

R&D Demonstration Survey Round 2: Projects Completed from 2008-2010

Final Report

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EXECUTIVE SUMMARY

ES.1 OVERVIEW AND PURPOSE

The New York State Energy Research and Development Authority's (NYSERDA) Research & Development (R&D) Program employs a variety of approaches designed to advance the development and market acceptance of innovative, efficient, and clean energy technologies. R&D demonstration projects are one of NYSERDA's best-established strategies for promoting these goals. Demonstration projects are designed to showcase the value and effectiveness of a new technology or process, or application of an existing technology in a commercial setting.

Demonstration projects cover a wide variety of technology areas and project types, including advanced materials, air and waste remediation, building systems, electric power delivery, energy storage, industrial products, heating and cooling, transportation, waste management, wastewater treatment, and others. The types of impacts associated with these projects are equally far-reaching.

While demonstration projects often generate impacts in their own right, these projects are designed to achieve additional impacts through successful replications. Replication projects involve an additional installation or scaling up of the technology or process demonstrated under the NYSERDA-funded project, or additional sales of the technology that was used in the demonstration. Replications may be carried out at the same site or different site as the original demonstration project, as well as by the same firm or a different firm.

This evaluation assesses the impacts of NYSERDA's R&D demonstration portfolio based on projects completed in 2008 – 2010.¹ The evaluation has the following objectives:

- Estimate the resource savings (e.g., kW, MWh, etc.), revenues, cost savings, and other impacts resulting from NYSERDA-funded demonstrations and replication projects.
- Characterize the number, scale, and type of replication projects.
- Determine the factors that helped or hindered replication.
- Assess the cost-effectiveness of NYSERDA's R&D demonstration portfolio.
- Evaluate participant satisfaction with NYSERDA's R&D Program.

ES.2 METHODS

The primary data source for this evaluation was a survey of R&D participants who completed demonstration projects between 2008 and 2010. The evaluators aimed to survey the individual that was most knowledgeable about each project. Since each project was unique, the type of person most knowledgeable about the impacts varied. The Principal Investigator (PI) listed in NYSERDA's R&D Metrics Database was assumed to be most knowledgeable and was the intended point of contact, but the survey allowed for a different respondent if the original PI was no longer with the firm, as long as that person was knowledgeable about the demonstration project. Depending on the project, the PI may be the integrator, vendor, or site owner. Integrators bring together the other market actors to create or "package" the demonstration project. Vendors supply the technology for the project. Site owners own the location where the project is demonstrated, and may or may not be involved with implementing the project at their site. Three separate survey instruments were developed for integrators, vendors, and site owners; however, most of the questions in the three surveys were identical or extremely similar. The main

¹ The evaluation follows a previous study that assessed the results of demonstrations completed in 2004 – 2007. Please refer to NYSERDA's *R&D Demonstration Survey Report*, prepared by Megdal & Associates, September 2012.

difference between the surveys was in the replication section; specifically, integrators and site owners were asked about additional technology installations, while vendors were asked about additional sales.

The survey population was drawn from NYSERDA's R&D Metrics Database, which includes basic project information for all of NYSERDA's R&D demonstration projects. Because a primary goal of the evaluation was to identify replications, projects were subjected to two screening criteria: (1) The project demonstrated a technology or process that could conceivably be replicated (i.e., it was not basic research, and the project was not terminated prior to implementation); and (2) the project was completed at least two years ago, giving sufficient lead time for replications. Based on these screening criteria,² NYSERDA provided IEC with a sample frame containing 88 demonstration projects that were completed between 2008 and 2010.³ Two projects had incorrect contact information (and no new contact information was found), another six companies went bankrupt, and another project was later determined not to be a demonstration project; these projects had to be dropped from the sample frame. Therefore, the final sample frame consisted of 79 demonstration projects. The evaluation team attempted to conduct a full census rather than drawing a sample. Of the 79 eligible projects, 61 completed the survey, yielding a response rate of 77%.⁴

In addition to the survey, the evaluation team also drew on the following data sources:

- **R&D Metrics Database.** NYSERDA requires demonstration participants to submit an annual summary of metrics addressing the energy, environmental, and economic benefits of their projects, during and after project implementation. Since 2009, NYSERDA has been collecting benefits data in an R&D Metrics Database. While the creation of the database is a positive development, the datasets are not as comprehensive as they could be. The evaluators used the available information as a starting point to collect benefits data. Data obtained prior to conducting the survey were validated with survey respondents.
- **Project Reports.** NYSERDA requires most demonstration participants to submit final reports that describe the demonstration project and the benefits realized by the end of the project.⁵ However, these reports do not seem to be archived in a central location, and the evaluators were only able to obtain a limited number of the documents. Reports obtained prior to conducting a survey were used as a starting point for the discussion; in addition, 10 reports that were obtained for non-surveyed projects contained useable benefits data. The evaluators incorporated these data in the analysis of demonstration benefits.
- **Research Project Updates (RPU).** The RPUs describe the status of NYSERDA's R&D demonstration projects, and in some cases, information about actual or expected benefits. The evaluators reviewed the RPUs prior to conducting each survey and drew on relevant information.

² In total, NYSERDA supported 124 R&D demonstrations that closed in 2008-2010. Of these 124 projects, 36 projects did not meet the screening criteria, leaving 88 projects in the initial sample frame.

³ The R&D Metrics Database does not include the project completion date; therefore, the contract closed date was used as a proxy. This is consistent with the methodology from the previous survey. In some cases, project activities ended well before the contract was closed.

⁴ Of the 18 non-completions, five PIs refused, four were unresponsive, and nine were no longer with the same firm and could not be reached. Excluding the nine PIs in the latter category from the sample frame would increase the response rate to 87%.

⁵ On-site power production projects are not typically required to submit a final report.

ES.3 DEMONSTRATION IMPACTS AND NYSERDA CONTRIBUTION

The initial section of the survey sought information about the characteristics of demonstration projects, prior experience with demonstrations before NYSERDA, and the benefits and challenges associated with planning and executing demonstrations. Key findings include the following:

- Out of 61 respondents, 28 projects were product demonstrations (46%), 18 were on-site power production (29%), and 15 were on-site process improvement projects (25%).
- A solid majority of respondents (73%) stated that the NYSERDA project was their first time demonstrating the technology. Of the 16 projects that had demonstrated the same technology before, most were demonstrated once or twice prior to the NYSERDA project.
- Since R&D efforts involve new and previously untested technologies, the survey included a question about whether projects accomplished their objectives. Ninety percent (90%) of respondents stated that the demonstration projects met “all” or “most” of their objectives, with over half of all projects meeting all of their objectives.
- Benefits from planning and executing the projects included (among others): knowledge about a different technology or process; experience working with manufacturers, regulators, and market actors; contacts with the local community and potential business partners; and enhanced reputation. The most common challenges included: cost, lack of interest among potential end users, and difficulty finding an appropriate site for the demonstration.

The survey asked respondents to describe the types of impacts that the demonstration projects generated, and to quantify these impacts where possible. Table ES-1 shows the number and percent of respondents who identified each benefit type as a direct benefit, overall and by project type.

Table ES-1. Direct Benefits by Project Type

Benefit Type	Number of Projects (n = 61)*	Percent	By Project Type		
			On-site Power Production	On-site Process Improvement	Product Demonstration
Knowledge Creation	38	62%	12	11	15
Energy Efficiency	34	56%	8	10	16
Demand Reduction	30	49%	14	5	11
Environmental Quality Improvement	28	46%	10	6	12
Power Production	23	38%	15	1	7
Marketability	23	38%	6	6	11
Product Quality/Reliability Improvement	21	34%	5	8	8
Productivity	20	33%	3	10	7
Air Emissions	19	31%	9	4	6
Operations & Maintenance	18	30%	3	6	9
Waste Management	15	25%	6	6	3
Reduced Material Costs	11	18%	3	5	3
Reduced Labor Costs	10	16%	1	5	4
Water Quality	9	15%	1	1	7
Water Reductions	7	11%	2	2	3
Other	18	30%	3	2	13

Notes: (*) Multiple responses were allowed. Percentages were calculated out of the 61 projects.

As shown in the previous table, 30% of respondents identified “other” benefits. Other benefits were very wide-ranging and included the following (among others): improved safety; increased tax base for the town; end-user behavioral changes; public health; media visibility; and a favorable regulatory ruling.

Given the broad range of projects and benefit types, summarizing the benefits of NYSERDA’s R&D demonstration projects in a limited number of metrics is challenging. The challenge is compounded by the time that elapsed since projects were completed, which makes it difficult for respondents to recall the precise benefits that their projects produced. Respondents with data in the R&D Metrics Database were asked to confirm or amend the data; however, most respondents did not have metrics data. Therefore, respondents were asked to provide their best estimate of the impacts. In addition, the limited number of project reports found online was used to supplement the survey data.

Based on the responses, benefits were quantified using three metrics: installed capacity (kW), energy savings (MWh/year), and fuel savings (therms/year). Respondents were asked an additional series of questions to ascertain NYSERDA’s contribution to the reported impacts. As discussed in the main report, the responses suggest that NYSERDA played an important role in catalyzing and accelerating the development of the demonstration projects.

Tables ES-2 – ES-4 present the results of this analysis. The tables show the projects that reported quantitative impact data, such as annual MWh of energy savings. It is possible that additional projects beyond those shown in the tables had impacts, but did not have data to quantify their benefits.

Table ES-2. Summary of NYSERDA Contribution to Energy Savings

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Energy Savings*	Energy Savings of Surveyed Projects (MWh/Year)	Number of Non-Surveyed Projects with Estimated Energy Savings	Energy Savings of Non-Surveyed Projects (MWh/Year)	Total Energy Savings (MWh/Year)	NYSERDA Contribution (MWh/Year)
On-site Power Production	18	7	21,098	0	0	21,098	17,062
On-site Process Improvement	15	1	685	1	3	688	88
Product Demonstration	28	4	400	1	5,800	6,200	4,688
Total	61	12	22,183	2	5,803	27,986	21,838

Note: (*) This table shows the projects that reported quantitative impact data (MWh/year).

Table ES-3. Summary of NYSERDA Contribution to Installed Capacity

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Installed Capacity*	Installed Capacity of Surveyed Projects (kW)	Number of Non-Surveyed Projects with Estimated Installed Capacity	Installed Capacity of Non-Surveyed Projects (kW)	Total Installed Capacity (kW)	NYSERDA Contribution (kW)
On-site Power Production	18	6	4,568	0	0	4,568	3,988
On-site Process Improvement	15	1	100	0	0	100	75
Product Demonstration	28	1	2	1	715	717	538
Total	61	8	4,670	1	715	5,385	4,601

Note: (*) This table shows the projects that reported quantitative impact data (installed kW).

Table ES-4. Summary of NYSERDA Contribution to Fuel Savings

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Fuel Savings*	Fuel Savings of Surveyed Projects (Therms/Year)	Number of Non-Surveyed Projects with Estimated Fuel Savings	Fuel Savings of Non-Surveyed Projects (Therms/Year)	Total Annual Fuel Savings (Therms/Year)	NYSERDA Contribution (Therms/Year)
On-site Power Production	18	0	0	0	0	0	0
On-site Process Improvement	15	2	41,600	2	30,582	72,182	44,137
Product Demonstration	28	3	17,204	0	0	17,204	13,729
Total	61	5	58,804	2	30,582	89,386	57,866

Note: (*) This table shows the projects that reported quantitative impact data (therms/year).

The study also evaluated revenues and cost savings that the demonstration projects achieved through 2013. As shown in Table ES-5, 10 surveyed projects and one non-surveyed project quantified the revenues associated with the demonstration project, with total revenues exceeding \$1.2 billion. This impressive figure is mostly due to a single project that reported \$1.2 billion in sales that the respondent attributed to the demonstration project.⁶ This type of result is typical for R&D portfolios, where one or two very successful projects often account for the majority of the portfolio's benefits. As shown in Table ES-6, 25 surveyed projects and seven non-surveyed projects quantified the cost savings associated with the demonstrations. Total cost savings were estimated at \$38.2 million.

Table ES-5. Summary of NYSERDA Contribution to Demonstration Revenues

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Revenue	Total Revenue of Surveyed Projects	Number of Non-Surveyed Projects with Estimated Revenue	Total Revenue of Non-Surveyed Projects	Total Revenue	NYSERDA Contribution
On-site Power Production	18	5	\$5,742,841	0	\$0	\$5,742,841	\$3,194,233
On-site Process Improvement	15	2	\$1,200,090,000	1	\$120,000	\$1,200,210,000	\$1,050,180,000
Product Demonstration	28	3	\$15,260,000	0	\$0	\$15,260,000	\$9,590,000
Total	61	10	\$1,221,092,841	1	\$120,000	\$1,221,212,841	\$1,062,964,233

⁶ Given the magnitude of the reported revenue for this one firm, the evaluators validated the figure by: (1) following up directly with the respondent after the initial survey to ensure that the respondent had understood the question and answered it correctly; and (2) cross-checking the survey data with the information contained in the final project report.

Table ES-6. Summary of NYSERDA Contribution to Demonstration Cost Savings

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Cost Savings	Total Cost Savings of Surveyed Projects	Number of Non-Surveyed Projects with Estimated Cost Savings	Total Cost Savings of Non-Surveyed Projects	Total Cost Savings	NYSERDA Contribution
On-site Power Production	18	9	\$14,680,938	1	\$2,000,000	\$16,680,938	\$11,748,933
On-site Process Improvement	15	6	\$13,857,392	4	\$2,046,229	\$15,903,621	\$8,514,463
Product Demonstration	28	10	\$5,332,558	2	\$325,700	\$5,658,258	\$3,545,264
Total	61	25	\$33,870,888	7	\$4,371,929	\$38,242,817	\$23,808,660

ES.4 REPLICATION IMPACTS AND DEMONSTRATION INFLUENCE

Replications are a primary goal of NYSERDA’s R&D demonstration projects. The survey included questions regarding the number and type of demonstration projects that were replicated, the total number of replications, impacts associated with the replications, and the contribution of the demonstration projects to developing the replications.

Key findings include the following:

- Of the 61 respondents, 40 projects (65%) reported replications of the technology or process used in the NYSERDA demonstration project.
- A majority of respondents (54%) reported replications for similar applications alone or in combination with different applications. Another seven projects (11%) reported replications for different applications only.
- Twenty-eight respondents (46%) reported at least one replication in New York. Thirteen of the 28 reported that NYSERDA provided funding for one or more replications, while the other 15 projects indicated that NYSERDA did not provide any funding.
- Overall, integrators and site owners reported 116 replication projects in New York and vendors reported \$2.4 million in replication sales.
- A majority of respondents characterized the replication impacts as the same or higher compared to the original demonstrations.
- Responses indicate that the original demonstration projects catalyzed and accelerated the development of the replication projects.
- Respondents provided a range of reasons for being able to replicate the NYSERDA project in New York State. Technical expertise and demonstrable savings achieved from the demonstrations were the most frequently mentioned factors.
- Respondents who have not replicated their projects in New York were asked to identify the barriers to replications in the state. The most commonly cited barrier was absence of other companies, institutions, or sites in New York to take advantage of the demonstrated technology, followed by cost and unproven technology.

The replication projects generated an estimated 16,704 MWh/year in electricity savings, 4,138 kW installed capacity, and 30,318 therms/year in fuel savings.⁷ In addition, the replications generated an estimated \$73.2 million in revenues and \$41.9 million in cost savings.

Combining the demonstration and replication impacts produces the results in Table ES-7.

Table ES-7. Summary of NYSERDA Contribution to Demonstration and Replication Impacts

Benefits Type	Estimated Benefits by Project Type			Total Benefits
	Power Production	Process Improvement	Product Demonstration	
Demonstration Installed Capacity (kW)	3,988	75	538	4,601
Replication Installed Capacity (kW)	4,075	63	-	4,138
Total Installed Capacity (kW)	8,063	138	538	8,739
Demonstration Electricity Savings (MWh/year)	17,062	88	4,688	21,838
Replication Electricity Savings (MWh/year)	16,558	-	146	16,704
Total Electricity Savings (MWh/Year)	33,620	88	4,834	38,542
Demonstration Fuel Savings (Therms/Year)	0	44,137	13,729	57,866
Replication Fuel Savings (Therms/Year)	-	1,000	29,318	30,318
Total Fuel Savings (Therms/Year)	0	45,137	43,047	88,184
Demonstration Cost Savings	\$11,748,933	\$8,514,463	\$3,545,264	\$23,808,660
Replication Cost Savings	\$36,160,752	\$5,435,000	\$274,719	\$41,870,471
Total Cost Savings	\$47,909,685	\$13,949,463	\$3,819,983	\$65,679,131
Demonstration Revenue	\$3,194,233	\$1,050,180,000	\$9,590,000	\$1,062,964,233
Replication Revenue	\$12,515,540	\$202,500	\$60,480,000	\$73,198,040
Total Revenue	\$15,709,773	\$1,050,382,500	\$70,070,000	\$1,136,162,273

ES.5 PROCESS EVALUATION RESULTS

Overall satisfaction with NYSERDA’s R&D Program was quite high, with 92% of respondents agreeing or strongly agreeing with the statement: “Overall, I am satisfied with my participation in NYSERDA’s R&D Program.” Respondents also gave very high ratings (greater than 80%) for communications with project participants and qualifications of program staff.

The lowest scores were providing marketing information (36%) and market intelligence (23%) that supports the demonstration process. However, several respondents commented that they do not view it as NYSERDA’s role to provide this type of information; therefore, disagreements with these statements do not necessarily imply dissatisfaction with the program.

ES.6 COST EFFECTIVENESS

The study assessed the cost effectiveness of NYSERDA’s R&D demonstration portfolio for projects completed in 2008 – 2010. Cost-effectiveness was assessed on three dimensions: (1) revenues generated

⁷ These values reflect NYSERDA’s estimated contribution.

and costs saved per NYSERDA dollar of investment in the demonstration projects; (2) electricity and fuel savings per NYSERDA dollar invested in the demonstration projects (this is a subset of the first metric); and (3) a qualitative assessment of whether participants considered their investments in the demonstrations worthwhile.

Table ES-8 shows the cost-effectiveness figures for combined demonstration and replication benefits. Overall, through 2013, the demonstration and replication projects saved or generated more than \$52 for every dollar that NYSERDA invested in its R&D demonstration portfolio. The revenue figure includes a single project that reported \$1.2 billion in sales. Even after removing this project from the analysis, cost-effectiveness is still positive, with \$6.69 in benefits for every dollar that NYSERDA spent.⁸ These figures represent the total cost savings and revenues achieved through 2013; in some cases, these benefits will continue into the future. However, the analysis was not able to account for costs that NYSERDA incurred for some of the replication projects. As such, the cost-effectiveness calculations in Table ES-8 only account for the \$22.7 million that NYSERDA invested in the demonstrations. If NYSERDA’s replication costs were included, this would lower the cost-effectiveness figures.

Table ES-8. Cost Effectiveness for Combined Demonstration and Replication Benefits

Benefit Type	Cost Effectiveness	Cost Effectiveness Adjusted (Outlier Removed)
Demonstration and Replication Cost Savings per NYSERDA \$	\$2.90	\$2.90
Demonstration and Replication Revenues per NYSERDA \$	\$50.09	\$3.80
Demonstration and Replication Dollars (Revenues and Cost Savings) per NYSERDA \$	\$52.98	\$6.69

The goals of NYSERDA’s R&D Program include public benefits ranging from improved system reliability to health and environmental improvements. While some demonstration projects may result in lower energy costs, cost-effective energy savings is not the main reason for NYSERDA funding these projects. Nonetheless, it can be useful to consider energy-cost savings within the context of the overall cost-effectiveness analysis. Therefore, the analysis estimated NYSERDA’s cost-effectiveness based on electricity savings (MWh) and fuel savings (therms).⁹ The analysis was conducted using a variety of scenarios, as shown in Tables ES-9 and ES-10. The scenario analysis considers two variables that determine the value of future energy savings: energy prices and technology lifespan. Forecasted energy prices are taken from the U.S. Energy Information Administration (EIA) *Annual Energy Outlook 2013* for the U.S. Middle Atlantic region, which includes New York State.¹⁰ The “medium” energy prices represent the EIA’s reference case; the “low” and “high” cases represent the EIA’s forecast under a lower-economic growth scenario and higher-growth scenario, respectively. The benefits also reflect whether the technologies or processes operate for one year, five years, 10 years, or 20 years. The survey did not ask about years of operation; however, NYSERDA’s experience has shown that many projects stay online longer than one year, while a 20-year lifetime might be longer than average.

⁸ NYSERDA spent \$22.7 million on 124 R&D demonstration projects that closed in 2008-2010, including surveyed and non-surveyed projects.

⁹ The study was not able to conduct a similar analysis for installed capacity (kW) given the available information. Installed capacity does not represent actual energy generated, but rather the ability to generate energy. Estimating the quantity of energy generated would require detailed information about each industry and each firm beyond the data collected in the survey.

¹⁰ The *Annual Energy Outlook 2013* report expresses energy prices in 2011 dollars.

Table ES-9. Estimated Electricity Savings from Demonstrations and Replications

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$3,085,079	\$3,977,218	\$3,969,997
5	\$15,341,045	\$18,640,532	\$18,989,436
10	\$30,996,681	\$37,215,246	\$38,395,173
20	\$61,751,985	\$74,688,518	\$77,979,418

Table ES-10. Estimated Fuel Savings from Demonstrations and Replications

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$91,911	\$101,175	\$101,175
5	\$450,535	\$496,131	\$500,795
10	\$930,576	\$1,023,183	\$1,042,365
20	\$2,000,873	\$2,195,079	\$2,264,397

The estimated electricity and fuel savings were summed to derive aggregate savings, and the aggregate savings were divided by NYSERDA’s costs to calculate cost effectiveness. As shown in Table ES-11, the benefits of electricity and fuel savings are expected to exceed NYSERDA’s investment in the demonstrations under the 10-year and 20-year scenarios (“low,” “medium,” and “high”). It should be noted that total savings (and therefore, cost effectiveness) may be understated as a result of some respondents not being able to quantify their energy savings. Therefore, the actual savings and cost effectiveness may be higher than the figures suggest. It is also important to note that energy cost savings are only a subset of the total cost savings presented in Table ES-8; as shown in that table, total cost savings and revenues exceed NYSERDA’s investment in the demonstration projects.

Table ES-11. Cost Effectiveness of Electricity/Fuel Savings from Demonstrations and Replications

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$0.14	\$0.18	\$0.18
5	\$0.70	\$0.84	\$0.86
10	\$1.41	\$1.69	\$1.74
20	\$2.81	\$3.39	\$3.54

The study also assessed cost-effectiveness from the firm’s perspective. Key findings include the following:

- Out of 61 respondents, 27 (44%) had considered alternative investments to the demonstration project. All but one of these respondents indicated that the demonstration was the best choice relative to the alternatives.
- A very strong majority (89%) indicated that the demonstration project was a good investment.
- A strong majority (79%) indicated that their return on investment was positive, 15% breakeven, and only 6% indicated that their return was negative.

The findings indicate that a strong majority of respondents considered the demonstration projects to be worthwhile investments.

Data limitations pose challenges for evaluating NYSERDA's R&D demonstration projects. Several projects were missing contact information or had either outdated or incorrect information. In other cases, the company contact was correct, but the Principal Investigator had moved on and could not be located. In addition, many respondents had difficulty recalling the benefits of projects that ended two or more years ago. The NYSERDA R&D Metrics Database does not currently include comprehensive benefits data, although this is expected to change over time. Final project reports are another potential source of benefits data, but they do not appear to be archived in a central location, and are difficult to retrieve.

ES.7 RECOMMENDATIONS

NYSERDA has committed to repeating the R&D demonstration survey at regular intervals to ensure the existence of a regularly updated, comparable set of information about NYSERDA's demonstration projects and associated replications. This survey and the previous round provided valuable information that can guide future survey efforts. Recommendations include the following:

Fully leverage information in the R&D Metrics Database and Final Project Reports. The R&D Metrics Database was created in 2009. It did not exist when the first survey was conducted, and it was not fully populated for the second (current) survey. Assuming these issues are addressed for future rounds, NYSERDA may be able to obtain benefits data for most or all projects before conducting the survey. The survey would then focus on validating the benefits data and obtaining information about replication projects. NYSERDA is currently planning for an evaluability assessment that would leverage and build on NYSERDA's previous database-building efforts, explore and categorize data from prior evaluations, and offer constructive input on issues that NYSERDA is still considering.

Interview all three types of participants for each demonstration project. Each NYSERDA demonstration project typically involves three categories of participants: 1) integrators who bring together market actors and "package" the project; 2) vendors who supply the technology, product, or process; and 3) site owners. The first two surveys interviewed a single type of respondent for each demonstration site – e.g., integrator, vendor, or site owner. Depending on available time and resources, NYSERDA may be able to survey all three types of participants for every site in future rounds. This would provide more comprehensive information about the benefits of NYSERDA's demonstrations.

Re-survey demonstration projects from prior rounds. The first two surveys focused on two distinct populations: projects completed in 2004-2007, and projects completed in 2008-2010. NYSERDA could consider re-surveying projects from 2004-2010, to learn whether demonstration benefits persisted and whether there have been any additional installations or sales of the demonstrated technology.

Clarify the definition of replication and track NYSERDA's replication costs. The first two R&D surveys defined replication projects broadly, and included replications with and without NYSERDA funding. However, NYSERDA is considering whether NYSERDA-funded replication projects should be "counted" as market replications. Going forward, NYSERDA should make a determination as to whether NYSERDA-funded replications will or will not be "counted" for the survey. If NYSERDA continues to include these projects, it should track the costs of each NYSERDA-funded replication in a way that can be traced back to the original demonstration. It would also be desirable to know whether these replications received funding from NYSERDA's R&D Program or NYSERDA's deployment programs. This information would provide a more comprehensive understanding of the demonstration-replication process and would allow for a more comprehensive assessment of NYSERDA's cost effectiveness.

Survey the replication sites. The first two rounds only surveyed demonstration participants, and asked if they were aware of any replication projects. Some respondents were unsure about the number of replications; others were unsure what specific benefits the replications had produced. Using a "snowball" survey technique, NYSERDA could ask demonstration respondents for "leads" at replication sites and follow up directly with the replicators. This would help verify the number of replications, quantify the

replication benefits, and understand the causal link between NYSERDA's demonstration projects and subsequent replications. In addition, the survey data could potentially be used to track changes in performance (such as installation costs, operating costs, sales volume, and return on investment) from the first replication to the fifth (or higher) replication.

Explore the impacts of knowledge creation. Sixty-two percent (62%) of respondents in the current survey identified knowledge creation as a direct benefit of their project – more than any other benefit category. NYSERDA could further explore the tangible and intangible benefits of knowledge creation in future rounds of the survey. For example, future surveys could ask respondents whether they have applied the knowledge they gained from the demonstration project in future projects or in their ongoing business practices. The survey could also inquire how the knowledge gained from the demonstration projects has affected their operations, productivity, and sales. In addition, if replicators are included in future rounds, the survey could ask whether they applied the knowledge, methods, or lessons from the demonstration projects – thereby tracing the transfer of knowledge from demonstration sites to replication sites – and their resulting changes in performance.

Section 1:

INTRODUCTION

This section begins with the background and purpose of the study. Next, it provides a brief overview of NYSERDA's Research and Development (R&D) Program, and offers definitions for demonstration and replication projects. The section concludes with the outline for the report.

1.1 BACKGROUND

NYSERDA's R&D Program employs a variety of approaches that aim to advance the development of innovative, reliable, efficient, and clean energy technologies, and increase their market acceptance and adoption. R&D demonstration projects are one of NYSERDA's best-established strategies for promoting these goals. These projects aim to demonstrate and obtain objective information on the technical performance, cost, and environmental impacts of emerging clean and energy-efficient technologies. Demonstration projects are designed to showcase the value and effectiveness of a new technology or process, or application of an existing technology in a commercial setting.

Demonstration projects cover a wide variety of technology areas and project types, including advanced materials, air and waste remediation, building systems, electric power delivery, energy storage, industrial products, heating and cooling, transportation, waste management, wastewater treatment, and others. While demonstration projects often generate benefits in their own right, these projects are designed to achieve additional impacts through successful replications.

In 2012, NYSERDA finalized the first study of its R&D demonstration projects.¹¹ The study was based on a survey and review of project records for projects that were completed between 2004 and 2007. The survey assessed: demonstration impacts, NYSERDA's influence on the demonstrations, replications and sales, demonstration influence on the replications, replication impacts, and participant satisfaction.

The current study updates the R&D demonstration survey with projects that were completed between 2008 and 2010. The survey was conducted on a census of all demonstration projects completed during the study period.

1.2 PURPOSE OF THE STUDY

The study has the following objectives:

- Estimate the resource savings (e.g., kW, MWh, etc.), revenues, cost savings, and other impacts resulting from NYSERDA-funded demonstrations and replication projects.
- Characterize the number, scale, and type of replication projects.
- Determine the factors that helped or hindered replication.
- Assess the cost-effectiveness of NYSERDA's R&D demonstration portfolio.
- Evaluate participant satisfaction with NYSERDA's R&D Program.

Audiences for the report's findings include: NYSERDA R&D directors, managers, and program staff, NYSERDA's Board of Directors and Officers, the New York State Department of Public Service, and other stakeholders with an interest in NYSERDA's R&D Program.

¹¹ *R&D Demonstration Survey Report*, prepared by Megdal & Associates, September 2012.

1.3 OVERVIEW OF NYSERDA R&D PROGRAM

The R&D demonstration projects covered in this report are an important part of NYSERDA's R&D Program and are aligned with the program's overarching goals. As articulated during the Systems Benefits Charge round three (SBC III) – which was in effect when the projects in this evaluation were completed¹² – overarching goals include the following:

- Improve New York's energy system reliability.
- Reduce the energy cost burden of New Yorkers.
- Mitigate the environmental and health impacts of energy use.
- Create economic opportunity and promote economic well-being.¹³

In pursuit of these goals, NYSERDA undertakes demonstration projects in a variety of program areas, organized under two departments. The R&D departments and program areas include the following:

End Use Application & Innovation

- Buildings Research
- Innovation & Business Development
- Manufacturing Technology & On-Site Power

Clean Energy Research & Market Development

- Energy Markets & Power Delivery
- Environment & Energy Resources
- Transportation & Power Systems

Under SBCIII, NYSERDA R&D also supported the Transmission and Distribution program. This is now part of the Energy Markets and Power Delivery program.

1.4 DEFINITION OF DEMONSTRATIONS AND REPLICATIONS

Demonstration projects are designed to test a new technology or a new application of an existing technology in order to accelerate commercialization, scale up production, or increase market adoption of successful technologies. Replication projects are a primary means by which demonstration projects achieve broader market impacts. This report characterizes demonstration and replication projects as follows:

- **Demonstrations** are defined as the demonstration of a new technology or process, or application of an existing technology in a commercial setting. Demonstration projects are designed to showcase the value and effectiveness of the technology or process being demonstrated. Given the breadth of projects across program areas, NYSERDA classifies demonstrations in three cross-cutting categories: (1) on-site power production, (2) on-site process improvement, and (3) product demonstration. Demonstration projects can be designed and proposed by three different types of market actors: (1) integrators, (2) site owners, and (3) vendors. Integrators bring together the other market actors to create or “package” the demonstration project. Vendors supply the technology for the project. Site owners own the location where the project is demonstrated, and may or may not be involved with implementing the project at their site.

¹² SBCIII covered the period from July 2006 through the end of 2011. In October 2011, the New York Public Service Commission extended the SBC program through the end of 2016. The SBC program is administered by NYSERDA.

¹³ NYSERDA. 2007. *SBC-Funded Research and Development (R&D) Program: Sector-level Program Logic*. Final Report. Prepared by GDS Associates, Inc. September 2007.

- **Replications** are defined somewhat differently depending on whether the market actor is an integrator, site owner, or vendor. For integrators and site owners, replication projects involve an additional installation or scaling up of the technology or process demonstrated under the NYSERDA-funded project. The replication could be at the same site as the NYSERDA demonstration project or at another site. Replications may be carried out by the same firm or a different firm than the original demonstration project. For vendors, replications are defined as additional sales of the same technology or services that were used in the NYSERDA-funded demonstration project. These additional sales could be to the same buyer that participated in the demonstration project or a different buyer. These definitions were provided to survey respondents to ensure consistency in responses.

1.5 OUTLINE OF REPORT

The remainder of this report presents the methods, findings, and conclusions for the R&D demonstration survey. The report is organized as follows:

- Methods and Analysis (Section 2) describes the survey implementation methodology, response rates, and methods for estimating NYSERDA's contribution to demonstration and replication impacts.
- Overview of NYSERDA Demonstration Projects (Section 3) provides an overview of the types of projects covered in the survey, prior experience with demonstration projects, whether the project objectives were achieved, and the benefits and challenges of planning and executing the project.
- Demonstration Impacts and NYSERDA's Contribution (Section 4) describes the quantity and distribution of impacts across demonstration projects, and estimates NYSERDA's contribution.
- Replications, Impacts, and Demonstration Influence (Section 5) describes the number and type of replications, their scale relative to the original demonstration projects, their estimated impacts, and the influence of the original demonstrations on the replications.
- Process Evaluation Results (Section 6) discusses participant satisfaction with NYSERDA's R&D Program as collected through process-related survey questions.
- Cost Effectiveness (Section 7) assesses the cost effectiveness of NYSERDA's R&D demonstration portfolio and summarizes participant feedback on the value of their investment.
- Conclusions and Recommendations (Section 8) presents overall conclusions and recommendations for future R&D demonstration surveys.

Section 2:

METHODS AND ANALYSIS

This section discusses the survey design process, sampling method, and framework for assessing NYSERDA's contribution to demonstration and replication projects.

2.1 SURVEY DESIGN AND IMPLEMENTATION

The R&D demonstration survey instrument, developed by IEC with input from NYSERDA evaluation and R&D staff, was designed to collect information about the benefits of demonstration projects, replications, NYSERDA's role, and satisfaction with NYSERDA's R&D program. The current instrument builds on the previous survey, but incorporates several refinements based on guidance from NYSERDA.

Differences between the previous and current survey include the following:

- Simplified language and sentence structure and “unpacked” compound questions into separate questions.
- Changed questions that asked for estimates of “lower bound,” “upper bound,” and “best estimate” percentages, to a simpler Likert Scale.
- Clarified the definition of replication, as described in Section 1.
- Added questions for qualitative measures of cost effectiveness.
- Replaced questions about “success” (which can unintentionally “lead” respondents to provide a favorable answer), to ask about the value of the project relative to the firm's other investment options.

The evaluators aimed to survey the individual that was most knowledgeable about each project. Since each project was unique, the type of person most knowledgeable about the impacts varied. The Principal Investigator (PI) listed in NYSERDA's R&D Metrics Database was assumed to be most knowledgeable and was the intended point of contact, but the survey allowed for a different respondent if the original PI was no longer with the firm, as long as that person was knowledgeable about the demonstration project. Depending on the project, the PI may be the integrator, vendor, or site owner. The database sometimes indicated the PI's role, but in many cases did not. As part of the scheduling process, APPRISE (IEC's survey subcontractor) determined whether the respondent was an integrator, vendor, or site owner to ensure that the appropriate survey instrument was used.

Although there were three separate survey instruments for integrators, vendors, and site owners, most of the questions in the three surveys were identical or extremely similar. The main difference between the surveys was the replication section. Specifically, the integrator and site owner surveys defined replication as *new installations or scaling up* of the demonstrated technology, while the vendor survey defined replication as additional *sales*. Other differences between the survey instruments were minor, and reflected differences in who was taking the survey (for example, the integrator survey asked about the respondent's interactions with vendors and site owners, while the site owner survey asked about interactions with integrators and vendors).

APPRISE pre-tested the survey with five respondents and IEC incorporated suggested revisions into the revised survey instruments. The most substantive change was in the benefits section. Although the previous survey classified benefits as “primary” or “secondary,” respondents for the five pre-tests typically responded in terms of “direct” or “indirect” benefits. Therefore, the benefits section was modified to employ the “direct/indirect” distinction.

On November 7, 2013, NYSERDA issued an advance notification to PIs selected to participate in the survey. The letter introduced the evaluation team, specified the project that the survey would focus on, and provided NYSERDA and IEC contact information for the PI to call if he or she had any questions.

Responses to this communication were shared by NYSERDA with the IEC project team to inform the screening and scheduling task.

The screening and scheduling calls began the week of November 11, 2013. Scheduling calls were attempted at least three times per week, at different times of day and on different days of the week. During scheduling, if a contact's voicemail was reached, a message was left. Every effort was made to connect with the original PI when possible, but if the listed PI was no longer available, referrals were followed. Up to 14 scheduling call attempts were made, with an average of five calls made per record during the screening period, which ended on December 23, 2013. While all surveys were scheduled by APPRISE, both IEC and APPRISE staff conducted them. Given the unique circumstances surrounding each demonstration project, the policy analysts who conducted the surveys were given the flexibility to tailor questions as necessary. The length of the surveys ranged from 25 to 90 minutes; the length varied based on the number of distinct benefits that the respondent could knowledgeably discuss, and whether or not the project resulted in replications. Respondents were not incentivized for their participation.

APPRISE developed an Access database to capture and quantify the in-depth survey data. The survey analysts entered their survey data into the database after completing the surveys. Analysts at IEC and APPRISE reviewed the data to ensure their accuracy and consistency. An IEC Associate conducted a thorough secondary review of the data, and an IEC Senior Associate conducted a final data quality check.

2.2 POPULATION AND SURVEY COMPLETIONS

The survey population was drawn from NYSERDA's R&D Metrics Database, which includes basic project information for all of NYSERDA's R&D demonstration projects. Because a primary goal of the evaluation was to identify replications, projects were subjected to two screening criteria: (1) The project demonstrated a technology or process that could conceivably be replicated (i.e., it was not basic research, and the project was not terminated prior to implementation); and (2) the project was completed at least two years ago, giving sufficient lead time for replications. Given the budget and timeline for this study, the survey was limited to projects that were not already surveyed in the previous round.

Based on these screening criteria,¹⁴ NYSERDA provided IEC with a sample frame containing 88 demonstration projects that were completed between 2008 and 2010.¹⁵ Two projects had incorrect contact information (and no new contact information was found), another six companies went bankrupt, and another project was later determined not to be a demonstration project; these projects had to be dropped from the sample frame. Therefore, the final sample frame for this study consisted of 79 demonstration projects. The evaluation team attempted to conduct a full census rather than drawing a sample from the 79 eligible projects. The sample was not stratified in any way.

The team made an extensive effort to minimize non-response bias and obtain as many completed surveys as possible, resulting in 61 completed surveys, as shown in Table 2-1. Of the 18 non-completions, five PIs refused, four were unresponsive, and nine were no longer with the same firm and could not be reached. Therefore, the response rate was 77% – the same response rate as for the previous R&D demonstration survey.¹⁶

¹⁴ Thirty-six projects did not meet the screening criteria and were therefore excluded, leaving 88 projects.

¹⁵ The R&D Metrics Database does not include the project completion date; therefore, the contract closed date was used as a proxy. This is consistent with the methodology from the previous survey. In some cases, project activities ended well before the contract was closed.

¹⁶ Excluding the nine PIs who had left their former firms and could not be reached from the sample frame would increase the response rate to 87%.

Table 2-1. Final Survey Disposition

Status	Count
Starting Number of Projects	88
Out of Sample Frame	9
Company Went Bankrupt, No PI Contact Information	6
Contact Information Was Incorrect, No New PI Contact Information	2
Not a Demonstration Project	1
In Sample Frame	79
Completions	61
Refusals	5
PI Not Responsive	4
PI No Longer with Firm, No Productive Referrals	9
Response Rate (61 completions out of 79 projects in sample frame)	77%
Adjusted Response Rate (61 completions out of 70 projects, excluding the 9 PI no longer with firm/no productive referrals)	87%

2.3 METHOD FOR ESTIMATING DEMONSTRATION PROJECT IMPACTS

While the survey was the primary method for estimating demonstration benefits, the evaluators also consulted NYSERDA’s R&D Metrics Database, Research Project Updates (RPU), and final project reports for the following information:

- **Survey.** Respondents were asked to report their benefits, or to confirm benefits data from the Metrics Database, RPU, or project reports. Respondents were asked the year(s) when benefits accrued to determine if benefits persisted after the project ended. While almost all respondents were able to describe their benefits in qualitative terms (e.g., power production, demand reduction, etc.), fewer were able to quantify the benefits. Many respondents stated that the quantifiable benefits were included in their final project reports to NYSERDA (see below), but could not recall the figures given the time that had elapsed since the project ended. Therefore, this evaluation presents the benefits data in two ways, qualitatively and quantitatively.¹⁷ Although the qualitative and quantitative results cannot be aggregated, the qualitative data suggests that total benefits likely exceed what the respondents were able to quantify.
- **R&D Metrics Database.** NYSERDA requires demonstration participants to submit an annual summary of metrics addressing the energy, environmental, and economic benefits of their projects, during and after project implementation.¹⁸ Since 2009, NYSERDA is collecting benefits data in an R&D Metrics Database. While the creation of the database is a positive development, the data are not as comprehensive as they could be. Out of 87 projects in the survey sample, eight

¹⁷ Qualitative results include respondents who were able to quantify their benefits *and* respondents who were not able to quantify their benefits.

¹⁸ The post-implementation reporting period varies by type of project.

had resource savings (energy, non-energy, or air emissions) captured in the database.¹⁹ Seven of these eight projects also reported net dollars (revenue generation or cost savings). Nine projects reported jobs created or retained, including five projects that reported resource savings and four projects that did not report resource savings. The evaluators used this information as a starting point, and attempted to verify the figures with survey respondents. Most of these respondents confirmed the accuracy of the figures; however, several of these same respondents reported additional benefits that were not in the R&D Metrics Database.

- **Reports.** NYSERDA requires most demonstration participants to submit final reports that describe the demonstration project and the benefits realized by the end of the project.²⁰ However, these reports do not seem to be archived in a central location. NYSERDA indicated that it was not possible to compile all of the reports within the short timeframe allotted for the survey. Therefore, APPRISE searched the Internet for published reports of the demonstration findings. In total, this search found 21 reports online, including 10 for which a survey was completed and 11 for projects where no survey was completed. In addition, the evaluators managed to obtain a limited number of reports prior to conducting the surveys, directly from the respondent or through a targeted Web search. Reports that were found prior to conducting a survey were used as a starting point for the discussion; in addition, 10 of the 11 reports for non-surveyed projects contained useable benefits data. IEC incorporated these data in the analysis of demonstration benefits. This report presents the findings in aggregate and separately for projects with and without a survey.
- **RPUs.** The RPUs describe the status of NYSERDA's R&D demonstration projects, and in some cases, information about actual or expected benefits. The evaluators reviewed the RPUs prior to conducting each survey and drew on relevant information.

2.4 METHOD FOR ESTIMATING REPLICATION PROJECT IMPACTS

A primary goal of the survey was to estimate the number of replication projects and their impacts. Integrators and site owners were asked to provide the number of replication projects; vendors were asked to provide the number and volume of sales. All respondents who reported at least one replication for a similar application in New York were asked how their replication impacts compared to the original demonstration impacts. Because replication projects are often implemented by a different firm than the original demonstration project, quantifying the impacts of replication projects can be quite challenging. Therefore, respondents were asked to consider the size of the replication impacts relative to the original demonstration impacts, which provides an indication of the scale of replication benefits without requiring a precise numeric estimate. Specifically, respondents were asked whether the replication impacts were lower, the same, or higher compared to the original demonstration project.

As shown in Table 2-2, a strong majority of respondents (79% excluding those who answered "Don't Know") stated that the replication benefits were *the same or higher* compared to the benefits of the original demonstration project. Similarly, 74% of respondents (excluding "Don't Know") stated that revenues generated or costs saved from the replications were *the same or higher* compared to the demonstration project. However, almost none of the respondents who reported "higher" replication impacts were not able to estimate *how much* higher the impacts were. Therefore, as a basis for deriving a quantitative estimate of the replication impacts, the evaluators assume that replication benefits are *equal*

¹⁹ An additional four projects had benefits information in the "notes" field.

²⁰ On-site power production projects are not typically required to submit a final report.

to the original demonstration benefits.²¹ Although this assumption will not hold for every project (and is, overall, a conservative assumption), it provides a lower-bound estimate of replication benefits that can be compared to the cost of NYSERDA's investment. If the benefits estimated under this conservative approach compare favorably with NYSERDA's costs, it increases confidence in the overall cost-effectiveness of the portfolio. Also, this conservative approach for estimating replication impacts is consistent with the method used in the previous survey.

Table 2-2. Comparison of Replication and Demonstration Impacts for Five Most Recent Replication Projects

	Comparison of Resource Savings (kW, MWh, Therms, Etc.) to Original Demonstration			Comparison of Revenue Generation and Cost Savings to Original Demonstration		
	Number	Percentage	Percentage Excluding "Don't Know"	Number	Percentage	Percentage Excluding "Don't Know"
Lower than Original Demo	5	5%	7%	6	7%	9%
The Same Size	18	19%	25%	17	18%	26%
Higher than Original Demo	39	42%	54%	31	34%	48%
Not Comparable	10	11%	14%	11	12%	17%
Don't Know	21	23%	--	27	29%	--
Total	93	100%	100%	92*	100%	100%

Notes: Respondents who reported at least one replication in New York were asked the questions in Table 3.2 for their *five most recent* replications. Because some respondents had more than five replications, the number of responses shown in Table 3-2 (n=93) is less than the total number of replications. (*) One respondent did not answer Q54.

2.5 METHOD FOR ESTIMATING NYSERDA'S CONTRIBUTION

An important element in impact assessment is separating impacts to which the program contributed from impacts that would have occurred without the program. The current survey uses a different methodology to accomplish this task than the previous survey. The previous survey calculated a "net-to-gross" ratio for the full set of surveyed projects, subtracting naturally occurring impacts ("free ridership") from the measured impacts. While this method is well-suited for traditional deployment programs, it is less conducive to measuring the impacts of R&D innovation projects. Therefore, NYSERDA requested IEC to develop an alternative methodology for estimating NYSERDA's contribution. This section summarizes the method developed by IEC, as presented in the approved Methods Document.²²

The analysis estimates NYSERDA's contribution based on a composite of five factors, which are in turn based on the respondent's answers to a number of survey questions:

- **Novelty:** Was this the first time that participants had demonstrated the technology?
 - *Q3. Is this the first time your firm used this technology? If no:*
 - *Q4. How many times had your firm used this technology prior to the demonstration project?*

²¹ For example, if a hypothetical demonstration project installed a 10-kW power production system, and the project was replicated 10 times, replication impacts are estimated as 100 kW.

²² IEC, *R&D Demonstration Project Survey Method*, November 9, 2013.

- *Q5. How did the demonstration project differ from previous uses of the technology?*
- **Importance:** How important was NYSERDA’s assistance in developing the demonstration projects?
 - *Q40: On a scale of 0 to 5, where 0 = “not at all important” and 5 = “very important,” how important or unimportant was NYSERDA’s financial assistance in your decision to do this project?*
 - *Q41: On a scale of 0 to 5, where 0 = “not at all important” and 5 = “very important,” how important or unimportant was NYSERDA’s technical assistance in your decision to do this project?²³*
- **Likelihood:** What is the likelihood that participants would have carried out the demonstration projects without NYSERDA?
 - *Q42: What is the likelihood that your firm would have completed this project in New York without NYSERDA’s financial assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.*
 - *Q43: What is the likelihood that your firm would have completed this project in New York without NYSERDA’s technical assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.²⁴*
- **Magnitude:** How did NYSERDA affect the magnitude of the impacts of the demonstration projects?
 - *Q44. Overall, without NYSERDA’s involvement, would the magnitude of the impacts for this project have been of the same size, smaller, or larger?*
- **Timing:** How did NYSERDA affect the timing of the demonstration projects?
 - *Q45. Without NYSERDA’s support, would you have carried out this project earlier, at about the same time, or later?*

Based on the respondent’s answers to the previous questions, the policy analysts who administered the survey calculated NYSERDA’s contribution score using the algorithm shown in Table 2-3.

The composite contribution score (Calculation #5 in Table 3-3) can range from -3 to +6. IEc converted the score to a percentage to estimate NYSERDA’s contribution, as follows:

- **-3, -2, -1, or 0:** NYSERDA contributed to *none* of the reported benefits (0%).
- **1 or 2:** NYSERDA contributed to a *modest* portion of the reported benefits (25%).
- **3:** NYSERDA contributed to a *moderate* portion of the reported benefits (50%).
- **4 or 5:** NYSERDA contributed to a *substantial* portion of the reported benefits (75%).
- **6:** NYSERDA contributed to *all* of the reported benefits (100%).²⁵

IEc multiplied NYSERDA’s contribution score for each project (expressed as a percentage) by the project’s reported benefits.²⁶ This calculation represents the best estimate of NYSERDA’s contribution to

²³ This question was only asked for respondents who indicated that NYSERDA provided technical assistance for the demonstration project (Q37).

²⁴ Again, this question was only asked for respondents who indicated that NYSERDA provided technical assistance for the demonstration project.

²⁵ If the contribution score was not an integer, the evaluators calculated the percentage as the midpoint between the two closest integers. For example, a contribution score of 5.5 was translated to 87.5% (the midpoint between 5 = 75% and 6 = 100%).

²⁶ For example, if a project installed a 100-kW system and had a composite contribution score of 3 (i.e., 50%), NYSERDA’s estimated contribution would be 50 kW (equals 50% of 100 kW).

each project. Summing these figures across all projects provides an estimate of NYSERDA's overall contribution. Given the uncertainties inherent in this type of analysis, the results are best interpreted as indicative of the general level and scale of NYSERDA's contribution, rather than a precise quantification of the benefits can be attributed directly to NYSERDA.

Table 2-3. Method for Calculating NYSERDA's Demonstration Contribution Score

Component	Survey Questions	Calculations
Novelty	Q3: Is this the first time your firm used this technology? <i>If no:</i> Q4: How many times had your firm used this technology prior to the demonstration project? Q5: How did the demonstration project differ from previous uses of the technology?	Calculation #1: If the firm had used the technology before, <i>and</i> the NYSERDA demonstration project was the same or smaller than the previous demonstrations, adjust downward by -1. Otherwise, the adjustment factor is 0.
Importance	Q40: On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's <i>financial</i> assistance in your decision to do this project? Q41: On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's <i>technical</i> assistance in your decision to do this project?	Calculation #2: Take the <i>higher</i> of the respondent's ratings for the importance of NYSERDA's financial assistance (Q40) and NYSERDA's technical assistance (Q41).
Likelihood	Q42: What is the likelihood that your firm would have completed this project in New York without NYSERDA's <i>financial</i> assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely. Q43: What is the likelihood that your firm would have completed this project in New York without NYSERDA's <i>technical</i> assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.	Calculation #3A: Take the <i>lower</i> of the respondent's ratings for financial assistance (Q42) and technical assistance (Q43). <i>If the firm did not receive technical assistance from NYSERDA, use Q42 only.</i> Calculation #3B: Now, take the inverse (e.g., 0 becomes 5, 1 becomes 4, etc.).
Magnitude	Q44: Overall, without NYSERDA's involvement, would the magnitude of the impacts for this project have been of the same size, smaller, or larger?	Calculation #4A: If the respondent indicates that the impacts of the demonstration project would have been the <i>same or larger</i> without NYSERDA's assistance, adjust downward by -1. Otherwise, make no further adjustment.
Timing	Q45: Without NYSERDA's support, would you have carried out this project earlier, at about the same time, or later?	Calculation #4B: If the respondent indicates that the project would have occurred earlier without NYSERDA, adjust downward by -1. If the project would have occurred at the same time, make no further adjustment. If the project would have occurred later, the adjustment factor is +1.
Demonstration Contribution Score	This is a composite score based on the previous questions. This calculation <i>averages</i> the respondent's assessment of the significance of NYSERDA's contribution and the likelihood of completing the project without NYSERDA, and adjusts by the factors noted above (i.e., comparable previous projects, magnitude of benefits, and timing).	Calculation #5: Take the <i>average</i> of calculations #2 and #3B, then add Calculations #1, #4A, and #4B to the total.

A similar method was used to estimate NYSERDA's contribution to replication benefits:

- **Importance:** How important was the demonstration project for developing the replication projects?

- Q58. On a scale of 0 to 5, where 0 = "strongly disagree" and 5 = "strongly agree," to what extent do you agree or disagree with the following statement: "Overall, the NYSERDA-funded demonstration project was critical for getting the replication project(s) developed."
- **Likelihood:** What is the likelihood that the replication projects would have been developed in New York without the demonstration project?
 - Q60. What is the likelihood that these replication projects would have been developed in New York without the NYSERDA-funded demonstration project? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.
- **Magnitude:** Would the impacts of the replication projects have been smaller without the demonstration projects?
 - Q61. Without the NYSERDA-funded demonstration project, would the magnitude of the impacts for these replication projects have been of the same size, smaller or larger?
- **Timing:** How did the demonstration project affect the timing of the replication projects?
 - Q62. Without the NYSERDA-funded demonstration project, would the replication projects have occurred sooner, at about the same time, or later?

Table 2-4 shows how the survey analysts calculated NYSERDA’s contribution to the replication projects, based on the respondent’s answers to the questions above.

Table 2-4. Method for Calculating NYSERDA’s Replication Contribution Score

Component	Survey Questions	Calculations
Magnitude	Q61: Without the NYSERDA-funded demonstration project, would the magnitude of the impacts for these replication projects have been of the same size, smaller or larger?	Calculation #6A: If the impacts of the replication project(s) would have been <i>the same or larger</i> without the demonstration project, adjust downward by -1. Otherwise, the adjustment factor is 0.
Timing	Q62. Without the NYSERDA-funded demonstration project, would the replication projects have occurred sooner, at about the same time, or later?	Calculation #6B: If the project would have occurred earlier without NYSERDA, adjust downward by -1. If the project would have occurred at the same time, the adjustment factor is 0. If the project would have occurred later, the adjustment factor is +1.
Likelihood	Q60. What is the likelihood that these replication projects would have been developed in New York without the NYSERDA-funded demonstration project? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.	Calculation #6C: Take the <i>inverse</i> of Q60.
Importance	Q58. On a scale of 0 to 5, where 0 = “strongly disagree” and 5 = “strongly agree,” to what extent do you agree or disagree with the following statement: “Overall, the NYSERDA-funded demonstration project was critical for getting the replication project(s) developed.”	Calculation #6D: Take the <i>average</i> of Q58 and Calculation #6C.
Replication Contribution Score	This is a composite score based on the previous questions.	Calculation #7: Add the results of Calculations #6A, #6B, #6D, and #1.

As with the demonstration score, the replication contribution score can range from -3 to +6. IEC converted the score to a percentage using the same method described above for the demonstration projects. For each replication project, IEC multiplied NYSERDA’s contribution (in percentage terms) by the estimated benefits of the replication.

2.6 METHOD FOR ESTIMATING COST EFFECTIVENESS

NYSERDA is interested in assessing the cost effectiveness of its R&D demonstration projects. This evaluation assesses cost effectiveness in two ways: quantitatively (from NYSERDA's perspective) and qualitatively (from the firm's perspective). These methods are explained below:

- **Quantitative (NYSERDA's perspective):** The previous survey was not able to calculate cost effectiveness because the cost data included only a subset of the demonstration projects. For the current round, NYSERDA asked IEC to consider methods for assessing cost effectiveness. To assess cost effectiveness quantitatively, the evaluators worked with NYSERDA to obtain comprehensive cost data for all R&D demonstration projects that were completed in 2008-2010. In total, NYSERDA spent \$22,683,039 on 124 R&D demonstrations that closed in 2008-2010. This figure includes the cost of the projects in the survey sample *and* demonstration projects that were not in the survey sample (e.g., terminated projects²⁷). IEC calculated the following metrics using the cost data and the benefits data described in the previous section:
 - NYSERDA cost per demonstration project revenues, adjusted for NYSERDA's estimated contribution.
 - NYSERDA cost per demonstration project cost savings, adjusted for NYSERDA's estimated contribution.
 - NYSERDA's cost per demonstration project net dollars; this is the sum of the two previous calculations.
 - All of the above including demonstration benefits *and* replication benefits. The cost-effectiveness calculation was not able to account for the costs that NYSERDA incurred for NYSERDA replication projects. Therefore, cost effectiveness was calculated separately for replications with and without NYSERDA funding.

In addition, IEC estimated the monetary value of electricity savings and fuel savings from the demonstration and replication projects, and the cost effectiveness of NYSERDA's investment relative to the estimated savings. To reflect different potential scenarios for future energy prices and technology lifespans, the analysis was carried out under a "low," "medium," and "high" scenario. The results of the scenario analysis are presented in Section 7.

- **Qualitative (firm's perspective):** Ideally, the evaluators would be able to calculate the "fully loaded" cost of the demonstration projects, including NYSERDA's costs and costs incurred by private firms. However, while the survey asked respondents for cost data, these data were not provided in a comprehensive or consistent way. Therefore, it was not possible to quantify firms' contributions to the demonstration projects. This was predictable given firms' general reluctance to share specific cost data with external parties. Therefore, the survey also included qualitative questions designed to assess the respondent's perceptions about cost effectiveness. Four questions were relevant for this analysis:
 - *Q12:* At the time the project began, were you considering alternatives to the ["product," "process," "technology," or "type of generation"] that you used in the NYSERDA project?
 - *Q13 (if "yes" to Q12):* Looking back, do you think the ["product," "process," "technology," or "type of generation"] that you used in the NYSERDA project was the best alternative?

²⁷ The cost reflects the money spent on the project (versus the original contracted amount). There are many projects that were terminated and the remaining funds were disencumbered.

Methods and Analysis

- *Q14*: Do you feel the [NYSERDA project description] project was a good investment?
- *Q15*: In general terms, how would you describe your return on this project – positive, negative, or breakeven/neutral?

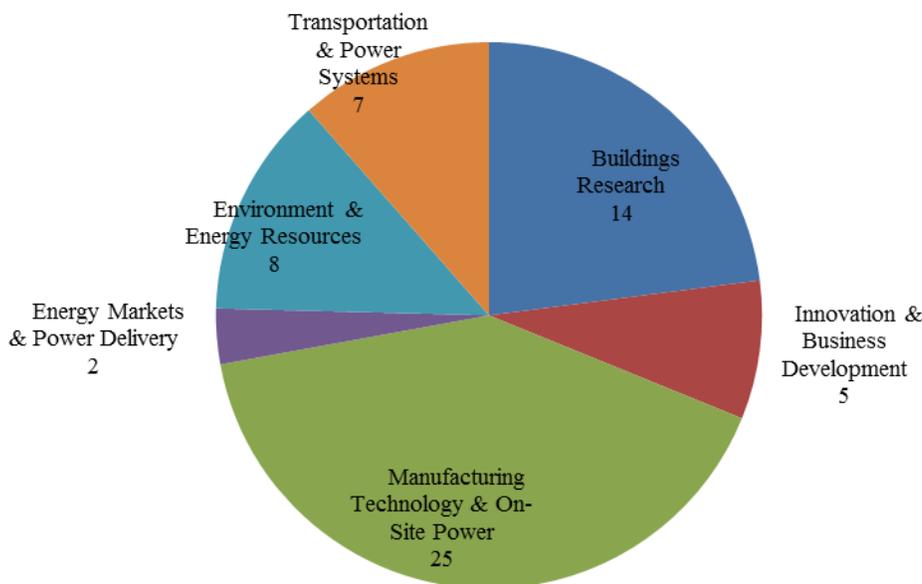
OVERVIEW OF NYSERDA DEMONSTRATION PROJECTS

This section provides an overview of demonstration projects with completed surveys in terms of program area, project type and market actor, prior experience with demonstration projects, and the benefits and challenges associated with planning and executing the projects.

3.1 NYSERDA PROJECT TYPES AND PARTICIPANTS

Figure 3-1 shows the distribution of survey respondents across NYSERDA’s R&D program areas. Overall, 72% of respondents had projects in the End Use Application & Innovation Department and the other 28% had projects in the Clean Energy Research & Market Development Department. In terms of specific program areas, Manufacturing Technology & On-site Power was the most common among survey respondents, followed by Buildings Research, Environment & Energy Resources, and Transportation & Power Systems.²⁸

Figure 3-1. Survey Respondents by NYSERDA Program Component (n=61)



Given the breadth of projects across programs, NYSERDA classifies demonstration projects into three distinct categories: on-site power production, on-site process improvement, and product demonstration. NYSERDA defines these categories in the following ways:²⁹

- **On-site Power Production:** These projects provide incentives for the on-site generation of power. They are intended to buy down the risk of installing clean energy equipment to increase

²⁸ Three of the seven Transportation & Power Systems projects were formerly classified under the now-closed Transmission & Distribution program.

²⁹ Definitions provided by NYSERDA in *Project Types and Groups* (undated file).

market penetration. Power systems funded in this category include: advanced distributed generation, biomass, combined heat and power, fuel cell, hydropower, photovoltaic, wind, and others.

- **On-site Process Improvement:** These projects are intended to demonstrate process efficiency at a particular site, typically (but not always) a manufacturing facility. Expected benefits include savings of energy, water, and other resources. There is a subset of process improvement projects where NYSERDA has worked with industry partners to develop new processes for their industries. Examples of process improvement projects include: paper drying by hot pressing, water recycling at a paperboard recycling plant, and improved plastic injection mold base.
- **Product Demonstration:** These projects involve the demonstration of a commercially available product in its intended environment (this does not include on-site power generation projects). The goal is to increase sales and usage of the demonstrated product in the market. Results are used for product commercialization or to generate objective performance information for policymakers or end-users. Products funded in this category encompass a wide range of technologies.

Table 3-1 shows the number and percent of survey respondents associated with each project type. All three project types are well-represented in the survey responses. Of the 61 respondents, 28 projects were product demonstrations, 18 were power production, and 15 were process improvement projects.

Table 3-1. Demonstration Survey Respondents by NYSERDA Project Type

Project Type	Number of Surveyed Projects	Percent of Surveyed Projects
On-site Power Production	18	29%
On-site Process Improvement	15	25%
Product Demonstration	28	46%
Total	61	100%

Demonstration projects can be designed and proposed by integrators, vendors, or site owners. For each project, only one of the three actors was solicited for the survey. As shown in Table 3-2, 70% of respondents were integrators, followed by vendors and site owners (15% each).

Table 3-2. Demonstration Survey Respondents by Participant Type

Project Type	Number of Surveyed Projects	Percent of Surveyed Projects
Integrator	43	70%
Vendor	9	15%
Site Owner	9	15%
Total	61	100%

3.2 EXPERIENCE WITH DEMONSTRATION PROJECTS PRIOR TO NYSERDA PROJECT

Initial survey questions covered prior experience with demonstrating the technology and a comparison of the prior demonstrations (if any) to the NYSERDA-funded demonstration. As shown in Table 3-3, a solid majority of respondents (44 projects, or 73%) stated that the NYSERDA project was their first time demonstrating the technology. Out of the 16 projects that had demonstrated the same technology before,

most were demonstrated once or twice prior to the NYSERDA project, while two projects had demonstrated the same technology more than a dozen times before.

Table 3-3. Number of Times the Technology was Demonstrated Prior to NYSERDA-Funded Project

Number of Times the Technology was Demonstrated Prior to the NYSERDA-Funded Project	Number of Projects (n=60)*	Percent of Projects
Not At All	44	73%
Technology Was Previously Demonstrated	16	27%
1 or 2 times	6	
3 to 4	1	
5 to 6	3	
7 to 12	0	
More than 12	2	
Don't Know/Did Not Specify How Many Times Previously Demonstrated	4	

Notes (*): One respondent did not answer the questions about prior demonstrations.

Respondents who had previously demonstrated the same technology were asked to provide additional information regarding the differences (if any) between the NYSERDA project and their previous demonstrations. As shown in Table 3-4, only two respondents indicated that their prior demonstrations were basically the same as the NYSERDA demonstration. Half of the respondents who had conducted prior demonstrations stated that the NYSERDA project involved a different application of the technology. Four respondents indicated that the NYSERDA demonstration project was larger in scale or used different inputs than their previous projects. The three “other” responses were as follows:

- One NYSERDA project involved a different method of generating electricity.
- Another NYSERDA project involved testing/quality assurance for an existing product.
- The third project involved new equipment that increased productivity and energy efficiency.

Table 3-4. Scope of NYSERDA Demonstration Project in Comparison to Previous Demonstrations

Response	Number of Projects* (n=16)	Percent
No Difference	2	13%
Smaller in Scale Than Previous Demonstrations	0	0%
Larger in Scale Than Previous Demonstrations	2	13%
Different Inputs	2	13%
Different Application of the Technology	8	50%
Other	3	19%

Notes (*): Multiple responses were allowed. The responses reflect the 16 projects with prior demonstration projects and percentages are calculated based on these 16 projects.

3.3 BENEFITS AND CHALLENGES

R&D efforts involve new and previously untested technologies where success is not assured. Therefore, the survey included a question to ascertain whether the demonstration projects accomplished their objectives. As shown in Table 3-5, 90% of respondents stated that their projects met “all” or “most” of their objectives, with over half of all projects meeting all of their objectives. Only one respondent reported meeting none of the project objectives.

Table 3-5. Extent to Which Demonstration Projects Achieved their Objectives

	Number of Projects (n=61)	Percent
All	33	54%
Most	22	36%
Some	4	7%
None	1	2%
No answer	1	2%
Total	61	100%

Respondents whose projects did *not* meet *all* of their objectives were asked to explain why. Typical answers included variations on the following themes:

- Operating and maintenance costs were higher than expected.
- Expected energy savings or productivity gains were lower than expected.
- Acceptance by the target market was lower than expected.
- The project is still evolving and not all objectives have been accomplished yet.

The survey also investigated the benefits and challenges encountered by respondents in the process of planning and executing their projects. The benefits questions, which were added to the current survey, allowed for open-ended responses. Many respondents cited the new knowledge or experience gained with different technologies, market actors, or regulators as benefits. The range of benefits from planning and executing the projects is broad and includes the following:

- Gained knowledge about a different technology, process, method, or approach.
- Gained valuable experience working with manufacturers, regulators, and market actors.
- Gained technical knowledge from working with experts in the field.
- Research conducted during the planning phase set the stage for a commercial project.
- Established contacts with the community and potential business partners.
- Gained knowledge about the business and the market.
- Enhanced the company’s credibility or reputation.
- Learned more about NYSERDA and developed a stronger relationship.

The questions about challenges were close-ended and used similar answer choices as the previous survey. Technological and regulatory barriers were the most common responses at 26% and 20%, respectively, as shown in Table 3-6. Several respondents identified cost (7%), lack of interest among potential end users

(5%), and difficulty finding an appropriate site (5%). Only two respondents identified lack of qualified personnel or expertise, and only one respondent identified lack of funding or timing.

Table 3-6. Challenges in Implementing the NYSERDA Demonstration Project

Challenge	Number of Projects* (n=61)	Percent
Technological barriers	16	26%
Regulatory barriers	12	20%
Cost prohibitive	4	7%
Lack of interest among potential end users	3	5%
Could not find an appropriate site	3	5%
Lack of qualified personnel or expertise	2	3%
Lack of funding	1	2%
Timing was not right	1	2%
Other	15	25%

Notes (*): Multiple responses were allowed. The percentages are calculated based on the 61 projects.

As shown in the previous table, one-fourth of all respondents cited “other” barriers, reflecting the diverse suite of projects in NYSERDA’s R&D portfolio. “Other” challenges included the following:

- Lack of coordination or cooperation from various market actors or end users.
- Construction-related challenges.
- Challenges procuring necessary equipment.
- Administrative difficulties.
- Difficulty writing the NYSERDA funding proposal (one respondent).

Section 4:

DEMONSTRATION IMPACTS AND NYSERDA CONTRIBUTION

This section describes the types of impacts reported by demonstration participants, and quantifies these impacts where possible using the survey responses and R&D metrics data. It also describes NYSERDA’s influence on the development of the projects and estimates NYSERDA’s contribution to reported impacts.

4.1 TYPES OF IMPACTS

The survey was designed to make the fullest possible use of the information in NYSERDA’s R&D Metrics Database. Survey respondents whose projects had data in the Metrics Database were asked to confirm the types of benefits reported. Most of these respondents validated the accuracy of the data; however, several mentioned additional benefits that were not captured in the R&D Metrics Database. This is not unexpected given the broad variety of potential benefits generated by the projects.

Table 4-1 shows the distribution of direct benefits among the surveyed demonstration projects. The single most commonly identified benefit was knowledge creation (62%), which is consistent with the technical expertise, market intelligence, and valuable experience reported in other questions about demonstration projects. Notably, even respondents whose projects did not accomplish their financial objectives found the projects worthwhile due to the knowledge generated. In terms of resource savings, over half of respondents (56%) identified energy efficiency as a direct benefit.

Table 4-1. Direct Benefits by Project Type

Benefit Type	Number of Projects (n = 61)*	Percent	By Project Type		
			On-site Power Production	On-site Process Improvement	Product Demonstration
Knowledge Creation	38	62%	12	11	15
Energy Efficiency	34	56%	8	10	16
Demand Reduction	30	49%	14	5	11
Environmental Quality Improvement	28	46%	10	6	12
Power Production	23	38%	15	1	7
Marketability	23	38%	6	6	11
Product Quality/Reliability Improvement	21	34%	5	8	8
Productivity	20	33%	3	10	7
Air Emissions	19	31%	9	4	6
Operations & Maintenance	18	30%	3	6	9
Waste Management	15	25%	6	6	3
Reduced Material Costs	11	18%	3	5	3
Reduced Labor Costs	10	16%	1	5	4
Water Quality	9	15%	1	1	7
Water Reductions	7	11%	2	2	3
Other	18	30%	3	2	13

Notes: (*) Multiple responses were allowed. Percentages were calculated out of the 61 projects.

As shown in the previous table, 18 projects (30%) identified “other” benefits. The other benefits were very wide-ranging and included the following:

- Capital avoidance; cost savings; and lower bills.³⁰
- Improved safety.
- Increased the town’s tax base.
- Reduced processing time.
- End-user behavioral changes.
- Temperature control.
- Public health.
- Customer education.
- Media visibility.
- Favorable regulatory ruling.
- Learned about the advantages and disadvantages of a new technology.
- Implemented a sound new technology.
- Downstream effects of the demonstration project.
- Established a new program that supports an emerging technology.
- Permanent avoidance of greenhouse gas associated with building heating.
- Peace of mind to farmers.

Respondents were also asked to describe the indirect benefits of their projects. Indirect benefits include secondary or downstream benefits resulting from the direct project benefits. For example, as shown in Table 4-2, 25% of respondents cited environmental quality improvement and reduced air emissions, which are indirect benefits resulting from energy efficiency and demand reduction.

Table 4-2. Indirect Benefits by Project Type

Benefit Type	Total	Percent	By Project Type		
			On-site Power Production	On-site Process Improvement	Product Demonstration
Environmental Quality Improvement	15	25%	4	4	7
Reduced Air Emissions	15	25%	2	4	9
Marketability	11	18%	7	3	1
Product Quality/Reliability Improvement	6	10%	2	1	3
Operations & Maintenance	6	10%	2	1	3
Reduced Material Costs	5	8%	1	1	3
Energy Efficiency	5	8%	2	2	1
Waste Management	4	7%	1	0	3
Reduced Labor Costs	3	5%	1	1	1
Water Reductions	2	3%	1	0	1
Power Production	1	2%	0	0	1
Demand Reduction	1	2%	0	1	0
Knowledge Creation	1	2%	0	0	1
Productivity	1	2%	1	0	0
Water Quality	1	2%	1	0	0

Notes: (*) Multiple responses were allowed. Percentages were calculated out of the 61 projects.

³⁰ As discussed in Section 4.3, many other respondents identified “cost savings” when asked about this in a subsequent question.

4.2 QUANTIFIABLE IMPACTS OF DEMONSTRATION PROJECTS

Given the broad range of projects and benefit types, summarizing the benefits of NYSERDA's R&D demonstration projects in a limited number of metrics is challenging. The challenge is compounded by the time that elapsed since projects were completed, which makes it difficult for respondents to recall the precise benefits that their projects produced. Respondents with data in the R&D Metrics Database were asked to confirm or amend the data; however, most respondents did not have metrics data. Therefore, respondents were asked to provide their best estimate of the impacts. In addition, the limited number of project reports found online was used to supplement the survey data.

Based on the responses, benefits were quantified using three metrics: installed capacity (kW), energy savings (MWh/year), and fuel savings (therms/year). Tables 4.3 – 4.5 present the results of this analysis.

The columns on the left side of the tables show the number of survey responses by project type, the number of surveyed projects that were able to quantify each impact, and the quantity of impacts reported. It is possible that additional projects beyond those shown in the tables had impacts, but there were no data to quantify their benefits.

The columns on the right side of the tables show the number of non-surveyed projects that estimated each impact and the quantity of impact; the last column sums the impacts from surveyed and non-surveyed projects.³¹ For example, of the 28 product demonstration projects that completed the survey, four projects estimated energy savings totaling 400 MWh/year. In addition, one non-surveyed product demonstration project reported energy savings of 5,800 MWh/year. Summing the benefits of the surveyed and non-surveyed projects yields 6,200 MWh/year, as shown in the last column. On-site power production accounted for half of the projects that quantified their energy savings and 75% of the total energy savings.

Table 4-3. Summary of Energy Savings from Demonstration Projects

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Energy Savings*	Energy Savings of Surveyed Projects (MWh/Year)	Number of Non-Surveyed Projects with Estimated Energy Savings	Energy Savings of Non-Surveyed Projects (MWh/Year)	Total Energy Savings (MWh/Year)
On-site Power Production	18	7	21,098	0	0	21,098
On-site Process Improvement	15	1	685	1	3	688
Product Demonstration	28	4	400	1	5,800	6,200
Total	61	12	22,183	2	5,803	27,986

Note: (*) This table shows the projects that reported quantitative impact data (MWh/year).

³¹ The data source for non-surveyed projects is a limited number of project reports found online. The data could not be confirmed with respondents. The data do not include benefits that may have accrued since projects were completed or replication benefits. This also includes one project with benefits data in the R&D Metrics Database that did not take the survey.

Another eight projects reported energy savings as efficiency improvements in percentage terms. The percent savings varied from 3% to 49%. However, in the absence of data about their baseline and current energy use, it is not possible to quantify the absolute impacts.

Table 4-4. Summary of Installed Capacity Impacts from Demonstration Projects

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Installed Capacity*	Installed Capacity of Surveyed Projects (kW)	Number of Non-Surveyed Projects with Estimated Installed Capacity	Installed Capacity of Non-Surveyed Projects (kW)	Total Installed Capacity (kW)
On-site Power Production	18	6	4,568	0	0	4,568
On-site Process Improvement	15	1	100	0	0	100
Product Demonstration	28	1	2	1	715	717
Total	61	8	4,670	1	715	5,385

Note: (*) This table shows the projects that reported quantitative impact data (installed kW).

Table 4-5. Summary of Fuel Savings from Demonstration Projects

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Fuel Savings*	Fuel Savings of Surveyed Projects (Therms/Year)	Number of Non-Surveyed Projects with Estimated Fuel Savings	Fuel Savings of Non-Surveyed Projects (Therms/Year)	Total Fuel Savings (Therms/Year)
On-site Power Production	18	0	0	0	0	0
On-site Process Improvement	15	2	41,600	2	30,582	72,182
Product Demonstration	28	3	17,204	0	0	17,204
Total	61	5	58,804	2	30,582	89,386

Note: (*) This table shows the projects that reported quantitative impact data (therms/year).

In addition to the standardized impacts shown above, 19 projects reported alternative impact metrics. Some of these alternative impacts include the following:

- Two projects reported combined annual reductions of 4,720 tons carbon dioxide and one project reported annual reductions of 4,060 English tons carbon dioxide.
- One project reported reductions of 0.72 English tons carbon monoxide, reductions of 5.32 English tons nitrogen oxides, and reductions of 0.04 English tons sulfur dioxide.³²
- One project reported annual reductions of 55.2 million cubic feet biogas.
- One project reported annual revenues of \$367 per cow.
- One project reported an increase of 900 degrees Fahrenheit in its manufacturing process.

³² This is one of the two projects that reported carbon dioxide reductions in the previous bullet point.

- One project reported average annual water savings of 753,287 gallons.
- One project reported a 30% improvement in productivity.

4.3 REVENUES AND COST SAVINGS OF DEMONSTRATION PROJECTS

This study also evaluated revenues and cost savings that the demonstration projects achieved through 2013. NYSERDA’s R&D Metrics Database includes some revenue and cost savings data, and the survey included questions to confirm the metrics data or collect new information. This approach was similar to the method used for estimating impacts.

As shown in Table 4-6, 10 surveyed projects and one non-surveyed project quantified the revenues associated with the demonstration project, with total revenues exceeding \$1.2 billion. This impressive figure is mostly due to a single project that reported \$1.2 billion in sales that the respondent attributed to the demonstration project.³³ This type of revenue distribution is typical for R&D portfolios, where one or two very successful projects often account for the majority of the portfolio’s benefits.

Table 4-6. Summary of Revenue Generated from Demonstration Projects

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Revenue	Total Revenue of Surveyed Projects	Number of Non-Surveyed Projects with Estimated Revenue	Total Revenue of Non-Surveyed Projects	Total Revenue
On-site Power Production	18	5	\$5,742,841	0	\$0	\$5,742,841
On-site Process Improvement	15	2	\$1,200,090,000	1	\$120,000	\$1,200,210,000
Product Demonstration	28	3	\$15,260,000	0	\$0	\$15,260,000
Total	61	10	\$1,221,092,841	1	\$120,000	\$1,221,212,841

As shown in Table 4-7, 25 surveyed projects and seven non-surveyed projects quantified the cost savings associated with the demonstrations. Total cost savings were estimated at \$38.2 million. This figure includes energy cost savings as well as cost savings resulting from enhanced productivity and efficiency.

³³ Given the magnitude of the reported revenue for this one firm, the evaluators validated the figure by: (1) following up directly with the respondent after the initial survey to ensure that the respondent had understood the question and answered it correctly; and (2) cross-checking the survey data with the information contained in the final project report.

Table 4-1. Summary of Cost Savings from NYSERDA Demonstration Projects

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Cost Savings	Total Cost Savings of Surveyed Projects	Number of Non-Surveyed Projects with Estimated Cost Savings	Total Cost Savings of Non-Surveyed Projects	Total Cost Savings
On-site Power Production	18	9	\$14,680,938	1	\$2,000,000	\$16,680,938
On-site Process Improvement	15	6	\$13,857,392	4	\$2,046,229	\$15,903,621
Product Demonstration	28	10	\$5,332,558	2	\$325,700	\$5,658,258
Total	61	25	\$33,870,888	7	\$4,371,929	\$38,242,817

It is important to note that the tables above only capture revenues and cost savings achieved at the time the survey was conducted or (in the case of non-surveyed projects) when the final report was submitted. Several respondents indicated that revenues and cost savings are expected to continue. Therefore, total revenues and cost savings should continue to grow over time.

4.4 NYSERDA INFLUENCE ON THE DEMONSTRATIONS

The survey included a number of questions to assess NYSERDA’s influence on the demonstration projects. An initial question aimed to establish the chronology of events by documenting when respondents first learned about NYSERDA’s R&D Program. The earlier in the project respondents learned about the program, the more likely it is that NYSERDA influenced the design of the project. As shown in Table 4-8, 77% of respondents learned about the program prior to planning their demonstration projects, and 13% learned about it during the planning phase. Only two projects (3%) learned about the program after starting implementation. While these figures do not by themselves establish NYSERDA’s influence, the timing is consistent with NYSERDA contributing to the development of the projects.

Table 4-8. When Firms Learned About NYSERDA R&D Program

Response	Number of Projects (n=61)	Percent of Projects	Adjusted Percent of Projects
Prior to Planning	47	77%	82%
During Planning	8	13%	14%
After Finalizing Plans	0	0%	0%
After Starting Implementation	2	3%	4%
Don’t Know	4	7%	--
Total	61	100%	100%

Respondents were asked to rate the importance of NYSERDA’s financial and technical assistance in their decision to undertake the demonstration project. As shown in Table 4-9, 94% of respondents rated NYSERDA’s financial assistance as a 4 or 5 out of 5.0. The average rating for this question was 4.8 out of 5.0. The responses indicate that NYSERDA’s financial assistance was influential in the firms’ decision to develop the demonstration projects.

Table 4-9. Importance of NYSERDA’s Financial Assistance in Decision to Undertake the Project

	Not At All Important					Very Important
	0	1	2	3	4	5
Number of Projects (n=61)	0	0	0	4	6	51
Percent of Projects	0%	0%	0%	6%	10%	84%

Out of 61 projects, 17 respondents indicated that they received NYSERDA’s technical assistance. As shown in Table 4-10, the perceived importance of NYSERDA’s technical assistance was more varied than financial assistance, with 42% of respondents rating technical assistance a 4 or 5. The average score for respondents who answered the question was 3.2.

Table 4-10. Importance of NYSERDA’s Technical Assistance in Decision to Undertake the Project

	Not At All Important					Very Important
	0	1	2	3	4	5
Number of Projects (n=17)	1	1	2	6	3	4
Percent of Projects (out of 17)	6%	6%	12%	35%	18%	24%

To provide a broader context for assessing NYSERDA’s influence on the demonstration projects, respondents were asked to consider other organizations that provided funding and technical assistance. As shown in Table 4-11, 36 projects (59%) received funding from other sources, in combination with technical assistance or alone. Respondents received nearly \$18.6 million in funding from a variety of sources, including non-profits, federal agencies, state agencies, institutions, and corporations. An even higher percentage of respondents (69%) received technical assistance from other organizations, either alone or in combination with financial assistance. Technical assistance providers included engineering firms, utilities, building and design firms, universities, manufacturers, and other entities. While these findings indicate that NYSERDA was not the only contributor, they do not indicate the extent to which NYSERDA’s contribution mattered. By design, NYSERDA’s R&D Program aims to be a catalyst rather than the sole actor; therefore, the program’s overall influence may not be directly proportional to the share of funding or other assistance provided by NYSERDA.

Table 4-2. Non-NYSERDA Funding and Technical Assistance

Assistance Type	Number of Projects (n=61)	Percent of Projects	Adjusted Percent of Projects
Funding Only	8	13%	14%
Technical Assistance Only	14	23%	24%
Both Funding and Technical Assistance	28	46%	48%
No Additional Funding or Technical Assistance	8	13%	14%
Don't Know*	3	5%	--
Total	61	100%	100%

Notes: (*) "Don't Know" includes one respondent who received technical assistance but did not know if other sources provided funding, plus two respondents who did not receive funding and were unsure if they received technical assistance.

To better understand NYSERDA's influence on the demonstrations, respondents answered questions about the likelihood of completing the project in New York State without NYSERDA. As shown in Table 4-12, 64% of respondents rated the likelihood of completing the project in New York without NYSERDA's assistance a 0 or 1 out of 5.0. The average rating was 1.2. This suggests that NYSERDA's financial assistance was an important factor in developing the demonstrations in New York. As shown in Table 4-13, the likelihood of completing the project without NYSERDA's technical assistance was more varied with 24% of respondents out of the 17 that received technical assistance giving a 0 or 1 rating. The average rating was 3.

Table 4-12. Likelihood of Completing the Project in NYS without NYSERDA's Financial Assistance

	Not At All Likely					Very Likely
	0	1	2	3	4	5
Number of Projects (n=61)	29	10	9	8	2	3
Percent of Projects	48%	16%	15%	13%	3%	5%

Table 4-13. Likelihood of Completing the Project in NYS without NYSERDA's Technical Assistance

	Not At All Likely					Very Likely
	0	1	2	3	4	5
Number of Projects (n=17)	3	1	0	6	3	4
Percent of Projects (out of 17)	18%	6%	0%	35%	18%	24%

Next, respondents answered questions about how NYSERDA affected the magnitude of project impacts and project timing. As shown in Table 4-14, 75% of respondents stated that projects would have happened on a smaller scale (34%) or not at all (41%) without NYSERDA. As shown in Table 4-15, a similar percentage of respondents (78%) indicated that their projects would have happened later (34%) or not at all (44%) without NYSERDA. Respondents who stated that the project would have happened later were asked to estimate how much later; the average response was 2.6 years. These responses suggest that NYSERDA played an important role in accelerating the projects and enhancing their impacts.

Table 4-14. Estimated Project Impacts Without NYSERDA

Response	Number of Projects (n=61)	Percent of Projects	Adjusted Percent of Projects
Same without NYSERDA	13	21%	22%
Smaller without NYSERDA	21	34%	36%
Larger without NYSERDA	0	0%	0%
Project Would Not Have Happened without NYSERDA	25	41%	42%
Don't Know	2	3%	--
Total	61	100%	100%

Table 4-15. NYSERDA's Effect on Project Timing

Response	Number of Projects (n=61)	Percent of Projects	Adjusted Percent of Projects
Earlier without NYSERDA	1	2%	2%
About the Same Time	11	18%	18%
Later (Average: 2.6 years Later)	21	34%	35%
Project Would Not Have Happened without NYSERDA	27	44%	45%
Don't Know	1	2%	--
Total	61	100%	100%

These findings are validated by a subsequent survey question that asked about NYSERDA's role as a catalyst for demonstration projects. As shown in Table 4-16, 95% of survey respondents indicated their agreement (4 or 5 out of 5.0) with the statement: "NYSERDA's credibility is an important catalyst for demonstration projects in New York." The average rating was 4.7. These findings indicate that NYSERDA played an important role in the development of the R&D demonstration projects.

Table 4-16. Importance of NYSERDA’s Credibility as a Catalyst for Demonstrations in New York

	Strongly Disagree					Strongly Agree
	0	1	2	3	4	5
Number of Projects (n=61)	0	0	1	2	13	45
Percent of Projects	0%	0%	2%	3%	21%	74%

4.5 NYSERDA CONTRIBUTION TO R&D DEMONSTRATION IMPACTS

Using the influence questions shown above and experience with prior demonstrations, a contribution score was derived for each demonstration project. The score is a composite of five factors that reflect NYSERDA’s influence.³⁴ The average contribution score across demonstration projects was 5.0 out of 6.0.³⁵ The contribution score for each project was converted to a percentage and applied to the impacts reported for each project.³⁶ For example, a contribution score of 5.0 translates to 75%.

Table 4-17 through Table 4-19 show that NYSERDA contributed to 21,838 MWh/year in energy savings, 4,601 kW installed capacity, and 57,866 therms in fuel savings. Given the uncertainties inherent in this type of analysis, the results are best interpreted as indicating the general scale of NYSERDA’s contribution rather than a precise quantification of impacts that can be directly attributed to NYSERDA.

Table 4-3. Summary of NYSERDA Contribution to Energy Savings

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Energy Savings	Energy Savings of Surveyed Projects (MWh/Year)	Number of Non-Surveyed Projects with Estimated Energy Savings	Energy Savings of Non-Surveyed Projects (MWh/Year)	Total Energy Savings (MWh/Year)	NYSERDA Contribution (MWh/Year)
On-site Power Production	18	7	21,098	0	0	21,098	17,062
On-site Process Improvement	15	1	685	1	3	688	88
Product Demonstration	28	4	400	1	5,800	6,200	4,688
Total	61	12	22,183	2	5,803	27,986	21,838

³⁴ The method used to calculate the contribution score is described in Section 2.5.

³⁵ This is the simple average across projects and is shown for illustrative purposes only. It does not account for the relative size of benefits reported by each project, and therefore cannot be applied to total reported benefits. Instead, the analysis calculates the contribution separately for each project based on the project’s reported benefits and the project’s individual contribution score.

³⁶ The contribution score for non-surveyed projects was estimated as the average contribution score for the project type.

Table 4-4. Summary of NYSERDA Contribution to Installed Capacity

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Installed Capacity	Installed Capacity of Surveyed Projects (kW)	Number of Non-Surveyed Projects with Estimated Installed Capacity	Installed Capacity of Non-Surveyed Projects (kW)	Total Installed Capacity (kW)	NYSERDA Contribution (kW)
On-site Power Production	18	6	4,568	0	0	4,568	3,988
On-site Process Improvement	15	1	100	0	0	100	75
Product Demonstration	28	1	2	1	715	717	538
Total	61	8	4,670	1	715	5,385	4,601

Table 4-5. Summary of NYSERDA Contribution to Fuel Savings

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Fuel Savings	Fuel Savings of Surveyed Projects (Therms/Year)	Number of Non-Surveyed Projects with Estimated Fuel Savings	Fuel Savings of Non-Surveyed Projects (Therms/Year)	Total Annual Fuel Savings (Therms/Year)	NYSERDA Contribution (Therms/Year)
On-site Power Production	18	0	0	0	0	0	0
On-site Process Improvement	15	2	41,600	2	30,582	72,182	44,137
Product Demonstration	28	3	17,204	0	0	17,204	13,729
Total	61	5	58,804	2	30,582	89,386	57,866

Using the same project contribution scores and percentages derived above, the study estimated NYSERDA’s contribution to demonstration revenues and cost savings. Tables 4-20 and 4-21 show that NYSERDA contributed to \$1.1 billion in revenues and \$23.8 million in cost savings. As discussed in Section 4.3, the revenues are mostly attributable to one project.

Table 4-20. Summary of NYSERDA Contribution to Demonstration Revenues

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Revenue	Total Revenue of Surveyed Projects	Number of Non-Surveyed Projects with Estimated Revenue	Total Revenue of Non-Surveyed Projects	Total Revenue	NYSERDA Contribution
On-site Power Production	18	5	\$5,742,841	0	\$0	\$5,742,841	\$3,194,233
On-site Process Improvement	15	2	\$1,200,090,000	1	\$120,000	\$1,200,210,000	\$1,050,180,000
Product Demonstration	28	3	\$15,260,000	0	\$0	\$15,260,000	\$9,590,000
Total	61	10	\$1,221,092,841	1	\$120,000	\$1,221,212,841	\$1,062,964,233

Table 4-21. Summary of NYSERDA Contribution to Demonstration Cost Savings

Project Type	Number of Surveyed Projects	Number of Surveyed Projects with Estimated Cost Savings	Total Cost Savings of Surveyed Projects	Number of Non-Surveyed Projects with Estimated Cost Savings	Total Cost Savings of Non-Surveyed Projects	Total Cost Savings	NYSERDA Contribution
On-site Power Production	18	9	\$14,680,938	1	\$2,000,000	\$16,680,938	\$11,748,933
On-site Process Improvement	15	6	\$13,857,392	4	\$2,046,229	\$15,903,621	\$8,514,463
Product Demonstration	28	10	\$5,332,558	2	\$325,700	\$5,658,258	\$3,545,264
Total	61	25	\$33,870,888	7	\$4,371,929	\$38,242,817	\$23,808,660

REPLICATIONS, IMPACTS, AND DEMONSTRATION INFLUENCE

Replications are a primary goal of NYSERDA’s R&D demonstration projects. This section covers the survey questions regarding the number and type of demonstration projects that were replicated, number of replications, impacts associated with the replications, and the contribution of the demonstration projects to developing the replications. This section also assesses the factors that can help or hinder replications.

5.1 NUMBER AND TYPES OF REPLICATIONS

The definition of replication varies by market actor. As discussed in Section 1.4, the survey defined replications for integrators and site owners as additional installations or scaling up of the technology or process demonstrated under the NYSERDA-funded project. Replications could be at the same site as the NYSERDA demonstration project or at another site, and may be carried out by the same firm or a different firm than the original demonstration. For vendors, replications are defined as additional sales of the same technology or services that were used in the demonstration project. The sales could be to the same buyer that participated in the demonstration project or to a different buyer.

Respondents were asked whether their firm or another firm replicated the NYSERDA demonstration project in a similar application or different application. As shown in Table 5-1, 33 projects (54%) reported replications for similar applications alone or in combination with different applications. Another seven projects (11%) reported replications for different applications only. Seventeen projects (28%) reported no replications, and the other four (7%) did not know.

Table 5-1. Comparison of NYSERDA-Funded Demonstrations to Replications by Application

Replication Market and Application	Number of Projects (n=61)	Percent of All Projects (n=61)	Percent of Replicated Projects (n=40)
Similar Application Only ¹	25	41%	63%
Different Application Only ²	7	11%	18%
Both Similar and Different Applications	8	13%	20%
No Replications	17	28%	--
Don't Know ³	4	7%	--
Total	61	100%	100%

Notes: (1) Six respondents answered “Yes” for similar applications and “Don’t Know” for different applications; two answered “Yes” for similar and did not answer for different. (2) Two answered “Yes” for different and “Don’t Know” for similar. (3) Two answered “No” for similar and “Don’t Know” for different, and two answered “Don’t Know” for both.

Respondents who reported different applications were asked to describe how the applications differed from the original demonstration project. Answers were varied and included the following:

- Different markets or technologies.
- Different uses.
- Modified the design for particular sites.
- Different companies and products.
- Applied some parts of the model but not others.

- Developed as part of a new (rather than existing) building.
- Different material, same general concept.
- No educational component.
- Different regulatory jurisdictions.

Respondents who reported at least one similar replication were asked about replications in New York State. As shown in Table 5-2, 28 projects reported at least one replication in New York. Thirteen of the 28 reported that NYSERDA provided funding for one or more replications, while the other 15 projects indicated that NYSERDA did not provide funding.³⁷ Overall, integrators and site owners reported 116 replication projects in New York and vendors reported \$2.4 million in replication sales.

Table 5-2. Replications in New York State by Project Type

Project Type	Number of Projects Surveyed	Number of Demonstration Projects with Replications in NYS			Percent of Projects Replicated (Out of 61)	Number of Replications (Integrators and Site Owners) ^{1,2}	Volume of Sales (Vendors) ³
		Total	Without NYSERDA Funding	With NYSERDA Funding			
On-site Power Production	18	12	5	7	67%	56	\$1,849,302
On-site Process Improvement	15	5	4	1	33%	14	--
Product Demonstration	28	11	6	5	39%	46	\$570,000
Total	61	28	15	13	46%	116	\$2,419,302

Notes: (1) Because only one type of respondent (integrator or site owner) was surveyed for each site, the numbers in this column are additive. (2) One respondent reported that their demonstration was replicated “innumerable times.” It is included in the number of demonstration projects with replications, but not in the total number of replications. (3) Vendors reported a total of 115 sales associated with the \$2,419,302 in sales revenue.

Table 5-3 shows replications across program areas. All of the major program areas had at least one demonstration project with replications in New York. Integrators and site owners reported 29 replications for Manufacturing Technology & On-Site Power and 20 replications each for Buildings Research and other End Use Application & Innovation projects. The majority of vendor replication sales (\$1.8 million out of \$2.4 million) were for Innovation & Business Development.

³⁷ This question was asked for up to five most recent replications.

Table 5-3. Replications in New York State by Program Area

Program Area	Number of Projects	Projects with Replications in NYS	Percent of Projects Replicated in NYS	Number of Replications (Integrators and Site Owners)	Volume of Sales (Vendors)
End Use Application & Innovation					
Buildings Research	12	4	33%	20	--
Innovation & Business Development	5	3	60%	12	\$1,849,302
Manufacturing Technology & On-Site Power	22	10	45%	29	--
Other	2	1	50%	20	--
Clean Energy Research & Market Development					
Energy Markets & Power Delivery	2	1	50%	11	--
Environment & Energy Resources	8	6	75%	19	\$270,000
Transportation & Power Systems	4	2	50%	4	\$300,000
Transmission & Distribution	3	1	33%	1	--
Other	3	0	0%	0	--
Total	61	28	46%	116	\$2,419,302

Respondents who had not replicated their demonstration project in New York were asked whether they expected their projects to be replicated in the future. As shown in Table 5-4, 50% of respondents who answered the question expected that their projects will be replicated in New York (65% if adjusted for those who answered “Don’t Know”). This includes projects that have already started actively planning for replications.

Table 5-4. Expectation that Projects will be Replicated in New York State in the Future

	Number of Projects (n=30)*	Percent of Projects (Out of 30)	Adjusted Percent of Projects
Yes	15	50%	65%
No	8	27%	35%
Don’t Know	7	23%	--
Total	30	100%	100%

Notes: (*) Three respondents without replications in New York did not answer this question.

5.2 SUPPORTING FACTORS AND BARRIERS TO REPLICATIONS IN NEW YORK

Respondents provided a range of reasons for being able to replicate the NYSERDA project in New York State. As shown in Table 5-5, technical expertise and demonstrable savings achieved from the demonstrations were the most frequently mentioned factors. Less than one-third of respondents cited financing as a factor. Six respondents mentioned other factors, including: the demonstration proved the technical functionality of the product or service; market demand for the product or service was strong; and the demonstration enhanced the reputation of the demonstrated technology or firm.

Table 5-5. Reasons for Replications

Reasons for Replications	Number of Projects (n=28)*	Percent of Projects (Out of 28)
Technical Expertise Gained	21	75%
Demonstrable Savings were Achieved	14	50%
Operating Conditions were Right	12	43%
Location Available	11	39%
Requested by Building Owner	10	36%
Financing Available	9	32%
Other	6	21%

Notes: (*) Respondents were allowed to select more than one answer.

Respondents who have not replicated their projects in New York were asked to identify the barriers to replications in the state. As shown in Table 5-6, four respondents cited the absence of other companies, institutions, or sites in New York to take advantage of the demonstrated technology. Cost and unproven technology were each cited by three respondents.

Table 5-6. Barriers to Project Replication

Reason	Number of Projects* (n=29)	Percent of Projects	Adjusted Percent of Projects
Absence of Suitable Companies/Institutions/Locations	4	14%	15%
Cost	3	10%	12%
Technology is Still Being Proven	3	10%	12%
Permitting/Regulatory Barriers	2	7%	8%
Proprietary Technology	2	7%	8%
Lack of Proximity to Potential Users	2	7%	8%
No Other Similar Company in New York State	2	7%	8%
Lack of Effective Marketing/Publicity	2	7%	8%
Complex Operating Environment/Too Many Competing Actors	2	7%	8%
New Markets/New Technologies	1	3%	4%
Company No Longer Makes the Product	1	3%	4%
Never Saw the Project Through to Completion	1	3%	4%
Project Answered all Questions it Set Out to Answer	1	3%	4%
Denied Commercialization	1	3%	4%
Don't Know	3	10%	12%

Notes: (*) Respondents could select more than one answer. Four projects without out replications did not answer the question.

5.3 REPLICATION IMPACTS

One of the study objectives was to estimate the impact of the replication projects. Because replication projects are often implemented by a different firm than the original demonstration project, quantifying the impacts of replication projects can be challenging. Therefore, as a first step, respondents were asked to consider the size of the replication impacts relative to the original demonstrations.

As shown in Table 5-7, a majority of respondents (79% excluding “Don’t Know”) characterized the replication impacts as the same or higher compared to the original demonstration. Similarly, more than half of respondents (74% excluding “Don’t Know”) stated that revenues or cost savings from the replications were the same or higher compared to the demonstrations. On this basis, the study conservatively estimates replication impacts assuming they are the same size as the original demonstration impacts.³⁸

Table 5-7. Scope of Replications in Comparison to NYSERDA Demonstration Project

	Comparison of Resource Savings (MWh, kW, Therms, Etc.) to Original Demonstration			Comparison of Revenue Generation and Cost Savings to Original Demonstration		
	Number	Percentage	Percentage Excluding “Don’t Know”	Number	Percentage	Percentage Excluding “Don’t Know”
Lower than Original Demo	5	5%	7%	6	7%	9%
The Same Size	18	19%	25%	17	18%	26%
Higher than Original Demo	39	42%	54%	31	34%	48%
Not Comparable	10	11%	14%	11	12%	17%
Don’t Know	21	23%	--	27	29%	--
Total	93	100%	100%	92*	100%	100%

Notes: Respondents who reported at least one replication in New York were asked the questions for their *five most recent* replications. Because some respondents had more than five replications, the number of responses shown in the table (n=93) is less than the total number of replications. (*) One respondent did not answer the question.

Tables 5-8 – 5-10 show the estimated impacts of the replication projects. Estimated impacts include 21,388 MWh/year in energy savings, 5,632 kW installed capacity, and 40,690 therms/year of fuel savings. The tables group benefits by project type. For example, of the 12 on-site power production projects that reported replications in New York, six had estimated energy savings. The replications from these six demonstration projects have estimated energy savings of 21,217 MWh/year.

³⁸ The method for estimating replication impacts is described in Section 2.4.

Table 5-8. Energy Savings from Replications in New York

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications and Estimated Energy Savings (MWh/Year)	Replication Energy Savings (MWh/Year)
On-site Power Production	18	12	6	21,217
On-site Process Improvement	15	5	-	-
Product Demonstration	28	11	2	171
Total	61	28	8	21,388

Table 5-9. Installed Capacity from Replications in New York

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications and Estimated Installed Capacity (kW)	Replication Installed Capacity (kW)
On-site Power Production	18	12	4	5,532
On-site Process Improvement	15	5	1	100
Product Demonstration	28	11	-	-
Total	61	28	5	5,632

Table 5-10. Fuel Savings from Replications in New York

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications and Estimated Fuel Savings (Therms/Year)	Replication Fuel Savings (Therms/Year)
On-site Power Production	18	12	-	-
On-site Process Improvement	15	5	1	1,600
Product Demonstration	28	11	2	39,090
Total	61	28	3	40,690

Tables 5-11 and 5-12 estimate the revenues and cost savings for replication projects in New York. The estimated revenue for the replications totals \$81.1 million, of which on-site power production accounts for \$20.2 million. Estimated cost savings totals \$63.3 million; power production accounts for \$55.7 million and process improvement accounts for \$7.3 million.

Table 5-11. Revenue from Replications in New York

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in NYS	Number of Demonstration Projects with Replications <u>and</u> Estimated Revenue	Replication Revenue
On-site Power Production	18	12	5	\$20,217,387
On-site Process Improvement	15	5	1	\$270,000
Product Demonstration	28	11	2	\$60,640,000
Total	61	28	8	\$81,127,387

Table 5-12. Cost Savings from Replications in New York

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in NYS	Number of Demonstration Projects with Replications <u>and</u> Estimated Cost Savings	Replication Cost Savings
On-site Power Production	18	12	8	\$55,724,852
On-site Process Improvement	15	5	2	\$7,256,000
Product Demonstration	28	11	4	\$356,992
Total	61	28	14	\$63,337,844

5.4 DEMONSTRATION INFLUENCE ON REPLICATIONS

The survey included a series of questions to assess the influence of the NYSERDA-funded demonstrations on the replication projects. Respondents who reported replications in New York were asked to express the extent of their agreement or disagreement with the statement: “Overall, the NYSERDA-funded demonstration project was critical for developing the replication project(s).” As shown in Table 5-13, 89% of respondents gave a rating of 4 or 5 out of 5.0. The average rating was 4.3 out of 5.0 indicating strong agreement about the influence of the demonstration projects.

Table 5-13. Influence of NYSERDA Demonstration Projects on Replications in New York State

	Strongly Disagree						Strongly Agree
	0	1	2	3	4	5	
Number of Projects (n=28)	0	0	1	2	12	13	
Percent of Projects (out of 28)	0%	0%	4%	7%	43%	46%	

Respondents who gave a rating of 3 or higher were asked to describe how NYSERDA’s assistance with the demonstration project influenced the ability to develop the replication projects. Responses included the following:

- The demonstration proved that it is possible to do this type of project.
- The demonstration dispelled false impressions about this type of project.

- The NYSERDA demonstration brought added credibility.
- The knowledge and expertise gained from the demonstration project helped with the replications.
- The demonstration resulted in improved marketing which led to increased sales of the technology.
- The demonstration provided the technical underpinnings for future projects.

Respondents were asked how the NYSERDA demonstration project affected the likelihood that the replications occurred. As shown in Table 5-14, 36% of respondents rated the likelihood as a 0 or 1 out of 5.0. Only one project (4%) gave a rating of 4 and none gave a rating of 5. The other 60% of respondents were in the middle.

Table 5-14. Likelihood that Replications Would Have Occurred in NYS without NYSERDA’s Demonstration

	Not At All Likely					Very Likely
	0	1	2	3	4	5
Number of Projects (n=28)	5	5	5	12	1	0
Percent of Projects (out of 28)	18%	18%	18%	42%	4%	0%

To further assess how the demonstration projects influenced the replications, respondents were asked how the demonstrations affected the magnitude of the replication impacts and the timing of the replications. As shown in Table 5-15, 46% of respondents indicated that the impacts would have been smaller (32%) or not happened at all (14%) without the NYSERDA demonstration project, while 32% indicated the impacts would have been the same. The findings also suggest that the demonstration projects accelerated the development of the replication projects. As shown in Table 5-16, 75% of respondents stated the replications would have happened later (64%) or not at all (11%) without the NYSERDA demonstration project. Respondents who reported that replications would have occurred later estimated that the demonstrations accelerated the replications by an average of 2.6 years.

Table 5-15. Estimated Magnitude of Replication Impacts Without the NYSERDA Demonstration Project

Magnitude of Replication(s) without NYSERDA Demonstration Project	Number of Projects	Percent of Projects	Adjusted Percent of Projects
Same	9	32%	41%
Smaller	9	32%	41%
Larger	0	0%	0%
Replication(s) Would Not Have Happened without NYSERDA	4	14%	18%
Don’t Know	6	21%	--
Total	28	100%	100%

Table 5-16. Estimated Timing of Replications without the NYSERDA Demonstration Project

Timing without NYSERDA Demonstration Project	Number of Projects	Percent of Projects	Adjusted Percent of Projects
Earlier	0	0%	0%
About the Same Time	4	14%	16%
Later (Average: 2.6 years later)	18	64%	72%
Replication(s) Would Not Have Occurred without NYSERDA	3	11%	12%
Don't Know	3	11%	0%
Total	28	100%	100%

Based on the answers to the previous questions, replication contribution scores were derived using a similar method as the demonstration contribution scores in Section 4. The average replication contribution score was 4.1 out of 6.0.³⁹ The contribution scores were converted to percentages and applied to the estimated replication impacts to estimate NYSERDA's contribution. For example, a contribution score of 4.1 translates to 75%.

Tables 5-17 – 5-19 summarize NYSERDA's contribution to replication project impacts. The tables show that NYSERDA demonstration projects contributed to 16,704 MWh/year in energy savings, 4,138 kW installed capacity, and 30,318 therms of fuel savings.

Table 5-17. Demonstration Contribution to Energy Savings from Replications

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications <u>and</u> Estimated Energy Savings (MWh/Year)	Replication Energy Savings (MWh/Year)	NYSERDA Demonstration Contribution (MWh/Year)
On-site Power Production	18	12	6	21,217	16,558
On-site Process Improvement	15	5	-	-	-
Product Demonstration	28	11	2	171	146
Total	61	28	8	21,388	16,704

³⁹ This is the simple average across projects and is shown for illustrative purposes only. It does not account for the relative size of benefits reported by each project, and therefore cannot be applied to total reported benefits. Instead, the analysis calculates the contribution separately for each project based on the project's reported benefits and the project's individual contribution score.

Table 5-18. Demonstration Contribution to Installed Capacity from Replications

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications <u>and</u> Estimated Installed Capacity (kW)	Replication Installed Capacity (kW)	NYSERDA Demonstration Contribution (kW)
On-site Power Production	18	12	4	5,532	4,075
On-site Process Improvement	15	5	1	100	63
Product Demonstration	28	11	-	-	-
Total	61	28	5	5,632	4,138

Table 5-19. Demonstration Contribution to Fuel Savings from Replications

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications <u>and</u> Estimated Fuel Savings (Therms/Year)	Replication Fuel Savings (Therms/Year)	NYSERDA Demonstration Contribution (Therms/Year)
On-site Power Production	18	12	-	-	-
On-site Process Improvement	15	5	1	1,600	1,000
Product Demonstration	28	11	2	39,090	29,318
Total	61	28	3	40,690	30,318

Tables 5-20 and 5-21 show NYSERDA’s estimated contribution to replication revenues and cost savings. The tables show that NYSERDA demonstration projects contributed to \$73.2 million in replication revenues and \$41.9 million in cost savings. Cost savings include energy cost savings as well as cost savings resulting from improved productivity and efficiency.

Table 5-20. Demonstration Contribution to Revenue from Replications

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications <u>and</u> Estimated Revenue	Replication Revenue	NYSERDA Demonstration Contribution
On-site Power Production	18	12	5	\$20,217,387	\$12,515,540
On-site Process Improvement	15	5	1	\$270,000	\$202,500
Product Demonstration	28	11	2	\$60,640,000	\$60,480,000
Total	61	28	8	\$81,127,387	\$73,198,040

Table 5-21. Demonstration Contribution to Cost Savings from Replications

Project Type	Number of Demonstration Projects Surveyed	Number of Demonstration Projects with Replications in New York State	Number of Demonstration Projects with Replications <u>and</u> Estimated Cost Savings	Replication Cost Savings	NYSERDA Demonstration Contribution
On-site Power Production	18	12	8	\$55,724,852	\$36,160,752
On-site Process Improvement	15	5	2	\$7,256,000	\$5,435,000
Product Demonstration	28	11	4	\$356,992	\$274,719
Total	61	28	14	\$63,337,844	\$41,870,471

Section 6:

PROCESS ANALYSIS

While impact assessment was the study’s primary purpose, the survey also included some questions about NYSERDA’s processes. This section covers survey questions about overall satisfaction and satisfaction with specific aspects of NYSERDA’s R&D Program.

6.1 PROGRAM AWARENESS AND COMMUNICATION

Respondents were asked how they first learned about the potential for NYSERDA assistance. As shown in Table 6-1, one-third of respondents cited prior participation in NYSERDA’s R&D Program. More than one-fifth of respondents (21%) learned about NYSERDA by word of mouth from business colleagues or clients. Advertising and contact from a NYSERDA representative were each cited by 11% of respondents.

Table 6-1. Sources of NYSERDA Program Awareness

Source of Program Awareness	Number of Projects (n=61)*	Percent of Projects
Prior Participation in NYSERDA R&D Program	20	33%
Word of Mouth – Business Colleague/Client	13	21%
Advertising	7	11%
Contacted by a NYSERDA Program Representative	7	11%
Another NYSERDA Program	3	5%
Word of Mouth – Friend/Relative	1	2%
Visited a Demonstration Site	0	0%
Other	12	20%
Don’t Know	1	2%

Notes: (*) Multiple responses were allowed.

6.2 SATISFACTION WITH PROGRAM ASSISTANCE

The survey included a set of questions designed to assess satisfaction with NYSERDA’s assistance. Respondents were asked to indicate their agreement or disagreement with a series of statements relating to program participation, including communication, timeliness of assistance, qualifications of program staff, and other aspects of NYSERDA’s assistance as shown in Table 6-2.

Overall satisfaction with NYSERDA’s R&D Program was quite high, with 92% of respondents agreeing or strongly agreeing (a 4 or 5 rating out of 5) that they are satisfied overall with their participation in the program. Respondents also gave very high ratings (greater than 80% gave a rating of 4 or 5) for NYSERDA’s communications with project participants and qualifications of program staff. The lowest scores were providing marketing information (36%) and market intelligence (23%) that supports the demonstration process. However, several respondents commented that they do not view it as

NYSERDA’s role to provide this type of information; therefore, disagreements with the statements do not necessarily represent dissatisfaction with the R&D Program.

Table 6-2. Respondent Feedback on NYSERDA’s R&D Program Characteristics (n=61)

Statement	Calculation	Strongly Disagree (1) to Strongly Agree (5)					Don’t Know/Refused
		1	2	3	4	5	
Overall, I am satisfied with my participation in NYSERDA’s R&D program.	Raw	7%	-	-	33%	59%	2%
	Adjusted ¹	7%	-	-	33%	60%	--
NYSERDA communicates well with demonstration project participants.	Raw	-	7%	8%	38%	43%	5%
	Adjusted ¹	-	7%	9%	40%	45%	--
NYSERDA staff members working with this program are well qualified.	Raw	5%	3%	3%	28%	56%	5%
	Adjusted ¹	5%	3%	3%	29%	59%	--
NYSERDA provides assistance in a timely manner.	Raw	7%	7%	11%	34%	39%	2%
	Adjusted ¹	7%	7%	12%	35%	40%	--
NYSERDA provides technical information that supports the demonstration process.	Raw	7%	16%	26%	25%	20%	7%
	Adjusted ¹	7%	18%	28%	26%	21%	--
NYSERDA provides technical information that supports the replication process.	Raw	10%	13%	28%	23%	16%	10%
	Adjusted ¹	11%	15%	31%	25%	18%	--
NYSERDA provides marketing information that supports the demonstration process.	Raw	10%	20%	23%	21%	15%	11%
	Adjusted ¹	11%	22%	26%	24%	17%	--
NYSERDA provides market intelligence that supports the demonstration process.	Raw	15%	21%	26%	15%	8%	15%
	Adjusted ¹	17%	25%	31%	17%	10%	--

Notes: (1) Adjusted percentages exclude “Don’t Know/Refused.” Percentages may not sum exactly to 100% due to rounding.

6.3 POTENTIAL IMPROVEMENTS RECOMMENDED BY SURVEY RESPONDENTS

Respondents were asked a series of open-ended questions about potential improvements that NYSERDA could undertake to encourage more demonstrations and replications.

Suggestions for how NYSERDA could encourage more demonstration projects included the following:

- Simplify the solicitation process.
- Improve outreach and communicate more with potential customers.
- Increase communication between NYSERDA and funding recipients.
- Disseminate information and communicate results more effectively.
- Talk to more people in industry to stay apprised of current trends and innovations.
- Understand the specific technologies better.
- Align projects with policy.
- Demonstrate best practices for proven technologies; do not focus solely on developing new products.

- Fund verification efforts to monitor projects.
- Give due attention to smaller projects.

Suggestions for how NYSERDA could encourage more replication projects included the following:

- Facilitate more knowledge sharing with peers about the benefits and costs of technologies.
- Post project reports online and offer an online database of project results.
- Attend local meetings and increase outreach to potential customers and partners.
- Attend more technical conferences and webinars.
- Align R&D with policy decisions and implications.
- Enhance communication with end users, not only with engineers.
- Market through other organizations.
- Hold open houses at demonstration sites.
- Publish a regular or quarterly report.
- Help bring market actors together to develop projects.
- Improve coordination with federal agencies.

Section 7:

COST EFFECTIVENESS

This section assesses the cost effectiveness of NYSERDA's R&D demonstration portfolio. The first part of the section calculates cost-effectiveness in terms of revenues and cost savings achieved per NYSERDA dollars spent. The second part calculates electricity and fuel savings per NYSERDA dollars spent. Calculations are presented separately for demonstration projects, replication projects, and the combined effects of demonstration and replication projects. The last part of this section is a qualitative assessment of whether participants consider the demonstrations to be worthwhile investments.

The benefit figures in this section are taken from Sections 4 and 5.⁴⁰ It should be noted that the revenue and cost savings figures represent the totals achieved through 2013; in some cases, these benefits will continue into the future. In those cases, the benefits per NYSERDA dollar will grow over time.

The cost includes NYSERDA's total investment in all R&D demonstration projects that closed in 2008-2010, including surveyed projects and non-surveyed projects (e.g., terminated projects⁴¹). In total, NYSERDA spent \$22.7 million on 124 R&D demonstration projects that closed during the study period.⁴² Dividing the benefits of the projects by NYSERDA's investment indicates the cost effectiveness of NYSERDA's R&D demonstration portfolio.

7.1 NYSERDA'S COST EFFECTIVENESS: REVENUES AND COST SAVINGS

The following metrics were calculated by dividing reported benefits by NYSERDA's investment:

- Demonstration project revenues per NYSERDA cost.
- Demonstration project cost savings per NYSERDA cost.
- Demonstration project total dollars (revenues and cost savings) per NYSERDA cost.
- All of the previous calculations for replication projects.
- All of the previous calculations combining demonstration and replication projects.

Table 7-1 shows the dollars saved and generated by the demonstration projects for every dollar of NYSERDA investment.⁴³ For example, the demonstrations saved \$1.05 in costs and generated almost \$47 in revenues for every dollar that NYSERDA spent. The revenue figure includes a single project that reported \$1.2 billion in sales. Excluding this one project reduces the revenues to \$0.57 per dollar spent.⁴⁴ The last row in the table combines cost savings and revenues. Overall, each dollar of NYSERDA investment yielded almost \$48 in revenues or cost savings. Excluding the one project that generated \$1.2 billion, the figure is much lower but still positive: \$1.62 in revenues or cost savings for every dollar spent.

⁴⁰ All of the benefits figures in this section reflect the benefits to which NYSERDA contributed. Section 2 .5 describes the method for estimating NYSERDA's contribution.

⁴¹ The cost reflects the money spent on the project (versus the original contracted amount). There are many projects that were terminated and the remaining funds were disencumbered.

⁴² Information provided by NYSERDA staff on February 11, 2014.

⁴³ Some portion of the revenues and cost savings may include the benefits of electricity and fuel savings presented below.

⁴⁴ This analysis is not meant to imply that the \$1.2 billion *should* be excluded; its purpose is to show how a single project affects the overall cost-effectiveness of the portfolio.

Table 7-1. Cost Effectiveness for Demonstration Benefits

Benefit Type	Cost Effectiveness	Cost-Effectiveness Adjusted (Outlier Removed)
Demonstration Cost Savings per NYSERDA \$	\$1.05	\$1.05
Demonstration Project Revenues per NYSERDA \$	\$46.86	\$0.57
Total Demonstration Dollars (Revenues Plus Cost Savings) per NYSERDA \$	\$47.91	\$1.62

Table 7-2 presents similar calculations for the replication projects. Overall, the replications saved or generated roughly \$5.07 for each dollar that NYSERDA invested in the original demonstration projects. The last two table columns differentiate between replications that were funded in whole or in part by NYSERDA and those that were funded without NYSERDA. Respondents were asked to describe the sources of funding for up to five of the most recent replications associated with their demonstration project. However, some respondents did not know if NYSERDA provided funding (many replications were carried out by different firms than the original demonstration), and others did not know the amounts. Moreover, given the limited time available for telephone surveys, the survey did not collect information on funding sources for replications beyond the most recent five. Therefore, the analysis uses a conservative approach for assigning replication projects to the “NYSERDA Funding” category; if one or more of the five most recent replications received NYSERDA funding, all of the replications associated with that demonstration project are assigned to that category. However, the figures do not reflect the costs incurred by NYSERDA for the replication projects, because these data were not available in a comprehensive or consistent way. As such, the cost-effectiveness calculations in Table 7-2 only account for the \$22.7 million that NYSERDA invested in its demonstration portfolio. If NYSERDA’s replication costs were included in the calculations, the cost-effectiveness figures for “All replications” and “Replications Receiving NYSERDA Funding” would be lower. This would not affect replications that were funded independent of NYSERDA.

Table 7-2. Cost Effectiveness for Replication Benefits

Benefit Type	Cost Effectiveness (All Replications)	Cost Effectiveness (Replications Receiving NYSERDA Funding)	Cost Effectiveness (Replications Not Receiving NYSERDA Funding)
Replication Cost Savings per NYSERDA \$	\$1.85	\$1.41	\$0.43
Replication Project Revenues per NYSERDA \$	\$3.23	\$2.92	\$0.31
Total Replication Dollars (Revenues and Cost Savings) per NYSERDA \$	\$5.07	\$4.33	\$0.74

Table 7-3 presents the cost-effectiveness figures for combined demonstration and replication benefits. Overall, the demonstration and replication projects saved or generated more than \$52 for every dollar invested in NYSERDA’s R&D demonstration portfolio. Removing the single demonstration project with \$1.2 billion in revenue, cost-effectiveness is still positive at \$6.69 per NYSERDA dollar of investment in the demonstration projects.

Table 7-3. Cost Effectiveness for Combined Demonstration and Replication Benefits

Benefit Type	Cost Effectiveness	Cost Effectiveness Adjusted (Outlier Removed)
Demonstration and Replication Cost Savings per NYSERDA \$	\$2.90	\$2.90
Demonstration and Replication Project Revenues per NYSERDA \$	\$50.09	\$3.80
Demonstration and Replication Total Dollars (Revenues and Cost Savings) per NYSERDA \$	\$52.98	\$6.69

7.2 NYSERDA’S COST EFFECTIVENESS: ELECTRICITY AND FUEL SAVINGS

As discussed in Section 1.3, NYSERDA’s R&D Program supports projects that are designed to deliver public benefits. These benefits range from improved system reliability to health and environmental improvements. While some demonstration projects may result in lower energy costs, cost-effective energy savings is not the main reason for NYSERDA funding these projects. Nonetheless, it can be useful to consider energy-cost savings within the context of the overall cost-effectiveness analysis.

This section analyzes NYSERDA’s cost-effectiveness in terms of electricity savings (MWh) and fuel savings (therms).⁴⁵ As described in Sections 4 and 5, respondents reported electricity and fuel savings on an annual basis (MWh/year and therms/year, respectively). Many respondents indicated that savings will continue in years to come – i.e., only a fraction of the expected benefits have been realized to date. However, all of NYSERDA’s demonstration project costs were incurred upfront. Therefore, to compare the benefits and costs on equal terms, the analysis estimates the value of future energy savings.

This type of analysis is complicated by the uncertainties inherent in predicting future energy prices and energy savings. It is also uncertain how far the technologies or processes resulting in the energy savings will continue into the future. To reflect the uncertainties, the analysis calculates NYSERDA’s cost-effectiveness under a variety of scenarios. The scenario analysis considers two variables that determine the value of future energy savings: energy prices and technology lifespan. Forecasted energy prices are taken from the U.S. Energy Information Administration (EIA) *Annual Energy Outlook 2013* for the U.S. Middle Atlantic region, which includes New York State. The “medium” energy prices represent the EIA’s reference case; the “low” and “high” cases represent the EIA’s forecast under a lower-economic growth scenario and higher-growth scenario, respectively.⁴⁶ The benefits also reflect whether the systems or processes operate for one year, five years, 10 years, or 20 years. The survey did not ask about years of operation; however, NYSERDA’s experience has shown that many projects stay online longer than one year, while a 20-year lifetime might be longer than average.

⁴⁵ The study was not able to conduct a similar analysis for installed capacity (kW) given the available information. Installed capacity does not represent actual energy generated, but rather the ability to generate energy. Estimating the quantity of energy generated would require detailed information about each industry and each firm beyond the data collected in the survey,

⁴⁶ *Annual Energy Outlook 2013* expresses all energy prices in 2011 dollars, unless otherwise noted. Expressing all savings in current dollars adjusts for the effects of inflation on energy prices in later years, and therefore represents a reasonably accurate assessment of the world from NYSERDA’s point of view. It does not, however, account for the firm’s opportunity cost of capital – i.e., other investments the firm could have made instead of investing in the project. If a private firm were considering the investments described in this section, it would further discount the future energy savings by its weighted average cost of capital – i.e., the cost required to finance the firm’s mix of debt and equity – thereby reducing the present value of the savings.

The first step in this analysis is estimating the benefits of future energy savings. Tables 7-4 – 7-6 estimate the electricity savings for demonstration projects, replication projects, and the combined benefits of demonstrations and replications. For example, as shown in Table 7-4, if demonstration projects operate for five years under the medium scenario, they will save an estimated \$10.6 million in electricity costs. If they operate for a shorter time, the benefits will be smaller (holding all else equal); if they operate longer than five years, the benefits will be larger. Similarly, the benefits depend on electricity prices, which vary across the “low,” “medium,” and “high” scenario. For example, if the projects operate for one year, they would have an estimated savings of \$1.7 million in the low scenario and \$2.3 million in the high scenario. Overall, the demonstration savings vary from \$1.7 million to \$44.2 million depending on electricity prices and lifespan.⁴⁷

Table 7-4. Estimated Electricity Savings from Demonstration Projects

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$1,748,030	\$2,253,523	\$2,249,432
5	\$8,692,358	\$10,561,874	\$10,759,566
10	\$17,562,966	\$21,086,454	\$21,755,010
20	\$34,989,165	\$42,319,108	\$44,183,758

Table 7-5. Estimated Electricity Savings from Replication Projects

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$1,337,049	\$1,723,695	\$1,720,565
5	\$6,648,687	\$8,078,658	\$8,229,871
10	\$13,433,715	\$16,128,792	\$16,640,163
20	\$26,762,819	\$32,369,410	\$33,795,660

Table 7-6. Combined Estimated Electricity Savings

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$3,085,079	\$3,977,218	\$3,969,997
5	\$15,341,045	\$18,640,532	\$18,989,436
10	\$30,996,681	\$37,215,246	\$38,395,173
20	\$61,751,985	\$74,688,518	\$77,979,418

Tables 7-7 – 7-9 show the same type of analysis for fuel savings. However, fuel savings also depend on the type of fuel used, because different fuel sources have different prices. The analysis identified the fuel source for five of the seven demonstration sites that reported quantifiable fuel savings; however, the fuel source for two sites was unknown. For these two sites, the analysis was based on the typical fuel mix for each project’s sector (commercial/industrial or residential) in New York State.⁴⁸ As shown in Table 7-9,

⁴⁷ Please refer to Appendix C for further details about the methodology for this analysis.

⁴⁸ Appendix C describes the data sources and methodology used for calculating the fuel mix.

the value of expected fuel savings ranges from \$91,911 to \$2.3 million depending on assumptions about lifespan and energy prices.⁴⁹

Table 7-7. Estimated Fuel Savings from Demonstration Projects

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$45,829	\$51,562	\$51,562
5	\$227,213	\$253,089	\$256,016
10	\$471,956	\$522,665	\$534,685
20	\$1,021,606	\$1,123,863	\$1,166,257

Table 7-8. Estimated Fuel Savings from Replication Projects

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$46,082	\$49,613	\$49,613
5	\$223,322	\$243,042	\$244,778
10	\$458,621	\$500,518	\$507,680
20	\$979,267	\$1,071,216	\$1,098,140

Table 7-9. Combined Estimated Fuel Savings

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$91,911	\$101,175	\$101,175
5	\$450,535	\$496,131	\$500,795
10	\$930,576	\$1,023,183	\$1,042,365
20	\$2,000,873	\$2,195,079	\$2,264,397

The estimated electricity and fuel savings were summed to derive aggregate savings,⁵⁰ and the aggregate savings were divided by NYSERDA’s costs to calculate cost effectiveness. Tables 7-10 – 7-12 present the results of the analysis. As shown in Table 7-12, the demonstration and replication projects could together save between \$0.14 and \$3.54 for every dollar that NYSERDA invested in the demonstration projects, depending on project lifespan and future energy prices. Given the uncertainties and limitations of this analysis, the figures should be interpreted as a general indication, rather than a precise estimate, of energy-cost savings.

It should also be noted that total savings (and therefore, cost effectiveness) may be understated as a result of some respondents not being able to quantify their energy savings. Therefore, the actual savings and cost effectiveness may be higher than the figures suggest. It is also important to note that the energy cost savings shown in Tables 7-10 and 7-11 represent a subset of the total cost savings presented in Sections 4.3, 5.3, and 7.1. In other words, energy cost savings are only a fraction of total cost savings, with total cost savings and revenues exceeding NYSERDA’s investment in the demonstration projects.

⁴⁹ The analysis assumes that the replication sites use the same fuel source as the demonstration sites.

⁵⁰ To save space, the report does not show this intermediate step.

Table 7-10. Cost Effectiveness of Electricity and Fuel Savings from Demonstrations

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$0.08	\$0.10	\$0.10
5	\$0.39	\$0.48	\$0.49
10	\$0.80	\$0.95	\$0.98
20	\$1.59	\$1.92	\$2.00

Table 7-11. Cost Effectiveness of Electricity and Fuel Savings from Replications

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$0.06	\$0.08	\$0.08
5	\$0.30	\$0.37	\$0.37
10	\$0.61	\$0.73	\$0.76
20	\$1.22	\$1.47	\$1.54

Table 7-12. Cost Effectiveness of Combined Electricity and Fuel Savings

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$0.14	\$0.18	\$0.18
5	\$0.70	\$0.84	\$0.86
10	\$1.41	\$1.69	\$1.74
20	\$2.81	\$3.39	\$3.54

7.3 PARTICIPANT PERSPECTIVES OF COST EFFECTIVENESS

The study also sought to assess cost-effectiveness from the firm's perspective. The survey included questions about resources committed by participants and their perceptions of whether the investment was worthwhile.

Out of 61 respondents, 18 contributed staff time to the project and 43 contributed project expenses ranging from \$1,020 to \$20 million, with an average contribution of \$1,514,340. These figures include cash and in-kind contributions. Moreover, the figures are partial and cannot be aggregated. Therefore, while the numbers give some indication of the level of the firm's investment, they cannot be used to quantitatively assess cost effectiveness.

Therefore, the study used a qualitative approach to assess the value of the investment from the firm's perspective. A series of questions asked respondents about other investments the firm was considering when it began the demonstration project and how those alternatives compared. As shown in Table 7-13, 27 out of 61 projects (44%) stated that they had considered alternatives to the demonstration project. As shown in Table 7-14, all but one of these respondents indicated that the demonstration was the best choice relative to the alternatives.

Table 7-13. Alternatives Considered at the Time of the Demonstration Project

	Number of Projects	Percent of Projects	Adjusted Percent of Projects
Yes	27	44%	47%
No	31	51%	53%
Don't Know	3	5%	--
Total	61	100%	100%

Table 7-14. Value of Demonstration Relative to Alternatives

	Number of Projects	Percent of Projects
Yes	26	96%
No	1	4%
Total	27	100%

The survey asked respondents if they considered the demonstration project to be a good investment, and whether their return on investment was positive, negative, or neutral. As shown in Table 7-15, 54 respondents out of 61 (89%) indicated that the demonstration was a good investment.

Table 7-15. Assessment of Whether the Demonstration was a Good Investment

	Number of Projects	Percent of Projects	Adjusted Percent of Projects
Yes	54	89%	93%
No	4	7%	7%
Don't Know/Refused	3	5%	--
Total	61	100%	100%

Note: Due to rounding, percentages do not sum to exactly 100%.

As shown in Table 7-16, 79% indicated that their return on investment was positive, 15% breakeven, and only 6% indicated that their return was negative. The findings indicate that a strong majority of respondents considered the demonstration projects to be worthwhile investments.

Table 7-16. Firm's Return on Investment

	Number of Projects	Percent of Projects
Positive	48	79%
Negative	4	6%
Breakeven/Neutral	9	15%
Total	61	100%

CONCLUSIONS AND RECOMMENDATIONS

This evaluation explored the impacts of NYSERDA’s R&D demonstration projects and replication projects. The findings also highlight the factors that support and hinder replications in New York. While the survey gathered valuable information, it also helped identify data gaps and limitations that could be addressed in the future. This section presents the overall conclusions of this study and recommendations for future R&D demonstration surveys.

8.1 CONCLUSIONS

The evaluation has the following major conclusions:

NYSERDA’s R&D demonstrations have mostly achieved their objectives while generating substantial impacts. Nine out of 10 survey respondents reported meeting “all” or “most” of their objectives, with over half of all projects meeting all of their objectives. Respondents cited a wide range of project impacts, including energy efficiency, demand reduction, power production, environmental quality improvement, marketability, knowledge creation, and many others. Given the broad range of projects and benefits, and the challenges of recalling savings from two or more years ago, many benefits could not be quantified. However, the benefits that could be quantified are impressive, as shown in Table 8-1. In addition, almost two-thirds of the surveyed demonstration projects (65%) reported replications, with 46% of projects reporting one or more replications in New York. These replications had their own significant impacts. Table 8-1 summarizes the demonstration and replication impacts to which NYSERDA contributed.

Table 8-1. Summary of NYSERDA Contribution to Demonstration and Replication Impacts

Benefits Type	Estimated Benefits by Project Type			Total Benefits
	Power Production	Process Improvement	Product Demonstration	
Demonstration Installed Capacity (kW)	3,988	75	538	4,601
Replication Installed Capacity (kW)	4,075	63	-	4,138
Total Installed Capacity (kW)	8,063	138	538	8,739
Demonstration Electricity Savings (MWh/year)	17,062	88	4,688	21,838
Replication Electricity Savings (MWh/year)	16,558	-	146	16,704
Total Electricity Savings (MWh/Year)	33,620	88	4,834	38,542
Demonstration Fuel Savings (Therms/Year)	0	44,137	13,729	57,866
Replication Fuel Savings (Therms/Year)	-	1,000	29,318	30,318
Total Fuel Savings (Therms/Year)	0	45,137	43,047	88,184
Demonstration Cost Savings	\$11,748,933	\$8,514,463	\$3,545,264	\$23,808,660
Replication Cost Savings	\$36,160,752	\$5,435,000	\$274,719	\$41,870,471
Total Cost Savings	\$47,909,685	\$13,949,463	\$3,819,983	\$65,679,131
Demonstration Revenue	\$3,194,233	\$1,050,180,000	\$9,590,000	\$1,062,964,233
Replication Revenue	\$12,515,540	\$202,500	\$60,480,000	\$73,198,040
Total Revenue	\$15,709,773	\$1,050,382,500	\$70,070,000	\$1,136,162,273

Demonstrable savings and technical expertise are important factors for developing replication projects in New York. Technical expertise and demonstrable savings achieved from demonstrations were the most frequently mentioned factors that support the development of replication projects in New York. This finding is consistent with NYSERDA’s rationale for conducting demonstration projects, which is to showcase the value and effectiveness of a new technology or process in a commercial setting. It also reflects the technical assistance provided by NYSERDA, as well as the contacts facilitated by NYSERDA between demonstration participants and industry experts. The barriers to replication that respondents identified most often include: absence of other companies, institutions, or sites in New York to take advantage of the demonstrated technology; cost; and uncertainties about unproven technologies. The barriers and success factors appear closely linked; for example, technical functionality and financial considerations play a key role in supporting and hindering replication. The absence of opportunities to replicate projects in New York is more difficult to explain, and suggests a need to consider broader market forces that help determine the success of new or less-proven technologies.

NYSERDA’s R&D demonstration portfolio performs well across several measures of cost-effectiveness. Tables 8-2 and 8-3 summarize NYSERDA’s cost effectiveness in terms of demonstration and replication benefits achieved per dollar spent on demonstration projects. The revenue benefits are quite high, particularly with one demonstration project that reported \$1.2 billion in sales. This result exemplifies the nature of R&D investment, where a small number of very successful projects typically justify the cost of the whole portfolio. It is notable that even without this one project, the benefits still exceed NYSERDA’s investment. Moreover, some of these projects are expecting additional revenues and cost savings in future years, which will further drive down the cost of NYSERDA’s investment relative to the benefits. The benefits of electricity and fuel savings – which are a subset of total cost savings – exceed NYSERDA’s investment in the demonstration projects in the 10-year and 20-year scenarios (“low,” “medium,” and “high”), but not in the one-year or five-year scenarios. However, this may reflect incomplete benefits data rather than any inefficiency on the part of NYSERDA. Also, it is important to note that NYSERDA funds R&D demonstrations to achieve public policy goals that are not uniformly centered on cost-effective energy savings. Survey responses suggest that participants generally found the demonstration projects to be worthwhile investments.

Table 8-2. Cost Effectiveness for Combined Demonstration and Replication Benefits

Benefit Type	Cost Effectiveness	Cost Effectiveness Adjusted (Outlier Removed)
Demonstration and Replication Cost Savings per NYSERDA \$	\$2.90	\$2.90
Demonstration and Replication Revenues per NYSERDA \$	\$50.09	\$3.80
Demonstration and Replication Dollars (Revenues and Cost Savings) per NYSERDA \$	\$52.98	\$6.69

Table 8-3. Cost Effectiveness of Electricity/Fuel Savings from Demonstrations and Replications

Lifespan (Years)	Energy Prices		
	Low	Medium	High
1	\$0.14	\$0.18	\$0.18
5	\$0.70	\$0.84	\$0.86
10	\$1.41	\$1.69	\$1.74
20	\$2.81	\$3.39	\$3.54

Participant satisfaction with NYSERDA’s R&D Program appears very high. Ninety-two percent (92%) of survey respondents agreed or strongly agreed with the statement: “Overall, I am satisfied with my participation in NYSERDA’s R&D Program.” Respondents also gave very high ratings (greater than 80%) for communications with project participants and qualifications of program staff. Though generally satisfied, respondents offered several suggestions for ways in which NYSERDA could further promote demonstration and replication projects in New York. These suggestions include, among others: simplify the application process; post project reports online and offer an online database of project results; align projects with relevant policies; facilitate more knowledge sharing activities with peers; and enhance communications with end users.

Data limitations pose challenges for evaluating NYSERDA’s R&D demonstration projects. Several projects were missing contact information or had outdated or incorrect information. In other cases, the company contact was correct, but the Principal Investigator had moved on and could not be located. In addition, many respondents had difficulty recalling the benefits of projects that ended two or more years ago. The NYSERDA R&D Metrics Database does not currently include comprehensive benefits data, although this is expected to change over time. Final project reports are another potential source of benefits data, but they do not appear to be archived in a central location, and are difficult to retrieve.

8.2 RECOMMENDATIONS

NYSERDA has committed to repeating the R&D demonstration survey at regular intervals to ensure the existence of a regularly updated, comparable set of information about NYSERDA’s demonstration projects and associated replications. This survey and the previous round provided valuable information that can guide future survey efforts. Recommendations include the following:

Fully leverage information in the R&D Metrics Database and Final Project Reports. The R&D Metrics Database was created in 2009. It did not exist when the first survey was conducted, and it was not fully populated for the second (current) survey. Assuming these issues are addressed for future rounds, NYSERDA may be able to obtain benefits data for most or all projects before conducting the survey. The survey would then focus on validating the benefits data and obtaining information about replication projects. NYSERDA is currently planning for an evaluability assessment that would leverage and build on NYSERDA’s previous database-building efforts, explore and categorize data from prior evaluations, and offer constructive input on issues that NYSERDA is still considering.

Interview all three types of participants for each demonstration project. Each NYSERDA demonstration project typically involves three categories of participants: 1) integrators who bring together market actors and “package” the project; 2) vendors who supply the technology, product, or process; and 3) site owners. The first two surveys interviewed a single type of respondent for each demonstration site – e.g., integrator, vendor, or site owner. Depending on available time and resources, NYSERDA may be able to survey all three types of participants for every site in future rounds. This would provide more comprehensive information about the benefits of NYSERDA’s demonstrations.

Re-survey demonstration projects from prior rounds. The first two surveys focused on two distinct populations: projects completed in 2004-2007, and projects completed in 2008-2010. NYSERDA could

consider re-surveying projects from 2004-2010, to learn whether demonstration benefits persisted and whether there have been any additional installations or sales of the demonstrated technology.

Clarify the definition of replication and track NYSERDA’s replication costs. The first two R&D surveys defined replication projects broadly, and included replications with and without NYSERDA funding. However, NYSERDA is considering whether NYSERDA-funded replication projects should be “counted” as market replications. Going forward, NYSERDA should make a determination as to whether NYSERDA-funded replications will or will not be “counted” for the survey. If NYSERDA continues to include these projects, it should track the costs of each NYSERDA-funded replication in a way that can be traced back to the original demonstration. It would also be desirable to know whether these replications received funding from NYSERDA’s R&D Program or NYSERDA’s deployment programs. This information would provide a more comprehensive understanding of the demonstration-replication process and would allow for a more comprehensive assessment of NYSERDA’s cost effectiveness.

Survey the replication sites. The first two rounds only surveyed demonstration participants, and asked if they were aware of any replication projects. Some respondents were unsure about the number of replications; others were unsure what specific benefits the replications had produced. Using a “snowball” survey technique, NYSERDA could ask demonstration respondents for “leads” at replication sites and follow up directly with the replicators. This would help verify the number of replications, quantify the replication benefits, and understand the causal link between NYSERDA’s demonstration projects and subsequent replications. In addition, the survey data could potentially be used to track changes in performance (such as installation costs, operating costs, sales volume, and return on investment) from the first replication to the fifth (or higher) replication.

Explore the impacts of knowledge creation. Sixty-two percent (62%) of respondents in the current survey identified knowledge creation as a direct benefit of their project – more than any other benefit category. NYSERDA could further explore the tangible and intangible benefits of knowledge creation in future rounds of the survey. For example, future surveys could ask respondents whether they have applied the knowledge they gained from the demonstration project in future projects or in their ongoing business practices. The survey could also inquire how the knowledge gained from the demonstration projects has affected their operations, productivity, and sales. In addition, if replicators are included in future rounds, the survey could ask whether they applied the knowledge, methods, or lessons from the demonstration projects – thereby tracing the transfer of knowledge from demonstration sites to replication sites – and their resulting changes in performance.

R&D Demonstration Survey Method

Appendices

Appendix A

ADVANCE LETTER AND TELEPHONE SURVEY INSTRUMENTS

PRINTED ON NYSERDA LETTERHEAD

[DATE]

[NAME & FIRM ADDRESS]

Dear [NAME]:

The New York State Energy Research and Development Authority (NYSERDA) has retained Industrial Economics, Inc. (IEc) and APPRISE to conduct an evaluation of projects NYSEDA has funded for the purpose of demonstrating specific technologies or processes. This important study will enable NYSEDA to better assess program accomplishments and improve programs that serve New York.

We wish to collect data about the [NAME OF THE PROJECT]. Our records indicate this project received NYSEDA funding from NYSEDA's R&D Program for the project that was completed in [MONTH/YEAR]. We are interested to learn about the results of NYSEDA's assistance on your ability to demonstrate the effectiveness of this project as well as potential applications beyond this particular site.

We would like to schedule an interview with you. The interview will take up to one hour to complete, and someone from APPRISE will call you to schedule a time that is most convenient for you. Policy analysts from IEc and APPRISE will conduct the interview.

IEc and APPRISE are independent researchers. The information you provide will be kept confidential to the extent permitted by law. We will report all responses in aggregate and will not attribute any comments to you.

Someone will be calling you within the next week to conduct this interview. Your participation is important to our evaluation effort. We know your time is valuable, and we sincerely appreciate your efforts to help us. If you have questions about the survey, please call Brian Peter at NYSEDA at (518) 862-1090, extension 3615, or Daniel Kaufman of IEc at (617) 354-0074. If you would like more information about IEc or APPRISE, please visit their websites: <http://www.indecon.com/> and <http://www.appriseinc.org/>.

Thank you for your assistance.

Sincerely,

Signed originals mailed

Brian Peter
Assistant Project Manager, Evaluation
NYSEDA
17 Columbia Circle
Albany, NY 12203

bwp@nyserda.ny.gov

NYSERDA
Demonstration Project Survey

INTEGRATORS

Interview Date: [mm/dd/yyyy]

Interviewer name:

Interviewer phone:

CNTRCT_ID:

Project Description:

Best Contact:

NYSERDA Project Manager

PI First Name and PI Last Name

Title:

Phone:

Email:

Project Role:

Company Name:

Program Area: [Buildings, Transportation, Energy Resources, etc.]

Project Type: [PRODUCT, PROCESS OR POWER PRODUCTION]

NYSERDA \$ (Encumbered \$ for this project.)

Earliest contract signed date

Latest contract closed date

Location

THE POLICY ANALYST CONDUCTING THE INTERVIEW WILL WORK THROUGH THE INSTRUMENT USING THE SPECIFIC DATASET INPUT AND PROJECT DESCRIPTION TO REFINE QUESTION WORDING AS NECESSARY TO PROVIDE CLEAR LANGUAGE AND TO OBTAIN THE INFORMATION DESIRED FROM EACH QUESTION. GIVEN THE INFORMATION IN THE DATASET, THE SURVEY INSTRUMENT FOR EACH INTERVIEW WILL BE MARKED FOR THE APPROPRIATE HANDLING OF QUESTIONS AND SKIP PATTERNS REGARDING THE IMPACTS FROM THE DEMONSTRATION PROJECT (QUESTIONS 17 THROUGH 32).

Identify the Appropriate Contact

Hello, my name is [interviewer name], and I am calling from [company name] on behalf of the New York State Energy Research and Development Authority, also known as NYSERDA. NYSERDA is conducting a study to assess the impact of its funding on New York State companies and on the State's economy. This study will also assess the impact of its funding and technological support on [use "product", "process", or "generation" depending on participant] demonstration projects conducted in New York State.

NYSERDA has contracted with Industrial Economics, Incorporated and APPRISE to perform this study. IEc and APPRISE are independent research and consulting firms. I would like to ask some questions about your involvement in a completed NYSERDA demonstration project – the [SUMMARIZE FROM CONTRACT DESCRIPTION]. The information you provide will be kept confidential to the extent permitted by law. We will report all responses in aggregate and will not attribute any comments to you. The information you provide will be used to improve NYSERDA's research and development programs. NYSERDA is contacting all participants who completed demonstration projects within the last five years.

SCREENING

Our records show that NYSERDA provided \$ _____ in funding to [COMPANY NAME] for the demonstration project [CONTRACT DESCRIPTION].

SCR-1. This survey will take about one hour to complete. We would like to talk to the person who is most knowledgeable about the project. If not you, could you please direct me to, or provide me with the name of the person who is the most qualified to discuss this project?

- a. Caller [PROCEED TO SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW]
- b. Most qualified contact [CONTACT THIS PERSON, REPEAT INITIAL INTRODUCTION AND THE INTRODUCTION TO THE SCREENING SECTION, AND CONTINUE WITH THE FOLLOWING QUESTION]

SCR-2 Mr./Ms. [name] referred me to you to answer specific about this project [DESCRIBE PROJECT BRIEFLY as this is another person]. This survey will take about one hour to complete. Can we discuss the project now, or can we schedule a time when I can call you back?

- a. Can discuss now [PROCEED TO SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW]
- b. Call back on _____ at time:
- c. [IF THIS PERSON IS NOT THE MOST QUALIFIED PERSON, LOOP BACK TO SCR-1]

SCR-3 Which of the following best describes your role in the [PROJECT]? [READ ALL CHOICES TO RESPONDENT AND SELECT THE MOST APPROPRIATE CHOICE.]

- a. I provided the [PRODUCT/PROCESS/TECHNOLOGY/TYPE OF GENERATION... tailor to the project based on project type] for this project. [USE VENDOR SURVEY INSTRUMENT]
- b. I am the site owner. [USE SITE OWNER SURVEY INSTRUMENT]
- c. I developed the project and brought together the vendor, site owner, and other market actors. [USE INTEGRATOR SURVEY INSTRUMENT]

SCR-4 Do you have any reports or presentations that describe the results of the [PROJECT]?

- a. Yes [ASK THE RESPONDENT TO SEND THE REPORTS IN ADVANCE OF THE CALL]
- b. No
- c. Don't Know [ASK THE RESPONDENT TO CHECK AND SEND WHAT THEY HAVE IN ADVANCE OF THE CALL]

SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW

[NOTE: PRIOR TO BEGINNING THE DISCUSSION, ASK THE RESPONDENT WHETHER OR NOT IT IS OKAY TO RECORD THE CALL.]

1. Our records show that NYSERDA provided funding to [COMPANY NAME] for a project involving [CONTRACT DESCRIPTION]. Is this an accurate description of the project?
- a) (1) Yes
 - b) (2) No

[IF Q1 = YES, SKIP TO Q3. IF Q1 = NO, ASK Q2.]

2. How would you describe the project?

Record open-ended response: _____

3. Is this the first time your firm used this ["product", "process", "technology" or "type of generation"tailor to project based on PROJECT TYPE]?
- a) (1) Yes
 - b) (2) No
 - c) (3) Don't know

[IF Q3 = NO, PROCEED TO Q4. OTHERWISE, SKIP TO Q6]

4. How many times had your firm used this ["product", "process", "technology" or "type of generation"tailor to project] prior to the [reference NYSERDA demo project]?
- a) [RECORD THE NUMBER OF TIMES]
 - b) Don't know

5. How did [reference NYSERDA demo project] differ from previous uses of this ["product", "process", "technology" or "type of generation"tailor to project]?

RECORD VERBATIM RESPONSE: _____

- a) _____
- b) _____
- c) _____

[RECORD VERBATIM COMMENTS FIRST; DO NOT READ LIST. THEN, LOOK AT THE LIST AND VERIFY THE RELEVANT SELECTION(S) WITH RESPONDENT.]

- d) No difference
- e) Smaller in scale than previous projects of this type
- f) Larger in scale than previous projects of this type
- g) Different inputs
- h) Different application of the technology
- i) Different type of facility

[POLICY ANALYST CALCULATION #1: DO NOT READ TO SURVEY RESPONDENT.

STEP ONE: IF Q3 = "YES" OR "DON'T KNOW", RECORD 0 ON THE LINE BELOW. SKIP STEP TWO.

STEP TWO: IF Q3 = "NO", LOOK AT ANSWER TO Q5. IF Q5 = D ONLY OR E ONLY, RECORD -1. ELSE RECORD 0.

CALCULATION #1: _____]

6. Now I would like to discuss the [SUMMARIZE CONTRACT DESCRIPTION] Project. How would you describe the objectives of this project? [OPEN-ENDED QUESTION TO PRIME THE RESPONDENT'S THINKING]

7A. Can you identify specific challenges you faced when planning this project? [ASK UNPROMPTED FIRST.]

- a. _____
- b. _____
- c. _____

[RECORD VERBATIM COMMENTS FIRST; DO NOT READ LIST. THEN, LOOK AT THE LIST AND VERIFY THE RELEVANT SELECTION(S) WITH RESPONDENT.]

- d. Lack of funding
- e. Cost prohibitive
- f. Lack of qualified personnel or expertise
- g. Lack of interest among potential end users
- h. Could not find an appropriate site
- i. Timing was not right
- j. Regulatory barriers
- k. Technological issues
- l. Other - specify: _____

7B. Can you identify specific challenges you faced when executing this project? [ASK UNPROMPTED FIRST.]

- a. _____
- b. _____
- c. _____

[RECORD VERBATIM COMMENTS FIRST; DO NOT READ LIST. THEN, LOOK AT THE LIST AND VERIFY THE RELEVANT SELECTION(S) WITH RESPONDENT.]

- d. Lack of funding
- e. Cost prohibitive
- f. Lack of qualified personnel or expertise
- g. Lack of interest among potential end users
- h. Could not find an appropriate site
- i. Timing was not right
- j. Regulatory barriers
- k. Technological issues
- l. Other - specify: _____

8A. Can you identify any benefits that you received from planning this project?

8B. Can you identify any benefits that you received from executing this project?

9. Overall, do you feel this project accomplished all, most, some, or none of its objectives?

- a. All
- b. Most
- c. Some
- d. None
- e. Don't know / refused [DO NOT READ THIS OPTION]

[IF RESPONDENT SELECTS "ALL" OR "DON'T KNOW," SKIP TO Q11. OTHERWISE, ASK Q10.]

10. Please explain why this project did not accomplish all of its objectives: _____

SECTION 2: COST EFFECTIVENESS

Now I would like to ask about the cost-effectiveness of the project.

11. NYSERDA furnished a grant for [NYSERDA \$]. In addition to that amount, how much did your firm invest in this project in terms of staff time and project expenses? \$ _____, _____ staff

[IDEALLY, COLLECT DATA ON \$ AND STAFF TIME. HOWEVER, IT IS OKAY IF THE RESPONDENT CAN ONLY PROVIDE ONE OR THE OTHER (OR NEITHER).]

12. At the time the project began, were you considering alternatives to the ["product", "process", "technology" or "type of generation"] that you used in the NYSERDA project?

- a. Yes, explain: _____
- b. No
- c. Don't know

[IF Q12 = YES, PROCEED TO Q13. OTHERWISE, SKIP TO Q14.]

13. Looking back, do you think the ["product", "process", "technology" or "type of generation"] that you used in the NYSERDA project was the best alternative?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

14. Do you feel the [PROJECT DESCRIPTION] project was a good investment?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

15. In general terms, how would you describe your return on this project? [READ LIST TO RESPONDENT]

- a. Positive
- b. Negative
- c. Breakeven or neutral

16. Have you advertised or communicated the results of this project to any potential buyers, suppliers, or business partners?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

SECTION 3: DEMONSTRATION PROJECT IMPACTS

Now I would like to talk with you more about the project's benefits.

[NOTE: WHEN ASKING FOR BENEFITS DATA, TRY TO GET NUMERICAL UNITS AS OPPOSED TO PERCENTAGES. IF RESPONDENT REPORTS A PERCENTAGE OR PERCENTAGE CHANGE, ASK IF HE/SHE CAN NUMERICALLY QUANTIFY THE CHANGE, OR IF HE/SHE CAN PROVIDE THE BASELINE THAT THE PERCENTAGE CHANGE IS BASED ON.]

IF PROGRAM DATA INCLUDES RESOURCE TYPE, ASK Q17-Q21. OTHERWISE, ASK Q17D, THEN SKIP TO Q22.]

17A. NYSERDA program records indicate that this project resulted in [RESOURCE TYPE 1] benefits involving [RESOURCE TYPE 2]. [NOTE: IF A PROJECT HAS MORE THAN ONE ENTRY FOR "RESOURCE TYPE 1," ASK THE QUESTION SEPARATELY FOR EACH ENTRY.]

Is that correct?

- Yes [SKIP TO Q18]
- No [ASK Q17B]
- Don't know [ASK Q17B]

17B. Did you previously report these benefits to NYSERDA?

- Yes [ASK 17C]
- No [SKIP TO 17D]
- Don't know [SKIP TO 17D]

17C. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [OPEN-ENDED: FILL IN RESPONDENT'S ANSWER]

17D. Which of the following describe the specific types of benefits this project produced? For each benefit that your project produced, please state if it was a direct benefit, indirect benefit, or uncertain benefit. [READ THE LIST. CHECK ALL THAT APPLY. FOR EACH BENEFIT TYPE IDENTIFIED BY RESPONDENT, ASK RESPONDENT IF THIS IS A DIRECT BENEFIT, INDIRECT BENEFIT, OR UNCERTAIN BENEFIT. MAKE SURE TO ASK ABOUT ANY OTHER BENEFITS THAT WE MAY NOT HAVE MENTIONED.]

- | | | | |
|--|---------------------------------|-----------------------------------|------------------------------------|
| <input type="checkbox"/> Power production | <input type="checkbox"/> Direct | <input type="checkbox"/> Indirect | <input type="checkbox"/> Uncertain |
| <input type="checkbox"/> Energy efficiency | <input type="checkbox"/> Direct | <input type="checkbox"/> Indirect | <input type="checkbox"/> Uncertain |

- Air emissions Direct Indirect Uncertain
- Productivity Direct Indirect Uncertain
- Waste management Direct Indirect Uncertain
- Product quality/reliability improvement Direct Indirect Uncertain
- Water reductions Direct Indirect Uncertain
- Water quality Direct Indirect Uncertain
- Operations & Maintenance Direct Indirect Uncertain
- Marketability Direct Indirect Uncertain
- Demand reduction Direct Indirect Uncertain
- Reduced labor costs Direct Indirect Uncertain
- Reduced material costs Direct Indirect Uncertain
- Environmental quality improvement Direct Indirect Uncertain
- Knowledge creation Direct Indirect Uncertain
- Other *Specify:* _____ Direct Indirect Uncertain

[ASK Q18 – Q21 IF Q17A = 1/YES AND NET UNITS ARE NOT MISSING. OTHERWISE, SKIP TO Q22.]

18. NYSERDA's records indicate that this project produced [IF BENEFIT IS POWER PRODUCTION] saved [IF BENEFIT IS NOT POWER PRODUCTION]. **IF MORE THAN ONE BENEFIT IS REPORTED, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH REPORTED BENEFIT.**

_____ [Net Units] _____ [Unit Type] _____ [Metric Year]

Are these numbers correct?

- (1) Yes [SKIP TO Q23]
- (2) No [ASK Q19]

19. Did you previously report these numbers to NYSERDA?

- (1) Yes [ASK Q20]
- (2) No [SKIP TO Q21]
- (3) Don't know [SKIP TO Q21]

20. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [ASK OPEN-ENDED FIRST, READ PROMPTS IF NEEDED.]

- Performance of the equipment changed over time
- We decommissioned the project
- Benefits were realized prior to the first reporting year

- Additional benefits accrued over time
- Other, please specify: ____

21. Please estimate the actual benefits.

_____ Specify unit: _____ [kWh, kW, MMBtu, pounds of pollutant, etc.]. Year(s): _____

[ASK Q22 IF THE PROGRAM DATA DOES NOT INCLUDE NET UNITS. IF MORE THAN ONE BENEFIT, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH BENEFIT. ASK ABOUT ALL DIRECT AND INDIRECT BENEFITS; DO **NOT** ASK ABOUT UNCERTAIN BENEFITS.]

22. Please provide an estimate of the [REDUCTION IN / PRODUCTION OF] in [ENERGY, kW, EMISSIONS, ETC. – TAILOR TO SPECIFICS]. IF MORE THAN ONE BENEFIT IS REPORTED, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH REPORTED BENEFIT.]

_____ Specify unit: _____ [kWh, kW, MMBtu, pounds of pollutant, etc.] Year(s): _____

[ASK Q23 IF RESPONDENT DID NOT ANSWER Q21 OR Q22. IF RESPONDENT ANSWERED Q21 OR Q22, SKIP TO Q24.]

23. Besides [METRIC YEAR(S) REPORTED IN THE DATABASE], has the project produced any other [UNIT TYPE] benefits?

- (1) Yes, explain: [Net Units] [Unit Type] [Metric Year(s)]
- (2) No
- (3) Don't know

23-AA. Besides [UNIT TYPE], has the project produced any other types of benefits?

- (1) Yes [IF YES, LOOP BACK TO Q17D]
- (2) No
- (3) Don't know

[IF PROGRAM DATA INCLUDES NET DOLLARS, ASK Q24-27. OTHERWISE, SKIP TO Q28.]

24. NYSERDA's records indicate that this project [GENERATED/SAVED]:

[Net Dollars] [Metric Year(s)]

Are these numbers correct?

- (1) Yes [SKIP TO Q32]
- (2) No [ASK Q25]

25. Did you previously report these numbers to NYSERDA?

- (1) Yes [ASK Q26]
- (2) No [SKIP TO Q27]
- (3) Don't know [SKIP TO Q27]

26. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [OPEN-ENDED] _____

27. Please estimate the actual net dollars in [REVENUE/COST SAVINGS] from this project:

\$_____, year(s): _____

[ASK Q28 IF THE PROGRAM DATA DOES NOT INCLUDE NET DOLLARS. OTHERWISE, SKIP TO Q32]

28. Did this project generate any revenue?

- (1) Yes [ASK Q29]
- (2) No [SKIP TO Q30]
- (3) Don't know [SKIP TO Q30]

29. Please provide an estimate of the revenue generated from this project.

\$_____, year(s): _____

30. Did this project generate any cost savings?

- (1) Yes [ASK Q31]
- (2) No [SKIP TO Q33]
- (3) Don't know [SKIP TO Q33]

31. Please provide an estimate of the cost savings generated from this project.

\$_____, year(s): _____

[ASK Q32 IF RESPONDENT DID NOT ANSWER Q27, Q29, OR Q31. IF RESPONDENT ANSWERED Q27, Q29, OR Q31, SKIP TO Q33.]

32. Besides [METRIC YEAR(S) REPORTED IN THE DATABASE], has the project generated any other [REVENUE/COST SAVINGS]?

- (1) Yes, amount: \$_____
- (2) No
- (3) Don't know

33. Who were the primary end users for this project?

_____ [RECORD OPEN-ENDED RESPONSE]

34. Did you receive any feedback from end-users from this project site?

- a. (1) Yes
- b. (2) No
- c. (3) Don't know

[IF YES, PROCEED TO Q35. IF NO OR DON'T KNOW, SKIP TO Q36]

35. Was the feedback useful for understanding whether or how the technology worked?

- a. (1) Yes
- b. (2) No
- c. (3) Don't know

SECTION 4: NYSERDA INFLUENCE ON THE DEMONSTRATION PROJECT

I would now like to discuss your interactions with NYSERDA concerning the [SUMMARY OF DEMONSTRATION PROJECT] Project.

36. When did you learn about NYSERDA's R&D program? [READ THE LIST OF RESPONSE OPTIONS, EXCEPT "DON'T KNOW"]

- a. (1) Before you began planning this project
- b. (2) During the planning process but before the plans were finalized
- c. (3) After the plans were finalized
- d. (4) After project implementation started
- e. (5) Don't know

37. Did NYSERDA provide technical assistance for this project?

- a. (1) Yes, explain: _____ Type of assistance: _____ Identify source: _____
- b. (2) No
- c. (3) Don't know

38. Did sources other than NYSERDA provide technical assistance for this project?

- a. (1) Yes, explain: _____ Type of assistance: _____ Identify source: _____
- b. (2) No
- c. (3) Don't know

39. Did sources other than NYSERDA provide funding for this project?

- a. (1) Yes, explain _____ \$_____ Identify source: _____
- b. (2) No
- c. (3) Don't know

40. On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's **financial** assistance in your decision to do this project?

(Not at all important) (Very important)
0 1 2 3 4 5

[ASK Q41 ONLY IF Q37 = "YES". IF Q37 = "NO" OR "DON'T KNOW", RECORD 0.]

41. On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's **technical** assistance in your decision to do this project?

(Not at all important) (Very important)
0 1 2 3 4 5

[POLICY ANALYST PERFORM CALCULATION #2: RECORD THE HIGHER SCORE OF Q40 OR Q41. DO NOT READ TO THE RESPONDENT: _____]

42. What is the likelihood that your firm would have completed this project in New York without NYSERDA's **financial** assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)
0 1 2 3 4 5

[ASK Q43 ONLY IF Q37 = "YES". IF Q37 = "NO" OR "DON'T KNOW", RECORD 0.]

43. What is the likelihood that your firm would have completed this project in New York without NYSERDA's **technical** assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)
0 1 2 3 4 5

[POLICY ANALYST PERFORM CALCULATION #3A: RECORD THE LOWER SCORE OF Q42 OR Q43: ____
CALCULATION #3B: TAKE THE INVERSE OF 3A. FOR EXAMPLE, 0 BECOMES 5, 1 BECOMES 4, ETC.
DO NOT READ TO THE RESPONDENT: _____]

44. Overall, without NYSERDA's involvement would the **magnitude** of the impacts for this project have been of the same size, smaller, or larger?

- a. (1) Lower
- b. (2) Same
- c. (3) Higher
- d. (4) Not Comparable, specify
- e. (5) Don't know

[IF Q52 = 4]

53b. Why are the impacts not comparable to the original demonstration project?

[IF MORE THAN 5 REPLICATIONS, ASK Q53 AND Q54 FOR THE MOST RECENT 5 ONLY. IF 5 OR FEWER REPLICATIONS, ASK FOR ALL.]

53. How did the ____ [Net Units and Unit Type] of the replications compare to the original demonstration?

	Replication				
	1	2	3	4	5
Lower than Original Demo	<input type="checkbox"/>				
The same size	<input type="checkbox"/>				
Higher than Original Demo	<input type="checkbox"/>				
Not Comparable, specify	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

54. How did the ____ [net dollars SAVED/GENERATED] of the replications compare to the original demonstration?

	Replication				
	1	2	3	4	5
Lower than Original Demo	<input type="checkbox"/>				
The same size	<input type="checkbox"/>				
Higher than Original Demo	<input type="checkbox"/>				
Not Comparable, specify	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

55. Did NYSERDA provide funding assistance, technical assistance, both of these or other assistance for the replications?

	Replication				
	1	2	3	4	5
Yes, Funding	<input type="checkbox"/>				

Yes, Technology Assistance	<input type="checkbox"/>				
Yes, Both Funding & Technology Assistance	<input type="checkbox"/>				
Yes, Other: _____	<input type="checkbox"/>				
No	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

56. Did any sources other than NYSERDA provide funding for the replications?

- a. (1) Yes, amount \$
- b. (2) No
- c. (3) Don't know

[IF "YES", PROCEED TO Q57. OTHERWISE, SKIP TO Q58]

57. What were the other funding sources?

- a. (1) Investment Capital (internally financed, investment financed through venture capital or stocks, loan) Estimated % of total funding
- b. (2) Federal Government Grant or Subsidized Financing Estimated % of total funding
- c. (3) NYS agency Grant or Subsidized Financing Estimated % of total funding
Specify NYS agency
- d. (4) Other private grant or philanthropic contribution Estimated % of total funding
- e. (5) Utility program Estimated % of total funding
- f. (6) Other, specify Estimated % of total funding
- g. (7) Don't know Estimated % of total funding

58. [On a scale of 0 to 5, where 0 = "strongly disagree" and 5 = "strongly agree," to what extent do you agree or disagree with the following statement: "Overall, the NYSERDA-funded demonstration project was critical for developing the replication project(s)."

(Strongly disagree) (Strongly agree)
0 1 2 3 4 5

[IF Q58 =>3, ASK Q59. OTHERWISE, SKIP TO Q60.]

59. Please briefly describe how NYSERDA's assistance with the demonstration project influenced the ability to do the replication projects.

60. What is the likelihood that these replication projects would have been developed in New York without the NYSERDA-funded demonstration project? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)
0 1 2 3 4 5

61. Without the NYSERDA-funded demonstration project, would the **magnitude** of the impacts for these replication projects have been of the same size, smaller or larger?

- a. Same
- b. Smaller
- c. Larger
- d. Replication project(s) would not have happened without NYSERDA
- e. Don't know [DO NOT READ]

62. Without the NYSERDA-funded demonstration project, would the replication projects have occurred sooner, at about the same time, or later?

- a. Earlier: ___ years earlier [ASK RESPONDENT TO ESTIMATE YEARS]
- b. About the same time
- c. Later: ___ years later [ASK RESPONDENT TO ESTIMATE YEARS]
- d. Project(s) would not have occurred without NYSERDA
- e. Don't know [DO NOT READ]

[POLICY ANALYST CALCULATION #6A: IF Q61 = A OR C, RECORD -1. IF Q61 = B, D, OR E RECORD 0.

POLICY ANALYST CALCULATION #6B: IF Q62 = A, RECORD -1. IF Q62 = B OR E, RECORD 0. IF Q62 = C OR D, RECORD +1.

POLICY ANALYST CALCULATION #6C: TAKE THE INVERSE OF Q60. E.G., 0 BECOMES 5, 1 BECOMES 4, ETC.

POLICY ANALYST CALCULATION #6D: TAKE THE AVERAGE OF #6C AND Q58.

POLICY ANALYST CALCULATION #7: ADD THE RESULTS OF CALCULATION #6A, CALCULATION #6B, CALCULATION #6D, AND CALCULATION #1: _____

DO NOT READ TO RESPONDENT]

-[SKIP SECTION 6 IF Q46 =YES and Q49>0]

SECTION 6: NON-REPLICATIONS

63. What do you think are the reasons why the NYSERDA project was not replicated in New York?

64. Do you expect the NYSERDA project will be replicated in New York at some point in the future?

- a. (1) Yes [REASONS]
- b. (2) No [REASONS]

SECTION 7: PROCESS EVALUATION

65. How did you become aware of NYSERDA and the potential for NYSERDA assistance?

[DO NOT READ, MARK ALL STATED IN REPLY]

- a. (1) Prior participation in a NYSERDA R&D program
- b. (2) Another NYSERDA program
- c. (3) Advertising
- d. (4) Word-of-mouth (PROBE FOR FOLLOWING):
 - a) Business colleague/client
 - b) Friend/relative

- e. (5) Contacted by a NYSERDA program representative
- f. (6) Visit to another NYSERDA demonstration project
- g. (7) Other

Please rate your agreement or disagreement with the following statements. Please use a 1 to 5 scale where 5 indicates strongly agree, 4 indicates agree, 3 indicates neither agree nor disagree, 2 indicates disagree, and 1 is strongly disagree.

66. NYSERDA provides technical information that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
67. NYSERDA provides marketing information that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
68. NYSERDA provides market intelligence that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
69. NYSERDA communicates well with demonstration project participants.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
70. NYSERDA provides assistance in a timely manner.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
71. NYSERDA staff members working with this program are well qualified.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
72. NYSERDA's credibility is an important catalyst for demonstration projects in New York.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
73. NYSERDA provides technical information that supports the replication process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
74. Overall, I am satisfied with my participation in NYSERDA's R&D program.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A

75. Besides increasing financial incentives, how could NYSERDA improve its R&D program to encourage more demonstration projects such as this? [LIST]

76. Besides increasing financial incentives, how could NYSERDA improve its R&D program to encourage more replications of its demonstration projects? [LIST]

SECTION 8: INTEGRATOR FIRMOGRAPHICS

I want to complete our interview with a few final questions about your firm.

77. What is the firm's principal business activity?

78. How many employees does the firm have overall? [APPROXIMATE NUMBER IS ADEQUATE.]

79. How many employees does the firm have in New York? [APPROXIMATE NUMBER IS ADEQUATE.]

[IF THE PROGRAM DATA INCLUDES JOBS CREATED/RETAINED, ASK Q80. OTHERWISE, SKIP TO Q83.]

80. Our records indicate that [COMPANY NAME] [CREATED/RETAINED] [NUMBER] jobs due to the NYSERDA demonstration project. Is this correct?

- a. Yes [SKIP TO Q86]
- b. No [ASK Q81]
- c. Don't Know [DO NOT READ. IF RESPONDENT DOES NOT KNOW, SKIP TO Q84.]

81. Did you report these numbers to NYSERDA?

- a. Yes [ASK Q82]
- b. No [SKIP TO Q83]
- c. Don't Know [SKIP TO Q83.]

82. Do you know why there is a difference between NYSERDA's records and the information you currently have? [ASK OPEN-ENDED FIRST, READ PROMPTS IF NEEDED]

- a. The company [ADDED/LOST] jobs after reporting the numbers to NYSERDA due to factors related to the demonstration project.
- b. The company [ADDED/LOST] jobs after reporting the numbers to NYSERDA due to factors unrelated to the demonstration project.
- c. Other, please specify: _____

83. Has the NYSERDA-funded demonstration project affected the firm's number of employees in New York?

- a. Yes
- b. No [SKIP Q84 and Q85]

84. How has the NYSERDA-funded demonstration project affected the firm's number of employees in New York?

- a. Created/retained jobs
- b. Lost jobs

85. How many jobs were [created/retained FOR Q84=A] [eliminated for Q84=B]?

- a. _____
- b. Don't know (DO NOT READ.)

86. Can NYSERDA call you back at a later time to obtain more information about the NYSERDA R&D Program?

- a. Yes
- b. No

ON BEHALF ON NYSERDA, THANK YOU FOR YOUR TIME IN HELPING US CONDUCT THIS RESEARCH.
HAVE A GREAT DAY.

NYSERDA
Demonstration Project Survey

VENDORS

Interview Date: [mm/dd/yyyy]

Interviewer name:

Interviewer phone:

CNTRCT_ID:

Project Description:

Best Contact:

NYSERDA Project Manager

PI First Name and PI Last Name

Title:

Phone:

Email:

Project Role:

Company Name:

Program Area: [Buildings, Transportation, Energy Resources, etc.]

Project Type: [PRODUCT, PROCESS OR POWER PRODUCTION]

NYSERDA \$ (Encumbered \$ for this project.)

Earliest contract signed date

Latest contract closed date

Location

THE POLICY ANALYST CONDUCTING THE INTERVIEW WILL WORK THROUGH THE INSTRUMENT USING THE SPECIFIC DATASET INPUT AND PROJECT DESCRIPTION TO REFINE QUESTION WORDING AS NECESSARY TO PROVIDE CLEAR LANGUAGE AND TO OBTAIN THE INFORMATION DESIRED FROM EACH QUESTION. GIVEN THE INFORMATION IN THE DATASET, THE SURVEY INSTRUMENT FOR EACH INTERVIEW WILL BE MARKED FOR THE APPROPRIATE HANDLING OF QUESTIONS AND SKIP PATTERNS REGARDING THE IMPACTS FROM THE DEMONSTRATION PROJECT (QUESTIONS 17 THROUGH 32).

Identify the Appropriate Contact

Hello, my name is [interviewer name], and I am calling from [company name] on behalf of the New York State Energy Research and Development Authority, also known as NYSERDA. NYSERDA is conducting a study to assess the impact of its funding on New York State companies and on the State's economy. This study will also assess the impact of its funding and technological support on [use "product", "process", or "generation" depending on participant] demonstration projects conducted in New York State.

NYSERDA has contracted with Industrial Economics, Incorporated and APPRISE to perform this study. IEC and APPRISE are independent research and consulting firms. I would like to ask some questions about your involvement in a completed NYSERDA demonstration project – the [SUMMARIZE FROM CONTRACT DESCRIPTION]. The information you provide will be kept confidential to the extent permitted by law. We will report all responses in aggregate and will not attribute any comments to you. The information you provide will be used to improve NYSERDA's research and development programs. NYSERDA is contacting all participants who completed demonstration projects within the last five years.

SCREENING

Our records show that NYSERDA provided \$_____ in funding to [COMPANY NAME] for the demonstration project [CONTRACT DESCRIPTION], and that your company provided the [PRODUCT / PROCESS / TECHNOLOGY / GENERATOR] for the project.

SCR-1. This survey will take about one hour to complete. We would like to talk to the person who is most knowledgeable about the project. If not you, could you please direct me to, or provide me with the name of the person who is the most qualified to discuss this project?

- a. Caller [PROCEED TO SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW]
- b. Most qualified contact [CONTACT THIS PERSON, REPEAT INITIAL INTRODUCTION AND THE INTRODUCTION TO THE SCREENING SECTION, AND CONTINUE WITH THE FOLLOWING QUESTION]

SCR-2 Mr./Ms. [name] referred me to you to answer specific about this project [DESCRIBE PROJECT BRIEFLY as this is another person]. This survey will take about one hour to complete. Can we discuss the project now, or can we schedule a time when I can call you back?

- a. Can discuss now [PROCEED TO SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW]
- b. Call back on _____ at time:
- c. [IF THIS PERSON IS NOT THE MOST QUALIFIED PERSON, LOOP BACK TO SCR-1]

SCR-3 Which of the following best describes your role in the [PROJECT]? [READ ALL CHOICES TO RESPONDENT AND SELECT THE MOST APPROPRIATE CHOICE.]

- a. I provided the [PRODUCT/PROCESS/TECHNOLOGY/TYPE OF GENERATION... tailor to the project based on project type] for this project. [USE VENDOR SURVEY INSTRUMENT]
- b. I am the site owner. [USE SITE OWNER SURVEY INSTRUMENT]
- c. I developed the project and brought together the vendor, site owner, and other market actors. [USE INTEGRATOR SURVEY INSTRUMENT]

SCR-4 Do you have any reports or presentations that describe the results of the [PROJECT]?

- a. Yes [ASK THE RESPONDENT TO SEND THE REPORTS IN ADVANCE OF THE CALL]
- b. No
- c. Don't Know [ASK THE RESPONDENT TO CHECK AND SEND WHAT THEY HAVE IN ADVANCE OF THE CALL]

SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW

[NOTE: PRIOR TO BEGINNING THE DISCUSSION, ASK THE RESPONDENT WHETHER OR NOT IT IS OKAY TO RECORD THE CALL.]

1. Our records show that NYSERDA provided funding to [COMPANY NAME] for a project involving [CONTRACT DESCRIPTION]. Is this an accurate description of the project?
- a) (1) Yes
 - b) (2) No

[IF Q1 = YES, SKIP TO Q3. IF Q1 = NO, ASK Q2.]

2. How would you describe the project?

Record open-ended response: _____

3. Is this the first time your firm provided the ["product", "process", "technology" or "type of generation"tailor to project based on PROJECT TYPE] for this particular type of project?
- a) (1) Yes
 - b) (2) No
 - c) (3) Don't know

[IF Q3 = NO, PROCEED TO Q4. OTHERWISE, SKIP TO Q6]

4. How many times had your firm sold the ["product", "process", "technology" or "type of generation"tailor to project] for this particular type of project prior to the [reference NYSERDA demo project]?
- a) [RECORD THE NUMBER OF TIMES]
 - b) Don't know

5. How did [reference NYSERDA demo project] differ from previous uses of this ["product", "process", "technology" or "type of generation"tailor to project]?

RECORD VERBATIM RESPONSE: _____

- a) _____
- b) _____
- c) _____

[RECORD VERBATIM COMMENTS FIRST; DO NOT READ LIST. THEN, LOOK AT THE LIST AND VERIFY THE RELEVANT SELECTION(S) WITH RESPONDENT.]

- d) No difference
- e) Smaller in scale than previous projects of this type
- f) Larger in scale than previous projects of this type
- g) Different inputs
- h) Different application of the technology
- i) Different type of facility

[POLICY ANALYST CALCULATION #1: DO NOT READ TO SURVEY RESPONDENT.]

STEP ONE: IF Q3 = "YES" OR "DON'T KNOW", RECORD 0 ON THE LINE BELOW. SKIP STEP TWO.
STEP TWO: IF Q3 = "NO", LOOK AT ANSWER TO Q5. IF Q5 = D ONLY OR E ONLY, RECORD -1. ELSE RECORD 0.

CALCULATION #1: _____]

6. Now I would like to discuss the [SUMMARIZE CONTRACT DESCRIPTION] Project. How would you describe the objectives of this project? [OPEN-ENDED QUESTION TO PRIME THE RESPONDENT'S THINKING]

7a. Were you involved with planning or executing this project?

- a. Yes [ASK Q7B]
- b. No [SKIP TO Q9]

7b-1. Can you identify specific challenges you faced when planning this project? [ASK UNPROMPTED FIRST.]

- a. _____
- b. _____
- c. _____

[PROMPT - BE CAREFUL NOT TO BIAS OR INFLUENCE RESPONSE, SUGGEST CODE FOR ANSWERS PROVIDED ABOVE IF APPROPRIATE]

- d. Lack of funding
- e. Cost prohibitive
- f. Lack of qualified personnel or expertise
- g. Lack of interest among potential end users
- h. Could not find an appropriate site
- i. Timing was not right
- j. Regulatory barriers
- k. Technological issues
- l. Other - specify: _____

7b-2. Can you identify specific challenges you faced when executing this project? [ASK UNPROMPTED FIRST.]

- a. _____
- b. _____
- c. _____

[PROMPT - BE CAREFUL NOT TO BIAS OR INFLUENCE RESPONSE, SUGGEST CODE FOR ANSWERS PROVIDED ABOVE IF APPROPRIATE]

- d. Lack of funding
- e. Cost prohibitive
- f. Lack of qualified personnel or expertise
- g. Lack of interest among potential end users
- h. Could not find an appropriate site
- i. Timing was not right
- j. Regulatory barriers
- k. Technological issues
- l. Other - specify: _____

8a. Can you identify any benefits that you received from planning this project?

8b. Can you identify any benefits that you received from executing this project?

9. Overall, do you feel this project accomplished all, most, some, or none of its objectives?

- a. All
- b. Most
- c. Some
- d. None
- e. Don't know / refused [DO NOT READ THIS OPTION]

[IF RESPONDENT SELECTS "ALL" OR "DON'T KNOW," SKIP TO Q11. OTHERWISE, ASK Q10.]

10. Please explain why this project did not accomplish all of its objectives: _____

SECTION 2: COST EFFECTIVENESS

Now I would like to ask about the cost-effectiveness of the project.

11. NYSERDA furnished a grant for [NYSERDA \$]. In addition to that amount, how much did your firm invest in this project in terms of staff time and project expenses? \$ _____, _____ staff

[IDEALLY, COLLECT DATA ON \$ AND STAFF TIME. HOWEVER, IT IS OKAY IF THE RESPONDENT CAN ONLY PROVIDE ONE OR THE OTHER (OR NEITHER)].

12. At the time the project began, were you considering alternative customers or applications for the ["product", "process", "technology" or "type of generation"] that you used in the NYSERDA project?

- a. Yes, explain: _____
- b. No
- c. Don't know

[IF Q12 = YES, PROCEED TO Q13. OTHERWISE, SKIP TO Q14.]

13. Looking back, do you think that providing the ["product", "process", "technology" or "type of generation"] for the demonstration project was the best alternative for your firm?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

14. Do you feel that the [PROJECT DESCRIPTION] project was a good investment?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

15. In general terms, how would you describe your return on this project? [READ LIST TO RESPONDENT]

- a. Positive
- b. Negative
- c. Breakeven or neutral

16. Have you advertised or communicated the results of this project to any potential buyers, suppliers, or business partners?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

SECTION 3: DEMONSTRATION PROJECT IMPACTS

Now I would like to talk with you more about the project's benefits.

[NOTE: WHEN ASKING FOR BENEFITS DATA, TRY TO GET NUMERICAL UNITS AS OPPOSED TO PERCENTAGES. IF RESPONDENT REPORTS A PERCENTAGE OR PERCENTAGE CHANGE, ASK IF HE/SHE CAN NUMERICALLY QUANTIFY THE CHANGE, OR IF HE/SHE CAN PROVIDE THE BASELINE THAT THE PERCENTAGE CHANGE IS BASED ON.]

[IF PROGRAM DATA INCLUDES RESOURCE TYPE, ASK Q17-Q21. OTHERWISE, ASK Q17D, THEN SKIP TO Q22.]

17A. NYSERDA program records indicate that this project resulted in [RESOURCE TYPE 1] benefits involving [RESOURCE TYPE 2]. [NOTE: IF A PROJECT HAS MORE THAN ONE ENTRY FOR "RESOURCE TYPE 1," ASK THE QUESTION SEPARATELY FOR EACH ENTRY.]

Is that correct?

- Yes [SKIP TO Q18]
- No [ASK Q17B]
- Don't know [ASK Q17B]

17B. Did you previously report these benefits to NYSERDA?

- Yes [ASK 17C]
- No [SKIP TO 17D]
- Don't know [SKIP TO 17D]

17C. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [OPEN-ENDED: FILL IN RESPONDENT'S ANSWER]

17D. Which of the following describe the specific types of benefits this project produced? For each benefit that your project produced, please state if it was a direct benefit, indirect benefit, or uncertain benefit. [READ THE LIST. CHECK ALL THAT APPLY. FOR EACH BENEFIT TYPE IDENTIFIED BY RESPONDENT, ASK RESPONDENT IF THIS IS A DIRECT BENEFIT, INDIRECT BENEFIT, OR UNCERTAIN BENEFIT. MAKE SURE TO ASK ABOUT ANY OTHER BENEFITS THAT WE MAY NOT HAVE MENTIONED.]

- Power production
- Direct
- Indirect
- Uncertain

- Energy efficiency Direct Indirect Uncertain
- Air emissions Direct Indirect Uncertain
- Productivity Direct Indirect Uncertain
- Waste management Direct Indirect Uncertain
- Product quality/reliability improvement Direct Indirect Uncertain
- Water reductions Direct Indirect Uncertain
- Water quality Direct Indirect Uncertain
- Operations & Maintenance Direct Indirect Uncertain
- Marketability Direct Indirect Uncertain
- Demand reduction Direct Indirect Uncertain
- Reduced labor costs Direct Indirect Uncertain
- Reduced material costs Direct Indirect Uncertain
- Environmental quality improvement Direct Indirect Uncertain
- Knowledge creation Direct Indirect Uncertain
- Other *Specify:* _____ Direct Indirect Uncertain

[ASK Q18 – Q21 IF Q17A = 1/YES AND NET UNITS ARE NOT MISSING. OTHERWISE, SKIP TO Q22.]

18. NYSERDA's records indicate that this project produced [IF BENEFIT IS POWER PRODUCTION] saved [IF BENEFIT IS NOT POWER PRODUCTION]. **IF MORE THAN ONE BENEFIT IS REPORTED, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH REPORTED BENEFIT.**

_____ [Net Units] _____ [Unit Type] _____ [Metric Year]

Are these numbers correct?

- (1) Yes [SKIP TO Q23]
- (2) No [ASK Q19]

19. Did you previously report these numbers to NYSERDA?

- (1) Yes [ASK Q20]
- (2) No [SKIP TO Q21]
- (3) Don't know [SKIP TO Q21]

20. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [ASK OPEN-ENDED FIRST, READ PROMPTS IF NEEDED.]

- Performance of the equipment changed over time
- We decommissioned the project

- Benefits were realized prior to the first reporting year
- Additional benefits accrued over time
- Other, please specify: ____

21. Please estimate the actual benefits.

_____ Specify unit: _____ [kWh, kW, MMBtu, pounds of pollutant, etc.]. Year(s): _____

[ASK Q22 IF THE PROGRAM DATA DOES NOT INCLUDE NET UNITS. IF MORE THAN ONE BENEFIT, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH BENEFIT. ASK ABOUT ALL DIRECT AND INDIRECT BENEFITS; DO NOT ASK ABOUT UNCERTAIN BENEFITS.]

22. Please provide an estimate of the [REDUCTION IN / PRODUCTION OF] in [ENERGY, kW, EMISSIONS, ETC. – TAILOR TO SPECIFICS]. IF MORE THAN ONE BENEFIT IS REPORTED, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH REPORTED BENEFIT.]

_____ Specify unit: _____ [kWh, kW, MMBtu, pounds of pollutant, etc.] Year(s): _____

[ASK Q23 IF RESPONDENT DID NOT ANSWER Q21 OR Q22. IF RESPONDENT ANSWERED Q21 OR Q22, SKIP TO Q24.]

23. Besides [METRIC YEAR(S) REPORTED IN THE DATABASE], has the project produced any other [UNIT TYPE] benefits?

- (1) Yes, explain: [Net Units] [Unit Type] [Metric Year(s)]
- (2) No
- (3) Don't know

23-AA. Besides [UNIT TYPE], has the project produced any other types of benefits?

- (1) Yes [IF YES, LOOP BACK TO Q17D]
- (2) No
- (3) Don't know

[IF PROGRAM DATA INCLUDES NET DOLLARS, ASK Q24-27. OTHERWISE, SKIP TO Q28.]

24. NYSERDA's records indicate that this project [GENERATED/SAVED]:

[Net Dollars] [Metric Year(s)]

Are these numbers correct?

- (1) Yes [SKIP TO Q32]
- (2) No [ASK Q25]

25. Did you previously report these numbers to NYSERDA?

- (1) Yes [ASK Q26]
- (2) No [SKIP TO Q27]
- (3) Don't know [SKIP TO Q27]

26. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [OPEN-ENDED] _____

27. Please estimate the actual net dollars in [REVENUE/COST SAVINGS] from this project:

\$_____, year(s): _____

[ASK Q28 IF THE PROGRAM DATA DOES NOT INCLUDE NET DOLLARS. OTHERWISE, SKIP TO Q32]

28. Did this project generate any revenue?

- (1) Yes [ASK Q29]
- (2) No [SKIP TO Q30]
- (3) Don't know [SKIP TO Q30]

29. Please provide an estimate of the revenue generated from this project.

\$_____, year(s): _____

30. Did this project generate any cost savings?

- (1) Yes [ASK Q31]
- (2) No [SKIP TO Q33]
- (3) Don't know [SKIP TO Q33]

31. Please provide an estimate of the cost savings generated from this project.

\$_____, year(s): _____

[ASK Q32 IF RESPONDENT DID NOT ANSWER Q27, Q29, OR Q31. IF RESPONDENT ANSWERED Q27, Q29, OR Q31, SKIP TO Q33.]

32. Besides [METRIC YEAR(S) REPORTED IN THE DATABASE], has the project generated any other [REVENUE/COST SAVINGS]?

- (1) Yes, amount: \$_____
- (2) No
- (3) Don't know

33. Who were the primary end users for this project?

[RECORD OPEN-ENDED RESPONSE]

34. Did you receive any feedback from end-users from this project site?
- a. (1) Yes
 - b. (2) No
 - c. (3) Don't know

[IF YES, PROCEED TO Q35. IF NO OR DON'T KNOW, SKIP TO Q36]

35. Was the feedback useful for understanding whether or how the technology worked?
- a. (1) Yes
 - b. (2) No
 - c. (3) Don't know

SECTION 4: NYSERDA INFLUENCE ON THE DEMONSTRATION PROJECT

I would now like to discuss your interactions with NYSERDA concerning the [SUMMARY OF DEMONSTRATION PROJECT] Project.

36. When did you learn about NYSERDA's R&D program? [READ THE LIST OF RESPONSE OPTIONS, EXCEPT "DON'T KNOW"]
- a. (1) I have not heard of NYSERDA's R&D program
 - b. (2) Before you began planning this project
 - c. (3) During the planning process but before the plans were finalized
 - d. (4) After the plans were finalized
 - e. (5) After project implementation started
 - f. (6) Don't know
37. Did NYSERDA provide technical assistance for this project?
- a. (1) Yes, explain: _____ Type of assistance: _____ Identify source: _____
 - b. (2) No
 - c. (3) Don't know
38. Did sources other than NYSERDA provide technical assistance for this project?
- a. (1) Yes, explain: _____ Type of assistance: _____ Identify source: _____
 - b. (2) No
 - c. (3) Don't know
39. Did sources other than NYSERDA provide funding for this project?
- a. (1) Yes, explain _____ \$_____ Identify source: _____

- b. (2) No
- c. (3) Don't know

40. On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's **financial** assistance in the decision to do this project?

(Not at all important) (Very important)
 0 1 2 3 4 5

[ASK Q41 ONLY IF Q37 = "YES". IF Q37 = "NO" OR "DON'T KNOW", RECORD 0.]

41. On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's **technical** assistance in the decision to do this project?

(Not at all important) (Very important)
 0 1 2 3 4 5

[POLICY ANALYST PERFORM CALCULATION #2: RECORD THE HIGHER SCORE OF Q40 OR Q41. DO NOT READ TO THE RESPONDENT: _____]

42. What is the likelihood that this demonstration project would have been completed in New York without NYSERDA's **financial** assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)
 0 1 2 3 4 5

[ASK Q43 ONLY IF Q37 = "YES". IF Q37 = "NO" OR "DON'T KNOW", RECORD 0.]

43. What is the likelihood that this demonstration project would have been completed in New York without NYSERDA's **technical** assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)
 0 1 2 3 4 5

[POLICY ANALYST PERFORM CALCULATION #3A: RECORD THE LOWER SCORE OF Q42 OR Q43: ____
 CALCULATION #3B: TAKE THE INVERSE OF 3A. FOR EXAMPLE, 0 BECOMES 5, 1 BECOMES 4, ETC.
 DO NOT READ TO THE RESPONDENT: _____]

44. Overall, without NYSERDA's involvement would the **magnitude** of the impacts for this project have been of the same size, smaller, or larger?

- a. Same
- b. Smaller
- c. Larger
- d. Project would not have happened without NYSERDA
- e. Don't know [DO NOT READ]

45. I would now like to ask you about how, if at all, NYSERDA's support affected the timing of the project. Without NYSERDA's support, would this project have occurred earlier, at about the same time, or later?

- a. Earlier: ___ years earlier [ASK RESPONDENT TO ESTIMATE YEARS]
- b. About the same time
- c. Later: ___ years later [ASK RESPONDENT TO ESTIMATE YEARS]
- d. Project would not have happened without NYSERDA
- e. Don't know [DO NOT READ]

[POLICY ANALYST CALCULATION #4A: IF Q44 = A OR C, RECORD -1. IF Q44 = B, D OR E, RECORD 0. DO NOT READ TO THE RESPONDENT: _____.]

[POLICY ANALYST CALCULATION #4B: IF Q45 = A, RECORD -1. IF Q45 = B OR E, RECORD 0. IF Q45 = C OR D, RECORD +1.]

[CALCULATION #5: TAKE THE AVERAGE OF CALCULATION #2 AND #3B. THEN, ADD THE RESULTS OF CALCULATIONS #1, #4A, AND #4B.

RECORD YOUR ANSWER HERE: _____. DO NOT READ TO THE SURVEY RESPONDENT.]

SECTION 5: REPLICATIONS

I have some questions now concerning your experience with demonstration projects and replications. NYSERDA classifies the project we have been discussing as a demonstration project.

We define a **demonstration** project as the demonstration of a new technology or process or application of an existing technology in a commercial setting. Demonstration projects are designed to showcase the value and effectiveness of the technology or process being demonstrated.

We define **replication** as additional sales of the same technology or services that were used in the NYSERDA-funded demonstration project. These additional sales could be to the same buyer that participated in the demonstration project or a different buyer.

46. NYSERDA funded the [SUMMARY OF DEMO PROJECT] demonstration project in [MONTH/YEAR]. Since that time, has your firm or another firm sold the technology used in the NYSERDA demonstration project for **similar** applications?

- a. (1) Yes Number of sales?: Total sales revenue? \$____Month, Year

- b. (2) No [IF MORE THAN 5, GET DATES FOR THE MOST RECENT 5]
- c. (3) Don't know

47. Has your firm or another firm sold the technology used in the NYSERDA demonstration project for a **different** application?
- a. (1) Yes Number of sales?: Total sales revenue? \$____Month, Year
 - b. (2) No [IF MORE THAN 5, GET DATES FOR THE MOST RECENT 5]
 - c. (3) Don't know

[IF Q47 = YES, ASK Q48. OTHERWISE, SKIP TO Q49.]

48. In what way was the application of the technology different from the original NYSERDA demonstration project? [RECORD OPEN-ENDED RESPONSES.]

[CONTINUE WITH Q49 IF Q46 = YES; SKIP TO Q63 IF Q46 = NO OR DON'T KNOW.]

49. Please estimate the sales of this technology for similar applications in New York since the completion of the NYSERDA demonstration project. [DO NOT ENTER "DON'T KNOW". QUESTION RESPONDENT TO GET AN ESTIMATE.]
- No. of sales: _____ \$_____

[IF Q49 = (0,\$0), SKIP TO Q63]

50. From the time that the NYSERDA demonstration project was operational, how long did it take to find the next customer in New York that wanted to use the technology for a similar application? From the NYSERDA demonstration project to the second project? To the third project? [GET NUMBER OF YEARS AND/OR MONTHS]
- a. First replication
 - b. Next replication
 - c. Next replication
51. What are the primary reasons other projects were able to apply the technology used in the demonstration project? [READ THE LIST OF OPTIONS, EXCEPT OTHER]
- a. (1) Technical expertise gained
 - b. (2) Financing available
 - c. (3) Location available
 - d. (4) Requested by building owner
 - e. (5) Operating conditions were right
 - f. (6) Demonstrable savings were achieved
 - g. (7) Other [LIST]

[IF 5 OR FEWER REPLICATIONS SKIP TO Q53.]

52. On average over all similar replications completed in New York State, how did the ___ [Unit Type] of the replications compare to the original demonstration? [IF MORE THAN ONE TYPE OF BENEFIT, ASK FOR EACH DIRECT BENEFIT TYPE.]

- a. (1) Lower
- b. (2) Same
- c. (3) Higher
- d. (4) Not Comparable, specify
- e. (5) Don't know

[IF Q52 = 4]

53b. Why are the impacts not comparable to the original demonstration project?

[IF MORE THAN 5 REPLICATIONS, ASK Q53 AND Q54 FOR THE MOST RECENT 5 ONLY. IF 5 OR FEWER REPLICATIONS, ASK FOR ALL.]

53. How did the ___ [Net Units and Unit Type] of the replications compare to the original demonstration?

	Replication				
	1	2	3	4	5
Lower than Original Demo	<input type="checkbox"/>				
The same size	<input type="checkbox"/>				
Higher than Original Demo	<input type="checkbox"/>				
Not Comparable, specify	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

54. How did the ___ [net dollars SAVED/GENERATED] of the replications compare to the original demonstration?

	Replication				
	1	2	3	4	5
Lower than Original Demo	<input type="checkbox"/>				
The same size	<input type="checkbox"/>				
Higher than Original Demo	<input type="checkbox"/>				
Not Comparable, specify	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

55. Did NYSERDA provide funding assistance, technical assistance, both of these or other assistance for the replications?

	Replication				
	1	2	3	4	5
Yes, Funding	<input type="checkbox"/>				
Yes, Technology Assistance	<input type="checkbox"/>				
Yes, Both Funding & Technology Assistance	<input type="checkbox"/>				
Yes, Other: _____	<input type="checkbox"/>				
No	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

56. Did any sources other than NYSERDA provide funding for the replications?

- a. (1) Yes, amount \$
- b. (2) No
- c. (3) Don't know

[IF "YES", PROCEED TO Q57. OTHERWISE, SKIP TO Q58]

57. What were the other funding sources?

- a. (1) Investment Capital (internally financed, investment financed through venture capital or stocks, loan) Estimated % of total funding
- b. (2) Federal Government Grant or Subsidized Financing Estimated % of total funding
- c. (3) NYS agency Grant or Subsidized Financing Estimated % of total funding
Specify NYS agency
- d. (5) Utility program
- e. Other private grant or philanthropic contribution Estimated % of total funding
- f. (6) Other, specify Estimated % of total funding
- g. (7) Don't know Estimated % of total funding

58. [On a scale of 0 to 5, where 0 = "strongly disagree" and 5 = "strongly agree," to what extent do you agree or disagree with the following statement: "Overall, the NYSERDA-funded demonstration project was critical for getting the replication project(s) developed."

(Strongly disagree)

(Strongly agree)

0 1 2 3 4 5

[IF Q58 =>3, ASK Q59. OTHERWISE, SKIP TO Q60.]

59. Please briefly describe how NYSERDA's assistance with the demonstration project influenced the ability to get the replication projects developed.

60. What is the likelihood that these replication projects would have been developed in New York without the NYSERDA-funded demonstration project? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)
 0 1 2 3 4 5

61. Without the NYSERDA-funded demonstration project, would the magnitude of the impacts for these replication projects have been of the same size, smaller or larger?

- a. Same
- b. Smaller
- c. Larger
- d. Replication project(s) would not have happened without NYSERDA
- e. Don't know [DO NOT READ]

62. Without the NYSERDA-funded demonstration project, would the replication projects have occurred sooner, at about the same time, or later?

- a. Earlier: ___ years earlier [ASK RESPONDENT TO ESTIMATE YEARS]
- b. About the same time
- c. Later: ___ years later [ASK RESPONDENT TO ESTIMATE YEARS]
- d. Project(s) would not have occurred without NYSERDA
- e. Don't know [DO NOT READ]

[POLICY ANALYST CALCULATION #6A: IF Q61 = A OR C, RECORD -1. IF Q61 = B, D OR E, RECORD 0.

POLICY ANALYST CALCULATION #6B: IF Q62 = A, RECORD -1. IF Q62 = B OR E, RECORD 0. IF Q62 = C OR D, RECORD +1.

POLICY ANALYST CALCULATION #6C: TAKE THE INVERSE OF Q60. E.G., 0 BECOMES 5, 1 BECOMES 4, ETC.

POLICY ANALYST CALCULATION #6D: TAKE THE AVERAGE OF #6C AND Q58.

POLICY ANALYST CALCULATION #7: ADD THE RESULTS OF CALCULATION #6A, CALCULATION #6B, CALCULATION #6D, AND CALCULATION #1: _____

DO NOT READ TO RESPONDENT]

-[SKIP SECTION 6 IF Q46 =YES and Q49>0]

SECTION 6: NON-REPLICATIONS

63. What do you think are the reasons why the NYSERDA project was not replicated in New York?

64. Do you expect the NYSERDA-funded demonstration project will be replicated in New York at some point in the future?

- a. (1) Yes [REASONS]
- b. (2) No [REASONS]

SECTION 7: PROCESS EVALUATION

65. How did you become aware of NYSERDA and the potential for NYSERDA assistance?

[DO NOT READ, MARK ALL STATED IN REPLY]

- a. (1) Prior participation in a NYSERDA R&D program
- b. (2) Another NYSERDA program
- c. (3) Advertising
- d. (4) Word-of-mouth (PROBE FOR FOLLOWING):
 - a) Business colleague/client
 - b) Friend/relative
- e. (5) Contacted by a NYSERDA program representative
- f. (6) Visit to another NYSERDA demonstration project
- g. (7) From the site owner or integrator
- h. (8) I was not aware of the potential for NYSERDA assistance.
- i. (9) Other

Please rate your agreement or disagreement with the following statements. Please use a 1 to 5 scale where 5 indicates strongly agree, 4 indicates agree, 3 indicates neither agree nor disagree, 2 indicates disagree, and 1 is strongly disagree.

66. NYSERDA provides technical information that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
67. NYSERDA provides marketing information that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
68. NYSERDA provides market intelligence that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
69. NYSERDA communicates well with demonstration project participants.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
70. NYSERDA provides assistance in a timely manner.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
71. NYSERDA staff members working with this program are well qualified.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
72. NYSERDA's credibility is an important catalyst for demonstration projects in New York.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
73. NYSERDA provides technical information that supports the replication process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A
74. Overall, I am satisfied with my participation in NYSERDA's R&D program.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) N/A

75. Besides increasing financial incentives, how could NYSERDA improve its R&D program to encourage more demonstration projects such as this? [LIST]

76. Besides increasing financial incentives, how could NYSERDA improve its R&D program to encourage more replications of its demonstration projects? [LIST]

SECTION 8: VENDOR FIRMOGRAPHICS

I want to complete our interview with a few final questions about your firm.

77. What is the firm's principal business activity?
-

78. How many employees does the firm have overall? [APPROXIMATE NUMBER IS ADEQUATE.]

79. How many employees does the firm have in New York? [APPROXIMATE NUMBER IS ADEQUATE.]

[IF THE PROGRAM DATA INCLUDES JOBS CREATED/RETAINED, ASK Q80. OTHERWISE, SKIP TO Q83.]

80. Our records indicate that [COMPANY NAME] [CREATED/RETAINED] [NUMBER] jobs due to the NYSERDA demonstration project. Is this correct?

- a. Yes [SKIP TO Q86]
b. No [ASK Q81]
c. Don't Know [DO NOT READ. IF RESPONDENT DOES NOT KNOW, SKIP TO Q84.]

81. Did you report these numbers to NYSERDA?

- a. Yes [ASK Q82]
b. No [SKIP TO Q83]
c. Don't Know [SKIP TO Q83.]

82. Do you know why there is a difference between NYSERDA's records and the information you currently have? [ASK OPEN-ENDED FIRST, READ PROMPTS IF NEEDED]

- a. The company [ADDED/LOST] jobs after reporting the numbers to NYSERDA due to factors related to the demonstration project.
b. The company [ADDED/LOST] jobs after reporting the numbers to NYSERDA due to factors unrelated to the demonstration project.
c. Other, please specify: _____

83. Has the NYSERDA-funded demonstration project affected the firm's number of employees in New York?

- a. Yes
b. No [SKIP Q84 and Q85]

84. How has the NYSERDA-funded demonstration project affected the firm's number of employees in New York?

- a. Created/retained jobs
b. Lost jobs

85. How many jobs were [created/retained FOR Q84=A] [eliminated for Q84=B]?

a. _____

b. Don't know (DO NOT READ.)

86. Can NYSERDA call you back at a later time to obtain more information about the NYSERDA R&D Program?

a. Yes

b. No

ON BEHALF ON NYSERDA, THANK YOU FOR YOUR TIME IN HELPING US CONDUCT THIS RESEARCH.
HAVE A GREAT DAY.

NYSERDA
Demonstration Project Survey

SITE OWNERS

Interview Date: [mm/dd/yyyy]

Interviewer name:

Interviewer phone:

CNTRCT_ID:

Project Description:

Best Contact:

NYSERDA Project Manager

PI First Name and PI Last Name

Title:

Phone:

Email:

Project Role:

Company Name:

Program Area: [Buildings, Transportation, Energy Resources, etc.]

Project Type: [PRODUCT, PROCESS OR POWER PRODUCTION]

NYSERDA \$ (Encumbered \$ for this project.)

Earliest contract signed date

Latest contract closed date

Location

THE POLICY ANALYST CONDUCTING THE INTERVIEW WILL WORK THROUGH THE INSTRUMENT USING THE SPECIFIC DATASET INPUT AND PROJECT DESCRIPTION TO REFINE QUESTION WORDING AS NECESSARY TO PROVIDE CLEAR LANGUAGE AND TO OBTAIN THE INFORMATION DESIRED FROM EACH QUESTION. GIVEN THE INFORMATION IN THE DATASET, THE SURVEY INSTRUMENT FOR EACH INTERVIEW WILL BE MARKED FOR THE APPROPRIATE HANDLING OF QUESTIONS AND SKIP PATTERNS REGARDING THE IMPACTS FROM THE DEMONSTRATION PROJECT (QUESTIONS 17 THROUGH 32).

Identify the Appropriate Contact

Hello, my name is [interviewer name], and I am calling from [company name] on behalf of the New York State Energy Research and Development Authority, also known as NYSERDA. NYSERDA is conducting a study to assess the impact of its funding on New York State companies and on the State's economy. This study will also assess the impact of its funding and technological support on [use "product", "process", or "generation" depending on participant] demonstration projects conducted in New York State.

NYSERDA has contracted with Industrial Economics, Incorporated and APPRISE to perform this study. IEC and APPRISE are independent research and consulting firms. I would like to ask some questions about your involvement in a completed NYSERDA demonstration project – the [SUMMARIZE FROM CONTRACT DESCRIPTION]. The information you provide will be kept confidential to the extent permitted by law. We will report all responses in aggregate and will not attribute any comments to you. The information you provide will be used to improve NYSERDA's research and development programs. NYSERDA is contacting all participants who completed demonstration projects within the last five years.

SCREENING

Our records show that NYSERDA provided \$ _____ in funding to [COMPANY NAME] for the demonstration project [CONTRACT DESCRIPTION].

SCR-1. This survey will take about one hour to complete. We would like to talk to the person who is most knowledgeable about the project. If not you, could you please direct me to, or provide me with the name of the person who is the most qualified to discuss this project?

- a. Caller [PROCEED TO SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW]
- b. Most qualified contact [CONTACT THIS PERSON, REPEAT INITIAL INTRODUCTION AND THE INTRODUCTION TO THE SCREENING SECTION, AND CONTINUE WITH THE FOLLOWING QUESTION]

SCR-2 Mr./Ms. [name] referred me to you to answer specific about this project [DESCRIBE PROJECT BRIEFLY as this is another person]. This survey will take about one hour to complete. Can we discuss the project now, or can we schedule a time when I can call you back?

- a. Can discuss now [PROCEED TO SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW]
- b. Call back on _____ at time:
- c. [IF THIS PERSON IS NOT THE MOST QUALIFIED PERSON, LOOP BACK TO SCR-1]

SCR-3 Which of the following best describes your role in the [PROJECT]? [READ ALL CHOICES TO RESPONDENT AND SELECT THE MOST APPROPRIATE CHOICE.]

- a. I provided the [PRODUCT/PROCESS/TECHNOLOGY/TYPE OF GENERATION... tailor to the project based on project type] for this project. [USE VENDOR SURVEY INSTRUMENT]
- b. I am the site owner. [USE SITE OWNER SURVEY INSTRUMENT]
- c. I developed the project and brought together the vendor, site owner, and other market actors. [USE INTEGRATOR SURVEY INSTRUMENT]

SCR-4 Do you have any reports or presentations that describe the results of the [PROJECT]?

- a. Yes [ASK THE RESPONDENT TO SEND THE REPORTS IN ADVANCE OF THE CALL]
- b. No
- c. Don't Know [ASK THE RESPONDENT TO CHECK AND SEND WHAT THEY HAVE IN ADVANCE OF THE CALL]

SECTION 1: NYSERDA DEMONSTRATION PROJECT OVERVIEW

[NOTE: PRIOR TO BEGINNING THE DISCUSSION, ASK THE RESPONDENT WHETHER OR NOT IT IS OKAY TO RECORD THE CALL.]

1. Our records show that NYSERDA provided funding to [COMPANY NAME] for a project involving [CONTRACT DESCRIPTION]. Is this an accurate description of the project?
- a) (1) Yes
 - b) (2) No

[IF Q1 = YES, SKIP TO Q3. IF Q1 = NO, ASK Q2.]

2. How would you describe the project?

Record open-ended response: _____

3. Is this the first time this ["product", "process", "technology" or "type of generation"tailor to project based on PROJECT TYPE] was used at your site?
- a) (1) Yes
 - b) (2) No
 - c) (3) Don't know

[IF Q3 = NO, PROCEED TO Q4. OTHERWISE, SKIP TO Q6]

4. How many times had this ["product", "process", "technology" or "type of generation"tailor to project] been used at your site prior to the [reference NYSERDA demo project]?
- a) [RECORD THE NUMBER OF TIMES]
 - b) Don't know

5. How did [reference NYSERDA demo project] differ from previous uses of this ["product", "process", "technology" or "type of generation"tailor to project]?

RECORD VERBATIM RESPONSE: _____

- a) _____
- b) _____
- c) _____

[RECORD VERBATIM COMMENTS FIRST; DO NOT READ LIST. THEN, LOOK AT THE LIST AND VERIFY THE RELEVANT SELECTION(S) WITH RESPONDENT.]

- d) No difference
- e) Smaller in scale than previous projects of this type
- f) Larger in scale than previous projects of this type
- g) Different inputs
- h) Different application of the technology
- i) Different type of facility

[POLICY ANALYST CALCULATION #1: DO NOT READ TO SURVEY RESPONDENT.]

STEP ONE: IF Q3 = "YES" OR "DON'T KNOW", RECORD 0 ON THE LINE BELOW. SKIP STEP TWO.

STEP TWO: IF Q3 = "NO", LOOK AT ANSWER TO Q5. IF Q5 = D ONLY OR E ONLY, RECORD -1. ELSE RECORD 0.

CALCULATION #1: _____]

6. Now I would like to discuss the [SUMMARIZE CONTRACT DESCRIPTION] Project. How would you describe the objectives of this project? [OPEN-ENDED QUESTION TO PRIME THE RESPONDENT'S THINKING]

7a. Were you involved with planning or executing this project?

- a. Yes [ASK Q7B]
- b. No [SKIP TO Q9]

7b-1. Can you identify specific challenges you faced when planning this project? [ASK UNPROMPTED FIRST.]

- a. _____
- b. _____
- c. _____

[PROMPT - BE CAREFUL NOT TO BIAS OR INFLUENCE RESPONSE, SUGGEST CODE FOR ANSWERS PROVIDED ABOVE IF APPROPRIATE]

- d. Lack of funding
- e. Cost prohibitive
- f. Lack of qualified personnel or expertise
- g. Lack of interest among potential end users
- h. Could not find an appropriate site
- i. Timing was not right
- j. Regulatory barriers
- k. Technological issues
- l. Other - specify: _____

7b-2. Can you identify specific challenges you faced when executing this project? [ASK UNPROMPTED FIRST.]

- a. _____
- b. _____
- c. _____

[PROMPT - BE CAREFUL NOT TO BIAS OR INFLUENCE RESPONSE, SUGGEST CODE FOR ANSWERS PROVIDED ABOVE IF APPROPRIATE]

- d. Lack of funding
- e. Cost prohibitive
- f. Lack of qualified personnel or expertise
- g. Lack of interest among potential end users
- h. Could not find an appropriate site
- i. Timing was not right
- j. Regulatory barriers
- k. Technological issues
- l. Other - specify: _____

8a. Can you identify any benefits that you received from planning this project?

8b. Can you identify any benefits that you received from executing this project?

9. Overall, do you feel this project accomplished all, most, some, or none of its objectives?

- a. All
- b. Most
- c. Some
- d. None
- e. Don't know / refused [DO NOT READ THIS OPTION]

[IF RESPONDENT SELECTS "ALL" OR "DON'T KNOW," SKIP TO Q11. OTHERWISE, ASK Q10.]

10. Please explain why this project did not accomplish all of its objectives: _____

SECTION 2: COST EFFECTIVENESS

Now I would like to ask about the cost-effectiveness of the project.

11. NYSERDA furnished a grant for [NYSERDA \$]. In addition to that amount, how much did you invest in this project in terms of staff time and project expenses? \$ _____, _____ staff

[IDEALLY, COLLECT DATA ON \$ AND STAFF TIME. HOWEVER, IT IS OKAY IF THE RESPONDENT CAN ONLY PROVIDE ONE OR THE OTHER (OR NEITHER).]

12. At the time the project began, were you considering alternatives to the ["product", "process", "technology" or "type of generation"] that you used in the NYSERDA project?

- a. Yes, explain: _____
- b. No
- c. Don't know

[IF Q12 = YES, PROCEED TO Q13. OTHERWISE, SKIP TO Q14.]

13. Looking back, do you think the ["product", "process", "technology" or "type of generation"] that you used in the NYSERDA project was the best alternative?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

14. Do you feel the [PROJECT DESCRIPTION] project was a good investment?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

15. In general terms, how would you describe your return on this project? [READ LIST TO RESPONDENT]

- a. Positive
- b. Negative
- c. Breakeven or neutral

16. Have you advertised or communicated the results of this project to any potential buyers, suppliers, or business partners?

- a. Yes, explain: _____
- b. No, explain: _____
- c. Don't know

SECTION 3: DEMONSTRATION PROJECT IMPACTS

Now I would like to talk with you more about the project's benefits.

[NOTE: WHEN ASKING FOR BENEFITS DATA, TRY TO GET NUMERICAL UNITS AS OPPOSED TO PERCENTAGES. IF RESPONDENT REPORTS A PERCENTAGE OR PERCENTAGE CHANGE, ASK IF HE/SHE CAN NUMERICALLY QUANTIFY THE CHANGE, OR IF HE/SHE CAN PROVIDE THE BASELINE THAT THE PERCENTAGE CHANGE IS BASED ON.]

IF PROGRAM DATA INCLUDES RESOURCE TYPE, ASK Q17-Q21. OTHERWISE, ASK Q17D, THEN SKIP TO Q22.]

17A. NYSERDA program records indicate that this project resulted in [RESOURCE TYPE 1] benefits involving [RESOURCE TYPE 2]. [NOTE: IF A PROJECT HAS MORE THAN ONE ENTRY FOR "RESOURCE TYPE 1," ASK THE QUESTION SEPARATELY FOR EACH ENTRY.]

Is that correct?

- Yes [SKIP TO Q18]
- No [ASK Q17B]
- Don't know [ASK Q17B]

17B. Did you previously report these benefits to NYSERDA?

- Yes [ASK 17C]
- No [SKIP TO 17D]
- Don't know [SKIP TO 17D]

17C. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [OPEN-ENDED: FILL IN RESPONDENT'S ANSWER]

17D. Which of the following describe the specific types of benefits this project produced? For each benefit that your project produced, please state if it was a direct benefit, indirect benefit, or uncertain benefit. [READ THE LIST. CHECK ALL THAT APPLY. FOR EACH BENEFIT TYPE IDENTIFIED BY RESPONDENT, ASK RESPONDENT IF THIS IS A DIRECT BENEFIT, INDIRECT BENEFIT, OR UNCERTAIN BENEFIT. MAKE SURE TO ASK ABOUT ANY OTHER BENEFITS THAT WE MAY NOT HAVE MENTIONED.]

- Power production Direct Indirect Uncertain
- Energy efficiency Direct Indirect Uncertain
- Air emissions Direct Indirect Uncertain
- Productivity Direct Indirect Uncertain
- Waste management Direct Indirect Uncertain
- Product quality/reliability improvement Direct Indirect Uncertain
- Water reductions Direct Indirect Uncertain
- Water quality Direct Indirect Uncertain
- Operations & Maintenance Direct Indirect Uncertain
- Marketability Direct Indirect Uncertain
- Demand reduction Direct Indirect Uncertain
- Reduced labor costs Direct Indirect Uncertain
- Reduced material costs Direct Indirect Uncertain
- Environmental quality improvement Direct Indirect Uncertain
- Knowledge creation Direct Indirect Uncertain
- Other *Specify:* _____ Direct Indirect Uncertain

[ASK Q18 – Q21 IF Q17A = 1/YES AND NET UNITS ARE NOT MISSING. OTHERWISE, SKIP TO Q22.]

18. NYSERDA's records indicate that this project produced [IF BENEFIT IS POWER PRODUCTION] saved [IF BENEFIT IS NOT POWER PRODUCTION]. **IF MORE THAN ONE BENEFIT IS REPORTED, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH REPORTED BENEFIT.**

_____ [Net Units] _____ [Unit Type] _____ [Metric Year]

Are these numbers correct?

(1) Yes [SKIP TO Q23]

(2) No [ASK Q19]

19. Did you previously report these numbers to NYSERDA?

(1) Yes [ASK Q20]

(2) No [SKIP TO Q21]

(3) Don't know [SKIP TO Q21]

20. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [ASK OPEN-ENDED FIRST, READ PROMPTS IF NEEDED.]

Performance of the equipment changed over time

- We decommissioned the project
- Benefits were realized prior to the first reporting year
- Additional benefits accrued over time
- Other, please specify: ____

21. Please estimate the actual benefits.

_____ Specify unit: _____ [kWh, kW, MMBtu, pounds of pollutant, etc.]. Year(s): _____

[ASK Q22 IF THE PROGRAM DATA DOES NOT INCLUDE NET UNITS. IF MORE THAN ONE BENEFIT, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH BENEFIT. ASK ABOUT ALL DIRECT AND INDIRECT BENEFITS; DO **NOT** ASK ABOUT UNCERTAIN BENEFITS.]

22. Please provide an estimate of the [REDUCTION IN / PRODUCTION OF] in [ENERGY, kW, EMISSIONS, ETC. – TAILOR TO SPECIFICS]. IF MORE THAN ONE BENEFIT IS REPORTED, ASK THE QUESTION AND RECORD RESPONSES SEPARATELY FOR EACH REPORTED BENEFIT.]

_____ Specify unit: _____ [kWh, kW, MMBtu, pounds of pollutant, etc.] Year(s): _____

[ASK Q23 IF RESPONDENT DID NOT ANSWER Q21 OR Q22. IF RESPONDENT ANSWERED Q21 OR Q22, SKIP TO Q24.]

23. Besides [METRIC YEAR(S) REPORTED IN THE DATABASE], has the project produced any other [UNIT TYPE] benefits?

- (1) Yes, explain: [Net Units] [Unit Type] [Metric Year(s)]
- (2) No
- (3) Don't know

23-AA. Besides [UNIT TYPE], has the project produced any other types of benefits?

- (1) Yes [IF YES, LOOP BACK TO Q17D]
- (2) No
- (3) Don't know

[IF PROGRAM DATA INCLUDES NET DOLLARS, ASK Q24-27. OTHERWISE, SKIP TO Q28.]

24. NYSEDA's records indicate that this project [GENERATED/SAVED]:

[Net Dollars] [Metric Year(s)]

Are these numbers correct?

- (1) Yes [SKIP TO Q32]
- (2) No [ASK Q25]

25. Did you previously report these numbers to NYSERDA?

- (1) Yes [ASK Q26]
- (2) No [SKIP TO Q27]
- (3) Don't know [SKIP TO Q27]

26. Do you know why there is a difference between NYSERDA's records and the information that you currently have? [OPEN-ENDED] _____

27. Please estimate the actual net dollars in [REVENUE/COST SAVINGS] from this project:

\$_____, year(s): _____

[ASK Q28 IF THE PROGRAM DATA DOES NOT INCLUDE NET DOLLARS. OTHERWISE, SKIP TO Q32]

28. Did this project generate any revenue?

- (1) Yes [ASK Q29]
- (2) No [SKIP TO Q30]
- (3) Don't know [SKIP TO Q30]

29. Please provide an estimate of the revenue generated from this project.

\$_____, year(s): _____

30. Did this project generate any cost savings?

- (1) Yes [ASK Q31]
- (2) No [SKIP TO Q33]
- (3) Don't know [SKIP TO Q33]

31. Please provide an estimate of the cost savings generated from this project.

\$_____, year(s): _____

[ASK Q32 IF RESPONDENT DID NOT ANSWER Q27, Q29, OR Q31. IF RESPONDENT ANSWERED Q27, Q29, OR Q31, SKIP TO Q33.]

32. Besides [METRIC YEAR(S) REPORTED IN THE DATABASE], has the project generated any other [REVENUE/COST SAVINGS]?

- (1) Yes, amount: \$_____
- (2) No

(3) Don't know

33. Who were the primary end users for this project?

_____ [RECORD OPEN-ENDED RESPONSE]

34. Did you receive any feedback from end-users from this project site?

- a. (1) Yes
- b. (2) No
- c. (3) Don't know

[IF YES, PROCEED TO Q35. IF NO OR DON'T KNOW, SKIP TO Q36]

35. Was the feedback useful for understanding whether or how the technology worked?

- a. (1) Yes
- b. (2) No
- c. (3) Don't know

SECTION 4: NYSERDA INFLUENCE ON THE DEMONSTRATION PROJECT

I would now like to discuss your interactions with NYSERDA concerning the [SUMMARY OF DEMONSTRATION PROJECT] Project.

36. When did you learn about NYSERDA's R&D program? [READ THE LIST OF RESPONSE OPTIONS, EXCEPT "DON'T KNOW." CHECK ALL THAT APPLY.]

- a. (1) Before you began planning this project
- b. (2) During the planning process but before the plans were finalized
- c. (3) After the plans were finalized
- d. (4) After project implementation started
- e. (5) From the integrator or vendor
- f. (6) I have not heard about NYSERDA's R&D Program
- g. (7) Don't know

37. Did NYSERDA provide technical assistance for this project?

- a. (1) Yes, explain: _____ Type of assistance: _____ Identify source: _____
- b. (2) No
- c. (3) Don't know

38. Did sources other than NYSERDA provide technical assistance for this project?

- a. (1) Yes, explain: _____ Type of assistance: _____ Identify source: _____
- b. (2) No
- c. (3) Don't know

39. Did sources other than NYSERDA provide funding for this project?

- a. (1) Yes, explain \$_____ Identify source: _____
- b. (2) No
- c. (3) Don't know

40. On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's **financial** assistance in the decision to do this project?

(Not at all important) (Very important)

0 1 2 3 4 5

[ASK Q41 ONLY IF Q37 = "YES". IF Q37 = "NO" OR "DON'T KNOW", RECORD 0.]

41. On a scale of 0 to 5, where 0 = "not at all important" and 5 = "very important," how important or unimportant was NYSERDA's **technical** assistance in the decision to do this project?

(Not at all important) (Very important)

0 1 2 3 4 5

[POLICY ANALYST PERFORM CALCULATION #2: RECORD THE HIGHER SCORE OF Q40 OR Q41. DO NOT READ TO THE RESPONDENT: _____]

42. What is the likelihood that this project would have been completed in New York without NYSERDA's **financial** assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)

0 1 2 3 4 5

[ASK Q43 ONLY IF Q37 = "YES". IF Q37 = "NO" OR "DON'T KNOW", RECORD 0.]

43. What is the likelihood that this project would have been completed in New York without NYSERDA's **technical** assistance? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)

0 1 2 3 4 5

[POLICY ANALYST PERFORM CALCULATION #3A: RECORD THE LOWER SCORE OF Q42 OR Q43: ____]

CALCULATION #3B: TAKE THE INVERSE OF 3A. FOR EXAMPLE, 0 BECOMES 5, 1 BECOMES 4, ETC.
DO NOT READ TO THE RESPONDENT: _____]

44. Overall, without NYSERDA's involvement would the **magnitude** of the impacts for this project have been of the same size, smaller, or larger?

- a. Same
- b. Smaller
- c. Larger
- d. Project would not have happened without NYSERDA
- e. Don't know [DO NOT READ]

45. I would now like to ask you about how, if at all, NYSERDA's support affected the **timing** of the project. Without NYSERDA's support, would this project have occurred earlier, at about the same time, or later?

- a. Earlier: ___ years earlier [ASK RESPONDENT TO ESTIMATE YEARS]
- b. About the same time
- c. Later: ___ years later [ASK RESPONDENT TO ESTIMATE YEARS]
- d. Project would not have happened without NYSERDA
- e. Don't know [DO NOT READ]

[POLICY ANALYST CALCULATION #4A: IF Q44 = A OR C, RECORD -1. IF Q44 = B, D OR E, RECORD 0.
DO NOT READ TO THE RESPONDENT: _____.]

[POLICY ANALYST CALCULATION #4B: IF Q45 = A, RECORD -1. IF Q45 = B OR E, RECORD 0. IF Q45 = C OR D, RECORD +1.]

[CALCULATION #5: TAKE THE AVERAGE OF CALCULATION #2 AND #3B. THEN, ADD THE RESULTS OF CALCULATIONS #1, #4A, AND #4B.

RECORD YOUR ANSWER HERE: _____. DO NOT READ TO THE SURVEY RESPONDENT.]

SECTION 5: REPLICATIONS

I have some questions now concerning your experience with demonstration projects and replications. NYSERDA classifies the project we have been discussing as a demonstration project.

We define a **demonstration** project as the demonstration of a new technology or process or application of an existing technology in a commercial setting. Demonstration projects are designed to showcase the value and effectiveness of the technology or process being demonstrated.

We define **replication** as an additional installation or scaling up of the technology or process demonstrated under the NYSERDA-funded project. The replication could be at the same site as the NYSERDA demonstration project or at another site. The replication could be conducted by your firm or another firm.

46. NYSERDA funded the [SUMMARY OF DEMO PROJECT] demonstration project in [MONTH/YEAR]. Since that time, has the technology or process from the NYSERDA demonstration project been replicated for **similar** applications?

- a. (1) Yes How Many?: Month, Year : ' ' ' ' '
b. (2) No [IF MORE THAN 5, GET DATES FOR THE MOST RECENT 5]
c. (3) Don't know

47. Has the technology or process from the NYSERDA demonstration project been replicated for a **different** application?

- a. (1) Yes How Many?: Month, Year : ' ' ' ' '
b. (2) No [IF MORE THAN 5, GET DATES FOR THE MOST RECENT 5]
c. (3) Don't know

[IF Q47 = YES, ASK Q48. OTHERWISE, SKIP TO Q49.]

48. In what way was the replication different from the original NYSERDA demonstration project? [RECORD OPEN-ENDED RESPONSES.]

[CONTINUE WITH Q49 IF Q46 = YES; SKIP TO Q63 IF Q46 = NO OR DON'T KNOW.]

49. How many times has the demonstration project been replicated in New York? [DO NOT ENTER "DON'T KNOW". QUESTION RESPONDENT TO GET AN ESTIMATE.]

[IF Q49 = 0, SKIP TO Q63]

50. From the time that the NYSERDA demonstration project was operational, how long did it take to complete the 1st replication in New York? From the NYSERDA demonstration project to the completion of the 2nd replication in New York? To the completion of the 3rd replication? [GET NUMBER OF YEARS AND/OR MONTHS]

- a. First replication
b. Next replication
c. Next replication

51. What are the primary reasons the demonstration project was able to be replicated? [READ LIST OF RESPONSE OPTIONS, EXCEPT "OTHER"]

- a. (1) Technical expertise gained
b. (2) Financing available
c. (3) Location available
d. (4) Requested by building owner
e. (5) Operating conditions were right

- f. (6) Demonstrable savings were achieved
- g. (7) Other [LIST]

[IF 5 OR FEWER REPLICATIONS SKIP TO Q53.]

52. On average over all similar replications completed in New York State, how did the ___ [Unit Type] of the replications compare to the original demonstration? [IF MORE THAN ONE TYPE OF BENEFIT, ASK FOR EACH DIRECT BENEFIT TYPE.]

- a. (1) Lower
- b. (2) Same
- c. (3) Higher
- d. (4) Not Comparable, specify
- e. (5) Don't know

[IF Q52 = 4]

53b. Why are the impacts not comparable to the original demonstration project?

[IF MORE THAN 5 REPLICATIONS, ASK Q53 AND Q54 FOR THE MOST RECENT 5 ONLY. IF 5 OR FEWER REPLICATIONS, ASK FOR ALL.]

53. How did the ___ [Net Units and Unit Type] of the replications compare to the original demonstration?

	Replication				
	1	2	3	4	5
Lower than Original Demo	<input type="checkbox"/>				
The same size	<input type="checkbox"/>				
Higher than Original Demo	<input type="checkbox"/>				
Not Comparable, specify	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

54. How did the ___ [net dollars SAVED/GENERATED] of the replications compare to the original demonstration?

	Replication				
	1	2	3	4	5
Lower than Original Demo	<input type="checkbox"/>				
The same size	<input type="checkbox"/>				
Higher than Original Demo	<input type="checkbox"/>				
Not Comparable, specify	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

55. Did NYSERDA provide funding assistance, technical assistance, both of these or other assistance for the replications?

	Replication				
	1	2	3	4	5
Yes, Funding	<input type="checkbox"/>				
Yes, Technology Assistance	<input type="checkbox"/>				
Yes, Both Funding & Technology Assistance	<input type="checkbox"/>				
Yes, Other: _____	<input type="checkbox"/>				
No	<input type="checkbox"/>				
Don't Know	<input type="checkbox"/>				

56. Did any sources other than NYSERDA provide funding for the replications?
 a. (1) Yes, amount \$
 b. (2) No
 c. (3) Don't know

[IF "YES", PROCEED TO Q57. OTHERWISE, SKIP TO Q58]

57. What were the other funding sources?
 a. (1) Investment Capital (internally financed, investment financed through venture capital or stocks, loan) Estimated % of total funding
 b. (2) Federal Government Grant or Subsidized Financing Estimated % of total funding
 c. (3) NYS agency Grant or Subsidized Financing Estimated % of total funding
 Specify NYS agency
 d. (4) Other private grant or philanthropic contribution Estimated % of total funding
 e. (5) Utility program Estimated % of total funding
 f. (6) Other, specify Estimated % of total funding
 g. (7) Don't know Estimated % of total funding

58. [On a scale of 0 to 5, where 0 = "strongly disagree" and 5 = "strongly agree," to what extent do you agree or disagree with the following statement: "Overall, the NYSERDA-funded demonstration project was critical for developing the replication project(s)."

(Strongly disagree) (Strongly agree)
 0 1 2 3 4 5

[IF Q58 =>3, ASK Q59. OTHERWISE, SKIP TO Q60.]

59. Please briefly describe how NYSERDA's assistance with the demonstration project influenced the ability to do the replication projects.

60. What is the likelihood that these replication projects would have been developed in New York without the NYSERDA-funded demonstration project? Please answer on a scale from 0 to 5, where 0 is not at all likely and 5 is very likely.

(Not at all likely) (Very likely)
 0 1 2 3 4 5

61. Without the NYSERDA-funded demonstration project, would the **magnitude** of the impacts for these replication projects have been of the same size, smaller or larger?

- a. Same
- b. Smaller
- c. Larger
- d. Replication project(s) would not have happened without NYSERDA
- e. Don't know [DO NOT READ]

62. Without the NYSERDA-funded demonstration project, would the replication projects have occurred sooner, at about the same time, or later?

- a. Earlier: ___ years earlier [ASK RESPONDENT TO ESTIMATE YEARS]
- b. About the same time
- c. Later: ___ years later [ASK RESPONDENT TO ESTIMATE YEARS]
- d. Project(s) would not have occurred without NYSERDA
- e. Don't know [DO NOT READ]

[POLICY ANALYST CALCULATION #6A: IF Q61 = A OR C, RECORD -1. IF Q61 = B, D, OR E RECORD 0.

POLICY ANALYST CALCULATION #6B: IF Q62 = A, RECORD -1. IF Q62 = B OR E, RECORD 0. IF Q62 = C OR D, RECORD +1.

POLICY ANALYST CALCULATION #6C: TAKE THE INVERSE OF Q60. E.G., 0 BECOMES 5, 1 BECOMES 4, ETC.

POLICY ANALYST CALCULATION #6D: TAKE THE AVERAGE OF #6C AND Q58.

POLICY ANALYST CALCULATION #7: ADD THE RESULTS OF CALCULATION #6A, CALCULATION #6B, CALCULATION #6D, AND CALCULATION #1: _____

DO NOT READ TO RESPONDENT]

-[SKIP SECTION 6 IF Q46 =YES and Q49>0]

SECTION 6: NON-REPLICATIONS

63. What do you think are the reasons why the NYSERDA project was not replicated in New York?

64. Do you expect the NYSERDA project will be replicated in New York at some point in the future?

- a. (1) Yes [REASONS]
- b. (2) No [REASONS]

SECTION 7: PROCESS EVALUATION

65. How did you become aware of NYSERDA and the potential for NYSERDA assistance?

[DO NOT READ, MARK ALL STATED IN REPLY]

- a. (1) Prior participation in a NYSERDA R&D program
- b. (2) Another NYSERDA program
- c. (3) Advertising
- d. (4) Word-of-mouth (PROBE FOR FOLLOWING):
 - a) Business colleague/client
 - b) Friend/relative
- e. (5) Contacted by a NYSERDA program representative
- f. (6) Visit to another NYSERDA demonstration project
- g. (7) I was not aware of the potential for NYSERDA assistance
- h. (8) Other

Please rate your agreement or disagreement with the following statements. Please use a 1 to 5 scale where 5 indicates strongly agree, 4 indicates agree, 3 indicates neither agree nor disagree, 2 indicates disagree, and 1 is strongly disagree.

66. NYSERDA provides technical information that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A
67. NYSERDA provides marketing information that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A
68. NYSERDA provides market intelligence that supports the demonstration process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A
69. NYSERDA communicates well with demonstration project participants.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A
70. NYSERDA provides assistance in a timely manner.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A
71. NYSERDA staff members working with this program are well qualified.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A
72. NYSERDA's credibility is an important catalyst for demonstration projects in New York.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	
73. NYSERDA provides technical information that supports the replication process.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A
74. Overall, I am satisfied with NYSERDA's R&D program.	(Strongly disagree) 1 2 3 4 5 (Strongly agree) Don't Know	N/A

75. Besides increasing financial incentives, how could NYSERDA improve its R&D program to encourage more demonstration projects such as this? [LIST]

76. Besides increasing financial incentives, how could NYSERDA improve its R&D program to encourage more replications of its demonstration projects? [LIST]

SECTION 8: SITE OWNER FIRMOGRAPHICS

I want to complete our interview with a few final questions about your firm.

77. What is the firm's principal business activity?
-

78. How many employees does the firm have overall? [APPROXIMATE NUMBER IS ADEQUATE.]

79. How many employees does the firm have in New York? [APPROXIMATE NUMBER IS ADEQUATE.]

[NOTE: ONLY ASK Q80-85 IF THE SITE OWNER WAS ACTIVELY INVOLVED IN PLANNING AND EXECUTING THE DEMONSTRATION PROJECT (Q7A). IF THE SITE OWNER WAS NOT DIRECTLY INVOLVED IN PROJECT PLANNING OR EXECUTION, SKIP TO Q86.]

[IF THE PROGRAM DATA INCLUDES JOBS CREATED/RETAINED, ASK Q80. OTHERWISE, SKIP TO Q83.]

80. Our records indicate that [COMPANY NAME] [CREATED/RETAINED] [NUMBER] jobs due to the NYSERDA demonstration project. Is this correct?
- a. Yes [SKIP TO Q86]
 - b. No [ASK Q81]
 - c. Don't Know [DO NOT READ. IF RESPONDENT DOES NOT KNOW, SKIP TO Q84.]

81. Did you report these numbers to NYSERDA?
- a. Yes [ASK Q82]
 - b. No [SKIP TO Q83]
 - c. Don't Know [SKIP TO Q83.]

82. Do you know why there is a difference between NYSERDA's records and the information you currently have? [ASK OPEN-ENDED FIRST, READ PROMPTS IF NEEDED]
- a. The company [ADDED/LOST] jobs after reporting the numbers to NYSERDA due to factors related to the demonstration project.
 - b. The company [ADDED/LOST] jobs after reporting the numbers to NYSERDA due to factors unrelated to the demonstration project.
 - c. Other, please specify: _____

83. Has the NYSERDA-funded demonstration project affected the firm's number of employees in New York?
- a. Yes
 - b. No [SKIP Q84 and Q85]

84. How has the NYSERDA-funded demonstration project affected the firm's number of employees in New York?
- a. Created/retained jobs
 - b. Lost jobs

85. How many jobs were [created/retained FOR Q84=A] [eliminated for Q84=B]?
- a. _____
 - b. Don't know (DO NOT READ.)

86. Can NYSERDA call you back at a later time to obtain more information about the NYSERDA R&D Program?
- a. Yes
 - b. No

ON BEHALF ON NYSERDA, THANK YOU FOR YOUR TIME IN HELPING US CONDUCT THIS RESEARCH.
HAVE A GREAT DAY.

R&D Demonstration Survey

Appendices

Appendix B

COMPARISON OF SURVEY RESULTS FROM ROUNDS 1 AND 2

Appendix B presents a comparison of major conclusions from the first two rounds of the R&D demonstration survey. It should be noted that the surveys covered two distinct populations: projects completed in 2004 – 2007 (Round 1), and projects completed in 2008 – 2010 (Round 2). Moreover, the methodology was revised for the second round, especially the method for estimating NYSERDA’s contribution to project impacts. Therefore, caution should be exercised when attempting to draw comparisons between the results of the two surveys. Nonetheless, a high-level comparison across selected metrics can provide insight about the performance of NYSERDA’s R&D demonstration portfolio over time. The remainder of this appendix describes the results of this high-level comparison.

B.1 COMPARISON OF IMPACTS

Tables B-1 and B-2 compare the impacts in Rounds 1 and 2, respectively. There are similarities and differences in the types of benefits that were quantified in each round. While both rounds estimated MWh and kW, the first round did not provide aggregated benefits for revenues and cost savings. On the other hand, Round 2 did not provide aggregated benefits for wastewater savings. One project in Round 2 reported water savings of 753,287 gallons, but this project was an outlier; the most commonly reported quantities benefits were expressed as MWh, kW, therms, or dollars saved or generated.

Table B-1. Summary of “Net Savings” in Round 1

Savings Type	Estimated Net Savings by Project Type			Total Estimated Net Savings
	Power Production	Process Improvement	Product Demonstration	
Program Net Savings (kW)	94	0	1,263	1,357
Replication Net Savings (kW)	7,967	0	3,032	10,999
Total Net kW Savings	8,061	0	4,295	12,356
Program Net Savings (MWh/year)	9,711	142,744	200	152,655
Replication Net Savings (MWh/year)	46,314	46,107	4,106	96,527
Total Net MWh/year Savings	56,025	188,851	4,306	249,182
Total Net Waste Water Savings¹ (x1000 Gallons)	509	35,522	0	36,031

¹ No replications were conducted for projects with estimated waste water treatment impacts.
Source: Megdal & Associates, *R&D Demonstration Survey Report*. September 2012.

Table B-2. Summary of Savings to Which NYSERDA Contributed in Round 2

Benefits Type	Estimated Benefits by Project Type			Total Benefits
	Power Production	Process Improvement	Product Demonstration	
Demonstration Installed Capacity (kW)	3,988	75	538	4,601
Replication Installed Capacity (kW)	4,075	63	-	4,138
Total Installed Capacity (kW)	8,063	138	538	8,739
Demonstration Electricity Savings (MWh/year)	17,062	88	4,688	21,838
Replication Electricity Savings (MWh/year)	16,558	-	146	16,704
Total Electricity Savings (MWh/Year)	33,620	88	4,834	38,542
Demonstration Fuel Savings (Therms/Year)	0	44,137	13,729	57,866
Replication Fuel Savings (Therms/Year)	-	1,000	29,318	30,318
Total Fuel Savings (Therms/Year)	0	45,137	43,047	88,184
Demonstration Cost Savings	\$11,748,933	\$8,514,463	\$3,545,264	\$23,808,660
Replication Cost Savings	\$36,160,752	\$5,435,000	\$274,719	\$41,870,471
Total Cost Savings	\$47,909,685	\$13,949,463	\$3,819,983	\$65,679,131
Demonstration Revenue	\$3,194,233	\$1,050,180,000	\$9,590,000	\$1,062,964,233
Replication Revenue	\$12,515,540	\$202,500	\$60,480,000	\$73,198,040
Total Revenue	\$15,709,773	\$1,050,382,500	\$70,070,000	\$1,136,162,273

Comparing across the two metrics that were common to both surveys, it appears that Round 1 projects outperformed Round 2 projects, especially on MWh. However, NYSERDA funds a wide variety of

demonstration projects with different goals and activities. It is possible that projects in Round 1 were generally more focused on power production as a primary goal. Moreover, it should be noted that the method used for estimating NYSERDA’s contribution differed across the two surveys. Specifically, Round 1 calculated a “net-to-gross” ratio, whereas Round 2 estimated NYSERDA’s contribution to R&D demonstration impacts. While the two concepts are not entirely dissimilar, the methodological distinction could explain some of the variance in results across the surveys.

It is not possible to compare cost effectiveness; this was a new analysis added in Round 2. Going forward, NYSERDA can continue to track measures of cost effectiveness and compare future results to Round 2.

B.2 COMPARISON OF FACTORS SUPPORTING AND HINDERING REPLICATION

Tables B-3 and B-4 show the reasons that respondents identified for replications in Rounds 1 and 2, respectively. In both rounds, technical expertise/experience and success/demonstrable savings were cited as key factors for successful replications. More than one in five respondents cited financing in both rounds; interestingly, the percentage increased in Round 2 (from 22% to 32%) even as financing declined in relative importance compared to other factors. This finding may reflect the broader financial climate, or the relative ease or difficulty of obtaining financing relative to technical support. The data are not sufficiently detailed to draw a definitive conclusion.

Table B-3. Reasons for Replications in Round 1

Reasons for Replications	Number of Projects (n=18)	Percent of Projects	Adjusted Percent of Projects
Financing Available	4	22%	27%
Success of Demonstration	3	17%	20%
Technical Experience Gained	2	11%	13%
Willing Participants	2	11%	13%
Other	4	22%	27%
No Answer	3	17%	--
Total	18		

Table B-4. Reasons for Replications in Round 2

Reasons for Replications	Number of Projects (n=28)*	Percent of Projects (Out of 28)
Technical Expertise Gained	21	75%
Demonstrable Savings were Achieved	14	50%
Operating Conditions were Right	12	43%
Location Available	11	39%
Requested by Building Owner	10	36%
Financing Available	9	32%
Other	6	21%

Notes: (*) Respondents were allowed to select multiple answers.

Comparison of Survey Results from Rounds 1 and 2

Tables B-5 and B-6 show the factors that respondents identified as barriers to project replication. The lack of customer interest, location issues, and replication not requested/needed in Round 1 correspond to the lack of suitable companies, institutions, or locations identified in Round 2. Cost and administrative (or permitting) issues were also identified in both surveys. It appears these barriers have continued. On the other hand, insufficient/unavailable equipment and specialization incompatibilities were identified in Round 1, but were not identified as being major issues in Round 2.

Table B-5. Barriers to Replication Identified in Round 1

Reason	Number of Projects¹ (n=22)	Percent of Projects	Adjusted Percent of Projects
Lack of Resources	5	23%	31%
Lack of Consumer Interest	3	14%	19%
Production Costs	2	9%	13%
Insufficient/ Unavailable Equipment	2	9%	13%
Replication not requested/needed	2	9%	13%
Administrative Issues	1	5%	6%
Location Issues	1	5%	6%
Unsuccessful Product	1	5%	6%
Replicated by others instead	1	5%	6%
Specialization incompatibilities	1	5%	6%
Not meant for commercialization	1	5%	6%
Don't Know/No Answer/Refused	6	27%	

¹ Multiple responses were allowed. Percents are based on the 22 projects without replications.

Table B-6. Barriers to Replication Identified in Round 2

Reason	Number of Projects* (n=29)	Percent of Projects	Adjusted Percent of Projects
Absence of Suitable Companies/Institutions/Locations	4	14%	15%
Cost	3	10%	12%
Technology is Still Being Proven	3	10%	12%
Permitting/Regulatory Barriers	2	7%	8%
Proprietary Technology	2	7%	8%
Lack of Proximity to Potential Users	2	7%	8%
No Other Similar Company in New York State	2	7%	8%
Lack of Effective Marketing/Publicity	2	7%	8%
Complex Operating Environment/Too Many Competing Actors	2	7%	8%
New Markets/New Technologies	1	3%	4%
Company No Longer Makes the Product	1	3%	4%
Never Saw the Project Through to Completion	1	3%	4%
Project Answered all Questions it Set Out to Answer	1	3%	4%
Denied Commercialization	1	3%	4%
Don't Know	3	10%	12%

Notes: (*) Respondents could select more than one answer. Four projects without out replications did not answer the question.

B.3 COMPARISON OF PROCESS EVALUATION RESULTS

Both rounds included similar questions about participant satisfaction with NYSERDA’s R&D Program. As shown in Tables B-7 and B-8, overall program satisfaction was quite high in both rounds. Opinions about the qualifications of staff working with this program were also consistently high. The responses suggest that the program made improvements in responding in a timely manner; 73% of respondents agreed with this statement in Round 2 (rating of 4 or 5, out of 5), up from 64% in Round 1.¹ Ratings for providing market knowledge/market intelligence still rank near the bottom of the list; however, several respondents in Round 2 stated they do not see this as function as part of NYSERDA’s role. Overall, the findings suggest that the program is maintaining or improving its performance in most categories.

Table B-7. Round 1 Respondent Feedback on NYSERDA’s R&D Program Characteristics

Program Characteristic	Agree or Strongly Agree	Disagree or Strongly Disagree
Overall Program Satisfaction	98%	2%
NYSERDA staff working with this program are well qualified	95%	0%
NYSERDA provides information that is highly supportive of the demonstration process	79%	5%
Turn-around time for assistance from NYSERDA does not significantly hamper demonstration efforts	64%	21%
The process of obtaining funding from NYSERDA is adequate	64%	24%
The assistance that NYSERDA provides to encourage knowledge gained from the demonstration is adequate	62%	14%
NYSERDA’s effort to increase market knowledge greatly assists in obtaining replications	46%	22%

Table B-8. Round 2 Respondent Feedback on NYSERDA’s R&D Program Characteristics (n=61)

Statement	Calculation	Strongly Disagree (1) to Strongly Agree (5)					
		1	2	3	4	5	Don’t Know/Refused
Overall, I am satisfied with my participation in NYSERDA’s R&D program.	Raw	7%	-	-	33%	59%	2%
	Adjusted ¹	7%	-	-	33%	60%	--
NYSERDA communicates well with demonstration project participants.	Raw	-	7%	8%	38%	43%	5%
	Adjusted ¹	-	7%	9%	40%	45%	--
NYSERDA staff members working with this program are well qualified.	Raw	5%	3%	3%	28%	56%	5%
	Adjusted ¹	5%	3%	3%	29%	59%	--
NYSERDA provides assistance in a timely manner.	Raw	7%	7%	11%	34%	39%	2%
	Adjusted ¹	7%	7%	12%	35%	40%	--
NYSERDA provides technical information that supports the demonstration process.	Raw	7%	16%	26%	25%	20%	7%
	Adjusted ¹	7%	18%	28%	26%	21%	--
NYSERDA provides technical information that supports the replication process.	Raw	10%	13%	28%	23%	16%	10%
	Adjusted ¹	11%	15%	31%	25%	18%	--
NYSERDA provides marketing information that supports the demonstration process.	Raw	10%	20%	23%	21%	15%	11%
	Adjusted ¹	11%	22%	26%	24%	17%	--
NYSERDA provides market intelligence that supports the demonstration process.	Raw	15%	21%	26%	15%	8%	15%
	Adjusted ¹	17%	25%	31%	17%	10%	--

Notes: (1) Adjusted percentages exclude “Don’t Know/Refused.” Percentages may not sum exactly to 100% due to rounding.

¹ Although the questions were worded somewhat differently, they address the same theme.

R&D Demonstration Survey

Appendices

Appendix C

ENERGY SAVINGS AND PRICE FORECAST

- Methodology for Estimating Future Energy Savings
- AEO 2013 Energy Prices by Sector and Source, Middle Atlantic, Reference Case
- AEO 2013 Energy Prices by Sector and Source, Middle Atlantic, High Economic Growth
- AEO 2013 Energy Prices by Sector and Source, Middle Atlantic, Low Economic Growth
- EIA State Energy Data 2011: Commercial Sector Energy Consumption Estimates
- EIA State Energy Data 2011: Industrial Sector Energy Consumption Estimates
- EIA 2009 Residential Energy Consumption Survey: Space Heating in U.S. Homes in Northeast Region, Divisions, and States

Appendix C describes the methodology used for estimating future energy savings in the cost-effectiveness analysis. As described in Sections 4 and 5 of the main report, most respondents reported electricity and fuel savings on an annual basis (MWh/year and therms/year, respectively); many of these respondents indicated that savings will continue into the future. However, all of NYSERDA’s demonstration project costs were incurred upfront. Therefore, to compare the benefits and costs on equal terms, the analysis estimates the monetary value of future energy savings.

Given the uncertainties inherent in predicting future energy savings, the report conducts a scenario analysis. The scenario analysis estimates how projected energy savings are expected to vary with different lifespans (one year, five years, 10 years, and 20 years) and future energy prices (“high,” “medium,” and “low”). The survey did not ask about years of operation; however, NYSERDA’s experience has shown that many projects stay online longer than one year, while a 20-year lifetime might be longer than average.

Forecasted energy prices were taken from the U.S. Energy Information Administration (EIA) *Annual Energy Outlook 2013* for the U.S. Middle Atlantic region, which includes New York State. The “medium” energy prices represent the EIA’s reference case; the “low” and “high” cases represent the EIA’s forecast under a lower-economic growth scenario and higher-growth scenario, respectively.

The analysis was conducted separately for electricity (MWh) and fuel (therms).¹ For electricity, annual savings (MWh/year) were converted to MMBTU, which is the unit that EIA uses in its energy price forecasts. The analysis used the standard conversion factor of 3.412 MMBTU/MWh. For example, demonstration projects reported 21,838 MWh/year in electricity savings; multiplying 21,838 MWh by 3.412 yielded 74,511 MMBTU. This value was then multiplied by EIA’s forecasted electricity prices (under the reference case, low case, and high case, respectively) to calculate the monetary savings.

As shown in Table C-1, the EIA price forecast shows residential, commercial, and industrial energy prices separately. In the absence of detailed data about which sector each site belongs to, the analysis took the simple average of the commercial and industrial prices. The top part of the table shows data excerpted from EIA’s energy price forecast; the shaded section at the bottom shows IEC’s calculations.

Table C-1. EIA Energy Price Forecast by Sector (Reference Case, Middle Atlantic Region)

Sector and Source	2012	2013	2014	2015	2016
Commercial¹					
Distillate Fuel Oil	25.697847	24.682537	22.63097	22.693171	23.075819
Residual Fuel	20.043619	18.818247	12.897819	12.887959	13.182909
Natural Gas	8.485619	8.919311	8.669165	8.524491	8.900762
Electricity	39.249451	36.473335	36.450665	35.80909	36.188709
Industrial¹					
Distillate Fuel Oil	26.608124	25.557804	23.023254	23.137028	23.528515
Residual Fuel Oil	19.71102	18.520655	12.897819	12.887959	13.182909
Natural Gas	5.653099	5.984531	5.834828	5.850177	6.195745
Metallurgical Coal	6.943663	7.206048	7.385982	7.787265	7.994534
Other Industrial Coal	3.59021	3.649058	3.596577	3.712585	3.762938
Electricity	21.238831	19.794004	19.665545	19.186272	19.442217
Commercial/Industrial Average²					
Distillate Fuel Oil	26.1529855	25.1201705	22.827112	22.9150995	23.302167
Residual Fuel	19.8773195	18.669451	12.897819	12.887959	13.182909
Natural Gas	7.069359	7.451921	7.2519965	7.187334	7.5482535
Electricity	30.244141	28.1336695	28.058105	27.497681	27.815463

Notes: (1) Excerpt from EIA “Energy Prices by Sector and Source, Middle Atlantic, Reference case,” 2013. (2) IEC calculations.

¹ All values used in this analysis are adjusted for NYSERDA’s contribution.

The analysis was repeated for the one-year, five-year, 10-year, and 20-year scenario. For example, the five-year scenario sums the energy prices in years 2012-2016. The analysis uses 2012 as Year 1 across projects. Some projects began to accrue benefits prior to 2012, but the survey did not capture this in a systematic way across all projects. In addition, the study assumes a lag time of two years from the end of the demonstration projects to the associated replication projects. Assuming the last demonstration project was completed in 2010, the associated replications would have been implemented in 2012. In the absence of detailed data about when each demonstration and replication project began to generate benefits, the analysis uses 2012 as the common starting point. Using the same starting point (2012) across projects facilitates comparisons by adjusting for differences in energy prices in the year when projects came online.² This has the advantage of smoothing over idiosyncratic fluctuations in energy prices when attempting to compare benefits over time. However, this approach has the disadvantage of not reflecting the actual energy prices at the time when the projects began to generate benefits.

Annual Energy Outlook 2013 expresses all energy prices in 2011 dollars unless otherwise noted; therefore, it was not necessary for this analysis to discount future prices back to current dollars. Expressing all savings in current dollars adjusts for the effects of inflation on energy prices in later years, and therefore represents a reasonably accurate assessment of the world from NYSERDA's point of view. It does not, however, account for the firm's opportunity cost of capital – i.e., other investments the firm could have made instead of investing in the project. If a private firm were considering the investments described in this section, it would further discount the future energy savings by its weighted average cost of capital – i.e., the cost required to finance the firm's mix of debt and equity – thereby reducing the present value of the savings.

The analysis used a similar process for fuel savings (therms/year). Therms were converted to MMBTU by dividing by 10. This value was then multiplied by EIA's forecasted prices (under the reference case, low case, and high case, respectively) to calculate the monetary savings. However, a complicating factor in the fuel analysis is that different sites use different types of fuel. A key question in projecting the fuel savings is which fuel source was displaced at each site. For example, if a site reduced its use of natural gas by 1,200 therms per year, the annual monetary savings would be calculated as 1,200 therms times the price of natural gas. If a firm switched to using natural gas in lieu of coal, the savings would be the quantity of the displaced coal times the price of coal. The evaluators were able to identify the fuel source for five of the seven demonstration sites; however, the fuel source for the other two demonstration sites could not be identified.³ For the two sites whose fuel source was unknown, the analysis calculated a "typical" fuel mix for the sector and state using the following data sources:

- **EIA State Energy Data 2011: Commercial Sector Energy Consumption Estimates.** This table shows the estimated energy consumption by the commercial sector in trillion Btu. The data are further broken out by state. The table includes a variety of fuel sources; based on knowledge about the demonstration projects, the evaluators selected the applicable fuel sources – coal, natural gas, distillate fuel oil, and residual fuel oil – and excluded non-applicable fuel sources (e.g., motor gasoline and kerosene). The analysis uses data for New York State.
- **EIA State Energy Data 2011: Industrial Sector Energy Consumption Estimates.** This table is analogous to the previous table, but shows estimated energy consumption for the industrial

² For example, prices may have been atypically high or atypically low in the year when a particular project came online. In addition, the demonstration projects as a group may have come online during a period when energy prices were different from when the replication projects came online.

³ The analysis assumes that the replication sites use the same fuel source as the demonstration sites.

sector instead of the commercial sector. The evaluators used the relevant data (same categories as above) for New York State.

- EIA 2009 Residential Energy Consumption Survey: Space Heating in U.S. Homes in Northeast Region, Divisions, and States.** This table provides residential data for 2009, broken out for selected states. An advantage of this table is that it is specific to heating as opposed to general energy consumption. A disadvantage is that the figures are expressed in millions of housing units, rather than Btu. The analysis used the figures for natural gas and fuel oil for New York State to calculate the relative percentage of homes that use each fuel source.

Of the two demonstration sites with unknown fuel sources, one was a commercial/industrial site and the other was residential. For the commercial/industrial site, the analysis first summed the commercial and industrial consumption for each fuel source, and then calculated commercial/industrial consumption of each fuel source as a percentage of total consumption. This is shown in Table C-2.

Table C-2. EIA Commercial and Industrial Sector Energy Consumption Estimates, 2011 (trillion Btu)

	Coal	Natural Gas	Distillate Fuel Oil	Residual Fuel Oil	Total
Commercial ¹	0.1	298.9	59.9	44.6	403.5
Industrial ¹	25.9	78.7	16.3	49.7	170.6
C/I Sub-total²	26	377.6	76.2	94.3	574.1
Percent of Total²	5%	66%	13%	16%	100%

Notes: (1) Excerpt from EIA data. (2) IEc calculations.

For the residential site, the analysis estimated the fuel mix by calculating the number of homes that use natural gas or fuel oil, respectively, as a percent of the total. The figures are shown in Table C-3.

Table C-3. Space Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

	Number of Housing Units (millions)	Percent of Housing Units
Natural Gas ¹	4.1	66%
Fuel Oil ¹	2.1	34%
Total²	6.2	100%

Notes: (1) Excerpt from EIA data. (2) IEc calculations.

The final step in the analysis calculated a “typical” fuel price for each sector (commercial/industrial and residential, respectively) based on the percentages derived in Tables C-2 and C-3. To do this, the percentages in the tables were applied to the energy prices from the *Annual Energy Outlook 2013*. For example, the “typical” energy price for the commercial/industrial site was calculated as follows: 5% of the coal price plus 66% of the natural gas price plus 13% of the distillate fuel oil price plus 16% of the residual fuel oil price.⁴ A similar method was used for the residential site using the percentages in Table C-3 and the EIA energy price forecast. The rest of the analysis for these two sites was carried out in the same way as for the sites with known fuel sources.

⁴ For each fuel source, the EIA “price” was the simple average of the commercial and industrial prices, as described above in the main text. The exception was coal, which only had an industrial (but not commercial) price.

**Energy Prices by Sector and Source, Middle Atlantic, Reference case
(2011 dollars per million Btu, unless otherwise noted)**

Sector and Source	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	Growth Rate (2011-2040)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Propane	21.97045	20.06136	27.47918	26.00795	25.46389	24.73688	24.83483	25.65107	26.10779	26.65389	27.11455	27.44455	27.80685	28.11268	28.40285	28.66199	28.89647	29.10994	29.37439	29.57237	29.77216	29.97613	30.14428	30.35348	30.61174	30.88811	31.17288	31.41276	32.05755	32.37519	32.75019	33.15288	0.40%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Distillate Fuel Oil	31.96201	26.68124	26.78817	25.53711	25.62548	25.99585	26.49615	26.65107	27.10862	27.57109	27.77445	28.10013	28.38165	28.56613	29.07317	30.16268	30.59691	31.04789	31.49310	31.90126	32.3342	32.7573	32.7573	33.47387	33.31661	34.19754	35.41274	35.66212	36.59367	37.16132	37.61362	38.05711	1.20%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Natural Gas	13.96526	12.58123	12.53114	12.10191	11.93682	11.75689	12.19147	12.11221	12.74474	12.93811	13.20725	13.43254	13.62386	13.78215	13.89576	14.18178	14.25703	14.49037	14.52016	14.68763	14.87974	15.02414	15.21365	15.48162	15.76349	16.44605	16.44605	16.71993	16.99904	17.30628	17.60132	17.90132	18.20132	0.30%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
Electricity	47.491482	46.560055	45.626205	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	44.171864	0.10%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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Propane	25.207697	23.783081	22.013229	20.328802	19.722401	18.916889	19.034151	19.934116	20.512598	21.061497	21.587227	21.965261	22.383533	22.751055	23.079552	23.388838	23.705	23.97457	24.23031	24.46241	24.70067	24.92234	25.149294	25.397005	25.70706	26.042299	26.416314	26.80044	27.19001	27.52749	27.859978	28.195978	0.50%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Distillate Fuel Oil	21.076435	25.522793	25.68747	24.68237	24.63097	22.69371	23.07619	23.07619	24.55525	24.79365	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	24.90555	1.00%																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
Natural Gas	10.53879	9.49743	8.85619	8.91911	8.66916	8.52491	8.90062	9.00043	9.35561	9.452087	9.54745	9.64038	9.74282	9.84527	10.00007	10.09686	10.19365	10.29044	10.38723	10.48402	10.58081	10.67760	10.77439	10.87118	10.96797	11.06476	11.16155	11.25834	11.35513	11.45192	11.54871	11.64550	11.74229	11.83908	11.93587	12.03266	12.12945	12.22624	12.32303	12.41982	12.51661	12.61340	12.71019	12.80698	12.90377	13.00056	13.09735	13.19414	13.29093	13.38772	13.48451	13.58130	13.67809	13.77488	13.87167	13.96846	14.06525	14.16204	14.25883	14.35562	14.45241	14.54920	14.64599	14.74278	14.83957	14.93636	15.03315	15.12994	15.22673	15.32352	15.42031	15.51710	15.61389	15.71068	15.80747	15.90426	16.00105	16.09784	16.19463	16.29142	16.38821	16.48500	16.58179	16.67858	16.77537	16.87216	16.96895	17.06574	17.16253	17.25932	17.35611	17.45290	17.54969	17.64648	17.74327	17.84006	17.93685	18.03364	18.13043	18.22722	18.32401	18.42080	18.51759	18.61438	18.71117	18.80796	18.90475	19.00154	19.09833	19.19512	19.29191	19.38870	19.48549	19.58228	19.67907	19.77586	19.87265	19.96944	20.06623	20.16302	20.25981	20.35660	20.45339	20.55018	20.64697	20.74376	20.84055	20.93734	21.03413	21.13092	21.22771	21.32450	21.42129	21.51808	21.61487	21.71166	21.80845	21.90524	22.00203	22.09882	22.19561	22.29240	22.38919	22.48598	22.58277	22.67956	22.77635	22.87314	22.96993	23.06672	23.16351	23.26030	23.35709	23.45388	23.55067	23.64746	23.74425	23.84104	23.93783	24.03462	24.13141	24.22820	24.32499	24.42178	24.51857	24.61536	24.71215	24.80894	24.90573	25.00252	25.09931	25.19610	25.29289	25.38968	25.48647	25.58326	25.68005	25.77684	25.87363	25.97042	26.06721	26.16400	26.26079	26.35758	26.45437	26.55116	26.64795	26.74474	26.84153	26.93832	27.03511	27.13190	27.22869	27.32548	27.42227	27.51906	27.61585	27.71264	27.80943	27.90622	28.00301	28.09980	28.19659	28.29338	28.39017	28.48696	28.58375	28.68054	28.77733	28.87412	28.97091	29.06770	29.16449	29.26128	29.35807	29.45486	29.55165	29.64844	29.74523	29.84202	29.93881	30.03560	30.13239	30.22918	30.32597	30.42276	30.51955	30.61634	30.71313	30.80992	30.90671	31.00350	31.10029	31.19708	31.29387	31.39066	31.48745	31.58424	31.68103	31.77782	31.87461	31.97140	32.06819	32.16498	32.26177	32.35856	32.45535	32.55214	32.64893	32.74572	32.84251	32.93930	33.03609	33.13288	33.22967	33.32646	33.42325	33.52004	33.61683	33.71362	33.81041	33.90720	34.00399	34.10078	34.19757	34.29436	34.39115	34.48794	34.58473	34.68152	34.77831	34.87510	34.97189	35.06868	35.16547	35.26226	35.35905	35.45584	35.55263	35.64942	35.74621	35.84300	35.93979	36.03658	36.13337	36.23016	36.32695	36.42374	36.52053	36.61732	36.71411	36.81090	36.90769	37.00448	37.10127	37.19806	37.29485	37.39164	37.48843	37.58522	37.68201	37.77880	37.87559	37.97238	38.06917	38.16596	38.26275	38.35954	38.45633	38.55312	38.64991	38.74670	38.84349	38.94028	39.03707	39.13386	39.23065	39.32744	39.42423	39.52102	39.61781	39.71460	39.81139	39.90818	40.00497	40.10176	40.19855	40.29534	40.39213	40.48892	40.58571	40.68250	40.77929	40.87608	40.97287	41.06966	41.16645	41.26324	41.36003	41.45682	41.55361	41.65040	41.74719	41.84398	41.94077	42.03756	42.13435	42.23114	42.32793	42.42472	42.52151	42.61830	42.71509	42.81188	42.90867	43.00546	43.10225	43.19904	43.29583	43.39262	43.48941	43.58620	43.68299	43.77978	43.87657	43.97336	44.07015	44.16694	44.26373	44.36052	44.45731	44.55410	44.65089	44.74768	44.84447	44.94126	45.03805	45.13484	45.23163	45.32842	45.42521	45.52200	45.61879	45.71558	45.81237	45.90916	46.00595	46.10274	46.19953	46.29632	46.39311	46.48990	46.58669	46.68348	46.78027	46.87706	46.97385	47.07064	47.16743	47.26422	47.36101	47.45780	47.55459	47.65138	47.74817	47.84496	47.94175	48.03854	48.13533	48.23212	48.32891	48.42570	48.52249	48.61928	48.71607	48.81286	48.90965	49.00644	49.10323	49.20002	49.29681	49.39360	49.49039	49.58718	49.68397	49.78076	49.87755	49.97434	50.07113	50.16792	50.26471	50.36150	50.45829	50.55508	50.65187	50.74866	50.84545	50.94224	51.03903	51.13582	51.23261	51.32940	51.42619	51.52298	51.61977	51.71656	51.81335	51.91014	52.00693	52.10372	52.20051	52.29730	52.39409	52.49088	52.58767	52.68446	52.78125	52.87804	52.97483	53.07162	53.16841	53.26520	53.36200	53.45879	53.55558	53.65237	53.74916	53.84595	53.94274	54.03953	54.13632	54.23311	54.32990	54.42669	54.52348	54.62027	54.71706	54.81385	54.91064	55.00743	55.10422	55.20101	55.29780	55.39459	55.49138	55.58817	55.68496	55.78175	55.87854	55.97533	56.07212	56.16891	56.26570	56.36249	56.45928	56.55607	56.65286	56.74965	56.84644	56.94323	57.04002	57.13681	57.23360	57.33039	57.42718	57.52397	57.62076	57.71755	57.81434	57.91113	58.00792	58.10471	58.20150	58.29829	58.39508	58.49187	58.58866	58.68545	58.78224	58.87903	58.97582	59.07261	59.16940	59.26619	59.36298	59.45977	59.55656	59.65335	59.75014	59.84693	59.94372	60.04051	60.13730	60.23409	60.33088	60.42767	60.52446	60.62125	60.71804	60.81483	60.91162	61.00841	61.10520	61.20200	61.29879	61.39558	61.49237	61.58916	61.68595	61.78274	61.87953	61.97632	62.07311	62.16990	62.26669	62.36348	62.46027	62.55706	62.65385	62.75064	62.84743	62.94422	63.04101	63.13780	63.23459	63.33138	63.42817	63.52496	63.62175	63.71854	63.81533	63.91212	64.00891	64.10570	64.20249	64.29928	64.39607	64.49286	64.58965	64.68644	64.78323	64.88002	64.97681	65.07360	65.17039	65.26718	65.36397	65.46076	65.55755	65.65434	65.75113	65.84792	65.94471	66.04150	66.13829	66.23508	66.33187	66.42866	66.52545	66.62224	66.71903	66.81582	66.91261	67.00940	67.10619	67.20298	67.30000	67.39679	67.49358	67.59037	67.68716	67.78395	67.88074	67.97753	68.07432	68.17111	68.26790	68.36469	68.46148	68.55827	68.65506	68.75185	68.84864	68.94543	69.04222	69.13901	69.23580	69.33259	69.42938	69.52617	69.62296	69.71975	69.81654	69.91333	70.01012	70.10691	70.20370	70.30049

Energy Prices by Sector and Source, Middle Atlantic, High economic growth
(2011 dollars per million Btu, unless otherwise noted)

Sector and Source	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	Growth Rate (2011-2040)					
Residential																																					
Propane	21.57965	20.05219	27.45783	26.10609	25.604268	25.029987	25.45554	26.118793	26.460222	27.193254	27.681923	28.073989	28.481134	28.765394	29.050508	29.335622	29.620736	29.905850	30.190964	30.476078	30.761192	31.046306	31.331420	31.616534	31.901648	32.186762	32.471876	32.756990	33.042104	33.327218	33.612332	33.897446	34.182560	34.93885			
Distillate Fuel Oil	31.96201	26.68124	26.78178	25.73287	25.79384	26.241486	26.241486	27.062327	27.538897	27.937504	28.3864	28.7853	29.23421	29.67313	30.11205	30.55097	30.98991	31.42885	31.86779	32.30673	32.74567	33.18461	33.62355	34.06249	34.50143	34.94037	35.37931	35.81825	36.25719	36.69613	37.13507	37.57401	38.01295	38.45189	38.89083		
Natural Gas	13.99526	12.58123	12.35218	12.45876	12.08444	11.88906	12.16905	12.67246	13.079871	13.32811	13.53211	13.74004	13.97361	14.21193	14.45025	14.68857	14.92689	15.16521	15.40353	15.64185	15.88017	16.11849	16.35681	16.59513	16.83345	17.07177	17.31009	17.54841	17.78673	18.02505	18.26337	18.50169	18.73999	18.97831	19.21663		
Electricity	47.491482	46.56005	45.12114	43.75169	45.36576	45.05619	44.98848	44.77079	45.02609	44.77079	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	44.85784	
Commercial																																					
Propane	25.207697	23.772453	21.98804	20.439817	19.955555	19.246153	19.485846	20.456709	21.081171	21.679266	22.243174	22.705757	23.13904	23.510103	23.85993	24.181349	24.470032	24.72873	24.975122	25.217178	25.452597	25.68712	25.889878	26.147518	26.436672	26.811804	27.139622	27.477667	27.830877	28.400447	28.723881						
Distillate Fuel Oil	21.074635	25.522793	25.678487	24.68237	24.289606	23.31735	23.28204	24.211493	24.679357	25.088556	25.589727	26.077415	26.560789	27.112989	27.596808	28.08974	28.451548	28.814248	29.268438	29.722628	30.176818	30.631008	31.085198	31.539388	32.000000	32.454190	32.918380	33.382570	33.846760	34.310950	34.775140	35.239330	35.703520	36.167710	36.631900	37.096090	
Natural Gas	10.538739	9.497483	8.485888	9.066708	8.808095	8.640168	9.056712	9.28284	9.612879	9.796559	9.938517	10.048324	10.306365	10.53874	10.742502	10.93874	11.127741	11.316740	11.505740	11.694740	11.883740	12.072740	12.261740	12.450740	12.639740	12.828740	13.017740	13.206740	13.395740	13.584740	13.773740	13.962740	14.151740	14.340740	14.529740	14.718740	
Electricity	41.874641	40.25901	39.181999	36.629452	37.609306	36.872856	36.938068	37.175213	37.957394	38.124825	38.250713	38.489101	38.537411	38.28147	38.61626	38.89702	36.924782	36.968796	36.618511	36.988174	37.360439	37.635799	38.398037	38.573616	39.471786	39.976662	40.748791	41.273396	41.761242	42.100204	42.788241						
Industrial 1/																																					
Propane	26.783178	22.529507	20.74805	19.165784	18.760881	17.982637	18.217529	19.176334	19.793648	20.385645	20.944357	21.405881	21.8885	22.29995	22.56215	22.88213	23.171497	23.440399	23.678205	23.921622	24.175038	24.393181	24.58825	24.856194	25.147182	25.24862	25.85263	26.196133	26.5525	26.910334	27.206755						
Distillate Fuel Oil	21.829166	26.43073	26.880124	25.57804	25.138612	24.30112	24.71952	25.176718	25.704139	26.327119	26.953148	27.581656	28.210164	28.838672	29.467180	30.095688	30.724196	31.352704	31.981212	32.609720	33.238228	33.866736	34.495244	35.123752	35.752260	36.380768	37.009276	37.637784	38.266292	38.894800	39.523308	40.151816	40.780324	41.408832	42.037340	42.665848	
Natural Gas	11.689151	10.783226	9.71102	10.282655	10.288414	10.289932	10.287874	10.377888	10.354848	10.363795	10.35073	10.439988	10.515157	10.671613	10.715532	10.778361	10.776615	10.588515	10.618204	10.919821	10.948128	10.95697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697	10.96697
Electricity	7.629351	7.71041	5.62699	6.11317	5.966049	5.959527	6.306863	6.525577	6.818648	6.979278	7.097888	7.22362	7.3748	7.512403	7.62522	7.75575	8.01055	8.02939	8.08886	8.211256	8.256041	8.372083	8.446218	8.705866	8.816249	9.127957	9.387684	9.579999	9.74241	10.97596	10.25161						
Metalurgical Coal	5.89326	6.27745	6.93147	7.28545	7.518696	7.86217	8.471179	8.964386	8.130898	8.324732	8.471179	8.571424	9.179214	9.314908	9.462386	9.6265	9.776615	9.958517	10.127741	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436	10.2436
Other Industrial Coal	3.078899	3.82299	3.89277	3.79657	3.649385	3.708606	3.723624	3.787558	3.903304	3.934453	3.979978	3.995	4.031565	4.09575	4.067405	4.081771	4.121887	4.137936	4.150429	4.170444	4.206513	4.228354	4.246237	4.259399	4.260539	4.23895	4.32895	4.356693	4.396475	4.4226	4.477397	4.488911					
Coal to Liquids	5.56541	5.14975	5.36998	4.149337	4.20509	4.209256	4.632116	4.793878	5.103964	5.25155	5.374287	5.488127	5.635886	5.81324	5.91387	6.042152	6.18884	6.419037	6.472178	6.620662	6.698159	6.826587	6.930296	7.174329	7.24212	7.610998	7.88818	8.56837	8.78533								
Electricity	25.39255	24.30720	21.19647	19.171109	20.389955	20.03501	20.248812	20.357715	20.90881	21.029396	21.186417	21.68389	21.913099	22.016474	22.11241	22.18723	22.786711	22.573013	23.87223	23.059923	23.255982	23.674599	23.841669	24.46671	24.9223	25.66119	26.01663	26.49176	26.90088	27.291399							
Transportation																																					
Propane	30.78386	25.38282	24.27417	21.34398	22.34302	22.41458	23.10875	23.65896	24.10118	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	24.52159	
Distillate Fuel Oil	26.135481	26.135481	24.03032	21.56214	21.60675	21.90708	23.28238	23.58446	24.16825	24.890188	25.81498	26.419234	26.949139	27.24244	27.496105	27.7822	28.159302	28.609898	28.88989	29.251362	29.675747	30.24725	30.75492	31.38417	32.12708	33.05622	43.87079	45.51749	46.81251	47.40648							
Motor Gasoline 4/	23.457163	29.041368	29.66089	27.34439	26.885403	26.52567	26.62602	26.867598	27.346027	27.912155	28.651913	29.13528	29.59309	29.79395	29.98885	30.29776	30.57443	30.89758	31.11919	31.40109	31.740599	32.1978	32.60991	33.10796	33.78843	34.45211	35.08663	35.67104	36.20545	36.69086	37.13587	37.53219	37.89259	38.21681			
Jet Fuel 5/	16.68294	22.65191	22.66928	20.708824	19.947081	19.988424	20.369148	20.73965	20.978142	21.497578	21.952103	22.388103	22.910738	23.32161	23.92926	24.47184	24.91649	25.38087	25.73418	26.220158	26.816038	27.378	27.81152	28.3838	29.01688	29.744783	30.467571	30.981213	31.785749	32.31005	32.71681						
Diesel Fuel (distillate fuel oil) 6/	22.072046	26.975737	27.73329	25.29232	25.67937	25.80368	26.302893	26.849489	27.274112	27.735254	28.307059	28.125552	29.298089	30.270733	30.735149	31.115484	31.510029	31.844484	32.25067	32.70866	33.240836	33.840542	34.23648	34.945755	35.542416	36.20021	36.7663	37.47554	38.21329	38.91468							
Electricity	9.980025	16.620077	17.40313	16.402508	11.236945	11.98804	11.483294	11.81044	12.05506	12.457732	12.793581	13.150541	13.50541	13.860055	14.22881	14.580067	14.95117	15.287281	15.56766	15.91037	16.18544	16.51563	16.81554	17.15063	17.59883	18.379187	18.800549	19.258228	20.38875	20.81653							
Natural Gas 7/	16.179142	16.88284	13.46655	15.21313	15.55133	15.14564	15.59311	15.86049	16.230433	16.45761	16.64886	16.86789	17.13504	17.470388	17.70816	18.03614	18.69671	18.86762																			

Natural Gas 7/	15.841271	16.888254	13.705427	15.761653	15.893721	16.086046	16.749243	17.22508	17.83367	18.28863	18.7311	19.172578	19.785419	20.456604	21.012066	21.754133	22.754995	23.411158	24.002211	24.725313	25.308081	25.988052	26.564514	27.378384	27.959785	28.845114	29.634405	30.245924	30.96244	31.834843	32.629452	2.30%	
Electricity	35.853615	35.965927	34.613689	34.416332	35.15662	35.274254	35.8092	36.208702	37.200996	37.671787	38.077374	38.820625	39.546452	40.320709	41.612645	42.885197	43.625622	44.831703	45.613461	46.778736	47.756752	48.881873	49.912498	50.852703	52.321056	53.646984	55.273151	56.58033	57.981613	59.136078	60.489151	1.80%	
Electric Power 8/																																	
Distillate Fuel Oil	18.802338	23.264605	23.837973	23.277601	21.139484	21.408525	22.132477	22.89567	23.542088	24.338936	25.088379	25.915095	26.8078	27.773369	28.787596	29.815941	30.794571	31.849567	32.805176	33.913261	35.053257	36.247551	37.389427	38.624393	40.073692	41.572033	43.018906	44.305752	45.895203	47.561882	49.161243	2.60%	
Residual Fuel Oil	11.62077	16.052482	17.212284	15.651244	12.594116	12.866449	13.280184	13.795811	14.372239	14.988748	15.478512	16.153803	16.817528	17.48889	18.172932	18.87377	19.735525	20.477224	21.260187	22.07373	22.984026	23.741018	24.793424	25.772722	26.704634	27.745829	28.748009	29.736245	31.122755	32.513103	33.714191	2.60%	
Natural Gas	5.489115	5.124975	3.633072	4.290295	4.321328	4.470612	4.975774	5.26644	5.088163	5.39882	6.040723	6.252706	6.50762	6.80672	7.022933	7.288635	7.750792	7.964658	8.146389	8.463642	8.655421	8.97939	9.226507	9.690015	9.97045	10.574982	11.087117	11.48841	11.967162	12.51005	13.001099	3.30%	
Steam Coal	2.600971	2.958866	2.950084	2.907113	3.037266	3.063363	3.086164	3.179789	3.289552	3.379472	3.465259	3.540971	3.616467	3.697912	3.76666	3.88629	3.948388	4.032273	4.112725	4.199292	4.308306	4.395417	4.488984	4.573112	4.679277	4.789493	4.902168	5.020648	5.1409	5.253784	5.348643	2.10%	
Average Price to All Users 9/																																	
Propane	24.269598	22.862368	21.16326	19.933319	19.580236	18.988776	19.150831	20.333261	21.191586	22.01825	22.937519	23.795418	24.672295	25.540281	26.380966	27.258898	28.148161	29.013895	29.805004	30.644543	31.479647	32.328845	33.127403	34.066223	35.056732	36.215252	37.344532	38.49321	39.691097	41.115776	42.252444	2.10%	
E85 3/	25.589691	26.135481	34.634544	32.661102	35.244629	35.251545	35.750217	36.474789	37.543594	38.771961	40.293564	41.492966	42.664268	44.699523	45.532612	46.659325	47.907593	48.961315	50.129982	51.394882	52.884075	54.305305	55.8955	57.728291	59.725173	61.637703	63.84762	65.725105	67.925171	70.169495	3.50%		
Motor Gasoline 4/	22.895582	28.967553	29.948657	28.241138	28.195704	28.201239	28.600176	29.199484	30.034874	31.017567	32.214484	33.194374	34.113413	34.887405	35.627441	36.42609	37.327461	38.26077	39.169652	40.103981	41.11591	42.307255	43.444244	44.716404	46.182632	47.780212	49.310158	50.707813	52.58009	54.940137	56.135597	2.30%	
Jet Fuel 5/	16.334209	22.651927	23.689095	21.92886	20.91923	21.229233	21.879393	22.561487	23.889324	24.696115	25.507101	26.454472	27.343027	28.420893	29.497377	30.66856	31.492815	32.391056	33.487144	34.736767	35.974533	37.056072	38.315781	39.719578	41.246201	42.679253	44.111721	45.844143	47.216368	48.655602	2.70%		
Distillate Fuel Oil	21.98155	26.64042	27.406839	26.253441	26.498369	26.923395	27.72646	28.609211	29.387369	30.240355	31.081802	32.08181	33.0593781	34.178689	35.285542	36.372875	37.394283	38.47081	39.464141	40.597103	41.773563	43.080853	44.309185	45.634155	47.211273	48.798409	50.3386	51.70645	53.397163	55.195953	56.921188	2.60%	
Residual Fuel Oil	10.423209	17.565975	18.835281	17.921284	12.602622	12.797966	13.235538	13.744211	14.269347	14.856552	15.386954	16.026493	16.671738	17.328625	18.013945	18.707951	19.499468	20.2176	20.919424	21.704044	22.624706	23.425133	24.350874	25.28548	26.208223	27.162762	28.137293	29.088333	30.431271	31.707069	32.886242	2.20%	
Natural Gas	9.278647	8.730949	7.546204	8.406269	8.36457	8.38577	8.886115	9.25798	9.691496	10.009379	10.308672	10.6227075	10.971616	11.31466	11.651193	11.932856	12.451791	12.6552243	12.912805	13.24513	13.506331	13.860126	14.236727	14.761735	15.21326	15.885097	16.500602	17.012005	17.593788	18.284986	18.938511	2.70%	
Metallurgical Coal	5.452337	6.627745	7.654472	7.539221	7.885131	8.351026	8.555026	8.830745	9.147098	9.415876	9.703976	9.982284	10.288532	10.588188	10.902196	11.22422	11.70142	11.94467	12.305928	12.713821	13.121563	13.4997	13.820366	14.172669	14.560583	14.963907	15.342481	15.722922	16.108231	16.511999	16.90217	3.30%	
Other Coal	2.623896	3.007366	2.989332	2.954538	3.079836	3.113468	3.139852	3.231598	3.25798	3.359933	3.52402	3.597935	3.674318	3.755662	3.834668	3.916431	4.003514	4.092472	4.172726	4.260542	4.37037	4.459412	4.550488	4.638267	4.74541	4.856157	4.969972	5.089884	5.212267	5.327099	5.423976	2.10%	
Coal to Liquids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
Electricity	40.047787	39.667118	38.725056	37.185425	38.849972	38.634495	39.010365	39.393188	40.392288	40.785885	41.284775	42.092464	42.747932	43.242897	44.412052	45.328594	45.261517	46.409004	46.806305	48.075066	49.226437	50.303543	51.895878	52.858063	54.736744	56.161987	57.940144	59.276508	60.759743	61.984493	63.655952	1.60%	
Non-Renewable Energy Expenditures by Sector (billion nominal dollars)																																	
Residential	39.675091	40.766396	39.082996	39.608463	40.050098	39.917618	40.696594	41.412224	42.40955	43.089321	43.62635	44.473442	45.332394	46.181293	47.440956	48.69421	49.789246	51.000048	51.857365	53.207638	54.344925	55.544754	56.913367	58.193554	59.829815	61.459961	63.197353	64.587196	66.251251	67.927406	69.782738	1.90%	
Commercial	32.628082	31.968863	30.379126	30.190964	30.818953	30.933947	31.754154	32.541924	33.704842	34.449276	35.131378	35.925215	36.721554	37.354977	38.368198	39.070168	39.188046	40.096722	40.755386	41.970814	43.055435	44.154076	45.590397	46.814438	48.474533	50.062607	51.849411	53.328148	55.037636	56.75452	58.686886	2.10%	
Industrial	32.706611	37.186759	35.130771	33.473054	34.938053	35.804824	36.954996	38.092809	39.240217	40.234665	41.084007	41.955887	42.644174	43.516709	44.240052	45.499027	47.345928	46.447414	47.112336	47.847298	49.579275	50.354346	51.127745	52.194021	53.391029	54.699516	56.344559	58.697866	58.411026	60.416584	3.00%		
Transportation	61.561665	77.178802	78.184096	72.823273	72.290916	72.747072	73.886946	75.747841	77.708916	79.990723	82.385117	84.409023	86.287048	87.716393	89.242256	90.674576	92.149437	93.456256	95.282455	97.112715	99.261075	101.906937	104.901691	107.280331	110.810417	114.580238	118.642876	122.786311	128.108185	133.967949	138.838272	2.00%	
Total Non-Renewable Expenditures	146.571457	167.080643	162.779007	156.105042	158.078033	159.33046	163.392685	167.794907	173.063522	177.763992	182.228698	186.290268	199.254578	203.31293	206.625748	212.318405	214.342606	219.422501	224.587322	231.187729	237.250115	243.508072	251.308777	259.493835	267.729156	276.046265	286.294434	296.460175	307.726288	2.10%			
Transportation Renewable Expenditures	0.082636	0.018352	0.011647	0.011502	0.006594	0.010119	0.010654	0.011227	0.011853	0.012457	0.013008	0.013527	0.013901	0.014418	0.014321	0.014469	0.014657	0.014855	0.014982	0.015132	0.015317	0.015378	0.015815	0.016097	0.016444	0.016831	0.017283	0.017765	0.018399	0.019105	0.019116	0.30%	
Total Expenditures	146.579712	167.088999	162.790649	156.116547	158.089723	159.340576	163.403316	167.806122	173.075378	177.776459	182.239975	186.796478	199.256248	203.336411	206.640411	212.333267	214.357599	219.437322	224.540652	231.203308	237.265808	243.524155	251.325241	259.510651	267.746429	276.063995	286.312836	296.479279	307.746485	2.10%			

1/ Includes combined heat and power plants that have a non-regulatory status, and small on-site generating systems.

2/ Excludes use for lease and plant fuel.

3/ E85 refers to a blend of 85 percent ethanol (renewable) and 15 percent motor gasoline (nonrenewable). To address cold starting issues, the percentage of ethanol varies seasonally. The annual average ethanol content of 74 percent is used for this forecast.

4/ Sales weighted-average price for all grades. Includes Federal, State, and local taxes.

5/ Kerosene-type jet fuel. Includes Federal and State taxes while excluding county and local taxes.

6/ Diesel fuel for on-road use. Includes Federal and State taxes while excluding county and local taxes.

7/ Natural gas used as a vehicle fuel. Includes estimated motor vehicle fuel taxes and estimated dispensing costs or charges.

8/ Includes electricity-only and combined

Energy Prices by Sector and Source, United States, Low economic growth (2011 dollars per million Btu, unless otherwise noted)

Sector and Source	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	Growth Rate (2011-2040)				
Residential																																				
Propane	27.612459	25.02761	23.718796	22.425152	21.904715	21.201927	21.700126	21.759882	22.10087	22.47085	22.86231	23.077224	23.136815	23.624901	23.80021	24.08467	24.145182	24.51852	24.75278	24.99704	25.042155	25.475168	25.65098	25.83689	26.036095	26.258572	26.472963	26.76148	27.073256	27.35449	27.57904	0.30%				
Distillate Fuel Oil	21.767905	26.377192	26.551687	26.480245	24.802465	24.709562	24.836808	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	24.709562	0.00%			
Natural Gas	11.899373	10.802348	10.46613	10.46613	10.136584	10.072795	10.06808	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	10.072795	1.00%			
Electricity	34.922237	34.138376	31.779731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	30.767731	0.20%			
Commercial																																				
Propane	24.00313	22.055248	20.411705	18.828791	18.201582	17.36541	17.328459	18.09036	18.49352	18.88743	19.32081	19.620653	19.981037	20.303465	20.596945	20.877684	21.166153	21.423835	21.719755	22.030088	22.347994	22.641502	22.897223	23.107689	23.365566	23.65485	23.944101	24.311203	24.722115	25.19355	25.38727	0.50%				
Distillate Fuel Oil	21.53447	25.86795	26.04821	26.04821	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	24.98688	0.00%		
Natural Gas	11.862396	19.165131	20.135022	18.811363	18.207299	17.408866	17.330789	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	18.110249	0.00%		
Electricity	9.396975	8.848661	8.072882	8.444036	8.190291	8.028808	8.214981	8.578873	8.517669	9.004212	9.007084	9.201427	9.397676	9.494752	9.570773	9.749081	9.800812	9.986407	10.141735	10.282772	10.424839	10.555222	10.615216	10.765115	11.005025	11.361542	11.724493	12.120746	12.405443	12.513743	12.513743	12.513743	1.00%			
Industrial 1/																																				
Propane	23.72747	22.495939	20.748369	19.145542	17.623985	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	16.356459	0.50%			
Distillate Fuel Oil	21.78206	26.50187	26.678213	26.619071	22.183874	22.245071	22.26706	23.041138	23.669213	23.906929	24.311844	24.788172	25.27382	25.61674	26.07536	26.429165	26.785116	27.143033	27.503449	27.83474	28.219309	28.554016	28.897297	29.215778	29.616226	30.009126	30.415413	30.812524	31.367789	32.61523	32.61523	32.61523	32.61523	0.00%		
Natural Gas 2/	5.48961	4.89107	4.80765	4.32111	4.397115	4.699115	4.32111	4.699115	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	4.32111	0.00%		
Metallicallurgical Coal	5.86456	7.01	7.229744	7.504471	7.701272	8.082412	8.276903	8.406076	8.556293	8.666813	8.811481	8.91404	9.06444	9.158922	9.208857	9.399324	9.510137	9.649312	9.796159	9.953738	10.110799	10.237353	10.384742	10.464723	10.580317	10.723603	10.844096	10.844096	10.997857	11.045993	11.052928	11.052928	11.052928	1.60%		
Other Industrial Coal	2.767579	3.429703	3.242764	3.288817	3.273858	3.348382	3.379764	3.379624	3.396648	3.411115	3.435217	3.452357	3.464447	3.479112	3.501418	3.530682	3.574874	3.599814	3.628807	3.661383	3.697458	3.737217	3.762237	3.782237	3.782237	3.782237	3.782237	3.782237	3.782237	3.782237	3.782237	3.782237	3.782237	0.00%		
Coal to Liquids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00%			
Electricity	20.260443	19.975758	18.444193	18.195911	18.252407	18.081338	18.663712	18.893908	18.847397	18.722275	18.572275	18.587465	18.546101	18.633698	18.657136	18.665657	18.566589	18.632029	18.687759	18.864912	18.999399	19.115986	19.21974	19.327618	19.428319	19.512458	19.588239	19.654458	19.711145	19.760429	19.804958	19.844796	19.882791	19.91827	0.20%	
Transportation																																				
Propane	27.523793	26.025111	24.718933	23.487434	22.949709	22.248741	22.220001	22.492793	23.157251	23.530607	23.889071	24.135602	24.427494	24.689238	24.925117	25.150488	25.381033	25.585735	25.820719	26.065732	26.313096	26.545004	26.731394	26.90781	27.107336	27.330462	27.545254	27.833809	28.144261	28.427759	28.694224	28.94204	0.30%			
Distillate Fuel Oil	25.56184	25.191607	31.602161	31.081361	26.592929	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	26.144695	0.00%		
Motor Gasoline 4/	23.17905	28.69213	29.102823	29.02668	26.30285	24.98824	25.239106	26.09898	26.98978	27.57322	27.842384	28.23965	28.486113	28.95114	29.23865	29.52386	29.809788	30.15786	30.45035	30.70764	31.04832	31.482736	31.982073	32.422638	32.937189	33.400615	33.812543	34.273809	34.780454	35.309795	35.90084	36.54984	37.19821	0.70%		
Jet Fuel 5/	16.56228	22.49404	22.52222	20.55489	19.26403	19.24263	19.417115	19.319359	20.31028	20.71516	21.00183	21.490427	21.88957	22.29988	22.73363	23.19795	23.65771	24.10248	24.565977	24.98135	25.470053	25.923079	26.30788	26.712489	27.12341	27.5367	27.94767	28.31249	28.58514	28.75784	29.03112	29.30689	29.62478	1.10%		
Diesel Fuel (distillate fuel oil) 6/	22.97545	26.16429	26.44445	26.44445	24.52079	24.073875	24.14002	24.58088	25.86808	26.27194	26.77228	27.26379	27.65579	28.04899	28.44078	28.83499	29.29948	29.65661	29.77714	30.14776	30.46513	30.83739	31.1494	31.49372	32.00013	32.50013	32.50013	32.50013	32.50013	32.50013	32.50013	32.50013	32.50013	32.50013	0.00%	
Natural Gas 7/	10.232665	17.915	18.27555	17.97426	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	15.5183	0.00%	
Electricity	16.510032	16.13741	15.88826	15.82964	15.64804	15.621594	15.58225	15.54275	15.16372	15.234272	15.269676	15.10527	15.69267	16.79735	16.88889	17.12582	17.32542	17.46103	17.86652	17.83664	18.075018	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	18.17848	0.70%
Electric Power 8/																																				
Distillate Fuel Oil	19.22202	23.30016	23.53246	22.58338	20.26847	20.301133	20.486301	20.879113	21.27125	21.58317	21.90099	22.241007	22.60985	23.0026	23.45189	23.80206	24.22961	24.62817	25.05442	25.40219	25.925209	26.34044	26.66677	27.071186	27.53031	28.01538	28.45319	28.97795	29.70072	30.40542	30.868103	31.26677	31.84632	32.408103	1.00%	
Distillate Fuel Oil	12.113053	15.974023	19.02774	17.03355	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	15.70382	0.00%	
Natural Gas	5.28165	4.774714	3.32354</																																	

Propane	15.891752	17.071365	14.917008	13.225659	12.548659	11.610066	11.817423	12.998517	13.849106	14.834007	15.94455	16.955366	18.157909	18.413942	20.657106	21.974463	23.440857	24.912151	26.569824	28.386887	30.331381	32.305	34.185444	36.227474	38.447414	40.943855	43.544193	46.70105	50.227202	53.78548	57.183933	4.30%		
E85 5/	25.027876	29.191607	24.198711	21.170292	26.94244	26.002149	26.67823	28.70883	30.496073	31.854367	35.439484	35.208366	36.429955	38.720237	38.813517	41.872124	41.871234	43.745102	46.534358	47.980776	49.28752	51.652607	54.27121	57.085188	60.170162	63.535066	67.223523	71.210494	75.491221	79.961517	4.10%			
Motor Gasoline 4/	22.57922	28.474845	29.481272	27.859764	27.813134	27.982627	28.625138	29.622567	30.582576	32.333073	34.240517	35.732426	37.50938	38.149116	42.497725	44.796265	46.225533	50.52734	52.960754	55.308444	57.864897	60.661144	63.666519	67.088142	70.520798	74.444626	78.775352	83.115196	88.126106	4.00%				
Jet Fuel 5/	16.220333	22.494694	22.927155	21.291538	20.311157	20.728754	21.479095	22.584276	23.718626	24.93187	26.205727	27.548229	29.07498	30.682178	32.4254	34.184357	36.067242	38.039722	40.180698	42.349762	44.752205	47.162777	49.561536	52.194717	55.076351	58.19241	61.394588	65.158737	69.168655	73.266724	76.988399	4.30%		
Distillate Fuel Oil	21.711246	26.179953	26.90099	25.638444	25.049726	25.685266	26.608585	27.581814	29.249161	30.674762	32.109258	33.872152	37.477142	39.372658	41.268959	43.176673	45.144734	47.590755	49.885315	52.28228	54.820229	57.288184	60.111145	63.181023	66.58449	70.088383	74.07695	78.486378	82.84127	86.982026	4.20%			
Residual Fuel Oil	10.826074	17.653021	19.304628	18.33754	18.33754	16.008066	16.697211	17.544795	18.466115	19.451397	20.466909	21.40034	22.872023	24.171937	25.419344	26.836201	28.346735	29.987701	31.721024	33.544834	35.345468	37.256466	39.303284	41.572125	44.079316	46.556278	49.400952	52.566459	55.703191	58.784643	4.20%			
Natural Gas	7.11784	6.684091	5.50221	6.200551	6.200551	6.312261	6.792859	7.170664	7.464041	8.032819	8.374262	8.788572	9.304142	9.831255	10.282079	10.751538	11.268484	11.79113	12.543981	13.291352	14.040358	14.835003	15.520304	16.30105	17.280603	18.353168	19.474708	21.486464	23.209448	24.761534	26.005293	4.80%		
Metallicallng Coal	5.840001	7.01	7.358006	7.773414	8.119772	7.734522	9.141757	9.531841	9.929243	10.400694	10.945366	11.467448	12.005389	12.597511	13.194083	13.877556	14.49996	15.22902	16.022992	16.875226	17.779558	18.620181	19.499105	20.430811	21.406839	22.498684	23.905446	24.544741	25.717899	26.770508	27.684486	4.30%		
Other Coal	2.01442	2.445466	2.512009	2.481309	2.580418	2.461071	2.781887	2.853306	2.926857	3.013935	3.114039	3.295134	3.451392	3.618997	3.795442	3.971315	4.155219	4.349822	4.559152	4.781084	5.019971	5.260027	5.499491	5.764384	6.021476	6.324659	6.653197	6.959101	7.297163	7.648173	7.990155	4.20%		
Coal to Liquids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Electricity	28.789976	29.029833	28.079011	28.056299	29.012312	29.512137	31.05484	32.091366	33.014053	33.783195	34.589084	35.684149	36.732738	38.073822	39.40099	40.811684	42.086227	43.682053	45.315151	47.288918	49.242104	51.250408	53.22773	55.315842	57.485115	60.227482	61.19471	66.437195	69.875732	73.186029	76.545807	3.40%		
Non-																																		
Renewable Energy Expenditures by Sector (billion nominal dollars)																																		
Residential	248.26976	248.064301	235.973724	239.768585	243.285461	247.179123	258.908805	268.36853	278.075256	287.052094	295.0336	305.487488	316.920105	329.917145	343.166168	357.951697	372.053101	387.692657	404.576446	422.843994	441.114563	460.286102	479.498007	499.771393	521.950317	548.322144	576.601868	608.501709	641.915222	674.818359	707.407227	3.70%		
Commercial	178.562811	179.96019	171.110567	172.272308	176.477798	180.468031	190.918915	199.896759	207.561905	215.50388	223.209488	232.765821	242.226569	252.327621	264.019897	274.94854	285.939575	298.896688	312.902931	328.959311	345.950311	363.958821	378.279602	396.930664	416.900656	441.022552	468.276652	497.80249	528.958496	559.235906	589.657038	4.20%		
Industrial	205.985886	227.344055	217.467819	212.478455	223.185955	237.353821	250.849777	264.532684	277.835297	290.571027	304.036574	320.033919	334.875885	349.029999	362.719306	376.515649	391.181946	407.535645	425.49408	444.97116	464.431824	484.394231	506.448547	531.269836	561.187805	593.152666	630.899292	669.53479	707.24231	743.641113	4.20%			
Transportation	572.106934	719.27655	726.440002	681.959839	671.857056	680.346497	697.231628	722.049316	752.127686	782.440491	815.971375	850.461365	886.813035	917.972534	948.364868	980.035095	1012.954346	1049.550049	1089.537842	1131.677124	1179.600207	1227.188697	1279.18042	1338.456177	1404.231445	1479.21106	1557.181885	1647.499512	1746.527446	1848.000977	1961.177734	3.50%		
Total Non-Renewable Expenditures	1205.025391	1374.64602	1350.991343	1299.48291	1304.098755	1331.178545	1384.414062	1440.515318	1502.297485	1562.831787	1628.789429	1692.757202	1766.699506	1836.102371	1904.509533	1975.31453	2047.862671	2127.20801	2214.552002	2309.211182	2410.795052	2513.866455	2621.307129	2741.606689	2874.342285	3004.415374	3159.212102	3344.702881	3586.930279	3789.31545	3996.883031	3.70%		
Transportation Renewable Expenditures	0.152984	1.722059	0.39781	0.929687	3.064185	3.419442	3.633543	3.555513	3.800075	3.762042	3.343596	4.154223	4.525013	5.446791	7.426293	9.198012	10.729758	11.070656	11.449039	12.488899	13.284778	14.001008	14.499491	15.058538	15.668416	16.370165	17.099417	17.96722	18.920602	19.889137	21.078564	9.00%		
Total Expenditures	1205.17845	1376.367065	1351.389771	1300.41272	1307.162964	1334.597778	1388.047729	1443.906738	1505.877563	1566.59375	1632.132385	1696.911377	1770.61883	1851.550049	1912.03754	1984.513428	2058.592285	2138.391602	2226.000737	2321.699551	2424.024414	2527.861432	2635.806641	2756.665283	2890.010986	3046.783951	3212.111768	3402.670166	3605.862061	3809.204834	4017.961914	3.80%		

1/ Includes combined heat and power plants that have a non-regulatory status, and small on-site generating systems.

2/ Excludes use for lease and plant fuel.

3/ E85 refers to a blend of 85 percent ethanol (renewable) and 15 percent motor gasoline (nonrenewable). To address cold starting issues, the percentage of ethanol varies seasonally. The annual average ethanol content of 74 percent is used for the forecast.

4/ Sales weighted average price for all grades. Includes Federal, State, and local taxes.

5/ Kerosene-type jet fuel. Includes Federal and State taxes while excluding county and local taxes.

6/ Diesel fuel for on-road use. Includes Federal and State taxes while excluding county and local taxes.

7/ Natural gas used as a vehicle fuel. Includes estimated motor vehicle fuel taxes and estimated dispensing costs or charges.

8/ Includes electricity only and combined heat and power plants that have a regulatory status.

9/ Weighted averages of end-use fuel prices are derived from the prices shown in each sector and the corresponding sectoral consumption.

Btu = British thermal unit.

.. = Not applicable.

Note: Data for 2010 and 2011 are model results and may differ slightly from official EIA data reports.

Sources: 2010 and 2011 prices for motor gasoline, distillate fuel oil, and jet fuel are based on prices in the U.S. Energy Information Administration (EIA), Petroleum Marketing Monthly, DOE/EIA-0380(2012/08) (Washington, DC, August 2012).

2010 residential, commercial, and industrial natural gas delivered prices: EIA, Natural Gas Annual 2010, DOE/EIA-0131(2010) (Washington, DC, December 2011).

2011 residential, commercial, and industrial natural gas delivered prices: EIA, Natural Gas Monthly, DOE/EIA-0134(2012/07) (Washington, DC, July 2012).

2010 transportation sector natural gas delivered prices are based on: EIA, Natural Gas Annual 2010, DOE/EIA-0131(2010) (Washington, DC, December 2011) and estimated State taxes, Federal taxes, and dispensing costs or charges.

2011 transportation sector natural gas delivered prices are model results.

2010 and 2011 electric power sector distillate and residual fuel oil prices: EIA, Monthly Energy Review, DOE/EIA-0035(2012/09) (Washington, DC, September 2010).

2010 and 2011 electric power sector natural gas prices: EIA, Electric Power Monthly, April 2011 and April 2012, Table 4.2, and EIA, State Energy Data System

2010, DOE/EIA-0214(2010) (Washington, DC, June 2012).

2010 and 2011 coal prices based on: EIA, Quarterly Coal Report, October-December 2011, DOE/EIA-0121(2011/4Q) (Washington, DC, March 2012) and EIA, AEO2013 National Energy Modeling System.

2010 and 2011 electricity prices: EIA, Annual Energy Review 2011, DOE/EIA-0384(2011) (Washington, DC, September 2012).

2010 and 2011 E85 prices derived from monthly prices in the Clean Cities Alternative Fuel Price Report. Projections: EIA, AEO2013 National Energy Modeling System.

Table C6. Commercial Sector Energy Consumption Estimates, 2011

State	Coal	Natural Gas ^a	Petroleum						Hydro-electric Power ^e	Biomass Wood and Waste ^f	Geothermal	Retail Electricity Sales	Net Energy ^g	Electrical System Energy Losses ^h	Total ^g
			Distillate Fuel Oil	Kerosene	LPG ^b	Motor Gasoline ^c	Residual Fuel Oil	Total ^d							
<i>(Trillion Btu)</i>															
Alabama	0.0	25.5	7.0	(s)	2.7	0.2	0.0	10.0	0.0	0.9	0.0	75.9	112.4	144.8	257.2
Alaska	9.4	16.9	10.1	0.1	0.6	0.7	0.0	11.5	0.0	0.3	0.1	9.7	48.0	20.2	68.2
Arizona	0.0	33.1	6.8	(s)	1.5	0.7	0.0	8.9	0.0	0.5	(s)	100.7	143.2	202.3	345.5
Arkansas	0.0	40.6	3.6	(s)	1.2	0.4	0.0	5.2	0.0	1.3	0.0	41.4	88.6	86.1	174.7
California	0.0	250.9	47.9	0.1	8.7	1.4	0.0	58.1	(s)	17.4	0.7	418.9	746.2	809.9	1,556.1
Colorado	3.2	57.6	5.9	(s)	2.9	0.2	0.0	9.1	0.0	1.2	0.2	67.9	138.6	148.6	287.2
Connecticut	0.0	46.1	12.4	0.1	3.5	0.2	(s)	16.2	0.0	0.8	0.0	44.7	107.7	76.6	184.4
Delaware	0.0	10.8	1.1	(s)	1.1	(s)	0.0	2.2	0.0	0.2	0.0	14.5	27.7	31.2	58.9
Dist. of Col.	(s)	17.2	0.7	(s)	(s)	1.4	0.0	2.1	0.0	(s)	0.0	30.6	49.9	69.7	119.6
Florida	0.0	55.5	14.6	0.1	7.1	4.9	0.1	26.8	0.0	2.5	2.4	313.1	400.3	571.3	971.6
Georgia	0.2	57.6	6.3	0.1	3.3	0.4	0.0	10.1	0.0	1.9	(s)	160.1	229.9	334.5	564.4
Hawaii	0.0	1.9	1.7	(s)	2.5	0.1	0.0	4.3	0.0	2.8	(s)	11.5	18.7	22.0	40.7
Idaho	0.2	17.2	2.4	(s)	1.0	0.1	(s)	3.6	0.0	0.5	0.6	20.4	42.4	42.9	85.3
Illinois	3.4	217.9	5.4	(s)	2.9	1.0	0.1	9.4	0.0	1.9	0.0	172.2	402.2	386.9	789.1
Indiana	6.9	76.9	3.2	0.1	3.1	3.4	0.0	9.7	0.0	5.6	0.9	82.3	181.9	194.9	376.9
Iowa	5.7	52.3	3.9	(s)	3.1	11.2	0.0	18.4	0.0	1.4	0.7	41.2	114.2	93.7	207.9
Kansas	0.0	32.8	1.6	(s)	1.2	0.3	(s)	3.2	0.0	0.6	0.4	53.3	90.2	126.2	216.4
Kentucky	1.2	35.4	2.3	(s)	2.0	0.2	0.0	4.5	0.0	1.9	1.0	63.9	107.9	145.3	253.3
Louisiana	0.0	26.4	5.7	(s)	1.0	0.2	0.0	7.0	0.0	0.3	1.0	82.8	117.5	163.9	281.4
Maine	0.0	6.9	13.9	0.2	5.7	0.1	1.3	21.2	0.0	3.8	0.0	13.7	45.6	18.1	63.7
Maryland	0.6	69.4	8.4	0.1	3.3	0.2	(s)	12.0	0.0	3.6	0.0	104.9	190.4	237.6	428.0
Massachusetts	0.0	83.4	20.9	(s)	2.5	0.8	2.1	26.4	0.1	1.4	0.9	60.6	172.8	105.0	277.8
Michigan	4.1	165.8	7.2	0.1	2.6	0.4	0.6	10.9	0.0	7.5	1.1	131.7	321.1	289.4	610.5
Minnesota	0.6	95.3	6.1	(s)	3.1	3.3	0.8	13.3	0.0	2.5	0.0	76.3	188.3	153.4	341.7
Mississippi	0.0	20.6	3.8	(s)	2.2	0.2	0.0	6.2	0.0	0.7	0.6	46.9	74.9	89.2	164.2
Missouri	2.8	62.8	2.6	(s)	3.4	0.3	0.0	6.4	0.0	3.5	0.0	105.6	181.1	232.5	413.6
Montana	0.2	22.7	0.7	(s)	1.2	0.1	(s)	2.0	0.0	0.4	0.1	16.7	42.2	36.0	78.3
Nebraska	0.0	32.5	1.1	(s)	0.6	0.4	0.0	2.1	0.0	0.5	0.4	31.2	66.6	69.2	135.8
Nevada	0.0	31.5	2.1	(s)	0.7	0.1	0.1	2.9	0.0	0.2	0.8	30.7	66.5	53.1	119.6
New Hampshire	0.0	9.2	6.3	0.1	4.3	0.3	1.6	12.5	0.0	1.1	0.0	15.3	38.1	28.5	66.6
New Jersey	0.0	196.8	14.3	0.1	1.7	0.3	0.8	17.3	0.0	5.3	0.0	133.5	352.8	278.7	631.5
New Mexico	0.0	25.6	1.4	(s)	1.3	0.1	0.0	2.8	0.0	0.9	0.1	31.6	61.0	65.7	126.7
New York	0.1	298.9	59.9	1.0	7.1	1.0	44.6	113.5	0.1	4.7	0.6	260.7	678.5	504.2	1,182.7
North Carolina	4.3	50.6	8.8	0.2	7.3	2.0	(s)	18.2	0.1	2.3	0.0	158.5	234.1	344.7	578.8
North Dakota	1.5	11.8	6.1	(s)	1.6	0.1	0.1	7.9	0.0	0.1	0.5	16.6	37.2	36.0	73.2
Ohio	5.1	166.5	13.3	0.1	4.0	0.5	(s)	17.9	0.0	2.9	0.9	160.7	354.0	357.5	711.5
Oklahoma	0.0	41.6	3.1	(s)	1.6	0.8	0.0	5.5	0.0	0.7	0.0	66.9	114.7	132.8	247.6
Oregon	0.0	31.0	3.0	0.1	1.4	0.2	0.2	4.8	0.0	2.4	0.7	53.8	92.8	102.6	195.4
Pennsylvania	4.3	147.0	21.2	0.2	8.2	0.5	0.3	30.3	0.0	5.3	0.9	148.5	336.4	301.8	638.2
Rhode Island	0.0	11.1	3.1	(s)	0.4	0.1	0.3	3.8	0.0	0.2	0.0	12.5	27.6	16.3	43.9
South Carolina	0.0	22.6	3.2	(s)	2.5	0.2	(s)	6.0	(s)	0.5	0.0	73.7	102.8	159.1	261.9
South Dakota	0.0	11.2	1.4	(s)	1.0	0.1	(s)	2.4	0.0	0.2	0.7	15.2	29.7	32.7	62.4
Tennessee	1.8	52.9	6.0	(s)	2.7	0.3	0.0	9.0	0.0	1.0	0.0	99.0	163.8	223.3	387.0
Texas	0.3	189.6	26.7	0.1	7.1	1.6	0.3	35.8	0.0	2.1	1.0	437.5	666.3	889.3	1,555.5
Utah	0.0	42.0	3.1	(s)	2.2	0.1	0.0	5.4	0.0	0.1	0.3	36.0	83.8	74.0	157.8
Vermont	0.0	2.5	3.8	(s)	3.3	(s)	0.3	7.4	0.0	1.3	0.0	6.9	18.1	11.1	29.2
Virginia	2.4	66.0	6.7	0.1	6.2	0.6	0.1	13.7	0.0	6.6	1.0	160.5	250.2	357.5	607.7
Washington	0.0	58.1	6.8	(s)	2.7	0.5	(s)	10.1	0.0	2.4	0.4	100.3	171.3	215.3	386.6
West Virginia	0.0	26.1	2.4	(s)	0.8	0.1	0.0	3.4	0.0	2.4	(s)	26.5	58.4	53.2	111.6
Wisconsin	2.7	88.3	4.8	(s)	3.2	0.3	0.0	8.3	0.0	2.9	0.0	78.7	180.9	176.0	356.9
Wyoming	0.5	12.1	2.2	(s)	1.5	3.2	0.0	6.9	0.0	0.2	0.5	14.9	35.1	32.6	67.6
United States	61.7	3,224.7	417.2	3.2	146.5	45.3	53.7	666.1	0.2	111.7	19.7	4,531.3	8,604.3	9,347.6	17,951.9

^a Natural gas as it is consumed; includes supplemental gaseous fuels that are commingled with natural gas.

^b Liquefied petroleum gases.

^c Motor gasoline as it is consumed; includes fuel ethanol blended into motor gasoline.

^d Includes small amounts of petroleum coke not shown separately.

^e Conventional hydroelectric power. Does not include pumped-storage hydroelectricity.

^f Wood, wood-derived fuels, and biomass waste.

^g Distributed solar thermal and photovoltaic energy consumed in the commercial sector is included in residential consumption. Includes small amount of solar and wind energy consumed by commercial plants with capacity of 1 megawatt or greater. Adjusted for the double-counting of supplemental gaseous fuels, which are

included in both natural gas and the other fossil fuels from which they are mostly derived, but should be counted only once in net energy and total.

^h Incurred in the generation, transmission, and distribution of electricity plus plant use and unaccounted for electrical system energy losses.

Where shown, (s) = Value less than 0.05 trillion Btu.

Notes: Totals may not equal sum of components due to independent rounding. • The commercial sector includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.

Web Page: All data are available at <http://www.eia.gov/state/seds/seds-data-complete.cfm>.

Sources: Data sources, estimation procedures, and assumptions are described in the Technical Notes.

Table C7. Industrial Sector Energy Consumption Estimates, 2011

State (Trillion Btu)	Coal	Natural Gas ^a	Petroleum						Hydro-electric power ^e	Biomass		Geo-thermal	Retail Electricity Sales	Net Energy ^{h,i}	Electrical System Energy Losses ^j	Total ^{h,i}
			Distillate Fuel Oil	LPG ^b	Motor Gasoline ^c	Residual Fuel Oil	Other ^d	Total		Wood and Waste ^f	Losses and Co-products ^g					
Alabama	65.0	179.1	23.9	3.7	3.3	6.7	46.3	83.9	0.0	147.2	0.0	(s)	115.1	590.4	219.5	810.0
Alaska	0.1	253.8	19.2	0.1	1.0	0.0	27.1	47.4	0.0	0.1	0.0	0.0	4.5	306.0	9.4	315.4
Arizona	10.0	22.0	33.2	1.4	4.6	(s)	18.4	57.6	0.0	1.4	3.1	0.2	42.1	136.5	84.7	221.2
Arkansas	5.6	93.1	31.1	2.6	4.0	0.1	17.4	55.1	0.0	72.7	0.0	(s)	58.0	284.5	120.5	405.0
California	35.6	767.4	77.2	23.9	29.6	(s)	312.5	443.2	0.0	28.4	10.0	1.2	170.4	1,456.2	329.4	1,785.7
Colorado	3.3	186.4	22.8	7.6	4.9	0.0	25.9	61.2	0.0	0.4	7.1	0.3	52.0	309.8	113.9	423.6
Connecticut	0.0	26.6	3.8	2.7	2.5	0.1	7.2	16.3	0.0	3.5	0.0	0.0	12.5	58.9	21.5	80.4
Delaware	0.0	20.3	1.7	0.6	0.9	1.6	29.7	34.5	0.0	(s)	0.0	0.0	8.8	63.7	19.0	82.7
Dist. of Col.	0.0	0.0	0.1	(s)	0.2	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.7	1.2	1.7	2.9
Florida	12.6	91.2	36.7	4.6	10.0	5.8	30.0	87.1	0.0	123.4	0.0	0.0	57.6	371.9	105.1	477.0
Georgia	29.2	147.6	27.6	5.0	6.8	2.9	41.6	83.8	0.2	149.2	5.7	(s)	107.5	523.1	224.7	747.7
Hawaii	1.3	0.4	2.0	0.1	0.8	2.9	16.1	21.8	0.5	4.3	0.0	(s)	12.5	40.4	23.9	64.3
Idaho	7.7	25.8	16.2	0.7	3.2	(s)	10.1	30.1	0.0	21.9	3.1	0.8	30.4	119.7	64.1	183.8
Illinois	110.6	286.5	36.0	43.6	10.7	0.1	165.8	256.3	0.0	12.9	69.7	0.0	153.0	885.7	343.8	1,229.5
Indiana	234.4	331.0	29.0	5.1	6.8	0.2	97.1	138.3	0.0	10.4	52.3	0.0	163.0	927.8	386.2	1,314.0
Iowa	70.3	168.7	34.6	34.3	7.1	0.2	13.2	89.3	0.0	18.4	202.4	0.0	65.6	596.8	149.1	745.9
Kansas	2.5	130.2	26.5	55.0	3.3	1.7	52.2	138.6	0.0	0.6	24.8	0.0	36.9	333.6	87.4	421.0
Kentucky	47.8	112.8	39.1	21.6	3.9	0.0	72.6	137.2	0.0	17.1	2.0	0.0	148.8	465.6	338.7	804.3
Louisiana	1.3	1,082.8	69.5	206.7	5.9	27.9	886.7	1,196.7	0.0	93.7	0.1	(s)	102.6	2,476.8	202.9	2,679.7
Maine	0.6	27.8	5.5	0.4	1.6	7.0	2.0	16.5	7.3	63.5	0.0	0.0	10.3	126.0	13.6	139.6
Maryland	21.7	21.8	7.4	1.6	4.1	1.6	22.9	37.6	0.0	9.2	0.0	0.0	17.1	107.4	38.7	146.1
Massachusetts	1.6	46.1	7.3	1.6	4.9	1.4	9.2	24.5	0.1	4.2	0.0	0.0	57.9	134.5	100.3	234.8
Michigan	66.7	160.4	18.6	3.6	6.3	1.4	55.1	85.0	0.3	35.6	15.2	0.0	107.9	471.1	237.0	708.1
Minnesota	24.7	159.4	39.4	7.1	6.9	1.6	74.8	129.7	1.1	33.7	63.8	0.0	80.6	493.0	162.0	655.0
Mississippi	2.6	119.3	13.5	2.5	3.2	0.3	56.5	76.0	0.0	48.6	3.1	(s)	55.5	305.1	105.7	410.8
Missouri	12.4	63.2	21.9	10.0	5.0	0.1	39.2	76.2	0.0	4.6	14.5	0.0	59.1	230.1	130.1	360.2
Montana	1.2	23.0	13.8	0.9	1.5	0.0	28.3	44.4	0.0	1.8	0.0	0.1	13.6	84.0	29.3	113.4
Nebraska	19.0	87.4	24.0	2.7	3.4	0.0	5.7	35.8	0.0	4.2	109.3	0.0	36.1	291.7	80.2	371.9
Nevada	2.5	11.4	10.4	0.9	1.5	0.0	6.8	19.6	0.0	0.5	0.0	0.4	45.8	80.2	79.3	159.5
New Hampshire	0.0	6.6	2.5	0.8	1.0	0.7	3.2	8.1	(s)	1.6	0.0	0.0	6.6	23.0	12.3	35.3
New Jersey	0.0	51.1	12.2	1.2	5.8	1.9	113.6	134.7	0.0	3.9	0.0	0.0	27.4	217.0	57.2	274.3
New Mexico	0.6	108.7	9.4	17.5	2.1	0.0	24.4	53.5	0.0	0.6	1.7	0.2	23.6	189.0	49.0	238.0
New York	25.9	78.7	16.3	2.0	8.1	7.8	49.7	84.0	0.7	14.0	9.3	0.0	45.8	258.4	88.6	346.9
North Carolina	19.8	100.5	17.4	10.2	8.9	5.8	32.5	74.8	(s)	72.5	0.0	0.0	90.6	358.1	197.0	555.1
North Dakota	92.7	39.7	50.3	1.4	1.6	0.2	13.2	66.8	0.0	2.0	21.4	0.0	14.7	234.3	32.0	266.3
Ohio	114.7	274.2	30.2	6.3	8.2	3.0	151.6	199.3	0.0	23.7	25.1	0.0	184.0	820.9	409.1	1,230.0
Oklahoma	11.8	266.4	14.8	1.9	4.4	3.7	75.0	99.8	0.0	20.8	0.0	0.0	53.9	452.7	107.1	559.8
Oregon	1.8	58.3	14.8	1.9	5.1	1.0	16.8	39.6	0.0	24.4	2.3	0.2	40.8	167.4	77.9	245.3
Pennsylvania	180.3	257.0	40.9	30.8	6.5	4.4	141.5	224.1	0.0	31.0	6.2	0.0	169.2	867.8	343.8	1,211.6
Rhode Island	0.0	7.6	0.7	0.3	0.6	0.6	1.7	3.9	0.0	0.1	0.0	0.0	3.1	14.7	4.1	18.8
South Carolina	23.2	78.6	8.2	2.0	2.6	3.3	28.6	44.8	0.0	79.4	0.0	0.0	95.9	321.8	207.0	528.9
South Dakota	3.1	41.5	13.2	0.9	1.7	0.2	6.3	22.4	0.0	0.2	57.6	0.3	8.8	133.9	19.0	152.9
Tennessee	66.9	99.3	11.1	1.1	4.4	0.2	65.4	82.2	0.0	45.7	12.5	0.0	97.7	404.4	220.3	624.6
Texas	19.5	1,786.7	176.6	1,708.0	31.4	28.6	1,200.3	3,145.0	0.0	61.9	17.7	0.0	348.5	5,379.2	708.3	6,087.6
Utah	13.8	62.3	12.2	0.7	2.0	(s)	29.4	44.3	0.0	0.4	0.0	0.3	31.8	152.9	65.5	218.4
Vermont	0.0	2.8	3.9	0.2	0.8	0.6	0.9	6.4	0.2	1.6	0.0	0.0	4.8	15.9	7.8	23.7
Virginia	70.3	75.3	14.6	2.2	5.0	6.4	22.4	50.5	0.1	50.7	0.0	0.0	58.7	305.6	130.8	436.5
Washington	1.8	78.5	17.0	4.2	5.9	1.6	107.2	135.9	(s)	69.9	0.0	0.0	95.3	381.4	204.5	585.9
West Virginia	63.3	45.7	28.3	0.5	1.0	0.3	9.5	39.6	5.4	1.3	0.0	0.0	40.0	195.3	80.3	275.6
Wisconsin	34.2	128.7	22.2	4.7	5.6	0.8	40.7	73.9	1.5	56.6	28.5	0.0	79.9	403.2	178.7	581.8
Wyoming	32.6	117.0	33.8	0.5	1.1	(s)	24.9	60.3	0.0	0.1	0.6	0.1	35.0	245.6	76.8	322.4
United States	1,566.7	8,410.8	1,242.5	2,249.7	261.7	134.9	4,329.3	8,218.1	17.5	1,473.6	768.9	4.2	3,382.4	23,825.3	7,098.5	30,923.8

^a Natural gas as it is consumed; includes supplemental gaseous fuels that are commingled with natural gas.
^b Liquefied petroleum gases.
^c Motor gasoline as it is consumed; includes fuel ethanol blended into motor gasoline.
^d Includes asphalt and road oil, kerosene, lubricants, and the 16 other petroleum products as described in the Technical Notes, Section 4, "Other Petroleum Products."
^e Conventional hydroelectric power. Does not include pumped-storage hydroelectricity.
^f Wood, wood-derived fuels, and biomass waste.
^g Losses and co-products from the production of fuel ethanol.
^h U.S. total includes 11.1 trillion Btu of net imports of coal coke that are not allocated to the states.
ⁱ Distributed solar thermal and photovoltaic energy consumed in the industrial sector is included in

residential consumption. Includes small amount of solar and wind energy consumed by industrial plants with capacity of 1 megawatt or greater. Adjusted for the double-counting of supplemental gaseous fuels, which are included in both natural gas and the other fossil fuels from which they are mostly derived, but should be counted only once in net energy and total.
^j Incurred in the generation, transmission, and distribution of electricity plus plant use and unaccounted for electrical system energy losses.
 Where shown, (s) = Value less than 0.05 trillion Btu.
 Notes: Totals may not equal sum of components due to independent rounding. • The industrial sector includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.
 Web Page: All data are available at <http://www.eia.gov/state/seds/seds-data-complete.cfm>.
 Sources: Data sources, estimation procedures, and assumptions are described in the Technical Notes.

Table HC6.8 Space Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Space Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Space Heating Equipment									
Use Space Heating Equipment.....	110.1	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Have Space Heating Equipment But Do Not Use It.....	2.4	Q	Q	Q	N	N	N	N	N
Do Not Have Space Heating Equipment.....	1.2	N	N	N	N	N	N	N	N
Main Heating Fuel and Equipment²									
Natural Gas.....	55.6	10.8	2.2	1.3	0.9	8.6	4.1	1.9	2.6
Central Warm-Air Furnace.....	44.3	6.1	1.0	0.6	0.4	5.2	2.0	1.5	1.6
For One Housing Unit.....	42.5	5.5	0.8	0.5	0.3	4.7	1.8	1.4	1.5
For Two or More Housing Units.....	1.8	0.6	0.1	0.0	Q	0.5	0.3	Q	Q
Steam or Hot Water System.....	6.9	4.3	1.2	0.7	0.5	3.1	1.9	0.3	0.9
For One Housing Unit.....	3.7	2.3	0.7	0.4	0.3	1.6	0.8	0.2	0.6
For Two or More Housing Units.....	3.2	2.0	0.5	0.2	0.2	1.6	1.1	Q	0.4
Built-In Room Heater.....	2.3	0.2	0.1	0.1	Q	Q	Q	Q	Q
Floor or Wall Pipeless Furnace.....	1.2	0.1	Q	Q	N	0.1	0.1	N	N
Other Equipment.....	0.9	Q	Q	Q	N	Q	Q	Q	Q
Electricity.....	38.1	2.4	0.4	0.3	0.2	2.0	0.5	1.3	0.1
Central Warm-Air Furnace.....	19.1	0.3	0.0	0.0	Q	0.2	0.1	Q	Q
Heat Pump.....	9.8	0.4	Q	Q	N	0.4	Q	0.4	N
Built-In Electric Units.....	5.7	1.4	0.3	0.2	0.1	1.1	0.3	0.7	Q
Portable Electric Heater.....	2.7	0.1	Q	Q	Q	Q	Q	Q	N
Other Equipment.....	0.9	0.2	Q	Q	Q	0.1	0.1	Q	Q
Fuel Oil.....	6.9	5.7	2.3	0.8	1.5	3.4	2.1	1.0	0.3
Steam or Hot Water System.....	3.9	3.6	1.4	0.5	1.0	2.2	1.3	0.6	0.3
For One Housing Unit.....	2.6	2.4	1.2	0.4	0.8	1.2	0.4	0.6	0.2
For Two or More Housing Units.....	1.3	1.3	0.2	0.1	0.2	1.0	0.9	Q	Q
Central Warm-Air Furnace.....	2.7	1.8	0.8	0.3	0.5	1.0	0.6	0.3	Q
Other Equipment.....	0.3	0.3	Q	Q	Q	0.2	0.2	Q	N
Propane/LPG.....	5.6	0.7	0.2	0.1	0.1	0.6	Q	0.5	Q
Central Warm-Air Furnace.....	3.9	0.5	Q	Q	Q	0.5	Q	0.4	Q
Other Equipment.....	1.7	0.2	0.1	Q	0.1	Q	Q	Q	N
Wood.....	2.8	0.6	0.3	Q	0.2	0.4	0.1	Q	Q
Heating Stove.....	2.2	0.5	0.2	Q	0.1	0.3	0.1	Q	Q
Other Equipment.....	0.6	0.1	0.1	Q	0.1	Q	Q	Q	N
Kerosene.....	0.5	0.3	0.1	Q	0.1	0.2	0.1	Q	N
Other Fuel.....	0.5	0.2	Q	Q	Q	0.1	0.1	Q	N
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N

Table HC6.8 Space Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Space Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Housing Units Served by Main Heating Equipment²									
One Housing Unit.....	101.2	15.8	4.4	2.0	2.4	11.4	4.2	4.6	2.6
Two or More Housing Units.....	8.9	4.9	1.1	0.4	0.6	3.9	3.0	0.3	0.6
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N
Age of Main Heating Equipment									
Less Than 2 Years.....	10.6	1.9	0.5	0.2	0.2	1.4	0.7	0.4	0.3
2 to 4 Years.....	15.9	2.8	0.7	0.3	0.4	2.1	0.9	0.6	0.6
5 to 9 Years.....	26.3	4.1	1.2	0.5	0.7	3.0	1.3	1.1	0.5
10 to 14 Years.....	20.4	3.4	0.9	0.4	0.5	2.5	1.3	0.8	0.5
15 to 19 Years.....	11.2	2.2	0.5	0.3	0.2	1.7	0.8	0.6	0.3
20 Years or More.....	25.7	6.4	1.7	0.8	0.9	4.7	2.2	1.5	1.0
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N
Routine Service or Maintenance Performed on Main Heating Equipment³									
Yes.....	44.0	9.5	3.1	1.3	1.8	6.4	2.8	2.3	1.4
No.....	66.0	11.2	2.4	1.2	1.2	8.8	4.4	2.7	1.8
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N
Proportion of Heat Provided by Main Heating Equipment									
All or Almost All.....	98.4	19.1	4.9	2.3	2.6	14.3	6.7	4.6	3.0
About Three-Fourths.....	6.8	1.0	0.3	0.1	0.2	0.7	0.4	Q	Q
Closer to One-Half.....	4.9	0.6	0.3	0.1	0.2	0.3	0.1	Q	Q
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N

Table HC6.8 Space Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Space Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Secondary Heating Fuel and Equipment (more than one may apply)									
Secondary Heating Equipment Used.....	42.7	7.0	2.3	0.9	1.4	4.7	1.6	2.2	0.8
Natural Gas.....	7.2	0.9	0.1	0.1	Q	0.8	0.3	0.2	0.2
Fireplace.....	4.8	0.5	Q	Q	Q	0.4	0.1	0.2	Q
Central Warm-Air Furnace.....	1.1	0.2	Q	Q	Q	0.2	Q	Q	Q
Other Equipment.....	1.4	0.3	0.1	Q	Q	0.2	Q	Q	Q
Electricity.....	26.8	4.3	1.3	0.6	0.7	2.9	1.0	1.5	0.4
Portable Electric Heater.....	22.7	3.6	1.1	0.5	0.5	2.6	0.9	1.3	0.4
Built-In Electric Units.....	2.3	0.6	0.3	0.1	0.2	0.3	0.1	0.2	Q
Heat Pump.....	1.3	Q	Q	Q	Q	Q	N	Q	N
Other Equipment.....	1.2	Q	Q	N	Q	Q	Q	Q	Q
Fuel Oil.....	0.4	0.3	0.2	Q	0.2	0.1	Q	Q	N
Propane/LPG.....	2.8	0.5	0.2	Q	0.1	0.3	Q	0.2	Q
Fireplace.....	1.5	0.3	0.1	Q	Q	0.2	Q	0.2	Q
Other Equipment.....	1.4	0.2	0.1	Q	0.1	Q	Q	Q	N
Wood.....	8.8	1.7	0.7	0.2	0.5	1.0	0.2	0.5	0.2
Fireplace.....	6.4	1.0	0.3	0.1	0.2	0.7	0.1	0.4	0.2
Heating Stove.....	2.6	0.8	0.5	0.1	0.3	0.3	0.1	Q	Q
Other Equipment.....	Q	Q	Q	Q	Q	N	N	N	N
Kerosene.....	0.9	0.1	Q	Q	Q	Q	Q	Q	N
Other Fuel.....	0.7	0.1	Q	Q	Q	Q	Q	Q	Q
No Secondary Heating Equipment Used.....	67.4	13.8	3.2	1.6	1.6	10.6	5.6	2.7	2.3
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N
Thermostats									
Number of Thermostats Used for Heating⁴									
0.....	8.2	3.2	0.3	0.2	0.1	2.9	2.2	0.4	Q
1.....	79.0	11.9	3.0	1.4	1.6	8.9	3.8	3.2	1.9
2 or More.....	16.9	4.9	1.9	0.7	1.2	3.0	1.0	1.1	0.9
Not Applicable.....	6.0	0.7	0.2	0.0	0.2	0.5	0.2	0.3	Q
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N

Table HC6.8 Space Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Space Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Have a Programmable Thermostat									
Yes.....	41.7	7.1	1.7	0.8	0.9	5.4	2.3	1.6	1.6
No.....	54.2	9.7	3.3	1.4	1.9	6.5	2.6	2.7	1.2
No Thermostat or Do Not Have or Use Heating Equipment.....	17.7	3.9	0.6	0.3	0.3	3.4	2.4	0.7	0.3
Use of Programmable Thermostat Reduces Temperature During Day									
Yes.....	22.1	3.7	1.0	0.5	0.5	2.7	1.3	0.6	0.8
No.....	19.6	3.3	0.6	0.3	0.3	2.7	1.0	1.0	0.8
Reduces Temperature During Sleeping Hours									
Yes.....	25.6	4.7	1.2	0.6	0.6	3.5	1.7	0.8	1.0
No.....	16.0	2.4	0.4	0.2	0.2	2.0	0.6	0.7	0.6
No Programmable Thermostat or Do Not Have or Use Heating Equipment.....	72.0	13.7	3.9	1.7	2.2	9.8	4.9	3.4	1.5
Winter Indoor Temperatures									
Daytime Temperature When Someone is Home									
63 Degrees or Less.....	6.1	1.6	0.6	0.2	0.3	1.0	0.5	0.4	Q
64 to 66 Degrees.....	11.8	2.7	1.0	0.4	0.5	1.7	0.7	0.6	0.4
67 to 69 Degrees.....	29.6	7.4	1.8	0.8	1.0	5.5	2.4	1.8	1.3
70 Degrees.....	26.2	5.3	1.3	0.6	0.7	4.0	2.3	1.0	0.7
71 to 73 Degrees.....	17.8	2.1	0.4	0.2	0.2	1.6	0.6	0.6	0.4
74 Degrees or More.....	18.5	1.7	0.4	0.2	0.2	1.4	0.6	0.5	0.2
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N
Daytime Temperature When No One is Home									
63 Degrees or Less.....	26.7	6.3	2.2	1.0	1.2	4.1	1.8	1.6	0.7
64 to 66 Degrees.....	21.8	4.3	1.2	0.5	0.7	3.1	1.3	0.8	1.0
67 to 69 Degrees.....	23.2	4.6	0.9	0.4	0.5	3.7	1.6	1.3	0.7
70 Degrees.....	17.2	3.3	0.8	0.3	0.4	2.5	1.6	0.5	0.4
71 to 73 Degrees.....	10.4	1.4	0.2	0.1	0.1	1.1	0.4	0.4	0.3
74 Degrees or More.....	10.9	1.0	0.2	0.1	0.1	0.7	0.4	0.2	Q
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N

Table HC6.8 Space Heating in U.S. Homes in Northeast Region, Divisions, and States, 2009

Million Housing Units, Final									
Space Heating	Total U.S. ¹ (millions)	Northeast Census Region							
		Total Northeast	New England Census Division			Middle Atlantic Census Division			
			Total New England	MA	CT, ME, NH, RI, VT	Total Middle Atlantic	NY	PA	NJ
Total Homes	113.6	20.8	5.5	2.5	3.0	15.3	7.2	4.9	3.2
Temperature at Night									
63 Degrees or Less.....	19.0	4.8	1.7	0.7	1.0	3.1	1.5	1.0	0.6
64 to 66 Degrees.....	20.0	4.7	1.3	0.6	0.7	3.4	1.6	0.9	1.0
67 to 69 Degrees.....	25.3	5.0	1.1	0.5	0.6	4.0	1.8	1.5	0.7
70 Degrees.....	19.5	3.4	0.9	0.4	0.5	2.6	1.5	0.6	0.5
71 to 73 Degrees.....	12.0	1.4	0.3	0.1	0.2	1.2	0.4	0.4	0.3
74 Degrees or More.....	14.3	1.3	0.3	0.1	0.1	1.1	0.5	0.4	0.2
Do Not Have or Use Heating Equipment.....	3.5	Q	Q	Q	N	N	N	N	N
Humidifier Use During 2009									
Use a Humidifier.....	17.2	3.2	1.1	0.4	0.7	2.1	0.6	0.8	0.6
1 to 3 Months.....	9.2	1.6	0.7	0.2	0.5	0.9	0.3	0.3	0.3
4 to 6 Months.....	5.7	1.3	0.4	0.2	0.2	0.9	0.3	0.4	0.3
7 to 9 Months.....	0.9	0.1	Q	Q	Q	Q	Q	Q	Q
10 to 11 Months.....	0.2	Q	N	N	N	Q	N	Q	N
Turned on All Year.....	1.2	0.2	Q	Q	Q	0.2	Q	Q	Q
Do Not Use a Humidifier.....	96.5	17.5	4.4	2.0	2.3	13.2	6.5	4.1	2.5

¹Total U.S. includes all primary occupied housing units in the 50 States and the District of Columbia. Vacant housing units, seasonal units, second homes, military housing, and group quarters are excluded.

²Use of heating equipment for another housing unit also includes the use of the heating equipment for a business or farm building as well as another housing unit.

³Only includes routine service or maintenance performed in the last year.

⁴Housing units with heating stoves, portable electric heaters, fireplaces, and cooking stoves as the main heating equipment were not asked if they had a thermostat.

Q = Data withheld either because the Relative Standard Error (RSE) was greater than 50 percent or fewer than 10 households were sampled.

N = No cases in reporting sample.

Notes: • Because of rounding, data may not sum to totals. • See Glossary for definition of terms used in these tables.

Source: U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C of the 2009 Residential Energy Consumption Survey.