KNOW

FR5. Did the project’s participation in the Industrial and Process Efficiency Program in any way influence the type of equipment, the ability of the equipment to save electricity, or the amount of measures that were incorporated?

1. YES
2. NO (ALL EQUIPMENT WOULD HAVE BEEN INCORPORATED AT THE SAME HIGH EFFICIENCIES) **[SKIP TO FR7]**
96. REFUSED **[SKIP TO FR7]**
97. DON’T KNOW **[SKIP TO FR7]**

FR6. Please briefly describe how you think the Industrial and Process Efficiency Program influenced the decision to incorporate high efficiency at **[SITE]**.

1. [NOTES FROM VERBATIM]
96. REFUSED
97. DON’T KNOW

[IF RESPONDENT PROVIDED VERBATIM ANSWER FOR FR4, FILL IN A "0 TO 4"SCORE INDICATING THE EXTENT TO WHICH THE PROGRAM INFLUENCED THE DECISION TO INCORPORATE HIGH EFFICIENCY MEASURES AND ACTIONS. DO NOT ASK RESPONDENT TO SCORE DIRECTLY. "0" INDICATES THAT THE PROGRAM HAD NO INFLUENCE; "4" INDICATES THAT THE PROGRAM WAS THE PRIMARY REASON THAT HIGH EFFICIENCY MEASURES WERE INCORPORATED.]

FR6a.

[NO PROGRAM INFLUENCE]				**[PROGRAM PRIMARY INFLUENCE]**
0	1	2	3	4

[FULL GUIDELINES FOR ASSIGNING PROGRAM INFLUENCE SCORE]

SCORE	CHARACTERIZATION OF PROGRAM INFLUENCE
0	NO INFLUENCE ON THE DECISION TO INSTALL HIGH EFFICIENCY EQUIPMENT OR ACTIONS. ALL EQUIPMENT WOULD HAVE BEEN INSTALLED AT THE SAME EFFICIENCIES/CAPABILITIES EVEN WITHOUT THE PROGRAM.
1	PROGRAM HELPED IN MAKING FINAL DECISION ON EQUIPMENT THAT HAD ALREADY BEEN THOROUGHLY CONSIDERED.
2	PROGRAM LENT CREDIBILITY TO THE DECISION TO INVEST IN HIGH EFFICIENCY AND/OR IT PROVIDED INFORMATION THAT HELPED EXPAND THE QUANTITY, SCOPE, OR EFFICIENCY/CAPABILITY OF THE EQUIPMENT.
3	PROGRAM IDENTIFIED A SIGNIFICANT NUMBER OF SPECIFIC HIGH EFFICIENCY OPTIONS THAT WERE INSTALLED BUT THAT HAD NOT PREVIOUSLY BEEN CONSIDERED AND/OR PROGRAM WAS A MAJOR DRIVER BEHIND A SIGNIFICANT INCREASE IN THE QUANTITY, SCOPE, OR EFFICIENCY/CAPABILITY OF HIGH EFFICIENCY.
4	PROGRAM WAS THE PRIMARY REASON THAT HIGH EFFICIENCY/DEMAND REDUCTION EQUIPMENT WAS INSTALLED.

FR7. On a scale of 0 to 4, where 0 equals "not at all important" and 4 equals "very important," please indicate how important you think the Industrial and Process Efficiency Program was in the decision to incorporate energy efficiency at this site?

0. NOT AT ALL IMPORTANT
1.
2.
3.
4. VERY IMPORTANT
96. REFUSED
97. DON'T KNOW

Next I'd like to try to quantify the impact of the Industrial and Process Efficiency Program at **[SITE]**. Let me ask about the measures I listed previously.

[ASK FR8 AND FR9 IN SEQUENCE FOR A MEASURE THEN GO TO NEXT MEASURE AND ASK FR8 AND FR9]

FR8. What is the likelihood that **[MEASURE]** of the same high level of efficiency would have been incorporated at this site if it had not been for the Industrial and Process Efficiency Program and its assistance? Would you say it…**[READ]**

1. Definitely **would not** have incorporated measures of the same high efficiency (0%) **[SKIP TO INSTRUCTIONS BEFORE FR9]**
2. **May have** incorporated measures of the same high efficiency, even without the program.
3. Definitely would have incorporated measures of the same high efficiency anyway (100%) **[SKIP TO INSTRUCTIONS BEFORE FR9]**

96. REFUSED **[SKIP TO INSTRUCTIONS BEFORE FR9]**
97. DON'T KNOW **[SKIP TO INSTRUCTIONS BEFORE FR9]**

FR8a. About what percent likelihood?

01 [RECORD PERCENT **[ACCEPT 0-100, EXCLUDING 0 AND 100]]**

96. REFUSED
97. DON'T KNOW

[PROGRAMMER: AUTOFILL FR8a = 0 IF FR8=1, FR8a = 100 IF FR8=3]

[ASK FR9 FOR LIGHTING AND VFDs]

FR9. What percentage of these high efficiency **[MEASURES]** would *the customer* have incorporated if they had not received the Industrial and Process Efficiency Program's assistance?

1. [RECORD PERCENT] **[ACCEPT 0-100]**
96. REFUSED
97. DON'T KNOW

[READ IF NECESSARY: So, assuming that the customer had decided to incorporate **[MEASURE]**, what share or percent of the measures do you think the customer would have had you implement in the absence of the Industrial and Process Efficiency Program and its incentives? That is, would they have made all of the changes or only part of them? And if part, what percent would you say the customer would have implemented?**]**

[FILL IN THE "LIKELIHOOD" VALUE FOR ALL MEASURES AND THE "SHARE OF MEASURES" VALUE OR BOTH VALUES FOR EACH RELEVANT MEASURE CATEGORY.]			
MEASURE NAME & ABBREVIATION	…WOULD HAVE BEEN INCORPORATED (AT HIGH EFFICIENCY/DEMAND REDUCTION CAPABILITY) WITHOUT THE Industrial and Process Efficiency PROGRAM		
	LIKELIHOOD FR8		SHARE FR9
Air Compressor- Motors	FR8_a	AND, as applicable	FR9_a
Air Compressor- Tank	FR8_b	AND, as applicable	FR9_b
Air Compressor- VFDs	FR8_c	AND, as applicable	FR9_c
Capacity Increase	FR8_d	AND, as applicable	FR9_d
HVAC- Chiller	FR8_e	AND, as applicable	FR9_e
HVAC-Controls	FR8_f	AND, as applicable	FR9_f
Lighting	FR8_g	AND/OR	FR9_g
Manufacturing Efficiency Process	FR8_h	AND, as applicable	FR9_h
Process Improvement	FR8_i	AND, as applicable	FR9_i
Server Refresh	FR8_j	AND, as applicable	FR9_j
VFDs (Non air compressor)	FR8_k	AND/OR	FR9_k

FR10. Most new equipment and design strategies have to meet current energy standards. But let's just focus on the fact that some of the new equipment, incorporated as a result of the Industrial and Process Efficiency Program are at a greater level of efficiency than standard new equipment, and these new efficiency measures provide extra energy savings.

Overall, across all measures, what percent of these extra energy savings at **[SITE]** would have been achieved anyway, even if the Industrial and Process Efficiency Program did not exist? Please provide a lower and upper bound, and then your best estimate.

[READ IF NECESSARY: For example, 50% means that half of the extra energy savings from the efficiency equipment or action would have been achieved anyway.**]**

FR10a. Lower bound
1. [RECORD PERCENT **[ACCEPT 0-100]**]
96. REFUSED
97. DON'T KNOW

FR10b. Upper bound
1. [RECORD PERCENT **[ACCEPT 0-100]**]
96. REFUSED
97. DON'T KNOW

FR10c. Best estimate
1. **[RECORD PERCENT. ACCEPT NUMBER BETWEEN FR10a and FR10b]**
96. REFUSED
97. DON'T KNOW

[FR10a ≤ FR10c ≤ FR10b]

SECTION: INFL – VENDOR VERSUS OWNER INFLUENCE

INF1. We are interested in knowing how influential the customer at **[SITE]** was in selecting the high efficiency equipment installed. Which of the following statements best describes the role of the customer for the decisions involving the greatest energy savings? **[READ RESPONSES]**
1. The customer knew what equipment they wanted, its price and planned for this equipment and then you agreed with the choice
2. The customer knew the equipment they wanted but wanted confirmation on their choice and the cost for obtaining and installing that equipment. You provided the information the customer still needed for the decision
3. The customer generally wanted high efficiency and you provided information and recommendations that enabled this equipment to be installed.
4. You suggested the energy efficient equipment or action and then got a supporting opinion from the customer
5. You chose the energy efficient equipment or action without input from the customer and then the customer followed your recommendation.
96. REFUSED
97. DON'T KNOW

SECTION: ST – FIRMOGRAPHICS (STATISTICS)

Thank you for your time so far. I just have a few more questions about your firm.

ST1. Is your firm a(n) . . . ? **[READ]**

1. Energy Services Company or ESCO
2. Architectural firm
3. Engineering firm
4. HVAC contractor
5. Lighting contractor
95. Or something else? (SPECIFCY ________)
96. REFUSED
97. DON'T KNOW

ST2. What percentages of all your projects address the following areas? **[READ IF NECESSARY**: "If half of all the projects your firm works on address lighting, then the response for lighting should be 50%. If all of your projects address lighting, then the response should be 100%."**]**

a. Lighting
b. HVAC (Heating, Ventilation, Air Conditioning)
c. Motors and drives
d. Building Shell
e. Load management/curtailment
f. CHP (Combined Heat and Power)
g. Process improvements (manufacturing, and/or water and wastewater)
h. Other (Specify________)

[PROGRAMMER NOTE: DOES NOT NEED TO ADD UP TO 100% AS PROJECTS CAN HAVE MULTIPLE AREAS ADDRESSED, SUCH AS LIGHTING AND HVAC]

1. [RECORD PERCENTAGES [ACCEPT 0-100]]
96. REFUSED
97. DON'T KNOW

[IF INTRO=INTRO2, SAY "NOW I'D LIKE TO ASK A SMALL SUBSET OF THESE QUESTIONS FOR THE PROJECTS AT [INSERT SITES]" AND ASK FR1-FR10C, AND INF1 FOR EACH SITE.]

[IF INTRO=INTRO1 OR FR1-FR10C AND INF1 ASKED FOR EACH SITE, SAY "THAT COMPLETES THIS TELEPHONE SURVEY. THANK YOU VERY MUCH FOR YOUR ASSISTANCE!"]