Appendix A:

GLOSSARY OF TERMS

Table A-1. List of Acronyms

Acronym	**Definition**
AEP	Projected annual energy output
ARRA	American Recovery and Reinvestment Act
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
BOCES	Boards of Cooperative Educational Services
Btu	British Thermal Unit
CCR	Central Contractor Registry
CDD	Cooling degree day
CEO	Code enforcement official
CO_2	Carbon dioxide
CUNY	City University of New York
DAS	Data acquisition system
DOE	Department of Energy
DOS	New York Department of State
DPS	Department of Public Service
DRG	Discovery Research Group
DSM	Demand side management
ECCCNYS, or Energy Code	Energy Conservation Construction Code of New York State
ECM	Energy conservation measure
ECS	Energy Conservation Studies
EECBG	Energy Efficiency and Conservation Block Grant
EEPS	Energy Efficiency Portfolio Standard
EER	Energy-efficiency rating
EM&V	Evaluation, measurement, and verification
EMS	Energy management system
EPA	Environmental Protection Agency
ERS	Energy & Resource Solutions
EUL	Effective useful life
FR	Full freerider
GHG	Greenhouse gas
Guidelines	*Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects*
GWP	Global warming potential

Acronym	Definition
HDD	Heating degree day
I/O	Input-output
IECC	International Energy Conservation Code
IPCC	Intergovernmental Panel on Climate Change
IPMVP	International Performance Measurement and Verification Protocol
kW	Kilowatt
kWh	Kilowatt hour
LIPA	Long Island Power Authority
M&V	Measurement and Verification
MCAC	Market Characterization, Assessment, and Causality
MMBtu	Millions of BTUs
MWh	Megawatt hour
NFR	Nonfreerider
NMR Group	Nexus Market Research Group, Inc.
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NTG	Net-to-gross
NYC	New York City
NYSERDA	New York State Energy Research and Development Authority
O&M	Operation and maintenance
PA Cost Test	Program Administrator Cost Test
PFR	Partial freerider
PI$^+$	Policy Insights$^+$
PNNL	Pacific Northwest National Laboratory
PON	Program Opportunity Notice
PPA	Power Purchase Agreement
PRS	Popular Research Systems
PSC	Public Service Commission
PV	Photovoltaic
RAC	Recovery Act Cost
REMI	Regional Economic Models, Inc.
RFP	Request for Proposals
RPS	Renewable Portfolio Standard
SAM	System Advisor Model
SBC	System Benefits Charge
SCT	Societal Cost Test
SEEARP	State Energy Efficiency Appliance Rebate Program

Acronym	Definition
SEP	State Energy Program
SHW	Solar hot water
SIT	*State Inventory Tool*
SUNY	State University of New York
T&D	Transmission & Distribution
TEP	Technical evaluation panel
TMY	Typical meteorological year
TRC	Total Resource Cost
VFD	Variable frequency drive
WRI	World Resources Institute
WTHI	Weighted temperature humidity index

Appendix B:

ACTION PLAN

B1. ACTION PLAN NOTICE

This Action Plan, developed in the fall of 2010, was approved in January 2011 and became the scope of work for the NYSERDA ARRA evaluation. Subsequent to the completion and acceptance of the Action Plan, the Program Areas funded by SEP and other ARRA dollars continued to evolve. The majority of these changes—which resulted in project cancellations and delays, and additional rounds of financing from some Program Areas—were the consequence of economic factors associated with the recession. These macroeconomic factors resulted in facilities not being able to contribute the funding anticipated, having to lay off key staff, or being affected by other impacts that caused many of the project changes. The changes in projects necessitated changes in the evaluation, as described in the relevant sections of the report. All of those changes are not reflected in the Action Plan included as this appendix.

NYSERDA ARRA
Impact Evaluation Action Plan: State Energy Programs, Energy Efficiency Community Block Grant, and Appliance Rebates

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Table of Contents

1.1 ACTION PLAN OVERVIEW

This action plan provides a roadmap for the impact evaluation of New York State Energy Research and Development Authority's (NYSERDA) American Recovery and Reinvestment Act (ARRA) funded programs. The plan details the processes, methods, and timelines for undertaking tasks and activities related to the evaluation of the ARRA-funded State Energy Program (SEP), Energy Efficiency and Conservation Block Grant (EECBG), and State Energy Efficiency Appliance Rebate Program (SEEARP). The activities for this evaluation include measuring and verifying energy impacts attributable to the programs; estimating job creation (including number, type, and duration) and other resulting economic and environmental impacts (as defined in subsequent sections); conducting a cost-effectiveness analysis; and providing reports on evaluation activities and results. Program impacts will be evaluated by program type—appliance rebate, energy codes, renewables, transportation, energy efficiency, and energy conservation studies—as described in Section 2 through Section 7. The macroeconomic, carbon, cost-effectiveness, and quality control sections of this document are over-arching deliverables applicable to the study as a whole (sections 8, 9, 10, and 11, respectively).

The evaluation team includes The Cadmus Group Inc. (Cadmus) and its subcontractors—Navigant Consulting, Inc., Energy & Resource Solutions, Inc. (ERS), NMR Group (NMR), Beacon Consultants Network, Inc., and Abt SRBI (collectively referred to as the Team). The Team and key staff are described in more detail in Appendix B.

1.2 NEW YORK GENERAL OBJECTIVES AND ARRA PROGRAM OVERVIEW

NYSERDA is implementing a robust, diversified portfolio of energy-efficiency and renewable energy programs designed to achieve Governor Paterson's goal of meeting 45% of the State's electricity needs through improved energy efficiency and clean renewable energy by the year 2015. Funds received through SEP and EECBG will complement the programs and public policies that support achievement of that aggressive goal, and will also contribute to the targeted reduction in energy use.

The State's Public Service Commission, through its System Benefits Charge, Energy Efficiency Portfolio Standard, Renewable Portfolio Standard, and utility rate proceedings, has put a comprehensive set of rate-payer funded programs in place that are administered by the New York State Energy Research and Development Authority (NYSERDA) and the State's investor-owned utilities. In addition, NYSERDA administers energy-efficiency and renewable energy programs intended to reduce emissions of greenhouse gases that are funded by the proceeds from auctions of CO_2 allowances under the Regional Greenhouse Gas Initiative (RGGI). NYSERDA also receives appropriations of state funds, and is the recipient of federal funding through the U. S. Department of Energy (DOE), EPA, and the Federal Highway Administration. This federal funding is designed to support energy research, development, and deployment programs in the buildings, industrial, transportation, and clean energy sectors. The Long Island Power Authority (LIPA) also offers substantial energy-efficiency and renewable energy programs and the New York Power Authority (NYPA) offers financing with no up-front costs for efficiency projects to public schools and other government facilities through its Energy Services Program.

NYSERDA's ARRA-funded programs, listed in Table 1, are described in more detail in each of the program description sections.

Table 1. ARRA-Funded Programs[1]

Funding	Programs/Technologies	Budget ($Million)	Projected Projects	Projected Annual Energy Impact	Projected Job Creation
SEP	Energy Conservation Studies (PON 4)	$5.0	219		
SEP	Transportation (RFP 1613 – Clean Fleets)	$4.6	130 alternative fuel vehicles	42 MBtus	43
SEP	Energy Efficiency and Renewable Energy for Municipalities, Schools, Hospitals, Public Colleges and Universities, and Non-Profits (RFP 1613)	$69.4	200 projects (various)	1,400,000 MBtus	694
EECBG	Energy Efficiency, Transportation, and Renewable Energy Sub-Grant Program for Small Municipalities (RFP 10)	$24.0	125	1,696,143 MBtus	360
SEP	Energy Code Trainings (RFP1621)	$3.3	1,347 training courses and plan review services	937,600 MBtus	72
EECBG	Energy ode - Locally based Circuit Riders (RFP 1621)	$2.5	350	3,606,539 MBtus	27
SEP	Energy Code Baseline Compliance	$0.65			
SEP	Renewable Energy (PON 1686)	$10.0	886 PV Systems	6,420 kW of PV installations	300
SEEARP	Appliance Rebate Program	$16.6	171,764	14,641,439 kWh	180

1.3 GENERAL OVERVIEW OF EVALUATION SCOPE

This action plan identifies key research objectives, along with evaluation metrics necessary for assessing each objective. For this evaluation, the Team shall assess customer satisfaction, where possible, through already-planned survey efforts. The primary objectives and metrics include:

- Determining attributable energy and demand savings by program;
- Quantifying renewable energy capacity and generation attributable to each program;
- Computing the carbon emissions reductions and environmental impacts of each program[2];
- Evaluating the economic impacts (including job creation and retention); and
- Determining the cost-effectiveness of ARRA-funded programs.

The Team shall ensure that work undertaken in this evaluation is pursuant, to the maximum extent possible, to evaluation guidelines[3] put forth by the DOE for ARRA-funded programs and with evaluation

[1] Metrics for the appliance rebate program and PON 1686 have been updated based on input from NYSERDA program staff. All other values were sourced from the DOE grant.

[2] Environmental impacts measured vary by program. In addition to carbon emissions, the appliance rebates program includes water savings; and the program with clean fleets includes NOx and particulates.

[3] Guidance for EECBG grant recipients:
http://www1.eere.energy.gov/wip/pdfs/eecbg_evaluation_guidelines_10_017.pdf; Guidance for SEP recipients:
http://www.tecmarket.net/documents/Final%20SEP%20Evaluation%20White%20Paper%2010-18.pdf

guidelines for ratepayer funded energy-efficiency programs designed to help meet New York's 15x15 goals.[4]

The Team has created sample designs for each technology grouping under the funding streams with a maximum 10% margin of error at the 90% confidence level for the overall funding source. In addition to evaluating each technology grouping, the Team shall examine the portfolio of programs as a whole, as well as for the activities funded through each of the major ARRA funding streams (SEP, EECBG, and SEEARP). Geographic analysis for all program and technology groupings in the gross and net impact portion of the evaluation will be performed for New York State as a whole, as well as divided by upstate and downstate territories. Similarly, the Team will investigate the relative impacts of Program marketing efforts in the upstate versus downstate regions.[5] For this evaluation, downstate includes projects located in the utility service territories of Consolidated Edison (New York City, parts of Westchester County), and the Long Island Power Authority Long Island - Nassau and Suffolk Counties). Upstate includes the balance of the State.

[4] On June 28, 2008 the New York State Public Service Commission adopted an Order approving the Energy Efficiency Portfolio Standard to reduce energy consumption in New York State by a total of 15 percent below 2006 levels by the year 2015; referred to as the 15x15 goal.

[5] This analysis will rely upon marketing questions included as part of the surveys conducted in support of the evaluation efforts as described throughout this Action Plan. Inclusion of these questions will be contingent upon survey length time constraints, and consequently, the final inclusion of this analysis will be contingent on the Team having obtained sufficient confidence and precision in the findings in both the upstate and downstate regions.

2.1 PROGRAM DESCRIPTION

The New York State Energy-Efficient Appliance Rebate Program (NYSEEARP; or, the Program) paid rebates to consumers who were replacing inefficient appliances with new ENERGY STAR® appliances. Additional incentives were offered to customers who recycled their replaced appliances. The Program launched on February 12, 2010 , when consumers purchasing an appliance were allowed to reserve a rebate, either through the Program Website or by calling the Program hotline. Residents also had the option of submitting the application and required proof of purchase information entirely by mail. Consumers received their rebate upon NYSERDA approval of their application and receipt of their mailed proof of purchase and recycling documentation. The NYSEEARP was available to New York residents who own their appliance(s) and replaced them with qualified ENERGY STAR appliances from any retailer. The Program was not intended for use by multifamily building owners, contractors, or builders and current projections indicate that this program will conclude by spring 2011.

Two program options were available. Option 1 was for a rebate on any one of three ENERGY STAR appliances: refrigerators, freezers, or clothes washers. Option 2 was for a rebate to purchase a combination of refrigerator, clothes washer, and dishwasher which were ENERGY STAR and also met the stricter Consortium for Energy Efficiencies (CEE) guidelines of at least Tier 2 for refrigerators and clothes washers, and Tier 1 for dishwashers. For both options, additional incentives of at least $25 per unit were paid to those who recycled their replaced appliance. Table 2 summarizes the rebate offerings.

Table 2. Appliance Rebate Offerings

Appliance or Bundle	Rebate without Recycling	Rebate with Recycling
Refrigerator	$75	$105
Freezer	$50	$75
Clothes Washer	$75	$100
Bundle of Refrigerator, Clothes Washer, and Dishwasher	$500	Up to $555*

* The $555 amount assumes that a consumer recycles all three appliances in the Option 2 package. Recycling fewer than three appliances resulted in a lower rebate.

Rebates were available on a first-come, first-serve basis, and a Website tracked the amount of funding reserved through on-line applications (this information was also available by calling the Program hotline). In anticipation of some consumers not completing their required follow-up paperwork, NYSERDA accepted a wait list of additional participants to ensure that all the funding would be spent.

NYSERDA, through its subcontractor Lockheed Martin, anticipated processing 172,987 rebates – a combination of 169,399 individual appliance rebates (option 1) and 3,588 high-efficiency appliance package rebates (option 2). Rebate application forms were assigned a unique rebate reservation, allowing the application to be recorded and tracked throughout the application and rebate payment process.

Prior to and continuing after the Program, NYSERDA cooperatively promotes ENERGY STAR products through its **New York Energy $mart℠** Products program (NYESP). Through NYESP, NYSERDA partners with approximately 350 retailers selling energy-efficient appliances by providing promotional incentives in exchange for collecting monthly sales data. This promotional network was leveraged to notify New York residents of the Program rebates. NYSERDA System Benefits Charge (SBC) funding was used for all marketing and outreach activities, but was not included in the ARRA cost sharing. Press releases and Public Service Announcements were also issued to announce and update New York residents on the Program status. Additionally, NYSEEARP was promoted on www.nyserda.org and www.getenergysmart.org Websites and through NYSERDA's Program hotline.

Table 3 displays program goals from NYSERDA's ARRA application to the U.S. DOE. The reduction/savings and jobs created amounts used in the table were based on DOE supplied estimates.

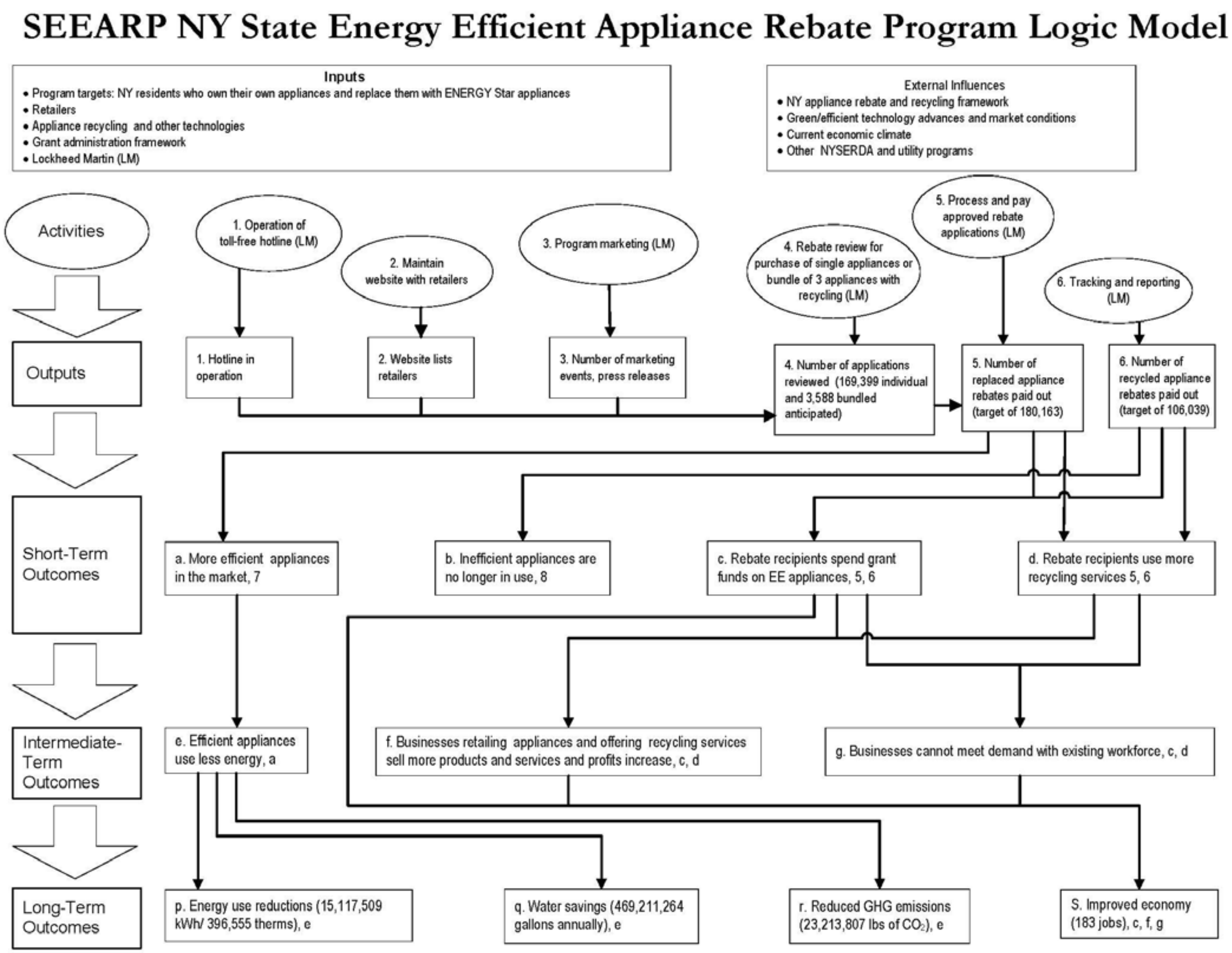
Table 3. New York ARRA Products Program Goals

Description	**Goal**
Individual Appliance Rebates Paid	169,399
Bundled Appliance Rebates Paid	3,588
Annual Energy Use Reductions	15,117,509 kWh 396,555 therms
Annual Water Savings	469,211,264 gallons
Reduced Greenhouse Gas Emissions	23,213,807 lbs of CO_2
Jobs Created	183

2.1.1 Program Logic

The theory behind the ARRA-funded appliance rebate program was to provide rebates to residents of New York for the replacement of appliances with new and efficient ones, along with the recycling of the old, inefficient appliances in order to reduce energy and stimulate the economy. Combining new purchases with recycling of old appliances improves the efficiency of the appliance market from both ends—by increasing the efficiency of appliances in regular use and also by preventing old appliances from being sold or given away in the secondary market.

Figure 1. Appliance Rebate Program Logic Model



2.2 RESEARCHABLE ISSUES AND PRIORITIZATION

The Evaluation Team has identified three primary and two secondary evaluation goals for NYSERDA's ARRA Appliance Rebate Program:

Primary Goals

1. Measure and verify attributable energy and water savings from the ARRA appliance rebates on a total program basis, as well as individually for both of the program options and the recycling promotion, and compute the program cost-effectiveness;
2. Estimate jobs created (including the number, type, and duration) and the resulting economic impacts; and
3. Estimate carbon emissions reductions.

Secondary Goals

1. Assess customer satisfaction, where possible, through data collection efforts already planned; and
2. Assess the relationship between early and regular replacement levels with inclusion of recycling. Assess the level of recycling by appliance type and with community resources for recycling.

Table 4 identifies the researchable questions, the activities to support answering each question, and the priority of each.

Table 4. Program Researchable Issues and Prioritization

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
ENERGY AND WATER IMPACTS			
What is the breakdown of appliance types bought and recycled through the Program?	Number of rebates paid for each appliance type and number of each type recycled.	Analyze tracking database	High
What are the gross natural gas (from water heating for dishwashers and clothes washers), electricity, and water savings from the Program?	Estimated savings per appliance by type and additionally for recycling.	Review ex ante estimates for reasonableness and compare to NY Technical Manual Calculations, Deemed Savings Database, and secondary data	High
What is the relationship between recycling, unit age, and early versus regular replacement?	Number of additional appliances removed from the secondary market.	Participant Surveys*	Medium
ATTRIBUTION			
What percentage of estimated *ex ante* savings would have occurred in the absence of the Program?	Understand participant's motivation for purchases.	Participant phone survey	High
Did the Program encourage additional energy efficiency and higher efficiency (i.e., higher CEE levels)?	Understand possible program spillover effects.	Participant phone survey	Medium
How should the share of savings be allocated between the ARRA program and NYESP Program?	Discuss and determine policy for attribution between ARRA and NYESP based on results of data collection efforts.	Surveys and policies	High
How many participants were influenced in addition to the number who would have purchased without the Program?	Estimate the change in retailer sales relative to existing ENERGY STAR sales trends.	Corporate Home Depot and Lowes interviews plus NYESP retailer sales analysis	Medium
COST-EFFECTIVENESS			
Does the Program pass the cost-effectiveness tests?	Understand program costs and benefits.	• SEP-RecTest • Program Admin Test • Societal Test	High
ECONOMIC IMPACTS			
How many jobs were created by the Program?	Understand the economic impact of the Program.	• Apply DOE job estimation method • Perform REMI analysis	High
EMISSIONS IMPACTS			
What emissions impacts are attributable to NYSERDA's ARRA-funded programs?	More in depth analysis and collaboration with task and program managers will be required to determine avoided emissions attributable specifically to the NYSERDA ARRA-funded programs.	Analysis of emissions data and energy savings.	High

* While this question can be explored in the Participant Surveys, in order to have statistical significance regarding recycling participation, the Enhanced Sample Design will be necessary. See Appendix A for additional evaluation activities subject to budget.

2.3 SUMMARY OF DATA COLLECTION ACTIVITIES

Table 5 provides an overview of proposed data collection activities (which are described in more detail in the following sections).

Table 5. Data Collection Activities

Activity	Purpose	2010
Participant Phone Survey	Program Attribution, Program Satisfaction, Number of Home Occupants, Condition of Replaced Appliances, Recycling Alternatives	630
Lowes and Home Depot Corporate Interviews	Combine with NYESP Partners Sales analysis for Program Attribution, Program Satisfaction	2*

* Since a sample of two is not large enough to provide a reliable quantitative estimate, we will use the data from these interviews as an indicator, along with NYESP partner sales data and survey questions and the Participant Survey.

2.3.1 Participant Telephone Survey

The Team shall conduct a Computer Assisted Telephone Interview (CATI) with participants in the ARRA Appliance Rebate Program. The sample will consist of ARRA Appliance Rebate Program participants from all counties in New York. The sample breaks down New York State by upstate and downstate regions as defined in Section 1: . The sample design stratifies participants from upstate and downstate into four categories each: three by appliance type for participants under ARRA Option 1 (ENERGY STAR qualified refrigerators, freezers, and clothes washers) and one category for participants under ARRA Option 2 who bought a bundle of ENERGY STAR or CEE appliances. The total number of targeted surveys is 560 (see Table 6), which provides a maximum 10% margin of error at the 90% confidence level for each of the subgroups, and a 3.3% margin of error for the overall sample.

Table 6. Participant Survey—Sample Design

Assumptions	Upstate	Downstate	Sample Size Total
Total Completed Surveys	280	280	**560 total**
Option 1: ENERGY STAR Refrigerator	70	70	**140+**
Option 1: ENERGY STAR Freezer	70	70	**140+**
Option 1: ENERGY STAR Clothes Washer	70	70	**140+**
Option 2: Appliances bundle (CEE high efficiency refrigerator, clothes washer, and/or dishwasher)	70	70	**140+**
Survey Length	--	--	**20 minutes**
Margin of Error at 90% Confidence Level	--	--	**10% for each subgroup (geographic and options), 3.3% overall**

The Team shall develop a survey questionnaire to be submitted for review by NYSERDA and revised by the Team accordingly. Program impacts will be assessed through questions that explore the options that participants would have considered in the absence of the Program. The participant survey will also help answer key process questions, such as satisfaction with the Program, ease of participation, and sources of information about the Program.

2.3.2 Corporate Home Depot and Lowes Interviews

Participating customers were asked on the rebate application form to report the retailer where they purchased their Program appliance. An initial analysis of rebate applications indicates that 31% of appliances were purchased at either Home Depot or Lowes[6] (neither retailer provides sales data through NYSERDA's NYESP program). Another 65% were purchased from retail stores who are "partners" in the NYESP program. The final 4% were purchased from other retailers who are NOT participants in the NYESP program. An understanding of NYSERDA's current sales analyses of ENERGY STAR appliances and any variation of sales trends during the ARRA Program period will assist in identifying Program "lift" (incremental net sales from the Program). NYESP data can be used to analyze the sales from NYESP partners, and the Home Depot and Lowes interview results will provide qualitative information to supplement sales data from the NYESP partners. If budget is available, the Team recommends performing additional retailer interviews to provide quantitative data for this part of the evaluation (see Appendix A for more information on this additional enhancement).

2.4 ENERGY-EFFICIENCY IMPACT EVALUATION ACTIVITIES *(TASK 2A)*

Evaluation activities to determine gross energy and water impacts include analyzing the Program tracking database, applying the calculation methods and deemed savings estimates identified in the NYS/DPS Tech Manual (The Manual), and reviewing and comparing to secondary data from similar programs elsewhere.

2.4.1 Tracking Database Analysis

Through its implementation contractor, Lockheed Martin, NYSERDA tracked the following types of information which shall be used to determine gross program impacts:

- Individual application data including the make, model number, and type of new appliance; the make and model of the recycled appliance; the retailer; and the participants contact information.
- Whether the application was approved and paid, and whether it included recycling.

To calculate gross program impacts, the Team shall analyze the data and calculate a sum of the estimated energy savings from paid applications for each appliance type, as well as for recycled appliances.

2.4.2 NYS /DPS Technical Manual Review

The Technical Manual (the Manual) describes the recommended approach to measure the savings from refrigerator and freezer replacements. According to The Manual, the energy consumption of ENERGY STAR refrigerators or freezers is based on the make and model, adjusted for the number of occupants in the home. Baseline energy consumption depends on whether the unit was an "early replacement" (the unit was in working order at time of replacement) or a "regular replacement" (the unit was no longer functioning at time of replacement). Early replacement energy consumption is calculated from the actual make and model of the unit replaced with adjustment factors for unit age, number of occupants in the dwelling, and the door seal condition. The regular replacement baseline energy consumption is based on the Federal Standard (NAECA) of maximum consumption for the type and size of refrigerator purchased.

[6] Lowes has since become a NYESP partner; however, only the retailers' sales data going forward is required to be reported.

The Manual also provides a deemed savings estimate for clothes washers and no estimates for dishwasher savings.

While The Manual is subject to change and the recommended verification approach appears to be more rigorous and data intensive than required by DOE, this work plan assumes that the Team shall follow the recommended approach in The Manual for all appliances rebated through the Program and note any differences from DOE deemed estimates, the NYSERDA Deemed Savings Database, and secondary data in other evaluations. This approach was selected because it is consistent with how the State will measure progress toward attainment of the State's energy efficiency portfolio standard 15 X 15 goal.

2.4.3 Engineering Review of *Ex Ante* Estimates

The Team shall perform an engineering review of the *ex ante* energy savings for dishwashers and compare the results against the NYSERDA Deemed Savings Database and against estimates used in other similar programs. The assumptions for clothes washers shall be reviewed by the Team and compared to the deemed estimates recommended in The Manual and compared to secondary data estimates from other similar programs. The Team shall review the estimates for refrigerators and freezers for consistency with the estimates calculated according to The Manual, and shall also compare the numbers to secondary data from other similar studies. As an example, the Team has access to metered data from nearly 2000 refrigerators in California.

2.5 ATTRIBUTION ACTIVITIES *(TASK 2B)*

An important aspect of the Appliance Rebate Program evaluation is determining whether the purchase was motivated by NYSERDA's ARRA program or by other factors. The intent of the rebates was to drive early replacement of inefficient appliances to higher efficiency models than would otherwise be chosen. Attribution activities are designed to measure the influence of the Program in achieving this objective. It should be noted that assessing the influence of the ARRA Appliance Rebate Program vs. the NYESP Program is challenging because consumers themselves may not be able to distinguish which program (if any) influenced their decision to buy a new appliance. The Evaluation Team will discuss and agree on an approach for allocating results between the NYESP and the ARRA programs with NYSERDA once the analysis is underway.

The following attribution activities include both primary data collection and an analysis of data collected through the NYSEP program. The primary data collection consists of the Participant Phone Survey and Corporate Home Depot and Lowes Interviews discussed above. Data collected through the NYSEP program consists of results from specific survey questions pertaining to the ARRA Program on a random consumer survey, a survey of participating retail stores, surveys of manufacturer and corporate retailer contacts, and trend analysis of participating retailers.

A net-to-gross (NTG) ratio can be estimated individually from each of the following approaches, which are discussed in more detail below:

- Participant Surveys
- NYESP Participating Retailer Sales Data combined with Lowes and Home Depot Corporate Interviews
- Supplier Interviews (if budget allows; see Appendix A for a description)

Determining how much weight to give to each attribution approach will depend on the quantity and quality of data the Team is able to collect. Should Lowes and Home Depot be unwilling to share information and there not be budget for the Supplier Interviews, the Participant Surveys will be the primary data source for estimating NTG. Information from survey data collected through the 2009 NYESP program will provide indications of the Program's potential sales influence; however, will not by themselves be used to estimate attribution. Once data have been collected and analyzed, the Team will discuss possible weighting approaches with NYSERDA.

2.5.1 Participant Surveys

One of the key considerations in development of the participant survey will be designing questions to isolate the impacts of the ARRA-funded rebates from the cumulative effect of NYSERDA's long-running appliance program. Possible participant survey questions could include:

- Were they aware of the ENERGY STAR label prior to the ARRA Program, were they aware of the ARRA funding, and what was the influence of the limited availability of ARRA rebates on the urgency they felt to apply for ARRA funding?
- Would they have purchased the appliance without the ARRA rebate? If so, when (e.g., earlier in 2009, 2010, or later).
- Is the new appliance a primary or secondary appliance (this question is most relevant to the refrigerator, and possibly the freezer)?
- Was the old appliance in working condition (early or regular replacement)?
- Had they considered buying a new appliance prior to hearing about the ARRA rebate?
- Does the new appliance replace another similar appliance or is it newly acquired?
- Would they have purchased an appliance with a similar or lower efficiency level in absence of the Program?
- How old was the replaced appliance (in other words, was this an early or regular replacement)? How would they have used, disposed of, or recycled their replaced appliance in absence of the Program? If they recycled a replaced appliance, would they have recycled the appliance in the same way in absence of the Program, or would they have hired someone to haul it away, given it away, sold it, or would they have continued to use the appliance?
- Did the retailer where they purchased the new appliance offer recycling? If so, how much influence was convenience on their decision to recycle?
- Had they considered recycling the old appliance prior to hearing about the ARRA rebate?
- If they did not recycle, how did they dispose of the old appliance?

The Team shall consult with NYSERDA to develop a precise battery of questions that will lead to calculation of freeridership and spillover.

2.5.2 Corporate Lowes and Home Depot Interviews

NYESP partners are required to submit appliance sales data to the Program on a regular basis. The Team shall compare sales of ENERGY STAR qualified appliances as reported by NYSERDA partners during the ARRA funding period to sales from the same period last year, thus isolating the program lift of ARRA funding from Program efforts. The purpose of the interviews is to assess the Program net impact on efficient appliance sales, from the supplier viewpoint. The corporate interviews shall ask Lowes and Home Depot representatives to provide sales data from the prior year, or, at a minimum, to estimate the sales lift due to the Program. Should sales data not be provided, the Team shall first estimate sales data based on responses to the sales lift questions combined with rebate counts from the tracking database. If neither sales data nor sales lift are provided, the analysis will rely on the NYESP Participating Retailer Sales Data combined with rebate counts from the tracking database. Results of non-NYESP participants will be estimated based on proportions reported by NYESP participating retailers. If additional funding were available, Supplier Interviews could be conducted with a sample of individual retailers who would be asked questions similar to those for Lowes and Home Depot. This information could be used to estimate the results of non-NYESP participant retailers. More information on this possible enhancement is described in Appendix A.

In addition to sales data and sales lift estimates, the Corporate Interviews (and Supplier Interviews if performed) would ask retailers about their recycling services, whether they were prompted by the Program, and if stocking patterns, pricing, and sales trends were affected by the Program or other extraneous factors (such as economic conditions or changes in consumer confidence).

2.5.3 NYESP Consumer Survey

The NYESP consumer survey targeted approximately 200 residents who purchased a new refrigerator, clothes washer, or dishwasher during 2009. As part of the screening for recent purchasers, potential survey respondents were first asked whether they shopped for an appliance during 2009, and if a purchase was not made, they were asked why not. The Team shall analyze responses to the screening questions to identify those who delayed their purchase in anticipation of upcoming rebates or bought one earlier than they otherwise would have in order to take advantage of the rebates, as one potential source of Program freeriders. While NYESP survey data will not definitively determine ARRA-related freeridership or Program influence, the questions will be indicative of the level of influence the ARRA program had in delaying potential 2009 appliance purchases into 2010.

2.5.4 NYESP Retail Store Survey

Another survey performed as part of the 2009 evaluation of the NYESP program asked 70 participating retailers if they advertised the upcoming ARRA Program rebates during the fourth quarter of 2009. The survey further asked retailers whether anticipated rebates affected their fourth quarter 2009 sales – and whether that impact was positive or negative. The Team shall analyze these responses to determine if retailers believe their fourth quarter sales were negatively impacted by ARRA Program anticipation.

2.5.5 NYESP Corporate Retailer and Manufacturer Surveys

A total of 13 representatives at retailer chains and manufacturers were surveyed regarding the NYESP program. In each of these surveys, the respondent was asked to identify any factors they believe impacted sales of ENERGY STAR products during 2009. The Team shall analyze these responses to determine if respondents identified the upcoming ARRA Program as a factor.

2.5.6 NYESP Participating Retailer Sales Data

Approximately 350 appliance retailers are NYSERDA partners in the NYESP program, and were therefore well positioned to promote the ARRA Program (since they already carried and promoted ENERGY STAR products). NYSERDA requires its partners to provide monthly sales data on ENERGY STAR and non-ENERGY STAR products sales. For these retailers, the Team shall analyze monthly sales data to determine whether the sales trends were significantly different during the ARRA appliance rebate period compared to pre and post, as well as to determine differences during the similar period/season in 2009. An initial review of tracking information indicates that approximately 65% of ARRA appliance sales occurred through NYESP program retailers.

2.6 INTERVIEWS

2.6.1 Management and Staff Surveys

At the start of the evaluation, the Team shall formally speak with the NYSERDA program management and implementation staff. These formal interviews shall focus on:

- *General process:* What aspects of the Program worked and did not work, and how could the Program be improved?
- *Planning vs. implementation:* What process was used to arrive at the final Program design, and what factors led to changes in the Program design and/or Program goals?
- *Program design:* What is the Program logic? How do implementers know if the Program has been successful? What overlap exists with other NYSERDA offerings and protocols? How did ARRA differ from other similar programs? Was there any transference of knowledge or approaches? What were the effects of ARRA requirements on Program design – and were these effects restrictive or permissive?
- *Project results:* How does the Program staff track whether the Program is on target to achieve its projected results? What is being done to ensure that projects keep to the ARRA required timeline?
- *Program satisfaction:* What is the retail satisfaction with the Program service, and what are the suggestions for improvement?
- *Marketing and outreach:* How is the Program message delivered? What marketing materials and methods are being used?
- *Evaluation:* What information would NYSERDA like the evaluation to deliver to help with the Program process?

The Team may conduct additional informal interviews with management and staff from time to time during the research process.

3.1 PROGRAM DESCRIPTION

The Energy Code Program, funded by the ARRA SEP and EECBG, provides technical assistance to the building community and local energy conservation code enforcement officials to achieve the highest practical levels of compliance with the new energy code. This effort will be closely coordinated between NYSERDA and the New York Department of State (DOS), an agency that promulgates and provides training on the energy code.

ARRA requires that states adopt a specific building energy code in order to receive additional state energy SEP grants. In a 2009 letter to the Secretary of the DOE, Governor David Paterson stated that New York would move to adopt the residential and commercial building code required by ARRA, and indicated they were expected to be implemented by December 2010. On April 1, 2010, the State Fire Prevention and Building Code Council voted to update the Energy Conservation Construction Code of New York State (ECCCNYS, or Energy Code) and base it on the 2009 International Energy Conservation Code (IECC) and the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 90.1-2007, along with several New York state-specific enhancements. The code will become mandatory for buildings permitted after December 28, 2010. Adoption was linked directly to New York's receipt of ARRA SEP funding.

The New York DOS is responsible for the promulgation and technical support of the Energy Code. NYSERDA has a long-standing relationship with DOS, having provided technical and training support previously through several Energy Code grants funded by DOE. ARRA-funded Code Training, Support and Compliance Assessment programs were developed by NYSERDA in close cooperation with DOS. These initiatives will support the Governor's effort to adopt a more stringent energy code, will provide various implementation and support services to the entire building community, and will work aggressively to achieve *no less than 90 percent compliance* in the commercial and residential sectors. The primary audience includes code enforcement officials (CEOs) in the 1,600 local municipalities that are charged with local code enforcement, as well as architectural and engineering professionals and design and build firms.

Activities funded through the SEP under NYSERDA's RFP 1621 and RFP 1720 will broadly provide implementation support, training services, and compliance assessments to the building community across the state. Program activities contemplated under RFP 1621 and funded through the EECBG will focus on local community support through regional code advisors, circuit-rider assistance, and plan review services. For several specific activities, funding is supported by a mix of the two funding sources (SEP and EECBG). All buildings that are heated or cooled for human occupancy are covered by the Energy Code. All measures that affect heating, cooling, electric energy use, and building process operations will be included within the Energy Code. Program services will be provided in the form of technical assistance, training, support, and compliance assessment.

While DOS will perform some CEO trainings, most program services will be provided by NYSERDA contractors that were selected through a competitive bid process. These contractors will provide the following services:

- Training and instructional courses across the state on a first-come, first-served basis.
- Technical assistance services to selected communities across the state at locations to be determined by NYSERDA and DOS.
- Compliance assessments, conducted statewide.

- Outreach through existing NYSERDA and DOS stakeholder channels, including but not limited to the New York State Builders Association, New York State Building Officials Conference, architectural and engineering associations, local engineering chapters, home improvement retailers, and retail lumber associations.
- A separate benchmarking compliance assessment in order to establish a baseline of compliance levels to measure improvements before the new code takes effect on December 28, 2010.
- A determination of the energy impacts on improved compliance (i.e., how much additional energy savings are accruing from specific increases in compliance with the new Energy Code requirements), which will be used to assess the overall energy savings impacts. Commercial and residential metrics will be calculated separately.

3.2 PROGRAM LOGIC MODEL

The Program theory behind the EECBG and SEP ARRA funds for code enforcement, support, and compliance assessment is to enhance the effectiveness of the new Energy Code. Activities such as technical assistance for architects, engineers, and builders, and training for the construction community, seek to increase understanding and knowledge of the code and of how to properly implement it. Building code enforcement and review capacity will increase with activities such as plan review services, compliance assessments, and supporting local municipalities and builders. These activities all seek to increase compliance with the New York building code and to increase the number of Program-related jobs pertaining to building code enforcement and related professions. Increased employment will result from increases in government expenditures on code-related jobs. Additionally, the improved efficiency resulting from compliance with the new Energy Code will result in reduced energy use from new construction and renovations (see Figure 2).

3.3 RESEARCHABLE ISSUES AND PRIORITIZATION

The Team shall address both impact and process evaluation issues. Supporting activities will include document reviews, interviews, surveys, and site visits. Table 7 indicates key researchable issues for the evaluation and the initial timing prioritization of each.

Figure 2. Energy Code Program Logic Model

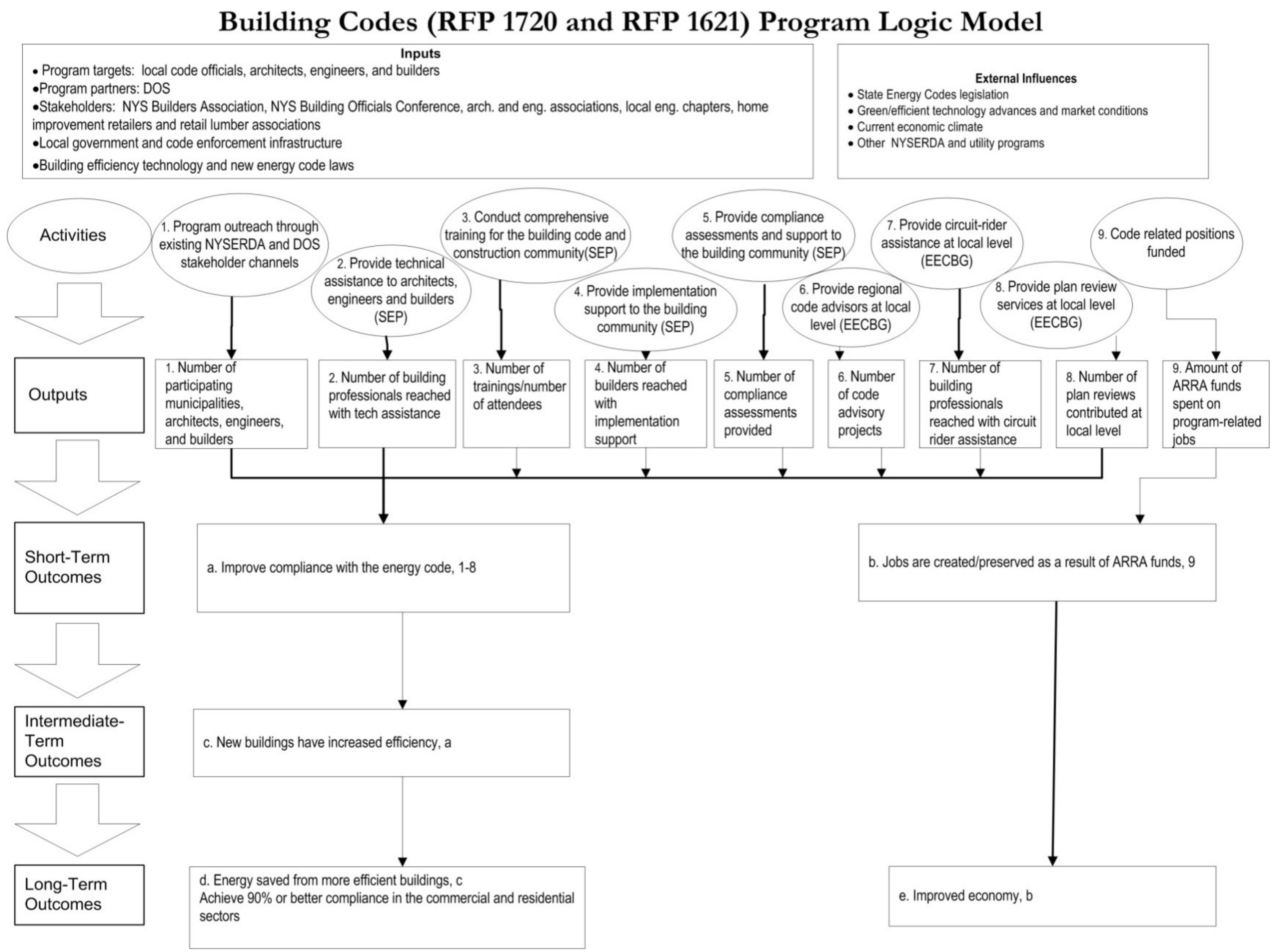


Table 7. Program Researchable Issues and Prioritization (RFP 1720 and 1621)

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
Is the content of the adopted Energy Code the same as what would have been adopted without ARRA funding?	What code requirements were added, increased or altered?	▪ Interview DOS and other code and policy experts ▪ Estimate energy savings from adopted code against baseline scenario	High
Did the availability of ARRA funding advance the timeline for adopting the new Energy Code?	Earlier adoption of the code would allow savings to be claimed sooner than originally planned.	▪ Interview DOS code experts, policy makers, and supporting NYSERDA staff ▪ Document reviews ▪ Estimate energy savings from accelerating code adoption	High
Were code enforcement procedures altered to accommodate the new code?	Has the number of code inspections increased? Do energy code checklists cover new areas of construction not in the previous checklists?	▪ Interview DOS code experts	Medium
Do the training and support services effectively foster increases in compliance with the new code?	Do these program activities effectively communicate changes introduced in the new code? Do they communicate the value of compliance and encourage higher compliance rates?	▪ Review training materials ▪ Pre-training surveys ▪ Training course exit surveys ▪ Follow on survey approximately six months later to determine changes to code adoption practices	High
Has the process to accommodate the new code changed the plan review or plan check process?	Has jurisdiction documentation been changed to accommodate the new code?	▪ Interview affected jurisdictions	Medium
What compliance level are buildings constructed under the new code achieving? What compliance level did buildings achieve under the prior code?	Can a sufficient sample of buildings constructed under the new code be site visited within the timeframe of this evaluation? What protocols were used to establish the baseline assessment?	▪ Determine level of code compliance through site visits ▪ Determine adequacy of separate baseline compliance assessment and estimate compliance level	High
What are the *ex ante* natural gas and electricity savings from the training programs?	Obtain estimates of *ex ante* savings associated with commercial and residential new construction	▪ Review *ex ante* estimates for reasonableness	Medium
How would the DOS training have been different without the ARRA funding?	Were specific courses created or changed as a result of ARRA funding?	▪ Interview NYSERDA and DOS staff	High

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
Would plan review services and circuit rider assistance have occurred without the ARRA funding?	If they would have occurred anyway, would they have been at the same level?	▪ Interview NYSERDA and DOS staff	Medium
COST-EFFECTIVENESS*			
Does the Program pass the cost-effectiveness tests?	Understand program costs and benefits.	• SEP-RecTest • Total Resource Test • Program Admin Test • Societal Test	High
ECONOMIC IMPACTS			
How many jobs were created by the Program?	Understand the economic impact of the Program.	• Apply DOE job estimation method • Perform REMI analysis	High
EMISSIONS IMPACTS			
What emissions impacts are attributable to NYSERDA's ARRA-funded codes training and support programs?	More in depth analysis and collaboration with task and program managers will be required to determine avoided emissions attributable specifically to the NYSERDA ARRA-funded programs (RFP 1621).	▪ Analysis of emissions data and energy savings.	High

* The cost-effectiveness tests will only include activities under RFP 1621 and will exclude the baseline assessment portion of the program under RFP 1720.

3.4 SUMMARY OF DATA COLLECTION ACTIVITIES

Table 8 provides an overview of proposed data collection activities that are generally listed in order of activity.

Table 8. Data Collection Activities

Activity	Purpose	2010	2011	2012	2013
Document/File Review Relevant to DOE, IECC, ASHRAE 90.1, and NY Energy Conservation Code.	To understand how the new Energy Code is applied to new construction To evaluate estimated savings	✓	✓		
Interview DOS code officials	To address early code adoption	✓	✓		
Document/File Review	Verify course material is consistent with new code	✓	✓		
Exit and Course Registation Survey	Capture participant impression of training quality and content	✓	✓		
NYSERDA and DOS Staff Interviews	Discuss program functional questions at a general level, as well as overlapping or competing programs	✓	✓		
Follow up participant interviews	Participants interiwed six to eight months after program events to determine program influence on participant behaviour.		✓	✓	
Implementer Interviews	Interviews will vary according to the support type provided, but will be similar across funding streams	✓	✓	✓	✓
Telephone Survey	Used as an interview mechanism to confirm site and project characteristics and to recruit sites for visits	✓	✓	✓	✓
Site Visits*, where building characteristics are verified with DOE checklist and energy performance modeled through eQuest.	To estimate compliance and savings The modeling will included 10 representative builing types. Minor alterations to the model will be made to extrapolate to the larger sample.		✓	✓	✓

* The plan is for the site visits to be selected randomly. The probability of code officials being also program participants should be high as the training is mandatory. Including other market actors (architects, engineer, etc..) , may introduce the need to select sites from areas where trainings occurred.

3.5 ARRA IMPACT EVALUATION ACTIVITIES (*TASK 2a)*

Assessing the impacts of the SEP-funded and the EECBG-funded Energy Conservation Code programs presents special challenges and requirements. Some of the key factors that differentiate this analysis from other ARRA-funded programs include:

- The grant of ARRA SEP funds to New York (used to support other energy saving programs) was conditional on New York State adopting a new Energy Code and reaching 90% compliance by 2017. Consequently, one of the major impacts of the ARRA grant was that it likely motivated and accelerated state action to adopt the updated and more stringent building energy code in order to be eligible for SEP funds for other programs.
- The activities conducted under the code programs supported by both ARRA funding streams can be characterized as training, education, and technical assistance only. These activities were

intended to increase awareness and modify behavior rather than provide direct support for energy-efficiency actions or measures.

- Program services are delivered by many contractors who, in turn, provide individual components of the programs (e.g., residential energy code training, circuit riders, and plan review).
- Some of the Program activities are intended to reach a target group of certain market actors (e.g., the CEOs).
- The key triggering event, the effective date of the new Energy Code, will not occur until December 28, 2010.
- The time lag between Program activities and when impacts are likely to be observable is relatively long because of the lead time needed to construct buildings. With the supplemental evaluation funding and scheduled extension through 2013, there should be a sufficient population of buildings constructed under the new Energy Code to permit an accurate analysis of code compliance.

The implications of these factors affect the evaluability of these programs and how the impacts can be addressed. Key implications include:

1. In addition to the impacts of the programs implemented with ARRA funding, ARRA was probably responsible for significant energy savings by motivating the state to adopt the latest building Energy Code.
2. Given the nature of the ARRA-funded code program, the impacts need to be analyzed using an approach that is especially suited to the program's focus on education, training, and technical assistance.
3. It will be challenging to associate impacts with specific Program activities and to quantify net impacts.
4. Analysis of impacts will be constrained by construction trends and timing.
5. Evaluation of the Program processes is likely to be valuable for informing ongoing and future code support program activities in the state.

The first implication listed above can be linked to direct energy impacts of ARRA (Task 2a), and the remaining implications are associated with the ARRA-funded program impacts (Task 2c). Consequently, this section is limited to discussing the methodology for assessing the direct energy impacts of code adoption (Task 2a). The next section discusses assessment of the ARRA-funded program impacts.

3.5.1 Code Adoption

Discussion

As noted earlier, the State Fire Prevention and Building Code Council voted in early 2010 to update the Energy Code and base it on the 2009 IECC and ASHRAE 90.1-2007, along with several state-specific enhancements. Adoption was linked directly to receipt of ARRA SEP funding.

There are two ways in which ARRA effects on code adoption could be associated with energy savings. First, in response to ARRA, New York may have adopted the new Energy Code *sooner* than it would have otherwise. Second, the code adopted may have been *more stringent* (more energy efficient) than it would have been without ARRA influence.

Impact Analysis

To the extent that ARRA accelerated adoption of the next state Energy Code, ARRA will produce gross energy savings equivalent to the difference in lifetime energy consumption of buildings built to the new and prior energy codes. These savings will occur for all new buildings constructed until the point when New York would have adopted the next energy code in the absence of ARRA.

To the extent that the residential and commercial building Energy Codes adopted in response to ARRA are more stringent than the codes New York would have adopted in the future, gross energy savings can be attributed to ARRA for the incremental energy savings over the relevant time horizon. The relevant time horizon extends to the point when the state would have adopted a code of at least the same level of stringency as the codes adopted in response to ARRA; the additional energy savings for buildings built during this time horizon would extend over the lifetime of the buildings.

To illustrate how the energy savings from ARRA altering the code adoption process will be estimated, assume that New York would have eventually adopted a new code equivalent to the ARRA requirement (referred to here as the "ARRA code") in two stages covering periods 1 and 2[7]. During the first period, we assume the code would have been the existing code and during the second period it would have been more stringent, but not yet at the ARRA code level. We assume that by the end of period 2, the code would have reached the ARRA code level. The *potential savings* from early adoption under ARRA can be calculated as:

$$Potential\ Savings\ = B_1 \times S_1 +\ B_2\ \times\ S_2$$

Where B denotes the number of new buildings constructed and 'S' is the average savings per building for the two periods, 1 and 2.

Potential savings are defined as the difference in energy consumption assuming that all new buildings meet the ARRA code and all would have met the code that would have been in place if New York had not adopted the ARRA code.

Since compliance is likely to be less than 100%, the *gross savings* can be calculated by adjusting for the compliance rate (the proportion of energy savings achieved relative to the maximum potential). Without the NYSERDA Code Program, it is reasonable to assume that compliance with the various code requirements would not vary significantly with the adopted code.[8] We assume this is true for the ARRA code or the code the state would have adopted if ARRA had not influenced adoption, so the gross savings would be estimated as follows:

$$Gross\ Savings = C_o\ \times Potential\ Savings$$

Where C_o is the baseline compliance rate. Once the effect of the Program on the compliance rate has been estimated, the energy savings impact of the Program can be estimated as follows:

$$Program\ Savings = (C_p\ -\ C_o)\ \times Potential\ Savings$$

Where C_p is the compliance rate resulting from the Program. This expression has been simplified somewhat for exposition here, and we will examine during the study whether it is appropriate to apply different compliance rates under the different scenarios.

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[7] Two stages are presented just to illustrate the approach if the code would have been adopted in phases. The actual approach will be based on interview findings about what would have happened in the absence of code adoption in response to ARRA.

[8] Through analysis of the Vermont Energy Investment Corp. (VEIC) baseline study, we will consider whether it is appropriate to apply a different compliance rate to the existing and new codes. The baseline study is described in more detail in section 3.6.2

Data Needs

To estimate these gross impacts, several types of data will be required, including:

- Documentation on the changes between the prior ECCCNYS and the new code, and estimates of the energy impacts of these changes.
- Perceptions of DOS code officials and others about the nature and impact of ARRA funds on this process.
- An estimate of the trend in levels and timing of energy efficiency required under a code that would have been adopted in the absence of ARRA.
- Estimates of the energy savings by building type. Building types will be determined from a source, such as McGraw-Hill Dodge data, for new construction starts.
- An estimate of the number of new buildings constructed over the relevant time horizon (to the point when the state would have adopted a code of at least the same level of stringency as the codes adopted in response to ARRA).

Estimates for code adoption trends and timing will be based on a review of past practices in New York and interviews with knowledgeable officials and market actors. Savings estimates by building types will be based on available information, prior analyses, and energy analyses, if required. Estimates of building construction will be based on historic data and reliable industry sources.

3.6 ARRA-FUNDED IMPACTS AND ATTRIBUTION *(TASK 2c)*

Unlike the evaluations of other ARRA-funded programs, there is a task specifically defined to analyze the code programs' impacts. As a result, this action plan does not require a separate attribution task (Task 2b), and the required steps in the evaluation of the SEP- and EECBG-funded activities are described in the following section.

The steps to analyzing the impacts of the Energy Code Program discussed in the next section include a literature review; an analysis of *ex ante* program impact estimates; input to the independent code compliance baseline study; surveys, interviews, and analyses; and building energy analyses.

3.6.1 Literature Review and *Ex Ante* Program Impact Estimates

The Team will research literature on code compliance impacts of programs similar to NYSERDA's. We will compile information from this review, and summarize findings that could inform the methodology or provide data for this study for use in the evaluation.

We will discuss the *ex ante* savings estimates that were included in the SEP and EECBG proposals for the code programs with NYSERDA. In addition, we will obtain and review documentation on the estimates and assumptions and their underlying data. This information will be used as appropriate in our study and will provide a reference point for our results. The Team does not anticipate relying strictly on the estimates for developing program realization rates if there is little documentation on how the estimates were developed and on assumptions made about program design, but it will be useful to clarify NYSERDA's assumptions and estimation approach.

3.6.2 Input to Code Compliance Baseline Study

NYSERDA has selected contractor Vermont Energy Investment Corp. (VEIC) to conduct a study of compliance with the existing New York building energy code. This study can provide useful information for the current evaluation by identifying existing code compliance issues and barriers, establishing baseline awareness levels, and providing other insights that will be useful to guide the current evaluation.

In addition, the results of the VEIC study will serve as a baseline against which to compare our compliance findings. The Team will work with NYSERDA and the compliance contractor to develop an understanding of the compliance study approach and to provide our input. Although this baseline study is being conducted on the current code, these findings will provide information on code enforcement in New York, as the same market actors will be working with the new energy code. Learning how well code enforcement officials and market actors know the current code and to what extent they comply with and enforce it will provide useful information. The Team will conduct additional interviews as needed to enhance the baseline information on code compliance, assess changes under the new code, and determine how those changes were influenced by Program activities.

3.6.3 Surveys and Interviews

Discussion

The code program includes a range of training and technical assistance activities directed at diverse audiences. Targeted audiences include the following:

- CEOs
- Architects and engineers
- Builders / contractors
- Vendors and trade allies
- Real estate professionals

The number and timing of training or technical assistance sessions for each type of activity varies, as do the number of participants. The objective of these program activities is to provide the basis for increasing the level of code compliance, which should increase energy savings relative to what would have occurred at the base level of compliance.

Surveys and interviews will provide feedback on the effectiveness of these training program activities; their influence on participant knowledge, awareness, and behavior; and their potential effects on code enforcement and compliance. However, determining effects on code compliance from program activities can only be inferential from the interviews, and will be indicative of their potential influences through reducing compliance barriers. Because code officials, contractors, and other market actors are unlikely to indicate that they would not have complied with the code had program services not been provided (since the code is a legal requirement), interviews and surveys will be designed carefully to focus on how the services facilitated enforcement and compliance, and if factors other than training contribute to better enforcement. Additionally, by asking participants how they learned about the trainings, a limited assessment of the programs marketing methods will be conducted.

Given the importance of understanding the effectiveness of the program services, our analysis of the program activities emphasizes determining participant satisfaction with the services (training, plan reviews, etc.) and how effective they believe these services will be at reducing compliance enforcement barriers. As the Team learns more about the activities of the baseline compliance study and the program activities, we will incorporate this into the design of our evaluation approach.

Analysis

Much of the analytic focus on program activities will be directed at assessing the program processes — how effective they are and how they can be improved. The overall goal of the program activities is to *increase code compliance*. Each activity will have specific objectives that, by being met, contribute to meeting the goal. Our general analytic approach to answer process questions will be to identify the objectives of each program activity and then evaluate how well each meets its objectives.

By reviewing the program theory and consulting with NYSERDA and the implementers, the Team will document the objectives for each program activity. For example, training of CEOs could have objectives of increasing understanding of the code and how to determine compliance. We will interview/survey target audiences *prior* to them being affected by a program activity; for example, CEOs will be interviewed prior to their training to assess their understanding of the new ECCCNYS and what barriers limit code compliance. In some cases, it may be possible or more appropriate to interview/survey a comparison group representing the same group targeted by the program, but who are not participating in the program activity.

The degree to which each activity is effective and meets its objectives will then be assessed by conducting an interview/survey of participants *after* they receive the Program service, and comparing results to the pre-participation or non-participant interview/survey. We propose conducting exit surveys with participants who received program support services, such as training, as follows:

> Exit Surveys. Brief exit surveys will be given to participants at the conclusion of support service activities. The purpose of the surveys is to assess participant satisfaction, obtain suggestions for improvement, understand what the participants found most useful, and determine how they anticipate these sessions influencing their activities and practices in the future. For CEOs, the survey will highlight activities related to plan review and building inspections conducted as part of their typical code enforcement activities. For architects, engineers, and contractors, the survey will focus on what they anticipated the effect of training to be on their usual design and/or construction practices. Given the large number of participants, the Team plans to conduct exit surveys (either at the event or online) at all the support service activities that represent a variety of target audiences. Overall, we expect to obtain up to 200 completed exit surveys with a representative sample of participants. We anticipate that the program implementation staff will request that participants respond to an online survey administered by BMI at the conclusion of each class.

To determine the longer-term effects of program activities, participant surveys/interviews will be conducted on a random sample six months to a year after participation. These surveys/interviews will repeat many of the same questions from the data collected shortly after participation; more importantly, they will examine behavior changes linked to the activity. Identifying behavior changes that affect the ease of complying with or enforcing the code will provide inferences about the effect of the program activities on compliance.

We will analyze the surveys and interviews and report our findings to NYSERDA. The report will focus on participants' satisfaction with each activity, the effectiveness of each activity, and the extent to which each activity resolved possible barriers to code compliance. Based on our findings from the initial and long-term surveys/interviews, we will also provide recommendations about improving the effectiveness of each activity.

Data and Information Needs

To conduct the surveys/interviews we will need several types of data and information, including:

- A list of all program activities with information on the implementer, content, purpose, timing, location, and target audience(s)
- Contact information for the implementer and all participants

3.6.4 Building Compliance and Energy Savings Analyses

Discussion

The new code takes effect on December 28, 2010, so only buildings permitted after that date are required to meet the new Energy Code. Several months or years often elapse between the permit application date and the construction completion date. This long timeframe is especially true for the larger commercial structures. Conducting site visits in the later part of 2011 through 2013 will allow us to sample a sufficient population of buildings constructed under the new code.

Compliance can be defined and analyzed in various ways. The simplest, but least informative, is to use a pass /fail criterion indicating whether a building meets the minimum code requirements in its entirety. More information is provided by compliance assessments that address individual building measures and their code requirements, and this would provide a basis for calculating the energy impacts of various compliance levels. The DOE has developed checklists for assessing compliance that provide insights into the relative energy impacts of the compliance level. The most complete assessment of compliance and energy impacts would involve analysis using building simulation tools, such as eQUEST. Full modeling of every building would be very expensive, so we propose a combination of methods to assess compliance and energy savings that remain within the study scope.

To maximize the leverage of the compliance study being conducted by VEIC for the current code, the Team will communicate with the VEIC researchers and ensure that our compliance analysis approach allows us to maximize the use of their results, with the intent of making it possible to deduce the approximate effects of the code program activities on compliance. However, the usefulness of the VEIC study data will depend on the method and scope this contractor applies, and when this action plan was being prepared, the Team did not have full details on the VEIC study. At a minimum, we anticipate the VEIC findings will help in identifying problem areas in code enforcement, and to provide input on the extent of current code enforcement. This analysis will be limited to the extent that the current study is based on the existing New York code, not on those codes going into effect in December 2010. We will continue to monitor the VEIC study and adjust our approach as needed to ensure we leverage it as much as possible.

To estimate the effects of program activities, the Team will collect information on sample buildings about the key individuals and organizations that were involved in the building design, construction, and code enforcement. The purpose will be to document what program activities influenced the key personnel who participated in the design, construction, and verification of code compliance for each building.

Analysis

Whether or not statewide code compliance is meeting the DOE 90% compliance requirement can be determined adequately in New York by analyzing a 90/10 sample consisting of 44 new commercial buildings, 44 commercial renovation buildings, and 68 residential buildings.[9] The Team proposes selecting a building sample distributed across the three climate regions in New York, proportionate to the sample sizes specified by the DOE Sample Generator. Given the expanded funding level, the Team will conduct site visits to the sample of buildings described above. To the greatest extent feasible, the sample will be selected randomly and previously audited buildings will not be excluded from the sample. In

[9] The assumptions for sample sizes are based on the new construction and renovation starts averaged over the last three years in http://energycode.pnl.gov/SampleGen/index.jsp?state=New%20York. The sample size is generated using a two-tailed test and is calculated for the state level. We will ensure that the sample is reasonably distributed between upstate and downstate areas, but the sample is not designed to ensure 90/10 for both upstate and downstate individually. Because permits are often not pulled for residential renovations, the majority of the 68 residential building sample will be newly constructed homes.

drawing the sample, the Team will also make best efforts to ensure that training participants are represented in the sample, and representation from specific trainings will be ensured by cross-checking site information with BMI course registration lists as available. We will create site data collection tools, especially leveraging the DOE checklists (residential and commercial), and conduct interviews to assess compliance and the role of program activities on enforcement and compliance.[10] These data collection tools will include space to document the makes and model numbers of equipment. This information will be used to research details including vintage subsequent to the site visit. We will focus primarily on new construction, and the expanded scope and schedule will allow us to include an adequately large sample of new buildings constructed to the new code. Given the slowdown in construction and recent market trends, we will also examine the code compliance of renovations in commercial buildings, targeting those areas where renovations are most common.

Compliance will be determined by using the as-built information with the DOE checklist and other methods, as appropriate. For each building, the Team will calculate the energy savings of the as-built building by estimating its energy use and comparing that amount to the consumption expected had the building complied with the preceding (now current) energy code.

This study will provide a measure of the average compliance levels for residential and commercial buildings and give an estimate of the average energy savings resulting from the new Energy Code. Given the expanded scope of this study, the Team will use the information available on the individuals and organizations involved with each building in order to assess the effect of the various program activities on compliance and energy savings. Depending on the completeness of information we receive on each building and the range of compliance levels, we will use a regression approach or other statistical method to estimate the effects of the different program offerings.[11]

<u>Data and Information Needs</u>

To conduct the proposed compliance and energy analysis, the Team will need at least the following data and information:

- Contact information for local building departments and officials
- Information identifying buildings permitted and constructed under the new Energy Code
- Building owner / occupant contact information
- Detailed building characteristics collected from site visits
- Contact information for code officials, architects, engineers, etc. who are identified through plan documents for individual sample buildings

The most difficult information to obtain will be the identification of newly permitted and constructed buildings. This is most challenging for commercial buildings. To identify such buildings, the Team will work with local building officials and possibly obtain supplemental data from industry sources, such as McGraw Hill, that tracks construction projects and their status.

[10] The final method for calculating energy savings will depend on the products DOE delivers for assessing compliance. The Team will monitor DOE's products, and will settle on the final approach for calculating savings during the first months of 2011.

[11] Although the Team was asked about the possibility of extrapolating compliance rates to future years, this study will be limited to providing a snapshot of compliance rates during the study period. At this time, extrapolation of compliance for future years is beyond the scope of this study and there exists very little empirical information and precedent to use as the basis for extrapolating changes in compliance.

3.7 TASK LEVEL BUDGET AND TIMEFRAME

Table 9 illustrates the estimated budget represented at a task level, expressed over the three program years.

Table 9. Task Level Budget

Tasks	Estimated Budget	Explanation	2011 %	2012 %	2013 %
Early code adoption analysis	$15,000	Allows estimate of savings due to early code adoption	100		
Supplement VEIC baseline effort	$42,000	To address interviews and baseline assessment not covered by VEIC (RFP 1720)	100		
Interviews=90 Surveys=200	$58,000	Covers interviews and surveys	40	30	30
Commercial = 88* (44 new, 44 renovation) Residential=68 Building departments=20	$559,660	Site visits to support 90% confidence and 10% precision estimates for residential and the combined commercial market (new construction and retrofit), used for compliance calculations	20	40	40
Building energy simulation modeling ($5k/bldg * 10 buildings)	$50,000	Increased number of buildings modeled to improve energy savings estimates	20	20	60
Travel	$52,594	Covers additional site visits	20	40	40
Research, Analysis, Development of energy savings estimating method, Reporting, and Administrative	$218,153	One more year added to evaluation, and scope of work increased to assess impacts of ARRA funding on energy code program activities	30	30	40
Budget totals**	$995,407				
% Spending per year			**28**	**34**	**38**

* At this time the team is recommending that we combine the sample for commercial new construction and retrofit to arrive at a sample size of 88 total for commercial. This meets the DOE requirements of 90/10 at the commercial level. As the project proceeds, if we are able to identify additional budget, we would recommend increasing this sample size to be 90/10 for the commercial sub-sectors, new construction and retrofit. Sample size requirements for each sub-sector would require contacting 70+ of each.

**Budget total is less cross cutting tasks ($6,810 carbon; $7,110 cost effectiveness; $9,783 macroeconomic, and $10,000 for attribution survey; totaling $33,703). Adding in the crosscutting tasks brings the estimated total budget for the energy code evaluation to $1,029,110 including 2012-2013 monies not included as part of this Action Plan. Please refer to Section 13 of this Action Plan for details regarding the 2010-2012 and the 2012-2013 budget estimates.

4.1 PROGRAM DESCRIPTION

Renewable energy projects taking part in this evaluation are funded under three separate NYSERDA program offerings (RFP 1613, RFP 10, and PON 1686) that are funded by two 2009 ARRA funding streams- SEP and EECBG grants. Each program has its own unique characteristics, requirements, and evaluation challenges.

4.1.1 RFP 1613 and RFP 10

RFP 1613 is funded through a $74 million SEP grant provided to municipalities, universities, schools, hospitals, and not-for-profits for energy related projects. Grants are awarded on a competitive basis for projects associated with energy-efficiency retrofits, transportation measures, material conservation programs, energy distribution technologies, traffic signal and street lighting efficiency projects, renewable energy installation for government buildings, or technical consultant services. Of the $74 million, approximately $24 million has been awarded to renewable energy projects.

RFP 10 is funded through a $24 million grant from the EECBG provided to small municipalities that are not eligible for direct formula ARRA grants for their energy reduction projects. Approximately $12.9 million of the total EECBG grant is being made available to small municipalities for renewable energy projects.

Both programs are summarized here, as their structure, purpose, and target audiences are similar.

In the RFPs' award design, NYSERDA sought to ensure a geographically equitable distribution of the funds through allocations to approximately 10 regions across the state and through funding caps.

Renewable energy technologies eligible for funding under RFP 1613 and RFP 10 include:

- Solar Photovoltaic (PV) (funded only in RFP 1613)
- Solar Thermal (water and space conditioning)
- Biomass
- Fuel Cells
- Wind

The specific distribution and quantities of projects for each RFP are detailed in Table 12.

4.1.2 PON 1686

The PON 1686 program is designed to expand the use of solar energy in commercial and residential PV systems across New York State. NYSERDA is providing capacity-based incentives to PV vendors, who will pass these incentives along to their customers, in order to induce the installation of aggregated PV systems at a lower cost. This approach will enhance business opportunities for installers through increased installation volume and the need for standardization. The goals are to increase the amount of energy generated from renewable resources, reduce greenhouse gas emissions, and create jobs.

The principal barrier to widespread adoption of PV is the initial high capital cost. The market for PV in New York is driven by national, state, and local incentive programs (various forms of rebates, performance payments, legislation, and tax credits) that are designed to bring the financial cost of the PV installation close to the level of the financial benefits the system will deliver. A complementary program, the NYSERDA PV Incentive program, which is funded through another ratepayer source, provides a fixed, capacity-based incentive for relatively small installations (up to 7 kW) for customers that pay a Renewable Portfolio Standard (RPS) charge for the electricity used in the building where the PV system is to be located. For non-residential systems, incentives are provided for systems up to 80 kW in size.

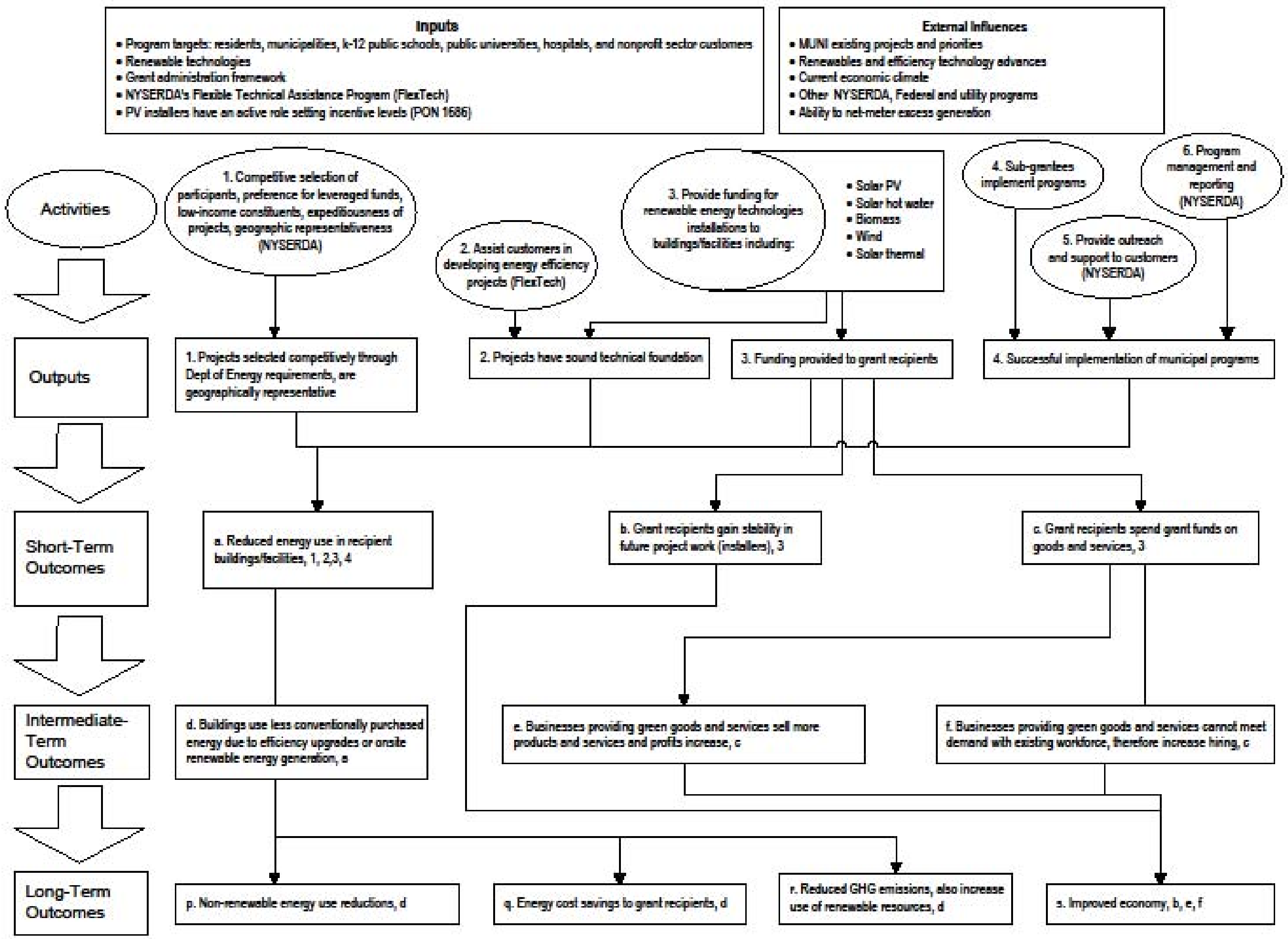
With SEP ARRA funds, NYSERDA developed a new competitive program to allow market participants to propose the incentive level necessary for them to elect to install aggregated blocks of PV systems. A competitive solicitation ranked proposals according to a set of predefined criteria, with priority for those requesting the least amount of incentive funding per watt of installed PV.[12] It is expected that this new, competitive program will result in between 3 and 6 MW of PV installations that will generate between 3,400 and 7,000 MWh annually. Four vendors were selected to administer seven PV contracts, with a defined goal of installed capacity at a specific dollar per watt value.

4.1.3 Program Logic

A program logic model is shown in Figure 3.

[12] While not currently a part of the Action Plan, the third year evaluation could compare if these incentives are more cost-effective than the fixed incentive approach employed in NYSERDA's other customer-sited tier programs. This effort however, would require additional cost-effectiveness runs that are not currently budgeted. As the evaluation proceeds the Team will be happy to discuss priorities should budget become available.

Figure 3. Program Logic Model for Renewable Energy Activities under RFP 10, RFP 1613, and PON 1686



According to the program theory, funds provided for solar PV installations at residential and non-residential sites (through PON 1686) will provide several key benefits:

- Reduced installation costs of solar PV systems by promoting:
  - Bulk orders of expensive equipment (e.g., PV modules, inverters)
  - Development of commodity PV systems that can be deployed more quickly and with less upfront design effort
  - Streamlined process for receiving NYSERDA funds for completed projects
- Reduced conventional energy consumption of a variety of buildings across New York State

Funding provided to municipalities, hospitals, schools, and universities under RFPs 10 and 1613 will provide the necessary impetus to complete a variety of renewable energy projects. These projects will reduce the conventional energy consumption of impacted facilities, as well as provide installation experience and infrastructure to support areas that are not currently supported by NYSERDA's RPS programs, such as solar thermal and biomass boiler technologies.

All three of these programs work together to remove or reduce market barriers, subsidize a developing market, and increase qualified labor in order to stimulate the renewables sector of the economy. The long-term outcomes include increased renewable energy generation, reduced demand for fossil fuels, reduced greenhouse gas emissions, and an improved economy as measured by job creation/retention.

4.2 RESEARCHABLE ISSUES AND PRIORITIZATION

Table 10 indicates key researchable issues for the evaluation, including the priority of each.

Table 10. Program Researchable Issues and Prioritization

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
GROSS ENERGY IMPACTS			
Will systems meet long-term energy yield projections?	More detailed monitoring will be required to verify performance characteristics of non-solar PV technologies.	On-site visits (PV) Metering (non-PV)	High
Are installers correctly estimating system energy output?		Document review On-site visits	High
NET ENERGY IMPACTS (ATTRIBUTION)			
To what degree did the ARRA-funded programs bring about generation that would not have happened absent the programs?	Participants may have installed measures on their own without NYSERDA ARRA funding.	Surveys/interviews	High
Has participation in other NYSERDA incentive programs been impacted by the ARRA-funded programs?	This diversion will be assessed at the aggregate level, not at the individual level. Installers and customer participation will both be examined.	Surveys Review of program data from other NYSERDA renewable energy programs	High
Are renewable energy projects subject to "take-back" effects?	Some users may reduce conservation efforts as a result of their participation in one of these programs, as they believe their power is "green." Because of this, some of the benefit of installing a renewable energy system may be lost because the overall energy use increases and offsets it.	Partcipant surveys	High
Have the ARRA-funded programs created any impact on services ancillary to the renewable energy industry?	Examples might include electrical inspection, interconnection approval, energy audits, and any impacts on the grid.	Installer and stakeholder interviews/surveys	Medium
Have participants taken other actions to increase capacity or save energy because of their participation in one of the ARRA-funded programs?	While such spillover may occur, the length of time it will take many projects to be completed may not allow for a full assessment of spillover in this evaluation in time for the DOE required reporting dates.	Surveys/interviews	Medium
COST-EFFECTIVENESS			
Does the Program pass the cost-effectiveness tests?	Understand program costs and benefits.	• SEP-RecTest • Total Resource Test • Program Admin Test • Societal Test	High
ECONOMIC IMPACTS			
How many jobs were created by the Program?	Understand the economic impact of the Program.*	• Apply DOE job estimation method • Perform REMI analysis	High
EMISSIONS IMPACTS			
What emissions impacts are attributable to NYSERDA's ARRA-funded programs?	More in depth analysis and collaboration with task and program managers will be required to determine avoided emissions attributable specifically to the NYSERDA ARRA-funded programs.	Analysis of emissions data and energy savings.	High

* Because RFP 1613 and 10 allocated program funds based on unemployment rates in 10 regions, the Team was asked about the possibility of conducting an analysis of jobs created by region. While this is possible, conducting this analysis would require the purchase of the expanded version of REMI and would require additional time to perform the analysis. Currently NYSERDA is only using the single region REMI model.

4.3 SUMMARY OF DATA COLLECTION ACTIVITIES

Table 11 provides an overview of proposed data collection activities for each evaluation year. The number of surveys, site visits, metered site visits, and document reviews the Team will complete in each year is approximate and depends on project implementation schedules. The sampling methodology used is described in Section 4.4.1, below.

Table 11. Data Collection Activities

Activity	Program	Purpose	2010	2011
Online Surveys	RFP 10	Collect basic process, net impact, and related data	10	32
Online Surveys	RFP 1613	Collect basic process, net impact, and related data	10	37
Telephone Surveys	PON 1686	Collect basic process, net impact, willingness to pay, and related data	15	60
Telephone Interviews	All	Explore attribution issues in depth with participants in RFP 10 and RFP 1613 and installers in PON 1686	7	17*
Staff/Management Interviews	All	Understand implementation goals, challenges, and lessons learned	10	0
Site Visits	All	Verify energy output and system downtime	0	185
Metered Visits	RFP 10 RFP 1613	Verify accuracy of the long-term system benefits/costs of non-PV systems	21	0**
Document/File Review	RFP 10 RFP 1613	Verify installer documentation and energy yield estimation methods; pre-screen for site visit selection	75	70

* This includes potential brief follow-up interviews with PV installers during 2011.
** Metering equipment will be installed in 2010, and monitoring/data collection is expected to continue into 2011.
Note: The per year numbers are subject to change based on project installation dates.

4.4 GROSS IMPACT EVALUATION ACTIVITIES *(TASK2a)*

Renewable energy projects, unlike many energy-efficiency measures, produce an energy output stream that can be directly observed and reported. However, as most renewable energy projects make use of inherently variable resources, beyond the control of the installer or end user, some types of projects require a more detailed consideration of the true, long-term benefits and impacts. Technologies using well understood resources and industry-proven energy yield calculation methods, such as solar PV, will be evaluated through on-site meter readings and reviews. The Team will use this evaluation to determine if installation conditions, such as shading, have been properly accounted for in reported energy yield estimates. However, projects using more intermittent resources, such as wind energy, will require the Team to conduct detailed monitoring before accurate projections of long-term benefits and costs can be established.

The Team shall use a combination of telephone surveys, document reviews, site visits, and monitoring to establish the impacts of NYSERDA's ARRA-funded renewable energy programs. While aspects of the three renewable energy programs will be evaluated individually, we will take advantage of program similarities to make our evaluation efforts more cost-effective.

Table 12 shows the number of projects per program and technology, as currently reported. The PON 1686 program will be separated into residential and non-residential, and the RFP 1613 and RFP 10 programs will be separated into PV and non-PV, in order to aid the Team in understanding the type of project and the necessary scope of evaluation. Within RFP 10 and RFP 1613, different sectors will also be analyzed for various performance factors.

Table 12. Renewable Energy Program and Technology Summary

Program	Technology	Population (Projects)	# Installations	Primary Evaluation Method for Gross Savings (see Table 13 for sampling information)
PON 1686 Residential	Solar PV	600 (Est)	600	On-site inspections
PON 1686 Non-Residential	Solar PV	20 (Est)	20	
RFP 10 Non-Residential	Solar PV	58	60	On-site inspections and document review
	Non PV	15	24	Monitoring and on-site inspections
	Biomass	1	1	
	Wind	7	14	
	Solar Heating	5	5	
	SWH	2	4	
RFP 1613 Non-Residential	Solar PV	68	80	On-site inspections and document review
	Non PV	20	38	Monitoring and on-site inspections
	Biomass	4	5	
	Wind	5	5	
	Solar Heating	6	6	
	CHP	1	1	
	SWH	4	21	

4.4.1 Sampling Methodology

As the most cost-effective and reliable method of verifying system energy output, site visits will be conducted to meet the sampling requirements of 10% precision at the 90% confidence level (90/10 sampling), or better. Based on currently available project lists and related information, the Team shall conduct a total of approximately 184 on-site inspections, sampled within appropriate subgroups, including:

- Funding Program
  - PON 1686
  - RFP 10
  - RFP 1613
- Sector
- Non-Residential (different sectors will be analyzed, though the results will not be used for sample stratification)
- Residential

- Technology

Sample sizes were calculated based on a two tail distribution, with an assumed coefficient of variation (CV) of 50%. Although this CV may be conservative for a large number of systems where a full year of energy output is available, this more conservative initial estimate will provide the Team with some flexibility to address:

- System downtime
- Additional stratification, if warranted
- Long installation timelines leading to systems having less than one year of energy output history
- Regional solar resource variability

The 90/10 confidence and precision levels will be applied to the residential solar PV systems, which represent the majority of installations, and a census of all other technologies will be performed, including non-residential PV. Table 13 shows the stratification of expected document reviews, site visits, and sites to be monitored by each program and project type. It was determined that additional stratification on building type within each program is not necessary; however, building types will be proportionately selected within each project-type stratification in order to best create a representative sample. Geographic diversity (upstate versus downstate regions as defined in Section 1:) will also be a sampling criterion so that we accurately account for the stratification of installations in the regions. The Team may align this geographic stratification with utility service territories, depending on the distribution of sites. The sample size was chosen based on the Team’s most current information regarding the number of installations, bearing in mind that a single project may include multiple installations of individual renewable energy systems.

The number of document reviews of solar PV systems was selected based on needing to conduct 25% more reviews than site inspections. The Team will select systems for site visits from this larger pool of systems receiving document reviews, and the additional 25% will provide the Team with flexibility, should any issues arise related to scheduling or non-responsiveness of site contacts.

The number of sites chosen for more detailed monitoring of non-solar PV systems was primarily driven by budget, system complexity, and resource variability. The Team will conduct document reviews for all non-PV systems, supplemented by site visits. The result will be a census overview of non-PV systems, with detailed monitoring providing greater insight into the operation and resource characteristics of the technologies employed.

Table 13. Site Visit and Monitoring Sampling

Program	Project Type	Total Projects	Number of Installations	Number of Document Reviews	Number of Site Visits	Onsite Monitoring of System Performance	Details
PON 1686	Residential PV	600	600	0	75	0	Approximately 25 sites will be inspected from each of the three residential installers.
	Non-Residential PV	20	20	0	20	0	A census of non-residential sites will be visited.
RFP 10*	PV	58	60	38	32	0	A 90/10 sample of PV systems will be selected for site visits.
	Non-PV	15	24	24	8	10	A census of non-PV technologies will be inspected. Selected systems will be included in a more detailed monitoring campaign. Sampling precision does not apply.
RFP 1613[a]	PV	68	80	44	36	0	A 90/10 sample of PV systems will be selected for site visits.
	Non-PV	20	38	38	13	11	A census of non-PV technologies will be inspected. Selected systems will be included in a more detailed monitoring campaign. Sampling precision does not apply.
Totals		**781**	**822**	**144**	**184**	**21**	

* Note that RFP 10 and RFP 1613 are non-residential only.

4.4.2 Document Reviews

In order to ensure confidence in estimated energy yields provided by system installers and designers, the Team shall conduct a review of all available project documents for RFP 10 and RFP 1613. These document reviews will focus on evaluating the accuracy of energy yield estimates completed by system designers and program implementation staff or contractors. Specific aspects of solar PV system designs to be considered include:

- Tilt and orientation
- Shading and nearby obstructions
- Energy conversion derating factors
- System cost information[13]

As part of these reviews, the Team will assess project documentation in order to: 1) best determine project characteristics; 2) perform a high level of QA/QC for determining project documentation expectations; 3) verify engineering and energy output estimations; and 4) pre-screen for site visits.

We will perform document reviews for a sample of solar PV installations and a census of all non-PV systems. The document reviews will be conducted after the final system inspection/approval is completed by NYSERDA, so that the Team can review the full set of project related documents. Document reviews will be conducted within 12 months of system installation. The Team will track our review results in a database used to pre-select systems for later on-site inspections. In order to provide flexibility in selecting and scheduling on-site inspections, and to provide a greater sampling of system design practices, we will conduct 25% more document reviews than on-site inspections for solar PV systems, as shown in Table 13. The Team will conduct document reviews for all non-PV systems. Since PON 1686 does not require installers to provide system design documentation or other detailed specifications, no document reviews will be conducted on these projects.

<u>Deliverables</u>

- Document review template
- Document review report for each site visited
- Section of final report

4.4.3 Site Visits

The Team shall deploy technical staff, trained and experienced in evaluating renewable energy systems, to conduct on-site inspections of a sample of installed systems. These inspections, conducted on systems we pre-select during the document review phase, will focus on confirming system energy output 6-12 months after installation. The Team will monitor installation progress to ensure that sufficient operational history is available for our analysis. This timeframe, when combined with the sampling plan, will allow us to quantify factors such as system downtime, shading, and weather-related impacts and their relationship to long-term program benefits and costs.

[13] Provided the information is available, costs attributable to interconnection will be correlated by utilities.

Deliverables

- Site visit checklists (by technology)
- Reports for each site visited
- Section of final report

4.4.4 Savings Validation

Energy savings (energy produced) shall be verified in one of several ways, depending on the technology installed. For solar PV systems, whose installation practices and methods for estimating energy output are well known, a combination of surveys, on-site inspections, and document reviews shall be used to verify energy savings. We will verify whether the funded projects meet their energy output expectations by obtaining and comparing readings from the on-site energy meters with the installers' estimates and with our energy output estimates. We shall endeavor to discover the cause of any significant discrepancies.

For other technologies, such as solar hot water heaters and wind turbines, methods of estimating benefits are less clear. Solar hot water heaters, for example, may be heavily impacted by changes in user behavior or by the type of backup heating used. It is difficult to estimate the benefits and costs of wind turbines, due to variable wind resource, equipment performance characteristics, and maintenance costs. Therefore, for non-solar PV projects, we will employ a series of system monitoring techniques and equipment in compliance with the International Program Measurement and Verification Protocol (IPMVP) Volume III. An overview of the monitoring methodology for each non-PV technology funded through NYSERDA's ARRA programs is outlined below. As the evaluation continues, the Team will prepare specific M&V plans for each project to be monitored. These plans will contain further details about the equipment to be installed, calculations made, and expected results for each individual project. In all cases, the Team will attempt to collect 12 months of data at monitored sites, but, due to program reporting timelines, shorter monitoring periods may need to be employed. In these cases, we will employ appropriate methods to adjust data collected during monitoring periods to applicable annual equivalents.

Solar Photovoltaic

We will verify energy savings generated by solar PV systems primarily through a combination of site visits and document reviews. Though the Team will deploy monitoring equipment for other technologies, solar PV systems generally have predictable energy output and built-in energy meters. We will include weather normalization (including solar radiation) by using regional weather stations. System performance will be analyzed in aggregate by program, by installer, and by sector so we can determine any systematic discrepancies.

Small Wind

Small wind turbines (SWT) have been used to generate electricity for decades. As an industry, the small wind market, over the past 10 years, has made enormous strides towards a more diverse and robust set of product offerings. SWTs operate on a much smaller scale than utility class turbines. Tower heights typically range from 30 to 120 feet for generators, with maximum rated outputs of up to 50kW. The performance of these systems is dependent on wind, a highly variable resource. Projects of this scale do not justify the research required to truly characterize a site's wind resource, so installers use wind maps and rules of thumb to select sites and predict energy output. Characterizing this variable resource and the system's response to that resource requires power performance monitoring.

Power performance monitoring involves measuring turbine output power, as well as metrological data including wind speed, wind direction, and temperature. Knowing the wind speed at the hub height of the turbine is crucial to resolving the system's power curve. The American Wind Energy Association

(AWEA) has set guidelines for testing the power and acoustic performance of SWTs; this standard is written for the certification of SWTs, which is beyond the scope of this evaluation. However, the Team has extensive experience with the AWEA standard and will follow applicable sections and best practices. We will collect data using a suite of wireless sensors, which we will install by mounting them on booms attached to the wind turbine tower during turbine installation. The sensors will communicate with a data logger via radio signals, and the logger will upload daily data files via a cellular modem. We will analyze the data and calculate a variety of performance metrics, such as the site's mean annual wind speed at hub height and each corresponding turbine's power curve.

The planned monitoring activities for SWTs will address the following questions for evaluating the impacts of NYSERDA's ARRA-funded projects:

1. Do funded systems meet their energy yield targets in their first year of operation? Are the first year's data representative of the average expected long-term performance?
2. How well do the installers using the available wind maps predict annual average wind speeds at the sites identified for monitoring and verification?
3. What impacts do local terrain features and obstructions have on the hub height wind speed and turbine performance?
4. At sites where turbines are performing poorer than expected based on measured wind speeds, what siting factors, turbine and installation characteristics, and environmental conditions likely contribute to this performance deficiency?
5. What industry best practices should NYSERDA encourage among all its eligible installers to ensure that SWTs are responsibly sited?

As of the writing of this plan, there have been 11 wind projects selected for award, representing 18 individual turbines. We will monitor the schedules of all funded projects, and when systems receive construction approval, we will evaluate the sites/systems and coordinate our equipment installation with the system installers and owners. We will install monitoring equipment at five of the 18 possible wind turbines. Sites will be selected based on geographic distribution, wind energy equipment, wind regime, and other differentiating factors-as well as screened for monitoring suitability/access.

<u>Biomass</u>

Heating systems using biomass feedstock, such as wood pellets or liquefied gases, can be used to reduce costs, price volatility, and dependence on fossil fuels. In order to ensure that funded systems are meeting performance expectations, we will monitor several key parameters of boiler performance:

- Hot water supply temperature
- Cold water return temperature
- Flow rate
- Fuel type and input rate
- Outdoor air temperature

As of the writing of this plan, there are five biomass boiler projects approved for funding under RFP 10 and RFP 1613. The Team will deploy monitoring equipment at a minimum of three sites for up to 12 months, to capture an entire heating season. We will compare the data collected during the monitoring period with previous fuel use records (for boiler replacement projects), normalized for weather conditions. If possible, we will use available data on the original equipment to estimate heat output as a function of weather conditions, in order to identify changes in use patterns after installation. Our monitoring will address the following evaluation questions:

- Does the use of biomass engender changes in user behavior (e.g., encourage conservation or reduce building occupants' desire to conserve)?
- Is the energy delivery rate of the biomass boilers consistent with manufacturer specifications and building thermal loads?
- Do any operational hurdles or characteristics need to be addressed before biomass boilers are implemented on a larger scale, such as securing stable feedstock sources?

Solar Space Conditioning

Technologies, such as transpired solar collectors (e.g., the "Solar Wall") use sunlight to heat air that is then circulated into a building's existing HVAC system. This preheated air reduces the need for energy from other sources and has been widely tested at national and international laboratories.

As of writing this report, there are 11 projects approved for funding under RFP 10 and RFP 1613. Of these, we will install monitoring equipment on five systems to gather the following data on key system parameters:

- Ambient air temperature
- Heated air temperature at inlet to building HVAC system
- Airflow rate into building HVAC system
- Applicable billing and weather data
- Insulation

We will analyze the data collected over a 12 month period to ensure that an entire heating season is captured. Some manufacturers also claim cooling benefits for their systems, and collecting 12 months of data will allow us to verify these claims. The Team will measure the delivery rate of heated air into the HVAC system, which will indicate the useful energy generated by the system, and we will compare this result to our analysis of weather-adjusted billing data for past heating seasons. Initially, we expect that the energy input of the solar space heating system would cause a reduction in the use of other energy inputs (presumably oil or gas fired boilers). However, there may be factors that reduce the net energy benefit of the system, such as mismatch between the availability of solar-heating and periods of high heating load. Our monitoring and data collection efforts will address the following evaluation questions:

- How does the raw energy output of each system correlate to reductions in the use of other fuels for heating?[14]
- Does the energy output profile of each system match the demand for heat in that building (e.g., can a system produce enough heat to bring the building up to temperatures for workers arriving at 8:00 a.m., or must conventional fuels bring the building up to temperature with the solar system then helping to maintain that temperature though the day)?

Solar Hot Water

Solar water heating (SWH) is a well established technology that has been used for decades (or even centuries) to capture sunlight and convert it into thermal energy to provide hot water for laundry, showers, and other applications. The system typically consists of a roof-mounted solar collector that absorbs sunlight and transfers the energy as heat into a water/antifreeze solution. This solution transfers the stored heat energy into a water storage tank via a heat exchanger. There are many variants of this basic

[14] Given our approach of using emission factors for CO2, we could also apply emission factors for other emissions as well.

design, but each serves the purpose of transferring heat to a fluid and, ultimately, reducing energy used from other sources to provide hot water.

In order to verify the savings attributable to a new SWH project, we will need to monitor several parameters:

- Temperature rise and flow rate of fluid passing through a collector
- Insulation
- Energy use of existing hot water heater before and after SWH installation

We will verify the savings of the SWH system by metering the energy consumed for water heating before and after the SWH system is installed. The energy of the backup water heater, combined with the input energy from the SWH system, will indicate the total hot water demand and allow us to normalize it for usage and calculate savings (assuming an equivalent amount of hot water would have been consumed without the SWH system being installed).

We will work closely with the program implementation team and the installer to coordinate our metering efforts with the equipment installation plan, in order to make metering the SWH system more economical by eliminating potentially costly modifications to the system (e.g., installing flow meters).

As of the writing of this plan, 11 SWH projects, consisting of 30 individual systems, have been approved for funding. We will monitor the installation schedules of the approved projects and begin monitoring energy use patterns prior to installation. Once the SWH systems are installed, we will collect post installation performance data. The Team will select a minimum of eight systems to evaluate based on configuration, geography, and other factors that will best represent the overall population of funded projects.

<u>Deliverables</u>

- Site specific M&V plans for non-PV technologies
- Savings validation protocols for solar PV systems
- Site specific M&V report for monitored sites
- Section of final report

4.5 NET IMPACT/ATTRIBUTION ACTIVITIES *(TASK 2b)*

In order to assess the net impact of the ARRA-funded activities on adoption of renewable energy technologies, the Team shall explore the degree to which program activities led to the installation of renewable energy capacity that would not have otherwise occurred. This attribution assessment involves adjusting gross generation by freeridership, spillover, and generation that can legitimately be claimed by other funding sources.

The attribution assessment shall explore the following topics:

- How RFP 10 and RFP 1613 participants and PON 1686 PV installers first heard about the ARRA-funded program.
- Awareness of the ARRA program and rebates applied to PV systems among residents and businesses benefitting from incentives through PON 1686.
- Motivations to take part in the program:
    - Why participants in RFP 10 and RFP 1613 and PV installers in PON 1686 chose to take part in the program.

  - Why residents and businesses installing PV systems rebated through PON 1686 chose their particular PV installer, as well as the size of their system.

- Diversion of participants from other NYSERDA or other utility renewable energy programs into ARRA-funded programs, in order to determine if the ARRA funds enticed installation of larger systems.
- Freeridership defined in a manner that takes into account the nature of the programs and federal guidance on ARRA project selection (i.e., “shovel ready” requirements).
- Take-back effects, or the reduction in conservation efforts because of the installation of a renewable system, which may reduce some of the renewable system benefit because overall energy use increases to offset it.
- Spillover to the extent that the timeline for each project allows for an assessment of additional actions customers have taken to generate or save energy because of participation in the ARRA-funded programs.

Attribution assessment is often one of the most challenging components of impact evaluations because it forces the evaluator to determine what would have happened in the absence of the program. In essence, the evaluator must measure a counterfactual—something that never actually happened. The nature of ARRA funding adds another layer of complexity to attribution analysis. The federal government provided strong directives to states receiving ARRA funds to award money to projects that are ready to move forward—shovel ready—but had difficulty securing financing due to the recession. This attribution assessment shall explicitly take such directives into account, adjusting the definition of freeridership to account for the degree to which ARRA funds allowed projects to continue that might have been delayed or would have been scaled back without ARRA funds. Furthermore, NYSERDA must spend the ARRA funds—including those for evaluation—no later than March 2012 for projects supported by SEP grants and no later than September 2012 for projects supported by EECBG; although many of the projects will not be completed until late 2011 or early 2012. This tight timeline challenges our ability to evaluate spillover for the projects, as many of the recipients or end-users will not yet have had the opportunity to take additional actions resulting from their participation in the ARRA-funded NYSERDA programs.[15]

The Team shall gather data on attribution using four primary methods:

1. An online survey of participants in RFP 10 and RFP 1613,
2. Follow-up interviews with a subset of online survey respondents,
3. A telephone survey of end-users in PON 1686, and
4. Interviews with PV vendors/installers taking part in PON 1686.

We will also review ARRA and NYSERDA program documents and databases as part of the process to search for potential diversion of projects from existing NYSERDA programs, as well as to determine the potential for spillover from ARRA into these same NYSERDA programs (see Section 4.5.5 for more details). The Team shall analyze responses to various survey and interview questions, as well as analyze pertinent information identified in documents and databases.

Online surveys shall be conducted with RFP 10 and RFP 1613 project participants throughout late 2010 and during early to mid 2011. Follow-up interviews will be conducted with a subset of respondents to delve more deeply into the attribution-related questions needed in 2011, discussed below. The Team shall also survey end-users of PV systems installed for PON 1686 projects in the summer or early fall of 2011, after there have been an ample number

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[15] It is our understanding that NYSERDA is considering ways to comply with the DOE timeline for ARRA funded projects, while allowing for continuation of the evaluation past the DOE timeline. If this extension comes to fruition, the Team could pursue these questions during the extended evaluation period.

of installations to meet sampling requirements. We will interview installers for PON 1686 projects in late 2010 to assess why they took part in the program and their experiences in implementing the program in 2010, with a follow-up interview in late 2011 to examine spillover and any changes they experienced in implementing the project during 2011. Since most (if not all) of the installers also participate in NYSERDA's fixed incentive PV program, the interviews will also ask their perspectives about setting their own incentives versus using a fixed incentive set by NYSERDA. Document and database reviews shall be ongoing through late 2011. Geographic analysis will be performed for New York State as a whole, as well as divided by upstate and downstate territories as defined in Section 1:

4.5.1 Online Surveys with Participants in RFP 10 and RFP 1613

The Team shall conduct an online survey with the participants in RFP 10 and RFP 1613 programs to gather information that will be used to estimate freeridership, spillover, net-to-gross ratios, and diversion from other programs—all of which are inputs for the development of a net generation estimate. The Team shall send the invitation—and any subsequent reminders—requesting all 160 participants in RFP 10 and RFP 1613 to complete the online survey (see sample design in Table 14), but only a total of 89 participants must answer the survey to achieve 90/10 confidence and precision for each program and technology.

Table 14. Attribution Online Survey Sample Design

Program	Project Type	Total Projects	Number of Surveys
RFP 10	PV	58	32
	Non-PV	14	10
RFP 1613	PV	68	34
	Non-PV	20	13
Total		**160**	**89**

The Team chose an online survey over a telephone survey so that the participant can answer the survey at a point in the participation and implementation process that makes the most sense for the individual project. NYSERDA awarded contracts for RFP 10 and RFP 1613 in three different rounds; some participants have likely already begun implementing the measures while others have not yet received their contracts. Telephone surveys work best when all respondents are at a similar stage in the participation process; this is because a survey firm must program the survey, train the staff, and set aside an appropriate block of hours to complete the calls. However, if the survey firm must stretch the calls out over the course of months, workers would need to be retrained and a greater number of hours be blocked for the calls, thereby increasing survey costs. Given the limited evaluation budget, it is not possible to field the telephone survey over multiple months, and NYSERDA and the Team do not want to threaten the validity of the results by surveying some participants too early in their implementation timelines or too long after the completion of a project.

The online survey will create one disadvantage for the evaluation: the Team loses the ability to probe more deeply on attribution-related questions (see below). For this reason, the online surveys shall be followed-up with in-depths interviews with some respondents, as discussed in Section 4.5.2 below.

Working with TRC and NYSERDA, the Team shall identify the individuals most responsible for deciding to take part in the ARRA-funded programs and for choosing the type and size of renewable technologies to adopt with program funding. Surveying the most knowledgeable person will ensure that the respondent is able to provide more informed and accurate answers to the questions from which the Team will estimate net generation. The Team shall invite this most knowledgeable person—perhaps through

NYSERDA if appropriate—to answer the online survey close to the time that the participant actually installs the measure(s). At this point in the process, most participants will still be able to recall why they took part in the program, and will also be able to think forward to potential additional energy saving activities they might take as a result of their participation in the NYSERDA ARRA program, thus capturing the two main components of net generation—freeridership and spillover. The Team will send reminder invitations up to three times to each respondent, switching to direct telephone appeals if the approach fails to meet the sample size (89 of 160) needed to achieve 90/10.

The survey shall build upon prior NYSERDA attribution evaluation survey activities, as well as on protocols vetted by the Team in previous evaluations of renewable energy technologies. The Team shall ensure that these questionnaires and protocols adhere to DOE's SEP and EECBG evaluation guidelines, as well as to those of the New York Evaluation Advisory Group. The Team shall develop a draft questionnaire and submit it for comment and review by NYSERDA. The Team shall revise and finalize the questionnaire upon receipt of comments. Although the exact wording may differ in the draft and final versions of the questionnaire, potential survey questions include, but are not limited to, the following:

- *Marketing and Motivation:* How did you first hear about the program? Why did you apply for funding through NYSERDA? Was your decision impacted by having the ultimate source of budget as ARRA funds? Was your decision impacted by the timing of when the funds were available? Did your prior participation in an energy audit or conservation study programs (such as ARRA Pon4 or Flex Tech) influence your decision to participate in this program? Is so, which audit program(s) did you previously participate in?
- *Alternative and Additional Funding:* Did you fund this project solely with NYSERDA ARRA funds or did you leverage other funds? If so, what were the other sources of funding used? What percent of the project did ARRA fund? If you did not leverage alternative funding with NYSERDA, what happened to the funds? Did you use funds originally meant for this project for another project, decline them, or did something else happen? Did other funding for the project require that you leverage resources? Did such requirements influence your decision to apply for NYSERDA ARRA funds?
- *Economy:* Did you have funding secured for the project before applying for NYSERDA ARRA funds? Did any of the project's funding fall through because of tightening credit or other economic conditions resulting from the recession?
- *Freeridership:* To the best of your knowledge, would your project have been completed without NYSERDA ARRA funds? Would it have occurred on the same timeline? Why or why not? Would the generating capacity of your project have been the same as what you installed under NYSERDA ARRA? Why or why not? Did NYSERDA ARRA-funding allow you—or require you—to change your plans in any way? If so, how?
- *Take Back:* Has your energy usage increased, decreased, or remained the same since installing the renewable technology? If it has changed, how was that change related to the installation of the measure(s)? (Note that an increase attributable to the program indicates take back, and a decrease indicates spillover).
- *Spillover:* What other actions, if any, have you taken to save energy or generate more capacity as a result of your participation in the NYSERDA ARRA-funded program? (This question shall be asked in initial surveys conducted in late 2010 and early 2011, and also in potential follow-up studies later in 2011).

4.5.2 Follow-up Telephone Interviews with RFP 10 and RFP 1613 Participants

The Team will conduct follow-up telephone interviews with a subset of online survey respondents. The exact number of interviews cannot be known until the Team analyzes the online survey data and identifies participants for whom follow-up would be useful or necessary, but ten interviews (five with participants in each program) serves as a preliminary estimate. The Team shall *not* interview *every* participant for whom determining attribution may be challenging—the budget does not allow for this in-depth examination—but shall instead target the largest projects (because of their likely greater contribution to overall generation) as well as any projects that may be representative of other participants in the program (in terms of the types of measures included and the questions that would help us assess attribution). The nature of the questioning shall be similar to that described above in Section 4.5.1, except that the interviewers shall probe in more depth on what drove the decision to participate and the importance of the NYSERDA ARRA funds to the project completion, including differences in the scope and anticipated project completion timeline had the participant not had ARRA funds.

4.5.3 Telephone Survey of PON 1686 End-Users

The Team shall conduct telephone surveys with 60 residents and 15 businesses (75 total participants) that purchased PV systems rebated by installers contracted with NYSERDA through PON 1686 (see Table 15). The purpose of these surveys is to determine participant awareness of the rebates applied by installers and the elasticity of the price they are willing to pay for the system. The Team will use this information to determine the net impact of the program on installed PV capacity.

Table 15. Attribution Telephone Survey Sample Design

Program	Project Type	Total Projects	Number of Surveys
PON 1686	Residential PV	600	60
	Non-Residential PV	15	15
Total		**615**	**75**

One of the main purposes of the telephone survey shall be to ascertain end-users' willingness to pay for the PV installations by asking respondents if they would have paid for the system at price points above the one they actually paid (i.e., their anchor price, which will vary for each customer), moving upward in price to determine how much they would have paid without the ARRA-funded incentives, based on the discount the installer applied to that particular end user. Respondents shall also be asked if they received other quotes for the system and why they chose the NYSERDA ARRA installer over other installers. Likewise, the survey shall ask participants if they considered taking part in other NYSERDA or utility PV programs, and why they ultimately chose to go with the ARRA installer. The survey shall also explore whether end-users expanded the size of their system because the ARRA-rebated price allowed them to get more capacity for the money they budgeted. Finally, the questions shall determine if the end-users have taken other actions to increase generation, save electric or fossil fuel energy, or reduce demand on the electricity grid as a result of their (perhaps unknown) involvement in the ARRA program.

In addition to the amount they would have been willing to pay, potential survey questions for PON 1686 end-users include, but are not limited to, the following:

- *Awareness of Program Participation:* Are you aware of the NYSERDA ARRA-funded program and NYSERDA's Power Naturally Solar PV program? Are you aware that the price you received for your system was rebated by your installers through the NYSERDA ARRA program?
- *Program Influence:* Did you receive quotes for more than one type of system? If so, why did you choose to have this particular system installed? Was price the deciding factor? If so, how much more or less was the quote you rejected, and what type of system was it for? Were you able to expand the size of the system you installed because of the rebated price offered by your installer?

Were any federal or state tax credits for renewable energy a deciding factor? Please list all the factors that led you to install the system, ranking their importance.

- *Take Back:* Has your energy usage increased, decreased, or remained the same since installing the PV system? If it has changed, was this change related to installation of the PV system? (Note that an increase attributable to the program indicates take back, and a decrease indicates spillover).
- *Spillover:* Have you taken any other actions to save energy or increase your generation capacity after having your system installed? (While this question shall be asked to all end-users, spillover may be difficult to assess for those with systems installed later in 2011 due to the tight timeline for complying with DOE requirements).

4.5.4 Interviews with PV Installers

The Team shall conduct in-depth interviews with all seven PV vendors/installers taking part in PON 1686. Installers shall be interviewed late in 2010 to assess why they decided to take part in the program, the impacts of the NYSERDA ARRA funds on the number of end-users installing PV systems in 2010, the capacity of the PV systems installed in 2010, and the impact of the NYSERDA ARRA program on participation in NYSERDA's Power Naturally Solar PV program in 2010. The Team will repeat this line of questioning with PV installers in late 2011 to determine if any changes occurred during 2011. Although the Team would prefer to wait until 2012 to repeat the line of questioning, the evaluation timeline will not allow for interviews in 2012 unless NYSERDA extends the evaluation beyond the deadlines set by the DOE. Furthermore, while we would prefer to interview the installers just once to avoid potential survey fatigue, conducting a single interview in late 2011 would limit the reliability of respondents' assessments of remembering why they took part in the program.

Potential interview questions for PV installers taking part in PON 1686 include, but are not limited to, the following:[16]

- *Motivation* (to be assessed only in late 2010): How did you become aware of the NYSERDA ARRA-funded program and why did you decide to participate in the program?
- *End-User Awareness* (to be assessed in both 2010 and 2011): Are end-users aware of the NYSERDA ARRA program and rebates due to the program? If so, when and how did the end-users become aware of the program? Did you tell them about the program, or did they already know? Did installers market programs to end-users differently when using fixed incentives in other NYSERDA programs versus their own setting of incentives for this program? Did installers offer different incentive levels to different customers; e.g., such as, did incentives vary by sector or system size? Did installers disclose incentives to end-users?
- *Diversion* (to be assessed in both 2010 and 2011): Were any end-users aware of NYSERDA's Power Naturally Solar PV program? Did you divert business away from the Power Naturally Solar PV program (or LIPA Solar Pioneer program) towards the ARRA program? Did any end-users increase their project beyond the size eligible for NYSERDA's Power Naturally (or LIPA's Solar Pioneer) solar PV program in order to participate in the NYSERDA ARRA program? If yes, why did they do so?
- *Leveraging Resources* (to be assessed in both 2010 and 2011): What percent of your PV projects were installed with the help of the NYSERDA ARRA program? What percent of your PV projects were installed with the help of NYSERDA's Power Naturally Solar PV (or LIPA's Solar Pioneer) program? What percent of your installations were helped by a utility program? What

[16] Note that the Team does not expect the PV installers to be knowledgeable about take back.

percent were installed without any ARRA or RPS incentive funds? How does this compare to 2010 (if asking in 2011)? 2009? 2008?

- *Freeridership* (to be assessed in both 2010 and 2011): For customers that participated in the NYSERDA ARRA program, what is the likelihood that they would have installed the same systems without the program?
- *Spillover* (to be assessed in both 2010 and 2011): Do you offer rebates through the NYSERDA ARRA program to all of your potential customers? Why or why not? What percent of your customers installed larger PV systems because of the NYSERDA ARRA program? Are you able to offer additional rebates on top of the rebate available by the NYSERDA ARRA funds? Have any of your customers taken additional actions to save energy or increase their generation capacity after having your system installed?
- *Other Economic Benefits* (to be assessed in 2011): Were you able to retain employees that you might otherwise have let go due to increased installation projects as a result of the ARRA program? Did you expand your workforce because of the ARRA program? If so, how many new employees did you hire for full vs. part time jobs? Did the taxes you pay (income, property, school, etc.) increase because of your participation in the ARRA program? If so, by what percent? Did you purchase additional goods and services as a result of the NYSERDA ARRA program? If so, what portion of those goods and services did you buy in New York State?

4.5.5 Document and Database Review

The Team shall review the NYSERA ARRA program participant documents and the NYSERDA RPS tracking databases to search for potential attribution effects of each program. Specifically, it is possible that some participants may have decided to apply for funding through ARRA instead of through the RPS,[17] but in the absence of ARRA funds would have applied through the RPS. In our document and database review, the Team will examine overall participation rates by size of project, sector (public, non-profit, private, etc.), and by budget for both programs for the time period in which ARRA applications were being accepted and awarded. This potential diversion into ARRA from RPS may result in a net decline in generation resulting from RPS—*but only if each* of the following criteria is met:

- There is a documented decrease in RPS participation for the types of projects funded through ARRA by technology and sector,
- There is a documented overall decrease in the percent of RPS funds expended compared to prior years, and
- There is a documented decrease in the gross generation achieved through RPS.

If any of these criteria are not met, the Team will not consider diversion to have occurred. Furthermore, while ARRA cannot take credit for any generation funded through RPS, it is possible that RPS participation increased due to the existence of NYSERDA ARRA funds. For example, if RPS participants heard about ARRA but decided they were not eligible or did not want to adhere to the additional rules set forth by the DOE, they may instead have decided to apply through RPS. While this evaluation will not include surveys or interviews with RPS participants, the Team will examine the database for evidence of any such impacts. Again, such evidence will not change our estimates of freeridership, spillover, or net-to-gross, but we shall report these results as an overall program impact.

[17] The Team understands that NYSERDA's RPS programs address only wind and solar PV technologies. Other technologies, such as solar thermal and biomass heating systems, will not be included in this analysis.

4.5.6 Estimating Net Impacts

The survey and interview tasks to be performed for RFP 10, RFP 1613, and PON 1686 will provide data with which the Team will use to ascertain whether participants can be classified as freeriders or spillover, with further distinctions between full and partial freeriders and within and outside of project spillover. The Team will also determine the price elasticity for PON 1686 end-users through their responses to the willingness to pay questions in the telephone survey. Ultimately, the Team will use all of this information to develop a net-to-gross ratio for each program that will be applied to gross energy savings/generation, economic impacts, and carbon impacts.

Prior to fielding the surveys and interviews, the Team shall develop attribution algorithms for each funding stream and technology. The Team shall present these algorithms when delivering online and telephone surveys and interview guides to allow NYSERDA staff to comment on them. The algorithms will be revised together with corresponding survey questions on attribution. The algorithms shall be sensitive to the program designs and directives from the DOE on the types of projects to fund, their shovel-ready nature, and their ability to leverage funds. For example, a municipality that took part in RFP 1613 may have intended to install PV panels on a middle school, but expected funding did not materialize due to the recession. NYSERDA ARRA funding, however, allowed the project to move forward in 2010 instead of waiting for another year or two when the economy might turn around and funding become available. At the most, such a project could be classified as a partial freerider—and because of the guidelines set by the DOE for project selection, such as prioritizing projects that were shovel-ready and projects that could leverage other resources—this project may not be considered a freerider at all.

After fielding the surveys, the Team shall develop a weighting scheme to adjust for disproportionate stratification in the sample design and will analyze the data according to the attribution algorithms. This analysis will result in the estimated net-to-gross ratio described above. The final estimates of freeridership, spillover, net-to-gross ratio, price elasticity, net generation, and supporting information will be presented in the final report, to be delivered in 2012.

<u>Deliverables</u>

- Draft and final online survey questionnaire
- Draft and final telephone survey questionnaire
- Draft and final in-depth, follow up interview guide
- Draft and final PV installer interview guide
- Section of final report

4.6 MANAGEMENT AND STAFF SURVEYS

It will be important for the Team to consider the history and inner workings of the programs being evaluated. At the start of the evaluation, we will formally speak with the program management and implementation staff, although we may also conduct informal interviews more frequently during our research process. The formal interviews will focus on:

- *General Process:* What aspects of the program worked and did not work, and how could the program be improved?
- *Planning vs. Implementation:* What process was used to arrive at the final program design, and what factors led to changes in the program design and/or program goals?

- *Program Design:* What is the program logic? How do implementers know if the program has been successful? What overlap exists with other NYSERDA offerings and protocols? How did ARRA differ from other similar programs?[18] Was there any transference of knowledge or approaches? Were the effects of ARRA requirements on program design restrictive or permissive?
- *Project Results:* How does the program staff track if the program is on target to achieve its projected result? What is being done to ensure that projects keep to the ARRA required timeline?
- *Program Satisfaction:* What is the retail satisfaction with the program service, and what are the suggestions for improvement?
- *Marketing and Outreach:* How is the project message delivered? What marketing materials and methods are being used?
- *Evaluation:* What information does NYSERDA want the evaluation to deliver to help with program process?

Deliverables

- Draft and final interview question list
- Section of final report

[18] For example, RPS-funded programs offer a combination of fixed incentives, capacity-based incentives per kW, and performance-based incentives per kWh.

5.1 PROGRAM DESCRIPTION

The transportation portion of ARRA-funded projects cuts across two programs:

- Clean Fleets – funded via SEP within RFP 1613
- Efficient Transportation System Implementation Projects – funded via EECBG within RFP 10

5.1.1 Clean Fleets Program Description

The Clean Fleets program offers financial incentives to speed the introduction of light-, medium-, and heavy-duty alternative fuel vehicles and certain advanced vehicle technologies into local communities. The goals are reduced consumption of petroleum, reduced greenhouse gas emissions, better air quality, and net job creation.

Clean Fleets funding was made accessible to applicants via RFP 1613, which has offered three rounds of funding to date.

Those eligible for funding include municipal governments, public K-12 schools, Boards of Cooperative Educational Services (BOCES), public universities or colleges, public and private hospitals, and not-for-profits. For applicants interested in purchasing a new vehicle, the program offered up to 75% of the incremental purchase cost of each vehicle. For those interested in purchasing anti-idling or fueling and refueling/recharging equipment, the incentive offered was up to 75% of the purchase cost for the equipment.

To be eligible, a Clean Fleets project also was required to meet the following criteria:

- Cost of annual energy saved is less than $5,000 of requested funding per 10 million source BTUs reduced;
- Petroleum displacement is at a total project cost of $35 per gallon saved per year or better;
- Particulate matter reduction required to be at a total project cost of at least $17,500 per pound per year;
- NOx reduction is at least $500 of total project cost per pound per year or better; and
- Greenhouse gas emissions are reduced by at least $3.50 of the total project cost per pound of CO_2 per year.

Funding was allocated based on unemployment levels in various regions of the state of New York.

The specific program objectives for Clean Fleets as laid out in NYSERDA’s application to the DOE included the following metrics:

- 350,000 gallons of petroleum reduced annually
- 43 jobs created
- 130 alternative fuel vehicles purchased
- 40 conventional vehicles converted to run on alternative fuel
- 4 alternative refueling stations put in place

Additional goals were laid out in Appendix I of RFP 1613 itself.

5.1.2 EECBG Program Description

The national EECBG program provides direct grants to large municipalities and provides funds to small municipalities indirectly through grants to states. The transportation portion of this program funds projects such as traffic signal synchronization, reduced vehicle miles traveled (such as ride sharing or telecommuting), and anti-idling equipment internal to the vehicle engine.

Only small municipalities are eligible to apply for funds through RFP 10. Each municipality may apply for 100% of the project cost, but can receive no more than $500,000. In addition, each project must achieve a cost per annual energy saved threshold of less than $7,500 per 10 million BTUs of source energy saved.

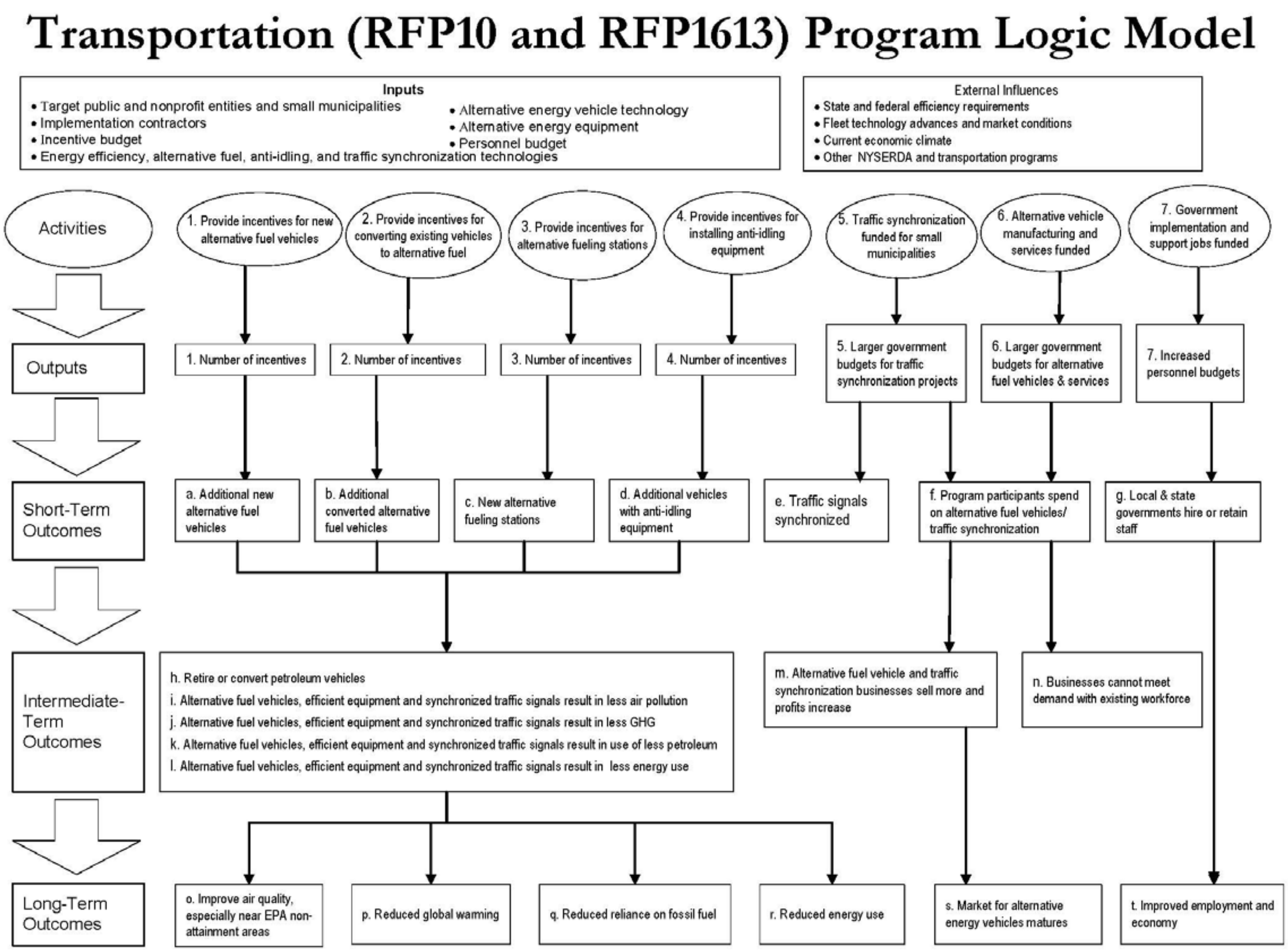
Within the EECBG program no specific transportation goals were identified; rather, for the program as a whole (i.e., for all types of projects permitted in RFP 10), the goals were as follows: 360 jobs created, 111,606 metric tons of CO_2 reduced, and 1,696,143 MBtus reduced. Therefore we will use those metrics (jobs created, metric tons of CO_2 reduced, and MBtus reduced) to evaluate the transportation-specific EECBG projects.

5.1.3 Transportation Program Logic Model

The program theory is that subsidizing alternative fuel vehicles and infrastructure, as well as changing driving behaviors, will create a solid foundation for the growth of a green vehicle market, stimulate jobs in that sector of the economy, and result in improved air quality, reduced greenhouse gas emissions, reduced reliance on fossil fuels, and reduced energy use.

Subsidies for an alternative transportation infrastructure, and the purchase and conversion of alternative energy vehicles, will allow this market to mature so that businesses supporting the alternative vehicle industry can become more competitive. The subsidies and promotion of a mature market and more developed infrastructure of fueling stations will also result in an improved economy. Subsidizing anti-idling technology, traffic signal synchronization and coordination, and installing GPS technology will reduce vehicle miles traveled (VMT), thereby improving air quality and reducing greenhouse gas emissions, energy use, and reliance on fossil fuels. Figure 4 outlines the logic model for the transportation programs.

Figure 4: Transportation Logic Model



5.2 RESEARCHABLE ISSUES AND PRIORITIZATION

Table 16 indicates key researchable issues for the evaluation and the corresponding priority of each. The Team will conduct evaluations mainly through document review, surveys to funding recipients, and calculation of energy savings using formulas deemed acceptable by DOE and EPA incentive programs or other resources. Examples of formulas we would use are the US EPA Diesel Emission Quantifier (DEQ), the WRI Mobile Combustion Tool, and the California Department of Transportation (CA DOT) Traffic Light Synchronization Program (TLSP) Evaluation Work Sheet.

Table 16. Program Researchable Issues and Prioritization

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
PROGRAM EFFECTIVENESS/GROSS ENERGY IMPACTS			
How many alternative fuel vehicles were purchased?	Original program goal was 130.	Document Review, Surveys	High
How many conventional vehicles were converted to alternative fuel?	Original program goal was 40.	Document Review, Surveys	High
How many alternative fuel refueling/recharging stations were installed?	Refueling installation projects include one CNG, one propane, one natural gas, and one electric vehicle recharging station.	Document Review, Surveys	High
How many projects affecting traffic sychronization, GPS - VMT reductions were installed?	3 traffic synchronizations projects and 2 VMT /GPS reduction projects	Document Review, Surveys	High
Did NYSERDA receive as many quality responses to the RFPs as expected? If not, why not?		Document Review, Surveys	Low-Medium
Did the RFPs allot enough time for awardees to complete projects? If not, why not?		Document Review, Surveys	Low-Medium
Were the metrics/criteria established by the RFPs realistic for respondents? If not, why not?		Document Review, Surveys	Low-Medium
How many gallons of petroleum were reduced?	Original Clean Fleets program goal was 350,000.	Calculations using DEQ and CA DOT TLSP	High
How many Btus were saved as a result of the programs?	Original Clean Fleets goal was 1,400,00 MBtus and EECBG total program goal was 1,696,143 MBtus.	Calculations will use conversion factors from the Outcome Estimator for SEP and EECBG programs.	High
NET ENERGY IMPACTS (ATTRIBUTION)			
Has participation in other NYSERDA incentive programs been impacted by the ARRA-funded programs?		Surveys	High
To what degree did the ARRA-funded programs bring about energy savings or use of	Participants or end-users may have installed transportation measures	Surveys	High

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
alternative fuels that would not have happened absent the programs?	without NYSERDA ARRA funding.		
Have participants installed additional capacity or taken other actions to save energy because of their participation in the ARRA-funded programs?	While such spillover may occur, the length of time it will take many projects to be completed may not allow for a full assessment of spillover in this evaluation.	Surveys/Interviews	Medium
COST-EFFECTIVENESS			
What is the cost-effectiveness of pollutants reduced?	Cost/ton of reducing CO_2, NOx, and PM.	Calculations using DEQ	Medium
Does the Program pass the cost-effectiveness tests?	Understand program costs and benefits.	• SEP-RecTest • Program Admin Test • Societal Test	High
ECONOMIC IMPACTS			
How many jobs were created by the Program?	Understand the economic impact of the Program.	• Apply DOE job estimation method • Perform REMI analysis	High
EMISSIONS IMPACTS			
What emissions impacts are attributable to NYSERDA's ARRA-funded programs?	More in depth analysis and collaboration with task and program managers will be required to determine avoided emissions attributable specifically to the NYSERDA ARRA-funded programs.	Analysis of emissions data and energy savings.	High
How many total tons were reduced in non-attainment areas?		Overlay projects with http://www.epa.gov/air/oaqps/greenbk/	High
HEALTH/ENVIRONMENTAL JUSTICE IMPACTS			
How many total tons of emissions were reduced for vulnerable populations?	Vulnerable populations include children, elderly, high population density, and environmental justice	Surveys and Web search to determine if these populations reside near project locations.	High
OTHER BENEFITS			
Other benefits we discover in the process of asking above questions.	Could include reduced congestion, decreased need for maintenance of vehicles, increased well-being of employees, etc.	Document Review, Surveys	Medium

5.3 SUMMARY OF DATA COLLECTION ACTIVITIES

Table 17 provides an overview of proposed data collection activities, which are discussed in more detail in Section 5.5. Please note that no site visits are anticipated.

Table 17. Data Collection Activities

Activity	2010	2011
Telephone Interviews	0	14-28
Document/File Reviews	14	As needed
NYSERDA Staff Interviews	3	3
Implementer Interviews	3	3

5.4 GROSS IMPACT EVALUATION ACTIVITIES *(TASK 2a)*

The 14 transportation projects chosen to receive ARRA funding can be grouped into six project types:

1. *Refueling/recharging.* Four projects entail installation of new alternative refueling stations or electric recharging stations. Assessing the savings from these recharging stations will require document reviews and telephone interviews to determine what was actually completed, and use of the EPA DEQ and/or other tools to calculate the energy savings from these facilities, which will allow the conversion and/or purchase of a certain number of cleaner vehicles.
2. *Conversion to alternative fuel vehicles.* Two projects entail converting conventional vehicles into alternative fuel vehicles. Assessing the gross energy savings from these conversions will require document reviews, telephone interviews, and use of the DEQ and/or other tools to calculate the energy savings.
3. *New alternative fuel vehicles.* Two projects entail purchasing alternative fuel vehicles, and similar to the conversion projects, will require document reviews, telephone interviews, and use of the DEQ and/or other tools to calculate savings.
4. *Traffic signal synchronization.* Three projects involve traffic signal synchronization or coordination. Evaluation of energy savings will entail document reviews, telephone interviews, and calculation using the CA DOT TLSP Evaluation Work Sheet.
5. *Anti-idling.* One project involves installing anti-idling measures in public works vehicles. Evaluation of energy savings will entail document reviews, a telephone interview, and calculations via the EPA DEQ and/or other tools.
6. *Installing GPS technology.* The last two projects involve installing and using GPS technology to change routes and minimize vehicle miles traveled. Evaluation of energy savings for those projects will entail document reviews, telephone interview, comparison of VMT pre- and post-project implementation, and any other methods that may be deemed necessary.

5.4.1 Telephone Interviews

The Team shall conduct telephone interviews with all 14 transportation participants in RFP 10 and RFP 1613 that received awards.

We anticipate conducting one telephone interview once projects are underway in order to gain a more complete understanding of issues related to motivation to participate, project implementation, and attribution (discussed more fully in Section 5.5). Then we will conduct follow up telephone interviews near the completion of the projects in order to allow us to best evaluate final net impacts of the projects.

The in-depth interview guides shall rely on attribution protocols vetted by the Team in previous evaluations of transportation technologies, renewable energy measures, and energy-efficiency projects. The Team shall ensure that these questionnaires, guides, and protocols adhere to the DOE's SEP and EECBG evaluation guidelines, as well as to those of the New York DPS and Evaluation Advisory Group. The Team shall develop and submit a draft questionnaire and interview guide for comment and review by NYSERDA. The Team shall revise and finalize the questionnaire and guide upon receipt of comments.

Potential interview questions will focus on the following issues, some of which focus more on attribution and net impacts, discussed further in Section 5.5:

- *Marketing:* How did you hear about RFP 1613 and RFP 10?
- *Ease of Participation:* Was the proposal process relatively straightforward, or was it onerous? Why? Did you have enough time to fill out the application? Were you allotted enough time to complete your project? Were the criteria by which you were judged reasonable? Why or why not?
- *Motivation:* Why did you decide to apply for funding through NYSERDA ARRA? What made you decide on this project rather than a different one?
- *Project Implementation:* What has your experience been with implementing your project? Do you think you will meet your goals? Why or why not?
- *Alternative and Additional Funding:* Did you fund this project solely with NYSERDA ARRA funds, or did you leverage other funds? If so, what were your other sources of funding? What percentage of the project did ARRA fund? If you did not leverage alternative funding with NYSERDA, what happened to the funds? Did you use the other funds for another project, decline them, or did something else happen? Did other funding for the project require that you leverage resources? Did such requirements influence your decision to apply for NYSERDA ARRA funds?
- *Economy:* Did you have funding secured for the project before applying for NYSERDA ARRA funds? Did any of the project funding you had planned on fall through because of the recession?
- *Freeridership:* To the best of your knowledge, would your project have been completed without NYSERDA ARRA funds? Would it have occurred on the same timeline? Why or why not? Would the project scope have been the same as what you implemented under NYSERDA ARRA? Why or why not? Did NYSERDA ARRA funding allow you—or require you—to change your project-related plans in any way? If so, how?
- *Spillover:* What other actions, if any, have you taken to save energy or adopt efficient or alternative transportation measures as a result of adopting transportation measures through NYSERDA ARRA?

These interviews shall be conducted by staff members at Beacon Consulting and NMR, who are both members of the Cadmus Team. Interviewers shall probe in depth on what drove the decision to participate and the importance of the NYSERDA ARRA funds on the project completion, paying attention to how scope and project completion timelines might have been affected by ARRA funds.

5.5 NET IMPACT/ATTRIBUTION ACTIVITIES *(TASK 2b)*

To assess the net impact of the ARRA-funded activities, the Team shall explore the degree to which program activities led to the adoption of transportation measures. In this assessment, we will explore freeridership, spillover, and impacts that can legitimately be claimed by other funding sources. Ultimately, the Team shall use the results of the net impact analysis to adjust our estimates of gross program impacts (i.e., energy savings, jobs creation, and carbon emissions reductions).

The attribution assessment shall explore the following topics:

- How participants adopting transportation measures first heard about the ARRA-funded program.
- Motivations to take part in the program.
- Diversion of participants from other NYSERDA programs into ARRA-funded programs.
- Freeridership defined in a manner that takes into account the nature of the programs and federal guidance on project selection.
- Spillover to the extent that the timeline for each project allows for an assessment of additional actions taken to save energy or to institute alternative or efficient transportation measures because of participation in the ARRA-funded programs.

The nature of ARRA funding adds a layer of complexity to the already challenging task of assessing attribution and determining net impacts. The federal government provided strong directives to states receiving ARRA funds to award money to projects that are ready to move forward but had difficulty securing enough financing due to the recession. This attribution assessment shall explicitly take such directives into account, adjusting the definition of freeridership to account for the degree to which ARRA funds allowed projects to continue that might have been delayed or would have been scaled back without ARRA funds.[19]

The Team shall gather data on attribution for the 14 transportation projects using the telephone interviews discussed above. Interviews shall be conducted beginning in early 2011 and continue through late 2011 at times that make sense for each participants individual implementation timeline. The Team may also review ARRA and other NYSERDA program documents and databases as part of our search for potential diversion of projects from existing NYSERDA programs, as well as to determine the potential for spillover from ARRA into these same NYSERDA programs. The attribution-related aspects of the document review will be at the aggregate program level, not at the level of individual participants. The Team shall analyze responses to interview questions and assess pertinent information identified in documents and databases. Document and database reviews shall be on-going, with a final review late in 2011 to search for potential spillover.

5.6 MANAGEMENT AND STAFF SURVEYS

At the start of the evaluation, the Team will formally speak with the program management and implementation staff, although informal interviews may happen more frequently during the research process. These formal interviews will focus on:

- *General Process:* What aspects of the program worked and did not work, and how could the program be improved?
- *Planning vs. Implementation:* What process was used to arrive at the final program design, and what factors led to changes in the program design and/or program goals?

[19] At this time however, based on the latest TRC project tracking spreadsheet, the Team anticipates that all of the projects will be completed by the March 2012 deadline.

- *Program Design:* How do implementers know if the program has been successful? What overlap exists with other NYSERDA offerings and protocols? How did ARRA differ from other similar programs? Was there any transference of knowledge or approaches? Were the effects of ARRA requirements on program design restrictive or permissive?
- *Project Results:* How does the program staff track if the program is on target to achieve its projected result? What is being done to ensure that projects keep to the ARRA required timeline?
- *Program Satisfaction:* What is the retail satisfaction with the program service? What suggestions do you have for improvement?
- *Marketing and Outreach:* How is the project message being delivered? What marketing materials and methods are being used?
- *Evaluation:* What information does NYSERDA want the evaluation to deliver to help with the program process?

6.1 PROGRAM DESCRIPTION

This action plan evaluates efficiency-related SEP and EECBG projects funded under RFPs 10 and 1613 (renewable energy and transportation-related projects were covered in Sections 4 and 5, respectively). Section 7 covers PON 4.[20]

6.2 PROGRAM LOGIC MODEL

The theory of the energy-efficiency programs funded by RFP 1613 (SEP) and RFP 10 (EECBG) involves providing funding to municipalities, small municipalities (RFP 10 only), schools, hospitals, public colleges and universities, and nonprofits for projects that save energy and create jobs. Eligible activities include cost-effective energy technologies such as general retrofits, lighting, cooling, heating, motors, building envelope, facility optimization, combined heat and power systems, and geothermal systems. Funding and supporting the implementation of these energy-efficiency activities is expected to result in increased building efficiencies, which will reduce energy use, save grant recipients money through reduced energy bills, and reduce greenhouse gas emissions. The expenditure of grant funds will support jobs at the recipient organization level as jobs are retained or created to implement programs. Money not spent on utility bills can be reinvested in the business, creating more jobs. Additionally, businesses providing energy-efficiency measures and services related to the projects funded will experience increased demand for their products and may need to hire more workers. Figure 5 illustrates the flow of the program's logic. Each block in the figure notes predecessors on which it is dependent.

6.3 RESEARCHABLE ISSUES AND PRIORITIZATION

Table 18 indicates key researchable issues for the evaluation and the initial timing prioritization of each issue (high, medium, and low (timing not critical)). The projects are broken down into four technology categories based on a review of projects underway to date: lighting, boilers and chillers, HVAC, and energy management systems (EMS) controls. These categories allow discussion of overall approaches; however, site-specific M&V techniques may vary with the site, mix of technologies, and presence of additional technologies.

[20] Separate site visits are not anticipated for sites that also funded personnel or conservation materials; however, as project details are reviewed, such projects could be included under the site visited if warranted.

Figure 5. Energy-Efficiency Program Logic Model

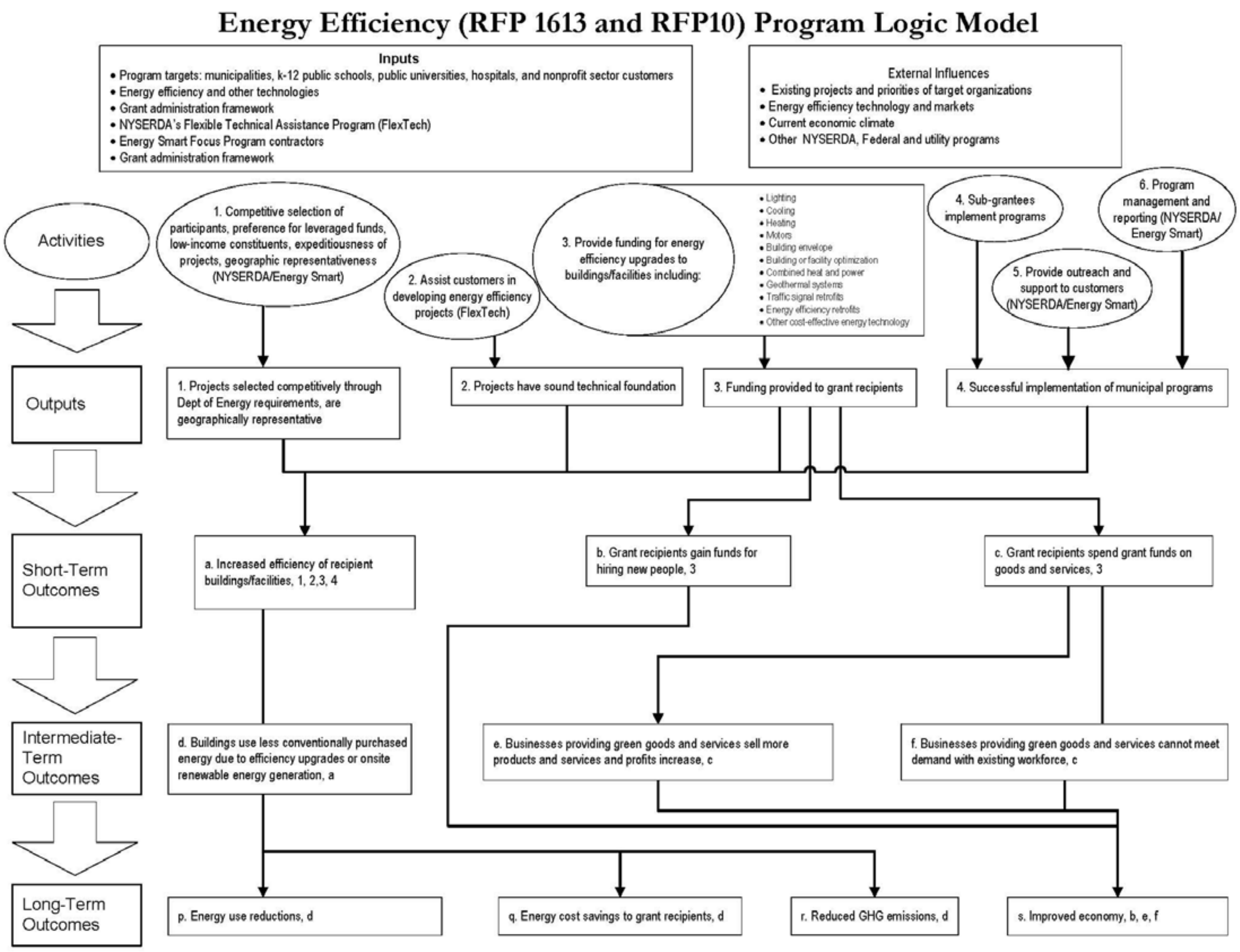


Table 18. Program Researchable Issues and Prioritization (RFP 10 and 1613)

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
GROSS ENERGY IMPACTS			
All	Are sample frames representative of savings and projects?	Detailed M&V plans	High
	Are savings claims calculated correctly and are they consistent with standard engineering practices?	File reviews	High
	How do measures, claimed savings, and projects compare with projects funded by other NY mechanisms and to other states' projects?	Secondary data collection	High
	Are measures installed as described including counts, ratings, and model numbers? Are the devices operating in general as described (e.g. operating hours)?	On-site visits	Medium
	Are there remaining opportunities? Opportunities can be within funded measures, or may be more cost-effective measures not funded. In general, this will be from an engineering point of view and will only note measures in the context of those funded. This will not be a new energy-efficiency investigation.	On-site visits	Low
Lighting	Are lighting levels sufficient ,qualitatively?	Spot measurement of light levels	Medium
	Is equipment being used as anticipated?	Basic bill analysis	High
	What are operating hours for the lights?	Lighting loggers or panel metering	Medium
Boilers and Chillers	Are set point temperatures and reset temperatures operating as designed and anticipated?	Site visits and metering	Medium
	Are energy savings normalized to outside conditions and production levels?	Site visits and metering	Medium
	Is equipment being used as anticipated?	Basic bill analysis	High
HVAC	Are set point temperatures and reset temperatures operating as designed and anticipated?	Site visits, EMS trending, and metering	Medium
	Are energy savings normalized to outside conditions?	Site visits, EMS trending, and metering	Medium
	Are features like economizers, DCV, and setbacks operational?	Site visits, observation, basic temperature logger metering	Medium
	Are data being trended?	On-site visits	Medium
EMS	Are set point temperatures and reset temperatures operating as designed and anticipated?	Site visits, EMS trending, and metering	Medium

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
NET ENERGY IMPACTS (ATTRIBUTION)			
Has participation in other NYSERDA incentive programs been impacted by the ARRA-funded programs?	Participants may have installed their own measures without NYSERDA ARRA funding.	Surveys	High
To what degree did the ARRA-funded programs bring about energy savings that would not have happened absent the program?	The length of time it will take many projects to be completed may not allow for a full assessment this evaluation.	Surveys/Interviews	Medium
Have participants installed other measures or taken other actions to save energy because of their participation in the ARRA-funded programs?	While such spillover may occur, the length of time it will take many projects to be completed may not allow for a full assessment of spillover in this evaluation.	Surveys/Interviews	Medium
COST-EFFECTIVENESS			
Does the Program pass the cost-effectiveness tests?	Understand program costs and benefits.	• SEP-RecTest • Total Resource Test • Program Admin Test • Societal Test	High
ECONOMIC IMPACTS			
How many jobs were created by the Program?	Understand the economic impact of the Program.	• Apply DOE job estimation method • Perform REMI analysis	High
EMISSIONS IMPACTS			
What emissions impacts are attributable to NYSERDA's ARRA-funded programs?	More in depth analysis and collaboration with task and program managers will be required to determine avoided emissions attributable specifically to the NYSERDA ARRA-funded programs.	Analysis of emissions data and energy savings.	High

6.4 SUMMARY OF DATA COLLECTION ACTIVITIES

Table 19 provides an overview of proposed data collection activities for M&V and attribution that are generally listed in order of activity; however, as projects are installed over time, the sequence of site-specific activities will vary.

Table 19. Data Collection Activities

Activity	Purpose	2010	2011
NYSERDA Staff Interviews	Discuss program functional questions at a general level and as related to overlapping or competing programs, if any.	up to 8	
Implementer/Installer Interviews	Interviews will vary by technology type, but will be similar across funding streams. These interviews will assess any barriers to installation of efficient equipment and issues related to attribution	up to 12	
Recruitment Calls - Telephone Program Participants (Customers)	Used to confirm site visit and brief project characteristics.	25	100
Attribution Survey with Participants conducted onsite	Used to gather information on attribution and to assess satisfaction with the program, with installers, and with the equipment and its operation.	25	100
Attribution Survey with Participants conducted by telephone	Used to gather information on attribution and to assess satisfaction with the program, with installers, and with the equipment and its operation.	0	17
Document/File Review	Verify that claimed savings were correctly calculated and are consistent with standard engineering practices.	60	142
Develop Site M&V Plan	Use file review to develop a site M&V plan.	25	100
Site Visits	Targeted to sites that provide the largest proportion of savings.	25	100
Metered Visits	Targeted to sites that provide the largest proportion of savings,(taking into consideration all technologies). Metering varies from simple run time logging to temperature and power monitoring.	25	100
Followup Attribution-Focused Telephone Interviews	To delve into attribution questions more deeply for projects for whom attribution is unclear and/or that represent numerous projects.	0	Up to 25

6.5 GROSS IMPACT EVALUATION ACTIVITIES *(TASK 2a)*

Based on applications received by late July 2010, projects under RFPs 10 and 1613 were divided into projects that were primarily lighting and those that were primarily HVAC. For each of those technologies and under each RFP, the projects were divided into two groups by their projected savings amount: (1) a group of larger projects that delivered over 90% of the total savings delivered by that funding source and technology combination, and (2) the remaining projects. For each RFP and technology group, a sample size was chosen based on achieving 90% confidence with results that will have a relative precision of 10%. This yields a better or finer precision by RFP. Because the largest projects have more impact, and the smaller projects are interesting qualitatively but have little impact on the overall realization rate, sampling will focus on those projects delivering 90% of the savings. The goal is 90/10 across the projects but because the largest ones proportionally determine savings, we plan on sampling randomly but proportionally with project savings (PPS – probability proportional to size).

The confidence and relative precision rates were calculated based on an initial coefficient of variation of 0.5. The weighted confidence and relative precision across the projects for each technology/RFP combination will then be within the desired 90/10 levels. The Team chose sample sized for surveys based on achieving 90/10 by funding source. As part of the aggregate analysis, we will calculate the coefficient of variation for the adjusted gross realization rate and report on the final achieved confidence and precision of the adjusted gross savings estimates at the program level. The projects occur in different regions of the state and are undertaken by different organizations, for example by school districts or by hospitals. In sampling the RFP and technology strata we will take steps to ensure representation by a variety of regions and organization types. Because expressly sampling each of these factors as strata would greatly increase sample size, sometimes to the point of census sampling (the entire population), this stratification by regions and organization type will not necessarily result in 90/10 at the regional level within an RFP and within a technology type. Although 90/10 for each of the seven regions used for distributing SEP and EECBG funds will not likely be achievable, the sample will be comprehensive enough to deliver 90/10 by an upstate and downstate geographic breakdown.[21]

The counts of expected data collection activities are listed by funding source in Table 20. The Team will review files of each of the 201 sampled projects. Of these, we will visit 125, with focus on the ones that provide the most savings by technology type (e.g., lighting, HVAC). All 125 will receive some sort of metering or measurement; however, measurement may use simple techniques like light level measurement of on time logging for lighting projects, or may include power metering for complex projects.

Table 20. Surveys and Site Visits by Funding Source[22]

Funding Source	Attribution Phone Surveys) (all will receive file reviews and a portion will receive site visits)	File Reviews	Site Visits	Measurement or Metering
RFP 1613 SEP excluding transportation	80	140	75	75
RFP 10 EECBG excluding transportation	62	62	50	50
Total	**142**	**202**	**125**	**125**

6.5.1 Modeling Approach

While much of the evaluation work will be based on observation and metering work, modeling will play a role in sites where a series of measures add up to save substantial energy in a building.[23] Modeling approaches will be defined in site specific M&V plans (SSMVP), and will include billing analysis and, in some cases, eQuest-type modeling.

[21] The downstate market consists of the Consolidated Edison and LIPA service area. Upstate is made up of the remainder of the state.

[22] Sample sizes are based on an assumed coefficient of variation of 0.5 and include a small population correction.

[23] In order to discern savings from normal variation in energy use for whole facility modeling including billing analysis, nominal savings need to be 15% of total use; however, in sites with highly variable energy use, nominal savings need to be 20%.

6.5.2 Site Visit Based Evaluation

<u>Summary</u>

Evaluators will conduct post-retrofit site visits and associated M&V to determine the savings realization rates associated with completed projects funded through RFPs 10 and 1613. The preliminary sample design requires M&V site visits of 125 projects.

The selection of an M&V methodology or analysis rigor for each site will be based on several factors (measure complexity, magnitude of savings, etc.). If the initial proportions of project activity continue over the implementation period, about half of the projects and savings will be due to lighting. The Team has budgeted site M&V unit costs accordingly. It is possible that the technology mixture will change as longer-developing, more complex projects matriculate in the second half of the program funding cycle. The initial plan is designed to perform the following types of on-site verification activities that would meet the evaluation goals; these may need to be adjusted based on actual site details:

- *Verification:* 100%. These sites include physical inspection and verification of the operating conditions of the systems under consideration. In addition each site will receive one of the following treatments:
    - *Verification with spot measurement:* 25%. These sites involve physical inspection of the installation with spot measurement/reading of the current operating conditions.
    - *Verification with basic rigor:* 50%. These sites will involve meeting–at a minimum–the standards of IPMVP Option A (Partially Measured Retrofit Isolation),[24] including the use of direct measurement.
    - *Verification with enhanced rigor:* 25%. These sites will largely involve using IPMVP Option B (Retrofit Isolation)[25] level analysis and/or a regression analysis.

Verification-level projects will follow a general site M&V plan that applies to multiple projects. For the basic and enhanced rigor projects, the lead engineer will develop a site-specific M&V plan using the available project data where the key variables will be identified. The appropriate level of rigor will be assigned to projects according to project size and expected uncertainty that the evaluation managers determine can most be eliminated through high-level M&V.

The balance of this section describes the one-time preparation and repeated site-specific steps needed to develop savings realization rates.

<u>Data Request</u>

The Team will deliver a memorandum to NYSERDA requesting program data. The data request typically has two stages. The first stage requests program tracking records and is used for the sample design. The requested data are the same as described for the MAR survey discussed under PON 4 in the next section, and is not repeated here. The second stage is for project-specific information associated with the sampled projects. Project-specific information includes applications, measure details, the applicants engineering analysis files in their native format (Microsoft Excel® files for example, instead of PDFs), NYSERDA and third party review documents, and contact information for key parties. Billing data are often critical

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[24] Savings are determined by field measurement of the key performance parameter(s), which define the energy use of the affected system(s) and/or the success of the project. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter and the length of the reporting period.

[25] Savings are determined by field measurement of the energy use of the affected system. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period.

and can be difficult to secure when program administrators are other than utility companies; this will be requested with the understanding of those challenges.

The Team will review the program data for missing information (such as electric and gas account numbers, contact information, and measure level information). We will assess whether to make additional data requests or use alternative information to fill the gaps or to use as a proxy for gaps, before proceeding with the development of the sample.

Develop Site Templates and Protocols

Customer recruitment and data collection will require templates to ensure evaluation quality and consistency. The Team will tailor templates developed as part of other evaluations to NYSERDA. Templates will include:

- Customer initial contact script
- Customer advance letter adapted from a NYSERDA template
- Customer baseline definition protocol
- Bill data release form, if necessary
- Site-specific M&V plan/report template that includes sections on:
  - Description of how the project saves energy.
  - Analysis methods to be used for evaluating the projected savings and a determination on whether this same method will be used in the application savings estimate.
  - Identification of the key savings calculation inputs required for analysis.
  - Evaluation protocol, including monitoring procedure and equipment to be used. If appropriate, data collection equipment redundancy will be addressed.
  - Proposed monitoring schedule.
  - Description and justification of the sampling rate of the equipment to be monitored where a number of similar items have been installed or are being controlled.

The management team and lead engineers will develop associated protocols for training project engineers who will perform data collection. NYSERDA will be given the opportunity to review the content and format of the templates for compliance with these guidelines, in addition to providing input.

Field Data Collection and Analysis Training

Lead engineers assigned to this project by the Team all have significant M&V experience prior to this work. Lead engineers for this project have a combination of in-house and outside training qualifications including PEs and CEMs. An all-firm training session will be organized to focus on the unique features of the NYSERDA ARRA impact evaluation. The training will include the following topics:

- Background: NYSERDA’s ARRA-funded SEP and EECBG programs
- Goals and evaluation scope
- Potential activity overlap with other programs
- Key contacts and method of gathering additional data through NYSERDA
- Review of tailored templates, highlighting any changes from typical
- Evaluation-specific technical requirements

- Initial site assignments
- Life cycle management: recruitment and replacement protocols, review and tracking protocols
- Step-by-step evaluation procedure
- Final delivery products
- Schedule

Site M&V Management

The Team will manage assignments to maximize efficient deployment of engineers geographically. The Team will use an in-house tracking tool to record and monitor recruitment calls and scheduling of logger deployment and pick-up, as well as to review cycles and additional tasks in an efficient manner.

Project-Specific Activities

Each evaluated project will be subject to M&V.

Document Review and Site Plan Development

The Team will assign sites to a lead engineer taking into consideration location, staff expertise, and any potential conflict of interest. Whether basic or enhanced, the lead will develop a site-specific M&V plan that identifies the information that must be confirmed or collected at each site. For less rigorous projects, the lead evaluator will use a generalized template for each type of measure. A checklist of other required information–such as building occupancy schedules and set points–will be produced. If the original project savings estimates were based on building simulation, the Team will assume that any available electronic simulation files will be provided (and that the original simulations are available). If the system is other than eQuest or another publicly familiar tool, the evaluator may elect to use a different approach. Evaluators will use actual concurrent weather data and metered power data to calibrate a simulation model. Typical, normalized weather data, such as TMY3, will be used to estimate savings.

Utility billing data will be requested and reviewed as part of M&V planning when reported savings are expected to exceed 10% of total facility energy use. Pre/post billing data can often provide powerful substantiation of impacts. Even if the custom sites are not incorporated into a formal billing analysis, billing data will be used for calibrating the site-by-site impact evaluations. Method replication tends to reduce realization rate variance compared to using wholly different methodologies. ERS, as part of the Team, will follow this approach when possible. If the application used an eQuest building simulation model to estimate savings and the project data include the eQuest INP and PD2 files, the Team will use this model as a starting point for analysis. INP and PD2 files are necessary, as they are the eQuest software input files that contain the specific configuration of the building simulated in the model. The Team expects to model most building shell and EMS measure savings using eQuest, a spreadsheet-based bin, or CLTD calculations, depending on the available data, magnitude of savings, and the *ex ante* basis.

The scope will include evaluation of savings for the primary energy type claimed (e.g., electricity or natural gas). Evaluators will also estimate the impact of measures that markedly affect energy use for a secondary energy source (one that is expected to achieve savings of at least 10% of the primary fuel site Btu savings). Each site plan drafted by the lead engineer will be reviewed and approved by a senior engineer. After approval of an evaluation site plan, the Team will contact NYSERDA to notify them of our readiness to visit the customer.

During planning, the engineer will determine if either sampling by measure (e.g., evaluating eight of 11 measures) or sampling within a measure (e.g., metering 10 out of 100 retrofitted fixtures) is necessary to meet budget constraints. The logic behind this decision will be described in the site specific M&V plans.

6.5.3 M&V for Energy Management System Improvements

EMSs are an effective tool for optimizing the energy efficiency of the HVAC systems within a building after they are installed, commissioned, and operating properly. The evaluation activities associated with the installation or upgrade of an EMS will confirm that the system has been installed and programmed correctly and that the associated equipment is operating in an efficient manner.

1. *Engineering Review* - As a first step in the evaluation, the Team will review the site's proposal and associated documentation. This will identify the specific improvements proposed and the associated energy and demand savings. Furthermore, a detailed analysis of the proposed savings calculation methodology will be performed, as well as confirmation of an accurate baseline condition assessment.
2. *Post Installation Assessment* - Once the appropriateness of the calculation methodology and confirmation of accurate baseline conditions have been established, the Team will develop a custom post-installation assessment strategy. This strategy will vary from site to site due to the varying types of HVAC equipment, EMSs, and operating sequences that may be utilized. The intent of the site-specific strategy will be to accurately document and measure the key variables within the EMS that drive proposed energy savings.
3. *Site Visits* - An important aspect in evaluating the effectiveness of an EMS is to obtain metered data from the site for both the pre- and post-installation conditions. The Team will conduct site visits and interviews with site personnel to document and confirm the EMS and HVAC system characteristics. In addition, we will utilize the EMS to the greatest extent possible in confirming the equipment schedules, run times, set points, and other pertinent operating parameters associated with the savings methodology. It is anticipated that for the baseline conditions and some post-installation instances, the EMS will not have the trending capability needed to confirm the operating parameters. In these cases, the Team will deploy short-term metering devices on the equipment and building spaces as needed.
4. *Savings Validation* - Upon completion of the proposal and savings methodology review and the site data gathering, the Team will compare the information to that submitted to NYSERDA from the participant. Any variances in operating parameters (e.g., schedules, set points, economizer operation) or building characteristics will be accounted for and the energy use, savings, and realization rates will be adjusted accordingly.

<u>M&V for Lighting</u>

Lighting M&V typically follows one of three technical tracks.

1. For fixture replacements and new construction, M&V plans will be built around time of use lighting loggers. The lead engineer will develop a sampling plan to measure the runtime of a representative number of unique circuits based on interview questions related to schedule and on the NYSERDA Sample Size Calculator Excel spreadsheet. In such plans, the fixture power will be determined from the NYSERDA Existing Facilities Lighting Form.[26] The engineer may spot measure the wattage of an individual fixture to verify the deemed power value, but this is not required.
2. For projects that include on-off lighting controls (with or without fixture replacement), the process will be the same as above with the addition of either (in order of preference): (1) measuring pre-retrofit operating hours; (2) measuring a comparable uncontrolled area post-

[26] http://www.nyserda.org/Programs/Existing_Facilities/documents/Existing%20Facilities%20Lighting%20 Form.xls

retrofit; (3) measuring energy use with controls disabled for a short period of time; (4) using a combination on-off / occupancy sensor loggers; or (5) using estimated pre-retrofit operating hours.

3. For projects that including lighting dimming controls, the Team will measure the log power and energy use of a sample of circuits using a current logger or, if there are indications of a dramatically inconsistent power factor, a real power logger.

For all options, the site visit will include verification of counts on all fixtures or on a random sample of retrofitted areas and store room inspections.

<u>M&V for Boilers and Chillers</u>

1. Generally, the Team will meter boiler gas use by proxy (if it is necessary to have such data) using EMS data, draft fan power, boiler water supply temperature, or another indicator of runtime, combined with spot measurement of combustion efficiency. For condensing boiler applications, the boiler return water temperature is a major determining factor of actual efficiency. Combustion air temperature can also be important. Condensing boiler calculations are complex when the condensate flow rate cannot be measured, a common scenario. If necessary, the Team will use the algorithms for this measure as described in NYSERDA's recently-completed gas impact evaluation report.[27]
2. For select applications, NYSERDA or the engineer may express a particular interest in combustion efficiency over time. If so, a logging combustion analyzer can be used. Likewise, if there is a particular need for direct gas sub metering where no meter already exists, it can be installed, but typically adds several thousand dollars to the overall cost. If the need for either a combustion analysis or direct gas metering is identified, evaluators will present the benefits and extra costs to NYSERDA for consideration, but such tasks are not included in the existing M&V budgets.
3. For chillers, similar condition monitoring and leveraged use of EMS data or chiller input power monitoring is typical.

<u>M&V for HVAC</u>

The HVAC improvements that facilities undertake reduces energy consumption and demand by increasing the efficiency of the equipment, and system operations can include the following examples of typical measures:

- Operating sequence modifications (e.g., scheduling, night setback, temperature reset)
- Equipment efficiency upgrades
- Installation of variable air volume systems and variable frequency drives
- Demand controlled ventilation, economizer mode

The diversity of HVAC systems and the numerous types of potential improvements make it necessary for the Team to identify the M&V methodology on a site-by-site basis, as opposed to one overall approach for all measures. This methodology identifies four categories that the projects may fall under and the recommended IPMVP methodology that will be followed. Table 21 shows the project categories and corresponding M&V protocol, and a description of the various options (A, B, C, and D) are listed on the following page.

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[27] *NYSERDA Natural Gas Program Evaluation, Measurement and Verification of Condensing Boilers,* prepared for The New York State Energy Research and Development Authority by ERS, June 2010.

Table 21. IPMVP Option Application Matrix

	Small Impact	Large Impact
Specific Measure	Option A or B	Option A, B, or C
Overall	Option A, B, or D	Option C or D

Specific Measure / Small Impact – This type of measure can be applied to a single piece of equipment or to an individual system. The impact that the changes have will not affect the total electrical consumption of the site by more than 20%. Individual measurements can easily be identified to allow for either a full or partial retrofit isolation.

Specific Measure / Large Impact – These types of projects will be of similar complexity to the small impact sites, except they will have a large impact on the overall utility usage (20% or greater of the total consumption), which can be identified through utility bill analysis. The Team may also determine that metering or spot measurements are necessary to evaluate the performance of the measures if the project type or utility data do not permit an accurate energy savings determination through billing analysis.

Overall / Small Impact – These types of measures will be more complex and affect the performance of more than one system within the facility. The savings impact on the overall utility usage will be less than 20%, which will not allow for an accurate determination of savings through billing analysis. Either a retrofit isolation method that identifies and measures the key variables driving the energy savings will be employed or, if available, the evaluation and calibration of a simulation model will be performed.

Overall / Large Impact – These measures will encompass several building systems and have a large impact on the overall energy savings of the facility (equal to or greater than 20% of the total usage). Due to the complexity of these measures and the interaction of various HVAC systems, either a whole facility approach will be used or the evaluation and calibration of an existing building simulation model will be performed.

The determining factor between the large and small impact sites is whether or not the measures have an energy savings impact of 20% or more of the site's total energy consumption. This figure was chosen to ensure that the energy savings determination can be clearly separated from any noise in the utility billing analysis. There may be instances where the energy savings are greater than 20% of the total usage, but due to other circumstances, a billing regression analysis is not the most accurate method of evaluating the project. In these cases, the other options recommended for the project's category will be utilized.

Once we identify which category the measure will be evaluated under, we will further determine which IPMVP option to employ. The following are some examples of considerations that will need to be taken into account.

- Is there trending capability at the site?
- Would spot measurements of key variables be sufficient?
- Is there an accurate simulation model available?
- Can utility data be obtained for pre and post measurements?

The methodology options refer to the following:[28]

- Option A – Partially Measured Retrofit Isolation: Savings are predicted using engineering or statistical methods that do not involve long-term measurement. This option will generally be acceptable only where other methods are not cost-effective and the savings are very predictable and reliable.
- Option B – Retrofit Isolation: Involves short-term or continuous metering during the performance period to determine energy consumption. Measurements are usually taken at the device or system level. This option is preferred because of its higher accuracy level.
- Option C – Whole Facility: Involves 1) comparing monthly billing data recorded for the whole building or project site by a utility meter or sub-meters, before and after project installation, and 2) analyzing that data to account for any variables, such as weather or occupancy levels. Energy savings can be determined once the variables are recognized and adjusted to match pre-installation conditions.
- Option D – Calibrated Simulation: Involves using software to create a simulated model of a building based on blueprints and site surveys. The model is calibrated by comparing it with billing or end-use monitoring data. Models of the project are typically constructed for 1) the existing base case, 2) a base case complying with minimum standards, and 3) a case with the energy measures installed.

<u>Site Visits</u>

The Team will begin recruiting participants for the on-site work in the course of telephone calls made during M&V plan development and will schedule the first site visit at least 48 hours in advance. The Team will keep NYSERDA informed of all scheduled site visits and will notify the appropriate individuals of all appointments at the customer site. Following review of the application material, the evaluator may contact the NYSERDA project manager to discuss the project. Additionally, each scheduled appointment will be called 48 hours before the visit to confirm the appointment.

Interviews with key facility personnel are invaluable and will occur upon arrival at the site to identify unexpected issues and modify our plans promptly and wisely. If there is an EMS, the engineer will attempt to leverage this resource and will work with the building operator to retrieve available reports of control points and schedules, as well as verify the current control strategy implementation.

All efficiency site visits are expected to require spot measurement or short-term metering in support of M&V analysis. During and after the interview, the lead analyst will:

1. Field-verify the installation of measures claimed by the participant to have been installed, including walking the site to spot-check connectivity by exercising end-use devices, such as turning fans on and off and moving dampers through their range.
2. Determine and validate project or measure-specific baselines.
3. Collect additional site data as indicators of the decision making process for that site (to be used as enhanced participant freeridership and spillover indicators).
4. Identify measures that received incentives through other NYSERDA programs. Currently, this information is intended for documentation. It may also assist NYSERDA in the final attribution of savings among the participating programs.
5. If logging is required, instrumentation will be installed and left in place for two to four weeks.

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[28] International Performance Measurement & Verification Protocol, Concepts and Options for Determining Energy and Water Savings, Volume 1, www.evo-world.org.

Project-level Analysis

Once the data has been retrieved and cleaned, site analysis can commence. Baseline conditions will be established using documentation provided in the project file, and then be refined based on site inspections and interviews. Other support information, such as fan or pump curves, may have to be acquired. The execution of the analysis will depend on the analysis approach and method described in the M&V plan and may be modified by new information or data from the site visit.

Where a site study includes a number of measures, the engineer will evaluate each measure separately followed by a final summation of all measures including interactive effects. Engineers will ensure that any modeling is conducted properly by verifying the sequence of measures.

After the site work and analysis are completed, the lead will convert the site-specific M&V plan into an M&V report that provides a concise executive summary, a narrative description of the project and methodology, and all the spreadsheets and documentation utilized through the course of the work, in accordance with reporting guidelines.

The Team will submit draft site reports to NYSERDA as each site is completed, allowing one week for response. The evaluator will review comments from all parties and address them in discussion with NYSERDA and/or in a final draft of the report. We understand that comments may be received from a variety of parties.

After final report review, we will redact customer identifiers from the site-specific M&V plan and report template in anticipation of the requirements for the final report appendices.

Aggregate Analysis

Upon site work completion, the Team will have reported and evaluated energy savings and realization rates for each evaluated project, as well as evaluated impacts on other fuel sources. In this aggregation step of the analysis, evaluators will apply case weights from the sample design to the individual results in order to determine the program-level adjusted gross impact and realization rates for each energy source (electricity, natural gas, and other), accompanied by confidence and precision estimates. The results will be calculated for each ARRA funding source and major technology (lighting, boilers, HVAC, chillers, and EMS).

Reporting and Presenting

When the data analysis is complete, the Team will prepare a draft report for review and comment by NYSERDA. The draft report will include an introduction to the program, research questions, the evaluation methodology, findings from the data collection and analysis, and conclusions and recommendations. Appendices will provide supporting information. The Team will be available to present our findings upon request from NYSERDA. Following review of the draft report, revisions will be made to address concerns where possible given the data available. Final instruments and data sets, along with the final report, will be provided to be part of NYSERDA's Data Warehouse.

6.5.4 NYS /DPS Technical Resource Manual Review

The New York Department of Public Service Technical Resource Manual (the manual) is the principal reference source for program administrators to estimate program-reported (*ex ante*) savings. The Team will use this manual's method to calculate evaluated (*ex post*) savings for measures we evaluates at a verification level of rigor - including all desk reviews - and that the manual covers. We may change the values of input variables and independently calculate savings using the manual approach if site-specific conditions warrant the change, even if the applicant or program initially used the TRM appropriately.[29]

For measures the Team evaluates at higher levels of rigor and for which a manual approach exists, we will consider the manual approach first, but may deviate and use another method to calculate *ex post* savings if it will result in more accurate estimates of the specific measure and site being studied. For all measures without a manual-described method, the Team will develop a savings calculation. If, in the course of evaluating sampled projects, the Team finds that a manual parameter or approach could be improved, we will draft a recommendation for NYSERDA to consider for delivery to the DPS that describes the basis for the recommendation and explains why a global change is needed.

6.6 NET IMPACT/ATTRIBUTION ACTIVITIES *(TASK 2b)*

To assess the net impact of the ARRA-funded activities on the adoption of energy-efficiency measures, the Team shall explore the degree to which program activities led to the installation of energy-efficiency measures that would not otherwise have occurred. The Team shall determine the amount of energy-efficiency savings that can be attributed to ARRA-funded programs. The attribution assessment involves adjusting gross energy savings by freeridership, spillover, and savings that can legitimately be claimed by other funding sources.[30]

The attribution assessment shall explore the following topics:

- How RFP 10 and RFP 1613 participants first heard about the ARRA-funded program
- Why participants in RFP 10 and RFP 1613 chose to take part in the program
- How participants decided what types of measures to adopt through the programs
- Diversion of participants from other NYSERDA or utility programs into ARRA-funded programs
- Freeridership defined in a manner that takes into account the nature of the programs and federal guidance on project selection
- Spillover to the extent that the timeline for each project allows for an assessment of additional actions taken to generate or save energy because of participation in the ARRA-funded programs

Attribution assessment is often one of the most challenging components of impact evaluations because it entails having the evaluator determine what would have happened in the absence of the program. In essence, the evaluator must measure a hypothetical —something that never actually happened. The nature of ARRA funding adds another layer of complexity to attribution analysis. The federal government provided strong directives to states receiving ARRA funds to award money to projects that were ready to move forward—shovel ready—but had difficulty securing enough financing due to the recession. This attribution assessment shall explicitly take such directives into account, adjusting the definition of freeridership to account for the degree to which ARRA funds allowed projects to continue that might have been delayed or would have had to be scaled back without ARRA funds. Furthermore,

[29] In some evaluations, the goal of verification-level site M&V is to ascertain if it is possible to achieve the reported savings. This evaluation will instead improve the estimate if there is project-specific information available that warrants the change.

[30] Saxonis (2007) defines freeridership as "*a program participant that would have, at least to some degree, taken the same action promoted by the program even if there were no program.*" He explains that spillover "*reflects benefits attributable to an energy program, but without requiring program incentives and not directly credited to the program.*" Attribution to other funding sources will involve separating savings due to the SEP and EECBG, as well as those that could be claimed by other NYSERDA and utility programs, among other potential sources.

NYSERDA must use the SEP ARRA funds (RFP 1613)—including those for evaluation—no later than March 2012 and for the EECBG (RFP 10) no later than September 2012, but many of the projects will not be complete until late in 2011 or early in 2012. This will challenge our ability to evaluate spillover for such projects, as many of the recipients or end-users will not have had the opportunity to take additional actions because of their participation in the ARRA-funded NYSERDA programs.

The Team shall gather data on attribution using an onsite survey with participants in RFP 10 and RFP 1613 to be conducted by a trained engineer at the time of the site visits described above. The surveys will be used to collect information on motivation to participate, freeridership, spillover, and other attribution-related issues. A follow-up telephone interview will be conducted by a trained interviewer with a subset of survey respondents to gain a more in-depth understanding of factors affecting attribution. ARRA and other NYSERDA program documents and databases may also be reviewed as part of the search for potential diversion of projects from existing NYSERDA programs, as well as to determine the potential for spillover from ARRA into these same NYSERDA programs. The Team shall analyze responses to various survey and interview questions as well as pertinent information identified in documents and databases.

6.6.1 Participant Survey Approach

The Team shall conduct a participant survey with 80 participants in RFP 1613 and 62 participants in RFP 10 to gather information that will be used to assess attribution, estimate freeridership and possibly spillover (depending on when projects are completed), and ultimately yield an adjustment that can be used to estimate net energy savings. Most (125) of these participants will be surveyed during the site visit, but the 17 who will not have a site visit—including the projects funding energy management personnel and materials conservation in RFP 10—will be surveyed by a trained interviewers over the phone. This sample size achieves 90% confidence and 10% precision, assuming a 50% break in responses.[31] Table 22 summarizes the survey sample design by funding source and delivery mode.

Table 22. Surveys and Interviews by Survey Method and Funding Source

Funding Source	Participant Survey
RFP 1613 SEP excluding transportation	80
RFP 10 EECBG excluding transportation	62
Total	**142**

To appreciate our choice of onsite surveys for this evaluation, it is first useful to understand certain aspects of telephone surveys, another common survey method.[32] Telephone surveys work best when all respondents are at a similar stage in the participation process; this is because a survey firm must program the survey, train the staff, and set aside an appropriate block of hours to complete the calls. If the survey firm must stretch out the calls over the course of months, it will have to retrain workers and block a greater number of hours for the calls, thereby increasing consistency and survey costs. In contrast, an onsite survey can be fielded over a longer period of time without greatly increasing costs. This characteristic of onsite surveys is very useful to the evaluation of the RFP 1613 and RFP 10. Participants

[31] The use of 50% break in responses is a conservative assumption that necessitates larger sample sizes. It assumes that 50% of respondents will answer “yes” to the key question under consideration (e.g., whether the program caused the impacts) and that 50% will answer “no” to the same question.

[32] A fourth type, the mail survey, is not appropriate for the types of questions the Team will ask.

in these two programs received notice of awards and signed contracts at different times over the past year; therefore, their implementation schedules will also differ, which affects their ability to answer attribution-related questions reliably. We will survey the 17 participants who will not have a site visit via a brief telephone call using the site visit questionnaire and fielded at a time that coincides with the projects' implementation schedules. By using a survey approach that can be fielded over time easily and cost effectively, the Team can target the timing of the survey to the individual schedule of each participant.

The survey questionnaire shall build from attribution protocols vetted by the Team in previous evaluations of energy-efficiency programs, including those conducted for NYSERDA SBC/EEPS programs. The Team shall ensure that these questionnaires and protocols adhere to the DOE's SEP and EECBG protocols, as well as to those of the New York Public Service Commission's Evaluation Advisory Group guidelines and relevant technical reference manuals. The Team shall develop a draft questionnaire and submit it for comment and review by NYSERDA. The Team shall revise and finalize the questionnaire. Although the exact wording may differ in the draft and final versions of the questionnaire, potential survey questions include, but are not limited to, the following:

- *Marketing and Motivation.*. How did you hear about the funding opportunity? Why did you decide to apply for funding through NYSERDA ARRA?
- *Alternative and Additional Funding.* Did you fund this project solely with the NYSERDA ARRA funds, or did you leverage NYSERDA ARRA funds with those from other sources? If so, what were the other sources of funding for the project? What percentage of the project did ARRA fund? If you did not leverage alternative funding with NYSERDA, what happened to the funds? Did you use the other funds for another project, decline them, or did something else happen? Did other funding for the project require that you leverage resources? Did such requirements influence your decision to apply for NYSERDA ARRA funds?
- *Economy.* Did you have funding secured for the project before applying for NYSERDA ARRA funds? Did any of the project's funding fail to materialize because of the recession?
- *Freeridership.* To the best of your knowledge, would your project have been completed without NYSERDA ARRA funds? Would it have occurred on the same timeline? Why or why not? Did NYSERDA ARRA funding allow you—or require you—to change your plans in any way (e.g., increasing the efficiency level or expand the scope of the project)? If so, how and why?
- *Spillover.* What other actions, if any, have you taken to save energy or generate more capacity as a result of your participation in this NYSERDA ARRA program?

6.6.2 Follow-up Telephone Interviews

The Team expects that determining attribution, freeridership, and spillover for some onsite survey respondents may require follow-up telephone interviews. These interviews shall be conducted by staff members at NMR who are part of the Team. We plan to conduct 25 interviews, or 20% of the total sample. Fifteen interviews would likely come from RFP 1613 and ten interviews from RPF 10. The Team shall *not* interview *every* case for whom determining attribution may be challenging—the budget does not allow for this in-depth examination—but shall instead target the largest projects (because of their likely greater contribution to overall savings), as well as any projects that may be representative of other participants in the program in terms of the types of measures included and the questions that remain regarding attribution.

The nature of the telephone interview questions shall be similar to that described in Section 6.6.1, but the interviewers shall probe in more depth on what drove the decision to participate and the importance of the NYSERDA ARRA funds to the project completion, including asking additional questions related to issues of scope and when the project might have been completed without the ARRA funds. Because follow-up interviews will come later in the evaluation period, they may also allow for in-depth questioning on spillover, which will be difficult to capture in the online surveys because participants will likely not yet have had the opportunity to take additional energy saving actions (or adopt additional renewable energy measures).

6.6.3 Installer and Vendor Interviews

During the M&V interviews with installers and vendors, we will also ask a few questions designed to assess attribution. In this program, it is the judgment of the Team that the municipalities and other institutional sites took the lead in deciding to participate and what to install. Therefore, the installer or vendor likely has limited information that would help us assess attribution. Nevertheless, we anticipate that the availability of the ARRA funding will have influenced the vendors' actions in some way. We shall explore whether the project grew in size due to funding (e.g. full re-lamping versus spot re-lamping), and whether the installer/vendor used the RFP funding as part of their sales and marketing efforts.

6.6.4 Estimating Net Impacts

Together, the surveys and interviews shall allow the Team to ascertain whether participants can be classified as freeriders or spillover, with further distinctions between full and partial freeriders and within and outside of project spillover. Ultimately, the Team will develop a net-to-gross ratio that will be applied to gross savings estimates of energy, carbon, and jobs, yielding an estimate of net savings. Prior to fielding the surveys responses, the Team shall develop attribution algorithms for each funding stream and technology. The algorithms shall be sensitive to the program designs and directives from the DOE on the types of projects to fund and the energy-efficiency technologies implemented through the program. For example, a municipality may have intended to upgrade the building envelope in all of its municipally owned buildings, but expected funding did not materialize due to the recession. NYSERDA ARRA-funding, however, allowed the project to move forward in 2010 instead of waiting until funding became available. At the most, such a project could be classified as a partial freerider—and, depending on the guidelines set by the DOE for project selection, such as being shovel ready but lacking funds or having the ability to leverage resources, this project may not be considered a freerider at all. The Team shall present these algorithms when delivering draft survey questionnaires and interview guides to allow NYSERDA staff to comment on them. The algorithms will be revised together with related survey questions on attribution.

After fielding the surveys, Cadmus shall develop a weighting scheme to adjust for disproportionate stratification in the sample design and analyze the data according to the attribution algorithms. This analysis will result in the estimated net-to-gross ratio described above. The final estimates of freeridership, spillover, net-to-gross ratio, net savings, and supporting information will be presented in the final report, to be delivered in 2012.

7.1 PROGRAM DESCRIPTION

PON 4 is a funding mechanism by which New York municipal governments, public K-12 schools, public universities or colleges (including SUNY, SUNY community colleges, CUNY, and CUNY community colleges), hospitals, and not-for-profits (defined as 501(c)(3)) can apply for Energy Conservation Studies. The intent is that studies will lead to subsequent applications for ARRA-funded installations through RFPs 10 or 1613 or other NYSERDA programs, and that the studies will be used to supply required technical information to document energy savings and costs of proposed projects.

RFP 10 and RFP 1613 applicants are not required to complete PON 4 studies and PON 4 study applicants are not required to install measures to receive cost-share funding. Eligible applicants can apply for funding for multiple studies; however, regardless of the numbers of studies received, each eligible applicant under PON 4 will receive funding not to exceed the least of $30,000, 100% of the study cost(s), or 25% of the site energy costs.

This action plan includes evaluation of PON 4 Energy Conservation Study ARRA Assistance for institutions, as most study recommendations address building energy efficiency. To the extent that the studies also recommend renewable energy and transportation measures, the same evaluation plan will apply. In some cases, the term “energy audit” is used as a synonym for “energy conservation study.”

7.1.1 Program Logic Model

The program theory of the Energy Conservation Studies funded by PON 4 involves providing funding for municipalities, schools, hospitals, public colleges and universities, and nonprofits to have Energy Conservation Studies completed. This will provide funding for jobs, as well as encourage applicants of the SEP and EECBG ARRA funds to have more developed projects that are more technically feasible and cost effective. The expenditure of grant funds will support jobs when grant recipients hire third party contractors to complete the Energy Conservation Studies (see Figure 6). Better projects will eventually lead to higher energy savings for other ARRA-funded programs.

7.2 RESEARCHABLE ISSUES AND PRIORITIZATION

Table 23 indicates key researchable issues for the evaluation and the corresponding priority of each. The issues include the implementation rate associated with conservation studies and with crossover to other NYSERDA programs.

Figure 6. Energy Conservation Program Logic Model

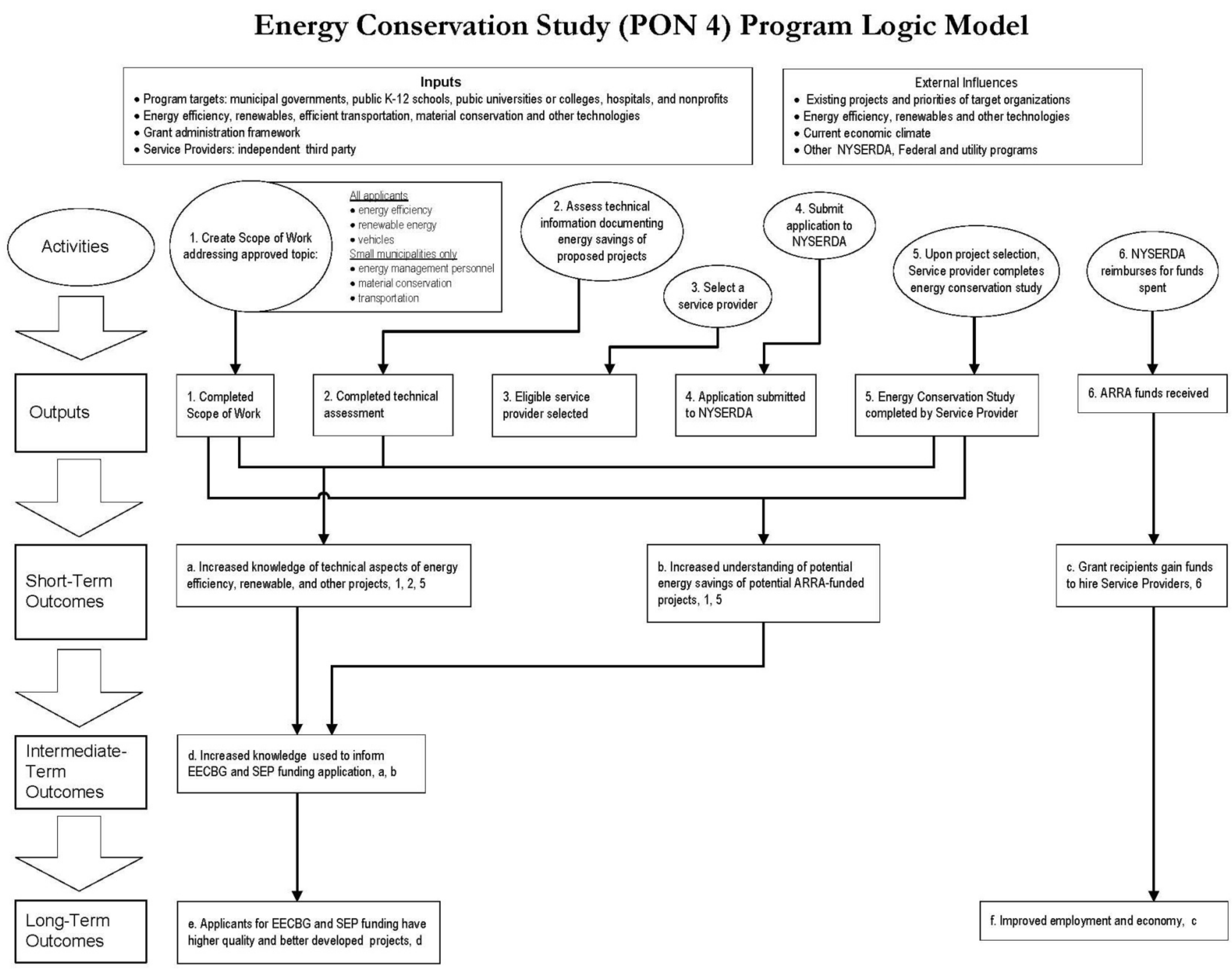


Table 23. Program Researchable Issues and Prioritization (PON 4)

Researchable Question	Discussion	Activity to Support Question	Initial Prioritization
GROSS ENERGY IMPACTS			
Which of the recommended measures have been installed so far, and when?	Start as late as possible to allow time for implementation.	Telephone interviews	Low
Which measures not yet implemented are expected to be installed, and when will they be scheduled?	Speculative responses will have debatable value.	Telephone interviews	Low
What percentage of the predicted savings is being realized for installed measures?		Secondary research of other NYSERDA programs	Low
NET ENERGY IMPACTS (ATTRIBUTION)			
To what degree did the ARRA-funded programs bring about energy savings that would not have happened absent the program?	Participants may have had firm plans (e.g., completed the feasibility study and/or secured funding) to install measures covered in the plan prior to the program.	Surveys	Medium
Have participants installed or taken other actions to save energy because of their participation in an ARRA-funded program?	While such spillover may occur, the length of time it will take many projects to be completed may not allow for a full assessment of spillover in this evaluation.	Surveys/Interviews	Medium
COST-EFFECTIVENESS			
Does the Program pass the cost-effectiveness tests?	Understand program costs and benefits.	• SEP-RecTest • Total Resource Test • Program Admin Test • Societal Test	High
ECONOMIC IMPACTS			
How many jobs were created by the Program?	Understand the economic impact of the Program.	• Apply DOE job estimation method • Perform REMI analysis	High
EMISSIONS IMPACTS			
What emissions impacts are attributable to NYSERDA's ARRA-funded programs?	More in depth analysis and collaboration with task and program managers will be required to determine avoided emissions attributable specifically to the NYSERDA ARRA-funded programs.	Analysis of emissions data and energy savings.	High

7.3 SUMMARY OF DATA COLLECTION ACTIVITIES

Table 24 provides an overview of proposed data collection activities. Because the primary activity under PON 4 is energy conservation studies, evaluation activities center on the outcomes of the studies, that is, the frequency with which the studies resulted in implemented energy-efficiency projects.

Table 24. Data Collection Activities

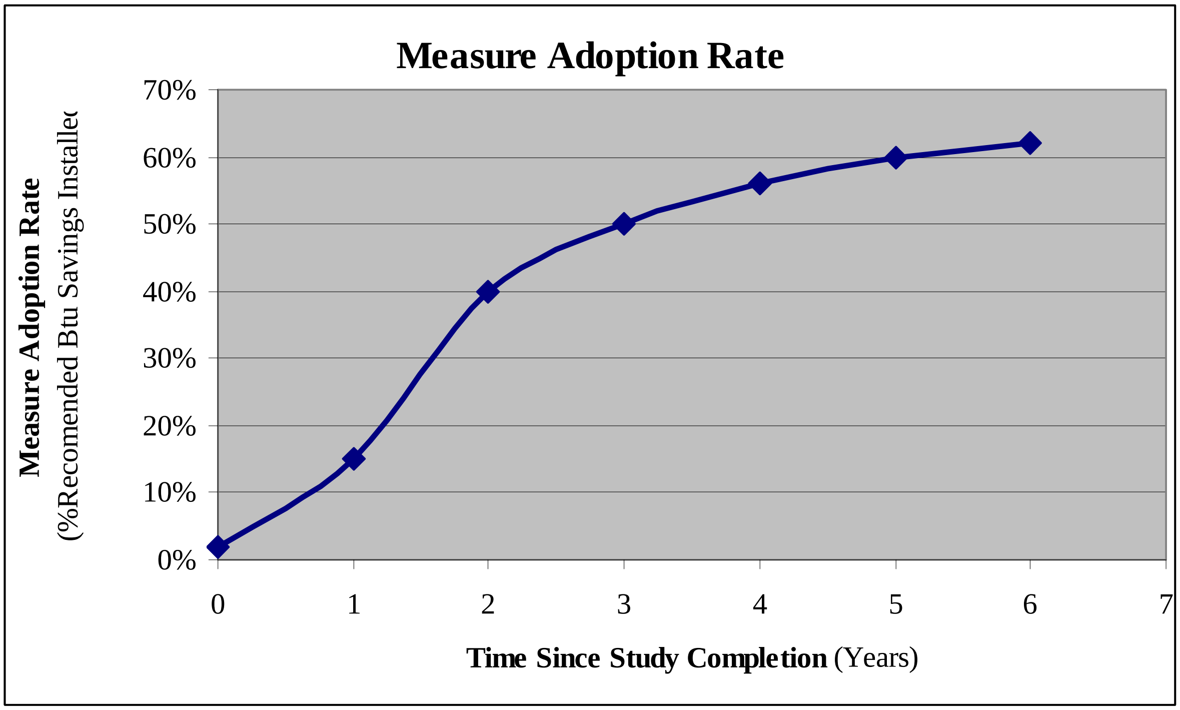
Activity	Purpose	2010	2011
NYSERDA Staff Interviews	Learn program operation and collect and understand tracking data.	✓	✓
Document/File Review	Prepare for measure adoption rate telephone calls and check for participation in other NYSERDA programs by ARRA study recipients.		✓
Telephone Survey	Interview PON4 Energy Study recipients to determine realization rates and attribution and to fully assess overlap		✓

7.4 GROSS IMPACT EVALUATION ACTIVITIES *(TASK 2a)*

7.4.1 Modeling Approach

The single biggest uncertainty to resolve in estimating the energy savings of a program that provides energy conservation studies is the percentage of recommended savings that are implemented. Measure adoption rate (MAR) quantifies the percent of savings recommended through an energy conservation study that is implemented. This value is time-dependent, first gradually increasing and eventually stabilizing, as illustrated in Figure 7.

Figure 7. Measure Adoption Rate (numbers are illustrative, not actual)



This study focuses on measuring the percentage of recommended savings that are implemented with original data collection, projecting its long-term value from that effort. Evaluators will conduct a telephone survey to determine the percent of savings from measures recommended in implemented studies funded by NYSERDA PON 4. Evaluators also will track anticipated near-term future adoption, and will determine which of the implemented measures received NYSERDA, utility, federal, or other funding assistance. The preliminary sample design requires completing telephone interviews for a sample of 56 projects, which achieves 90/10 assuming a 50% break in responses based on a simple random sample of the 218 projects funded and applying a finite population correction factor.

The evaluation will build on methods and tools used by NYSERDA's SBC/EEPS impact evaluation team in the just-completed Measure Adoption Rate (MAR) study of the FlexTech program.[33] The most notable difference between that evaluation and this one is that this PON 4 evaluation will be limited to collecting data on recently completed projects. The SBC/EEPS impact evaluation of FlexTech generally occurred one to two years after the completion of studies to allow ample time for implementation. In contrast, the timeline for this evaluation necessitates that the Team conduct evaluation activities within a year of when some studies were completed. Evaluators will need to project long-term adoption rates with less primary data because fewer studies will likely have been converted to completed projects. This may affect the reliability of the results and will certainly lead to wider confidence intervals around estimates of gross and net savings. This is addressed in more detail below.

The Team will use secondary data to estimate the savings realization rate (SRR) for the ARRA conservation study projects.

[33] Portions of this section of the ARRA evaluation plan reflect the scope of work described in the *NYSERDA Flexible Technical Assistance Program Evaluation, Measurement, and Verification Plan*, July 16, 2009.

Telephone interviews will be conducted to collect data necessary to estimate freeridership (FR), spillover (SO), and the overlap factor (OF) associated with other programs, especially other ARRA programs–see the net impact formula below.

$$\text{Net impact} = \text{Reported Impact} * \text{MAR} * \text{SRR} * (1 - \text{FR} + \text{SO}) * (1 - \text{OF})$$

7.4.2 Telephone Survey

The survey effort begins with the data request, which is discussed in Section 14: and then focuses on questionnaire development.

Instrument Design

The Team will use the questionnaire template used by NYSERDA's SBC/EEPS impact evaluation team, and enhance it to focus on the concerns of this evaluation, including:

- Transportation
- Renewables
- Participation overlap across NYSERDA and other programs, to the extent this line of questioning is not replicating the attribution battery
- More emphasis on future actions predicted to occur in the event that the survey is not replicated over time.[34]

This plan assumes preparation of one draft and two revised versions of the questionnaire. The Team will also draft an advance letter to precede the calls based on versions NYSERDA has used in the past.

Telephone Survey Training

Each interviewer will receive two hours of formal training and two hours of practice telephone calls prior to making their first customer call. The training will include evaluation discussion (such as goals), technical training (such as how to define an implemented project), and interview training (such as how to ask a question without biasing the respondent). NYSERDA is invited to attend the training by conference call or in person at our Massachusetts office.

Project-Specific Activities

ERS will use an in-house tracking tool to record and monitor calls and to report on their progress. For each project, NYSERDA will mail the advance letters and the interviewer will:

1. Review the study report
2. Identify the best contacts
3. Call NYSERDA in advance for preparation, if necessary
4. Prepare for within-project measure sampling, if necessary, to keep the total interview time to between 20 and 30 minutes
5. Conduct the interview
6. Complete data entry in the in-house tracking tool
7. Perform QC of entered data

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[34] If the findings of this survey indicate that the adoption rate curve differs from that of the SBC curve, and also finds that there is significant implementation activity completed in response to the study (and that activity does not receive incentive funding through other programs), then it will be worthwhile to repeat the study at a later date.

Secondary Research on Realization Rates of Implemented Measures

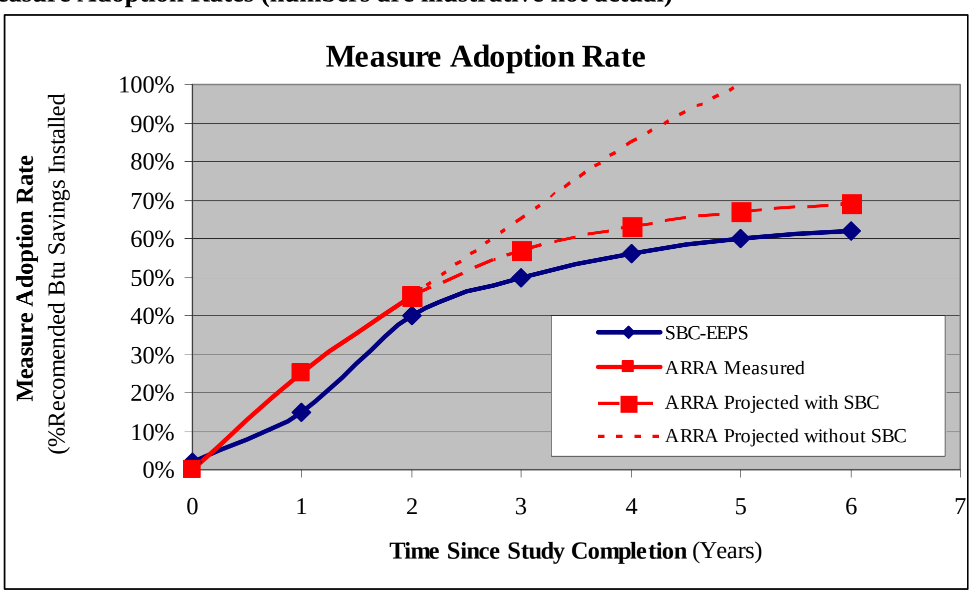
The Team configured the evaluation schedule to leave as much time as possible for study recipients to implement measures before interviewers call them asking which measures they have implemented. The PON 4 evaluation personnel will not have time to perform PON 4-specific M&V and the budget does not fund site-specific M&V. The program is designed to funnel study recipients to ARRA-funded installation support programs. In addition, the evaluation is being conducted so soon after the study completions that we anticipate that a material percentage of the projects will still be in progress at the time of our calls. Some projects may either not have completed commissioning/shakedown or may not have had enough time to accumulate post-retrofit performance data. For these reasons, evaluators plan on using SRRs from those programs to estimate the realization rates for measures implemented.

PON 4 studies are likely to identify a number of measures that were implemented without subsequent ARRA funding. For those measures, the Team will assign SRRs based on secondary research, which may be other ARRA-funded realization rates (RR), NYSERDA Existing Facilities RRs, TA RRs from the SBC impact evaluation, or other sources. The exact basis will be determined after evaluators have the opportunity to consider the characteristics of the implemented measures.

Aggregate Analysis

The two primary results of the study will be an estimated adoption rate and an estimated program overlap factor. The adoption rate increases over time until reaching a plateau. Even though evaluators will delay data collection to the end of the evaluation reporting timing requirements, the measured adoption rate will reflect behavior that is relatively early in the project development cycle. One product of the FlexTech research is the update to a 2004 adoption rate curve that projects the MAR over time. As part of this ARRA analysis, the Team will compare the PON 4 adoption rates at the same points in time as the FlexTech study, and will use the shape of the FlexTech curve in combination with the predictive responses of this study to project the long-term adoption rate of the PON 4 studies. Figure 8 illustrates how the SBC/EEPS research will be used to inform the ARRA extrapolation, and how erroneous conclusions could be made lacking such information. Without the blue SBC-EEPS curve providing guidance, a simple extrapolation of the solid red ARRA Measured adoption rate curve would result in the upper dotted curve shown in Figure 8. With the blue curve informing the projection, the Team will develop the more likely lower red dashed line (ARRA Projected with SBC).

Figure 8. Measure Adoption Rates (numbers are illustrative not actual)



The Team will use survey responses to determine which installed measures received funding from non-NYSERDA programs. We will also use the responses as one of two sources of information for estimating inter-NYSERDA cross-program participation. Analysts will request that NYSERDA extract and provide a tracking database of participants in NYSERDA ARRA and other incentive programs, including any cross-program notes. This will be the second source of information for estimating cross-program participation. All projects will be checked for overlap as part of survey call preparation.

As part of the aggregate analysis, we will calculate the coefficient of variation for the adjusted gross realization rate (MAR * SRR) and report on the confidence and precision of the adjusted gross savings estimates at the program level.

7.5 REPORTING AND PRESENTATION

When the data analysis is complete, the Team will prepare a draft report for review and comment by NYSERDA. The draft report will include an introduction to the Program, the research questions asked, the evaluation methodology, findings from the data collection and analysis, and conclusions and recommendations. Appendices will provide supporting information. The Team will be available to prepare a presentation upon request from NYSERDA. Following review of the draft report, it will be revised to address concerns where possible given the data available. Final instruments and data sets, along with the final report, will be provided to be part of NYSERDA's Data Warehouse.

7.6 NET IMPACT/ATTRIBUTION ACTIVITIES *(TASK 2b)*

As mentioned above, the Team shall conduct a telephone survey of 56 PON 4 participants to determine whether they have adopted measures and to gather attribution-related information such as freeridership (FR), spillover (SO), and the overlap factor (OF).[35] The results of this assessment will serve as inputs in the following equation:

$$\text{Net impact} = \text{Reported Impact} * \text{MAR} * \text{SRR} * (1 - \text{FR} + \text{SO}) * (1 - \text{OF})$$

Surveys shall be conducted with PON 4 participants in 2011 to allow for more projects to be implemented. The surveys will be supplemented with a document and database review in order for the Team to determine if the participants implemented the measures through another NYSERA ARRA or SBC/EEPS program. This information will factor into our estimate of overlap. The document and database review shall be ongoing, with a final review late in 2011 to search for potential spillover.

7.6.1 Telephone Surveys

The Team shall conduct computer assisted telephone surveys (CATI) with 56 of the 218 participants who had an energy conservation study completed through PON 4. The Team shall identify the individuals most responsible for deciding to conduct an energy conservation study through the ARRA-funded programs and for deciding whether to implement the project.[36] As was described in more detail above, the Team will use the questionnaire template employed by NYSERDA's SBC/EEPS impact evaluation team and enhance it to reflect the circumstances of the NYSERDA ARRA funding and program design.

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[35] The in-depth nature of the questioning needed for PON 4 is not conducive to an online survey, so the Team shall rely on telephone surveys.

[36] A preferred approach would be to interview multiple decision makers and triangulate their results, similar to the enhanced net-to-gross approach used to evaluate SBC/EEPS programs. However, the budget does not allow interviewing multiple decision makers and conducting the additional analysis necessary to arrive at a triangulated estimate of attribution.

Although the exact wording may differ in the draft and final versions of the questionnaire, potential survey questions include, but are not limited to, the following:

- *Marketing and Motivation.* How did you find out about and why did you decide to apply for energy conservation study funding through NYSERDA ARRA?
- *Implementation.* Have you implemented any of the measures addressed in the energy conservation studies? If so, which measures? How did you fund the installed measure (through NYSERDA ARRA RFPs 10/1613, other NYSERDA programs, utility programs, capital budget, or another source)?
- *Implementation Plans:* If you have not implemented measures, do you plan to? Which measures? When will implementation occur? Have you already secured funding for the measure? From where/whom did you secure funding? If no funding has been secured, how do you expect to fund the measure implementation? If applicable, why have you decided not to implement any or all of the measures?
- *Economy:* For measures already implemented, did you have funding secured for the project before applying for NYSERDA ARRA funds? Did any of the project funding fall through because of tightening credit or other economic conditions related to the recession?
- *Freeridership:* To the best of your knowledge, would your project have been completed without the NYSERDA ARRA energy conservation study funding? Would the implementation have occurred on the same timeline? Why or why not? Would the scope of the project have been the same without ARRA funding? Why or why not? Did the NYSERDA ARRA-funded conservation study lead you to change your measure adoption plans in any way? If so, how?
- *Spillover:* What other actions, if any, have you taken to save energy or generate more electricity capacity as a result of installing the measure(s) addressed in the energy conservation study?

The requirement to sample at 90/10 means that the sample size will be too large for the Team to conduct in-depth interviews with PON 4 participants, so the Team shall instead use a CATI survey. However, it is likely that the circumstances underlying their decision to take part in the program and the scope of the study will vary from case to case. For this reason, the Team shall train interviewers to probe on key open-ended questions that provide a qualitative understanding of factors affecting net impacts. Together, the open and close-ended questions shall allow the Team to ascertain whether participants can be classified as freeriders or spillover, with further distinctions between full and partial freeriders and within and outside of project spillover. For example, a school district may have intended to upgrade the lighting in the elementary schools with a grant, but the grant required that they first conduct an energy conservation study. The district may not have been able to pay for the study on its own, but the NYSERDA ARRA-funding allowed the study to take place in 2010 and the implementation of the lighting project to move forward in 2011, instead of having to wait for the economy to turn around and funding for the study to become available. At most, such a project could be classified as a partial freerider—and, depending on the guidelines set by the DOE for project selection—this project may not be considered a freerider at all.

7.6.2 Estimating Net Impacts

The surveys shall allow the Team to ascertain not only the actual and intended MAR, but also whether participants who adopted measures or plan to do so can be classified as freeriders or spillover, with further distinctions between full and partial freeriders and within and outside of project spillover. Prior to fielding the surveys responses, the Team shall develop attribution algorithms for four different groups of respondents:

1. Respondents who intended to install the measure(s) at some point regardless of the NYSERDA programs
2. Respondents who intended to install the measure(s) no later than December 31, 2012
3. Respondents who secured funding to install the measure(s) (through grants, capital improvements budgets, etc.) no matter when the installation date took place
4. Respondents who had already installed the measure(s) at the time of the survey

The algorithms shall be sensitive to the program designs and directives from the DOE on the types of projects to fund as well as on the various technologies addressed in the study.[37] The Team shall present these algorithms when delivering draft telephone surveys to allow NYSERDA staff to comment on them. The algorithms shall be revised together with related survey questions on attribution.

Ultimately, the Team shall develop four different methods of estimating net savings based on the four respondent categories presented above. In assessing the estimated net savings from this effort, it will be important to keep in mind that many people never act on an intention to implement a measure. In the sectors covered by the ARRA conservation studies, budget and politics may be the two most important factors limiting actual implementation among those who intend to do so. Therefore, the validity of the results will likely be higher for the third and fourth groups, even though it is likely that the numerical net savings estimates will be lower.[38]

After fielding the surveys, Cadmus shall analyze the data according to the attribution algorithms.[39] This analysis will result in the estimated net savings as described above. The final estimates of measure adoption rates, freeridership, spillover, net-to-gross ratio, overlap factors, net savings, and supporting information will be presented in the final report, to be delivered in 2012.

[37] The Team shall not develop separate net savings estimates by technology, but the survey questions will differ somewhat for studies covering lighting vs. renewables, vs. transportation, for example.

[38] Note that this refers to actual achieved net savings, not to freeridership, spillover, net-to-gross ratios, or overlap factors that may or may not differ between the four groups.

[39] The use of a simple random sample will not necessitate a weighting scheme. However, the Team will extrapolate the savings in a manner described in Section 7.4.1: Modeling Approach.

Section 8: **ECONOMIC IMPACT EVALUATION ACTIVITIES *(TASK 2d)***

This task will estimate net job creation and other economic effects attributable to the NYSERDA ARRA programs discussed in this action plan. These evaluation results encompass a broad range of impacts (direct, indirect, and induced). This approach will exceed what has been reported by ARRA recipients, which only include direct FTE jobs.

8.1 MODELING APPROACH

In order to maintain consistency with NYSERDA/NY State Economic Development Council and the nation-wide ARRA evaluation, the Team will use a model developed by Regional Economic Models, Inc. (REMI), called PI^+, to perform dynamic input-output analysis based on program spending.

Table 25 lists the various considerations the Team will use to determine the direction and scope of the economic impact analysis, as well as our current recommendations.

Table 25. Economic Modeling Details

Item	Modeling Details
Model	REMI PI^+ v1.1: NY State with 70 sectors
Baseline	No ARRA programs
Spending	ARRA funds plus leveraged funds categorized according to applicable sector
Program Years	Start of program throughout measure life
Energy Savings	Convert to dollar amount
Net-to-Gross	Will be considered
Energy Prices	Acknowledged, will be assumed to keep up with inflation or allow auto-adjustments from the model
Decoupling	Acknowledged, will likely ignore
Cap & Trade	Acknowledged, will likely ignore

8.1.1 Activity 1: Map Program Spending to Appropriate Industry Sectors and Review Assumptions

The Team will begin our analysis by confirming final assumptions with NYSERDA and checking them against the national evaluation approach. Then, we will create a Microsoft Excel® template for each program that lists program activities and maps program spending to the appropriate industry sectors[40] in the REMI model. This template will be sent to NYSERDA for review and approval. Prior to actual data from the evaluation being available, we will model each program using inputs derived from program assumptions to assess the results and modify the template as necessary.

[40] The model is sensitive to the amount and sector to which spending is allocated. There may be situations where inputs such as incremental costs and benefits of program activities are not well defined or unavailable, resulting in greater uncertainty in the outputs. We will analyze these situations using our best judgment and any additional guidance from NYSERDA,

8.1.2 Activity 2: Perform Macroeconomic Modeling

Once the results of our evaluation are available, the Team will update the template and run the REMI model. We will review outputs, and re-run the model for varying scenarios. We will perform analysis on the program, funding stream, and portfolio levels for the whole state of New York. Outputs of this activity include cumulative and annual:

- Jobs (in FTE job years)
- Gross State Product
- Income
- State Revenue
- Direct, indirect, and induced effects presented by occupation/industry

The carbon emissions impact evaluation is an over-arching deliverable applicable to the study as a whole. The methodology presented in this section will be used for all of the ARRA-funded programs discussed in this report. Our goals when evaluating carbon emission impacts are to:

- Document differences between NYSERDA and DOE carbon emission calculation methodologies and recommend modifications, if any, to the NYSERDA methodology in order to meet the ARRA carbon emission reporting requirements,
- Calculate avoided carbon emissions from each of the ARRA-funded programs, and
- Report those avoided carbon emissions in the final report of all ARRA-funded programs.

Three activities will be undertaken to achieve these goals:

1. *NYSERDA/DOE carbon emission methodology comparisons.* The Team will prepare and submit a technical memorandum to NYSERDA summarizing any differences between the NYSERDA and ARRA-approved DOE calculation methodologies. This memorandum will also provide recommended modifications to NYSERDA's carbon emission calculations methodologies to ensure that they align with DOE's carbon methodology. In the event that the ARRA-approved methodology is not detailed enough to provide a robust comparison, the Team will compare the NYSERDA methodology to an industry standard, such as the World Resources Institute (WRI) protocol, or other applicable best practice standard based on discussions with NYSERDA.[41]
2. *Avoided carbon emission calculations.* The Team will prepare and submit another technical memorandum that summarizes program associated avoided carbon emissions and the calculations used to develop them. The memo will present key information in data tables.
3. *Final avoided carbon emission reporting.* The Team will prepare a final report with overall avoided carbon emissions for the entire program period.

9.1 ACTIVITES

9.1.1 Activity 1: NYSERDA/DOE Calculation Methodology Comparison

- Review ARRA avoided carbon emission reporting requirements.
- Obtain and review NYSERDA methodologies.
- Specifically identify and document differences between the NYSERDA methodology of calculating carbon emissions and the industry standard (DOE or another mutually agreeable protocol).
- Document the extent to which NYSERDA methodologies are aligned with the selected industry standard.
- Develop recommendations for NYSERDA in their approach to calculating carbon emissions, and discuss these recommendations with NYSERDA staff.
- With NYSERDA guidance, incorporate/implement the recommendations into an evaluation methodology that aligns best with ARRA-approved guidelines.
- Provide a technical memorandum summarizing the comparison and recommendations for NYSERDA.

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[41] *The GHG Protocol for Project Accounting* (World Resources Institute and World Business Council for Sustainable Development, 2005).

9.1.2 Activity 2: Avoided Carbon Emissions

- Obtain Emissions Factors (EF) from NYSERDA. These EFs represent the amount of carbon emitted per unit of energy generated (e.g., at power plants, or at other distributed generation sources). The amount of carbon emissions being avoided (displaced) will be calculated by multiplying the energy savings by the EFs to determine the quantity of emissions that did not occur, and thus are associated with, the program.
- Compare NYSERDA's EF calculation methodology to an industry standard.
- Identify any differences in EF calculation methodologies and discuss with NYSERDA as needed.
- Calculate avoided emissions using agreed-upon methodology and EFs.
- Report emissions in technical memorandum and data charts.

9.1.3 Activity 3: Reporting

- Prepare templates for review by NYSERDA.
- Incorporate input from NYSERDA into templates.
- Provide interim memos and a final report.

9.2 APPROACH

The Team will use the updated methodology (which is to be outlined in the technical memorandum we produce as a result of Activity 1) to guide our calculation of avoided emissions. The main inputs to the calculations are as follows:

- *Fuel savings – by program*. The carbon task lead will work with other task leads to obtain fuel saving amounts realized by each program. The Team will consider net fuel savings in calculating avoided carbon emissions. These savings may also include the following:
    - Electric DSM technologies that avoid electricity consumption, which may include refrigerators, light bulbs, and washing machines, among others.
    - Gas DSM technologies that avoid natural gas consumption, which may include water heaters, clothes dryers, and ovens, among others.
    - Solar PV and wind turbines, providing avoided (displaced) electric generating plant emissions associated with program energy impacts (defined by WRI as "*combustion emissions from generating grid-connected electricity*").
    - Solar thermal and biomass, providing reduced use of natural gas at the customer site (defined by WRI as "*combustion emission from generating energy or off-grid electricity*").[42]
- *Emission Factors*. The Team will work with NYSERDA to ensure that appropriate EFs are used to calculate the avoided carbon emissions from each program. To the extent that NYSERDA has additional EFs available, the Team may consider additional ways to represent the data.

[42] Based on recent studies (e.g., Manomet, 2010), the carbon benefits of biomass projects may be substantially lower than manufacturers and biomass proponents would suggest; in some cases, even on par with, or worse than conventional fossil fuels such as coal or natural gas. Based on this, Cadmus recommends that EFs for biomass projects be carefully evaluated before being applied to the overall avoided emission calculations for that program in order to avoid overstating the potential climate mitigation benefits of these technologies. This information will be critical to the consideration of possible future programs to support biomass technologies.

NYSERDA must demonstrate the cost-effectiveness of its ARRA-funded programs to the DOE. For this evaluation, the Team will evaluate the cost-effectiveness of all evaluated programs.

Cost-effectiveness will be determined in accordance with commonly accepted cost-effectiveness procedures,[43] State of New York Public Utility Commission guidelines, and DOE requirements. We will begin our assessment of cost-effectiveness with a valuation of each conservation measure's net benefits and total incremental installed costs. The Team will employ multiple perspectives in our approach to the assessment of cost-effectiveness in order to satisfy reporting requirements and to reflect the various benefits and costs of NYSERDA's portfolio of ARRA-funded activities. For each perspective, a measure, program, or portfolio will be deemed cost-effective if its net benefits are positive. Table 26 outlines the test perspectives that will be calculated and their corresponding benefits and costs.

Table 26. Description of Cost-Effectiveness Tests

Test	Description
SEP Recovery Act Test	This test, which is a reporting requirement of the DOE, measures the avoided source BTUs against each $1,000 of total investment.
Total Resource Cost Test	This test examines the benefits and costs from a total resource perspective. It measures the total costs and benefits in the territory served. Benefits are avoided energy and capacity costs, adjusted for line losses. Costs include any administration or implementation costs associated with funding the program as well as any costs incurred by ratepayers and program participants.
Program Administrator Cost Test	This test examines the program benefits and costs from NYSERDA's perspective. Benefits are avoided energy and capacity costs, adjusted for line losses. Costs include any administration, implementation, or incentive costs associated with funding the program.
Societal Cost Test	This test measures the total program costs and benefits to society. Benefits are avoided energy and capacity costs, adjusted for line losses, and any additional quantifiable benefits. Costs include any administration or implementation costs associated with funding the program, as well as any costs incurred by program participants. Two variations of this test will be calculated: one that accounts for quantifiable avoidable carbon emission benefits, and one that includes both avoided carbon emission and macroeconomic benefits.

Table 27 shows the cost-effectiveness tests that we expect to perform for each program. The Team's ability to calculate these tests is contingent upon the availability of the necessary data elements, which are outlined in Table 29.

[43] Such as the *California Standard Practice Manual for Economic Analysis of Demand-Side Management Programs and Projects,* California Energy Commission, July 2002.

Table 27. Anticipated Cost-Effectiveness Tests by Program

	SEP Recovery Act Test	Total Resource Cost Test*	Program Administrator Cost Test	Societal Cost Test**
Appliance	✓	✓	✓	✓
Energy Code***	✓		✓	
Renewable Energy	✓	✓	✓	✓
Transportation	✓		✓	✓
Energy Efficiency	✓	✓	✓	✓
Conservation Studies	✓	✓	✓	✓
Portfolio	✓		✓	

* This test will be calculated with both a 5.5% discount rate and again with a societal discount rate.

** This test will be also calculated in two variations: one to account for avoided carbon emission benefits, and another to account for both avoided carbon emission and macroeconomic benefits.

*** The cost-effectiveness tests will only include activities under RFP 1621 and will exclude the baseline assessment portion of the program under RFP 1720.

In addition to evaluating the cost-effectiveness of each program, to the Team will examine the portfolio of programs as a whole, as well as the activities funded through each of the major ARRA funding streams (SEP, EECBG, and SEEARP). The results from this examination will demonstrate the cost-effectiveness of each technology (e.g., efficient appliances), as well as the cost-effectiveness of the suite of activities funded by each separate funding stream (e.g., all projects funded by EECBG). The various funding streams and the technologies they support are documented in Table 28.

Table 28. ARRA Funding Streams

Technology/Program	SEP	EECBG	SEEARP
Appliance			✓
Energy Code	✓	✓	
Renewable Energy	✓	✓	
Transportation	✓	✓	
Energy Efficiency	✓	✓	
Conservation Studies	✓		

Table 29 delineates the benefit and cost components of each of the tests that the Team will calculate. In addition to utilizing data provided by NYSERDA and assessed through the gross and net impact portions of the evaluation, the Team will research source BTUs for the SEP Recovery Act Test (SEP-RAC) test and fuel prices for vehicles replaced or modified through the transportation program. Because the Total Resource Cost (TRC) and Societal Cost Tests (SCT) require participant cost data, these tests will likely be impossible to perform for the Energy Code program,[44] and may not be possible for the Transportation program. The Team will, however, make an effort to obtain sufficient data, and will perform all tests that are relevant to each program or portfolio.

Table 29. Benefit and Cost Components of Standard Tests

	Elements	SEP-RAC	TRC	UCT	SCT
Benefits	Avoided Energy	✓	✓	✓	✓
	Avoided electricity (supply, T&D)		✓	✓	✓
	Avoided gasoline (supply, T&D)		✓	✓	✓
	Avoided gasoline and oil (supply)		✓	✓	✓
	Environmental Benefits				✓
	Macroeconomic Benefits				✓
Costs	NYSERDA Administration and Implementation Costs	✓	✓	✓	✓
	NYSERDA Incentives	✓	✓	✓	✓
	Direct Participant Costs		✓		✓

In order to calculate the cost-effectiveness tests outlined above, the Team will use Cadmus' proprietary cost-effectiveness model, DSM Portfolio Pro. The Team will populate DSM Portfolio Pro with NYSERDA's avoided costs and financial inputs as well as with weather-adjusted 8,760 hourly end-use load shapes. The Team will work with NYSERDA to finalize all model inputs and underlying assumptions to ensure that the tests are calculated with the greatest reasonable degree of accuracy.

[44] The cost-effectiveness analysis will be performed only on RFP 1621 programming, since RFP 1720 is not directly responsible for energy savings.

Section 11: **QUALITY ASSURANCE/CONTROL PLAN**

The Team will maintain rigorous quality assurance and quality control (QA/QC) processes in which all research designs, analyses, and deliverables are overseen by experienced senior level staff. In addition to following recognized protocols appropriate to each program and project grouping, the QA/QC process will involve two phases. In the first phase, QA/QC will be provided by the Team's assigned task managers and program managers, who were selected based on their subject matter expertise (see Appendix B). The second phase will involve an additional review by Dr. M. Sami Khawaja of Cadmus and Mr. Brent Barkett of Navigant Consulting, both of whom have extensive experience overseeing projects of a similar nature and scope. The second phase will also leverage Mr. Barkett's deep knowledge of NYSERDA and the New York market for energy-efficient products and services, as well as renewable energy resources. Each of the research designs, analyses, and deliverables will receive both phase 1 and phase 2 reviews.

The QA/QC process will involve multiple components including the following:

- Review of M&V processes (e.g., staff training and oversight, equipment error and calibration schedule, modeling calibration and verification procedures)
- Raw data quality checks and cleansing routines
- Mathematical and statistical review
- Technical content and context review
- Editorial review by one of Cadmus' technical editing staff

The following QA/QC will be performed during data collection and analysis:

- Telephone interviewers will receive specific training on the survey instrument and each interviewer will be supervised for their first three to five phone interviews,
- Final survey instruments will be pre-tested with a subset of the eligible sample to identify and resolve any issues with the question sets,
- Survey data will be cleansed and analyzed for consistent responses among questions, with the first review occurring after instrument pre-testing, and
- Spreadsheets containing engineering formula to calculate energy savings will be independently reviewed to ensure formula are structured properly and consistent with applicable technical references (e.g., NY DPS Technical Manual, Deemed Savings Database, etc.).

The QA/QC process will be implemented in real-time to identify issues as they arise and facilitate timely resolution and course corrections as needed. Experience has shown that ongoing QA/QC protocols are essential for ensuring that high-quality work products are delivered in a timely and cost-effective manner.

Supplemental to the QA/QC process discussed above, the Team will hold bi-weekly telephone/Webinar meetings to ensure that appropriate communications are occurring and that key project staff maintain awareness of the range of activities being coordinated. These meetings will be in addition to regular calls with NYSERDA project management staff to review project progress and evaluation status.

Section 12: **EVALUATION TIMELINE**

With the exception of Energy Codes, which necessitates a longer evaluation time line, Table 30 provides the evaluation timeline for the first two years of the project. Timeline activities are subject to change if conditions warrant and the plan is revised. The timeline for the third year of the project will be further developed in late 2011.

Table 30. Evaluation Timeline

Activity	2010 (Per Quarter)				2011 (Per Quarter)				2012 (Per Quarter)				2013 (Per Quarter)			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Energy Code																
Telephone Surveys				✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
Site Visits							✓	✓	✓	✓	✓	✓	✓	✓		
Stakeholder Interviews				✓	✓	✓	✓	✓	✓							
Training Surveys (Exit & 6 Month)				✓	✓	✓	✓									
Document/File Review			✓	✓	✓											
NYSERDA Staff Interviews				✓												
Implementer Interviews				✓												
Analysis				✓		✓		✓	✓	✓	✓			✓	✓	
SEP Program Evaluation Report									✓						✓	
EECBG Program Evaluation Report											✓				✓	
Appliances																
Participant Telephone Survey					✓											
Retailer Telephone Survey					✓											
Ex Ante Reviews				✓	✓											
Analyze Tracking Database				✓	✓											
NYSERDA Staff Interviews					✓											
Implementer Interviews					✓											
Renewables																
Online Attribution Surveys				✓	✓	✓										
Follow-up Attribution Interviews						✓	✓									
Telephone End-User Attribution Surveys							✓	✓								
Site Visits							✓	✓	✓	✓						
Metered Visits				✓	✓	✓	✓									
Stakeholder Interviews				✓	✓											
Document/File Review				✓	✓	✓	✓									
Plan Review					✓											
NYSERDA Staff Interviews				✓												
Implementer Interviews				✓												

Activity	**2010 (Per Quarter)**				**2011 (Per Quarter)**				**2012 (Per Quarter)**				**2013 (Per Quarter)**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Energy Efficiency																
Telephone Recruitment Survey			✓	✓	✓	✓										
Participant Attribution Surveys				✓	✓	✓	✓	✓								
Participant Attribution In-depth Interviews					✓	✓	✓	✓								
Site Visits				✓	✓	✓	✓	✓								
Metered Visits				✓	✓	✓	✓	✓								
Stakeholder Interviews				✓	✓	✓	✓									
Document/File Review			✓	✓	✓											
NYSERDA Staff Interviews				✓												
Implementer Interviews				✓												
Energy Conservation Study																
NYSERDA Staff Interviews				✓	✓											
Document/File Review					✓	✓										
Telephone Survey						✓	✓									
Secondary Research							✓	✓								
Transportation																
In-Depth Telephone Interview					✓	✓	✓	✓								
Document/File Review				✓	✓	✓	✓	✓								
NYSERDA Staff Interviews				✓												
Implementer Interviews					✓											
Macroeconomics																
Macroeconomic Activity 1				✓	✓	✓										
Macroeconomic Activity 2						✓	✓	✓	✓							
Carbon																
Carbon Methodology Comparison				✓	✓	✓	✓									
Avoided Carbon Emissions					✓	✓	✓	✓								
Carbon Templates (EC, EE, and EA)							✓	✓	✓							
Cost-Effectiveness																
Develop Cost-effectiveness Inputs					✓	✓	✓	✓	✓	✓						
Cost-effectiveness Analysis and Reporting								✓	✓	✓	✓					
SEP Program Evaluation Report									✓							
EECBG Program Evaluation Report											✓					

Section 13: **EVALUATION BUDGET**

Table 31 outlines the evaluation budget for all of the NYSERDA programs. The budget is inclusive of all SEP, SEEARP, and EECBG evaluation activities through to their respective initial report (March 2012 for SEP/SEEARP and September 2012 for EECBG).

The Team is not charging for meter costs, although it is Cadmus' standard practice to have a meter leasing fee. As the prime contractor, Cadmus made the strategic decision to not charge NYSERDA on this particular contract as a part of the contract negotiations process.

Table 32 shows the breakdown of the budget by the source of ARRA funding.

Table 31. Action Plan Evaluation Budget

Evaluation Action Plan	Appliance	Energy Conservation Studies (PON 4)	Renewables (1613, 10, & 1686)	Energy Efficiency (1613 & 10)	Transportation (1613 & 10)	Energy Codes	Total
Task 2a M&V Data Collection	$50,585	$32,760	$296,115	$597,286	$11,542	$0	**$988,288**
Task 2a M&V Analysis	$3,098	$19,477	$166,332	$95,785	$20,328	$0	**$305,020**
Task 2b Attribution Data Collection	$18,000	$9,000	$17,000	$11,000	$6,000	$0	**$61,000**
Task 2b Attribution Analysis	$46,500	$23,000	$31,500	$29,000	$11,000	$0	**$141,000**
Task 2c Energy Codes Data Collection	$0	$0	$0	$0	$0	$255,158	**$255,158**
Task 2c Energy Codes Analysis	$0	$0	$0	$0	$0	$57,024	**$57,024**
Program Subtotal (Task 2a, 2b and 2c)	**$118,183**	**$84,237**	**$510,947**	**$733,071**	**$48,870**	**$312,182**	**$1,807,490**
Task 1 Action Plan Development/Updates	$0	$0	$0	$0	$0	$0	**$350,000**
Task 2e Carbon	$5,810	$5,810	$5,810	$5,810	$4,810	$1,901	**$29,951**
Task 2e Carbon Methodology Review	$0	$0	$0	$0	$0	$0	**$6,124**
Task 3 Cost Effectiveness	$9,250	$9,250	$8,590	$9,250	$5,032	$1,984	**$43,356**
Task 2d Macroeconomic	$4,997	$4,642	$5,585	$9,792	$3,652	$2,730	**$31,398**
Travel	$1,500	$1,500	$85,056	$35,000	$1,500	$18,267	**$142,823**
Task 4 Ad Hoc / Tools (REMI - 1 region, 2 yrs)	$0	$0	$0	$0	$0	$0	**$21,000**
Task 2f Reporting and Management	$41,629	$22,160	$78,199	$129,985	$27,682	$17,458	**$317,113**
Cross Cutting Task Subtotal	**$63,186**	**$43,361**	**$183,240**	**$189,837**	**$42,677**	**$42,340**	**$941,765**
Evaluation Total	**$181,369**	**$127,598**	**$694,187**	**$922,908**	**$91,547**	**$354,522**	**$2,749,255**

Table 32. Budget Breakdown by ARRA Funding

Task	Budget	SEP %	EECBG %	SEEARP%	SEP	EECBG	SEEARP
Action Plan	$350,000	86.23%	10%	3.77%	$301,805	$35,000	$13,195
Transportation	$91,547	90%	10%	0%	$82,392	$9,155	$-
Energy Efficiency	$922,908	90%	10%	0%	$830,617	$92,291	$-
Energy Audits	$127,598	100%	0%	0%	$127,598	$ -	$-
Renewable Energy	$694,187	90%	10%	0%	$624,768	$69,419	$-
Appliance Efficiency	$181,369	0%	0%	100%	$-	$ -	$181,369
Energy Codes	$354,522	66.12%	33.88%	0%	$234,410	$120,112	$-
Macroeconomic Impacts Tool	$21,000	86.23%	10%	3.77%	$18,108	$2,100	$792
Carbon Methodology Review	$6,124	86.23%	10%	3.77%	$5,281	$612	$231
Total	**$2,749,255**				**$2,224,979**	**$328,689**	**$195,587**
% Breakdown					**81%**	**12%**	**7%**

In addition to the budgets described in tables Table 31 and Table 32, the evaluation team is providing a budget estimate for potential work to be performed in late 2012 and 2013. The expectation is that this proposed budget and potential work for late 2012 and 2013 will be further fleshed out by the Team based on experience in the first year of the evaluation and will ultimately be approved by NYSERDA in late 2011 or in 2012; thus, it is not considered a part of the current Action Plan. The general tasks covered in this budget include ongoing data collection efforts for meters in the field, follow up surveys, updated analysis, administrative, and reporting to ensure a complete and thorough evaluation of the programs are completed. Due to the time constraints for the 2012 reports and potential project completion dates, it is possible that some of the activity planned and budgeted under the 2012 budgets, will need to be carried into late 2012 or 2013 to ensure that the evaluation efforts meet the specified goals detailed in sections Section 2 through Section 9. The combined total for all evaluation work budgeted for 2010 through 2013 is $3,986,865.

Table 33 and Table 34 shows the breakdown of the additional budget by program and the source of ARRA funding.

Table 33. Additional Action Plan Evaluation Budget for Task 5

Evaluation Action Plan	Appliance	Energy Conservation Studies (PON 4)	Renewables (1613, 10, & 1686)	Energy Efficiency (1613 & 10)	Transportation (1613 & 10)	Energy Codes	Total
Task 2a M&V Data Collection	$0	$21,840	$94,353	$141,343	$5,685	$0	**$263,221**
Task 2a M&V Analysis	$0	$20,619	$50,385	$12,298	$5,082	$0	**$88,384**
Task 2b Attribution Data Collection	$0	$5,460	$23,588	$24,086	$0	$0	**$53,134**
Task 2b Attribution Analysis	$0	$4,649	$10,873	$1,781	$0	$0	**$17,303**
Task 2c Energy Codes Data Collection	$0	$0	$0	$0	$0	$479,502	**$479,502**
Task 2c Energy Codes Analysis	$0	$0	$0	$0	$0	$107,162	**$107,162**
Program Subtotal (Task 2a, 2b and 2c)	**$0**	**$52,568**	**$179,199**	**$179,508**	**$10,767**	**$586,664**	**$1,008,706**
Task 1 Action Plan Development/Updates	$0	$0	$0	$0	$0	$0	**$15,000**
Task 2e Carbon	$0	$1,000	$1,000	$1,000	$1,000	$4,909	**$8,909**
Task 2e Carbon Methodology Review	$0	$0	$0	$0	$0	$0	**$0**
Task 3 Cost Effectiveness	$0	$1,880	$1,880	$2,500	$1,258	$5,126	**$12,644**
Task 2d Macroeconomic	$0	$1,614	$1,947	$3,398	$913	$7,053	**$14,925**
Travel	$0	$1,000	$12,758	$5,250	$0	$34,327	**$53,335**
Task 4 Ad Hoc / Tools (REMI - 1 region, 2 yrs)	$0	$0	$0	$0	$0	$0	**$0**
Task 2f Reporting and Management	$0	$11,956	$33,310	$35,395	$6,921	$36,509	**$124,091**
Cross Cutting Task Subtotal	**$0**	**$17,450**	**$50,895**	**$47,543**	**$10,092**	**$87,924**	**$228,904**
Evaluation Total	**$0**	**$70,018**	**$230,094**	**$227,051**	**$20,859**	**$674,588**	**$1,237,610**

Table 34. Budget Breakdown by ARRA Funding for Task 5

Task	Budget	SEP%	EECBG%	SEEARP%	SEP	EECBG	SEEARP
Action Plan	$15,000	86.23%	10%	3.77%	$12,935	$1,500	$565
Transportation	$20,859	90%	10%	0%	$18,773	$2,086	$-
Energy Efficiency	$227,051	90%	10%	0%	$204,346	$22,705	$-
Energy Audits	$70,018	100%	0%	0%	$70,018	$-	$-
Renewable Energy	$230,094	90%	10%	0%	$207,085	$23,009	$-
Appliance Efficiency	$-	0%	0%	100%	$-	$-	$-
Energy Codes	$674,588	66.12%	33.88%	0%	$446,038	$228,550	$-
Macroeconomic Impacts Tool	$-	86.23%	10%	3.77%	$-	$-	$-
Carbon Methodology Review	$-	86.23%	10%	3.77%	$-	$-	$-
Total	$1,237,610				$959,195	$277,850	$565
% Breakdown					78%	22%	0%

Section 14: **EVALUATION DATA REQUEST**

NYSERDA has already shared many beneficial datasets and documents. The Team appreciates this information sharing and would like to continue the process that NYSERDA staff share data they feel is relevant to the evaluation. Table 35 outlines the Team's general data request. These data are required from either NYSERDA or the program implementer to successfully accomplish program evaluation tasks. The Team will request data only as needed and provide NYSERDA and their program implementers with sufficient time and direction to complete the request. The table shows the general types of requests and their intended use. Actual requests will be sent in a memorandum format and will include sufficient detail to allow NYSERDA and program participants to respond. An example of a more detailed request for PON 4 is shown below.

Example: PON 4 Data Request. The MAR survey requires detailed program data to be used in sampling and for the measure-by-measure inquiry. The data requirements for the MAR survey include the following:

- Project level information including address, contact information for the site owner and engineer, the type of project (custom, design/build), and the type of business
- Measure level information (in easily readable electronic format) such as a description of the measure, quantity recommended, energy savings (electric, gas, and other fuels), and demand savings
- 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 gas end uses
- Program study reports for the participant MAR sample, preferably in electronic format

The ARRA participant list of those that have received contracts will comprise the sampling frame for the on-site survey. The data request will specify a date range for contract payment that allows at least six months and, if possible, one year between the report completion date and the MAR telephone call, in order to allow time for action to be taken in response to the recommendations.

As part of data request, the Team will request access to NYSERDA's database, which will allow us to cross reference for projects that are receiving support from non-ARRA-funded NYSERDA programs.

Table 35. Data Request

Data Type	Description	Program/Task
Program/RFP marketing plan and materials		All programs: General
Participant and non-participant population and contact information		All programs: General
Program data and tracking and participant databases		All programs: General
Technical assumptions used in estimating initial savings and source of each		All programs: General
Previous studies/evaluations		All programs: General
List of benchmark utilities/programs of interest		All programs: General
Implementation Contractor Contact Information	Follow-up questions	All programs: General
All project submissions for RFPs that were chosen to receive funding		All programs: General
All written evaluations of submittals with graded criteria		All programs: General
Measure life (expected useful life in years)		All programs: Impact calculations/Cost-effectiveness, macroeconomics
Measure savings (kWh/therms) and assumptions		All programs: Impact calculations/Cost-effectiveness
Water savings estimates		All programs: Impact calculations/Cost-effectiveness
Incremental measure cost ($)	Incremental cost of the measure from the base level efficiency	All programs: Cost-effectiveness, macroeconomics
Per unit installation cost ($) (optional)		All programs: Cost-effectiveness, macroeconomics,
Incentive/rebate payment ($)		All programs: Cost-effectiveness, macroeconomics
Program and portfolio administrative costs	By funding stream (EECBG/SEP)	All programs: Cost-effectiveness, Macroeconomic
Avoided energy and capacity costs	8760 hourly costs	All programs: Cost-effectiveness, macroeconomics
Fuel costs	For Transportation Program	All programs: Cost-effectiveness, Macroeconomic
Emissions data		All programs: Cost-effectiveness
Load shapes	8760 hourly load shapes for all sectors and end uses evaluated	All programs: Cost-effectiveness
Measure end use and applicable building type		All programs: Cost-effectiveness
Carbon emissions estimates or targets		All programs: Cost-effectiveness
System peak definition		All programs: Cost-effectiveness

Data Type	Description	Program/Task
Discount rates	For Program Administrator Cost Test, Societal Cost Test, and Total Resource Cost Test	All programs: Cost-effectiveness
Line losses	By sector	All programs: Cost-effectiveness
Job creation numbers reported to Office of Management and Budget (OMB) and DOE		All programs: Macroeconomic
Other funding source amount ($)		All programs: Macroeconomic
O&M costs/savings		All programs: Macroeconomic
List of economic assumptions for use with model regarding baseline scenario and other variables		All programs: Macroeconomic
List of expenditures broken out by program and industry/activity		All programs: Macroeconomic
Emissions factors (including methodologies/calculations and any verfication information)		All programs: Carbon evaluation
Technical assumptions on GHG emission reductions goals in "program descriptions" document		All programs: Carbon evaluation
NYSERDA carbon protocols / calcuation methodologies	NYSERDA specific calculation or accounting methodologies Emissions factors Background on GHG reduction goals	All programs:Carbon evaluation
Survey instruments from NYSERDA SEP, EEPS, and RPS evaluations using the enhanced net-to-gross approach or other standard batteries of attribution or net-to-gross questions.		All programs: Net Impact
Project status	Monthly updates of all projects' construction/installation status to inform survey and site visit timing	RFP 1613, 10 and PON 4, 1686: Document review, survey, site visit
Project information	Contact information and location(s), all other application and project documentation	RFP 1613, 10 and PON 4, 1686: Document review, survey, site visit
Project inspection results	Inspection reports and photographs from implementation contractor after their post installation inspection, if applicable, is complete	RFP 1613, 10 and PON 4, 1686: Gross savings
Project design documents (solar PV)	Documented design features of planned project: • Shading factor (solar PV) • System rated capacity • Annual energy output estimate • Tilt/orientation of solar PV array(s) • Installation costs • Contact information for installer	Renewables: Gross savings

Data Type	Description	Program/Task
Project design documents (non-solar PV)	Documented design features of planned project: • Fuel/resource documentation (e.g., wind speed, biomass fuel stock) • Installation costs • System design/installation drawings/site plan • Contact information for installer	Renewables
NYSERDA Renewable Portfolio Standard Program customer-sited tier information	Listing of RPS customer-sited tier participants from 2007 to 2010: • By renewable technology • By PON • By sector (public, C&I, residential, etc.) • Including kW installed for electric generation projects • Participants • Incentive received • kW installed • Energy output estimated • Actual energy output (if available) • Program marketing Percent of available RPS funds expended from 2007 to 2010 by PON for system sizes consistent with these programs	Renewables: Net savings
Relevant NYSERDA program records for 2007-2010 (i.e., for pre-existing transportation-related programs)		Transportation: Attribution
Survey instruments from NYSERDA evaluations using the enhanced net-to-gross approach		Energy Efficiency: Net Impact
NYSERDA Flex Tech and Technical Assistance Program Information	Listing of Participants from 2007 to 2010 • By FT or TA • By sector (public, C&I, residential, etc.) • Including list of recommended action • Including any information on implementation of measures Percentage of available FT/TA funds expended from 2007 to 2010	Energy Conservation Studies: Net Impact

Data Type	Description	Program/Task
NYSERDA Existing Facilities, Lighting, and HVAC programs available to municipalities, universities, schools, hospitals, and non-profits	Listing of Participants from 2007 to 2010 • By program and/or PON • By sector (municipalities, schools, etc.) • Measure(s) incented • Incentive received • Energy savings estimated Percentage of available funds expended from 2007 to 2010, by program/PON	Energy Conservation Studies: Net Impact
Energy Code training schedule		Energy Code
Curricula for training courses	Course outlines and curricula for all Energy Code training courses	Energy Code
NYSERDA database extract	List of trained participants from 2010 and 2011 Energy Code training classes	Energy Code
Commercial and residential new construction database extract	McGraw Hill Dodge or other new construction database	Energy Code
NYS code book	Listing of new energy code going into effect December 28, 2010	Energy Code
Program database extract	• List of sites or locations supported by circuit riders or other support services • List of all program activities with information on the implementer, content, purpose, timing, location, and target audience(s) • Contact information for the implementer and all participants • Contact information for local building departments and officials • Information identifying buildings permitted and constructed under the new energy code • Building owner/occupant contact information • Detailed building characteristics collected from site visits	Energy Code
Plan review training documents	Documents supporting support services such as circuit riders	Energy Code

APPENDIX A
ADDITIONAL EVALUATION ACTIVITIES SUBJECT TO BUDGET

This section includes additional evaluation activities identified by the Team as potential enhancements that could be approved by NYSERDA, budget permitting. As the evaluation progresses, the Team will discuss the need for these potential enhancements with NYSERDA, including potential prioritization and trade offs that might need to be made on other core tasks to incorporate the additional work. The evaluation enhancements described in this section are currently not considered part of the core Action Plan.

APPLIANCE PROGRAM

1. **Supplier Interviews**

   To supplement data from NYESP participating retailers and the Home Depot/Lowes corporate interviews, a survey of 70 retail stores is recommended to fully understand the sales trends of ENERGY STAR® appliances before, during, and after the ARRA promotion. NYESP data can be used for the share of sales made by NYESP partners, but the Team recommends that we also gather data from a sample of the remaining retailers. To achieve a 90% confidence interval with +/- 10% precision, a sample of 70 retailers is necessary.

2. **Enhanced Sample Design for Participant Surveys**

   The Enhanced Sample Design for the participant surveys would allow for stratification by rebate type: appliance only and appliance with recycling for each type of appliance in Option 1 and for the bundle of appliances in Option 2 (see Table A1). This sample design includes a geographic breakdown similar to the sample design described earlier. The total number of targeted surveys under the Enhanced Sample Design is 1,190, which provides a maximum 10% margin of error at the 90% confidence level for each of the subgroups and a 2.4% margin of error (also at 90% confidence) for the overall sample. The Enhanced Sample Design would allow exploration of specific recycling and motivation questions to be reported with statistical accuracy, such as determining the relationship between recycling, unit age, and early versus regular replacement (see list item number 3, below).

Table A1: Participant Survey—Enhanced Sample Design

Rebate Status	Assumptions	Upstate	Downstate	Long Island	Sample Size Total
	Total Completed Surveys	560	560	70	**1,190**
Appliance Only					
	Option 1: ENERGY STAR Refrigerator	70	70	Unspecified	**140+**
	Option 1: ENERGY STAR Freezer	70	70	Unspecified	**140+**
	Option 1: ENERGY STAR Clothes Washer	70	70	Unspecified	**140+**
	Option 2: Appliances (bundle, CEE high efficiency refrigerator, clothes washer, dishwasher)	70	70	Unspecified	**140+**
Appliance with Recycling					
	Option 1: ENERGY STAR Refrigerator	70	70	Unspecified	**140+**
	Option 1: ENERGY STAR Freezer	70	70	Unspecified	**140+**
	Option 1: ENERGY STAR Clothes Washer	70	70	Unspecified	**140+**

Rebate Status	Assumptions	Upstate	Downstate	Long Island	Sample Size Total
	Option 2: Appliances (bundle, CEE high efficiency refrigerator, clothes washer, dishwasher)	70	70	Unspecified	**140+**
	Survey length				**20 minutes**
	Margin of error at 90% confidence level				**10% for each subgroup, 2.4% overall**

3. **Determine Relationship Between Recycling and Early or Regular Replacement and Estimate Energy Savings Associated with Recycled Appliances**

   In theory, consumers are more likely to recycle an appliance if it has reached the end of its useful life, as an appliance in good working condition may have value in the used appliance market. Incremental energy savings from the ARRA recycling incentives are anticipated to come from those who chose to recycle rather than re-sell their working unit, as those with non-working appliances may have disposed of them in another manner, and the unit would otherwise not be using energy. If the Enhanced Sample Design is funded (as described in item number 2 above), the Team can analyze this data with statistical confidence to estimate savings from appliance recycling.

RENEWABLE ENERGY

1. **Biomass Boilers**
   - Current action plan calls for metering three of the six installed boilers
   - Metering the additional three boilers would cost approximately $40,000
2. **Solar Water Heaters**
   - Current action plan calls for metering eight of the 25 systems to be installed
   - Metering the additional 17 systems would cost approximately $210,000
3. **Solar Space Heating**
   - Current action plan calls for metering five of the 11 systems
   - Metering the six additional systems would cost approximately $75,000

ENERGY EFFICIENCY AND CONSERVATION STUDY

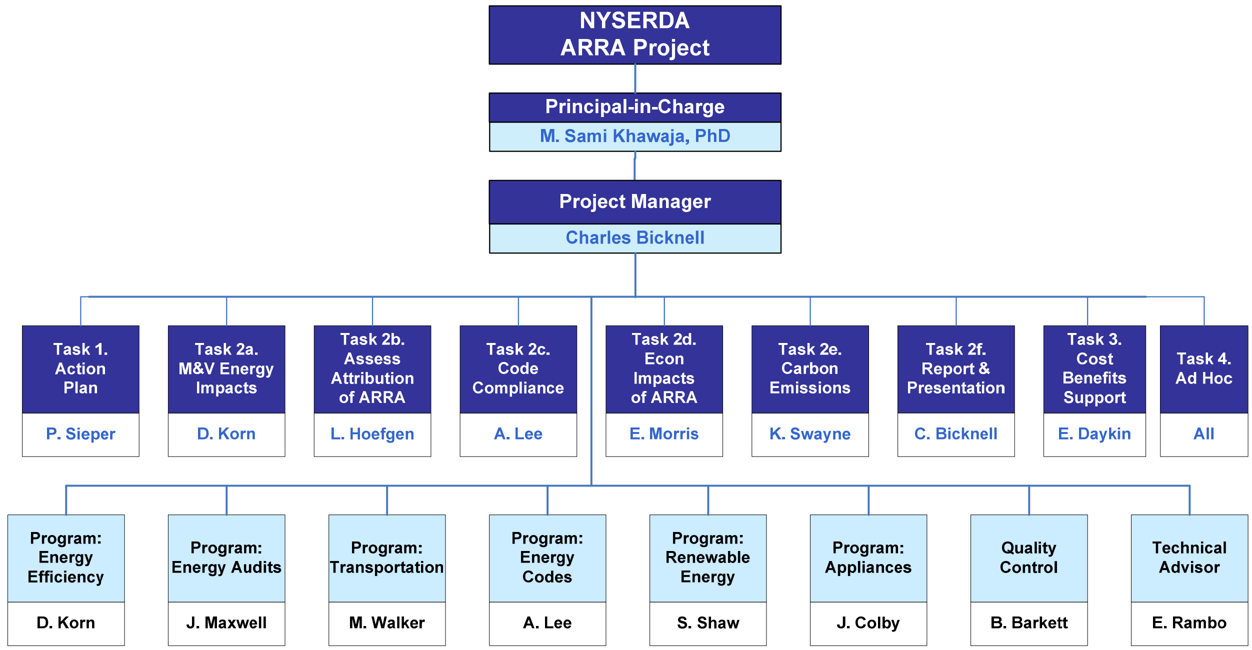
1. For select applications, NYSERDA or the Cadmus engineer may express particular interest in combustion efficiency over time. If so, a logging combustion analyzer can be used. Likewise, if there is a particular need for direct gas sub-metering where no meter already exists, it can be installed. If the need for either combustion analysis or direct gas metering is identified, evaluators will present the benefits and extra costs to NYSERDA for consideration, but such tasks are not included in the existing M&V budgets. The cost for gas sub-metering could add approximately $5,000 per site.
2. Conducting an enhanced net-to-gross assessment, where the Team surveys multiple decision makers per project and use, can benefit from other information to help triangulate the reason(s) why a facility took a certain action. This would be beneficial—particularly for the PON 4 study. These interviews can be time consuming and can take several senior staff hours per facility in order to ensure that contextual answers are handled correctly. The cost of this approach for PON

4 would vary on the number of implementing sites, but would range between $400 to $500 per interview.

3. The original budget assumed that MAR work for PON 4 did not include site visits or M&V work. The rationale for this approach was that for audits conducted in 2010, actual project implementation might not take place until late 2011. Further M&V work often requires that the project be in place for several months, and even longer for billing analysis. We did not anticipate that there would be much to view on-site, and opted for an interview approach. If the timing and the amount of budget is flexible, then some projects may be installed and operational in time for the Team to visit them. The cost of performing site M&V work is similar to the work on RFP 10 and 1613; about $4,000 per site on average.

APPENDIX B
EVALUATION TEAM

Figure 9: Team Structure Matrix



BEACON CONSULTANTS NETWORK INC.

Mike Walker (*Transportation*) is president of Beacon Consultants Network Inc., a consulting firm specializing in effecting human behavior change. Beacon helps its clients create programs, products, and services that transform the way groups of people think and act. If your computer enters "sleep mode" to save energy, or if your employer offers commuter benefits, or if you've elected to become an organ donor online, you are already familiar with some of Beacon's work. Prior to founding Beacon, Mr. Walker served as COO of an IT services firm, Complete Communications, Inc., was VP of client services at Belenos, Inc., and a manager at Deloitte Consulting.

Emily Norton (*Transportation*) is a senior consultant with Beacon Consultants and has nearly 20 years of social marketing experience in the corporate, public policy, and political arenas, focused primarily on energy and the environment. She has developed considerable expertise in helping organizations adopt sustainable business practices. As a result of her work, major corporations are reducing their energy bills, driving cleaner cars, manufacturing more energy-efficient products, and purchasing fuel-efficient hybrid trucks.

THE CADMUS GROUP INC.

Dr. M. Sami Khawaja, (*Management*) is the principal-in-charge of the project. Dr. Khawaja is a vice president at Cadmus, overseeing the firm's Energy Services Group (formerly Quantec, LLC), which currently has a professional staff of over 130. Dr. Khawaja has more than 25 years of economic consulting experience, specializing in forecasting, market transformation assessment, pricing, cost/benefit analysis, and statistical and quantitative analysis for utilities and government agencies. He is also a nationally-recognized leader of program design and evaluation methods.

Dr. Khawaja is well versed in commonly used sampling techniques in load research, including ratio-based sampling and model based statistical sampling. His extensive experience in statistical sampling design has ranged from simple random sampling for residential surveys to more sophisticated sampling design for quality control of large commercial and industrial programs.

In addition to being one of the authors of the International Performance Measurement and Verification Protocol (IPMVP), Dr. Khawaja co-authored the Program Impact Evaluation Guide for the public-private collaborative National Action Plan for Energy Efficiency. Earlier this year, he served as the lead author on the Impact Evaluation Guide for the Electric Power Research Institute.

An adjunct professor of economics at Portland State University, Dr. Khawaja teaches quantitative economics and statistics. He is one of the founders of the Applied Energy Economics and Policy graduate certificate program at Portland State.

Dr. Allen Lee, (*Energy Codes*) a principal with Cadmus, will be overseeing implementation of the EM&V activities outlined in the codes action plan. He will guide the resolution of any technical issues, provide high-level guidance on task completion, and review materials for quality control and adherence to the highest standards of evaluation protocols. Dr. Lee has more than 25 years of experience designing, managing, and providing technical leadership on a wide range of projects and programs involving energy policy, energy efficiency, renewables, environmental analysis, and sustainability. Dr. Lee has brought multidisciplinary expertise to challenging research projects for public and private sector clients and has been directly involved in formulating public policy. In addition, he has developed and managed evaluations of dozens of utility programs involving efficiency improvements in residential and commercial buildings, including several code program studies.

David Korn, CEM, (*Energy Efficiency*) a principal with Cadmus that has more than 20 years of experience in energy and environmental consulting and engineering, will oversee the impact and M&V of energy efficiency and energy conservation study areas. His expertise encompasses a broad range of energy conservation issues, ranging from preparing detailed technical evaluations of products (such as industrial transformers) to managing a multi-million dollar regional effort to promote energy-efficient products. Additionally, Mr. Korn has developed specifications for battery charging systems, dehumidifiers, water coolers, computers, and for the correct installation of air conditioning equipment. He has supervised the construction of cogeneration systems and performed energy audits on millions of square feet of buildings. Specializing in laboratory and *in-situ* metering, Mr. Korn and his engineering team have investigated the energy use of buildings and building systems in thousands of locations. They have also evaluated consumer products ranging from air conditioners, dehumidifiers, water coolers, computers, computer monitors, external power supplies, and battery charging systems. He currently serves on the technical committee overseeing the International Performance Measurement and Verification Protocol.

Dr. David Sumi, (*Carbon*) a principal at Cadmus, is the technical advisor for the carbon task. Dr. Sumi has more than 25 years of experience in evaluation and performance measurement research. Dr. Sumi's work focuses on energy efficiency, demand side management (DSM), and quantifying a range of impacts from DSM programs (such as direct energy, environmental, economic, and other non-energy benefits). His work has entailed managing research and evaluation projects (including several multi-year evaluation projects) for more than 30 utilities, energy research consortia, and government agencies. His experience encompasses coordination between measurement and verification protocols for energy-efficiency programs and the WRI Greenhouse Gas Protocol.

David Beavers, CEM, CSDP, (*Renewables*) is a senior associate at Cadmus. Mr. Beavers has more than 15 years of field and consulting experience related to engineering and energy. For the past eight years, he has led Cadmus projects related to solar development, quality assurance, and monitoring and verification studies for both public and private clients. Mr. Beavers' currently serves as the sole Third Party Meter Reader for tracking and verification of energy generated from PV sources used to claim Massachusetts Solar Renewable Energy Certificates; inspecting systems installed by new installers for compliance with electrical and building codes and other technical requirements, and serving as an owner's agent for communities wanting to install PV systems. Mr. Beavers will serve as a technical resource on solar PV, solar hot water, and solar thermal M&V.

Charles Bicknell, *(Management)* will be the primary day-to-day manager of the project and the primary point of contact for NYSERDA. Mr. Bicknell is a senior associate and is the deputy group manager of the energy services group at Cadmus. He has seven years of experience managing DSM projects and conducting evaluations of programs across the country. Mr. Bicknell's evaluation experience including previous evaluations of the SBC funded programs at NYSERDA and managing the evaluations of the 2006-2008 residential programs run by the Investor-Owned Utilities in California. In addition to program evaluations, Mr. Bicknell has managed program planning and potential studies, and prior to getting into the DSM field, developed financial models for an Investment Bank in New York.

Eli Morris, (*Macroeconomics*) a senior associate with Cadmus, has extensive experience in DSM potentials assessment, program planning, cost-effectiveness, and data analysis for electric and natural gas utilities. Mr. Morris has conducted in-depth analysis to quantify the various benefits of energy-efficiency programs, including the value of avoided energy and capacity, macroeconomic impacts, and other non-energy benefits. On this project, Mr. Morris will lead the effort to quantify macroeconomic impacts.

Elizabeth Daykin, (*Cost-Effectiveness*) a senior associate at Cadmus, specializes in program planning and statistical analysis. She conducts quantitative and qualitative data analysis for a broad range of projects, including program evaluations, benefit-cost analyses, impact evaluations, and potentials assessments. Ms. Daykin has worked with clients throughout the U.S. to model cost-effectiveness, leading the development of Microsoft Excel® and Web-based versions of analytical tools, such as DSM Portfolio Pro, for use in program planning and evaluation. In addition to her work with energy industry clients, Ms. Daykin has worked with clients in the financial sector on programs involving forecasting, market characterization, cost-effectiveness, and statistical modeling.

Jane Colby, (*Appliances*) the program manager for the Appliance Rebate Programs, is a senior associate with Cadmus and has over 20 years of utility industry experience. For Cadmus, Ms. Colby has managed numerous residential evaluation projects and portfolios using her extensive project management, energy engineering, and statistical analysis experience. She also has experience developing and negotiating complex power transactions involving power assets and long term contracts as well as wholesale electricity trading and integrated resource planning. She is uniquely skilled at conceptualizing, planning, and organizing research projects and at analyzing and presenting complex data. Ms. Colby will supervise the gross program impacts analysis.

Shawn Shaw, (*Renewables*) a senior associate at Cadmus, has over a decade of experience working with renewable energy projects and programs. Mr. Shaw will be managing the overall renewable energy program evaluation effort, providing management, technical guidance, planning, and reporting functions.

Dr. Stephen Jurovics, (*Energy Codes*) a senior associate with Cadmus, has 23 years of experience with building energy and environmental issues, and will be supporting the EM&V activities outlined in the energy code program action plan. He will identify the specific differences between the existing New York State residential and commercial energy code and the new residential code, IECC 2009, and commercial code, ASHRAE 90.1-2007. This work will support, in part, a review of the training materials being offered to code officials and building professionals, for completeness and accuracy. This work will also aid in the determination of energy savings arising from implementing this new ARRA-required energy code in December 2010, rather than at a later date.

Bill Falkenhayn, (*Energy Codes*) an associate with Cadmus, will be implementing the EM&V activities outlined in the energy code program action plan and will plan out the optimal course of action for completing the EM&V tasks. Mr. Falkenhayn will also ensure the budget meets expectations and will address project management issues on a day-to-day basis. Mr. Falkenhayn provides expertise in project management, program evaluation, and qualitative data analysis. He led an evaluation effort for the California Public Utilities Commission, where he managed internal staff while coordinating efforts of partner contractors and utility staff, to produce quantitative and qualitative analysis of Title 24 Building Codes. He also provides logic models, survey design, and data collection planning and analysis.

Charles McClelland, (*Renewables*) an associate with Cadmus, has extensive experience evaluating wind project sites, equipment, and wind resource. He has installed numerous 50m meteorological towers, as well as conducted design reviews, inspections, and feasibility studies for wind projects throughout New England. Mr. McClelland will lead the wind energy M&V aspects of the project.

Heidi Ochsner, (*Renewables*) an associate with Cadmus, is an environmental engineer with experience in managing projects and evaluating renewable energy and energy-efficiency programs. Ms. Ochsner is knowledgeable about the performance and greenhouse gas impacts of distributed generation technologies including PV, wind, solar water heating, and biogas-fueled and natural gas-fueled combined heat and power systems. She has collected and processed metered data, installed monitoring equipment, designed samples, and performed uncertainty analysis. Ms. Ochsner will provide technical input to M&V for a variety of technologies.

Jamie Lalos, *(Management)* an associate with The Cadmus Group, will be assisting with high-level project management and over-sight. Ms Lalos has more than eight years of experience in designing, marketing, and evaluating energy-efficiency programs. In addition, Ms. Lalos is assisting numerous utilities with their market research efforts as well as process and impact evaluations. Ms. Lalos joined Cadmus in 2008, after more than 6 years at the New York State Energy Research and Development Authority (NYSERDA), managing a variety of residential energy efficiency programs. In her role at NYSERDA, she managed comprehensive marketing plans and activities to increase residential energy efficiency program participation through increasing consumer awareness of energy efficiency and NYSERDA's program offerings. As part of the evaluation of residential efficiency program marketing, Ms. Lalos oversaw the development and implementation of consumer and trade ally focus groups to gauge the effectiveness of these efforts as well as test new creative and messaging. She also oversaw the process of redesigning residential outreach strategy and marketing materials.

Kate Swayne, (*Carbon*) an associate with Cadmus, will manage the carbon evaluation task for this evaluation. Ms. Swayne is an experienced project manager specializing in carbon and energy-efficiency projects including process and impact evaluations. Ms. Swayne has worked in the field of energy efficiency, renewable energy, climate change, and environmental protection for seven years. Ms. Swayne recently served as the project manager for a baseline greenhouse gas emissions inventory and climate evaluation for a $13 billion, global services firm.

Before joining Cadmus in 2008, Ms. Swayne worked for Marsh and McLennan Companies in Washington D.C. as a sustainability and climate risk consultant. In this position, Ms. Swayne focused on informing the development of a sound federal cap and trade policy as well as robust internal sustainability initiatives. Ms. Swayne also advised clients on a host of climate risk issues and served as a liaison to groups such as the United States Climate Action Partnership, International Emissions Trading Association, World Resources Institute, and the Climate Disclosure Standards Board.

Philip Sieper, (*Management*) an associate and experienced research and project manager at Cadmus. Mr. Sieper conducts quantitative and qualitative data analysis for a broad range of projects including program evaluations and market characterization studies. He has also managed project and data collection activities for various evaluation studies. Before joining Cadmus, Mr. Sieper was responsible for project, product, and research management, as well as quantitative and qualitative analysis. He has more than 12 years of experience in the energy industry, primarily in overseeing global research groups and products focused on electricity markets at Platts.

Thomas Doherty, (*Energy Audits*) an associate with Cadmus, has more than 10 years of experience in energy consulting and engineering. He is an expert in evaluating building systems and controls and in analyzing energy conservation measures to promote efficient systems operation. Mr. Doherty has extensive experience with the design review, installation, and operation of building mechanical and electrical systems– including chiller/boiler plants, HVAC systems, lighting, variable speed drives, and building automation systems.

Tony Larson, (*Energy Codes*) an associate of Cadmus, will be performing the engineering review of this project. Mr. Larson conducts research on energy-efficient building technologies and renewable energy systems. He has performed quantitative and qualitative analysis for several Cadmus projects, and has worked with engineering modeling applications such as eQUEST and ENERGY-10, and conducting site visits, telephone surveys, and interviews.

Crystal Weston, (*Energy Codes*) a senior analyst at Cadmus, has extensive program implementation, evaluation, and environmental consulting experience. Ms. Weston conducts qualitative and quantitative assessments, market research, cost-benefit analysis, and logic-model and performance measure creation for a variety of programs. Her primary role in this project will be to conduct qualitative and quantitative assessments, economic impact analysis, and logic-model and performance measure creation for programs. She will assist the evaluation of the energy code and standards programs by researching code implementation and impacts and analyzing data. She will evaluate the macroeconomic impacts of the ARRA programs, including utilizing economic impacts software. For process evaluations, Ms Weston will work with program managers to create logic models that will inform the process and impacts evaluations.

Danielle Kolp, (*Renewables*) a senior analyst and project manager at Cadmus, has five years of experience with data analysis and project management. At Cadmus, Ms. Kolp has performed numerous impact and process evaluations, cost-effectiveness analyses, and program planning projects. She also has extensive experience with several renewable technologies, specifically dealing with PV system technical specifications, policy issues, program planning, and incentive level structures. Ms. Kolp will be overseeing various evaluation tasks and conducting portions of the technical evaluation activities.

Dr. Cynthia Kan (*Macroeconomic***)** is a senior analyst with Cadmus. She specializes in energy-efficiency planning activities, and she contributes technical inputs for use in conservation potential modeling. Dr. Kan's evaluation services include process and impact analysis that covers standard energy-efficiency programs, as well as leading edge programs on emerging energy-efficiency financing strategies and education. In support of these projects, she benchmarks best practices, maps processes, develops verification protocols, and analyzes macroeconomic impact (such as job creation). Dr. Kan will oversee the macroeconomic impact analysis for the Team.

Michelle DePasse, (*Appliances*) a senior analyst with Cadmus, will be performing corporate retailer interviews and analysis of NYESP program data. Ms. Depasse has over 10 years of experience in construction management and green buildings, in addition to research and training experience.

Anna Carvill, *(Management)* an analyst with the Cadmus Group Inc., will be assisting with overall project management and organization. Ms. Carvill has experience with project management, data collection and analysis, data research, and reporting. Since joining Cadmus, Ms. Carvill worked with a west coast public utility commission, one of the firm's largest clients, and has played key management roles in several impact and process evaluations in California, Colorado, Utah and Massachusetts.

Brian Shepherd, (*Appliances*) an analyst with Cadmus, will be involved with data analysis for the Appliance Rebate Programs. Mr. Shepherd analyzes data in SAS for various rebate program evaluations as well as measure audit data.

Kate Bushman, (*Cost-Effectiveness*) an analyst with Cadmus, performs quantitative and qualitative analysis for complex energy-related projects. At Cadmus, she has applied her skills to process and impact evaluations of energy-efficiency programs in the residential, commercial, and industrial sectors. Ms. Bushman has conducted detailed cost-effectiveness analysis using DSM Portfolio Pro for numerous gas and electric utilities, and recently completed an assessment of a $50 million portfolio of programs spanning three states.

Scott Davis, *(General)* a senior analyst at The Cadmus Group Inc., will be assisting the management team with data organization and management. Mr. Davis has a multidisciplinary background in engineering, and has worked in the energy industry since 2007. He provides technical, analytical, and research skills to a variety of energy-related projects. He has managed large datasets, designed demand response and energy-efficiency plans, and provided his engineering skills in the field.

ERS, INC.

Jonathan Maxwell (*Energy Efficiency*) is a director and principal engineer at ERS, Inc. with more than 15 years of experience in energy-efficiency program evaluation and implementation. He has managed major field data collection efforts for evaluation and load research and has trained more than 200 energy professionals on a wide variety of topics, mostly related to field data collection and analysis. Mr. Maxwell has conducted more than 100 C/I site visits and led start-up, hiring, training, and daily project management for four energy audit programs that provided a combined 1,600 audits per year to utility customers. He also directed four industrial compressed-air program design and evaluation and market potential studies in New England and New Jersey.

NAVIGANT CONSULTING

Brent Barkett (*Quality Control*) is a director at Navigant. He has more than 10 years' experience in the utility and energy industries. Mr. Barkett has examined the cost-effectiveness and energy savings and demand reductions associated with various energy-efficiency and demand response programs. For the past five years, Mr. Barkett has served as the chair of the Association of Energy Services Professionals'

Pricing and Demand Response Topic Committee. Mr. Barkett will provide quality assurance and quality control for the Team.

Frank Stern (*Renewables*) is a director at Navigant. His focus is on helping organizations make wise choices about energy resources. He has over 20 years of experience in a variety of areas in the energy industries, including renewable energy, climate change policy analysis, demand-side management program evaluation and planning, generation asset and contract valuation, and competitive bidding resource selection. Mr. Stern led a team to provide technical and analytical support to NYSERDA in the evaluation of the New York State Renewable Portfolio Standard with regard to assessments of market conditions.

Jane Pater Salmon (*Carbon, Renewables*) is an associate director with Navigant. Her work focuses on strategic planning, market assessment, the intersection of business and policy, and the diffusion of innovation. Ms. Salmon has worked on greenhouse gas inventories for the Philippine government, both as a Fulbright Scholar and for major corporations. She is published in peer-reviewed proceedings on the role of energy efficiency in greenhouse gas cap and trade schemes. Ms. Salmon worked with the National Renewable Energy Laboratory to explore the interaction of greenhouse gas regulatory systems and green power marketing efforts. In addition, Ms. Salmon developed a strategy for a major global energy firm to reach carbon neutrality.

Stu Slote (*Energy Code*) is an associate director with Navigant and was formerly a senior consultant with Summit Blue. He has over 25 years of experience in the energy-efficiency industry. His areas of expertise include building energy code development, adoption, implementation, and assessment; screening, assessment, and promotion of efficiency markets and measures; and the design, implementation, and evaluation of utility demand side programs.

Fred Wellington (*Carbon*) is a managing consultant in Navigant's energy practice, where he specializes in clean energy strategy. Most recently, Mr. Wellington has advised investor and publicly-owned utilities on strategic clean energy issues such as rooftop solar business models and opportunities, compliance options and costs associated with renewable energy and GHG policies, REC valuation and trading, and carbon markets. He also has experience modeling potential greenhouse gas compliance costs under various cap and trade policy proposals and has worked with several government agencies on clean energy policy formation and implementation. Mr. Wellington has authored several publications on clean energy topics, including article which have been published in Harvard Business Review and Public Utilities Fortnightly.

Michael Sherman (*Energy Efficiency*) is a managing consultant with Navigant. He has more than 20 years' experience in energy efficiency in the public and private sectors, including policy and legislation development, regulation, program planning, and evaluation. Mr. Sherman has led multiparty and multidisciplinary stakeholder groups to optimal, efficient solutions. He has led process and impact evaluations of residential, low income, commercial, and industrial energy-efficiency programs. Mr. Sherman determined net-to-gross impacts due to market effects for Wisconsin's Focus on Energy. He has particular expertise in process evaluation and in all aspects of energy-efficiency programs for low income households. Previously, as director of energy-efficiency programs in the Massachusetts Department of Energy Resources, he led a Massachusetts planning process resulting in the design and implementation of a $2.1 billion, three-year plan for utility energy-efficiency programs.

NMR GROUP

Dr. Lynn Hoefgen (*Attribution*) is president of NMR. He has over 25 years experience in energy-related evaluation and market research. Dr. Hoefgen has been a key member of the team that has helped NYSERDA coordinate and supervise other evaluation contractors, has helped write NYSERDA's annual program evaluation and status report for several years, and set up a system to track indicators of program success. Recently, Dr. Hoefgen has led various projects assessing approaches to determining attribution and net savings and has spearheaded efforts at implementing innovative approaches to measuring net-to-gross ratios for residential appliances, lighting, and energy code and standards. Dr. Hoefgen is serving as the principal-in-charge of the attribution and net savings efforts for the Team.

Dr. Greg Clendenning (*Attribution, Renewables*) is a senior project manager at NMR. Dr. Clendenning has extensive experience in the use of quantitative and qualitative research techniques and in monitoring and evaluating energy-efficiency and renewable energy programs. Dr. Clendenning's evaluation research experience includes clean and renewable energy, residential lighting and appliance programs, commercial lighting, residential housing programs, and branding issues. He previously performed a market conditions assessment of NYSERDA's Renewable Portfolio Standard Program. Dr. Clendenning will be serving as the renewable energy attribution task manager.

Dr. Lisa Wilson-Wright (*Attribution*) is a senior project manager with NMR. She has extensive experience in the use of quantitative and qualitative research techniques to help inform energy efficiency, clean energy, and environmental policy. This includes conducting multivariate regression analysis, survival analysis, and billing analysis using PRISM. She has also designed and administered surveys, conducted in-depth interviews, and analyzed qualitative data. Dr. Wilson-Wright will oversee attribution and net savings efforts for the Team.

Susan Oman, (*Attribution, Appliances*) a senior project manager at NMR, has over 20 years of experience in the energy industry. She has worked extensively on projects relating to energy efficiency and renewable energy, with particular expertise in energy-efficient lighting programs and technologies. Ms. Oman has conducted a range of market research and market evaluation projects in the residential, commercial, and industrial sectors, including extensive research into appliance rebate and retirement programs. Ms. Oman will be serving as the appliances attribution task manager for the Team.

Thomas Mauldin (*Attribution*, *Energy Code*) is a senior project manager at NMR. He has managed program evaluation studies, market assessments, and implementation programs throughout his eleven years in the energy efficiency field. Mr. Mauldin has conducted studies regarding a wide variety of energy technologies, including residential lighting, appliances, and homes, as well as commercial motors, HVAC, and new construction. These studies have included in-depth interviews, telephone surveys, and on-site field inspections conducted with a variety of groups, including manufacturers, retailers, architects, engineers, contractors, businesses, residential customers, and program staff. Mr. Mauldin will be serving as the energy code attribution task manager.

David Filiberto (*Attribution, Renewables*) is a project analyst with NMR with expertise in the fields of environmental policy analysis and economics. He has developed innovative, community-based approaches to survey design, and prepared reports for diverse clients, including NYSERDA, addressing energy efficiency and renewable energy programs, guidelines for consistent reporting of evaluation M&V results, and community planning. He has deep knowledge of carbon markets, energy, water resources, and climate change-related disease and is a published author on climate change, energy policy, and renewable energy. Dr. Filiberto will be serving as the energy conservation studies attribution task manager and will also assist in the attribution assessment of the transportation and energy-efficiency programs.

Abt SRBI

Abt SRBI Inc. is a national survey research organization with headquarters in New York City and offices in Florida, Maryland, New Jersey, North Carolina, Georgia, greater Cincinnati, West Virginia, Tennessee, and Arizona. As a full-service survey research organization, Abt SRBI provides a wide range of support services, from focused group discussions, to developing questionnaires, to performing multivariate analysis of survey results.

Interviews for this project will be conducted from Abt SRBI's telephone center in New York City. Abt SRBI operates five telephone research centers, in New York City, New York; Fort Myers, Florida; West Long Branch, New Jersey; Huntington, West Virginia; and Hadley, Massachusetts. Together, Abt SRBI has more than 500 telephone interviewing positions and a staff of 600 experienced telephone interviewers. All interviewing positions are equipped for computer-assisted telephone interviewing and are continuously monitored for quality control. In addition to conducting interviews with consumers, Abt SRBI has an experienced corps of executive interviewers who are skilled in completing interviews with difficult to reach business customers. At least 15% of all interviews are silently monitored for quality control purposes and all interviewers are thoroughly trained and continuously evaluated.

Abt SRBI has been conducting evaluation and market research projects for clients in the energy industry since its founding in 1981. Its experience includes telephone surveys of residential and commercial/ industrial customers regarding a variety of energy conservation and efficiency topics (CFLs, appliance purchases and sales tracking, new construction, ENERGY STAR, HVAC retrofits, mobile homes, and energy audits).

Lisa Haislip will supervise the interview and survey data collection efforts for the Team.

Lincoln Wood will head the interview and survey data collection efforts.

Appendix C:

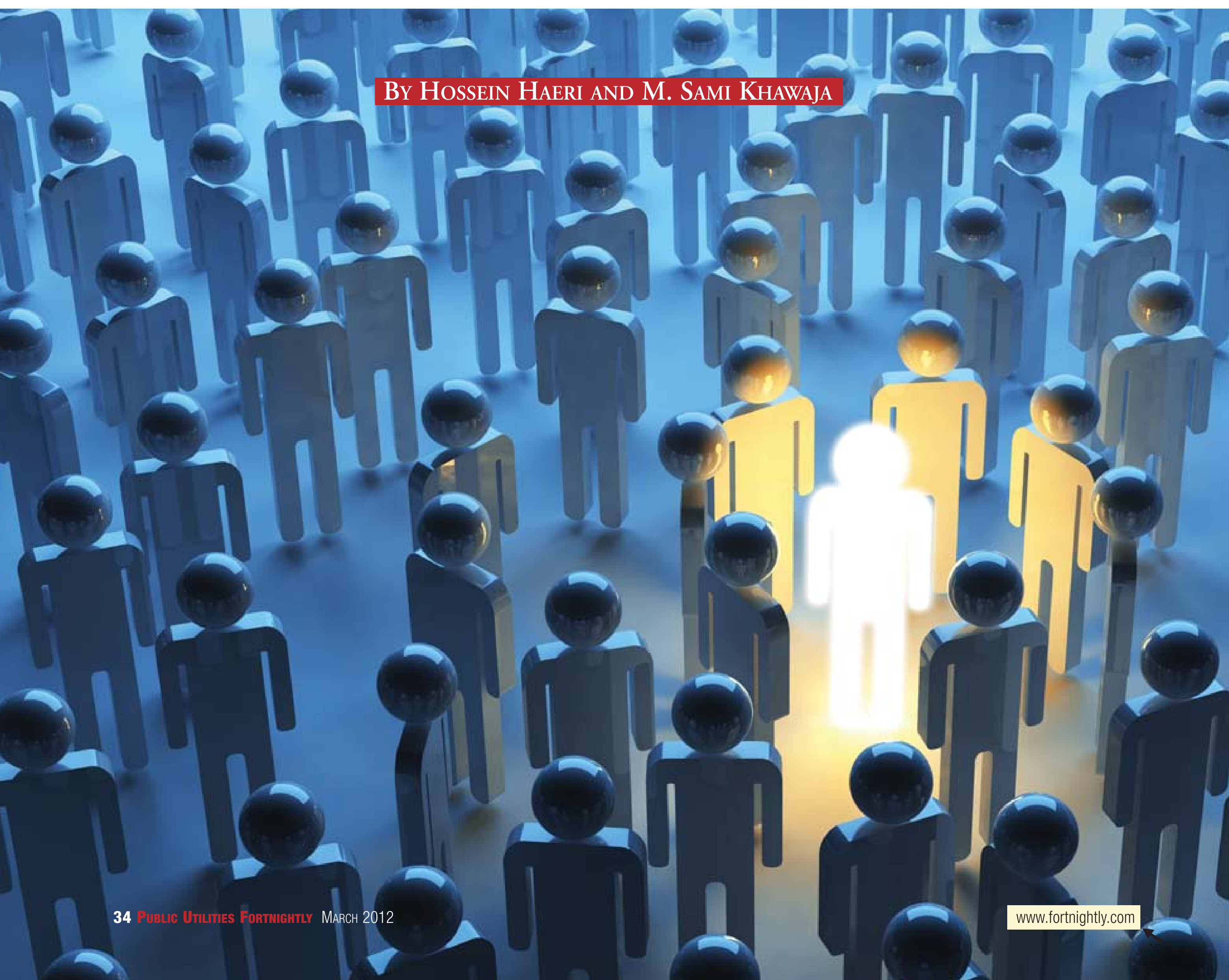
WHITE PAPER

“The Trouble with Freeriders – The debate about freeridership in energy efficiency isn’t wrong, but it is wrong headed,” by Hossein Haeri and M. Sami Khawaja.

The Trouble with Freeriders

The debate about freeridership in energy efficiency isn't wrong, but it is wrongheaded.

By Hossein Haeri and M. Sami Khawaja



The energy efficiency programs administered by California's investor-owned utilities reported 6,500 GWh of electricity and 84 million therms of natural gas savings for the three-year program cycle from 2006 to 2008. Yet valuations of these programs later credited the utilities for less than two-thirds of the electricity and slightly more than just one-half of the natural gas savings the utilities claimed. The rest—2,400 GWh and 40 million therms, to be exact—was claimed by freeriders.

And for the next three-year program cycle, from 2010 to 2012, California utilities appear set to invest $3.1 billion from 2010 to 2012 to meet the saving targets, 6,965 GWh and 153 million therms, approved by the California Public Utilities Commission (CPUC).[1] However, if things go as they did before—and indications are that they might—much of these savings will again go to freeriders.

Investment in energy efficiency has been growing rapidly throughout the United States. In a recent report, the Consortium for Energy Efficiency (CEE) estimated that spending on ratepayer-funded energy efficiency programs was $5.3 billion in 2009, with planned expenditures of 6.6 billion in 2010.[2] More than 50 percent of the expenditures were concentrated in California, New York, Massachusetts, and the Pacific Northwest—a group of states that accounts for 20 percent of U.S. electricity and natural gas consumption. Expenditures are also growing geographically, as the number of states offering energy efficiency programs has increased from 37 to 46 in just the past three years.

This trend is likely to continue for at least the near future. Energy efficiency resource standards with aggressive saving targets are in effect in 26 states and probably will be put into place in more states through legislative action, regulatory mandates, or voluntary goals. Program administrators in these states are accelerating their programs to meet mandated saving goals. As these programs expand and investments in them increase, so will concerns about how freeriders factor into success and compliance metrics. And mechanisms for performance risk and reward appear even more controversial.[3] As a result, freeridership likely will continue playing a prominent part in the regulatory and policy discourse about ratepayer-funded conservation.

Signs suggest a coming shift in the focus in energy efficiency, from energy resource planning to greenhouse gas emission reductions. As the goals of the two policies converge, questions arise about how to track and appropriately credit energy savings attributable to a myriad of different programs, such as 1) the regional greenhouse gas initiatives, 2) regional market transformation initiatives, 3) the federal *American Recovery and Reinvestment Act* (ARRA), 4) state tax policies to promote energy efficiency, and 5) local stimulus funds earmarked for energy efficiency and creation of green jobs. Such questions will only intensify the debate over freeridership, and about monitoring and attributing savings.

The Origin of the Species

Freeridership is a long-standing issue in all areas of social science that involve public policy. Russell Hardin, in the *Stanford Encyclopedia of Philosophy*, traces the origins of the concept to *Plato's Republic* and points to references to it in the works of the 18th and 19th century political philosophers, including David Hume and John Steuart Mill, among others. As Hardin points out, despite this widespread recognition, it wasn't until 1965 that the concept of freeridership and its implications for public policy were systematically formulated by Mancur Olson in his *Logic of Collective Action*.[4]

With ratepayer-funded conservation, freeridership is probably less about fairness and more about economics.

Olson's analysis was based on Paul Samuelson's theory of public goods. Samuelson, in 1954, noted that some goods, once they're made available to one person, can be consumed by others at no additional marginal cost.[5] This condition, called "jointness of supply" or "non-rivalrous consumption," refers to situations where consumption of a good by one person doesn't affect others' consumption of the good. In other words, the good, once provided for anyone, "is *de facto* provided for everyone in the relevant area or group."[6]

A second distinctive feature to Samuelson's theory of public goods is the impossibility of exclusion: Once a public good is supplied at all, excluding anyone from its consumption is supposedly impossible.[7] This attribute gives rise to freeridership, whereby some individuals either consume more than their fair share of a common resource, or pay less than their fair share of its costs. In certain cases, individual consumers may reap benefits without paying for them.

Hossein Haeri is executive director and **M. Sami Khawaja** is senior vice president at The Cadmus Group. The authors acknowledge the research assistance of Seth Kadish of The Cadmus Group.

A compelling case exists that some goods are both joint in supply and non-excludable—the so-called "pure public goods," such as clean air. But ratepayer-funded energy efficiency programs don't fit this category, at least not closely, for they lack both of the defining features of a public good. They are hardly non-rivalrous, as there have been many cases of budget constraints prohibiting some eligible consumers from participating in a program. Nor are they non-excludable, since utilities routinely set eligibility criteria for participation, and enforce those criteria when possible.

Indeed, the logic of public goods is of little practical relevance in the context of ratepayer-funded energy efficiency. In these cases, freeridership refers to program participants who presumably would have conserved regardless of the program. These consumers are presumed to be predisposed to conservation; they practice efficiency whether or not any incentives are available. As such, they're the opposite of what Samuelson would have considered freeriders: people unwilling to pay for a good while enjoying its benefits. Early adopters of energy efficiency and renewable technologies are a case in point.

Cause and Effect

The fundamental problem with freeridership in energy efficiency is attribution; that is, whether and to what extent the observed change in energy consumption or the adoption of an energy-efficient product is likely to have been triggered by a program. And the problem is by no means peculiar to energy efficiency. It arises in many policy areas, whenever economic agents are paid an incentive to do what they might have done anyway. The problem is inherent, for example, in the additionality requirement, which is the defining characteristic of the CO_2 offset concept established by the clean development mechanism (CDM) of the Kyoto Protocol. The mechanism, which is now the world's largest greenhouse gas emissions offset scheme, is intended to validate and measure impacts from projects to ensure that they produce authentic benefits and are genuinely additional activities that wouldn't otherwise have been undertaken.

In energy efficiency, freeridership factors into the calculation of a program's impacts as the ratio of savings attributable to the program (net savings) and the savings expected to be achieved according to planning assumptions (gross savings). The result is the net-to-gross (NTG) ratio.[8]

For utilities administering ratepayer-funded programs, the implications of NTG calculations can be large and wide-ranging. The calculations affect nearly all essential criteria that define and determine performance, particularly saving claims and cost-effectiveness. Uncertainty arises because the NTG ratio usually isn't known until well after a program has been implemented. Utilities become exposed to financial risks, particularly in jurisdictions where performance standards include penalties for under-performance (*e.g.*, Pennsylvania, New York, and Washington), provisions for lost-revenue recovery (*e.g.*, Nevada and North Carolina), or shareholder incentive (*e.g.*, California and New York).

For these reasons, the concept of freeridership has been a uniquely charged topic, eliciting frustration and disagreement among energy-efficiency policy makers, program administrators, and evaluation experts. Despite years of research, no commonly held or precise understanding has been established of what NTG means, what it includes, how best to measure it, and what to do with the results once the measurement is done. In fact, its very definition isn't firmly settled *(see "From Gross to Net.")*

Freeridership, and the broader concept of NTG, remain, in the words of William Saxonis, a regulator in New York, a "regulatory dilemma."[9]

Freeridership remains the most common criticism of ratepayer-funded energy efficiency among the skeptics,[10] along with the so-called rebound effect (the notion that greater efficiency leads to increased consumption due to an income price effect) and persistence of savings. The debate over these topics dates back to the mid-1980s, when energy efficiency consisted of what were, by today's standards, small-scale conservation programs focusing mostly on residential weatherization. Citing freeridership as an argument against public intervention in energy-efficiency markets, the critics of ratepayer-funded conservation argued that the presence of freeridership overstates the energy-savings potential of conservation programs and understates their actual cost, distorting resource choices.

Skeptics have criticized ratepayer-funded conservation on the grounds of distributional concerns arising from the potentially adverse rate impacts.[11] Because freeridership is correlated with the level of financial incentives available to the participant, the reasoning goes, if incentives are too high and the participant isn't expected to commit his or her own money to the effort, freeridership will go up, reducing the effectiveness of the program and leading to higher average rates for consumers, particularly those who don't benefit from the program.[12]

This argument sounds right, but is wrong. Free riders in energy efficiency programs tend to be those willing to adopt a measure with low (not high) incentives, relative to a measure's incremental cost. These are the consumers who most likely would have adopted the energy efficiency on their own. This negative correlation between freeridership and incentives was amply demonstrated in a recent study in Washington. The study surveyed about 350 consumers who had participated in eight conservation programs that offered different levels of incentives. Participants were asked a number of questions on why they took part in these programs. Based on their answers, each respondent was assigned a freeridership score. A comparison of these scores with the incentives received by the respondents showed a strong

From Gross to Net

Freeridership—and the general issue of attributing observed results to program implementation—has long been recognized as a problem in ratepayer funded conservation. The problem is discussed thoroughly in early manuals for impact evaluation of conservation programs by the Oakridge National Laboratory[1] and the Electric Power Research Institute.[2]

Conceptually, freeridership reflects an aspect of self-selection bias, a problem in voluntary programs under which participants may be propelled to adopt conservation measures by factors unrelated to a conservation program.

That places a premium on how NTG is defined, the net-to-gross ratio—the ratio of savings attributable to the program (net savings) versus the savings expected to be achieved according to planning assumptions (gross savings).

But no consensus exists on what NTG means and what its elements are. The lack of a common perspective was amply demonstrated in a 2010 scoping study sponsored by the New England Energy Efficiency Partnership (NEEP).[3] The study started with a survey of local experts in energy efficiency, asking them apparently simple questions: What are "net" savings? What are the elements of NTG? What's the proper role of NTG in program evaluation? How should it be measured and what would be the appropriate amount that should be invested in measuring it?

It turns out that none of these questions has an obvious or easy answer. The study concluded that, even within a region with one of the longest histories of energy conservation, "the definition and measurement of net energy savings remains a controversial issue." Even more surprising is that the experts could not even agree on whether more consistent definitions and measurement approaches were needed or even desirable. The lack of consensus was echoed in a 2007 survey of 20 energy efficiency program planners, implementers, and evaluators, carried out for the California Evaluation Outreach Initiative under the auspices of CPUC.[4] *–HH and MSK*

Endnotes:

1. *Handbook of Evaluation of Utility DSM Programs*, ORNL/CON-336, Oak Ridge National Laboratory, December 1991.
2. *Impact Evaluation of Demand-Side Management Programs, Vol. 1: A Guide to Current Practice*, EPRI CU-7179, Electric Power Research Institute, Palo Alto, Calif., February 1991a.
3. *Evaluation, Measurement, and Verification Forum, Northeast Energy Efficiency Partnerships (NEEP), Net Savings Scoping Paper*, Prepared by NMR Group and Research Into Action, November 2010.
4. *Survey of Energy Efficiency Evaluation Measurement and Verification (EM&V) Guidelines and Protocols and Gaps and Needs*, Schiller Consulting, Prepared for The California Evaluation Outreach Initiative, May 2007.

negative correlation between ridership and incentives.[13]

An element of equity does come into play in ratepayer-funded conservation. Any disparity between how benefits and costs are distributed among customers is important; If a customer enjoys the benefits of conservation, one might wonder why the bill for those services should be divvied up and sent to his neighbors, especially if he was willing to pay for them. However, in the context of ratepayer-funded conservation, freeridership is probably less about fairness and more about economic efficiency.

The economic efficiency argument was first formulated systematically in 1992 by Paul Joskow and Donald Marron.[14] In their analysis of data on 16 utility-sponsored conservation programs, the authors identified freeridership as one of the most important issues in determining the costs and valuing the benefits of conservation programs. The particularly remarkable aspect of the study was its characterization of freeridership as a dynamic problem. The problem, they argued, derives from the fact that freeridership isn't limited to consumers who would have adopted energy-efficiency measures without the utility program, but also involves consumers who are likely to adopt the measures in the future.

From this perspective, a conservation program merely speeds up the adoption of energy-efficiency measures and increases the maximum penetration the measures are likely to achieve. Freeridership, therefore, isn't merely a question of "*whether* some of this year's participants would have adopted a conservation measure absent the utility's program, but *when* they would have adopted the measure."[15] Thus, if all of the participants would have installed the measure at some point in the future whether the program existed or not, "the static approach significantly overstates the actual savings of the program." The failure to account for such dynamic diffusion effects, they argue, results in overestimating the savings and underestimating the cost of conservation.

This argument is true, but only partly. Rather, it only applies to programs involving a retrofit—replacing functioning equipment with more efficient equipment. It doesn't apply to programs that offer incentives for replacement of equipment on burnout, a significant part of today's portfolios of ratepayer-funded programs. In these cases, if the failed appliance isn't replaced with an energy efficient one at the time of its replacement, the opportunity to do so will be lost for the course of the equipment's useful life.

The argument is also one-sided. It places the emphasis on the acceleration component of diffusion and ignores the potentially large effects of conservation programs on shifting the curve. What if the services offered under a program induced participants to take further conservation actions? What if they encouraged other consumers to adopt conservation measures without taking advantage of the program's incentives? They might take action because the program changed their perceptions about the benefits of conservation, or because the increase in demand induced a shift in supply, making energy-efficient products more available.

These behavioral effects on participants (participant spillover) and consumers in general (non-participant spillover or market transformation), although they're hard to quantify, can be sizable. Joskow and Marron recognized the validity of this proposition, but didn't explicitly account for these effects in their analysis.

Motivation and Social Desirability

A variety of methods have been used to either measure or account for freeridership. These methods fall into one of two general categories. The first is the general difference-in-differences approach, which involves comparing actual energy consumption of participants before and after they participate in a program to change consumption among a comparable group of non-participants in the same period.

Implemented properly and with a well-chosen comparison group, this quasi-experimental research design produces reasonably reliable results for net savings, but doesn't provide separate estimates for the components of NTG, freeridership, spillover, and market transformation effects, individually. The method is often implemented using regression-based techniques to control for residual difference between the two groups, evaluate the sensitivity of savings to various factors, and estimate savings for individual measures for programs that bundle measures.

The main limitation of this approach is that it isn't well suited for measuring savings for programs involving large commercial and industrial consumers. These consumers tend to be unique in many ways, identifying a comparable group of non-participants is often impractical. Savings, relative to total consumption, may also tend to be too small to measure against the many unpredictable factors that affect energy consumption of these consumers. It's also less effective in new construction programs, where the lack of pre-program data doesn't allow a complete comparison.

The second, and by far the more commonly used, group of methods rely on "self-report." At a basic level, self-report involves asking participants a series of questions about what they would have done in the absence of the program. Responses are then scaled, weighted, and combined to produce a composite freeridership score (or index) for each respondent. The scores for individual respondents are then weighted (by their savings) and averaged to produce a program-level freeridership fraction.

The obvious limitation of the self-report approach is that it doesn't produce an NTG ratio. Other components of NTG—spillover and market transformation effects—have to be estimated separately and then factored into the calculations. But eliciting reliable information about intentions and motivations can be thorny.

Using surveys to assess freeridership also raises concerns about response bias, particularly those biases involving social desirability, which is the tendency of respondents to gauge their responses to conform to socially acceptable values. This issue is well recognized in social sciences, and it's discussed in a vast body of academic and professional literature, including conservation program evaluation manuals.[16]

One aspect of social desirability is the tendency of respondents to offer what they think is the right answer, and this tends to result in an overstatement of freeridership. Also, as some evaluation experts have noted, people have internal reasons as explained by social psychology's attribution theory that motivate them to make certain decisions and to follow a cognitive process for justifying those decisions.[17]

Survey design practices have improved, and sophisticated ways of designing questionnaires promise a more nuanced way of eliciting information more reliably. Instead of simply asking what participants would have done in the absence of the program, multiple questions probe respondents about timing (would they have adopted the measure at the same time), amount (would they have adopted the measures in the same quantity), and level (would they have adopted the measures at the same level of efficiency).

Freeridership is a long-standing issue. The *Stanford Encyclopedia of Philosophy* traces the concept to *Plato's Republic*.

What questions to ask, what kind of scale to use for recording responses, what weights to consider appropriate, and how to apply the final scores are decisions that expose the analysis to subjective judgment.[18] This problem could make the analysis a subjective exercise, open to constant dispute. Different evaluations of similar programs conducted by analysts using seemingly similar methods have produced drastically different results. The use of surveys for determination of spillover effects, for participants or non-participants, is especially sensitive to variances in spillover scores. Small fractions multiplied by very large numbers of customers can dramatically boost the savings.

Another—and less tractable—aspect to response bias is construct validity, which raises questions about what the survey results actually measure. The problem stems from the fact that survey respondents are naturally predisposed to conservation; After all, they are program participants. Thus, it remains far from clear whether their responses are conditioned by the effects of the conservation program itself.

The survey results would overstate freeridership because the survey may be asking the question from the wrong people: those identified as freeriders are, in fact, exactly the type of participants program administrators would want for a program.[19] What's being measured, it appears, are the effects of the program—not what would have been expected in its absence.[20] In areas with long histories of conservation programs and activities, it's no longer possible to parse out who is a freerider and who was influenced by the program.

Could it be that, in the case of such transformed markets, what's being measured in freeridership surveys is in fact the opposite: spillover?

Considerable practical matters limit the usefulness of self-report as a means of eliciting information about freeridership in upstream, mass-market programs, where it might not be possible to identify participants, let alone freeriders, because consumers might not be aware that the price they pay for a product includes a utility discount. This happens routinely in programs that offer point-of-sale incentives for products such as compact fluorescent light bulbs.

The use of self-report is even more problematic in the large commercial, industrial, and new-construction sectors, where investment decision-making processes are complex and finding the right people to survey is rarely easy. Using the method is even more problematic in upstream programs deployed through retailers, where purchasing and stocking decisions can be especially complex, particularly in chains, where decisions tend to be made centrally and based on competitive considerations.

Self-report remains the most common method for determining freeridership. The approach has been defended by its protagonists as a transparent and appropriate approach for evaluating complex and diverse programs and markets.[21] They have argued that the method's shortcomings are mostly a matter of misunderstanding and misapplication,[22] and that the noted biases are readily addressed through improved survey design, better scaling algorithms, and analytic techniques.[23]

A report produced by an independent evaluator in 2006, summarizing the results of recent programs in California, noted that "the issues of identifying freeriders are complicated and estimating reliable program-specific freeridership is problematic at best."[24] One year later, the California Public Utilities Commission formed a working group of experts to explore ways to improve the self-report method and produce standardized questionnaires to collect the data and algorithms to analyze them consistently. The result was 17 recommendations that were largely useful but somewhat too general to address the fundamental shortcomings of the approach.[25]

A 2011 study commissioned by the Association of Energy Efficiency Program Administrators in Massachusetts developed survey instruments to assess freeridership and spillover in the commercial and industrial sectors. These instruments go a long way toward standardizing the data collection, scoring, and analytic steps.[26] The study concludes that the self-report techniques are "based on sound methodologies and are consistent with analytical methods used in the social sciences." But the study doesn't satisfactorily address the essential questions of response bias.

Baseline and Spillover

Related to the measurement problem is an idea advanced by some energy-efficiency planners. Freeridership, they say (and NTG, too), is essentially a question about baseline. "Counterfactual" is another way to put it: that is, the conditions that might have existed in the absence of a program.

As the argument goes, if actual market conditions, instead of hypothetical conditions based on codes and standards, were used as the basis for calculating expected savings of conservation measures, the resulting estimates would then need no further adjustment.

> **Using surveys to assess freeridership raises concern about bias — especially involving social desirability.**

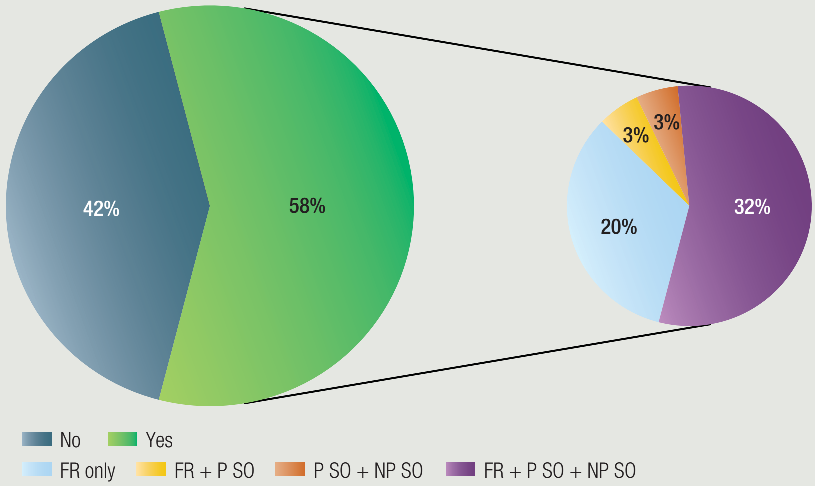
True enough, the concepts of NTG and baseline are linked. The actual penetration of conservation measures is a reasonably strong indicator of what might have happened in the absence of a program—but only for a planned program. It doesn't address the question of attribution in *ex post* evaluation of existing programs, because the observed market conditions also reflect not only a program's known direct impacts, but also the effects it might have induced—in other words, spillover. Disentangling what might have occurred in the absence of a program from the program's spillover effects is practically impossible in most cases. The longer a program operates, the more biased the estimates of freeridership are likely to be.[27]

Policy Differences, State by State

The definition, measurement, and treatment of freeridership, and NTG in general, vary across jurisdictions in the U.S. Some jurisdictions include both freeridership and spillover in their definitions of net savings, while others allow only freeridership to be counted. In several cases, freeridership and spillover are measured separately and incorporated in NTG, while other jurisdictions estimate NTG without specifying freeridership and spillover individually. In the majority of cases where NTG is required, it's applied only prospectively for planning and improving program design.

A review of practices in 31 jurisdictions with active energy efficiency programs illustrates this variation. All but six of these jurisdictions (82 percent) have energy efficiency resource standards (EERS) in place, setting minimum performance requirements.[28] Remarkably, documents and reports are lacking on NTG or how

FIG. 1 TREATMENT OF FREERIDERSHIP AND SPILLOVER BY JURISDICTION



Different states take different approaches to defining, measuring, and accounting for freeridership and program result assessments in general. Some jurisdictions calculate both freeridership and benefit spillover in their definitions of net savings, while others count only freeridership.

Notes: FR = freeridership; P SO = participant spillover; NP SO = non-participant spillover; EERS = energy efficiency resource standards.

		Spillover		
Jurisdiction	**EERS**	**Participant**	**Non-Participant**	**Freeridership**
Arizona	Yes	No	No	No
Arkansas	Yes	Yes	Yes	Yes
California	Yes	Yes	No	Yes
Colorado	Yes	No	No	Yes
Connecticut	Yes	Yes	Yes	Yes
Delaware	No	No	No	No
District of Columbia	No	No	No	No
Florida	Yes	Yes	Yes	Yes
Hawaii	Yes	No	No	Yes
Idaho	No	No	No	No
Illinois	Yes	Yes	Yes	Yes
Indiana	Yes	No	No	Yes
Iowa	Yes	No	No	No
Maine	Yes	No	No	Yes
Maryland	Yes	No	No	No
Massachusetts	Yes	Yes	Yes	Yes
Michigan	Yes	No	No	No
Minnesota	Yes	No	No	Yes
Nevada	Yes	No	No	Yes
New Hampshire	No	Yes	Yes	No
New Jersey	No	No	No	No
New York	Yes	Yes	Yes	Yes
North Carolina	Yes	No	No	No
Ohio	Yes	No	No	No
Oregon	Yes	Yes	Yes	Yes
Pennsylvania	Yes	No	No	No
Texas	Yes	No	No	No
Utah	No	Yes	Yes	Yes
Vermont	Yes	Yes	Yes	Yes
Washington	Yes	No	No	No
Wisconsin	Yes	No	No	Yes

Source: The Cadmus Group

it's treated in different jurisdictions. For many jurisdictions, this information must be gleaned from multiple sources, such as regulatory filings and evaluation reports. Indeed the authors' research couldn't determine with certainty the requirements for calculating and reporting NTG in several jurisdictions.

The available information shows that 13 of the jurisdictions (42 percent) have no NTG requirements. 18 jurisdictions (58 percent) include freeridership in determination of NTG, and in seven of these jurisdictions freeridership is applied at the energy efficiency measure level. In six jurisdictions (20 percent) only freeridership in accounted for. Participant spillover is measured in 12 jurisdictions (37 percent) and in 10 cases (32 percent) NTG calculations include all three effects *(see Figure 1)*.

The high proportion of cases where only freeridership is assessed suggests an asymmetrical treatment of spillover and freeridership effects. Should spillover be included, it's likely that many of the NTG ratios will be near or greater than 1.0. Over two-thirds of all evaluation studies reviewed in a recent best-practice study had a net-to-gross value of approximately 1.0.[29]

Finally, there are cases where NTG—or its components—don't require measuring. Gross savings, adjusted for actual installation rates, are employed instead as the measure of program performance. That's also the case with regional transmission organizations (RTO) such as the New England independent system operator (ISO-NE), where verified gross savings are used as the basis for verification of energy-efficiency bids into the forward energy market.

There's also the question of what to do with the NTG ratio once it's measured, and how to factor it into performance metrics, such as cost-effectiveness tests. Although the total resource cost test (TRC)—as formulated in the *California Standard Practice for Cost-Benefit Analysis* *of Conservation and Load Management Programs* (SPM)—has been almost universally adopted as the principal criterion for economic assessment of conservation programs, there was no clear or uniform method to how the NTG should be applied to the cost side of the TRC equation. Indeed it wasn't until 2007, almost 25 years after the SPM's initial publication in 1983, that the CPUC issued a memorandum to clarify the matter.[30] Even today there's little consensus on how to account for NTG in the calculation of TRC.

Assessing Blame

It's tempting to blame the critics of energy efficiency for the prolonged confusion over what to make of freeridership; and that wouldn't be entirely wrong. But skepticism about ratepayer-funded conservation isn't the full story. The fact is that the proponents of energy efficiency have failed to devise and make a convincing case for workable solutions to the problem.

In truth, the energy efficiency community holds no common view about a precise definition of what constitutes net savings or how to quantify it. Even the relevance of freeridership lacks consensus. Advocates of ratepayer-funded conservation have regarded freeridership as irrelevant and have dismissed it as a mere distraction.[31] Some skeptics, on the other hand, have singled out freeridership as a fundamental flaw in energy-efficiency policy; a byword for everything that's wrong with ratepayer-subsidized conservation.

Freeridership and the broader question of attribution are legitimate concerns when ratepayer funds are used for what's presumed to be a socially optimal outcome. Efficient allocation of resources must be a part of the process of making policy decisions and designing programs to implement them.[32]

But the lack of progress and the resulting uncertainty have surely inhibited creativity and innovation in program design and delivery. Program administrators have tended toward risk aversion, encouraged to focus on performance targets and to avoid regulatory penalties, instead of experimenting with potentially better programs.

An even more important reason for taking these seemingly conceptual and methodological disagreements seriously is this: If the concept of NTG and its measurement are perceived by policymakers and much of the public as dubious and inherently problematic, then political support for energy efficiency and, critically, its role in addressing larger global environmental issues, could dissipate.

Of course, measuring program performance remains a challenge. The measurement of NTG remains, as some experts have noted, an art rather than a science. [33]

But what if the measurement itself turns out to be the problem? Certainly, program administrators should avoid programs where freeridership is known to be high and discontinue offering the programs when high freeridership is suspected. But insisting on measuring freeridership with tools of questionable reliability isn't the answer.

A Modest Proposal

Knowing whether a program is likely to attract freeriders may be easier than it's made to appear. Simple rules might well do.

First, regulators could establish a series of hurdles, or tests, that a program has to pass to avoid high freeridership. The exact nature of the tests would vary depending on the program, but the amount of the incentive relative to the cost of the measure is a good general gauge. When very low incentives appear to attract a large number of participants, or net benefits to participants are very high, chances are the majority of participants will be freeriders.

Second, program administrators should monitor product markets closely to see if a transformation has occurred and exit the market when it has. Expected savings and costs of conservation measures should be revised periodically based on actual saturation of energy-efficient products. In this way, research and evaluation resources are invested in improving programs, rather than merely proving compliance.

Freeriders are, in fact, exactly the type of participants that administrators would want for a program.

For this approach to work, regulators would have to recognize such obvious, albeit hard-to-quantify, benefits, and be willing to credit program administrators with the results by lowering their saving targets accordingly, or even reward them. These ideas already seem to be taking hold in several states, where gross savings, adjusted for a deemed level of freeridership, are the basis for determining compliance and program performance. This sensible approach ought to address most of the concerns about freeriders. More importantly, it will encourage program administrators to undertake more optimal levels of energy efficiency and focus more on programs such as market transformation that might produce longer-lasting effects at potentially lower costs.

Well-conceived and effectively executed programs will likely generate enough spillover savings to offset freeridership. What few freeriders remain can be regarded, as one evaluation expert puts it, simply "a cost of doing business."[34]

Endnotes:

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3. For a discussion of risk-reward mechanism in California see Rufo, Michael, *Evaluation and Performance Incentives: Seeking Paths to (Relatively) Peaceful*

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7. It's been argued that exclusion is, more often than not, merely a problem of technology, not of logic. People are often easily excluded from enjoying public goods such as television broadcasting through the use of various devices that enable providers to charge the beneficiaries and to exclude those who don't pay, as for example, service providers that use cable rather than broadcasting over the air to provide television programming at a substantial price.
8. In some jurisdictions NTG is defined more broadly and the difference between gross and net savings includes other factors such as spillover, price-induced, or naturally occurring conservation and, in the case of certain upstream programs, leakage: purchase of energy-efficiency products by consumers outside a program administrator's service area.
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27. Friedman, Rafael, "Maximizing Societal Uptake of Energy Efficiency in the New Millennium: Time for Net-to-Gross to Get Out of the Way?" Proceedings, *International Energy Program Evaluation Conference*, Chicago, August 2007.
28. The surveyed jurisdictions were Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Hawaii, Idaho, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Texas, Utah, Vermont, Washington, and Wisconsin.
29. Quantum Consulting (now part of Itron). This study was managed by Pacific Gas & Electric under the auspices of the California Public Utility Commission in association with the California Energy Commission. The information from the study is available at: http://www.eebestpractices.com/index.asp
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Appendix D:

SURVEYS

- Energy Code Program Area
    - CEO Multiple Submission Survey
    - CEO Single Submission Survey
    - Program Manager Interview Guide
- Energy Efficiency and Renewable Energy Program Areas
    - NYSERDA ARRA Renewable and Energy Efficient Programs, Spillover Survey, RFP10 End Users (Non-Residential)
- Energy Efficiency Program Area
    - NYSERDA Energy Efficiency Program Survey
- Renewable Energy Program Area
    - NYSERDA ARRA Renewable Energy Programs, Online Participant Survey, RFP 10 and RFP 1613
- Transportation Program Area
    - Transportation Program Area Participant Survey

Plan Review Support Service

Multiple Submissions

Intro: Hello, my name is **[INTERVIEWER NAME]** from The Cadmus Group, and I'm calling on behalf of NYSERDA and its partners Newport Ventures and T.Y.Lin International. I am calling to speak with **[CEO NAME],** is he/she available? ***Once CEO is on Phone, reintroduce and continue.***

I am calling to discuss the plan review assistance services T.Y. Lin provided for the 2010 Energy Conservation Construction Code of New York State (ECCCNYS-2010). NYSERDA funded these services and wants to understand how useful they were and what could be done to improve them. I would like to ask you a few questions and would greatly appreciate your feedback. This call should take about 10 minutes.

A. Background Info

First I have a few questions that will help me understand a little about what you do.

1. Do you do both plan review and field inspections?
    a. Plan review only
    b. Field inspections only
    c. Both
2. Approximately what percent of the projects you review fall under the residential ECCCNYS? What percent are covered by the commercial code? [Total needs to add to 100%]

a.	Residential	___%
b.	Non-residential (commercial)	___%
	Total	100%

3. What are the principal occupancies of the commercial buildings for which you enforce ECCCNYS-2010? [Note: Multiple responses possible]
[Skip this question if respondent does not work with commercial buildings]
    a. Education
    b. Food Sales
    c. Food Service
    d. Health Care
    e. Lodging
    f. Retail/Mercantile
    g. Office
    h. Public Assembly
    i. Public Order and Safety
    j. Religious Worship
    k. Service
    l. Warehouse and Storage
    m. Manufacturing (Identify Industry Type e.g., chemical, food, paper, etc.)
    n. Vacant

o. Housing
p. Other [Specify]____

4. How many residential projects does your office process through plan review in a typical year?

5. How many commercial projects does your office process through plan review in a typical year?

B. Participation and Awareness

6. How did you find out about the plan review services?

____

7. Why did you decide to use these services?

____

8. Were there any reasons you were reluctant to use these services?
   Yes   If yes, what were the reasons?
   No

C. Residential Project Feedback

[Skip Section C if respondent did not get service for any residential projects]

9. Our records indicate that you submitted at least one residential project with multiple submissions for plan review services to gain additional comments. Is that correct?
   a. Yes
   b. No [If no, provide name of project]
   c. Don't Know [If no, provide name of project]

10. Why did you select this project (these projects) for plan review assistance?

11. What were the most significant issues that were identified by the reviewer?

12. Why did you decide to resubmit that project (those projects) for a follow-on review?

13. Compared to your first submission for plan review services, how helpful were the additional comments and insights provided with follow-on submissions?

14. How did you use the information from the reviews?

15. How helpful was the text portion of the plan review summary?

16. How helpful was the compliance checklist?

17. How helpful was the inspection checklist?

18. What recommendations do you have for how the residential plan review services could be improved?

19. Before you received the plan review services how would you rate your knowledge of the residential provisions of the ECCCNYS-2010 (energy code)? Please provide a number between 0 and 10, where 0 means "not at all knowledgeable" and 10 means "extremely knowledgeable."

    [Enter number 0 – 10] ____

20. After receiving the plan review services how would you rate your knowledge of the residential code provisions using the same scale?

    [Enter number 0 – 10] ____

21. What were the most useful things you learned from receiving the plan review services for residential projects?

D. Commercial Building Project Feedback

[Skip Section D if respondent did not get service for any commercial projects]

22. Our records indicate that you submitted at least one commercial project with multiple submissions for plan review services to gain additional comments. Is that correct?
    a. Yes
    b. No [If no, provide name of project]
    c. Don't Know [If no, provide name of project]

23. Why did you select this project (these projects) for plan review assistance?

24. What were the most significant issues that were identified by the reviewer?

25. Why did you decide to resubmit that project (those projects) for a follow-on review?

26. Compared to your first submission for plan review services, how helpful were the additional comments and insights provided with follow-on submissions?

27. How did you use the information from the reviews?

28. How helpful was the text portion of the plan review summary?

29. How helpful was the compliance checklist?

30. Would a commercial inspection checklist be helpful for you in your code enforcement duties?

31. What recommendations do you have for how the commercial plan review services could be improved?

32. Before you received the plan review services how would you rate your knowledge of the commercial provisions of the ECCCNYS-2010 (energy code)? Please provide a number between 0 and 10, where 0 means "not at all knowledgeable" and 10 means "extremely knowledgeable."

    [Enter number 0 – 10] ____

33. After receiving the plan review services how would you rate your knowledge of the commercial code provisions using the same scale?

    [Enter number 0 – 10] ____

34. What were the most useful things you learned from receiving the plan review services for commercial projects?

E. Overall Feedback

35. After receiving plan review services, did you return the plans to the project applicant with recommended changes or requests for more information? If so, how did the applicant address the changes or information needs?

    a. How do you think this process improved the applicant's knowledge of the new code provisions?

36. Is there anything T.Y.Lin, NYSERDA, DOS or DOE can do to improve their plan review service communications with Code Enforcement Officials? [Open Ended]

37. How satisfied are you with the way the plan review services were provided? Would you say you are very satisfied, somewhat satisfied, unsatisfied, or very unsatisfied? Why do you say that?

38. What were the main ways the plan review services helped you improve how you do your job?

39. Would a similar service for inspections be helpful?

40. Did you use this plan service more as a learning tool or as a support tool to assist in taking on your work load?

41. What other comments do you have about the plan review services that you would like to provide?

Thank you for your time. NYSERDA greatly appreciates your feedback.

Plan Review Support Service

Single Submissions

Intro: Hello, my name is **[INTERVIEWER NAME]** from The Cadmus Group, and I'm calling on behalf of NYSERDA and its partners Newport Ventures and T.Y.Lin International. I am calling to speak with **[CEO NAME],** is he/she available? ***Once CEO is on Phone, reintroduce and continue.***

I am calling to discuss the plan review assistance services T.Y. Lin provided for the 2010 Energy Conservation Construction Code of New York State (ECCCNYS-2010). NYSERDA funded these services and wants to understand how useful they were and what could be done to improve them. I would like to ask you a few questions and would greatly appreciate your feedback. This call should take about 10 minutes.

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a.	Residential	___%
b.	Non-residential (commercial)	___%
	Total	100%

3. What are the principal occupancies of the commercial buildings for which you enforce ECCCNYS-2010? [Note: Multiple responses possible]
[Skip this question if respondent does not work with commercial buildings]
    a. Education
    b. Food Sales
    c. Food Service
    d. Health Care
    e. Lodging
    f. Retail/Mercantile
    g. Office
    h. Public Assembly
    i. Public Order and Safety
    j. Religious Worship
    k. Service
    l. Warehouse and Storage
    m. Manufacturing (Identify Industry Type e.g., chemical, food, paper, etc.)
    n. Vacant

o. Housing
p. Other [Specify]____

4. How many residential projects does your office process through plan review in a typical year?

5. How many commercial projects does your office process through plan review in a typical year?

B. Participation and Awareness

6. How did you find out about the plan review services?

____

7. Why did you decide to use these services?

____

8. Were there any reasons you were reluctant to use these services?
   Yes If yes, what were the reasons?
   No

C. Residential Project Feedback

[Skip Section C if respondent did not get service for any residential projects]

9. Our records indicate that you submitted at least one residential project for plan review services without resubmitting that project for additional comments. Is that correct?
   a. Yes
   b. No [If no, provide name of project]
   c. Don't Know [If no, provide name of project]

10. Why did you select this project (these projects) for plan review assistance?

11. What were the most significant issues that were identified by the reviewer?

12. How did you use the information from the review?

13. How helpful was the text portion of the plan review summary?

14. How helpful was the compliance checklist?

15. How helpful was the inspection checklist?

16. What recommendations do you have for how the residential plan review services could be improved?

17. Why did you decide not to resubmit that project (those projects) for a follow-on review?

18. Before you received the plan review services how would you rate your knowledge of the residential provisions of the ECCCNYS-2010 (energy code)? Please provide a number between 0 and 10, where 0 means "not at all knowledgeable" and 10 means "extremely knowledgeable."
    [Enter number 0 – 10] ____
19. After receiving the plan review services how would you rate your knowledge of the residential code provisions using the same scale?
    [Enter number 0 – 10] ____
20. What were the most useful things you learned from receiving the plan review services for residential projects?

D. Commercial Building Project Feedback

[Skip Section D if respondent did not get service for any commercial projects]

21. Our records indicate that you submitted at least one commercial building project for plan review services without resubmitting that project for additional comments. Is that correct?
    a. Yes
    b. No [If no, provide name of project]
    c. Don't Know [If no, provide name of project]
22. Why did you select this project (these projects) for plan review assistance?
23. What were the most significant issues that were identified by the reviewer?
24. How did you use the information from the review?
25. How helpful was the text portion of the plan review summary?
26. How helpful was the compliance checklist?
27. Would a commercial inspection checklist be helpful for you in your code enforcement duties?
28. What recommendations do you have for how the commercial plan review services could be improved?
29. Why did you decide not to resubmit that project (those projects) for a follow-on review?
30. Before you received the plan review services how would you rate your knowledge of the commercial provisions of the ECCCNYS-2010 (energy code)? Please provide a number between 0 and 10, where 0 means "not at all knowledgeable" and 10 means "extremely knowledgeable."
    [Enter number 0 – 10] ____
31. After receiving the plan review services how would you rate your knowledge of the commercial code provisions using the same scale?
    [Enter number 0 – 10] ____
32. What were the most useful things you learned from receiving the plan review services for commercial projects?

E. Overall Feedback

33. After receiving plan review services, did you return the plans to the project applicant with recommended changes or requests for more information? If so, how did the applicant address the changes or information needs?
    a. How do you think this process improved the applicant's knowledge of the new code provisions?

34. Is there anything T.Y.Lin, NYSERDA, DOS or DOE can do to improve their plan review service communications with Code Enforcement Officials? [Open Ended]

35. How satisfied are you with the way the plan review services were provided? Would you say you are very satisfied, somewhat satisfied, unsatisfied, or very unsatisfied? Why do you say that?

36. What were the main ways the plan review services helped you improve how you do your job?

37. Would a similar service for inspections be helpful?

38. Did you use this plan service more as a learning tool or as a support tool to assist in taking on your work load?

39. What other comments do you have about the plan review services that you would like to provide?

Thank you for your time. NYSERDA greatly appreciates your feedback.

NYSERDA Plan Review Services, T.Y.Lin International

Program Manager Interview Guide

Name:

Title:

Program Role

1. Please describe your role and responsibilities for the NYSERDA plan review services.
2. What background and experience do you have that were most useful for providing these services?
3. What are the ideal requirements for someone to provide these services?

Marketing

4. How was the service marketed and how were the jurisdictions informed about these services? Who did the marketing for these services?
5. What marketing was most effective? Least effective?
6. What gaps did you see in which jurisdictions were reached by the marketing? How could these gaps be filled in the future?
7. What were the most common reasons jurisdictions requested the services?
8. Do you think any jurisdictions hesitated to request the services? If so, why?
9. Were any requests for services rejected? If so, why?
10. If T.Y.Lin received a project that did not have enough information, what did you do?

Program Design and Implementation

11. NYSERDA provided us copies of the reports and checklists you delivered to the code officials. Please explain what the role of the residential inspection checklist was, if it was useful, and if a commercial checklist would have been useful.
12. Please explain what your process was to provide the plan review services?
    a. What documents did you request from the code officials when they asked for plan review services?
    b. What did you look for in your review?
    c. How did your review vary depending on whether a commercial project complied under ECCCNYS or ASHRAE 90.1?
13. How did your services vary between commercial and residential buildings?

14. How did your services vary between different size jurisdictions?
15. What obstacles or bottlenecks, if any, did you encounter in providing the plan review services? How did you resolve them?

Single Submission vs. Multiple Submissions

16. A number of code enforcement officials submitted a project for review only once, even though the recommendation was for a resubmittal. Why do you think they didn't resubmit? What did they do about your recommendations for the projects in the cases where they didn't resubmit?
17. What factors do you think mostly affected whether they would resubmit a project (such as size of the jurisdiction, type of project, knowledge level of the code officials)?
18. When officials did resubmit, what improvements did you usually find? What areas were most likely to still require revisions?

Findings

19. What were the most common problems you found with residential projects?
20. What factors do you think contributed to the problems you found in residential projects? For example, complexity of the project design; lack of designer/builder experience; lack of code official experience; lack of training of code officials or designers/builders; other?
21. What were the most common problems you found with commercial projects?
22. What factors do you think contributed to the problems you found in commercial projects? For example, complexity of the project design; lack of building professional builder experience; lack of code official experience; lack of training of code officials or designers/builders; other?

Tracking & Quality Assurance/Quality Control

23. How did you track the services provided?
    a. What information was collected?
    b. Was there a database for tracking your services? If so, what types of data did it contain?
24. Please explain the QA/QC process you used for these reviews?

Quality and Effectiveness

25. How did code officials use the plan review services you provided for residential projects? How much do you think the reviews changed their residential review practices and energy savings in residential projects they review in the future?
26. How did code officials use the plan review services you provided for commercial projects? How much do you think the reviews changed their commercial review practices and energy savings in commercial projects they review in the future?

27. For the code officials who received these services, what long-term effects do you think these services will have on their practices?
28. How much do you think the code officials who received the services will share what they learned with other code officials in their jurisdiction? In other jurisdictions?
29. How helpful and effective do you think code officials felt the plan review services were overall?
30. In what ways do you think the program to provide these services was most successful and effective?
31. In what ways do you think the program was least successful and effective?
32. What changes would you recommend?

Wrap-Up

33. What additional comments or suggestions would you like to make about the plan review services program?

NYSERDA ARRA Renewable and Energy Efficient Programs, Spillover Survey, RFP10 End Users

(Non-Residential)

Hello, my name is _______________ and I am calling from The Cadmus Group on behalf of the New York State Energy Research and Development Authority (NYSERDA). I would like to ask you some questions regarding any equipment installations or actions you have undertaken since you received approval from NYSERDA on the [RENEWABLE OR ENERGY EFFICIENT MEASURE(S))] your company recently installed.

Your answers are important to us. Your experience, together with the experiences of other organizations like yours will help NYSERDA improve future programs. This is not a sales or marketing call.

Your responses will be kept private to the extent permitted by law. NYSERDA's analysis will only use summary level data and will not identify individual organizations.

The survey should take no more than 5 minutes. Is this a good time to talk? [If not, ask when is a good time to reschedule.]

Do you have any questions?

[IF NECESSARY, OFFER THE CONTACT NAME FROM BELOW AS THE PERSON TO CONTACT WITH ANY QUESTIONS ABOUT THE VALIDITY OF THE RESEARCH.]

Rebecca Reed	NYSERDA	866-697-3732 X3559

Q1. Just to confirm, we show that your organization installed a [EQUIPMENT or MEASURE TYPE] at [INSERT ADDRESS & NAME OF BUSINESS & TYPE OF BUSINESS]. Is this correct?

1. Yes [Continue]
2. No [Ask what piece of information is incorrect and record]

Q2. Are you the person who is most knowledgeable about equipment installations at this facility?

1. Yes
2. No [ASK TO SPEAK WITH PERSON MOST KNOWLEDGEABLE ABOUT THE EQUIPMENT, REPEAT INTRODUCTION AND ASK 0]

Renewable and EE Spillover

S1. Since getting approval to install your [[EQUIPMENT or MEASURE TYPE], have you installed any additional renewable or energy efficient measures at this location or facilities in New York state?

1. Yes
2. No [skip to S7]

-98 Don't know
-99 Refused

S2. [IF S1 = 1 (YES)] What have you installed? [PLEASE SPECIFY. Probe respondent for details about the new renewable or energy efficient measure(s): size, efficiency, etc]

S3. [IF S2 = Wind or PV] How much additional electric capacity from renewable energy generation have you added?

_______________ [kW of additional capacity]

S4. [IF S2 =Efficiency Measures or Biomass, Solar Thermal, Solar Wall, Solar Water Heater, or Other] How much energy usage do you offset with your new system?

_______________ [kWh or therms or BTUs]

S5. Would you say that your involvement with NYSERDA's rebate program for your [EQUIPMENT OR MEASURE TYPE] was influential in your decision to install the additional renewable or energy efficient measure(s)? Was the program:

1. Not at all influential
2. Somewhat influential
3. Neither [DO NOT READ]
4. Very influential
5. Extremely influential

-98 Don't know
-99 Refused

S6. Did you receive any rebates, grants, or tax credits for the installation of your new equipment?

1. No
2. Yes – Please specify ____________________

S7. Since installing your [EQUIPMENT TYPE], have you installed any energy efficient or ENERGY STAR-qualified equipment? [If needed, list equipment types in question below.]

1. Yes – GO TO S8
2. No – GO TO S10

-98 Don't know
-99 Refused

S8. What energy efficient or ENERGY STAR rated equipment did you install? [Ask all follow up questions for each and every piece of equipment claimed.]

Equipment / Improvement S8a. Yes or No	S8b – [If mentioned] Did you receive a rebate or tax credit from another entity for any of the additional equipment installed?	S8c - If yes, which rebate or tax credit program was it?	S8d – How would you rate the influence of your renewable or efficiency measure installation on this purchase? 1- Not very influential, 2- Somewhat influential, 3-Neither [DO NOT READ], 4- Very influential, 5- Extremely influential
1. Air conditioner			
2. Clothes washer			
3. Dishwasher			
4. Duct sealing			
5. Gas Furnace			
6. Heat Pump			
7. Insulation			
8. Lighting			
9. Pool equipment			

10. Programmable Thermostat			
11. Refrigerator/freezer			
12. Dryer			
13. Television			
14. Water heater			
15. Whole house fan			
16. Windows/doors			
17. Other Specify 1			
18. Other Specify 2			
19. Other Specify 3			
20. Other Specify 4			

S9. [For any equipment listed in S8d that received an influence rating of 4 or 5] Can you please tell me a little more about the equipment you mentioned above? What fuel are you now saving with this upgrade [If not obviously electric]? What type, and how old, was the previous equipment?

Equipment 1:____

Equipment 2:____

Etc.

S10. Since receiving approval to install your renewable or efficiency measure(s), have you taken any energy saving behaviors? [If needed, list behavior types in question below.]

1. Yes – GO TO S11
2. No – GO TO S12

   -98 Don't know

   -99 Refused

S11. What behaviors are these?	S11a. Yes or No	S11b– How would you rate the influence of your renewable or energy efficient measure(s) installation on this purchase? 1- Not very influential, 2- Somewhat influential, 3-Neither [DO NOT READ], 4- Very influential, 5- Extremely influential
Increase thermostat settings in the summer		
Decrease thermostat settings in winter		
Decrease temperature setting on water heater		
Decreased hot water use		
Turn the lights off more		
Decreased the number of electrical equipment plugged in		
Turn off office equipment when not in use		
Installed motion sensors for lighting		
Other		
Other		

S12. [For any equipment listed in S11b that received an influence rating of 4 or 5] Can you please tell me a little more about the equipment you mentioned above? What fuel are you now saving with this upgrade [If not obviously electric]? What type, and how old, was the previous equipment?

Equipment 1:____

Equipment 2:____

Etc.

S13. Do you have any comments or questions? [RECORD]

This concludes the survey. Thank you for taking the time to answer these questions. Have a great day!

NYSERDA Energy Efficiency Program Survey

Thank you for participating in this study of energy efficiency programs administered by the New York State Energy Research and Development Authority (NYSERDA). We are asking you to complete this survey because your organization has participated in the Energy Efficiency Program for Municipalities, Schools, Hospitals, Public Colleges and Universities, and Non-Profits (RFP 1613), funded by NYSERDA's ARRA (the American Recovery and Reinvestment Act of 2009, also commonly referred to as the "Recovery Act" or "Stimulus" Funding) program.

NYSERDA is interested in your answers about why you participated in the NYSERDA ARRA program and how it influenced your energy efficiency project. These questions will help us understand the overall impacts of the American Recovery and Reinvestment Act of 2009. NYSERDA has contracted with independent research firms, The Cadmus Group, Inc. and NMR Group, Inc., to conduct the study. The study team of The Cadmus Group, Inc. and NMR Group, Inc., as independent research firms, will keep the information private to the extent permitted by law.

NYSERDA's analysis will only use summary level data and will not identify individual respondents or firms. If you have any questions about the survey, please contact Mark Lesiw of The Cadmus Group either by phone (303-389-2533) or by email (Mark.Lesiw@CadmusGroup.com).

If you have any concerns about the nature of this study and the reasons you are being asked to respond to it, please contact Rebecca Reed of NYSERDA either by phone (866-697-3732 ext. 3559) or by email (rlr@nyserda.org).

Completing this survey:
• Please carefully read all questions and directions
• Respond to all questions to the best of your ability
• The estimated length of the survey is 10 minutes. Y

our participation in this study supports energy efficiency development in New York.

Thank you very much for your help!

All fields with an asterisk (*) are required.

Introduction
First we would like to ask you a few questions about your energy efficiency project and how you found out about the NYSERDA ARRA program.

Awareness

*1. A1. How did you hear about the NYSERDA ARRA Program? [MARK ALL THAT APPLY](*Required)

Select at least 1 choices.

☐	1. Through NYSERDA's FlexTech program
☐	2. Through participation in other NYSERDA program
☐	3. Contractor / installer
☐	4. Program marketing materials
☐	5. Program outreach sessions
☐	6. Email or mailing from NYSERDA
☐	7. Webinar
☐	8. NYSERDA website
☐	9. Story in the media
☐	10. Colleague, friend, family -- word of mouth
☐	98. Don't know
☐	Other:

Motivation

*2. Why did you apply for Recovery Act funds from NYSERDA to implement this project? Please focus your answer on why you applied for the FUNDS, not why you decided to install the measure(s).(*Required)

*3. M2. To what extent was your decision to APPLY for funds from NYSERDA affected by the fact that the funds were provided by the Recovery Act? Please use a scale from 1 to 5 in which 3 is not a factor at all, 1 is a critical negative factor and 5 is a critical positive factor in your decision to apply. Please think only about your decision to apply for the funds, not your experiences after having received the funds. [NEGATIVE MEANS THAT IT WAS A DRAWBACK OF PARTICIPATION; POSITIVE MEANS IT WAS A DRIVER TO PARTICIPATION](*Required)

Select one.

- ○ 1. A critical negative factor
- ○ 2. Somewhat of a negative factor
- ○ 3. Not at all a factor
- ○ 4. Somewhat of a positive factor
- ○ 5. A critical positive factor
- ○ 98. Don't know

*4. M3. To what extent was your decision to apply for funds from NYSERDA affected by WHEN the funds would become available? Please use a scale from 1 to 5 in which 3 is not a factor at all, 1 is a critical negative factor and 5 is a critical positive factor in your decision to apply. [NEGATIVE MEANS THAT IT WAS A DRAWBACK OF PARTICIPATION; POSITIVE MEANS IT WAS A DRIVER TO PARTICIPATION](*Required)

Select one.

○	1. A critical negative factor
○	2. Somewhat of a negative factor
○	3. Not at all a factor
○	4. Somewhat of a positive factor
○	5. A critical positive factor
○	98. Don't know

*5. M4. Prior to participating in the NYSERDA program, had you participated in any other NYSERDA energy efficiency, energy conservation, or renewable energy program?(*Required)

Select one.

○	1. Yes	(Go to question number 6.)
○	2. No	(Go to question number 9.)
○	98. Don't know	(Go to question number 9.)

*6. M5. In what type of NYSERDA programs have you participated? [Please mark all that apply](*Required)

Select at least 1 choices.

☐	1. Energy audit	(Answer question number 6.1.)
☐	2. Technical study	(Answer question number 6.1.)
☐	3. New construction	(Answer question number 6.1.)
☐	4. Equipment replacement incentive	(Answer question number 6.1.)
☐	5. Renewable energy	(Answer question number 6.1.)
☐	Other	(Answer question number 6.1.)

*6.1 M5.1. [Please specify the NYSERDA program](*Required)

*7. M6. On a scale from 1 to 5, how influential was your participation in other NYSERDA programs in your decision to apply to this program? Please use a scale from 1 to 5 in which 1 illustrates a previous negatively influential experience, 3 was not at all influential and 5 is positively influential. [NEGATIVE WOULD MEAN YOU HAD A BAD EXPERIENCE AND WERE HESITANT TO TAKE PART BECAUSE OF IT; POSITIVE WOULD MEAN YOU HAD A GOOD EXPERIENCE AND IT ENCOURAGED YOU TO TAKE PART](*Required)

Select one.

○	1. Negatively influential
○	2. Somewhat negatively influential
○	3. Not at all influential
○	4. Somewhat positively influential
○	5. Positively influential
○	98. Don't know

*8. M7. Was/were the measure(s) you installed with the most recent NYSERDA assistance recommended in any energy audit or conservation study you had previously completed through a NYSERDA program?(*Required)		
Select one.		
○	1. Yes [PLEASE SPECIFY THE NYSERDA PROGRAM]	(Answer question number 8.1.)
○	2. No	

*8.1 M7.1 Please specify the NYSERDA program.(*Required)

Alternative and Additional Funding & Economy
Next we have some questions about the funding sources for your energy efficiency project.

*9. AF1. Approximately what percentage of the total project budget did the NYSERDA Recovery Act funds provide?(*Required)		
Select one.		
○	1. NYSERDA Recovery Act Funding did not cover any of the project budget (0%)	(Go to question number 10.)
○	2. NYSERDA Recovery Act Funding covered a portion of the project budget _____%	(Answer question number 9.1.) (Go to question number 10.)
○	3. NYSERDA Recovery Act Funding covered the entire budget of the project (100%)	(Go to question number 11.)

*9.1 AF1.1. [Please record percent](*Required)

*10. AF2. Did any of the other financing you received for this project require that you obtain matching funds from other sources?(*Required)		
Select one.		
○	1. Yes	(Answer question number 10.1.)
○	2. No	

*10.1 AF3. To what extent was your decision to apply for Recovery Act funds from NYSERDA affected by the requirement from other sources to obtain matching funds for the project? Please use a scale from 1 to 5 where 1 is a critical negative factor and 5 is a critical positive factor.(*Required)

Select one.

○	1. A critical negative factor
○	2. Somewhat of a negative factor
○	3. Not at all a factor
○	4. Somewhat of a positive factor
○	5. A critical positive factor
○	98. Don't know

*11. E1. BEFORE applying for Recovery Act funds from NYSERDA, had you ATTEMPTED to secure financing for this project?(*Required)

Select one.

○	1. Yes	(Go to question number 12.)
○	2. No	(Go to question number 17.)

*12. E2. Had you SUCCESSFULLY SECURED at least some other financing for this project BEFORE applying for the NYSERDA funds?(*Required)

Select one.

○	1. Yes	(Go to question number 13.)
○	2. No	(Go to question number 17.)

*13. E3. How did you use the previously secured funds? [Mark All That Apply](*Required)

Select at least 1 choices.

☐	1. Used them to pay for part of the costs of the energy efficiency project	(Go to question number 17.)
☐	2. Declined the funds BEFORE receiving NYSERDA Recovery Act funds	(Go to question number 15.)
☐	3. Declined the funds AFTER receiving NYSERDA Recovery Act funds	(Go to question number 15.)
☐	4. Lost the funds	(Go to question number 14.)
☐	5. Have not used previously secured funds yet	(Go to question number 17.)
☐	6. Used the previously secured funds for another project	(Go to question number 17.)
☐	98. Don't know	

*14. E4. Did Recovery Act funds from NYSERDA substitute for the funds that you LOST?(*Required)

Select one.

○	1. Yes, Recovery Act funds from NYSERDA substituted for the lost funds	(Go to question number 17.)
○	2. No, we substituted the lost funds from a source other than NYSERDA	(Go to question number 0.)
○	3. No, we did not substitute the funds but the project was still able to move forward	(Go to question number 0.)
○	Other: ________	(Go to question number 17.)

E5. Directions

15. E5. Did NYSERDA Recovery Act substitute for the funds that you DECLINED, or did something else happen?

Select one.

○	1. Yes, NYSERDA Recovery Act funds substituted for the lost funds
○	2. No, we substituted the lost funds from a source other than NYSERDA
○	3. No, we did not substitute the funds but the project was still able to move forward
○	Other:

E6. Directions

16. E6. If the NYSERDA Recovery Act funds had not been available, what is the likelihood that you would have still completed this energy efficiency project? Please use a scale of 1 to 5 in which 1 is “not at all likely” and 5 is “very likely.”
Select one.

○	1. Not at all likely
○	2. Somewhat unlikely
○	3. Neither likely or unlikely
○	4. Somewhat likely
○	5. Very likely
○	98. Don't know

*17. AF5. Did the NYSERDA Recovery Act award allow you to divert funds from the energy efficiency project to other projects in need of financing?(*Required)

Select one.

○	1. Yes	(Go to question number 18.)
○	2. No	(Go to question number 0.)

*18. AF6. Did any of these diverted funds finance the installation of additional renewable energy or energy efficiency projects?(*Required)

Select one.

○	1. Yes	(Answer question number 18.1.) (Go to question number 19.)
○	2. No	(Go to question number 0.)

*18.1 AF7. Please explain what type of renewable or energy efficiency projects you completed with the diverted funds, noting if the measure also received funds from another NYSERDA or utility program.(*Required)

*19. AF8. If the NYSERDA Recovery Act funds had not been available, what is the likelihood that you would have diverted internal funds to other energy efficiency projects? Please use a scale of 1 to 5, where 1 = "not at all likely" and 5 = "very likely."(*Required)

Select one.

○	1. Not at all likely
○	2. Somewhat unlikely
○	3. Neither likely or unlikely
○	4. Somewhat likely
○	5. Very likely
○	98. Don't know

Project Planning

20. FR1. Prior to participating in the NYSERDA Recovery Act program, were you planning to install similar energy efficiency measures?

Select one.

○	1. Yes	(Go to question number 21.)
○	2. No	(Go to question number 22.)

*21. FR2. Below is a list of statements describing the planning process. Please indicate which statement BEST describes which point in the planning process this project was in before you participated in the NYSERDA Recovery Act program.(*Required)

Select one.

○	1. We had no formal plans for the project. We had some preliminary, internal discussions but no plans and no contact with a vendor, contractor or installer.
○	2. We had taken initial steps toward considering the high efficiency measures, such as requesting information from or generally discussing high efficiency options with a vendor, contractor, or installer
○	3. We had in-depth discussions of specific types of high efficiency equipment, including the positive and negative attributes and costs.
○	4. We had identified specific equipment manufacturers and models that we wanted to install, but had not yet begun the budgeting process.
○	5. We had identified specific equipment, manufacturers and models; however, budgets did not support the completion of the project.
○	6. We had identified specific equipment, manufacturers and models and incorporated the project into our budget.

*22. FR3. Did your participation in the NYSERDA Recovery Act program influence EITHER the decision to implement the project or install the exact type, size, or amount of high efficiency measures included in the project?(*Required)		
Select one.		
○	1. Yes	(Go to question number 23.)
○	2. No	(Go to question number 24.)

*23. FR4. How did the NYSERDA Recovery Act program and funding influence your decision to implement this project? Below is a list of statements describing how the NYSERDA program and funding may have influenced your decision. Please indicate which statement best describes the influence of the NYSERDA program on your decision.(*Required)	
Select one.	
○	1. The NYSERDA program funding had no influence on the decision. All the measures would have been installed at the same efficiencies and in the same amounts without the program funding.
○	2. The NYSERDA program funding helped in making the final decision on the high efficiency measures that had already been thoroughly considered.
○	3. The NYSERDA program funding lent credibility to the decision to invest in high efficiency.
○	4. The NYSERDA program funding was a major driver in expanding the quantity, scope, or efficiency of the equipment.
○	5. The NYSERDA program funding was the primary reason that the high efficiency measures were installed.

*24. FR5. On a scale of 1 to 5, in which 1 is not at all important and 5 very important, please indicate how important the NYSERDA ARRA program was in your decision to install high efficiency measures at this site.(*Required)	
Select one.	
○	1. Not at all important
○	2. Somewhat unimportant
○	3. Neither important or unimportant
○	4. Somewhat important
○	5. Very important
○	98. Don't know

25. A. [EFFICIENCY OF MEASURE] What is the likelihood that you would have installed this exact same high efficiency equipment at this time if you had not received funding through the NYSERDA program? [Please use a scale from 0% to 100%, where 0% means that you definitely would NOT have installed the same high efficiency equipment and 100% means you definitely WOULD HAVE installed the same equipment].

Select one.

○	1. Definitely would NOT have incorporated measure of the same high level of efficiency (0%)	
○	2. May have incorporated measure of the same high level of efficiency, even without the program. About what percent likelihood? _____%	(Answer question number 25.1.)
○	3. Definitely would have incorporated measure of the same high level of efficiency anyway (100%)	

25.1 A.1. [Please record percent]

26. B. Next, please think about the scale of the energy efficiency measures you installed. What percentage of these high efficiency measures would you have incorporated if you had not received the NYSERDA Recovery Act funds?

Select one.

○	1. Definitely would NOT have incorporated ANY of these measures (0%)	
○	2. May have incorporated SOME of these measures, even without the program. About what percent of measures would have installed anyway? _____%	(Answer question number 26.1.)
○	3. Definitely would have incorporated ALL of these measures even without the program (100%)	

26.1 B.1. [Please record percent]

*27. FR7. Please explain what the project would have been like without the NYSERDA ARRA funds?(*Required)

*28. F1. What is the principal business activity where the high efficiency measures were installed?(*Required)

Select one.

○	1. Education	(Go to question number 29.)
○	2. Food Sales	(Go to question number 31.)
○	3. Food Service	(Go to question number 31.)
○	4. Health Care	(Go to question number 30.)
○	5. Lodging	(Go to question number 31.)
○	6. Retail/Mercantile	(Go to question number 31.)
○	7. Office	(Go to question number 31.)
○	8. Public Assembly	(Go to question number 31.)
○	9. Public Order and Safety	(Go to question number 31.)
○	10. Religious Worship	(Go to question number 31.)
○	11. Service	(Go to question number 31.)
○	12. Warehouse and Storage	(Go to question number 31.)
○	13. Manufacturing (Identify Industry Type e.g., chemical, food, paper, etc.)	(Go to question number 31.)
○	14. Vacant	(Go to question number 31.)
○	Other: ______	(Go to question number 31.)

*29. F5. Approximately how many students attend this school?(*Required)

Select one.

If answered, go to question number 31.

○	1. fewer than 100
○	2. 100 to 249
○	3. 250 to 499
○	4. 500 to 749
○	5. 750 to 999
○	6. 1,000 or More

*30. F6. Approximately how many hospital beds are in this health care facility?(*Required)
Select one.

○	1. Zero
○	2. 1 to 5
○	3. 5 to 9
○	4. 10 to 19
○	5. 20 to 49
○	6. 50 to 99
○	7. 100 to 249
○	8. 250 or More

*31. F2. Approximately, when was this building originally built?(*Required)
Select one.

○	1. Before 1960
○	2. 1961-1970
○	3. 1971-1980
○	4. 1981-1990
○	5. 1991-2000
○	6. 2001-2005
○	7. After 2005

*32. F3. What is the approximate square footage of the building where the energy efficient measures were installed?(*Required)
Select one.

○	1. Less than 1,000 square feet
○	2. 1,000 to 4,999
○	3. 5,000 to 14,999
○	4. 15,000 to 24,999
○	5. 25,000 to 49,999
○	6. 50,000 to 99,999
○	7. 100,000 to 199,999
○	8. 200,000 to 499,999
○	9. 500,000 or more

*33. F4. Approximately how many full-time equivalent workers are employed at this facility?(*Required)

Select one.

○	1. fewer than 5
○	2. 5 to 9
○	3. 10 to 19
○	4. 20 to 49
○	5. 50 to 99
○	6. 100 to 249
○	7. 250 or More

NYSERDA ARRA Renewable Energy Programs, Online Participant Survey, RFP 10 and RFP 1613

7/18/11

[INTRO PAGE 1] Thank you for participating in this study of renewable energy programs administered by the New York State Energy Research and Development Authority (NYSERDA). Information collected during this survey will be used to help NYSERDA track, and improve, the effectiveness of its programs.

We are asking you to complete this survey because your municipality, university, school, hospital or not-for-profit organization has participated in at least one of NYSERDA's ARRA (the American Recovery and Reinvestment Act of 2009, also commonly referred to as the "Recovery Act" or "Stimulus" Funding) funded programs:

- Energy Efficiency Program for Municipalities, Schools, Hospitals, Public Colleges and Universities, and Non-Profits (RFP 1613), or
- Energy Efficiency and Conservation Block Grant, Implementation Funding for Small Municipalities (RFP 10)

NYSERDA is interested in your answers about why you participated in the NYSERDA ARRA program and how it influenced your renewable project. These questions will help us understand the overall impacts of the American Recovery and Reinvestment Act of 2009 .

Completing this survey:

[INTRO PAGE 2]

- Please carefully read all questions and directions
- Respond to all questions to the best of your ability
- The estimated length of the survey is 10 minutes. The survey may be completed in more than one session, if necessary. Your answers will be automatically saved if the survey is closed prior to completion. Upon reopening the survey with the original link provided, you will have the choice to resume from the last completed question or to start at the beginning and review your previous answers.

Your participation in this study supports renewable energy development in New York.

Thank you very much for your help!

NYSERDA has contracted with independent research firms, The Cadmus Group, Inc. and NMR Group, Inc., to conduct the study. The study team of The Cadmus Group, Inc. and NMR Group, Inc., as independent research firms, will keep the information private to the extent permitted by law. NYSERDA's analysis will only use summary level data and will not identify individual respondents or firms.

If you have any questions about the survey, please contact Greg Clendenning of NMR either by phone (617-284-6230, ext. 3) or by email (gclendenning@nmrgroupinc.com). If you have any concerns about the nature of this study and the reasons you are being asked to respond to it, please contact Rebecca Reed of NYSERDA either by phone (866-697-3732 ext. 3559) or by email (rlr@nyserda.org).

Our records indicate that Paige Holman at paige.holman@cadmusgroup.com is the primary contact for this project and is most knowledgeable about the decision making process to install the equipment.

If the contact information is correct, please check this box:

☐ Contact Information Is Correct

If you are not the person listed above, but are best qualified to answer these questions, please fill in your name and email address below so that we may update our records.

Name: __________

Email: __________

Programming Note: Section headings are NOT to be included in the online survey.

Introduction

First we would like to ask you a few questions about your renewable energy project and how you found out about the NYSERDA program.

I1. According to our records, your _________________ has received funding from NYSERDA to install a renewable energy project. Can you confirm this is correct?

1. Yes [CONTINUE]
2. No [Please fill in correction]

I1a [If I1=2] Our records indicate that your organization has received funding from NYSERDA at this time. Currently those are all the questions we have, but a representative may contact you in the future to resolve the misunderstanding. Thank you for your time. [SCREEN OUT]

I2. Our records also show that the funding provided was to install a __________________ system, is this correct?

1. Yes [CONTINUE]
2. No [Please fill in correction]

Awareness

A1. How did you hear about the program opportunity? **Please mark all that apply.**

1. Through NYSERDA's FlexTech program
2. Through participation in another NYSERDA program [PLEASE SPECIFY]
3. Renewable energy contractor / installer
4. Program marketing materials
5. Program outreach sessions
6. Email or mailing from NYSERDA
7. Webinar
8. NYSERDA website
9. Story in the media
10. Colleague, friend, family -- word of mouth

-97 Other [PLEASE SPECIFY]

Motivation

M1. Thinking about the equipment you installed with the assistance of NYSERDA funding, what was the most important reason for installing the system? **Please select just one response.**

1. Reduce energy bills / energy savings
2. Reduce our carbon footprint and emissions
3. Green marketing / public relations
4. Regulatory requirement or mandate
5. Hedge against future increases in energy prices
6. Concern for the environment
7. Increase energy independence
8. Promote renewable energy; help increase the adoption of renewable energy

-97 Other [SPECIFY]

M2. Why did you apply for funds from NYSERDA for the equipment? Please focus your answer on why you applied for the **funds**, not why you decided to install a renewable technology.

1. Could not find funding from other sources
2. Contractor suggested I apply
3. Other funding sources required me to match or leverage funds
4. Thought chances of getting funded were good
5. Looking to accelerate project
6. Could not afford to do the work without funding

-97 Other [PLEASE SPECIFY]

M3. Are you aware that the funding your [school] received from NYSERDA for the equipment was provided by the Federal Government through the American Recovery and Reinvestment Act of 2009 (ARRA), also commonly referred to as the “Recovery Act” or “Stimulus” Funding?

1. Yes [GO TO M4]
2. No [GO TO M6]

M4. [IF YES TO M3] When did you become aware that the funds were provided by the Recovery Act?

1. When we learned about the NYSERDA program
2. During the application review process
3. When NYSERDA awarded us the funds
4. When NYSERDA began asking for information to fulfill the federal reporting requirements

-97 Other [PLEASE SPECIFY]

M5. [IF YES TO M3] To what extent was your decision to apply for funds from NYSERDA affected by the fact that the funds were provided by the Recovery Act? Was it….

1. A critical negative factor (a drawback from participation)
2. Somewhat of a negative factor
3. Not at all a factor
4. Somewhat of a positive factor
5. A critical positive factor (a driver towards participation)

M6. To what extent was your decision to apply for funds from NYSERDA affected by **when** the funds became available? Was it...

1. A critical negative factor (a drawback from participation)
2. Somewhat of a negative factor
3. Not at all a factor
4. Somewhat of a positive factor
5. A critical positive factor (a driver towards participation)

M7. Prior to participating in this NYSERDA program, had you participated in any other NYSERDA energy efficiency, energy conservation, or renewable energy program?

1. Yes [GO TO NEXT QUESTION]
2. No [GO TO AF1]

M8. [IF YES TO M7] In what type of NYSERDA programs have you participated? **Please mark all that apply**.

1. Energy audit [PLEASE SPECIFY THE NYSERDA PROGRAM]
2. Technical study [PLEASE SPECIFY THE NYSERDA PROGRAM]
3. New construction [PLEASE SPECIFY THE NYSERDA PROGRAM]
4. Equipment replacement incentive [PLEASE SPECIFY THE NYSERDA PROGRAM]
5. Renewable energy [PLEASE SPECIFY THE NYSERDA PROGRAM]

-97 Other [PLEASE SPECIFY]

M9. [IF YES TO M7] How influential was your participation in other NYSERDA programs in your decision to apply to this program? Was it…

1. A critical negative influence (a drawback from participation)
2. Somewhat of a negative influence
3. Not at all an influence
4. Somewhat of a positive influence
5. A critical positive influence (a driver towards participation)

M10. [IF YES TO M7] Was the equipment you installed with the NYSERDA ARRA funds recommended in any energy audit or conservation study you had previously completed through a NYSERDA or Utility Program?

1. Yes [PLEASE SPECIFY THE NYSERDA OR UTILITY PROGRAM]
2. No

Alternative and Additional Funding & Economy

Next we have some questions about the funding sources for your renewable energy project.

AF1. Did the NYSERDA ARRA funds cover the **entire** cost of your system?

1. Yes [GO TO E1]
2. No

AF2. Approximately what percentage of the total project budget did the NYSERDA ARRA funds provide?

_____ %

AF3. What other funding sources did you use to complete the project? **Please mark all that apply.**

1. Grants [PLEASE SPECIFY GRANT ORGANZATION OR AGENCY]
2. Tax credits
3. Rebates on the equipment
4. Loans
5. Operating budget
6. Capital improvement budget

-97 Other [PLEASE SPECIFY]

AF4. Did any of the other financing you received for this project require that you obtain matching funds from other sources?

1. Yes
2. No [GO TO E1]

AF5. [IF YES TO AF4] To what extent was your decision to apply for funds from NYSERDA affected by the requirement from other sources to obtain matching funds for the project? Was it….

1. A critical negative factor (a drawback from participation)
2. Somewhat of a negative factor
3. Not at all a factor
4. Somewhat of a positive factor
5. A critical positive factor (a driver towards participation)

E1. **Before** applying for the NYSERDA funds, had you **attempted** to secure financing for this project?

1. Yes [GO TO NEXT QUESTION]
2. No [GO TO AF8]

E2. [IF E1= 1 (YES)] Had you **successfully secured** at least some other financing for this project **before** applying for the NYSERDA funds?

1. Yes [GO TO NEXT QUESTION]
2. No [GO TO AF8]

E3. [IF E2= 1 (YES)] How did you use the previously secured funds?

1. Used them to pay for part of the costs of the renewable project [GO TO AF9]
2. Declined the funds BEFORE receiving NYSERDA Recovery Act funds [ASK E6 AND E7]
3. Declined the funds AFTER receiving NYSERDA Recovery Act funds [ASK E6 AND E7]
4. Lost the funds [ASK E4 AND E5]
5. Have not used previously secured funds yet [GO TO AF9]
6. Other [PLEASE SPECIFY]

E4. [IF E3= 4 (LOST THE FUNDS)] Why did you LOSE the funds?

1. Tightening of the credit market
2. Funding source said they were no longer available
3. Could not meet requirements set forth by the funding source

-97 Other [SPECIFY]

E5. [IF **Error! Reference source not found.**= 4 (LOST THE FUNDS)] Did NYSERDA Recovery Act substitute for the funds that you **lost** , or did something else happen?

1. Yes, NYSERDA Recovery Act funds substituted for the lost funds
2. No, we substituted the lost funds from a source other than NYSERDA
3. No, we did not substitute the funds but the project was still able to move forward

-97 Other [SPECIFY]

[IF ALSO RESPONDED Error! Reference source not found.= 2 OR 3 CONTINUE TO E6; OTHERWISE, SKIP TO E8]

E6. [IF E3= 2 OR 3 (DECLINED THE FUNDS)] Why did you DECLINE the funds?

1. Could not meet requirements set forth by the funding source
2. Requirements set forth by funding sources were burdensome

-97 Other [SPECIFY]

E7. [IF E3= 2 OR 3 (DECLINED THE FUNDS)] Did NYSERDA Recovery Act substitute for the funds that you **declined** , or did something else happen?

1. Yes, NYSERDA Recovery Act funds substituted for the lost funds
2. No, we substituted the lost funds from a source other than NYSERDA
3. No, we did not substitute the funds but the project was still able to move forward

-97 Other [SPECIFY]

E8. [IF E3= 2 or 3 or 4 (DECLINE OR LOST FUNDS)] If the NYSERDA funds had not been available, what is the likelihood that you would have still completed this energy efficiency project?

1. Not at all likely
2. Somewhat unlikely
3. Neither likely or unlikely
4. Somewhat likely
5. Very likely

AF6. [IF E2= 1 (YES), OTHERWISE, SKIP TO AF8] Had you secured other financing for the project that you subsequently turned down after receiving the NYSERDA Funds?

1. Yes [GO TO NEXT QUESTION]
2. No [GO TO AF8]

AF7. What type of financing did you turn down? **Please mark all that apply.**

1. Loan
2. Grant
3. Funding from another NYSERDA program [PLEASE SPECIFY]
4. Funding from a utility program [PLEASE SPECIFY]

-97 Other [PLEASE SPECIFY]

AF8. If the NYSERDA funds had not been available, what is the likelihood that you would have installed the same system?

1. Not at all likely
2. Somewhat unlikely
3. Neither likely or unlikely
4. Somewhat likely
5. Very likely

AF9. Did the NYSERDA award allow you to divert funds that had been budgeted for this project to go to other projects in need of financing?

1. Yes [GO TO NEXT QUESTION]
2. No [GO TO FR1]

AF10. [IF YES TO AF9] If the NYSERDA funds had not been available, what is the likelihood that you would have diverted internal funds to other projects?

1. Not at all likely
2. Somewhat unlikely
3. Neither likely or unlikely
4. Somewhat likely
5. Very likely

AF11. [IF YES TO AF9] Did any of these diverted funds finance the installation of additional renewable energy or energy efficiency projects?

1. Yes [GO TO NEXT QUESTION]
2. No [GO TO AF15]

AF12. [IF YES TO AF11] Please explain what type of renewable or energy efficiency projects you completed with the funds. If applicable, please also indicate if the measures received funds from another NYSERDA program, or other utility program [Please mark all that apply]

		Received other NYSERDA Funds	Received other Utility Funds
1.	Solar photovoltaic (PV)		
2.	Solar hot water		
3.	Solar thermal		
4.	Biomass boiler		
5.	Wind turbine		
6.	Energy efficient lighting		
7.	Energy efficient heating system		
8.	Energy efficient cooling system		
9.	Energy efficient hot water system		
10.	Insulation		
11.	Weatherization/Envelope		
-97.	Other [PLEASE SPECIFY]		

AF 15. [IF NO TO AF11] How did you use the diverted funds?

1. Other capital improvement projects [SPECIFY]
2. Staff retention
3. New staff hires

-97. Other [PLEASE SPECIFY]

AF 16. [IF 2 to AF15] How many staff members were you able to retain?

AF 17. [IF 3 to AF15] How many staff members were you able to hire?

Free Ridership

FR1. Prior to participating in this NYSERDA program, were you planning to install a similar system?

1. Yes [CONTINUE FR2]
2. NO [GO TO FR3]

FR2. Below is a list of statements describing the planning process. Please indicate which statement <u>best</u> describes the point in the planning process this project was in before you participated in the NYSERDA program.

1. We had no formal plans for the project. We had some preliminary, internal discussions but no plans and no contact with a vendor, contractor or installer.
2. We had taken initial steps toward considering the renewable equipment, such as requesting information from or generally discussing options with a vendor, contractor, or installer.
3. We had in-depth discussions of specific types of renewable equipment, including the positive and negative attributes and costs.
4. We had identified specific equipment manufacturers and models that we wanted to install, but had not yet begun the budgeting process.
5. We had identified specific equipment, manufacturers and models; however, budgets did not support the completion of the project.
6. We had identified specific equipment, manufacturers and models and incorporated the project into our budget.

FR3. How did the NYSERDA program and funding influence your decision to install your renewable system? Below is a list of statements describing how the NYSERDA program and funding may have influenced your decision. Please indicate which statement <u>best</u> describes the influence of the NYSERDA program on your decision.

1. The NYSERDA program funding had no influence on the decision. The same type of system and the same capacity system would have been installed even without the program funding.
2. The NYSERDA program funding helped in making the final decision on the system that had already been thoroughly considered.
3. The NYSERDA program and funding helped in choosing to install a system that had been discussed but not thoroughly considered.
4. The NYSERDA program funding was a major driver in the decision to install the system.
5. The NYSERDA program funding was the primary reason that the system was installed.

FR4. Please indicate how important the NYSERDA program was in your decision to install your system.

1. Not at all important
2. Somewhat unimportant
3. Neither important or unimportant
4. Somewhat important
5. Very important

FR5. What is the likelihood that you would have installed the same efficiency or size renewable energy system ***at this time*** if you had not received funding through the NYSERDA program? Please use a scale from 0% to 100%, where 0% means that you definitely would **NOT** have installed a renewable energy system and 100% means you definitely **WOULD HAVE** installed the same renewable energy system].

________%

FR6. Next, please think about the capacity of your renewable energy system. If the NYSERDA Program funds had not been available, what capacity system would you have installed? Please estimate a lower bound, an upper bound and your best estimate of the capacity of the system you would have installed. If you would not have installed a system without the NYSERDA funds, please enter “0” in each box below.

Lower Bound: ____ kW or Btu
Upper Bound: ____ kW or Btu)
Best Estimate: ____ (kW or Btu)

Takeback

Next we have some questions about your energy usage and other actions you may have taken since installing the renewable energy technology.

T1. Has your energy usage increased, decreased, or remained the same since installing the renewable technology?

1. Energy usage has **increased**
2. Energy usage has **decreased**
3. Energy usage has **stayed the same**

T2. [If T1 = 1 or 3] Which of the following actions has your building experienced **since** the installation of your renewable equipment? Please check all that apply.

1. Increased your temperature settings during the winter
2. Decreased your temperature settings during the summer
3. Increased your plug load (the number of electrical devices plugged in)
4. Leaving lights on more frequently
5. Not shutting off office equipment
6. Increased hot water use
7. Installed any additional large piece of equipment
8. Other:

Firmographics

F1. Approximately when was this building originally built?

1. Before 1960
2. 1961-1970
3. 1971-1980
4. 1981-1990
5. 1991-2000
6. 2001-2005
7. After 2005

F2. What is the approximate square footage of the building where the equipment was installed?

1. Less than 1,000 square feet
2. 1,000 to 4,999
3. 5,000 to 14,999
4. 15,000 to 24,999
5. 25,000 to 49,999
6. 50,000 to 99,999
7. 100,000 to 199,999
8. 200,000 to 499,999
9. 500,000 or more

F3. Approximately how many full-time equivalent workers are employed at this facility?

1. fewer than 5
2. 5 to 9
3. 10 to 19
4. 20 to 49
5. 50 to 99
6. 100 to 249
7. 250 or More

F4. [IF EDUCATION FROM SAMPLE READ-IN] Approximately how many students attend this school?

1. fewer than 100
2. 100 to 249
3. 250 to 499
4. 500 to 749
5. 750 to 999
6. 1,000 or More

F5. [IF HEALTH CARE FROM SAMPLE READ-IN] Approximately how many hospital beds are in this health care facility?

1. Zero
2. 1 to 5
3. 5 to 9
4. 10 to 19
5. 20 to 49
6. 50 to 99
7. 100 to 249
8. 250 or More

This concludes the survey. Thank you for taking the time to answer these important questions. Your survey is not complete until you have selected the 'SUBMIT' button below. A member of the evaluation staff may contact you in the future for a follow-up interview to clarify some of your responses to this survey.

Table 1: Plan for Analysis

Question	Workplan Topic	Workplan link
I1, I2	Background, verify correct contact and system data	
A1	Marketing and Motivation	How did you first hear about the program
M1, M2	Marketing and Motivation	Why did you apply for funding through NYSERDA
M3, M4, M5	Marketing and Motivation	Was your decision impacted by having the ultimate source of budget as ARRA funds
M6	Marketing and Motivation	Was your decision impacted by the timing of when the funds were available
M7, M8, M9, M10	Marketing and Motivation	Did your prior participation in an energy audit or conservation study programs (such as ARRA Pon4 or Flex Tech) influence your decision to participate in this program? Is so, which audit program(s) did you previously participate in?
AF1	Alternative and Additional Funding	Did you fund this project solely with NYSERDA ARRA funds or did you leverage other funds
AF3	Alternative and Additional Funding	If so, what were the other sources of funding used
AF2	Alternative and Additional Funding	What percent of the project did ARRA fund
AF6, AF7, AF9	Alternative and Additional Funding	Did you use funds originally meant for this project for another project, decline them, or did something else happen
AF4	Alternative and Additional Funding	Did other funding for the project require that you leverage resources
AF5	Alternative and Additional Funding	Did such requirements influence your decision to apply for NYSERDA ARRA funds
E1, E2	Economy	Did you have funding secured for the project before applying for NYSERDA ARRA funds?
E3	Economy	Did any of the project's funding fall through because of tightening credit or other economic conditions resulting from the recession?
FR1, FR2, FR3, FR4, FR5, FR6, E3, AF6, AF8, AF9, AF10, AF2	Free Ridership	To the best of your knowledge, would your project have been completed without NYSERDA ARRA funds? Would it have occurred on the same timeline? Why or why not? Would the generating capacity of your project have been the same as what you installed under NYSERDA ARRA? Why or why not? Did NYSERDA ARRA-funding allow you—or require you—to change your plans in any way? If so, how?
AF11, AF12, 0	Spillover	What other actions, if any, have you taken to save energy or generate more capacity as a result of your participation in the

Question	Workplan Topic	Workplan link
		NYSERDA ARRA-funded program?
0	Economy	
T1, T2	Takeback	Has your energy usage increased, decreased, or remained the same since installing the renewable technology? If it has changed, how was that change related to the installation of the measure(s)?
F1, F2, F3, F4, F5, F6	Firmographics	

MEMO

To:
CC:
From:
Date:
RE:

The grant recipient to be interviewed is the XX. The project consists of XX.

We will interview XX. His contact information is below. The aim of the survey is to obtain answers to questions laid out in the Action Plan.

CONTACT INFO

Here is a suggested TIMELINE in order for the interview to take place as soon as possible:

Timeline:
XX

Questions for the purpose of Gross Impact Evaluation, Economic Impact, Emissions Impacts
INDIVDUAL FOR EACH PROJECT

Questions to be asked for purpose of Awareness and Motivation

Awareness
First we would like to ask you a few questions about your transportation portion of the American Recovery and Reinvestment Act (ARRA) funded projects and how you found out about the NYSERDA ARRA program.

How did you hear about the RFP 1613, Project Implementation Funding? Highlight all that apply

1. Through NYSERDA's FlexTech program
2. Through participation in other NYSERDA program ________________________
3. The NYSERDA RFP
4. Program marketing
5. Outreach by NYSERDA staff
6. Contractor / installer
7. NYSERDA website
8. Story in the media
9. Colleague, friend, family -- word of mouth

97. Other [PLEASE SPECIFY] ____
98. Don't know
99. Refused

Motivation
M1. Why did you apply for funds from NYSERDA to implement this project? Please focus your answer on why you applied for the funds, not why you decided to install the measure(s). [DO NOT READ RESPONSES; HAVE RESPONDENT BE SPECIFIC; CHOOSE FROM RESPONSES PROVIDED OR FILL IN RESPONSE IF NOT AMONG LISTED RESPONSES; ALLOW MORE THAN ONE RESPONSE]

1. Could not find funding from other sources
2. Contractor suggested I apply
3. Other funding sources required a higher match or leverage
4. Thought chances of getting funded were good
5. Could not afford to do the project without funding

97. Other [PLEASE SPECIFY] ___________________________________
98. Don't know
99. Refused

M2. At the time you applied for funds from the NYSERDA program, were you aware that the funds provided through this program were provided by the Federal Government (via the U.S. Department of Energy) as part of the American Recovery and Reinvestment Act of 2009 (ARRA), also commonly referred to as the "Federal Stimulus Bill"?

1. Yes
2. No [GO TO 0]

98. Don't know [GO TO 0]

99. Refused [GO TO 0]

M3. [IF YES TO 0] To what extent was your decision to apply for funds from NYSERDA affected by the fact that the funds were provided by the Recovery Act? Please use a scale from 1 to 5 in which 1 is a critical negative factor (a drawback to participation), 2 is somewhat of a factor, 3 is not a factor at all, 4 is a somewhat positive factor and 5 is a critical positive factor (a driver to participation) in the decision to apply.

1. A critical negative factor (A drawback to participation)
2. Somewhat of a factor
3. Not at all a factor
4. Somewhat of a positive factor
5. A critical positive factor (A driver to participation)

98. Don't know

99. Refused

M4. To what extent was your decision to apply for funds from NYSERDA affected by WHEN the funds would be available to you? Please use a scale from 1 to 5 in which 1 is a critical negative factor (a drawback to participation), 2 is somewhat of a factor, 3 is not a factor at all, 4 is a somewhat positive factor and 5 is a critical positive factor (a driver to participation) in my the decision to apply.

1. A critical negative factor (A drawback to participation)
2. Somewhat of a factor
3. Not at all a factor
4. Somewhat of a positive factor
5. A critical positive factor (A driver to participation)

98. Don't know

99. Refused

M5. Prior to participating in the NYSERDA ARRA program, had you participated in a previous NYSERDA transportation Program?

1. Yes
2. No [GO TO 0]

98. Don't know [GO TO 0]

99. Refused [GO TO 0]

M6. Please describe the project or program _______________

Questions to be asked for purposes of Attribution

Economy

Next we have some questions about the funding sources for your transportation project. The first few questions are about any finances you may have secured before you applied for the NYSERDA ARRA funds.

E1. Before applying for the NYSERDA ARRA funds, had you attempted to secure financing for this project?

1. Yes
2. No [GO TO AF1]
98. Don't know [GO TO AF1]
99. Refused [GO TO AF1]

E2. [IF 0 = 1 (YES)] Had you successfully secured at least some other financing for this project before applying for the NYSERDA funds?

1. Yes [GO TO E3]
2. No [GO TO AF1]
98. Don't know [GO TO AF1]
99. Refused [GO TO AF1]

E3. [IF **Error! Reference source not found.**= 1 (YES)] How did you use the previously secured funds?

1. Used them to pay for part of the costs of the project [GO TO AF2]
2. Declined the funds BEFORE receiving NYSERDA ARRA funds [ASK 0 AND 0]
3. Declined the funds AFTER receiving NYSERDA ARRA funds [ASK 0 AND 0]
4. Lost the funds [ASK 0 AND 0]
5. Have not used previously secured funds yet [GO TO AF2]
6. Other [PLEASE SPECIFY]

E4. [IF E3= 4 (LOST THE FUNDS)] Why did you LOSE the funds?

1. Tightening of the credit market
2. Funding source said they were no longer available
3. Could not meet requirements set forth by the funding source
97. Other [SPECIFY]

E5. [IF E3= 4 (LOST THE FUNDS)] Did NYSERDA ARRA funds substitute for the funds that you lost, or did something else happen?
1. Yes, NYSERDA ARRA funds substituted for the lost funds
2. No, we substituted the lost funds from a source other than NYSERDA
3. No, we did not substitute the funds but the project was still able to move forward

97. Other [SPECIFY]

[IF ALSO RESPONDED E3= 2 OR 3 CONTINUE TO 0; OTHERWISE, SKIP TO 0]

E6. [IF E3= 2 OR 3 (DECLINED THE FUNDS)] Why did you DECLINE the funds?
1. Could not meet requirements set forth by the funding source
2. Requirements set forth by funding sources were burdensome

97. Other [SPECIFY]

E7. [IF E3= 2 OR 3 (DECLINED THE FUNDS)] Did NYSERDA ARRA funds substitute for the funds that you declined , or did something else happen?
1. Yes, NYSERDA ARRA funds substituted for the lost funds
2. No, we substituted the lost funds from a source other than NYSERDA
3. No, we did not substitute the funds but the project was still able to move forward

97. Other [SPECIFY]

E8. [IF E3= 2 or 3 or 4 (DECLINE OR LOST FUNDS)] If the NYSERDA ARRA funds had not been available, what is the likelihood that you would have still completed this transportation project?
1. Not at all likely
2. Somewhat unlikely
3. Neither likely or unlikely
4. Somewhat likely
5. Very likely

Alternative and Additional Funding

Next we have a few questions about the funding you secured for your transportation project.

AF1. If the NYSERDA ARRA funds for the transportation project had not been available, what is the likelihood that you would have performed some type of transportation project?

1. Not at all likely
2. Somewhat unlikely
3. Neither likely or unlikely
4. Somewhat likely
5. Very likely

AF2. Did the NYSERDA ARRA award allow you to divert funds that had been budgeted for this project to go to other projects in need of financing?
1. Yes [GO TO NEXT QUESTION]
2. No [GO TO **Error! Reference source not found.**]

AF3. [IF YES TO AF2] If the NYSERDA ARRA funds had not been available, what is the likelihood that you would have diverted internal funds to other projects?
1. Not at all likely
2. Somewhat unlikely
3. Neither likely or unlikely
4. Somewhat likely
5. Very likely

AF4. [IF YES TO AF2] Did any of these diverted funds finance the installation of additional renewable energy or energy efficiency projects?
1. Yes [GO TO NEXT QUESTION]
2. No [GO TO AF7]

AF5. [IF YES TO AF4] Please explain what type of renewable or energy efficiency projects you completed with the diverted funds, noting if the measure also received funds from another NYSERDA or utility program.

1. Solar photovoltaic (PV)
2. Solar hot water
3. Solar thermal
4. Biomass boiler
5. Wind turbine
6. Energy efficient lighting
7. Energy efficient heating system
8. Energy efficient cooling system
9. Energy efficient hot water system
10. Insulation
11. Weatherization/Envelope

97. Other [PLEASE SPECIFY]

AF6. Which renewable or energy efficiency projects also received funds from another NYSERDA or utility program? [PLEASE SPECIFY]

AF7. [IF NO TO AF4] How did you use the diverted funds?
1. Other capital improvement projects [SPECIFY]________________
2. Staff retention

3. New staff hires
97. Other [PLEASE SPECIFY]

Free Ridership

FR1. At which point in the planning process was this project when you first heard about the NYSERDA ARRA program?

1. Planned entire project after hearing about the NYSERDA program
2. Project was being planned, but plans were not finalized
3. Project was planned but had no funding
4. Project was planned but only partially funded
5. Project was planned and fully funded, but decided to pursue NYSERDA funding
97. Other [SPECIFY]
98. Don't know
99. Refused

FR2. [IF FR1 = 1] Did you plan the project because of the availability of the NYSERDA ARRA program funds, or would you have planned the project without the program?
1. Planned the project because of the NYSERDA program
2. Would have planned the project without the program
98. Don't know
99. Refused

FR3. [IF FR1 NE 1] Did you have to make any changes to your existing plans in order to receive the NYSERDA ARRA funds?
1. Yes
2. No
98. Don't know
99. Refused

FR4. [IF FR3 = 1 YES] Please describe how the plans were changed [PLEASE SPECIFY] ______

FR5. On a scale of one to five, where one is "not at all likely", two is somewhat likely, three is neither likely or unlikely, four is somewhat likely and five is "very likely", please rate the likelihood that you would have completed this project without the NYSERDA ARRA funds. [RECORD RESPONSE]
1. Not at all likely
2. Somewhat unlikely
3. Neither likely or unlikely
4. Somewhat likely

5. Very likely
98. Don't know
99. Refused

FR6. [IF 0 = 1 TO 4] What might have kept you from completing this project without the NYSERDA ARRA funds? [PLEASE SPECIFY]

____

FR7. [IF 0 greater than 1, 98 (Don't know) or 99 (refused)] If the NYSERDA ARRA funds had not been available, would you have completed the exact same transportation project, or would you have completed a project that differed in some ways (e.g., different scale, efficiency level, scope)

1. Same
2. Different
98. Don't know
99. Refused

FR8. [IF 0 = 2 (DIFFERENT measures)] [PROBE FOR SCOPE OF PROJECT, ETC. AND ASK RESPONDENT TO BE AS SPECIFIC AS POSSIBLE] ____________

FR9. [IF 0 greater than 1, 98 (Don't know) or 99 (refused)] If the NYSERDA ARRA funds had not been available, would you still have installed the specified transportation measure(s) at the same time as you did with the NYSERDA funds, earlier, or later?

1. Same time
2. Earlier
3. Later
98. Don't know
99. Refused

FR10. [IF 0 = 2 (earlier) or 3 (later)] How much [earlier / later] would you have installed the measure(s)? [PLEASE SPECIFY]

_____ Years [and / or] _______ Months ! Q`2

98. Don't know
99. Refused

FR11. [IF 0 = 2 OR 3] Why would you have installed the specified transportation measure at a different time? [PLEASE SPECIFY]

Spillover

S1. Since installing the specified transportation measure through the NYSERDA ARRA program, have you taken any additional actions to save energy?

1. Yes
2. No
98. Don't know
99. Refused

S2. [IF 0 = 1 (YES)] What additional actions have you taken? [Open Ended]
1. Encouraged staff members to take energy savings actions [SPECIFY TYPES]
2. _OTHER ________________________________

S3. [IF 0 = 1 (YES)] On a scale of one to five, where one is "no influence at all" two is "a little influence", three is "neutral", four is "a fair amount of influence" and five is "a great deal of influence" please rate the influence that participating in the NYSERDA ARRA program had on your decision to take EACH additional energy-saving actions? [TECHNICIAN, PROBE FOR EACH ADDITIONAL ACTION IN 0 AND RECORD RESPONSE]

____

Close – 1. Is there anything else you would like to tell us about your participation in the ARRA Transportation program?

Close – 2. Thank you very much for your time.

Appendix E:

FREERIDERSHIP ANALYSIS

E1. Energy Efficiency Program Area

E2. Renewable Energy Program Area

E3. Transportation Program Area

E4. Energy Codes Program Area

E1. ENERGY-EFFICIENCY PROGRAM AREA

Energy-Efficiency Program Area Freeridership Algorithm

Following an algorithm previously developed by NYSERDA and modified for the Energy-Efficiency Program Area, the Cadmus Team estimated freeridership for energy-efficiency projects through two sets of questions: direct freeridership questions (FR6A and FR6B) program area influence freeridership questions (FR2, FR4, and FR5).[1] Finally, the Cadmus Team weighted freeridership by the energy savings for each participant. In summary, estimating freeridership involved four steps:

1. Determining direct freeridership
2. Calculating Program Area influence score
3. Adjusting direct freeridership based on the Program Area influence score[2]
4. Weighting by the energy savings

The Cadmus Team also developed two alternative estimates of freeridership. In these cases, NYSERDA is credited with savings proportionate to its contribution to the overall funding for the project according to a directive from the DOE (AF1).[3] The directive to allocate program effects in proportion to the amount of the project funded through ARRA recognizes that many projects receive funds from multiple sources (e.g., ARRA, other funding agencies, their own operating budgets). Each of these entities has a legitimate claim on the energy saved, jobs created, and greenhouse gases reduced as a result of the project. To avoid double-counting the impacts, the DOE concluded that the best approach was to have ARRA-funded programs claim program effects only in proportion to their savings.

The Cadmus Team's first alternative estimate adjusted the savings by the percentage of the project that respondents self-report as being paid for by NYSERDA. The Team's second alternative estimate used data from the Program Area tracking database (specifically column L divided by column K in the spreadsheet *ARRA Project Status Update – Program Eval dated 12-19-11*). Thus, a fifth step in estimating freeridership was:

5. Adjusting freeridership by the percent of the project funded by NYSERDA ARRA

Note that the tables in the Energy-Efficiency Program Area portion of this appendix present data and calculations based on a *subset* of respondents, and are shown as examples only. Please see the main document for calculations based on all 14 respondents rather than the three examples presented here.

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[1] The algorithm also allowed for adjustments for the impacts of lost or diverted funding (E6) and diverting funds to other projects after securing NYSERDA ARRA funds (AF8), but neither question applied to any of the 14 RFP 10 respondents included in this report.

[2] The Cadmus Team compared the Program Area influence score to the direct freeridership score in order to examine the consistency of respondents' assessments of the Program Area's influence. NYSERDA's MCAC evaluation team had previously assigned a range of reasonable freeridership values for each Program Area influence score. For example, a maximum Program Area influence score of 5 is assumed to have a lower bound of 0% freeridership and an upper bound of 25% freeridership, with the assumption that a freeridership value higher than 25% would be inconsistent with the maximum Program Area influence score. For more details, see: Summit Blue. *Commercial/Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation*. 2007.

[3] United States Department of Energy. *DOE Recovery Act Reporting Requirements for the State Energy Program (SEP).* 2010. Effective date: March 1, 2010.

Direct Freeridership

The Cadmus Team estimated direct freeridership using the response to either FR6A (percentage likelihood to install same measure) or FR6B (percentage of energy-efficiency measure that would have been installed without ARRA funds), or by using the average of both questions, then determining the calculation based on the nature of the project. This is illustrated in Table E-1 using a subset of data from actual respondents.

Table E-1. Direct Freeridership, Energy-Efficiency Program Area

Respondent	FR6A: Percentage likelihood to install same measure	FR6B: Percent of measures installed without ARRA funds	Direct FR: Average of FR6A and FR6B
a	80%	80%	80%
b	0%	20%	10%
c	30%	25%	28%

Program Area Influence Score

The Cadmus Team estimated the Program Area influence score by calculating the average score of FR2,[4] FR4, and FR5 as illustrated in **Error! Reference source not found.**. The algorithm allowed for the inclusion of E6 (likelihood of completing the project if NYSERDA ARRA funds had not replaced funding lost or turned down from another source), and AF8[5] (likelihood of diverting funds to other renewable or energy-efficiency projects if NYSERDA ARRA funds had not been available for the completed project); however, neither question applied to any of the RFP 10 respondents.

Table E-2. Energy-Efficiency Program Area Influence Score

Resp.	FR2	FR2, reverse scored	FR2, reversed, adjusted to 5-point scale	FR4	FR5	E6 (lost or turned down funding)	AF8 (diverted funding)	AF8, reverse scored	Program Area Influence Score (average of FR2, FR4, FR5, E6, and AF8)
a	1	6	5.0	5	5	N/A	N/A	N/A	5.0
b	N/A	N/A	N/A	4	5	N/A	N/A	N/A	4.5
c	2	5	4.2	3	5	N/A	N/A	N/A	4.1

[4] The Cadmus Team reverse scored question FR2 such that the response indicating the greatest influence of NYSERDA ARRA funding on the project also received the highest score, and then adjusted the answers to a 5-point scale by multiplying the outcome by 5/6.

[5] The Cadmus Team reverse scored question AF8 such that the response indicating the greatest influence of NYSERDA ARRA funding on the project also received the highest score.

The Program Area influence score is associated with lower and upper bounds of freeridership, as defined by the FlexTech algorithm[6] (Table E-3).

Table E-3. Energy-Efficiency Program Area Influence Scores and Corresponding Lower and Upper Bounds of Freeridership

Average Program Area Influence Score	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00
Lower Bound Freeridership Value	75%	70%	60%	50%	40%	30%	25%	20%	10%	0%	0%	0%	0%
Upper Bound Freeridership Value	100%	100%	100%	100%	90%	80%	75%	70%	60%	50%	40%	30%	25%

Next, the Team compared direct freeridership scores to the lower and upper bounds of freeridership, as determined by the Program Area influence score (Table E-4). The Cadmus Team rounded the Program Area influence score to the closet influence score listed on the upper and lower bounds (Table E-4); for example, the Team treated a score of 1.9 as 2.0.

Wherever the direct freeridership fell outside the bounds of the Program Area influence score, the Team changed the direct freeridership score to either the lower or upper bound value, whichever was closest. The freeridership rate shown at the bottom of Table E-4 (23%) applies only to the three example projects, and not all 14 projects described in the full body of the report. The freeridership rate for the full sample of 14 respondents is 19% before adjusting for the percent of the project funded by NYSERDA, and is 16% after applying the adjustment.

[6] The Cadmus Team compared the Program Area influence score to the direct freeridership score in order to examine the consistency of respondents' assessments of the Program Area's influence. NYSERDA's MCAC evaluation team had previously assigned a range of reasonable freeridership values for each Program Area influence score. For example, a maximum Program Area influence score of 5 is assumed to have a lower bound of 0% freeridership and an upper bound of 25% freeridership, with the assumption that a freeridership value higher than 25% would be inconsistent with the maximum Program Area influence score. For more details, see: Summit Blue. *Commercial/Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation*. 2007.

Table E-4. Comparison of Direct Freeridership to Upper and Lower Bounds of Freeridership, Determined by Energy-Efficiency Program Area Influence Score

Resp.	Direct FR	Lower Bound of FR (Prog. Area Infl)	Upper Bound of FR (Prog. Area Infl)	FR Score	Gross Energy Savings (MMBtu)	Percent of Project Funded by NYSERDA ARRA	NYSERDA ARRA Gross Savings (MMBtu)	Freeridership Savings (MMBtu)
a	80%	0%	25%	25%	463	80%	371	93
b	10%	0%	30%	10%	330	90%	297	30
c	28%	0%	50%	28%	1,137	50%	569	156
Total Savings							**1,237**	**279**
Savings Weighted Overall Freeridership (Freeridership savings / NYSERDA ARRA gross savings)							**23%**	

E2. RENEWABLE ENERGY PROGRAM AREA

Renewable Energy Program Area (RFP 10) Freeridership Calculations

Following an algorithm previously developed by NYSERDA and modified for this Program Area, The Evaluation Team estimated freeridership through several sets of questions: direct freeridership questions (FR5 and FR6), Program Area influence freeridership questions (FR2, FR3, and FR4), Program Area influence questions based on the impacts of lost funding (E8), turning down other funds after securing NYSERDA ARRA funds (AF8), and diverting funds to other projects after securing NYSERDA ARRA funds (AF10).

In addition, NYSERDA is credited with savings proportionate to its contribution to the overall funding for the project according to a directive from the DOE.[7] This directive to allocate Program Area effects in proportion to the amount of the project funded through ARRA recognizes that many projects receive funds from multiple sources—ARRA, other funding agencies, their own operating budgets, etc. Each of these entities has a legitimate claim on the energy saved, jobs created, and greenhouse gases reduced. To avoid double-counting savings, the DOE concluded that the best approach is to have ARRA-funded programs claim program effects only in proportion to their savings.[8] Finally, The Cadmus Team weighted freeridership by the energy savings for each participant.

In summary, estimating freeridership involves five steps:

6. Determining direct freeridership
7. Calculating the Program Area influence score
8. Adjusting direct freeridership based on the Program Area influence score[9]
9. Adjusting freeridership by the percent of the project funded by NYSERDA ARRA
10. Weighting by the energy savings

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[7] United States Department of Energy. *DOE Recovery Act Reporting Requirements for the State Energy Program (SEP)*. 2010. Effective date: March 1, 2010.

[8] This consideration for attributing effects with multiple funders and influences is likely to become increasingly important in the energy-efficiency community, because multiple entities have set goals and made commitments to reduce energy use and greenhouse gas emissions. For example, if a public university must follow state-mandated goals to reduce energy use, and they installs a high-efficiency boiler in the biology building, the university will want to claim those savings even if an energy-efficiency program paid for 50% of the project. Both the university and the efficiency program administrators need to demonstrate progress to the state on reducing their energy use and greenhouse gas emissions. Some specialists in the energy-efficiency community have concluded that the fairest way to avoid double-counting savings is to stop the practice of having program administrators claim all the savings from a project, and instead have them claim only the portion they actually funded. To follow the example through, the university and program would then each present a portion of the savings to the state, thereby both showing progress on their goals.

[9] The Evaluation Team compared the Program Area influence score to the direct freeridership score in order to examine the consistency of respondents' assessments of the Program Area's influence. NYSERDA's MCAC evaluation team had previously assigned a range of reasonable freeridership values for each Program Area influence score. For example, a maximum Program Area influence score of five is assumed to have a lower bound of 0% freeridership and an upper bound of 25% freeridership, with the assumption that a freeridership value higher than 25% would be inconsistent with the maximum Program Area influence score. For more details, see Summit Blue. *Commercial/Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation*. 2007.

Direct Freeridership

The Cadmus Team estimated direct freeridership (FR) by calculating the average response to FR5 (percentage likelihood to install same system) and FR6 (capacity of system that would have been installed without ARRA funds), which is illustrated in Table E-5 using a subset of data from actual respondents.

Table E-5. Direct Freeridership, Renewable Energy Program Area

Respondent	Capacity (kW)	FR5: Percentage likelihood to install same system	FR6: Capacity of system that would have been installed without ARRA funds (kW)	FR6: Capacity that would have installed / capacity installed	Direct FR (Average of FR5 and FR6)
a	10 kW	0%	0	0%	0%
b	50 kW	0%	0	0%	0%
c	50 kW	0%	0	0%	0%
d	20 kW	10%	0	0%	5%

Program Area Influence Score

The Cadmus Team estimated the Program Area influence score by calculating the average score of FR2,[10] FR3, FR4, and, if applicable, E8 (likelihood of completing project if NYSERDA ARRA funds had not replaced funding lost from another source), AF8 (likelihood of completing project for which the respondent had declined funds if the NYSERDA ARRA funds were not available), and AF10 (likelihood of diverting funds to other renewable or energy-efficiency projects if NYSERDA ARRA funds had not been available for the completed project). This is illustrated in Table E-6 using examples from actual respondents.

Table E-6. Program Area Influence Score, Renewable Energy Program Area

Resp.	FR2	FR2, reverse scored	FR2, reversed, adjusted to 5-point scale	FR3	FR4	E8: Lost funding	AF8: Turned down funding	AF10: Diverted funding	AF10, reverse scored	Program Area Influence Score (average of FR2, FR3, FR4, E8, AF8, and AF10)
a	N/A	N/A	N/A	5	5	N/A	N/A	N/A	N/A.	5.0
b	N/A	N/A	N/A	5	5	N/A	N/A	N/A	N/A	5.0
c	N/A	N/A	N/A	5	5	N/A	N/A	N/A	N/A	5.0
d	N/A	N/A	N/A	5	5	N/A	N/A	N/A	N/A	5.0

[10] The Cadmus Team reverse scored FR2 such that the response indicating the greatest influence of NYSERDA ARRA funding on the project also received the highest score, then adjusted the answers to a 5-point scale by multiplying the outcome by 5/6.

The Program Area influence score is associated with lower and upper bounds of freeridership, as defined by the FlexTech algorithm (Table E-7).[11]

Table E-7. Program Area Influence Scores and Corresponding Lower and Upper Bounds of Freeridership, Renewable Energy Program Area

Average Program Area Influence Score	**1.00**	**1.33**	**1.67**	**2.00**	**2.33**	**2.67**	**3.00**	**3.33**	**3.67**	**4.00**	**4.33**	**4.67**	**5.00**
Lower Bound Freeridership Value	75%	70%	60%	50%	40%	30%	25%	20%	10%	0%	0%	0%	0%
Upper Bound Freeridership Value	100%	100%	100%	100%	90%	80%	75%	70%	60%	50%	40%	30%	25%

Next, The Cadmus Team compared direct freeridership scores to the lower and upper bounds of freeridership, as determined by the Program Area influence score (Table E-8). Wherever the direct freeridership fell outside the bounds of the Program Area influence score, The Cadmus Team changed the direct freeridership score to either the lower or upper bound value, whichever was closest.
The Team then estimated the savings-weighted overall freeridership value by first calculating the NYSERDA ARRA gross savings by multiplying gross energy savings by the percent of the project funded by NYSERDA ARRA funds, then applying freeridership rates to the savings, and summing the freeridership savings across all the projects, then dividing this number by the sum of anticipated savings attributable to NYSERDA. The calculated freeridership rate applies only to these four example projects, and not to all 23 projects described in the full body of the report. The freeridership rate for the full sample was 5%.

Table E-8. Comparison of Direct Freeridership to Upper and Lower Bounds of Freeridership, Determined by Program Area Influence Score, Renewable Energy Program Area

Resp.	**Direct FR**	**Lower Bound of FR (Prog. Area Infl.)**	**Upper Bound of FR (Prog. Area Infl.)**	**FR Score**	**Gross Energy Savings (MMBtu)**	**Percent of Project Funded by NYSERDA ARRA**	**NYSERDA ARRA Gross Savings (MMBtu)**	**Freeridership Savings (MMBtu)**
a	0%	0%	25%	0%	38.0	90%	34.2	0.0
b	0%	0%	25%	0%	175.6	5%	8.8	0.0
c	0%	0%	25%	0%	187.4	95%	178.0	0.0
d	5%	0%	25%	5%	98.7	100%	98.7	4.9
Total Savings							**319.7**	**4.9**
Savings Weighted Overall FR (Freeridership savings/NYSERDA ARRA gross savings)							**2%**	

[11] The Evaluation Team compared the Program Area influence score to the direct freeridership score in order to examine the consistency of respondents' assessments of the Program Area's influence. NYSERDA's MCAC evaluation team had previously assigned a range of reasonable freeridership values for each Program Area influence score. For example, a maximum Program Area influence score of five is assumed to have a lower bound of 0% freeridership and an upper bound of 25% freeridership, with the assumption that a freeridership value higher than 25% would be inconsistent with the maximum Program Area influence score. For more details, see Summit Blue. *Commercial/Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation*. 2007.

E3. TRANSPORTATION PROGRAM AREA

A NTG analysis is not included for the Transportation Program Area because individual survey responses could not be shared anonymously due to small sample size.

E4. ENERGY CODES PROGRAM AREA

The NTG analysis for the Energy Codes Program Area is included in this report as Appendix G - The Cross Cutting Analysis for May Codes Report.

Appendix F:

NYSERDA AMERICAN REINVESTMENT AND RECOVERY ACT 2012 IMPACT EVALUATION REPORT: EARLY BUILDING ENERGY CODE ADOPTION REPORT

NYSERDA American Reinvestment and Recovery Act 2012 Impact Evaluation Report: Early Building Energy Code Adoption

Prepared For:
The New York State
Energy Research and Development Authority
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Contract Number: 27475

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Section 1:

EXECUTIVE SUMMARY

On February 13, 2009, in response to a deepening recession in the United States economy, the U.S. Congress passed the American Reinvestment and Recovery Act (ARRA). President Obama signed the legislation into law on February 17, 2009. ARRA expressed three immediate goals:

1. To create new jobs as well as save existing ones.
2. To spur economic activity and invest in long-term economic growth.
3. To foster unprecedented levels of accountability and transparency in government spending.

A key ARRA provision was to fund "shovel-ready" projects that could begin construction on an accelerated schedule.

Bill components made funding available to states through two separate Department of Energy (DOE) managed programs: the State Energy Program (SEP), and the Energy Efficiency and Conservation Block Grant (EECBG). ARRA-funded Program Areas were designed to be distinct from (but complement) NYSERDA's existing robust and diversified portfolio of energy-efficiency and renewable energy programs, aimed at complying with the statewide goal of meeting 45% of New York State's electricity needs through improved energy efficiency and clean renewable energy by the year 2015. Funds received through SEP and EECBG complemented the programs and public policies supporting achievement of that aggressive goal, and contributed to the targeted reduction in energy use.

The Energy Code Program served as a component of SEP and EECBG, providing technical assistance to the building community and local energy conservation code enforcement officials, and seeking to achieve the highest practical levels of compliance with provisions set forth in the new Energy Code. This effort was closely coordinated between NYSERDA and the New York Department of State (DOS), an agency promulgating and providing energy code training. In 2009, NYSERDA also issued RFP 1656 for evaluation services to determine these programs' impacts. This contract was awarded to a team led by Cadmus, which ensured work undertaken in this evaluation was pursuant (to the maximum extent possible) to: evaluation guidelines[1] set forth by the DOE for ARRA-funded programs; and evaluation guidelines for ratepayer-funded, energy-efficiency programs, designed to meet New York's energy-efficiency policy goals.[2]

Prior to ARRA's adoption, New York's energy codes were based on: the 2004 International Energy Conservation Code (IECC) for residential buildings; and the American Society of Heating, Refrigerating, and Air Conditioning (ASHRAE) Standard 90.1-2004 for commercial buildings. In response to ARRA, New York adopted the 2009 IECC code for residential and ASHRAE 90.1-2007 for commercial buildings. Adoption of these codes occurred earlier than scheduled prior to ARRA requirements. Early code adoption resulting from ARRA will likely produce significant energy savings over the approximately 30-year life of new buildings and additions constructed under the more advanced codes. To evaluate these savings, Cadmus completed the following tasks:

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[1] Guidance for EECBG grant recipients: http://www1.eere.energy.gov/wip/pdfs/eecbg_evaluation_guidelines_10_017.pdf; Guidance for SEP recipients: http://www.tecmarket.net/documents/Final%20SEP%20Evaluation%20White%20Paper%2010-18.pdf

[2] On June 28, 2008, the New York State Public Service Commission adopted an Order approving the EEPS to reduce energy consumption in New York State by 15% below the 2006 forecast for the year 2015 (referred to as the 15x15 goal).

1. Calculating per-unit energy savings for residential and commercial buildings associated with each new code or standard through building simulation models.
2. Identifying the number of new units in the early code adoption period, using forecasts from McGraw-Hill and Hanley Wood.
3. Calculating total energy savings (kWh and therms) resulting from early code adoption in New York State's three climate zones.
4. Providing a range of potential code compliance rates to modify final energy savings estimates, accounting for possible losses due to incomplete compliance.

The analysis included commercial new construction and commercial additions. Energy-saving impacts of building envelope upgrades represented the majority of savings from code changes. The Cadmus Team excluded commercial renovation energy savings, due to the following:

- These typically do not include improvements to building envelopes (other than glazing);
- Data are not readily available on renovations; and
- Accurately representing savings across the renovation population would have been difficult using prototypical building models.

Hanley Wood only provided data on single-family new construction; so the Cadmus Team could not characterize savings associated with residential renovations and additions. As such, reported energy savings can be expected to fall within the lower bound of expected energy savings from early code adoption.

Table 1-1 shows effective dates for changes to residential and commercial codes for two scenarios:

1. Dates expected without ARRA; and
2. Actual dates with ARRA.

This information proved critical for analyzing how ARRA affected code adoption, thus determining ARRA's effects on energy savings. Major effects of early code adoption included:

- Skipping over the code upgrade from 2004 IECC to 2006 IECC, which DOS had prepared to take effect in April 2010; and
- Implementing the 2009 IECC and ASHRAE 90.1-2007 codes in December 28, 2010, about 16 months before they would have become effective, without ARRA.

According to DOS officials, residential and commercial codes would achieve equivalence with and without ARRA funding from April 2012 on.

Table 1-1. Effective Dates for Code Adoption

Effective Date	Expected Without ARRA		With ARRA	
	Residential	Commercial	Residential	Commercial
Prior to April 2010	2004 IECC	ASHRAE 04	2004 IECC	ASHRAE 04
April 2010	**2006 IECC**	ASHRAE 04	2004 IECC	ASHRAE 04
December 28, 2010	2006 IECC	ASHRAE 04	**2009 IECC**	**ASHRAE 07**
April 2012	**2009 IECC**	**ASHRAE 07**	2009 IECC	ASHRAE 07
April 2015	**2012 IECC**	**ASHRAE 10**	**2012 IECC**	**ASHRAE 10**

Note: Cells with **bold text** indicate when a code change would occur under each scenario.

Table 1-2 summarizes annual energy savings from early code adoption of single-family homes, commercial new construction, and commercial additions during the period when codes diverged. This period represents: eight months of lost savings due to delays in implementing a new IECC for residential buildings; and 16 months of energy savings due to accelerated adoption of 2009 IECC and ASHRAE 90.1-2007.

Table 1-2. Early Code Adoption Annual Savings

Building Type	Therm Savings	MWh Savings
Single-Family	3,784	748
Commercial New Construction	1,808,114	19,088
Commercial Additions	550,321	5,069
Total	**2,362,220**	**24,906**

The following represent findings from the early code adoption analysis.

- Early code adoption will contribute annual savings of 2,362,220 therms and 24,906 megawatt-hours (MWh), representing lifetime energy savings of 70,866,594 therms and 747,169 MWh.
- Most commercial new construction savings will be realized in standalone retail, outpatient health care, and secondary school building types. These three building types account for 43% of natural gas savings and 63% of electricity savings (while accounting for only 19% of new floor space).
- Savings per square foot vary widely across commercial building types, with retail, outpatient healthcare, and education facilities having the highest savings per square foot.

Section 2:

INTRODUCTION

2.1 OVERVIEW OF APPROACH

On February 13, 2009, in response to a deepening recession in the United States economy, the American Reinvestment and Recovery Act (ARRA) was passed by the U.S. Congress. President Obama signed the legislation into law on February 17, 2009. ARRA expressed three immediate goals:

1. To create new jobs as well as save existing ones.

2. To spur economic activity and invest in long-term economic growth.

3. To foster unprecedented levels of accountability and transparency in government spending.

A key ARRA provision was to fund "shovel-ready" projects that could begin construction on an accelerated schedule.

Bill components made funding available to states through two separate Department of Energy (DOE) managed programs: State Energy Program (SEP); and Energy Efficiency and Conservation Block Grant (EECBG). ARRA-funded Program Areas were designed to be unique from, but complement, NYSERDA's existing robust, diversified portfolio of energy-efficiency and renewable energy programs, aimed at complying with the statewide goal of meeting 45% of the State's electricity needs through improved energy efficiency and clean renewable energy by the year 2015. Funds received through SEP and EECBG complemented the programs and public policies supporting achievement of this aggressive goal, and contributed to the targeted reduction in energy use.

The Energy Code Program served as a component of SEP and EECBG, providing technical assistance to the building community and local energy conservation code enforcement officials, seeking to achieve the highest practical compliance levels with provisions set forth in the new Energy Code. This effort was closely coordinated between NYSERDA and the New York Department of State (DOS), an agency promulgating and providing energy code training. In 2009, NYSERDA also issued RFP 1656 for evaluation services, seeking to determine the programs' impacts. This contract was awarded to a team led by Cadmus, which ensured work undertaken in the evaluation was pursuant, to the maximum extent possible, with: evaluation guidelines[3] set forth by the DOE for ARRA-funded programs; and evaluation guidelines for ratepayer-funded, energy-efficiency programs, designed to help meet New York's energy-efficiency policy goals.[4]

Prior to ARRA's adoption, New York's energy codes were based on: the 2004 International Energy Conservation Code (IECC) for residential buildings; and the American Society of Heating, Refrigerating, and Air Conditioning (ASHRAE) standard 90.1-2004 for commercial buildings. In response to ARRA, New York adopted the 2009 IECC code for residential buildings and ASHRAE 90.1-2007 for commercial buildings. Early code adoption resulting from ARRA will likely produce significant energy savings over

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[3] Guidance for EECBG grant recipients: http://www1.eere.energy.gov/wip/pdfs/eecbg_evaluation_guidelines_10_017.pdf; Guidance for SEP recipients: http://www.tecmarket.net/documents/Final%20SEP%20Evaluation%20White%20Paper%2010-18.pdf

[4] On June 28, 2008, the New York State Public Service Commission adopted an Order approving the EEPS to reduce energy consumption in New York State by a total of 15% below the 2006 forecast for the year 2015; referred to as the 15x15 goal.

the approximately 30-year life of new buildings and additions constructed under the more advanced codes. To evaluate these savings, Cadmus completed the following tasks.

1. Calculating per-unit energy savings for residential and commercial buildings associated with each new code or standard, using building simulation models.

2. Identifying the number of new units in the early code adoption period, using forecasts from McGraw-Hill and Hanley Wood.

3. Calculating total energy savings (kWh and therms) resulting from early code adoption in New York State's the three climate zones.

4. Providing a range of potential code compliance rates to modify final energy savings estimates, accounting for possible losses resulting from incomplete compliance.

The analysis included commercial new construction and commercial additions. Energy-saving impacts of building envelope upgrades represented the majority of savings from the code changes. The Cadmus Team excluded commercial renovation energy savings because:

- They typically do not include improvements to building envelopes (other than glazing, data are not readily available regarding renovations; and

- It would have been difficult to accurately represent savings across the renovation population using prototypical building models.

Hanley Wood only provided data on single-family new construction; so the Cadmus Team could not characterize savings associated with residential renovations and additions. As such, reported energy savings can be expected to fall within the lower bound of expected energy savings from early code adoption.

2.2 BACKGROUND

On the Cadmus Team's behalf, NYSERDA requested analysis from Pacific Northwest National Laboratory (PNNL) on commercial and residential buildings' energy savings for the 2003, 2006, 2009, and 2012 IECC, and for ASHRAE 90.1 variants. Cadmus had planned to use these analyses to estimate effects of New York's early adoption of model codes in response to ARRA. Under its DOE funding, PNNL can provide analyses requested by state organizations. However, PNNL could not perform these analyses due to constraints in federal budget allocations. PNNL provided a proposal and budget to perform this work under a direct contract with NYSERDA, proposing a budget of $170,000, which would have been in addition to the already approved budget for this evaluation. The proposed timing would have required at least three months to complete the simulation analysis, which limited the time available for extrapolation of results to the statewide population and analysis before the reporting deadline.

Cadmus and NYSERDA determined neither PNNL's proposed cost nor schedule were compatible with the initial evaluation's scope and timeline. To provide NYSERDA with an estimate of these impacts at a relatively low cost, with acceptable accuracy, Cadmus developed an alternative approach, relying on existing information and simulation runs, similar to those requested from PNNL.

This approach used available simulation models PNNL had applied in prior analyses of the impacts of new codes. The only available PNNL simulation models used IECC code variants for commercial buildings, rather than ASHRAE 90.1 variants, approved for the NYS code. An analysis by PNNL determined, however, the IECC and ASHRAE codes could potentially produce very comparable energy savings for most building types[5]. Consequently, it should be possible to use IECC-based model results to estimate commercial building savings from changes in the NYS code, based on ASHRAE 90.1. Overall, results of Cadmus' analysis should be sufficiently accurate to estimate the contribution of accelerated code adoption toward New York's 15-by-15 electricity reduction goal.[6]

Table 1-1 shows effective dates for changes to residential and commercial codes for two scenarios:

1. Dates expected without ARRA; and
2. Actual dates with ARRA.

This information proved critical in analyzing how ARRA affected code adoption. Major effects of early code adoption included:

- Skipping over the code upgrade from 2004 IECC to 2006 IECC, which DOS had prepared to go into effect in April 2010; and
- Implementing the 2009 IECC and ASHRAE 90.1-2007 codes in December 28, 2010, about 16 months before they would have become effective without ARRA.

According to DOS officials, residential and commercial codes would reach equivalence with and without ARRA funding as of April 2012.

Table 2-1. Effective Dates for Code Adoption

Effective Date	Expected Without ARRA		With ARRA	
	Residential	Commercial	Residential	Commercial
Prior to April 2010	2004 IECC	ASHRAE 04	2004 IECC	ASHRAE 04
April 2010	**2006 IECC**	ASHRAE 04	2004 IECC	ASHRAE 04
December 28, 2010	2006 IECC	ASHRAE 04	**2009 IECC**	**ASHRAE 07**
April 2012	**2009 IECC**	**ASHRAE 07**	2009 IECC	ASHRAE 07
April 2015	**2012 IECC**	**ASHRAE 10**	**2012 IECC**	**ASHRAE 10**

Note: Cells with **bold text** indicate when a code change would occur under each scenario.

2.3 HVAC SAVINGS ADJUSTMENTS

The federal National Appliance Energy Conservation Act of 1987 (NAECA) amended the Energy Policy Conservation Act to establish energy efficiency-standards for 12 types of "consumer products" including furnaces, central air conditioners, and heat pumps. NAECA also required the DOE to: update standards for these products; and specify effective dates for the revised standards. For example, a revised federal standard in 2006 increased the residential air conditioning Seasonal Energy Efficiency Ratio (SEER) minimum requirement from 10 to 13.

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[5] http://www.mesaaz.gov/sustainability/pdf/MesaFinalCommercialReportFeb2011.pdf
[6] http://www.nysenergyplan.com/final/Energy_Efficiency.pdf: "The '15 by 15' clean energy goal proposes to reduce electricity end-use by 15 percent below 2015 forecasted levels, while simultaneously meeting 30 percent of the State's electricity supply needs through renewable resources."

The latest update resulted in DOE issuing new standards, with an effective date of January 2010. Savings from these new standards would have occurred, regardless of the New York building code in effect on January 2010. Thus, the Cadmus Team had to update the prototypical building simulation models for the various energy codes, removing effects of these DOE standards from the savings calculations.

Table 2-2 describes how the 2009 IECC efficiency requirement and federal standards compare for heating, ventilating, and air-conditioning (HVAC) equipment.[7,8] It proved inappropriate to credit early code adoption with savings for 2009 IECC equipment efficiencies only meeting federal standards, as those already would be required by law.

Table 2-2. HVAC Efficiency Comparison Between IECC and Federal Standards

Table	HVAC Category	Finding
1	Unitary A/C	Efficiency specifications agree with federal standards; no credit due to the NY Code upgrade for energy savings.
2	Unitary A/C	NYS can take credit for energy savings arising from the last three categories appearing to agree with a proposed rule (water source, groundwater source, ground source), but all other categories agree with federal standards; so no credit will accrue due to NY Code upgrade for these.
3	PTAC, PTHP	IECC 2009 efficiency specifications agree with 2006 values; no energy savings will accrue due to NY Code upgrade from this equipment category.
4	Warm air furnaces	IECC 2009 efficiency specifications agree with 2006 values; no energy savings will accrue due to NY Code upgrade from this equipment category.
5	Boilers	IECC 2009 values differ from 2006 values, but agree with federal standards; no energy savings result due to NY Code upgrade from this equipment category.
6	Condensing units	IECC 2009 efficiency specifications agree with 2006 values; no energy savings will accrue due to NY Code upgrade from this equipment category.
7	Water chilling packages	IECC 2009 values differ from 2006 values, and do not match federal standards; NYS can accrue credit due to NY Code upgrade from this equipment category.

[7] 2009 IECC, Tables 503.2.3(1-7).

[8] 10 CFR Parts 430-434 and other sources.

Section 3:

DATA SOURCES AND METHODOLOGY

3.1 DATA SOURCES

The Cadmus Team used the following data sources for the Early Code Adoption analysis:

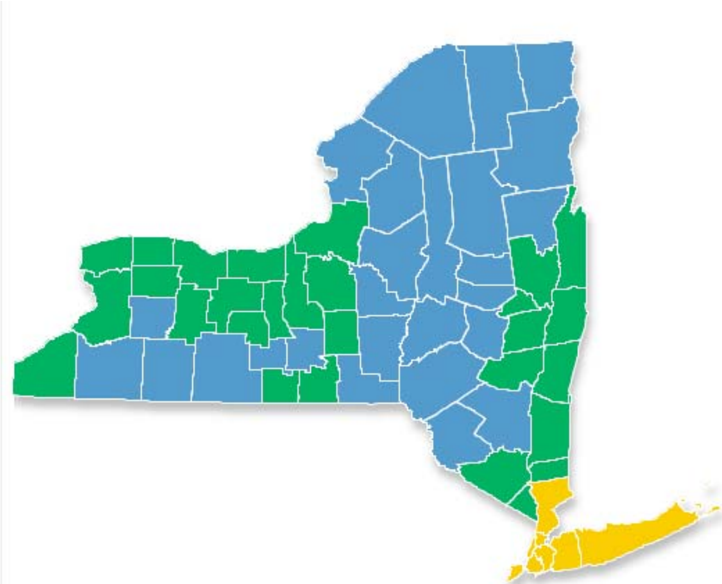
- Interviews with two DOS staff;
- Revised 2010 minimum federal energy efficiency standards;
- IECC documentation;
- ASHRAE Standard 90.1 documentation;
- McGraw Hill/FW Dodge commercial construction forecast data;
- Hanley Wood residential construction forecast data;
- DOE EnergyPlus prototypical models from PNNL; and
- VEIC. *New York Energy Code Compliance Study*. 2011.

3.2 ENERGY SIMULATION MODELS

The Cadmus Team modified prototypical building simulation models to estimate savings for 16 commercial building types and one residential building type (single-family). The commercial types were consistent with the 16 types covered in DOE's 90.1 Prototype Building Models.[9] For each type, Cadmus considered buildings constructed in each of New York's three climate zones (4A, 5A, and 6A), as shown in Figure 3-1. Zones 5A and 6A represent areas with much higher heating loads than in Zone 4A. Table 3-1 shows individual building types and climate zones considered.

[9] http://www.energycodes.gov/commercial/901models/

Figure 3-1. New York State Climate Zones



Yellow = 4A, Green = 5A, Blue = 6A

Table 3-1. Market Segmentation

Sector	Type	Climate Zones	Construction Type
Residential	Single-Family	4A, 5A, 6A	New
Commercial	Apartment High Rise	4A, 5A, 6A	New, Additions
	Apartment Mid Rise		
	Health Hospital		
	Health Out Patient Healthcare		
	Hotel Large		
	Hotel Small		
	Office Large		
	Office Medium		
	Office Small		
	Restaurant Fast Food		
	Restaurant Sit Down		
	Retail Stand Alone		
	Retail Strip Mall		
	School Primary		
	School Secondary[10]		
	Warehouse		

[10] The Schools Secondary category includes colleges and universities.

The Cadmus Team obtained and ran PNNL's prototypical EnergyPlus models for each commercial building type and IECC code, updating each model to represent the three climate zones and ensure HVAC equipment met the 2010 minimum federal efficiency requirements in all the runs; so no savings were counted due to the federal equipment standards. The Cadmus Team then ran each model for the various building types, climate zones, and energy codes to obtain total building electric and natural gas annual usage. The whole building energy use intensity (EUI) for each building type was calculated by dividing annual energy use by the building floor area in square feet. The Cadmus Team calculated energy savings based on differences for gas and electric EUI between each code for the three New York climate zones. Cadmus multiplied the values by actual or forecast square footage of new construction, or additions, in each climate zone, and summed the results for all three climate zones to estimate the statewide impacts.

For the residential simulation models, the Cadmus Team obtained prototypical single-family models PNNL had developed using EnergyGauge[11] software for the 2004 and 2006 IECC. PNNL could not provide models based on the 2009 IECC, so Cadmus modified the 2006 IECC prototypical model to reflect 2009 IECC requirements. As with the commercial models, the Cadmus Team ran each model for the various climate zones and energy codes to obtain total building electric and natural gas usage. These values represented the energy consumption per housing unit (UEC) for each climate zone and energy code. The Cadmus Team then calculated energy savings, based on UEC differences between each code for the three New York climate zones. Cadmus multiplied these values by the number of units in each climate zone, and added the individual climate zone results to estimate statewide impacts.

3.3 CONSTRUCTION FORECASTS

For each building type and climate zone, the model incorporated forecasts of new commercial floor space (square feet) and new, residential, single-family buildings (housing units). McGraw-Hill Dodge provided forecasts of commercial building starts through 2015, and Hanley Wood Consulting provided forecasts of new single-family homes. McGraw-Hill Dodge did not provide forecasts of commercial additions. The Cadmus Team assumed new floor space from additions would grow at the same rate as forecasts of new construction.[12] For each building type in each climate zone, the Cadmus Team produced a forecast for additions by using the average of total floor space in 2009 and 2010, and applying new construction forecast growth rates.

To track when savings occurred due to accelerated code adoption, it was necessary to account for lag times between construction starts and building completions (and readiness for occupancy). For commercial buildings, Cadmus used an average time of eight months from the start of construction to occupancy. For single-family residential buildings, Cadmus used an average construction lag of seven months.[13] These lag times were applied to actual and forecast construction starts to determine the savings' time profile. The construction lag had no impact on annual savings or lifetime savings, and only affected when the savings would be realized.

[11] http://www.energygauge.com/

[12] The Cadmus Team initially considered using the average additions for 2009 and 2010, but this period was in the depths of the recession. Since the McGraw-Hill Dodge forecast showed an expected increase in new construction, the Team made the assumption that additions also would increase at the same rate. The only exception was School Primary and School Secondary, where the forecast new construction declined and it was assumed that additions would remain at the average 2009-2010 level to provide school space in lieu of new buildings.

[13]The U.S. Census Bureau's Survey of Construction provides estimates of the average length of time from construction start to completion, by year. Cadmus used a 10-year average. http://www.census.gov/construction/nrc/lengthoftime.html

As Table 2-1 shows, energy codes were expected to be at the same levels by April 2012 under both scenarios, with and without ARRA. Consequently, after accounting for the seven- to eight-month construction lag, there would be no further effect of accelerated code adoption on buildings completed after the end of 2012.

3.4 EARLY CODE ADOPTION MODEL

Cadmus estimated energy savings from early adoption of codes by comparing two scenarios: one in which building energy codes would have been adopted on the expected schedule, without ARRA's effect, and one in which ARRA influenced the codes adopted on an earlier schedule. The model estimated annual savings for buildings completed in a given month by taking the difference between the whole building EUI under the "No ARRA"" scenario code and the whole building EUI under the "ARRA" code scenario, and multiplying by either the number of new buildings (residential) or new square feet of floor space (commercial). Specifically:

$$\boldsymbol{Energy\ Code\ Savings_{msw}} = [\boldsymbol{NC_{msw}} * \left(\boldsymbol{EUI_{sw}^{No\ ARRA\ Code(m)}} - \boldsymbol{EUI_{sw}^{ARRA\ Code(m)}}\right)]$$

Where:

m = Month.

s = Segment (also called "building type" [e.g., "Retail, Single-Family, Health Care, etc…"]).

w = Climate zone.

Energy Code Savings$_{msw}$ =Annual energy savings due to early code adoption for buildings of segment *s*, in climate zone *w*, for buildings completed in month *m*.

NC_{msw} = Number of new building units of segment *s*, in climate zone *w*, in month *m*. Units measured in square feet of new floor space for commercial segments, and buildings for single-family residential.

$EUI_{sw}^{No\ ARRA\ Code(m)}$= The whole building EUI[14] for building *s*, in climate zone *w*, with the applicable code in the "No ARRA" scenario, completed in month *m*.

$EUI_{sw}^{ARRA\ Code(m)}$= The whole building EUI for building *s*, in climate zone *w*, with the applicable code in the "ARRA" scenario, completed in month *m*.

Total early code adoption savings result from the sum of $\boldsymbol{Energy\ Code\ Savings_{msw}}$ across all segment/climate zone/month combinations. Early code adoption savings were driven by the difference in EUIs between the ARRA and no-ARRA scenarios, and projected new floor space (or buildings for single-family) over the code adoption period.

[14] Whole building energy use intensities (EUIs) were annualized per UEC figures. For residential buildings, these figures are normally calculated on a per-building basis and, for commercial, are per square foot. For example, if the electric EUI for an Office is 500, on average, offices use 500 kWh/sqft per year.

Section 4:

RESULTS

4.1 RESIDENTIAL SINGLE-FAMILY

Table 4-1 shows annual gas and electric savings by climate zone for all homes affected by early code adoption.[15]

Table 4-1. Annual Early Code Adoption Savings by Climate Zone

Climate zone	Number of New Homes*	Therm Savings	MWh Savings
4A	2,040	24,476	233
5A	6,303	-12,607	416
6A	2,695	-8,085	100
Total	**11,038**	**3,784**	**748**

*Represents the number of homes completed that were permitted under the 2009 IECC due to early code adoption.

Early energy code adoption will have contributed to (1) a decrease in annual natural gas consumption of 3,784 therms per year and (2) a decrease in annual electricity consumption of 748 MWh per year for all residential, single-family buildings constructed by the end of 2012. Two factors are important to note in the calculation of the impact of early code adoption :

- Skipping implementation of the 2006 IECC had no negative effect on electric and natural gas savings. There was no difference in electricity or natural gas consumption between the 2004 and 2006 IECC code simulation models, after correcting for the impact of the 2006 federal standard that mandated an increase in minimum SEER level for residential air conditioners.

- Although natural gas consumption in climate zones 5A and 6A actually increased under the 2009 IECC compared to the 2006 IECC, the increase was more than offset by the savings in zone 4A.

There was no change in electricity or natural gas consumption for homes permitted between April 2010 and December 2010, a period when New York retained the 2004 IECC rather than moving to the 2006 IECC as planned originally. Over this eight-month period, estimated residential electricity and natural gas consumption was equal to what it would have been in new, single-family homes under the "No ARRA" scenario. Electric and natural gas savings for homes permitted between January 2011 and April 2012 (the 16-month period when New York was under a more stringent code) totaled 748 MWh and 3,784 therms, respectively. Table 4-2 breaks out savings for these two periods.

[15] Cadmus identified differences between the residential savings estimates the Team developed for this study and the estimates provided in *Impacts of the 2009 IECC for Residential Buildings at State Level* published by Pacific Northwest National Laboratory for U.S. Department of Energy in 2009. After a thorough review of the inputs, analysis, and outputs that identified no errors in the analysis, the Cadmus Team contacted the report's author, Robert Lucas, on August 3, 2012. Mr. Lucas indicated he had used a modified version of the software that allowed running of batch jobs and he also had found differences between the results produced by the two versions of the same software. The Cadmus Team decided to use the results of the Team's energy analysis, which were more conservative than those from PNNL, as the basis for estimates of energy savings and all other impacts.

Table 4-2. Savings by Period under the ARRA Scenario

Period	Therm Savings	MWH Savings
Delayed Adoption: 2004 IECC Instead of 2006 IECC (April 2010 to December 2010)	0	0
Early Adoption: 2009 IECC Instead of 2006 IECC (January 2011 to April 2012)	3,784	748
Total	**3,784**	**748**

Table 4-3 shows the change in consumption, going from an older code to a newer code, by climate zone, for the three codes analyzed. As shown, both electric and natural gas heating savings were negative in zones 5A and 6A going from the 2006 to the 2009 IECC. This was a result of the increased lighting efficiency requirements in the 2009 IECC, which had an interactive effect on the heating load. This effect was not enough in climate zone 4A to offset the heating savings.

Table 4-3. Change in Annual Consumption per Home Under Code Scenarios

Climate Zone	Code Scenario	Electric Cooling Savings (kWh)	Electric Heating Savings (kWh)	Electric Total Savings (kWh)	Gas Heating Savings (Therms)
4A	2004 to 2006	0	0	0	0
	2006 to 2009	110	4	114	12
5A	2004 to 2006	0	0	0	0
	2006 to 2009	76	-10	66	-2
6A	2004 to 2006	0	0	0	0
	2006 to 2009	48	-11	37	-3

Under the ARRA scenario, most homes completed in 2010 and 2011 would consume less electricity and gas than they would have under the scenario without early code adoption triggered by ARRA. Homes completed after the end of 2012 would have been permitted under the 2009 IECC in both scenarios, resulting in no new annual early code adoption savings in 2013 and beyond.

4.2 COMMERCIAL NEW CONSTRUCTION

Table 4-4 summarizes early code adoption savings for commercial new construction. Commercial buildings permitted over the early code adoption period from December 2010 to April 2012 represented annual savings of over 1.8 million therms and 19,000 MWh.

Table 4-4. Commercial New Construction Early Code Adoption Savings by Building Type.

Building Type	New Floor Space (000s Square Feet)	Therm Savings	MWh Savings
Apartment High Rise	15,021	94,016	1,471
Apartment Mid Rise	7,295	85,376	607
Health Hospital	644	-14,997	28
Health Out Patient	1,891	66,336	4,365
Hotel Large	2,041	179,611	767

Building Type	New Floor Space (000s Square Feet)	Therm Savings	MWh Savings
Hotel Small	1,651	127,945	422
Office Large	1,650	41,697	183
Office Medium	2,132	33,103	1,694
Office Small	1,122	14,896	185
Restaurant Fast Food	95	41,783	-91
Restaurant Sit Down	186	63,815	95
Retail Standalone	4,131	370,292	4,775
Retail Strip Mall	505	58,672	677
School Primary	1,416	117,376	980
School Secondary	3,665	349,664	2,909
Warehouse	6,368	178,528	21
Total	**49,813**	**1,808,114**	**19,088**

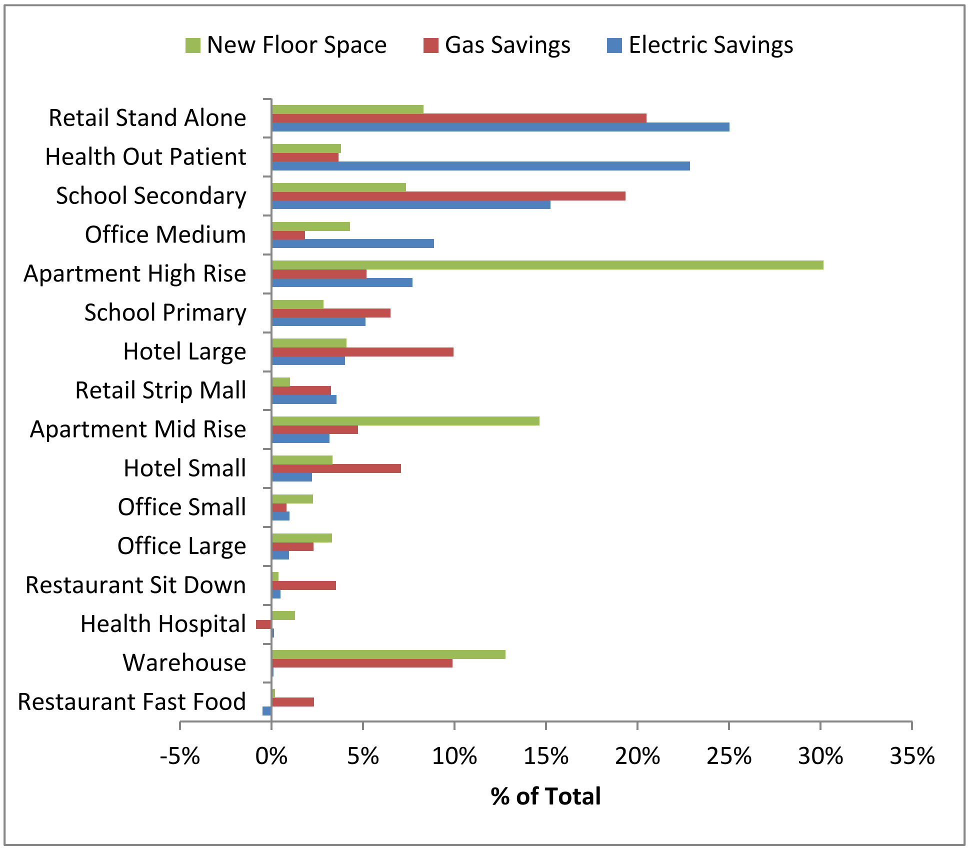
New standalone retail, outpatient health care, and secondary schools represented the largest share of annual electric savings, accounting for 25%, 23%, and 15% of savings, respectively. Standalone retail, secondary schools, large hotels, and warehouses represented the largest share of natural gas savings, accounting for 20%, 19%, 10%, and 10%, respectively. Analysis identified an increase in gas use for hospitals, and an increase in electric use for fast food restaurants due to the more stringent code.

Upon reviewing the models, Cadmus determined the large ventilation rates required in fast food restaurants resulted in increased fan energy use after natural infiltration rates were limited under the 2009 IECC code. Increased fan energy offset other electric energy savings for this building type, resulting in overall negative savings.

Increased ventilation rate requirements also resulted in larger heating consumption for the hospital building type. Cadmus investigated the increased heating consumption for the model in question and determined both the chiller and boiler plant sizes increased in capacity in the 2009 IECC version of the model compared to the 2006 version. The increased plant sizes are the main contributing factor to the negative heating savings and limited cooling savings resulting from the models. By contrast, when comparing the plant capacities resulting from the 2012 version of the model, the capacities are less than the plant sizes found in the 2006 version of the model. Based on several output reports the automatic control of ventilation air rates by algorithms within the software is the main contributing factor leading to the increased plant sizes.

Figure 4-1 shows the portion of total floor space, gas savings, and electricity savings for each commercial building type.

Figure 4-1. Relative Gas and Electric Savings for Building Types



As shown in Figure 4-1, the amount of projected new floor space did not completely drive relative gas and electricity savings across building types. For example, new mid-rise and high-rise apartments accounted for 45% of new floor space over the code adoption period, but only 10% of gas savings and 11% of electric savings. Savings were largely driven by the difference in per-square foot consumption between the ARRA scenario and the no-ARRA scenario. Table 4-5 illustrates how statewide average per square foot savings differed across commercial building types. The savings accounted for differences in savings across climate zones to provide a statewide average.

Table 4-5. Statewide Average Per Square Foot Savings Over Code Adoption Period

Building Type	Statewide Average Therm/Sqft Savings	Statewide Average kWh/Sqft Savings
Apartment High Rise	0.01	0.10
Apartment Mid Rise	0.01	0.08
Health Hospital	-0.02	0.04
Health Outpatient	0.04	2.31
Hotel Large	0.09	0.38
Hotel Small	0.08	0.26
Office Large	0.03	0.11
Office Medium	0.02	0.79
Office Small	0.01	0.17
Restaurant Fast Food	0.44	-0.96
Restaurant Sit Down	0.34	0.51
Retail Standalone	0.09	1.16
Retail Strip Mall	0.12	1.34
School Primary	0.08	0.69
School Secondary	0.10	0.79
Warehouse	0.03	0.00

Table 4-6 breaks out annual savings by climate zone.

Table 4-6. Commercial New Construction Annual Savings by Climate Zone

Climate Zone	Therms	MWh
4A	920,064	9,588
5A	673,416	7,595
6A	214,634	1,905
Total	**1,808,114**	**19,088**

Most savings were concentrated in New York's more populous areas, although, as shown in Figure 4-2, distribution of savings by climate zone differed from distribution of new floor space by climate zone. Table 4-7 shows weighted average savings per square foot, by climate zone.

Figure 4-2. Distribution of New Floor Space and Savings by Climate Zone

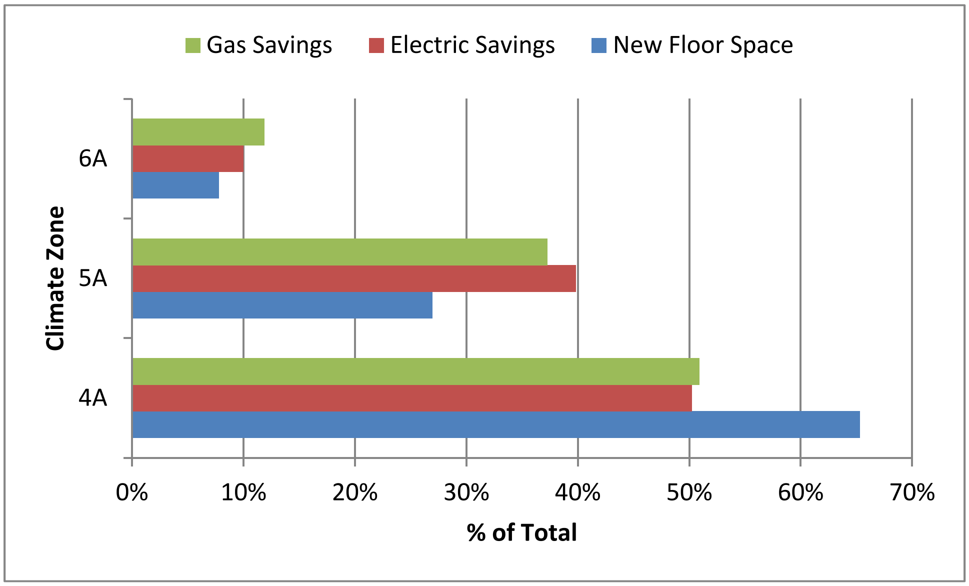


Table 4-7. Average Annual Savings Per Square Foot by Climate Zone

Climate Zone	Average Therm/Sqft Savings	Average kWh/Sqft Savings
4A	0.03	0.29
5A	0.05	0.57
6A	0.06	0.49

The following two factors drove differences in average savings per square foot by climate zone:

- Each climate zone had a different mix of building types. Climate zone 4A, which includes New York City, had relatively more mid-rise and high-rise apartments, compared to the other climate zones. With low savings per square foot, these building types drove down overall savings per square foot in zone 4A.

- Colder climates of New York's northern zones (5A and 6A) contributed to greater potential savings from code changes affecting heating, as apparent in the relative weighted average therm per square foot estimates.

Most annual savings will be realized from buildings completed in 2012 due to the projected eight month construction lag. Assuming this construction lag, the first buildings permitted after early code adoption on December 28, 2010, would have been completed by late August 2011. The last buildings under early code adoption would have been completed in December 2012. Table 4-8 summarizes total annual savings by the year of building completion.

Table 4-8. Savings by Year Building is Completed

Building Type	Annual Therm Savings	Annual MWh Savings
2011	330,572	3,350
2012	1,477,542	15,738
Total	**1,808,114**	**19,088**

4.3 COMMERCIAL ADDITIONS

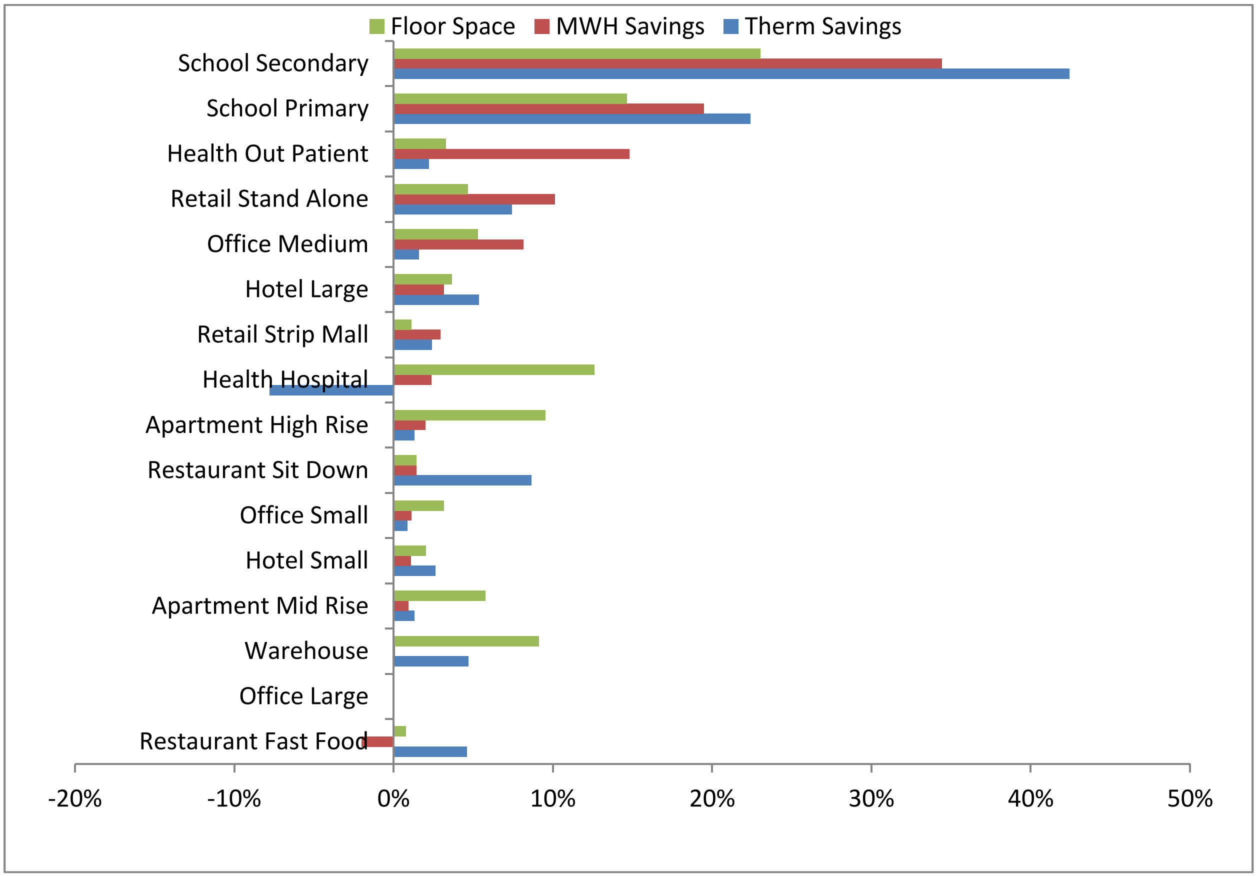
Table 4-9 shows annual early code adoption savings for commercial additions, by building type. Commercial additions contributed to annual savings of 550,321 therms and 5,069 MWh.

Table 4-9. Commercial Additions Annual Early Code Adoption Savings by Building Type

Building Type	New Floor Space (000s Square Feet)	Therms	MWh
Apartment High Rise	965	7,123	101
Apartment Mid Rise	582	7,096	47
Health Hospital	1,275	-42,676	120
Health Out Patient	331	12,229	750
Hotel Large	372	29,379	159
Hotel Small	204	14,332	55
Office Medium	534	8,783	412
Office Small	321	4,745	56
Restaurant Fast Food	76	25,214	-101
Restaurant Sit Down	144	47,576	73
Retail Stand Alone	471	40,793	512
Retail Strip Mall	111	13,226	149
School Primary	1,480	123,306	988
School Secondary	2,328	233,405	1,744
Warehouse	922	25,792	4
Total	**10,115**	**550,321**	**5,069**

Figure 4-3 shows distributions of floor space and savings for additions across building types.

Figure 4-3. Distribution of Floor Space and Savings for Additions by Building Type



As with new construction, most natural gas and electricity savings for commercial additions should be realized in schools, outpatient health care, and standalone retail. Primary schools represented a larger share of new floor space in additions, moving this to second in the list of top saving building types. As with the new construction models, hospital heating energy and fast food fan energy increased due to increased mechanical ventilation requirements in the 2009 IECC.

Also similar to new construction, savings estimates were only partially driven by square feet. As shown in Table 4-10, statewide average savings per square foot varied across building types. Statewide annual average savings per square foot for commercial additions differed from new construction due to the distribution of new floor space across climate zones differed for the two calculation models.

Table 4-10. Statewide Average Savings per Square Foot by Building Type

Building Type	Statewide Average Therm/Sqft Savings	Statewide Average kWh/Sqft Savings
Apartment High Rise	0.01	0.10
Apartment Mid Rise	0.01	0.08
Health Hospital	-0.03	0.09
Health Out Patient	0.04	2.26
Hotel Large	0.08	0.43
Hotel Small	0.07	0.27
Office Medium	0.03	1.28
Office Small	0.06	0.73
Restaurant Fast Food	0.18	-0.70
Restaurant Sit Down	0.10	0.15
Retail Stand Alone	0.37	4.62
Retail Strip Mall	0.01	0.10
School Primary	0.05	0.42
School Secondary	0.25	1.89
Warehouse	0.00	0.00

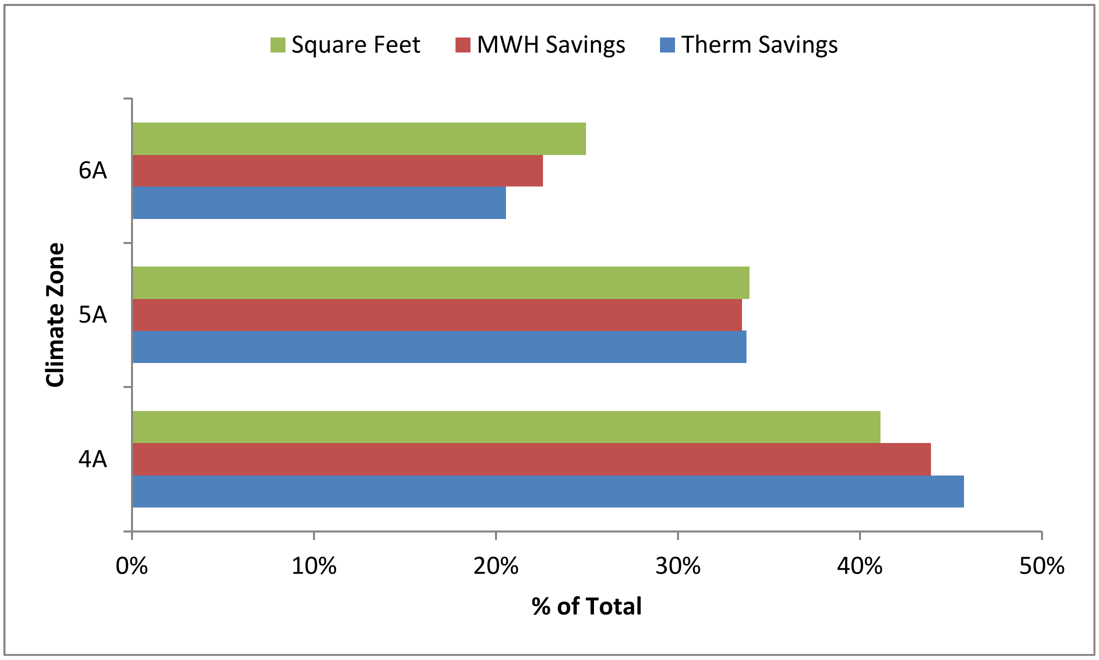
Most savings occurred in the climate zone with the largest amount of commercial additions (4A). Table 4-11 summarizes annual savings by climate zone.

Table 4-11. Early Code Adoption Savings for Commercial Additions by Climate Zone

Building Type	Therms	MWh
4A	251,577	2,226
5A	185,763	1,699
6A	112,982	1,145
Total	**550,321**	**5,069**

As shown in Figure 4-4, distributions of savings across climate zones resembles the distribution of commercial addition floor space.

Figure 4-4. Distribution of Commercial Additions Savings Across Climate Zones



As shown in Table 4-12, unlike new construction, climate zone 4A had slightly higher average therm and kWh annual savings per area than the other two climate zones. Higher average savings per square foot in climate zone 4A could have resulted from a higher concentration of building types with high savings per square foot (such as schools and outpatient health care).

Table 4-12. Average Commercial Addition Savings by Climate Zones

Climate Zone	Average Therm/Sqft Savings	Average kWh/Sqft Savings
4A	0.06	0.54
5A	0.05	0.50
6A	0.04	0.45

4.4 COMPLIANCE RATE IMPACTS

The degree that builders, architects, and engineers comply with energy code represents an important component of achieving energy savings from new code adoption. Actual savings from a new code depend on: compliance rates for the preceding code; and compliance rates for the new code. In general, compliance rates should increase over time, after a code goes into effect, due to experience, learning, training, and similar factors. However, few available studies quantify compliance rates, let alone assess how they change over time. The Cadmus Team is working with NYSERDA to plan an assessment of compliance with the new codes.

The preceding results have been based on the assumption that savings from a change in the code result from the difference in energy use between a building exactly meeting the initial code and one redesigned to exactly meet the updated code. As accurate estimates are not yet available of compliance with any of the codes, the Cadmus Team examined the saving effect using estimates developed by VEIC in their 2011 compliance study. Table 4-13 provides statewide estimates of early code adoption annual energy savings adjusted for their estimates. The analysis adjusts the Cadmus Team residential savings by the VEIC estimate of 64% for performance path compliance with the ECCC NYS 2007. For commercial buildings, the Cadmus Team savings estimates are adjusted by an estimated compliance rate of 36%, based on VEIC's analysis of compliance with ASHRAE 90.1-2004 and 2007. The same compliance rate adjustment is assumed for commercial additions.[16]

Table 4-13. Early Code Adoption Annual Savings Adjusted Using VEIC Compliance Estimates

Model	Assumed Compliance	Therm Savings	MWH Savings
Single Family	64%	2,422	479
Commercial New Construction	36%	650,921	6,872
Commercial Additions	36%	198,116	1,825
Total		**851,459**	**9,176**

4.5 LIFETIME ENERGY SAVINGS IMPACTS

The California Energy Commission estimates newly constructed buildings will provide energy savings for at least 30 years.[17] The Cadmus Team applied this value to estimate expected lifetime energy savings attributable to early code adoption, as shown in Table 4-14.

Table 4-14. Lifetime Early Code Adoption Energy Savings at 100% of Modeled Savings

Building Type	Therm Savings	MWh Savings
Single-Family	113,532	22,448
Commercial New Construction	54,243,422	572,641
Commercial Additions	16,509,640	152,080
Total	**70,866,594**	**747,169**

[16] It is important to note, however, that the effect of noncompliance on the savings depends on the compliance rate for each of the codes. The original analysis assumes 100% compliance with all codes. It is likely compliance with a code in place for several years would be higher than it would be with a new code. Consequently, rather than assume the savings are proportional to a single compliance rate, it would be more accurate to determine savings by applying the appropriate compliance rate to each code over time.

[17] From personal communication with CEC staff during a December 10, 2011 interview.

Section 5:

CONCLUSIONS AND RECOMMENDATIONS

The Cadmus Team identified energy savings for early code adoption activities resulting from ARRA funding. By the end of 2012, early code adoption will contribute annual savings of 2,362,220 therms and 24,906 MWh. Summed over all buildings affected by early code adoption, this represents lifetime energy savings of 70,866,594 therms and 747,169 MWh, assuming 100% of the modeled energy savings are achieved.

Most commercial new construction savings will be realized in standalone retail, outpatient health care, and secondary school building types. These three building types account for 43% of natural gas savings and 63% of electricity savings (while accounting for only 19% of new floor space). Savings per square foot vary widely across commercial building types. Retail, outpatient healthcare, and education facilities have the highest savings per square foot.

An earlier VEIC study found that compliance with the prevailing energy code was not 100%. Assuming that the VEIC estimates were an indication of how much noncompliance would affect energy savings from early code adoption, the savings estimated here for residential buildings would be reduced by 36% and the savings for commercial buildings would be reduced by 64%.

As noted, the Cadmus Team conducted the commercial analysis using prototypical IECC models from PNNL. The NYS code requires commercial buildings to follow the ASHRAE 90.1 code, which differs slightly from IECC. To further clarify Energy Code Program impacts, the Cadmus Team recommends continuing discussions with DOE/PNNL about possibly completing the more thorough analysis with ASHRAE 90.1 simulation models, and incorporating results into a supplemental report. The Cadmus Team also recommends conducting future sensitivity analyses, based on results from code compliance studies.

Appendix G:

CROSS-CUTTING ANALYSIS FOR NEW YORK'S EARLY BUILDING CODE ADOPTION REPORT

G1. Employment Impacts of Early Building Code Adoption

G2. Carbon Emission Reductions Analysis

G3. Cost-Effectiveness Analysis

1.1 EMPLOYMENT IMPACTS OF EARLY BUILDING CODE ADOPTION

New York's Early Building Code Adoption, which was supported by SEP and EECBG-funded educational efforts, will result in new or renovated building stock that meets the requirements of the 2009 IECC. The Early Building Energy Code Adoption report (Appendix F) estimates that 11,038 new residential homes will be affected, along with 59,927 square-feet of commercial new construction and additions. However, the report also estimates compliance rates of 64% and 36% for new residential construction and new commercial construction and additions, respectively. These rates effectively reduce the amount of affected new construction in both the residential and commercial sectors, to 7,064 new residential homes and 21,574 square-feet of commercial new construction and additions, respectively.

Table G-1 and Table G-2 summarize the total incremental cost of building in compliance with the new code, which the Cadmus Team estimated from secondary sources. The cost for building a single family residence will increase by $836 per home.[1] The cost for constructing commercial buildings will increase between $0.33 and $0.64 per square foot, depending on the region within the State.[2] These construction costs are incurred by anyone who purchases either a new building or a building addition. No incentives are provided through either NYSERDA or ARRA funds.

Table G-1. Residential Incremental Cost of Construction due to Early Code Adoption, Energy Code Program Area

Sector	Number of New Homes (A)	Compliance Rate (B)	Number of New Homes Under Compliance (A × B)	Incremental Cost per Home (C)	Total Incremental Cost (A × B × C)
Single Family	11,038	64%	7,064	$836	$5,905,772

[1] Building Codes Assistance Project. *True Cost of the 2009 International Energy Conservation Code for Homes in New York.* March 31, 2011.

[2] Pacific Northwest National Laboratories. *Cost-Effectiveness and Impact Analysis of Adoption of Standard 90.1-2007 for New York State*. June 25, 2009.

Table G-2. Commercial Incremental Cost of Construction due to Early Code Adoption, Energy Code Program Area

Sector	Climate Zone	New Floor Space (000s Sq.ft.) (A)	Compliance Rate (B)	New Floor Space Under Compliance (000s Sq.ft.) (A × B)	Incremental Cost (per Sq.ft.) (C)	Total Incremental Cost* (A × B × C × 1000)
New Construction	4A	32,535	36%	11,713	$0.64	$7,545,449
	5A	13,413	36%	4,829	$0.33	$1,601,122
	6A	3,864	36%	1,391	$0.34	$470,826
Additions	4A	4,160	36%	1,498	$0.64	$964,779
	5A	3,431	36%	1,235	$0.33	$409,562
	6A	2,524	36%	909	$0.34	$307,548
Total		**59,927**	**36%**	**21,574**	**$0.52**	**$11,299,284**

*Product may not exactly match table values due to rounding of incremental cost

Note: Columns may not sum due to rounding.

Table G-3 shows the electric and gas savings for each sector from the Early Building Energy Code Adoption report (Appendix F). The persistence of these savings is assumed to be 30 years.

Table G-3. Evaluated Annual Savings from Early Code Adoption by Sector, Energy Code Program Area

Sector	Annual Electric Savings (MWh)	Annual Natural Gas Savings (Therms)
Residential	479	2,422
Commercial	8,697	849,037
Total	**9,176**	**851,459**

Note: Columns may not sum due to rounding.

Results Summary

The Cadmus Team used REMI PI+ to model employment impacts from the new code adoption. The methodology and approach used to model the impacts is explained in Section 4.3.4 of the main report. The reported employment impacts are all relative to the PI^{+} control forecast, and include both part time and full time jobs. During the first Program Area year and cumulatively from 2011 to 2040, early code adoption results in net positive job-years in New York State under both scenarios analyzed (first year and 30 year), as shown in Table G-4.

The scenarios modeled with wholesale prices are consistent with NYSERDA's standard methodology for assessing economic impacts from DSM programs, while the scenarios modeled with retail prices reflects the national ARRA evaluation's approach to monetizing energy savings. The cumulative 30-year impacts of early code adoption are an order of magnitude larger than the first-year impacts, as the persistence of bill savings has greater impacts to the regional economy than the initial creation of jobs required to build to the new code.

Table G-4. First and 30-Year Cumulative Employment Impacts from Early Code Adoption in New York State, Energy Code Program Area

Scenario	Wholesale Prices (Job-Years)	Retail Prices (Job-Years)
First Year Impacts	93	106
30-Year Impacts (cumulative)	1,485	1,882

Year-Over-Year Results

Figure G-1 shows the employment impact by year and by stimuli type when modeled using wholesale electric prices. The grey line shows the net impacts resulting from summing the negative and positive stimuli. The majority of first-year jobs are a result of ARRA and co-funding direct spending. The persistence of bill savings continues to generate positive job impacts long after early code adoption is complete. The positive effects of the direct spending outweigh the negative effects of the co-funding costs.

Figure G-1. Employment Impact of Early Code Adoption by Stimuli Type (evaluated with wholesale prices), Energy Code Program Area

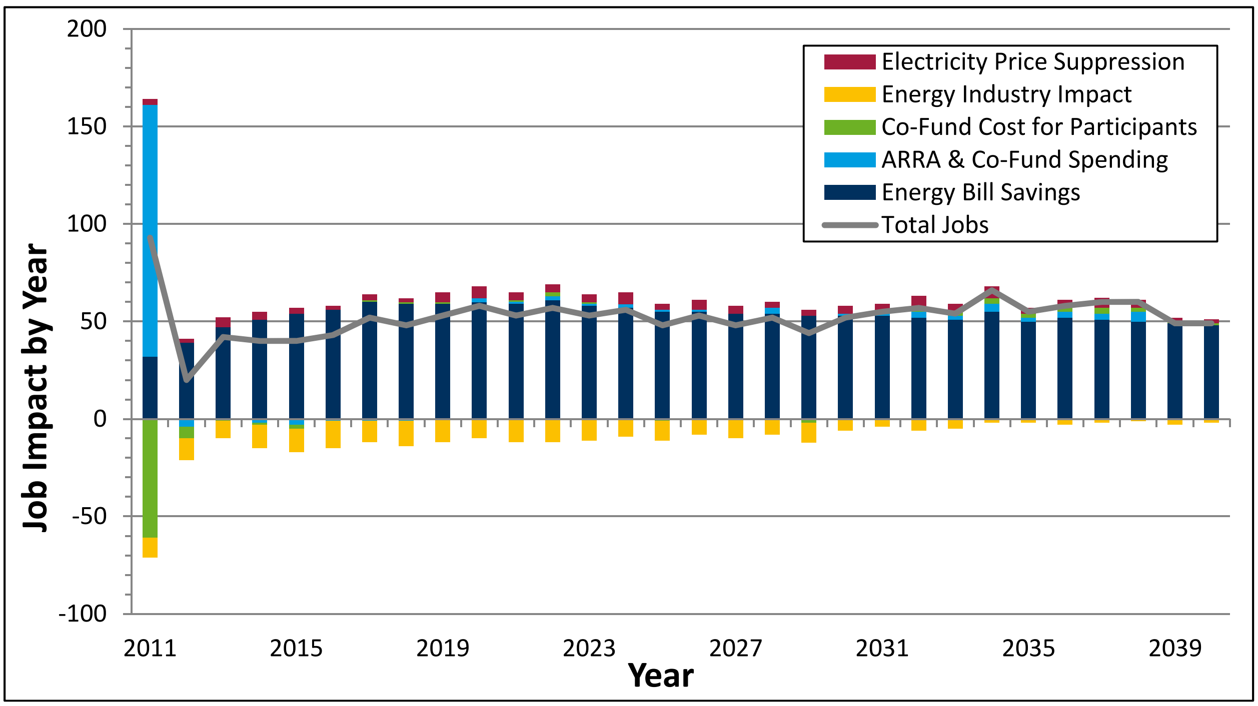
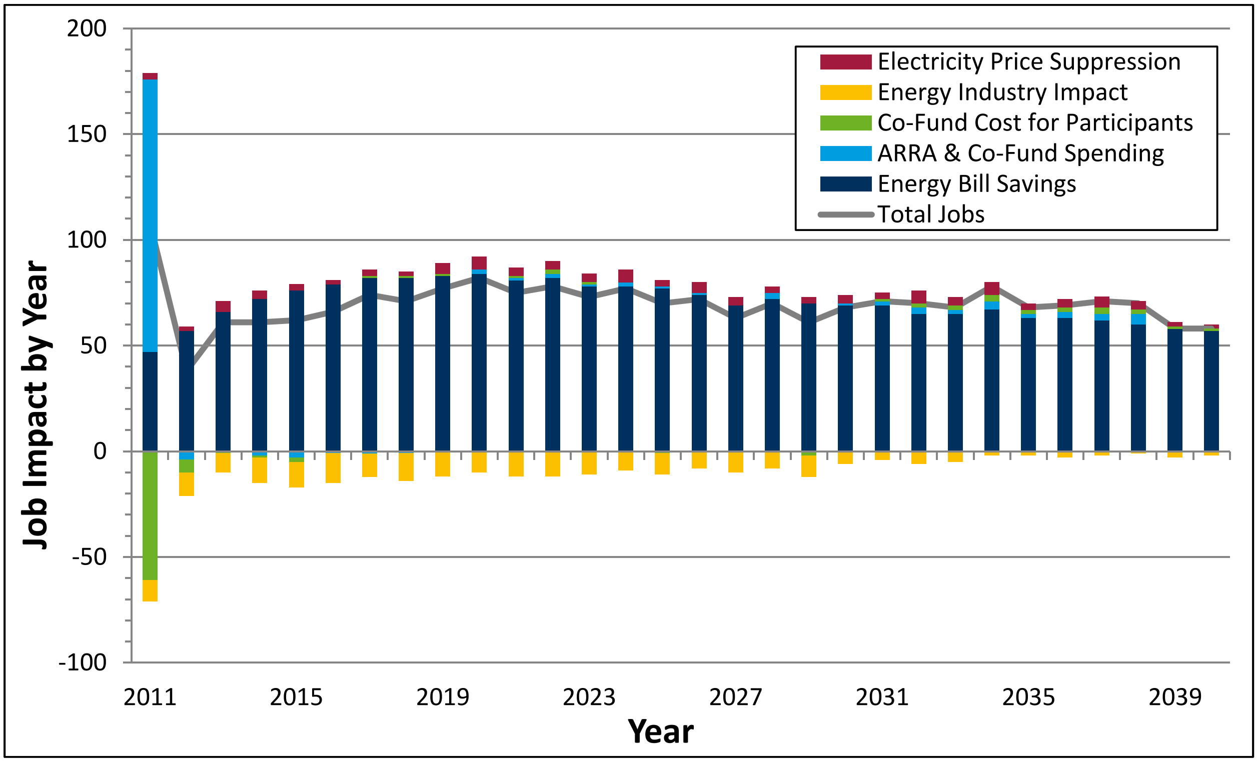


Figure G-2 shows the employment impacts by year and by stimuli type when modeled using retail electric prices. Bill savings are more pronounced in these results than in the results shown in Figure G-1 using wholesale prices; this is because electricity consumers in this scenario have higher cost savings, due to the difference between retail and wholesale prices, to re-spend on other goods and services. Note that there is no mechanism on the negative side offsetting the use of retail prices in calculating electric bill savings.

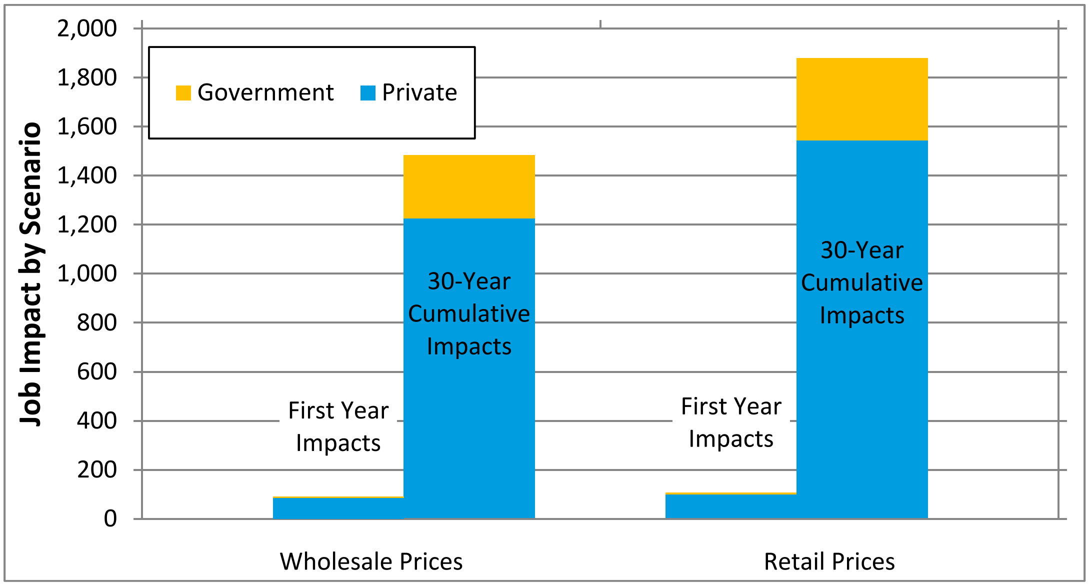
Figure G-2. Employment Impact of Early Code Adoption by Stimuli Type (evaluated with retail prices), Energy Code Program Area



Results by Sector

Due to the limitations of the REMI model, the Cadmus Team modeled all bill savings accruing to the government sector as increased government spending, without any increase in taxes (as described in Table 4-18 of the main report), leading to increases in government job creation. Figure G-3 shows the decomposition of first and 30-year cumulative net job impacts on private sector jobs versus government sector jobs for both the wholesale and retail price scenarios. Most of the net first-year jobs are created in the private industry. Over time, net job-years in both the private and government sectors will increase.

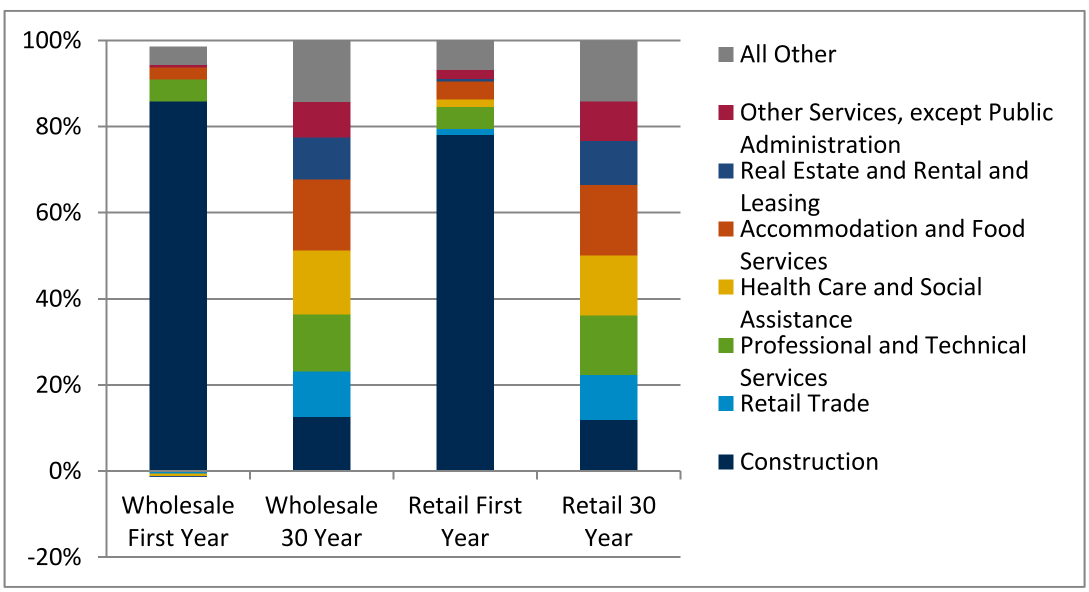
Figure G-3. First and 30-Year (cumulative) Employment Impact of Early Code Adoption by Sector (private vs. government), Energy Code Program Area



Results by Industry

Figure G-4 shows the distribution of jobs created during the first year and cumulatively over 30 years for both wholesale and retail prices in the top seven private sector industries, plus all others industries combined together. A substantial proportion of the jobs created in the first year for both wholesale and retail prices are in the construction industry. This proportion significantly decreases over 30 years as the share of jobs added in other industries increases; these industries include health care and social assistance, retail trade, accommodation and food services, and real estate and rental and leasing.

Figure G-4. Top Industries by Net Jobs Added (first and 30-year cumulative), Energy Code Program Area



Employment Analysis Conclusions

Within the limitations of the PI^+ model and based on the Cadmus Team's assumptions, the results indicate that NYSERDA's Energy Code Program Area resulted in net positive job creation within New York over what would have occurred without the program area. Jobs are created as a result of the short-term co-funding costs of participants, initial code adoption activities, and the long-term persistence of bill savings after adoption is completed.

1.2 CARBON EMISSION REDUCTIONS ANALYSIS

GHG Evaluation Approach

In order to determine the amount of GHG emissions displaced by each NYSERDA ARRA-funded program area, the Cadmus Team developed and applied an overarching approach to each program area's net annual and net lifetime savings for projects completed by June 30, 2012. The Team then created a set of tables that include all projects that are assumed will be complete by the end of that program area. The Cadmus Team refined this overarching approach for each specific program area, as needed. The approach[3] is based on the WRI's *Guidelines,* WRI's Climate Analysis Indicator Tool, EPA's SIT, interviews with technical staff at both WRI and EPA, and a literature review.

Review of NYSERDA Emission Factors

The emissions factors provided by NYSERDA were derived from the EPA's SIT and the EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2006* (April 2008). The emissions factors assume CO_2 equivalent conversions that were derived from GWP numbers in the IPCC's *Second Assessment Report (1995)*.

NYSERDA developed its own electricity emissions factor based on *Patterns & Trends: New York State Energy Profiles: 1994-2008* (NYSERDA, January 2010) and methodology from the *GHG Inventory and Forecast for the 2009 NYS State Energy Plan* (NYSERDA, August 2009; this electric emissions factor includes the electricity imported into New York State and accounts for T&D losses; thus no line loss factor was applied).

NYSERDA provided the Cadmus Team with the electricity emission factors shown in Table G-5 for this analysis.

Table G-5. New York State Electric Grid Average Plug Load Efficiency Emissions Factors

	Electric (lb CO_2e/MWh)	Transport (lb CO_2e/MWh)	Residential (lb CO_2e/MWh)	Commercial (lb CO_2e/MWh)	Industrial (lb CO_2e/MWh)
Electricity	826.00	826.00	826.00	826.00	826.00

Note: These numbers were provided by NYSERDA. Source: Mas, Carl. *NYS Grid Emission Intensity*. 2010. The workbook was based on data from: NYSERDA. *Patterns & Trends: New York State Energy Profiles: 1994-2008.* January 2010. and methodology from: NYSERDA. *GHG Inventory and Forecast for the 2009 NYS State Energy Plan.* August 2009.

The fuel combustion emissions factors that NYSERDA provided came from the EPA's SIT, released on January 3, 2011, and EPA, April 2008 (Annexes 2 and 3). For transportation projects, the CO_2e emissions

[3] These emission displacements are associated with both electric and fossil fuel saving measures. Under a cap-and-trade system, the total number of emission allowances is determined by regulation. Regulated entities can purchase allowances and collectively emit up to the cap that is currently in place. Therefore, in the near term, electric efficiency projects may not decrease the overall amount of emissions being released into the atmosphere. Nevertheless, electric efficiency projects will reduce end-users' responsibility or environmental footprint associated with emissions from electricity production. Beginning in Q1 2010, NYSERDA estimates displacements in emissions of CO_2, nitrous oxide, and sulfur dioxide associated with electric efficiency projects based on average emission rates that include emissions associated with imports of electricity. NYSERDA had previously reported emissions displacements using marginal emission factors; they made this transition to average emission factors to be consistent with a footprint displacement framework (per NYSERDA on April 10, 2012).

factors did not vary by vehicle type, as they are on a per-fuel basis. NYSERDA provided the Cadmus Team with the fuel combustion emissions factors shown in Table G-6 for this analysis.

Table G-6. Fuel Combustion Emissions Factors by Sector (lb CO^2 equivalent/MMBtu)

Fuel Type	Electric	Transport	Residential	Commercial	Industrial
Coal	204.95	N/A	224.89	211.43	207.58
Natural Gas	116.96	117.25	117.14	117.14	113.38
#2/ Distillate	163.78	163.22	163.78	163.78	161.80
#6/ Residual	166.28	N/A	N/A	166.28	174.20
Kerosene	N/A	N/A	162.10	162.10	159.89
Propane / Liquefied Petroleum Gas	N/A	140.51	136.94	136.94	139.45
Coking Coal	N/A	N/A	N/A	N/A	186.12
Asphalt	N/A	N/A	N/A	N/A	166.64
Lube	N/A	163.57	N/A	N/A	146.71
Other Petroleum Products	N/A	N/A	N/A	N/A	143.31
Gasoline	N/A	159.09	N/A	N/A	N/A
Aviation Fuel	N/A	160.88	N/A	N/A	N/A
Landfill Gas	0.26	N/A	N/A	N/A	N/A
Wood	4.34	N/A	15.79	15.79	3.92

Note: The values in this table represent aggregate CO_2, CH4, and N2O emissions. Provided by NYSERDA. Sources: White cells are from the EPA *State Climate Energy Program's State Inventory Tools* released on January 3, 2011 (http://www.epa.gov/statelocalclimate/resources/tool.html). Grey cells are from EPA, April 2008 (Annexes 2 and 3).

Recommended Emissions Factors

The Cadmus Team supports NYSERDA's decision to reference their own emissions factor for electricity and the EPA SIT for the fuel combustion emissions factors. The EPA SIT tool was specifically designed to help states develop GHG emissions inventories, and is considered best practice by both the EPA and WRI. The state inventory component of the tool provides users with the option of entering their own state-specific data or using default data specific to each state. Default data have been collected by "*federal agencies and other sources covering fossil fuels, agriculture, forestry, waste management, and industry*"[4] and are the basis for this tool. GWPs in the SIT were derived from the IPCC's *Second Assessment Report (1995).*[5]

[4] EPA. *State Inventory Tool*. Available online: http://www.epa.gov/statelocalclimate/resources/tool.html.

[5] The main activity of the IPCC is to provide regular assessment reports about the status of climate change knowledge.

Calculation Methods

To calculate both annual and lifetime emissions displaced from each program area, the Cadmus Team applied the EPA SIT emissions factors from NYSERDA to the net annual and net lifetime savings values (by fuel type) determined during the program areas' evaluations.

In completing these calculations, the Cadmus Team relied on several assumptions. The first is that the amount of GHG displaced is an estimate based on available best-practice tools. As neither New York nor DOE have a singular method for calculating displaced GHG emissions at this time, the calculations could come out slightly different if another tool were used. Each calculation method also has its own set of variables—such as temperature, measures and fuel types included, emissions factors, and methods—thus outputs could vary. In the future, depending on legislation and the progression of study in this area, emissions factors are likely to be updated, possibly altering the amount of GHG displaced over the lifetime of each project.

Recommendations for Estimating Emissions Displaced from the ARRA-funded Program Areas

Based on the assessments described above, the Cadmus Team recommends that NYSERDA use a hybrid approach for calculating emissions displaced across its portfolio of program areas. The Team's recommended approach leverages the emissions factors from the EPA SIT for fuel combustion and from NYSERDA's developed electricity emissions factor, and combines these in a simple spreadsheet format that is consistent with the WRI's GHG Protocol Guidelines.[6] The basis for this recommendation is:

- To ensure consistency of reporting across the organization
- To maximize the ability to compare savings across the program areas and across program area years
- To ensure transparency and replicability of the approach

Measurement and Verification of Displaced GHG from NYSERDA's ARRA-Funded Program Areas

The Cadmus Team calculated the displaced GHG emissions associated with NYSERDA's ARRA-funded program areas. To conduct this analysis, the Team used the verified net energy impacts, in terms of net metric tons of GHG emissions avoided over the EUL of the projects, and also calculated the amount of emissions displaced by each program area annually. In this analysis, the Cadmus Team referred to the WRI's *Greenhouse Gas Protocol* and the EPA SIT.

Using the fuel type, the amount of fuel, and the appropriate emissions factor, the Cadmus Team calculated aggregate GHG emissions in CO_2e. The emissions factors provided by NYSERDA relied on the GWPs from the IPCC *Second Assessment Report*, which the EPA SIT defaults to. However, because these GWPs are inherent in the emissions factors, the Cadmus Team was not able to determine savings by each gas type (CO_2, methane, and nitrous oxide).

GHG Displaced Emissions Displaced for the Energy Code Program Area

The Cadmus Team calculated the displaced annual and lifetime GHG emissions for each program area using the inputs specified above. The Team multiplied the net verified savings for each program area by the NYSERDA-provided appropriate emissions factor to determine annual displaced emissions. To determine lifetime displaced emissions, the Cadmus Team first multiplied the net verified savings by the EUL of each measure, by fuel type and then by the appropriate emissions factors. The Team then summed

[6] WRI. *Greenhouse Gas Protocol.* Available online: http://www.ghgprotocol.org/calculation-tools/all-tools.

and reported all displaced emissions as aggregate displaced GHG emissions in CO_2e, both annually and for the projects' lifetimes.

The Energy Code Program Area provided technical assistance to the building community and local energy conservation CEOs. The Program Area goal was to achieve the highest practical levels of compliance with provisions set forth in the new Energy Code. This effort was closely coordinated between NYSERDA and the DOS, an agency that promulgates and provides limited training to code officials on the Energy Code. The EECBG funding directly supported the provision of plan review services to CEOs, and supported CEO and building industry training jointly with SEP funding. The Cadmus Team did not calculate displaced GHG emissions for the activities supported by the Energy Code Program Area.

In addition to assessing the impacts of the activities funded by EECBG, the Cadmus Team examined the impacts of early adoption of the residential and commercial building energy codes associated with the ARRA requirements. These impacts did not result from EECBG-funded activities, but constituted an important energy-savings contribution of ARRA. The Team calculated displaced GHG emissions for the effects of early code adoption.

The early code adoption savings by fuel type and the associated GHGs displaced are listed in Table G-7 and Table G-8.

Table G-7. Residential and Commercial Combined Displaced Net Annual GHG Emissions for the Energy Code Program Area Evaluated Through June 30, 2012 and Projected Findings.

Energy Code Sector Fuel Type	Amount Displaced	Units	Emissions Factor (lbs CO_2e/MWh)	Emissions Factor (lbs CO_2e/MMBtu)	Metric Tons (CO_2e)
Electric	9,180	MWh	826.00	NA	3,440
Natural Gas	85,100	MMBtu	NA	117.14	4,520
Total					**7,960**

Table G-8. Residential and Commercial Combined Displaced Net Lifetime GHG Emissions for the Energy Code Program Area Evaluated Through June 30, 2012 and Projected Findings.

Energy Code Sector Fuel Type	Amount Displaced	Units	Emissions Factor (lbs CO_2e/MWh)	Emissions Factor (lbs CO_2e/MMBtu)	Metric Tons (CO_2e)
Electric	275,000	MWh	826.00	NA	103,000
Natural Gas	2,550,000	MMBtu	N/A	117.14	136,000
Total					**239,000**

1.3 COST-EFFECTIVENESS ANALYSIS

For the cost-effective analysis, the Cadmus Team calculated the ratio of benefits to costs created or incurred due to the Energy Code Program Area. Benefits generally include energy savings from the higher efficiency building codes. Costs generally include the ARRA dollars used to implement the new building codes. There are different tests that consider the affects from different viewpoints. The Energy Code Program Area passed all of the benefit-cost ratio tests that were performed.

Approach

In assessing cost-effectiveness, the Cadmus Team analyzed Energy Code Program Area costs and benefits from four different perspectives, using Cadmus' DSM Portfolio Pro[7] model. Benefit/cost ratios conducted for these tests are based on methods described in the California Standard Practice Manual[8] for assessing DSM programs' cost-effectiveness. In addition to the California tests, the Team used the DOE Recovery Act Reporting Requirements for the SEP[9] to determine the SEP-RAC test ratio. The tests analyzed are described as follows:

- **SEP-RAC Test:** This test, which is a SEP reporting requirement of the DOE, measures the avoided source Btus that would have been consumed without investment by the State's ARRA-funded program areas. The benefit/cost ratio is equal to 10 MMBtus of annual savings per $1,000 of ARRA money spent.
- **TRC Test:** This test examines the benefits and costs from a total resource perspective. It measures the total costs and benefits in the territory served. Benefits are avoided energy and capacity costs, adjusted for line losses. Costs include any administration or implementation costs associated with funding the program area, as well as any costs incurred by ratepayers and program area participants.
- **PA Cost Test:** This test examines the program area benefits and costs from NYSERDA's perspective. Benefits are avoided energy and capacity costs, adjusted for line losses. Costs include any administration, implementation, or incentive costs associated with funding the program area.
- **SCT:** This test measures the total program area costs and benefits to society. Benefits are avoided energy and capacity costs, adjusted for line losses, and any additional quantifiable benefits. Costs include any administration or implementation costs associated with funding the program area, as well as any costs incurred by program area participants. This test includes the benefits of avoided GHG emissions.

For more details on the equations, inputs, and assumptions of the cost-effectiveness tests, see the full NYSERDA SEP and EECBG evaluation reports.

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[7] DSM Portfolio Pro has been independently reviewed by various utilities, their consultants, and a number of regulatory bodies, including the Iowa Utility Board, the New York PSC, the Colorado Public Utilities Commission, and the Nevada Public Utilities Commission.

[8] CPUC. *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects.* October 2001.

[9] DOE. *Recovery Act Reporting Requirements for the SEP*. SEP Program Notice 10-06. March 1, 2010.

SEP-RAC Assumptions

The fossil fuel power factor is the ratio of energy from fossil fuels used to generate electricity over all the electricity generated for use in the territory. Essentially, it is the overall fossil fuel power plant efficiency multiplied by the percent of electricity from fossil fuels. This number was provided by NYSERDA and equals 9,949.2 source Btus per kWh generated.

From the DOE, the SEP-RAC test is described as follows:

> *The SEP Recovery Act Financial Assistance Funding Opportunity Announcement of March 12, 2009, published by the United States DOE, specifies that "Each state portfolio of projects funded by SEP ARRA grants should seek to achieve annual energy savings of at least 10 million source BTUs for each $1,000 of total investment." These energy savings will occur each year over the EUL of the actions induced by the State's portfolio. The evaluations conducted using SEP Recovery Act funds should calculate and report the results from this test for the projects evaluated. There are no other cost-effectiveness test requirements for SEP Recovery Act project portfolios. The cost-effectiveness test normally required within state regulatory environments that are focused on least-cost, net present value energy supplies do not apply to the SEP Recovery Act projects. DOE's objective is to achieve deep lasting savings that provide net energy efficiency, renewable energy, GHG displacement, and job impacts well into the long-term future.*[10]

Considering line losses and adjusting for the source Btus of electricity with a fossil fuel power factor, Equation G-1 was used to calculate the annual energy benefits for SEP-RAC.

Equation G-1. Annual Energy Benefits for SEP-RAC

$$\begin{aligned} SEP\ RAC\ Benefits \\ &= Electric\ Savings \times Fossil\ Fuel\ Power\ Factor \\ &+ All\ Other\ Fossil\ Fuel\ Savings \end{aligned}$$

The fossil fuel power factor is used to convert electricity savings at the plug into fossil fuel energy savings at the source of generation; this was defined in the text above. The final ratio as required by the SEP-RAC test is tens of millions of source Btus avoided per thousands of dollars spent, according to Equation G-2.

Equation G-2. SEP-RAC Test

$$SEP\ RAC\ Test = \frac{SEP\ RAC\ benefits\ in\ tens\ of\ millions\ BTUs}{ARRA\ funds\ in\ thousands\ of\ dollars} = \frac{10\ MMBtu\ savings}{\$1{,}000\ spent}$$

A ratio greater than or equal to one (≥1) indicates that the funding passed the test.

Early Code Adoption Costs

The Energy Code Program Area incurred a variety of costs, including for education, books, travel, and consulting with numerous professional organizations. Table G-9 shows the costs for NYSERDA to implement, manage, market, and evaluate the Program Area.

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[10] DOE. *Recovery Act Reporting Requirements for the SEP*. SEP Program Notice 10-06. March 1, 2010.

Table G-9. Energy Code Program Area Costs by Category and Funding

Category	SEP Funding	EECBG Funding	Total Funding
Administration	$159,000	$78,000	$237,000
Implementation	$517,000	$2,487,000	$3,004,000
Marketing	$6,000	$0	$6,000
Evaluation	$140,000	$58,000	$198,000
Total	**$822,000**	**$2,623,000**	**$3,445,000**

There are also costs associated with constructing buildings according to the new code. The *Early Building Energy Code Adoption Evaluation Report* provides the quantity of each building type in each climate zone affected by the new building code. From secondary sources, the Cadmus Team determined the incremental cost for each building to comply with the new code. These construction costs are incurred by the Program Area participants (i.e., anyone who builds a new building or building addition); these are not incentivized by NYSERDA or ARRA. The cost calculations are presented in the Employment Impacts section (Table G-1 and Table G-2).

Early Code Adoption Savings

In accordance with the DOE requirements for SEP, inputs used to calculate the SEP-RAC test are provided for re-creation of the results. Table G-10 shows the end-use savings for each program area for one year of the evaluated scenario. Downstream savings values came from the NYSERDA *American Reinvestment and Recovery Act 2012 Impact Evaluation Report: Early Building Energy Code Adoption Report,* which reflect the end-use savings. Upstream totals are a conversion of downstream savings that include the fossil fuel power factor correction and account for source Btus at the site of generation. The Fossil Fuel Power Factor is 9,949.2 upstream Btus per downstream electric kWh.

Table G-10. Evaluated Annual Savings by Sector, Energy Code Program Area

Sector	Downstream Electric (MWh)	Downstream Natural Gas (Therms)	Upstream Total Savings (MMBtu)
Residential	479	2,422	5,010
Commercial	8,697	849,037	171,430
Total	**9,176**	**851,459**	**176,440**

Note: Columns may not sum due to rounding.

Portfolio Results

Table G-11 presents Energy Code Program Area cost-effectiveness analysis results. Energy code benefits are the result of SEP and EECBG activities. Some notes to keep in mind when looking at all results tables include:

- A ratio ≥1 is considered beneficial, or passing.
- All costs are reported in dollars rounded to the nearest thousand; this aligns with SEP-RAC test requirements.
- SEP-RAC benefits are reported in MMBtu rounded to the nearest ten; this aligns with SEP-RAC test requirements.

- SEP-RAC ratios are reported in the DOE requirement of 10 MMBtu/$1,000.
- The TRC test, PA Cost test, and SCT benefits are reported in dollars.
- The TRC test, PA Cost test, and SCT ratios are in the California requirements of benefit $/cost $.

Table G-11. Evaluated Cost-Effectiveness Results, Energy Code Program Area

Cost-Effectiveness Test	Costs	Benefits	Benefit/Cost Ratio
SEP-RAC	$3,446,000	176,440 MMBtu	5.1
TRC	$20,651,000	$31,444,000	1.5
PAC	$3,446,000	$31,444,000	9.1
SCT	$20,651,000	$33,333,000	1.6

Cost-Effectiveness Analysis Conclusions

The Energy Code Program Area passed all cost-effectiveness tests. It did especially well in the SEP-RAC and PA Cost tests, because these tests only consider the costs paid by ARRA, and not the incremental cost of construction. When construction costs are added, the Program Area still does very well for the TRC test and SCT, due to the high evaluated savings from the Program Area.

Appendix H:

SURVEY PROCESS RESULTS

H1. Energy Code Program Area

- CEO Feedback on Plan Review Services
- Early Code Adoption – as included in the SEP Report Appendices
- Early Code Timing – as included in the SEP Report Appendices
- Energy Code Content – as included in the SEP Report Appendices
- Energy Code Compliance – as included in the SEP Report Appendices

H2. Energy-Efficiency Program Area

- Participant Survey Findings
- Program Area Awareness and Motivation to Participate

H3. Renewable Energy Program Area

H4. Transportation Program Area

- Transportation Program Area Awareness and Motivation
- Alternative and Additional Funding
- Spillover
- Demographics

H1. ENERGY CODE PROGRAM AREA

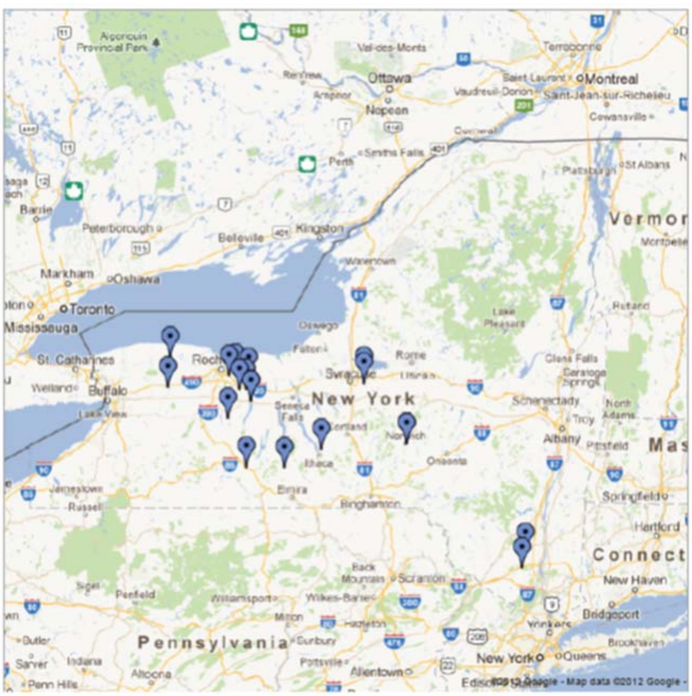
CEO Feedback on Plan Review Services

The Cadmus Team interviewed 19 CEOs, representing 19 municipalities, by phone between July 31 and August 6, 2012. The Team worked from a list of 19 CEOs that provided one-time submissions only and 18 CEOs that provided resubmissions for the plan review services offered by T. Y. Lin. The Cadmus Team contacted all 37 listed CEOs multiple times, unless they were going to be out of the office throughout the entire calling period. Table H-1 shows the distribution of the interviewed CEOs by category. Figure H-1 is a map showing the geographic distribution of the CEOs in New York that the Team interviewed. As shown, the majority are located in municipalities close to or near Rochester, where T.Y. Lin is headquartered.

Table H-1. Number of CEOs Interviewed by Submission and Project Type, Energy Code Program Area

Projects	Residential Only	Commercial Only	Residential and Commercial
One-time Submissions	4	5	0
Resubmissions	4	4	2
Total	**8**	**9**	**2**

Figure H-1. Distribution of Interviewed CEOs, Energy Code Program Area



The Cadmus Team initially thought that there might be some interesting differences in responses between CEOs who had single submissions for plan review assistance and those who made multiple submissions on the same project. Instead, there were few differences of note between these groups. For that reason, the following text concentrates mostly on results for CEOs as a group.

Background Information

As shown in Table H-5, 16 of 19 CEOs the Cadmus Team interviewed said they conducted both plan reviews and field inspections. The remaining three were managers who oversaw plan reviews.

Table H-2. CEO Roles, Energy Code Program Area

Do you conduct both plan review and field inspections?	Number of Responses
Yes	16
Not applicable (manager)	3
Total	**19**

The types of projects the CEOs we interviewed review tend to be residential. On average, CEOs reported that 88 residential projects and 25 commercial projects went through plan review in a typical year. There was a high degree of variability in the project counts among CEOs, ranging from one or two per office to as many as 300 residential projects and 57 commercial projects.

Participation and Awareness

The two most popular ways CEOs found out about plan review services were through a building codes class (six of 19) and an e-mail from NYSERDA (five of 19). Other ways mentioned were postcards from T.Y. Lin (three), the local building association (three), and miscellaneous others (three).

The reasons people decided to use the services are shown in Table H-3. Most often, CEOs said the Program Area's availability and zero cost were the main reasons, but learning more about the Energy Code and T.Y. Lin's reputation and quality of work were also frequently mentioned.

Table H-3. Why CEOs Used Plan Review Services, Energy Code Program Area (multiple responses)

Why did you decide to use these services?	Number of Responses
It was available/Free is good	6
Code complexities/To learn more about the Energy Code	4
T.Y. Lin's reputation/T.Y. Lin does excellent work	4
Like not adding to permit costs	1
Good opportunity	1
Second opinion is always good to get	1
Very busy, wear a lot of hats	1
Curiosity	1
Recommendation from another CEO	1

When asked if they were reluctant to use these services, 100% of CEOs (all 19) said no. This reflects the general high level of enthusiasm the participating CEOs had for the Program Area and its value to them in the plan review process.

Residential and Commercial Project Feedback

The Cadmus Team asked CEOs a set of questions specifically about their residential projects and another very similar set of questions about their commercial projects. When asked why they selected the projects they did for plan review assistance, CEOs with residential projects tended to mention curiosity about the Program Area or that they just wanted to try it (five of nine). CEOs with commercial projects tended to choose projects that were big, complex, or had technical difficulties that made the plan review assistance quite valuable to them. One CEO said he could not have accomplished his commercial project plan review without the plan review assistance.

There was very little negative feedback about plan review assistance services. However, one CEO mentioned that it took three weeks to get documents back from the reviewers, which he felt was one week too long. One other CEO mentioned a similar concern about the time it took for the review.

CEOs mentioned a variety of significant issues that were identified by the plan reviewer. Heating vents and building envelope issues were identified on both residential and commercial projects. Unique to residential projects were four of nine CEOs who said the designer's plans and/or designer's knowledge of the Energy Code was lacking. One CEO said that "*most residential projects were like pulling teeth, the architect was not towing the line.*" On the commercial side, the most significant issue found was an instance were the contractor had oversized the HVAC system. T.Y. Lin caught the error in their review. This would have had significant consequences for the client, and the CEO was clearly impressed that T.Y. Lin had found the error.

CEOs made uniformly positive comments about the text portions of the plan review and the compliance checklists. There were no big differences between residential and commercial projects. CEOs tended to appreciate the easy-to-understand layman's terms used in the text portion of the review, and also found the checklists very helpful. One CEO was so enthusiastic that he discussed passing the checklist along to colleagues.

As shown in Table H-4, CEO self-reported awareness of the residential and commercial energy codes did improve, on average, before and after using the plan review services. Two interviewees who categorized themselves as very knowledgeable said their awareness was about the same before and after, but all the other CEOs reported an increase in awareness, to varying degrees.

Table H-4. Changes in Rating of Knowledge About Energy Code, Energy Code Program Area

On a scale of 1 to 10, where 1 is lowest and 10 highest, how would you rate your knowledge of the Energy Codes:	Residential Energy Code Awareness (average; n=9)	Commercial Energy Code Awareness (average; n=8)
Before plan review services	6.2	6.4
After plan review services	8.1	7.6

The Cadmus Team asked CEOs what the most useful things were they learned from residential and commercial plan review services. Responses were varied. Duct sealing and proper insulation techniques were mentioned for both residential and commercial projects. One CEO mentioned the failure of the contractor to properly insulate non-conditioned space on a residential project. He guessed that 50% of CEOs did not know about that. On the commercial side, CEOs mentioned learning how to check for an oversized HVAC system. Three CEOs simply described it as a good overall learning experience.

Overall Feedback

All CEOs, except one who was not sure, said they had returned the plans to the project applicant after receiving plan review services. Nine of 19 specifically mentioned sending a letter out requesting they make the necessary changes. CEOs generally reported that the requested changes or information needs were addressed. Several were clear in separate comments that the project applicant did not have a choice if they wanted a permit. There was a consensus among CEOs that designers took the information more seriously than owners, who may or may not build again.

When asked if there was anything T.Y. Lin or NYSERDA could do to improve plan review service communications, 15 of 19 said no. E-mails were mentioned as a great tool by one CEO. Another mentioned that T.Y. Lin or NYSERDA could offer continuing education classes. One CEO who was especially enthusiastic said NYSERDA should have a seminar or training class about the services. He had been trying to spread the word to other municipalities who were asking about the Program Area. This CEO thought a seminar or class could help other CEOs understand the value the Program Area offers.

Seventeen of 19 CEOs said they were very satisfied with the way plan review services were provided, with two others not responding to this question. This result reflects the high regard CEOs expressed for the service and the talents of T.Y. Lin.

Results were mixed when the Cadmus Team asked whether a similar service for inspections would be helpful. Six said yes, one said no, four said maybe, and five said they didn't know. Two CEOs thought NYSERDA was already funding such a service. One mentioned that T.Y. Lin had offered such a service, but he did not take them up on it. Two CEOs went on to provide additional comments, one saying, "*Instead of reviewing the plans, they should be teaching us how to review the plans*." The other said he already used a third-party inspection service.

CEOs were pretty evenly divided when we asked if they used the plan review service more as a learning tool or as a workload support tool. The largest group, seven of 17 who responded, said it was split 50-50 between being a learning tool and a support tool. Six said it was more of a support tool, while four of 17 said it was more of a learning tool for them. All CEOs said they would use the service if it was offered again.

CEOs made several miscellaneous comments at the end of the interview, all centering on their positive reaction to the Program Area. Typical comments were "*Can't say enough good things about it; I am very happy with T.Y. Lin*" and *"It's an asset to any code official, they would be foolish not to utilize it."*

Finally, we received one additional comment by phone two weeks after the interviews ended. One of the CEOs called back to say, "*If I could tell you anything that would help us (CEOs) the most, it would be to educate the design professionals. We can educate the contractor in the course of permit review and then later in the field, but if we have to educate the design professionals as well, it makes our job much harder."* This comment echoes extemporaneous comments made by other CEOs during the interviews, such as "*NYSERDA should be targeting the architects and engineers for code training,*" and "*The designers are the ones with the advanced degrees, they should be keeping up with the code changes*."

One-time Submissions

Seven of the nine CEOs the Cadmus Team interviewed who had just a single submission for plan review services said they conducted both a plan review and field inspections. The remaining two were managers who oversaw plan reviews.

CEOs who provided only one-time submissions were much more likely to handle residential projects than commercial projects. Six respondents (66%) provided feedback that they review an average mix of 83% residential and 16% commercial projects. Among commercial projects, five CEOs mentioned handling retail buildings and two mentioned restaurants. Education, warehouse, assembly, and institutional categories were each mentioned once.

The Cadmus Team asked CEOs how many residential and commercial projects (both new construction and additions/renovations) their office processes through plan review in a typical year. Annual averages of 117 residential and 16 commercial projects were reported, with significant variation across jurisdictions. Estimates for residential projects ranged from seven to 300. Estimates for commercial projects ranged from one to 50.

CEOs with only one submission first heard about the plan review services in a variety of ways, including postcards from T.Y. Lin; e-mails from Newport Ventures, the DOS, and NYSERDA; building codes classes; contact by a T.Y. Lin staff person; and the local building owners association.

Four of the nine respondents said they decided to use the plan review services simply because it was available and free. Other reasons mentioned were code complexities (two respondents), curiosity, a recommendation from a fellow CEO, and T.Y. Lin's overall reputation. All nine answered no when asked, "*Were there any reasons you were reluctant to use the plan review services?*"

The four CEOs who submitted residential projects for a single review indicated using the service because it was available and they were either interested in learning more about the Energy Code or because it was recommended by a colleague or mentioned in a building owners meeting they had attended. All four said they used the information from the plan review to work directly with the applicant and/or homeowner on the project. Overall they found the review to be very helpful, especially the text portion. CEOs in general found the text portion of the plan reviews to be written in clear, plain layman's terms and also comprehensive. One CEO in this group reported that the detailed checklists were somewhat confusing, but the other CEOs had positive things to say about the checklist.

When asked how to improve the residential plan review services, two of four who responded said it is fine and should be continued free-of-charge. Another CEO mentioned the importance of always confirming that what was built matches the plans. One other CEO said he would like this kind of review to be more widespread, in order to help enforce the codes across the board and throughout the State. He thought this would help eliminate confusion and misunderstandings among designers and contractors about the Energy Code.

The Cadmus Team asked the four CEOs that submitted residential projects for only a single review why they chose not to resubmit their residential projects. All four said it was not necessary. In one case, the architect made the changes T.Y. Lin had recommended, which the CEO then confirmed. In another case, the CEO had followed up and the designer had sent revised plans addressing all the issues, which he felt was sufficient. This CEO also was concerned about the estimated two-week turnaround to resubmit plans back to T.Y. Lin.

The Cadmus Team also asked CEOs who submitted residential project for a single review about their knowledge of the residential portion of the Energy Code both before and after using the plan review services. CEOs self-assessed their knowledge on a scale of 1 to 10, where 1 indicating being not knowledgeable at all about the code and 10 indicated being very knowledgeable. These CEOs reported an average knowledge level of 5.8 before using the plan review services, and 7.5 after using the services.

The five CEOs who submitted commercial projects for only one plan review used the service to assist them with review of their larger, more technically complex projects. As with all the CEOs interviewed, this group indicated having a high regard for T.Y. Lin's services and were happy to have their expert assistance on big projects. Only three of these five CEOs could recall for certain that they had submitted their projects for just a single review.

The most significant issues T.Y. Lin identified during the reviews related to heating vents, insulation, air infiltration, HVAC, and the building envelope. The three CEOs who were sure they had requested only one-time reviews said they used the information from the review to have the contractor, engineer, or client make the necessary changes. One CEO said he got significant pushback from the engineer, but then the project was cancelled. The other two were able to get the necessary changes made by the contractors or architects involved, and were satisfied that the requested changes had been met.

As with the residential reviews, CEOs who had a commercial project reviewed tended to find all elements of the plan review summary very helpful, particularly the text portion. They said the checklists were also very helpful and useful. CEOs with commercial projects gave themselves a slightly higher rating (7.7) of their knowledge about the commercial Energy Code prior to receiving the plan review services than the CEOs with residential projects rated their knowledge of the residential Energy Code. Unlike the CEOs with residential projects, the average self-rating for these CEOs after receiving the services remained the same.

CEOs with commercial projects stated that the most useful thing they gained from the process was having more code awareness, which led to overall greater diligence on commercial projects, as well as having a very useful tool when discussing necessary changes with designers. One CEO was simply grateful for the time freed up by using the plan review services.

The CEOs who had submitted either a residential or commercial project for a single review provided feedback about their interactions with project applicants after receiving plan review services. Eight of these nine CEOs said they returned the plans to the project applicant with recommended changes or requests for more information. Three specifically said the applicant addressed the requested changes and that they would not have issued the permit otherwise. One who worked with the homeowner directly said the homeowner eventually learned a great deal from the plan review feedback, but was very frustrated at the beginning. One said he would usually meet with the owner and/or designer, which always helped increase awareness of the new codes even if the other party was unhappy about the new code. Single submission CEOs in general said that the architects and designers they worked with learned a great deal about the new code provisions from the plan review results.

When asked if there was anything T.Y. Lin or NYSERDA can do to improve the plan review services, six of nine single submission CEOs said no. One CEO said that communicating information about the Energy Code by e-mails is a great tool that could be used more. He also commented that continuing education classes would be useful. Other comments were mostly positive remarks about the excellent free services. One CEO mentioned that a representative from T.Y. Lin had come out and walked through the job site answering questions, which was very helpful. One CEO mentioned that it took three weeks to get a review back, and that it could be faster. To provide T.Y. Lin with insight on the difficulties for CEOs, one CEO said that he wears many hats in his small community of about 5,000, but he does not handle many permits. He said his infrequent permit reviews made it especially hard to review the complex Energy Code, and therefore the plan review services were invaluable to him.

When asked about their overall satisfaction with the plan review services, eight of nine single submission CEOs said they were very satisfied. The CEO who was concerned about the three week plan review turnaround said he was somewhat satisfied.

The Cadmus Team asked single submission CEOs if a service similar to the plan review but meant for inspections would be helpful. They had some confusion about what exactly this service would entail, with four respondents saying they do not know. Of the other four CEOs who provided responses, two said maybe, one said yes, and one said no. One CEO said, "*I'm not sure how that would go. Also, instead of having someone else review the plans they should be training us how to review the plans.*" Another commented that they already use a third-party inspection service. This CEO indicated that New York State allows CEOs to bring in third-party inspectors on their own authority and add the costs directly to the building permit. A few of the interviewed CEOs either do this regularly or keep it in mind as a useful option.

When asked if they use the plan review service more as a learning tool or as a support tool, the responses were mixed. Three of eight CEOs who provided responses said it is more of a learning tool, and two said it is more of a support tool. One CEO said that at first it was more of a learning tool, and then it became a support tool. The remaining two said it served both purposes equally.

When asked for other comments, six CEOs enthusiastically volunteered positive comments about the quality of T.Y. Lin's services and their value. One CEO said, "*It's an asset to any code enforcement official; they would be foolish not to utilize it.*"

Resubmissions

Although there were some differences, CEOs who resubmitted projects for review were similar in many ways to those in the one-time submissions group. They were similar in that nine of 10 conducted both plan reviews and field inspections. The tenth was a manager who concentrated on overseeing plan reviews.

This group did more reviews of commercial projects on average, with a residential/commercial split of 67% to 33%; double the percentage of commercial projects than those CEOs who had one-time submittals only. On average, CEOs with multiple plan submittals process 70 residential and 25 commercial projects in a typical year. Like the one-time submissions group, there was wide variability in the number of plan reviews conducted across municipalities, ranging from two to 250 residential projects and from one to 50 commercial projects.

The project resubmissions group first heard about the plan review services in two main ways: through building codes classes and/or NYSERDA training (four respondents) or through an e-mail from NYSERDA or the DOS (four respondents). Two other CEOs said they first heard about the plan review services from T.Y. Lin.

When asked why they decided to use these services, the most common reason was their respect for the quality of work provided by T.Y. Lin, which was cited by three respondents. Three CEOs also suggested that the plan review service provided them with an opportunity to get more information about the Energy Code. Two CEOs indicated that the fact the service was free was the primary reason they used it. Two stated using the service because it helped with their workload.

The five CEOs with residential project resubmissions indicated a range of issues that were identified through the plan review service. These included: the plans not matching the drawings; a lack of duct work details; building envelope problems; and an incorrect REScheck being submitted.

When the Cadmus Team asked these CEOs why they decided to resubmit the project for a follow-on review, the following comments were provided: they wanted to make sure the information provided on the submittal was correct (two respondents), not all issues from the first review were resolved (two respondents), and there was a belief that the designer had no intention of following through with the plan review suggestions (one respondent). An additional comment provided was that the general design submitted initially had been modified and he wanted to make sure it still complied.

Two of the five CEOs with residential project resubmissions said the T.Y. Lin plan review information was useful to back up their independent plan review. Two said they learned about the Energy Code from the information in the review, and one noted that the checklist made it easy to conduct the inspection.

The CEOs with residential project resubmissions were uniformly positive about all aspects of the plan review services report, including the text portion and the compliance and inspection checklists, referring to each of them as very helpful. Two CEOs additionally mentioned the text portion was presented clearly, and was written in plain English. Another CEO said he copied the compliance checklist and gave it to colleagues. One CEO said of the inspection checklist, "*It wasn't rocket engineering, but I could not have done it.*"

The CEOs with residential resubmissions rated their knowledge level of the residential Energy Code prior to going through plan review as an average of 6.6 on a scale of 1 to 10. They rated their knowledge at an average of 8.6 after receiving plan review services.

The Cadmus Team asked CEOs what the most useful things were they learned from receiving the plan review services. Their responses were varied. Two CEOs responded that they learned about different aspects of the ducts, one learned about proper duct sealing, and one learned about insulating ducts in non-conditioned space, stating, *"[The most useful thing learned was about] failure of contractor to properly insulate in non-conditioned space, such as ducts running through a garage. Fifty percent of CEOs don't know about that.*" One CEO mentioned learning how to conduct a blower test properly.

When the Team asked CEOs with commercial project resubmissions why they submitted the project(s) for plan review, all made at least one comment similar to the fact that it was a big, complex project and/or they could not have gotten it done without the plan review assistance. Two CEOs additionally said they wanted to learn more about the Energy Code, along with a few other miscellaneous comments.

Like the other groups, CEOs with commercial project resubmissions tended to point to a variety of issues when asked about the most significant problems the reviewer identified. They included issues with heating vents, taping around fenestrations, and fan motors. As with the other groups of CEOs, T.Y. Lin identified five projects with differences between the documents, drawings, and COMcheck data. In another case, T.Y. Lin determined that the HVAC system was oversized.

The five CEOs' reasons for resubmitting the commercial projects also varied considerably. Three resubmitted their project to complete the review process because they had started it. One CEO noted that most of the issues were related to a lack of documentation, so they resubmitted the project to provide those documents. Four CEOs said the second set of comments from T.Y. Lin were very helpful. One CEO was neutral, saying he just signed off on the changes T.Y. Lin made.

The CEOs did not provide much feedback about how they used the review information, but they did mention that the applicants had to conform to the changes. They typically noted that differences were resolved with T.Y. Lin's extensive and always available assistance.

As with the residential resubmission group, the commercial resubmission CEOs generally said that the plan review text summary and checklists were very helpful and useful ways to communicate Energy Code-related issues. All of these CEOs also said that a commercial inspection list would be helpful in their code enforcement activities.

When asked how commercial plan review services could be improved, two of the five commercial resubmission CEOs offered a strong opinion that builders, developers, and designers need to become more aware of the Energy Code requirements. One mentioned that an angry contractor wanted to know why a small town's Energy Code was so stringent. The CEO had to inform this contractors that they follow the State Energy Code, not the town code. Another CEO said NYSERDA should be doing more to educate architects and other designers about the Energy Code so their design plans more faithfully reflect the necessary requirements. One CEO, who was working with out-of-state designers on larger projects, said that it was a great help to have the third-party assessment in hand (from T.Y. Lin) when convincing the out-of-state designers to follow the State Energy Code.

When asked to rate their knowledge of the code, CEOs who resubmitted commercial projects gave themselves a slightly lower knowledge rating than the CEOs who did not resubmit their commercial projects. They rated their knowledge an average of 5.6 (compared to 7.7 for the one-time submitters) prior to receiving the plan review services, which increased to 7.6 after receiving the services (7.7 for the one-time submitters).

When asked what the most useful things were they learned from plan review services, three of the five CEOs who resubmitted commercial projects said the services were an overall good learning experience. Specific responses covered the following diverse set of issues that were each given by one respondent:

- Air sealing techniques
- Pool mechanical room requirements

- HVAC system oversizing
- Ensuring that COMcheck matches the plans

One respondent said he learned that checking compliance could be simple by using the checklist.

All of the CEOs who resubmitted commercial projects reported that they returned plans to the project applicant and recommended changes or requested more information. They also all said that the applicants came back with the appropriate changes made. They agreed that the process was a big help in improving the applicants' knowledge of the new Energy Code provisions. One CEO stated, "*Often lots of information gets omitted in plans. I hope this alerts designers we are serious about Energy Code enforcement.*" Another said, "*We get pushback, but the designers eventually learn.*"

ENERGY CODE PROGRAM AREA – AS INCLUDED IN THE SEP REPORT APPENDICES

Early Code Adoption

NYSERDA Program Area staff and DOS staff provided a comprehensive overview of the code adoption process and timing, as well as ARRA's impact on these topics.

Energy Code Timing

ARRA funding accelerated new Energy Code adoption in New York State by two years. New York introduced its first Energy Code in 1979, and transitioned to the ECCCNYS in 2002 (effective July 1, 2002) based on a national model energy code, with assistance from the 1999 DOE State Energy Code Assistance Grant. In April 2008, the Energy Code was updated based on ASHRAE 90.1-2004 for commercial buildings. This code is typically updated every three years.

DOS staff reported that the State was prepared to update to the 2006 IECC in April 2010. However, in early 2009, then-Governor David Paterson chose to take advantage of ARRA funding to advance the Energy Code, requiring the State to adopt the 2009 IECC and ASHRAE 90.1-2007. This effort passed implementation of the 2006 IECC entirely. The adoption process required considerable time to evaluate the impacts of the new code, determine New York-specific exceptions to the code, and confirm compliance with other State requirements. Early training curriculum was developed and delivered in advance of the code's effective date of December 28, 2010.

New York operated under the 2004 IECC for residential and ASHRAE 90.1-2004 for commercial from April 2010 to December 2010. Without ARRA, the State would have updated to the more stringent 2006 IECC during that time, although the commercial code would have remained the same. Any residential buildings that received construction permits during this period were therefore covered by a less stringent code, which likely resulted in lost energy savings potential for the State.

ARRA funding accelerated adoption of the 2009 IECC and ASHRAE 90.1-2007 by about 16 months. Based on the views of DOS staff, the schedule for future code adoptions will be unaffected by ARRA. These changes are shown in Table H-5Table H-5. Expected Effective Dates for Code Adoption, Energy Code Program Area.

Table H-5. Expected Effective Dates for Code Adoption, Energy Code Program Area

	Without ARRA		With ARRA	
Effective Date	**Residential**	**Commercial**	**Residential**	**Commercial**
Prior to April 2010	2004 IECC	2003 IECC/ASHRAE 04	2004 IECC	2003 IECC/ASHRAE 04
April 2010	**2006 IECC**	ASHRAE 04	2004 IECC	ASHRAE 04
December 28, 2010	2006 IECC	ASHRAE 04	**2009 IECC**	**ASHRAE 07**
April 2012	**2009 IECC**	**ASHRAE 07**	2009 IECC	ASHRAE 07
April 2015	**2012 IECC**	**ASHRAE 10**	**2012 IECC**	**ASHRAE 10**

Note: Cells with **bold text** indicate a code change under each scenario.

Another impact of ARRA was its effect on the "50% rule" for both commercial and residential construction. New York had exempted building renovations from the Energy Code if they affected less than 50% of the building floor area (NYS Energy Law, Article 11). For example, if a developer remodeled only 48 floors of a 100-story building, the project would be exempt from code requirements.

DOS officials believed this undermined code compliance may have prevented many buildings from achieving code-required performance. Given the requirement in ARRA to demonstrate 90% code compliance, legislation eliminating this exemption was passed and all renovated buildings are required to comply. DOS officials project a higher code compliance rate and substantial improvement in energy performance now that all permitted projects must meet the code requirements for implemented work.

The earlier code adoption due to ARRA should result in considerable energy savings, which are expected to offset the lost energy potential from the planned code upgrade that was delayed from April 2010 to December 2010. The gross energy savings impacts for the code change and the elimination of the exemption will be calculated by the Cadmus Team in a follow-up report in May 2012.

Energy Code Content

New York State based the most recently adopted code, ECCCNYS 2010, on the 2009 IECC. However, several more stringent provisions were added; including those for party walls in multifamily dwellings, demand controlled ventilation, and air barrier sealing.

Despite these differences, one DOS official stated the current Energy Code is the least different from the IECC model code than it has ever been. DOS staff indicated that the additional provisions added to the 2009 IECC were not a result of ARRA funding, but instead intended to match New York-specific concerns.

Energy Code Compliance

Compliance represents the degree to which new buildings reflect the provisions of the prevailing Energy Code. One requirement of ARRA funding, as noted above, is that the State must develop and implement a plan to achieve 90% compliance with the target codes by 2017, including measuring current compliance each year.

Vermont Energy Investment Corporation (VEIC) conducted a baseline compliance study[1] for buildings constructed before the code update. VEIC used two different methodologies and determined that compliance with previous energy codes did not achieve 90% compliance. One method VEIC followed was using the DOE Building Energy Code Program (BECP) protocol to define compliance as the percentage of all Energy Code requirements that were met as determined using a checklist developed by Pacific Northwest National Laboratories. The other method VEIC followed was using a set of common compliance tools, REScheck™ and COMcheck™, to examine building component performance through the heat transfer rate.

NYSERDA and the Cadmus Team identified limitations in the VEIC analysis that affect the accuracy of the compliance rate estimates. Due to budget limitations, VEIC's new commercial building sample consisted of only 26 buildings, 22 of which were designed to the latest commercial code and four of which were designed to the prior code. The 22 designed to ASHRAE Standard 90.1-2007 represent only half the number of buildings recommended by the BECP protocol for new commercial buildings. In addition, VEIC included a sample of 44 new residential buildings (consistent with the BECP protocol). VEIC did not assess compliance for any commercial or residential renovation projects due to insufficient documentation to adequately identify and characterize renovation projects.

1 VEIC. *New York Energy Code Compliance Study*. 2011.

However, VEIC's analysis produced a number of important recommendations, as well as a reasonable foundation for future compliance study projects. Their primary recommendations included:

- Modify and simplify the suggested BECP protocol to create a streamlined approach for ongoing monitoring and compliance assessment
- Systemize New York State data collection for compliance evaluation and interpretation
- Address gaps in compliance and enforcement priorities
- Address legislative context and obstacles

Additional details can be found in the VEIC report. The Cadmus Team believes these recommendations can improve compliance rates.

Future studies of code compliance will be conducted by NYSERDA under its SBC ratepayer-funded Technology and Market Development Program.

Training Participant Results

As part of the code adoption process, DOS and NYSERDA developed training for relevant stakeholders, primarily CEOs but also including architects, engineers, builders, contractors, realtors, and vendors. ARRA requirements for 90% compliance by 2017 were a significant motivation for this increased level of training services.

The survey questions and format that the Cadmus Team conducted with Wave 1 and Wave 2 participants differed due to timing and the other limitations previously noted. Through these surveys, participants provided feedback on marketing efforts, their satisfaction, and the trainings' effectiveness.

The Cadmus Team analyzed the training survey data and had intended to disaggregate survey results between CEOs and industry professionals required to comply with the code, such as architects, engineers, and builders. Unfortunately, raw survey data from Wave 1 pre-training surveys were not available to provide this level of detail. Consequently, the Cadmus Team also aggregated results for the Wave 1 pre- and post-training surveys, since it was not possible to compare the pre- and post-training results separately by participant group. However, the Cadmus Team was able to examine differing responses from CEOs and industry professionals for the Wave 1 post-training and for both pre- and post-training Wave 2 surveys.

The survey sample dispositions for each wave are shown in Table H-6 and Table H-7. The Cadmus Team attempted to present the highest feasible granularity available for each set of survey responses by separating them into pre- and post-training responses, as well as by segregating responses from CEOs and industry professionals. The Wave 2 results provided the best data on participant feedback due to the high level of granularity available in the responses and the participants' immediate opportunity to provide feedback on training details.

Table H-6. Survey Disposition for Wave 1 (Spring 2011), Energy Code Program Area

	Pre-Training		Post-Training	
Occupation	**Frequency**	**Portion of Total**	**Frequency**	**Portion of Total**
Code Official	153	22%	97	47%
Architect	193	28%	12	6%
Builder	22	3%	19	9%
Electrician	6	1%	2	1%
Engineer	123	18%	2	1%
General Contractor	17	2%	10	5%
HERS Rater	7	1%	7	3%
HVAC Contractor	9	1%	4	2%
Third-Party Inspector	22	3%	4	2%
Other	148	21%	51	25%
Total	**700**		**208**	

Table H-7. Survey Disposition for Wave 2 (Fall 2011), Energy Code Program Area

Occupation	Frequency	Portion of Total
Code Official (CEOs)	188	57%
Architect	21	6%
Builder	22	7%
Electrician	1	0%
Engineer	30	9%
General Contractor	15	5%
HERS Rater	2	1%
HVAC Contractor	4	1%
Third-Party Inspector	2	1%
Other	44	13%
Total	**329**	

Wave 1 post-training surveys do not reflect a similar disposition to Wave 1 pre-training surveys, indicating that the industry professionals who represented the majority of the Wave 1 trainings (such as architects, builders, and engineers) were less motivated to respond to the online post-training survey. Wave 2 results show a high level of response from CEOs (57%), similar to that achieved for the Wave 1 post-training survey (47%). The CEOs demonstrated a higher response rate than the industry professionals, likely because of their role and regular training requirements, and/or the requirement of submitting surveys in order to have their mandated training considered complete.

These trainings met a variety of participants' needs. DOS requires CEOs to attend code training annually. Architects and engineers often need to receive continuing education credits, and these trainings were approved for credit. Table H-8 and Table H-9 indicate that providing continuing education credit was one of the main reasons participants attended these trainings.

For Wave 2, the Cadmus Team was able to distinguish between CEOs and industry professionals, and the results in Table H-9 show that education credits were the primary reason CEOs attended. Industry professionals indicated they were motivated to attend primarily to improve their professional knowledge, but gave education credits as the second largest motivation.

VEIC's baseline compliance report recommended that New York State increase code knowledge in the building trades community. The survey results suggest that NYSERDA and DOS efforts are beginning to fulfill this objective, with industry professionals using the trainings to improve their professional understanding of code issues.

Table H-8. Training Motivation for Wave 1 and Wave 2 Participants, Energy Code Program Area

	Wave 1		Wave 2	
Motivation	**Frequency**	**Portion of Total**	**Frequency**	**Portion of Total**
Required by my professional organization	40	6%	28	9%
Required by my employer/job	37	6%	30	9%
To improve my professional knowledge	361	55%	156	48%
For the continuing education credits	188	29%	111	34%
Other	31	5%	3	1%
Total	**657**		**328**	

Note: Totals may not sum to 100% due to rounding.

Table H-9. Training Motivation for Wave 2 Code Enforcement vs. Industry Professionals, Energy Code Program Area

	Code Enforcement Officials		Industry Professionals	
Motivation	**Frequency**	**Portion of Total**	**Frequency**	**Portion of Total**
Required by my professional organization	18	10%	10	7%
Required by my employer/job	15	8%	15	11%
To improve my professional knowledge	83	44%	73	52%
For the continuing education credits	69	37%	42	30%
Other	2	1%	1	1%
Total	**187**		**141**	

The NYSERDA Energy Code Program Area implementation staff used a variety of methods to recruit participants, including contractors, a Website, e-mail, and mail (Table H-10). NYSERDA and DOS combined reached the largest portion of participants in both waves (53% of Wave 1 and 37% of Wave 2 participants who responded to the surveys). Another source of training participants involved professional channels, such as the New York State Builders Association and architectural and engineering professional associations, which combined recruited 12% of Wave 1 participants and 22% of Wave 2 respondents.

Table H-10. Sources of Training Notification, Energy Code Program Area

	Wave 1		Wave 2	
Source	**Frequency**	**Portion of Total**	**Frequency**	**Portion of Total**
New York State Builders Association	17	2%	29	9%
DOS	91	10%	68	21%
NYSERDA	376	43%	62	16%
Colleague	132	15%	31	9%
Word-of-mouth	72	8%	24	7%
Professional organization	89	10%	44	13%
Other	90	10%	70	21%
Total	**867**		**328**	

Note: Totals may not sum to 100% due to rounding.

The pre- and post-training surveys inquired about participants' knowledge of the ECCCNYS 2010. Participants rated their knowledge of the code on a scale of 0 to 10, with 0 indicating no knowledge and 10 indicating complete knowledge. The Cadmus Team then converted these results into weighted averages based on the number of respondents that provided each rating on the scale. The data collected from the Wave 1 pre-training survey was incomplete. The survey contractor could not provide the frequency of respondents who provided a rating of 10 on rating questions. As respondents were not required to provide an answer for pre-training survey questions, the Cadmus Team could not differentiate between those respondents who did not provide an answer and those who provided a rating of 10 for questions requesting a rating. Due to the uncertainty in the number of respondents providing a rating of 10, the Cadmus Team considered the rating scale for Wave 1 pre-training surveys to be 0 to 9, with 0 indicating no knowledge and 9 indicating strong knowledge. This issue was unique to Wave 1 pre-surveys and did not reoccur in Wave 1 post- surveys or any of Wave 2 surveys.

The Wave 1 pre-training survey asked participants about their level of understanding the ECCCNYS 2010 before training, to which their average response was 4.2 on the 0 to 9 point rating scale (Table H-11). The Wave 1 post-training survey, conducted online six months or more after the training and using a scale of 0 to 10, inquired about participants' perceptions of their knowledge of the code before and after the training, allowing a comparison of how participants' perceptions of their prior knowledge may have changed from before to after the training. The Wave 2 survey respondents reported that their average rating for understanding the code was 5.7 before the training and 7.0 after the training, an increase of 1.3 points on the rating scale. Because of the differences in the respondents and rating scale, it is not possible to compare the pre- and post-training survey results directly.

Table H-11. Participant Understanding of ECCCNYS 2010, Energy Code Program Area

	Responses 6-Months Post-Training	
Pre-Training (n=586)	**Understanding Before Training (n=179)**	**Understanding After Training (n=179)**
4.2	5.7	7.0

The Wave 2 pre-training and post-training surveys collected data consistently, in which participants rated their knowledge of the code on a scale of 0 to 10, with 0 indicating no knowledge and 10 indicating complete knowledge. The Wave 2 participant results showed that CEOs reported having higher initial familiarity with the code than professionals who had to comply with the code (5.3 versus 4.4, respectively). However, both groups considered their post-training level of familiarity to be nearly equivalent (7.2 versus 7.1, respectively; Table H-12).

Table H-12. Wave 2 Participant Understanding of ECCCNYS 2010, Energy Code Program Area

Period	Code Enforcement Officials	Industry Professionals	Overall
Pre-Training	5.3 (n=189)	4.4 (n=141)	4.9
Post-Training	7.2 (n=168)	7.1 (n=137)	7.2

The Cadmus Team examined Wave 1 and Wave 2 results for participant understanding of ECCCNYS 2010 using the Wilcoxon signed-rank test.[2] Even though the ranked improvement was relatively small (1.3 for Wave 1 and 2.3 for Wave 2), the test shows a statistically significant positive change in each group's ranking of their ECCCNYS 2010 knowledge after the ARRA-funded training and support services.

The Cadmus Team asked participants their overall level of satisfaction with the training. Table H-13 shows the results. Participants rated their satisfaction on a 0 to 10 scale, with 0 indicating high dissatisfaction and 10 indicating high satisfaction. Wave 1 post-training survey participants who were surveyed at least six months after the training reported slightly positive satisfaction (6.9). Wave 2 participants, surveyed immediately after the training, reported very high satisfaction (8.4). Since the Cadmus Team did not have satisfaction data collected immediately after training from the Wave 1 participants, it is uncertain whether the lower ratings by the Wave 1 participants was due to the passage of time since the training or some inherent differences in the satisfaction with the training. In each case, industry professionals indicated slightly higher satisfaction than CEOs, consistent with the larger increase in their understanding as was shown in Table H-13.

Table H-13. Participant Satisfaction with Code Training, Energy Code Program Area

Wave	Code Enforcement Officials	Industry Professionals	Overall
1	6.9 (n=90)	6.9 (n=89)	6.9
2	8.3 (n=167)	8.6 (n=137)	8.4

During pre-training surveys, participants provided feedback on the importance of enforcing the ECCCNYS 2010 provisions in new and existing buildings in their community. The weighted average results used the 0 to 9 scale, and are shown in Table H-14. As might be expected, CEOs in Wave 2 rated enforcing the code as slightly more important than industry professionals did, although both groups indicated that enforcement has high importance. In all cases, the respondents rated enforcing the code in renovations as important, but gave it a slightly lower rating than enforcing it in new buildings.

[2] More details on this method can be found at: http://www.experiment-resources.com/wilcoxon-signed-rank-test.html.

Table H-14. Participant Views on the Importance of Enforcing ECCCNYS 2010 Provisions, Energy Code Program Area

	Wave 1	Wave 2		
Building Type	All	Code Enforcement Officials (n=189)	Industry Professionals (n=138)	Overall
New	7.3 (n=409)	8.2	7.9	8.1
Existing	6.8 (n=449)	7.7	7.4	7.5

Participants also rated the importance for new buildings to comply with the Energy Code, as shown in Table H-15. The results are similar to those for enforcing new building codes, with participants ranking compliance as even more important than enforcement.

Table H-15. Participant Views on the Importance for New Buildings to Comply with the Code, Energy Code Program Area

Wave 1	Wave 2		
All (n=409)	Code Enforcement Officials (n=185)	Industry Professionals (n=142)	Overall
7.7	8.9	8.8	8.9

Respondents rated their views on increasing the stringency of the Energy Code with time, as implemented through regular adoption of more advanced codes based on successive versions of the IECC and ASHRAE. The respondents also considered this important, as shown in Table H-16, although they believed it to be slightly less important than code enforcement or compliance.

Table H-16. Participant Views on Increasing the Stringency of the Code, Energy Code Program Area

Wave 1	Wave 2		
All (n=435)	Code Enforcement Officials (n=187)	Industry Professionals (n=140)	Overall
6.8	7.5	7.6	7.5

One Program Area training and support service goal was to provide participants with an overview of the plan review process for implementing or complying with the ECCCNYS 2010. Program Area implementation staff indicated this training generated less than the expected interest among CEOs and industry professionals. Staff reported that although contractors performed good outreach, the training was only successful in one location. Staff believed the CEOs and industry professionals were uncomfortable with the thought of someone “looking over their shoulder” during the plan review process.

The Cadmus Team identified six participants who reported taking the Green Building Residential Plans Examiner Certification course. Participants rated the plan review overview portion of the training on a scale of 0 to 10, where 0 indicates that it was not at all helpful and 10 indicates that it was extremely helpful (Table H-17). On average, participants considered the plan review overview to be slightly helpful (6.8).

Table H-17. Participant Rating of Plan Review Overview Training Helpfulness, Energy Code Program Area

Course	Code Officials (n=6)
Green Building Residential Examiner Certification	6.8

Program Area implementation staff emphasized that the trainings to date were early efforts which will be evaluated internally by NYSERDA Energy Code staff. Updated in-person and online trainings will be delivered throughout 2012.

H2. ENERGY EFFICIENCY PROGRAM AREA

Participant Survey Findings

The main purpose of the attribution survey was to collect data necessary for the Cadmus Team to estimate freeridership and net savings resulting from the NYSERDA ARRA Energy-Efficiency Program Area. However, the Team also used the survey to explore key process questions, such as sources of information about the Program Area, the application process, and ease of participation, each of which are summarized below. The remainder of the attribution survey is outlined in Appendix H, which summarizes the awareness, motivation, economic factors, alternative funding, and spillover characteristics of participants in the Energy-Efficiency Program Area.

Program Area Awareness and Motivation to Participate

As shown in Table H-18, respondents learned about the Energy-Efficiency Program Area in a variety of ways. A large proportion heard about it through NYSERDA sources, with two respondents (14%) having seen the Program Area on the NYSERDA Website, two (14%) having learned of the Program Area through marketing materials, and one (7%) citing Program Area outreach sessions as their source of awareness. In addition, two respondents (14%) cited hearing about NYSERDA ARRA through NYSERDA's FlexTech Program, and two others (14%) noted participating in an unspecified NYSERDA program. Word-of-mouth (n=3; 21%), as well as contractors and installers (n=2; 14%), were also important sources of awareness. These findings support a strategy of maintaining multiple channels of marketing for future NYSERDA programs, as the NYSERDA ARRA Program Area funding is no longer available.

Table H-18. How Participants Heard about Energy-Efficiency Program Area (multiple responses)

Sources of Awareness	Responses
Sample size	*14*
Word-of-mouth (colleague, friend, family member)	21% (3)
Contractor/installer	14% (2)
NYSERDA Website	14% (2)
Through NYSERDA's FlexTech Program	14% (2)
Participation in another NYSERDA program	14% (2)
Program Area marketing materials	14% (2)
Program Area outreach sessions	7% (1)
Story in the media	7% (1)
Grant consultant	7% (1)
Town grant writer	7% (1)
Consulting architect	7% (1)
Online (unspecified)	7% (1)
Seminar	7% (1)
Don't know/refused	14% (2)

Note: Total may not equal 100% due to rounding and multiple responses. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

The Cadmus Team asked respondents why they decided to apply for NYSERDA funds to implement the project. As shown in Table H-19, a substantial proportion of respondents (n=5; 36%) indicated that their budgets could not accommodate the work without the ARRA funding. Other reasons for applying for the funds included the need for more efficient equipment (n=2; 14%), to save energy (n=2; 14%), and to reduce the burden on local taxpayers of paying for such projects (n=2; 14%).

Additional reasons, each cited by one respondent (7%), were to implement the first efficiency project for county buildings, to reduce energy costs for the facility, because they always seek grants, and because a consultant architect suggested applying. These findings suggest that, as the Program Area theory anticipated, many participants turned to NYSERDA ARRA to fund projects that may not have otherwise moved forward without the Program Area. However, other participants voiced reasons for applying to the Program Area that provide less clarity regarding whether the project would have moved forward without NYSERDA ARRA funds.

Table H-19. Why Applied for NYSERDA Funds (multiple responses), Energy-Efficiency Program Area

Reason	Responses
Sample size	*14*
Could not afford the project without funding	36% (5)
Need for more efficient equipment	14% (2)
To save energy	14% (2)
Didn’t want to burden local taxpayers	14% (2)
To implement the first efficiency project for all county buildings	7% (1)
Consulting architect who performed efficiency study suggested applying	7% (1)
Always seeking grants (in general)	7% (1)
To reduce energy costs	7% (1)

Note: Total may not equal 100% due to rounding and multiple responses. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

When planning this evaluation, NYSERDA Program Area staff wanted to know if the source of the funds—the national ARRA legislation—enticed people to apply to the Program Area. The ARRA legislation had received a great deal of media coverage, being presented as a way to create jobs and end the recession. NYSERDA thought that the media attention and support for the goals of the broader ARRA legislation may increase interest in the Program Area. Therefore, the Cadmus Team asked respondents whether the fact that the funds were provided by ARRA affected their decision to apply for NYSERDA funds, using a scale from 1 (indicating that it was a critical negative factor) to 5 (indicating it was a critical positive factor). Table H-20 shows that 43% (n=6) of the respondents said that the fact that AARA provided the funds was not a factor at all in applying, while the remaining respondents said it was either somewhat of a positive factor (n=4; 29%) or a critical positive factor (n=4; 29%) in applying. The results indicate that the source of the funds was of moderate importance to some participants, and none viewed the fact that the funds came from ARRA as a negative factor.

Table H-20. Influence of ARRA Funding on Decision to Apply for NYSERDA Funds, Energy-Efficiency Program Area

Influence	Responses
Sample size	*14*
Mean	3.9
1 Critical negative factor	0
2 Somewhat of a negative factor	0
3 Not a factor at all	43% (6)
4 Somewhat of a positive factor	29% (4)
5 Critical positive factor	29% (4)

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

The NYSERDA ARRA funds were meant to be distributed quickly, and NYSERDA said that some participants may have applied for the funds because they offered a way to implement planned energy-efficiency projects on a shorter timeframe than waiting for other sources of funding to manifest.

The Cadmus Team gauged the effect of the NYSERDA fund timing on the decision to apply for funds by asking respondents, "*To what extent was your decision to apply for funds from NYSERDA affected by <u>when</u> the funds would become available?*" (Table H-21). Respondents rated the influence of the fund timing on the same 1 to 5 scale as in the previous question. Half of the respondents (n=7; 50%) said that the timing was not at all a factor in their decision to apply, while 43% (n=6) said the timing was a positive factor. None of the respondents indicated that the timing was a negative factor in applying for the funds. These findings suggest the timing of the funds was of only moderate importance in respondents' decisions to apply for NYSERDA ARRA funds.

Table H-21. Influence of NYSERDA Funds Timing on Decision to Apply, Energy-Efficiency Program Area

Influence	Responses
Sample size	*14*
Mean	3.5
1 Critical negative factor	0
2 Somewhat of a negative factor	0
3 Not at all a factor	50% (7)
4 Somewhat of a positive factor	36% (5)
5 Critical positive factor	7% (1)
Don't know/refused	7% (1)

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

In an effort to understand whether prior participation in other NYSERDA programs influenced participation in the Energy-Efficiency Program Area, the Cadmus Team asked the respondents a series of questions about their prior experiences with NYSERDA programs. The first question in this series asked respondents to relate whether they had previously participated in any other NYSERDA energy efficiency, energy conservation, or renewable energy programs. As shown in Table H-22, over one-quarter of respondents (29%) reported that they had.

Table H-22. Previous Participation in Other NYSERDA Energy Efficiency, Energy Conservation, or Renewable Energy Programs, Energy-Efficiency Program Area

Participation in Another NYSERDA Program	Responses
Sample size	*14*
Yes	29% (4)
No	50% (7)
Don’t know/refused	21% (3)

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

The Cadmus Team then asked the four respondents who reported having previously taken part in other programs to describe the type of prior program in which they had participated. Table H-23 shows that some of these respondents had participated in multiple programs of various types. Three respondents had participated in an energy audit, while one each had participated in programs involving incentives for replacing equipment, new construction, and renewable energy. Therefore, although only four of the 14 respondents had taken part in prior NYSERDA programs, these four respondents appeared to be committed to making energy efficiency and renewable energy improvements with NYSERDA support.

Table H-23. Types of NYSERDA Programs in Which Respondents Had Participated (multiple responses), Energy-Efficiency Program Area

Influence	Responses
Sample size	*4*
Energy audit	75% (3)
Equipment replacement incentive	25% (1)
New construction	25% (1)
Renewable energy	25% (1)

Note: Base is respondents who had previously participated in other NYSERDA programs.

Note: Total may not equal 100% due to rounding and multiple responses. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

Using a scale from 1 (indicating a negative influence) to 5 (indicating a positive influence), the four respondents who had participated in other NYSERDA programs indicated the type and extent of influence their experience with those programs had on their decision to apply for NYSERDA ARRA funding. As shown in Table H-24, two of these respondents indicated that the prior programs positively influenced their decision to apply for NYSERDA funds (i.e., gave a rating of 5), while two respondents said that their past experience with NYSERDA programs had no influence on their decision. These findings indicate that other NYSERDA programs induced at least some informal spillover to the NYSERDA ARRA Program Area, but the sample size of only four respondents is too small to reflect conclusive evidence of spillover.

Table H-24. Influence of Past NYSERDA Program Experience on Decision to Apply for ARRA Funds, Energy-Efficiency Program Area

Influence	Responses
Sample size	*4*
Mean influence rating	4.0
1 Negatively influential	0
2 Somewhat negatively influential	0
3 Not at all influential	50% (2)
4 Somewhat positively influential	0
5 Positively influential	50% (2)

Note: Base is respondents who had previously participated in other NYSERDA programs.

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

NYSERDA also wanted to understand if the measures installed through NYSERDA ARRA had been recommended in prior programs, especially the FlexTech and Technical Assistance programs or the NYSERDA ARRA-funded Energy Conservation Studies (ECS) Program Area. Therefore, the final question the Cadmus Team asked about prior participation was whether the measures installed through the current Program Area had been recommended in a previous NYSERDA energy-efficiency audit or study (Table H-25). One of the four respondents who had previously participated in prior NYSERDA programs responded affirmatively, specifying that the measures were recommended by the PON 4 Program. While the Program Area theory predicted that NYSERDA ARRA would provide a source of funds for participants to implement measures recommended in prior studies, it appears that this has not generally been the case.

Table H-25. Whether Installed Measures Were Recommended in Previous NYSERDA Audit or Study, Energy-Efficiency Program Area

Whether Installed Measures Through Current Program Area were Recommended in Previous NYSERDA Study or Audit	Responses
Sample size	*4*
Yes	25% (1)
No	75% (3)

Note: Base is respondents who had previously participated in other NYSERDA programs.

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

H3. RENEWABLE ENERGY PROGRAM AREA

The Cadmus Team focused the initial Renewable Energy Program Area survey questions on how respondents heard about RFP 10, their motivations for participating, and their past participation in other renewable energy or energy-efficiency programs.

As shown in Table H-26, respondents learned about the Program Area in a variety of ways. A large proportion heard about it through NYSERDA sources, with seven of the 23 respondents (30%) mentioning the NYSERDA Website, four (16%) mentioning e-mails or mailings from NYSERDA, one respondent citing the Flextech Program (4%), and two respondents (14%) citing another NYSERDA program. Renewable energy contractors and installers were also frequently mentioned, with approximately one-third of respondents (seven, or 34%) mentioning this source. Other sources include word-of-mouth (7%), a story in the media (3%), and local or state governments (3%).

Some Program Area outreach and marketing strategies appear to have had limited success. Only one respondent each cited learning about the Program Area from Program Area marketing materials, Program Area outreach sessions, and a Webinar (one respondent each, or 3%, each).

Table H-26. How Participants Heard about Renewable Energy Program Area (Multiple Responses)

Sources of Awareness	Overall*	Solar PV, Upstate	Solar PV, Downstate	Non-solar PV
Sample size	*23*	*14*	*3*	*6*
NYSERDA Website	30% (7)	21% (3)	33% (1)	50% (3)
Renewable energy contractor/installer	34% (7)	36% (5)	0% (0)	33% (2)
E-mail or mailing from NYSERDA	16% (4)	14% (2)	0% (0)	33% (2)
Word-of-mouth (e.g., colleague, friend, family member)	7% (2)	7% (1)	33% (1)	0% (0)
Participation in another NYSERDA program (besides Flex Tech)	14% (2)	14% (2)	0% (0)	0% (0)
Story in the media	3% (1)	0% (0)	0% (0)	17% (1)
Town/state government	3% (1)	7% (1)	0% (0)	0% (0)
Program Area marketing materials	3% (1)	7% (1)	0% (0)	0% (0)
Grant writer	3% (1)	7% (1)	0% (0)	0% (0)
Program Area outreach sessions	3% (1)	0% (0)	0% (0)	17% (1)
Webinar	3% (1)	7% (1)	0% (0)	0% (0)
Consulting firm	3% (1)	7% (1)	0% (0)	0% (0)
Community Green Energy Council	4% (1)	7% (1)	0% (0)	0% (0)
Internet search engine	4% (1)	0% (0)	0% (0)	17% (1)
NYSERDA's FlexTech Program	4% (1)	0% (0)	33% (1)	0% (0)
NYCOM bulletin	4% (1)	0% (0)	0% (0)	17% (1)
Neighboring communities were participating	7% (1)	7% (1)	0% (0)	0% (0)

Note: Columns may not sum to 100% due to rounding and multiple responses. The percentages reflect weighted data numbers, while the numbers inside the parentheses are unweighted frequencies.

When asked to name the most important reason they decided to incorporate the equipment they installed with the assistance of NYSERDA funding, the majority (14 respondents, or 61%) said that they did so in order to save energy or reduce their energy bills (Table H-27). Three respondents (12%) sought to promote renewable energy, and another three respondents (13%) installed the equipment to increase their energy independence. Other motivations respondents mentioned were to reduce their organization's carbon emissions (two respondents, or 7%) and hedging against future energy price increases (one respondent, or 7%).

Table H-27. Why Respondents Installed System, Renewable Energy Program Area

Reason	Overall*	Solar PV, Upstate	Solar PV, Downstate	Non-solar PV
Sample size	*23*	*14*	*3*	*6*
Reduce energy bills/energy savings	61% (14)	71% (10)	33% (1)	50% (3)
Increase energy independence	13% (3)	14% (2)	0% (0)	17% (1)
Promote renewable energy	12% (3)	7% (1)	67% (2)	0% (0)
Reduce carbon footprint/emissions	7% (2)	0% (0)	0% (0)	33% (2)
Hedge against future increases in energy prices	7% (1)	7% (1)	0% (0)	0% (0)

Note: Columns may not sum to 100% due to rounding. The percentages reflect weighted data numbers, while the numbers inside the parentheses are unweighted frequencies.

In the subsequent question, the Cadmus Team asked respondents why they decided to apply for NYSERDA funds for the equipment (Table H-28). The majority (17 respondents, or 77%) did so because their budgets did not allow for the work to be completed without the funding. Two respondents (9%) could not find funding from other sources, while another two said that their contractor suggested that they apply for the funds. Individual respondents (3% each) applied because they thought that they stood a good chance of getting the NYSERDA funding, and because other funding sources required matching or leveraged funds.

Table H-28. Why Applied for NYSERDA Funds, Renewable Energy Program Area

Reason	Overall*	Solar PV, Upstate	Solar PV, Downstate	Non-solar PV
Sample size	*23*	*14*	*3*	*6*
Could not afford to do work without funding	77% (17)	93% (13)	67% (2)	33% (2)
Could not find funding from other sources	9% (2)	0% (0)	33% (1)	17% (1)
Contractor suggested applying	9% (2)	0% (0)	0% (0)	33% (2)
Thought chances of getting funding were good	3% (1)	7% (1)	0% (0)	0% (0)
Other funding sources requred matching or leveraged funds	3% (1)	0% (0)	0% (0)	17% (1)

Note: Columns may not sum to 100% due to rounding. The percentages reflect weighted data numbers, while the numbers inside the parentheses are unweighted frequencies.

When the Team respondents asked if they were aware at the time of the interview that the funding their organization received from NYSERDA for the equipment was provided by the federal government through the American Recovery and Reinvestment Act of 2009 (ARRA), all of them responded affirmatively. We then asked *when* they became aware that the funds were provided by ARRA (Table H-29). The majority (13 respondents, or 56%) became aware of this fact when they first learned about the

NYSERDA Program Area, whereas nine respondents (39%) became aware during the application review process. One respondent (4%) was not aware until the funds were actually awarded.

Table H-29. When Became Aware of ARRA Funding, Renewable Energy Program Area

Stage of Application/Project	Overall*	Solar PV, Upstate	Solar PV, Downstate	Non-solar PV
Sample size	*23*	*14*	*3*	*6*
When learned about NYSERDA Program	56% (13)	50% (7)	67% (2)	67% (4)
During application review process	39% (9)	43% (6)	33% (1)	33% (2)
When NYSERDA began asking for information to fulfill the federal reporting requirements	4% (1)	7% (1)	0% (0)	0% (0)

Note: Columns may not sum to 100% due to rounding. The percentages reflect weighted data numbers, while the numbers inside the parentheses are unweighted frequencies.

H4. Transportation Program Area

This section summarizes the awareness, motivations, economic factors, alternative funding sources, and spillover characteristics of Transportation Program Area project respondents.[3] While this information is presented to support the Cadmus Team's gross and net savings estimates, the analyses outlined in the main document refer to the results presented below, as they explain freeridership and spillover effects from participating in the NYSERDA ARRA-funded Transportation Program Area.

Program Awareness and Motivation to Participate

The four respondents learned about the Transportation Program Area through outreach by a contractor/installer/engineering/architectural firm (two responses), through NYSERDA staff (one response), and through an internal grant department (one response; Table H-30).

Table H-30. How Participants Heard About the Transportation Program Area

Sources of Awareness	Overall
Responses	*4*
Outreach by NYSERDA staff	1
Contractor/installer/enginnering/architechtural firm	2
Internal grant department	1
Don't know/refused	-

The Cadmus Team asked respondents why they decided to apply for NYSERDA ARRA funds. As shown in Table H-31. Why Applied for NYSERDA FundsTable H-31, two respondents applied because they thought the project would be beneficial to their communities. One respondent wished to embrace green technology, while another said the project would be a good return on invested funds.

Table H-31. Why Applied for NYSERDA Funds, Transportation Program Area

Reason	Overall
Responses	*4*
Embracing green technology	1
Benefit to the community	2
Good return on investment	1
Don't know/Refused	-

All of the surveyed respondents were aware at the time of the interview that the NYSERDA funding their organization received for the project was provided by the federal government through ARRA.

The Team then asked respondents how the fact that the funds were provided by ARRA affected their decision to apply for participation. Table H-32 shows that all four respondents said the ARRA association was a positive factor in their decision to apply.

[3] Transportation projects were funded through the Clean Fleets Program (via SEP within RFP 1613) and through the Efficient Transportation System Implementation Projects (via EECBG within RFP 10).

Table H-32. Influence of ARRA Funding on Decision to Apply for NYSERDA Funds, Transportation Program Area

Influence	**Overall**
Sample size	*4*
Critical negative factor	-
Somewhat of a negative factor	-
Not at all a factor	-
Somewhat of a positive factor	2
Critical positive factor	2

The effect of the NYSERDA ARRA fund timing on respondents' decisions to apply was gauged by asking, "*To what extent was your decision to apply for funds from NYSERDA affected by* <u>*when*</u> *the funds would be available to you?*" Three out of four respondents said that timing was somewhat of a positive factor, while one respondent said the ARRA funds were not a factor when deciding to apply (Table H-33).

Table H-33. Decision to Apply for ARRA Funding Affected by When the Funds Were Available, Transportation Program Area

Influence	**Overall**
Sample size	*4*
Critical negative factor	-
Somewhat of a negative factor	-
Not at all a factor	1
Somewhat of a positive factor	3
Critical positive factor	-

Table H-34 reports whether respondents had participated in a previous NYSERDA transportation program. All respondents indicated they had not or did not know if they had previously participated in such a program.

Table H-34. Previous Participation in a NYSERDA Transportation Program

Influence	**Overall**
Sample size	*4*
Yes	-
No	3
Don't know/refused	1

Alternative and Additional Funding

The survey included three questions about the funding sources for respondents' transportation projects: whether they had attempted to secure financing for the project before they applied for NYSERDA ARRA funds, whether those attempts were successful, and how the previously secured funds were used.

One out of the four respondents had previously attempted to secure financing for their transportation project. However, this respondent had not successfully secured any financing for the project prior to applying for the NYSERDA ARRA funds.

Table H-35 shows the likelihood that respondents would have performed some type of transportation project if the NYSERDA ARRA funds had not been available. Respondents rated the likelihood using a scale from 1 (indicating that it was not at all likely) to 5 (indicating that it was very likely). Two out of four respondents reported that they were not at all likely to have performed some sort of project. One respondent indicated they were somewhat unlikely, while another reported they would have been somewhat likely to have performed a project without the NYSERDA ARRA funding.

Table H-35. Likelihood of Performing a Project in Absence of NYSERDA Funds, Transportation Program Area

Likelihood	Overall
Sample size	*4*
Mean (Scale 1-5)	2.00
1 Not at all likely	2
2 Somewhat unlikely	1
3 Neither likely nor unlikely	-
4 Somewhat likely	1
5 Very likely	-

The Team asked respondents whether the NYSERDA ARRA award allowed them to divert funds that had been budgeted for the current transportation project(s) to other projects. One respondent reported diverting monies to a capital improvement project (road paving).

Spillover

The Cadmus Team asked respondents a series of questions about the influence of the Transportation Program Area on any additional energy saving actions they incorporated at their site.

At the time of the survey, none of the respondents were influenced to implement additional measures because of participation in the Program Area.

Demographics

The four interviewed Transportation Program Area participants all represented municipal organizations.

Appendix I:

DEMOGRAPHICS

I1. ENERGY CODE PROGRAM AREA

Plan Review Services Document Review

Throughout the course of two years, T.Y. Lin reviewed 78 residential plans for 49 unique projects and 74 commercial plans for 47 unique projects. Fifty-five CEOs in 36 jurisdictions used the services. Table I-1details the number of unique projects by sector and submission type.

Table I-1. Number of Unique Projects Submitted for Plan Review Services, Energy Code Program Area

Projects	Residential	Commercial	Total
Resubmission	21	20	41
One-time Submission	28	27	55
Total	**49**	**47**	**96**

The distribution of projects that received plan review services (in time for the Cadmus Team interview with T.Y. Lin) by jurisdiction is shown in Table I-2.

Table I-2. Unique Projects Submitted for Plan Review Services by Jurisdiction, Energy Code Program Area

Jurisdiction	Number of Residential Projects Submitted	Number of Commercial Projects Submitted
City of Canandaigua	2	0
City of Corning	0	1
City of Geneva	1	0
City of New Rochelle	0	2
City of Norwich	1	0
City of Port Jervis	0	1
City of Syracuse	1	7
City of Tonawanda	0	1
Monroe County	0	4
Ontario County	0	1
Town of Batavia	0	3
Town of Canadice	2	0
Town of Canandaigua	2	1
Town of Chili	0	4
Town of Dix	1	0
Town of Farmington	4	1
Town of Greece	0	1
Town of Macedon	1	0
Town of Newburgh	1	0
Town of North Elba	0	1
Town of Norwich	0	2
Town of Perinton	2	0
Town of Pittsford	0	1
Town of Pittsford	0	1
Town of Pittsford	10	0
Town of Riga	1	0
Town of Victor	0	3
Town of Wallkill	9	0
Village of Albion	0	1
Village of Bath	0	1
Village of Fairport	1	3
Village of Fayetteville	8	4
Village of Fredonia	1	0
Village of Lansing	0	2
Village of Maybrook	1	0
Village of Penn Yan	0	1

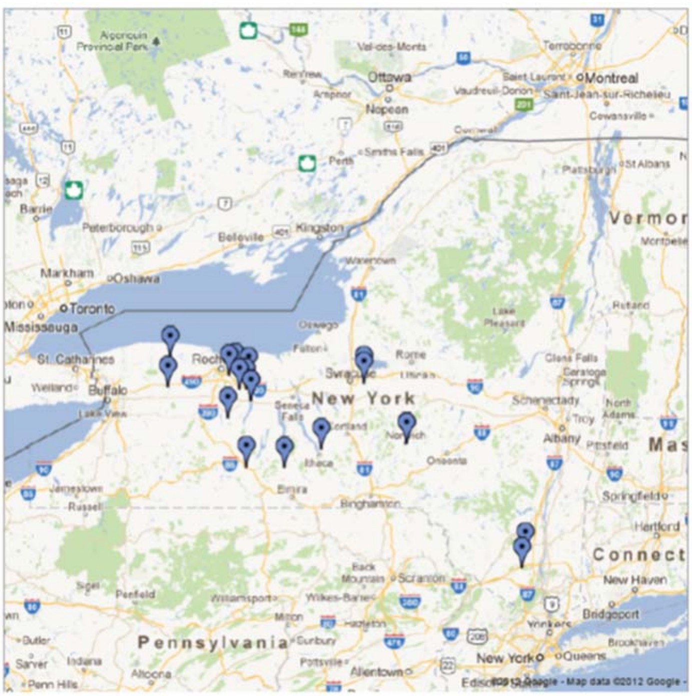
CEO Feedback on Plan Review Services

The Cadmus Team interviewed 19 CEOs, representing 19 municipalities, by phone between July 31 and August 6, 2012. The Team worked from a list of 19 CEOs that provided one-time submissions only and 18 CEOs that provided resubmissions for the plan review services offered by T. Y. Lin. The Cadmus Team contacted all 37 listed CEOs multiple times, unless they were going to be out of the office throughout the entire calling period. Table I-3 shows the distribution of the interviewed CEOs by category. Figure I-1 is a map showing the geographic distribution of the CEOs in New York that the Team interviewed. As shown, the majority are located in municipalities close to or near Rochester, where T.Y. Lin is headquartered.

Table I-3. Number of CEOs Interviewed by Submission and Project Type, Energy Code Program Area

Projects	Residential Only	Commercial Only	Residential and Commercial
One-time Submissions	4	5	0
Resubmissions	4	4	2
Total	**8**	**9**	**2**

Figure I-1. Distribution of Interviewed CEOs, Energy Code Program Area



I2. ENERGY-EFFICIENCY PROGRAM AREA

The Energy-Efficiency Program Area attribution survey gathered information about the characteristics of respondents' organizations. As shown in Table I-4, respondents reported a variety of principal activities at the sites where projects were completed. Office-related work was the most common activity (35%), followed by fire and emergency service (14%) and municipalities (14%). Other uses were voiced by only one respondent each.

Table I-4. Principal Activity of Organization, Energy-Efficiency Program Area

Activity of Site Where Study was Conducted	Responses
Sample size	*14*
Office	35% (5)
Fire and emergency service	14% (2)
Municipality	14% (2)
Public assembly	7% (1)
Public parking lots and streets	7% (1)
Civic center	7% (1)
Garage	7% (1)
Storage of highway equipment, vehicle repairs	7% (1)

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

The buildings in which projects were conducted were relatively old, with one-half built before 1960 and none built after 2000 (Table I-5).

Table I-5. When Building was Built, Energy-Efficiency Program Area

Range	Responses
Sample size	*14*
Before 1960	7 (50%)
1961-1970	1 (7%)
1971-1980	1 (7%)
1981-1990	4 (28%)
1991 or later	1 (7%)

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

The buildings ranged in size from less than 1,000 square feet (14%) to more than 200,000 square feet (7%; Table I-6). One-half of the buildings were less than 15,000 square feet, and most of the remaining (5 buildings or 35%) were between 15,000 square feet and 99,999 square feet in size.

Table I-6. Size of Building, Energy-Efficiency Program Area

Range	Responses
Sample size	*14*
Less than 15,000 square feet	7 (50%)
15,000-99,999	5 (35%)
100,000-199,999	1 (7%)
200,000 or more	1 (7%)

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

The number of full-time equivalent employees at each facility varied widely, from fewer than five (28%) to 250 or more (14%;Table I-7). The majority of respondents (56%) reported having staff sizes between these two extremes.

Table I-7. Number of Full-Time Equivalent Employees at Facility, Energy-Efficiency Program Area

Range	Responses
Sample size	*14*
Fewer than 5	28% (4)
5-19	14% (2)
20-49	21% (3)
50-99	14% (2)
100-249	7% (1)
250 or more	14% (2)

Note: Total may not equal 100% due to rounding. The percentages before the parentheses show the percentage of results, while the numbers inside the parentheses reflect frequencies.

I3. RENEWABLE ENERGY PROGRAM AREA

The buildings with installed renewable energy systems vary widely in age. Nearly one-half (46%) were built after 1991, while 24% were built in 1970 or earlier. The remaining 30% were built between 1971 and 1990 (Table I-8).

Table I-8. When Building was Built

Year	Overall	Solar PV, Upstate	Solar PV, Downstate	Non-Solar PV
Sample size	*23*	*14*	*3*	*6*
Before 1960	4 (18%)	4 (29%)	0 (0%)	0 (0%)
1961-1970	2 (6%)	0 (0%)	0 (0%)	2 (33%)
1971-1980	4 (20%)	3 (21%)	1 (33%)	0 (0%)
1981-1990	3 (10%)	1 (7%)	0 (0%)	2 (33%)
1991-2000	5 (23%)	3 (21%)	1 (33%)	1 (17%)
2001-2005	5 (23%)	3 (21%)	1 (33%)	1 (17%)
After 2005	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Note: Columns may not sum to 100% due to rounding.

Note: The numbers before the parentheses are unweighted frequencies, while the percentages inside the parentheses reflect weighted data.

The buildings ranged from between 1,000 and 4,999 square feet to over 500,000 square feet (Table I-9). The most common building size was between 5,000 and 14,999 square feet (29% of buildings).

Table I-9. Building Size

Square feet	Overall	Solar PV, Upstate	Solar PV, Downstate	Non-Solar PV
Sample size	*23*	*14*	*3*	*6*
1,000-4,999	5 (26%)	2 (14%)	2 (67%)	1 (17%)
5,000-14,999	6 (29%)	5 (36%)	1 (33%)	0 (0%)
15,000-24,999	3 (10%)	1 (7%)	0 (0%)	2 (33%)
25,000-49,999	3 (12%)	2 (14%)	0 (0%)	1 (17%)
50,000-99,999	3 (10%)	1 (7%)	0 (0%)	2 (33%)
100,000-199,999	1 (4%)	1 (7%)	0 (0%)	0 (0%)
200,000-499,999	1 (4%)	1 (7%)	0 (0%)	0 (0%)
500,000 or more	1 (4%)	1 (7%)	0 (0%)	0 (0%)

Note: Columns may not sum to 100% due to rounding.

Note: The numbers before the parentheses are unweighted frequencies, while the percentages inside the parentheses reflect weighted data.

The number of full-time employees at these facilities ranged from fewer than five (24%) to between 100 and 249 (7%), with the most frequently reported number of employees being between five and nine (39%; Table I-10).

Table I-10. Number of Full-time Equivalent Employees at Facility

Range	Overall	Solar PV, Upstate	Solar PV, Downstate	Non-Solar PV
Sample size	*23*	*14*	*3*	*6*
Fewer than 5	5 (24%)	1 (7%)	2 (67%)	2 (33%)
5-9	9 (39%)	6 (43%)	1 (33%)	2 (33%)
10-19	4 (18%)	4 (29%)	0 (0%)	0 (0%)
20-49	2 (8%)	1 (7%)	0 (0%)	1 (17%)
50-99	1 (4%)	1 (7%)	0 (0%)	0 (0%)
100-249	2 (7%)	1 (7%)	0 (0%)	1 (17%)
250 or more	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Note: Columns may not sum to 100% due to rounding.

Note: The numbers before the parentheses are unweighted frequencies, while the percentages inside the parentheses reflect weighted data.

I4. TRANSPORTATION PROGRAM AREA

This section outlines the demographics of the organizations that implemented projects through RFP 10 and were evaluated as part of the Transportation Program Area. Table I-11 summarizes the demographic details.

Table I-11. Types of Organizations That Implemented Projects Through the Transportation Program Area

Type of Organization	Number of Projects	Type of Projects Implemented
Cities	4	Three projects consisted of replacing and synchronizing three corridors of traffic signals to minimize delays and emissions. One project consisted of implementing RouteSmart on seven refuse and recycling vehicles to determine the most efficient collection routes to minimize emmisions and fuel use.

The following are specific project-related details:

- ***City 1 - Traffic signal synchronization.*** The population was 33,262 in the year 2000. The principal transportation system is comprised of roadways. The project consisted of coordinating seven traffic signals along 1.3 miles of a principal arterial street, and four traffic signals along 0.7 miles of a minor arterial street. This coordination was implemented with the objective of reducing fuel consumption due to idling and delays, in order to increase the ease and flow of traffic through the intersections. Emission reductions as a result of decreases in idling will also be recognized.
- ***City 2 - Traffic signal synchronization.*** The city is located on the eastern shore of Lake Erie in Western New York State. The city population was 19,064 in the year 2000. As part of an effort to bring in new business and tourist attractions, the roadways were modified to meet new demand. The project consisted of coordinating 11 traffic signals along 2.6 miles. This coordination allows for increased fuel efficiency as a result of reduced idling, as well as a reduction of accidents related to traffic flow.
- ***City 3 - Traffic signal synchronization.*** The city is located in the central area of Chautauqua County, New York and is adjacent to the southeastern end of Chautauqua Lake. The city population was 31,730 in the year 2000. The principal transportation system is comprised of roadways. The project consisted of coordinating seven traffic signals along 0.6 miles of Main Street, a four-lane urban minor arterial street, with the goals of reducing congestion, as well as reducing fuel waste and emissions as a result of idling.
- ***City 4 - Integration/converting RouteSmart software into the city's GIS system.*** The goal of this program was to determine the optimal route for refuse and recycling trucks. The city is situated approximately 20 miles south of the Thousand Islands. As of the 2010 census, it had a population of 27,023, an increase of 1.2% since the year 2000.[1] The original project was for implementing GPS units on seven refuse and recycling trucks to determine the most efficient routes for collection. The scope was revised, and the city purchased and subsequently trained on RouteSmart software, which was then integrated into the city's GIS system, allowing the city to track and map the most efficient routes for the vehicles. These adjustments reduce fuel consumption, and the reduction of doubling back for pickups reduces traffic and emissions.

[1] http://en.wikipedia.org/wiki/Watertown_%28city%29,_New_York

Appendix J:

RENEWABLE AND ENERGY-EFFICIENCY PROJECT-LEVEL SAVINGS SUMMARIES

- Energy-Efficiency Program Area Project-Level Savings Summaries
- Renewable Energy Program Area Project-Level Savings Summaries

Table J-1. Energy Efficiency Energy Program Area Project-Level Savings Summary

Project	Projected Electricity Savings/Generation (kWh)	Projected Fuel Savings (MMBtu)	Evaluated Gross Electricity Savings/Generation (kWh)	Evaluated Gross Fuel Savings (MMBtu)	Realization Rate
1	-	47	-	38	80%
2	-	76	-	77	101%
3	-	422	-	427	101%
4	-	457	-	463	101%
5	-	23	-	24	102%
6	1,204	-	1,196	-	99%
7	3,085	-	2,513	-	81%
8	3,581	-	575	-	16%
9	7,280	-	6,138	-	84%
10	17,321	-	13,930	(3)	76%
11	28,948	-	21,501	-	74%
12	45,289	-	45,706	-	101%
13	78,550	-	78,028	-	99%
14	81,000	-	98,396	-	121%
15	82,148	-	81,602	-	99%
16	101,768	-	86,713	-	85%
17	142,700	-	141,752	-	99%
18	161,635	-	160,562	-	99%
19	333,994	-	322,258	-	96%
20	520,085	-	525,811	-	101%
21	660,196	-	655,811	-	99%
22	813,224	-	807,824	-	99%
23	-	-	-	-	0%
24	-	78	-	76	98%
25	(21,628)	393	(21,484)	384	97%
26	16,358	445	15,614	445	99%
27	12,265	102	12,184	103	101%
28	3,076	43	3,331	41	98%
29	24,077	5	23,917	5	99%
30	1,395	44	1,386	43	98%
31	-	49	-	48	98%
32	1,933	177	1,920	173	98%
33	13,617	20	13,527	20	99%
34	31,049	150	5,416	151	66%

Project	Projected Electricity Savings/Generation (kWh)	Projected Fuel Savings (MMBtu)	Evaluated Gross Electricity Savings/Generation (kWh)	Evaluated Gross Fuel Savings (MMBtu)	Realization Rate
35	55,593	10	55,224	10	99%
36	2,675	140	2,657	137	98%
37	37,472	(122)	37,223	(119)	130%
38	2,185	71	2,170	72	101%
39	2,793	-	2,774	-	99%
40	4,873	-	4,841	-	99%
41	13,981	-	20,951	-	150%
42	16,920	39	31,891	-	112%
43	19,161	-	19,034	-	99%
44	79,113	33,495	78,588	33,910	101%
45	96,878	-	78,460	-	81%
46	16,387	433	15,926	433	100%
47	8,688	207	8,630	202	98%
48	118,938	-	118,148	-	99%
49	157,032	-	155,989	-	99%
50	-	648	-	650	100%
51	163,759	-	162,672	-	99%
52	174,698	-	173,538	-	99%
53	-	2,898	-	2,934	101%
54	1,283,035	3,293	1,283,035	3,293	100%
55	359,616	-	357,228	-	99%
56	28,505	3,377	28,505	3,377	100%
57	425,714	-	422,887	-	99%
58	-	55	-	60	110%
59	2,510	77	2,493	75	98%
60	1,388	120	1,379	117	98%
61	21,480	-	21,337	-	99%
62	-	359	-	364	101%
63	10,354	41	10,285	40	98%
64	17,615	-	17,498	-	99%
65	175,935	904	199,052	1,023	113%
66	22,725	276	22,574	280	101%
67	83,183	270	82,631	274	100%
68	339,574	-	337,319	-	99%
69	171,412	1,319	170,274	1,290	98%

Project	Projected Electricity Savings/Generation (kWh)	Projected Fuel Savings (MMBtu)	Evaluated Gross Electricity Savings/Generation (kWh)	Evaluated Gross Fuel Savings (MMBtu)	Realization Rate
Total	**7,078,343**	**50,444**	**7,031,338**	**50,938**	**100%**

Note: Columns may not sum due to rounding. Differences between savings reported here and savings reported in executive summary tables are due to differences in rounding from source documents

Table J-2. Renewable Energy Program Area Project-Level Savings Summary

Proposal Number	Claimed Electrical Generation (kWh)	Claimed Fuel Savings (MMBTU)	Evaluated Electrical Generation (kWh)	Evaluated Fuel Savings (MMBTU)	Realization Rate
18	5,258		5,613	-	1.07
19	55,987		66,055	-	1.18
20	20,711		24,435	-	1.18
28	56,647		66,833	-	1.18
47	54,521		58,206	-	1.07
52	37,677		40,224	-	1.07
58	37,592		44,352	-	1.18
68	40,097		42,807	-	1.07
78	54,242		57,908	-	1.07
81	12,740		13,601	-	1.07
85	46,427		49,565	-	1.07
92	45,894		48,996	-	1.07
106	9,313		9,943	-	1.07
112	47,800		56,395	-	1.18
116	11,146		11,899	-	1.07
133	30,147		32,185	-	1.07
136	55,662		65,671	-	1.18
137	75,934		89,588	-	1.18
141	29,086		31,052	-	1.07
142	38,073		40,647	-	1.07
144	26,801		28,613	-	1.07
146	35,970		38,401	-	1.07
147	66,795		71,310	-	1.07
148	68,002		72,599	-	1.07
149	35,619		38,027	-	1.07
154	56,397		66,538	-	1.18
155	33,316		35,568	-	1.07
157	(548)	71	(384)	50	0.70
163	(20,800)	3,734	(8,658)	1,554	0.42
194	-	91	-	91	1.00
196	-	265	-	414	1.56
220	14,070		16,600	-	1.18
229	54,038		57,691	-	1.07
246	14,334		15,303	-	1.07
253	29,112		31,080	-	1.07
257	(8,050)	3,056	(3,351)	1,272	0.42

Proposal Number	Claimed Electrical Generation (kWh)	Claimed Fuel Savings (MMBTU)	Evaluated Electrical Generation (kWh)	Evaluated Fuel Savings (MMBTU)	Realization Rate
260	53,308		56,911	-	1.07
263	40,489		43,226	-	1.07
265	49,648		53,004	-	1.07
272	51,437		54,914	-	1.07
273	24,206		25,842	-	1.07
284	6,568	102	4,598	72	0.70
288	20,385		21,763	-	1.07
292	11,696		13,799	-	1.18
305	30,023		32,052	-	1.07
312	30,137		35,556	-	1.18
313	10,566		11,280	-	1.07
317	20,843		22,252	-	1.07
337	84,293		89,991	-	1.07
340	45,347		48,412	-	1.07
341	45,347		48,412	-	1.07
368	32,893		35,116	-	1.07
372	27,320		27,007	-	0.99
373	28,928		28,597	-	0.99
375	34,814		34,415	-	0.99
376	41,100		43,878	-	1.07
377	42,378		45,242	-	1.07
398	16,638		17,763	-	1.07
405	72,848		77,772	-	1.07
407	52,418		62,377	-	1.19
408	47,120		50,305	-	1.07
410	47,141		50,327	-	1.07
412	30,870		32,957	-	1.07
413	26,256		28,031	-	1.07
414	14,238		15,200	-	1.07
Total	**2,209,265**	**7,320**	**2,426,314**	**3,453**	

Note: Columns may not sum due to rounding. Differences between savings reported here and savings reported in executive summary tables are due to differences in rounding from source documents