

# **2014–2017 Industrial and Process Efficiency Program Impact Evaluation**

## *Appendices*

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# NYSERDA Record of Revision

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## Notice

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## Appendix A. Sample Design

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### A.1 Sample Design

The evaluation included IPE projects that were initiated through two funding sources, Energy Efficiency Portfolio Standard 2 (EEPS-2) and Clean Energy Fund Transition (CEF). The sample design initiated at the start of the evaluation included only EEPS-2 funded projects. During the course of the evaluation, as CEF funded projects were completed, they were added to the evaluation sample. Details of the EEPS-2 and CEF based sample designs are included in the following sections.

#### 1.A.1 EEPS-2 Funded Projects

Stratified ratio estimation (SRE) was used for the EEPS-2 project sample design because it allows for efficient sampling design and generally requires a lower sample size for a targeted level of precision if there is a strong correlation between the program-reported savings and the evaluated savings. As noted, the sample frame constructed includes all projects with at least one measure completed between January 1, 2014, and December 29, 2017. The principal consulting firm designed the sample and provided the workbook to NYSERDA and the supplemental consulting firm to review and to randomly select projects from the non-census strata. The consulting firms and NYSERDA collaborated to identify any sites that may be a real or perceived conflict of interest for the principal consulting firm due to their involvement in the Program as outreach contractors, Technical Reviewers, or contracted Project Manager. Any sites identified as a conflict of interest were assigned to the supplemental consulting firm. A summary of the sampling plan is represented in Table A-1.

**Table A-1. Summary of the Sampling Plan**

Sampling Component	Sample Approach	Comments
Sample frame	Program-reported data; all projects with at least one measure completed between January 1, 2014, and December 29, 2017	Program-reported data was provided by NYSERDA.
Method	Stratified ratio estimation	Correlation between program-reported and evaluation savings was expected to be strong; the error ratios from the previous (2010–2012) evaluation were 0.29 for kWh and 0.10 for natural gas.
Variable to estimate	Realization rate (RR) for annual electric (kWh) or natural gas (MMBtu) savings	M&V to establish evaluated savings and RR is calculated as the ratio of the evaluated savings to the program-reported savings.
Primary sampling unit	Project	A “project” refers to any project with at least one measure completed during the 01/01/2014 through 12/19/17 time period. Many projects have multiple measures.
Upper-level stratification variables	Measure type (non-process, process, data center) and fuel type	Separate sampling for each fuel type and facility/measure type; fuel types are separated due to few projects with natural gas savings.
Lower-level stratification variables	Size	Size was determined by the annual kWh savings (for projects with electric savings) and MMBtu savings (for projects with natural gas savings).

**Upper-Level Stratification**

The sample design stratified projects by three project types:

1. Process efficiency projects in data centers
2. Process efficiency projects in industrial and manufacturing facilities
3. Non-process projects in all facility types

Each project was assigned to a single category, based on the project or measure type shown in NYSERDA’s tracking database.

Sample sizes within each upper-level stratification category were calculated using a target of 10% precision at 90% confidence.

Error ratios (ERs) were estimated in the sample design based on the results of the previous evaluation; they were modified to produce a sample design with sufficient precision and project representation.

Electric and natural gas strata were each assigned a single error ratio. Electric projects made use of an

error ratio of 0.30 while an error ratio of 0.5 was used for natural gas projects. The natural gas sample was designed with a higher error ratio to include more gas projects in the sample. The confidence/precision targets and assumed error ratios by stratification category are shown in Table A-2.

**Table A-2. Populations and Target Samples by Upper-Level Strata**

Measure Type/Facility Type	No. of Projects with Completed Measures	% Energy Savings	Target Precision w/ 90% confidence	Sample	Error Ratio
<b>Electric</b>					
Non-process/all facility types	135	77%	10%	22	0.3
Process/industrial	39	9%	10%	17	0.3
Process/data center	29	13%	10%	16	0.3
<b>Total Electric</b>	<b>188</b>	<b>100%</b>	<b>10%</b>	<b>55</b>	<b>N/A</b>
<b>Natural Gas</b>					
Non-process/all facility types	28	33%	10%	14	0.5
Process/industrial	27	67%	10%	16	0.5
<b>Total Natural Gas</b>	<b>55</b>	<b>100%</b>	<b>10%</b>	<b>30</b>	<b>N/A</b>
<b>Total Combined</b>	<b>206<sup>a</sup></b>	<b>100%</b>		<b>85</b>	<b>N/A</b>

<sup>a</sup> Both electricity and natural gas savings were claimed for 37 of the projects in the sample frame, bringing the total number of projects to 305 rather than 243 (the sum of the total electric and natural gas projects in table above).

**Lower-Level Stratification**

The lower-level stratification variable is project size. Size categories were based on the magnitude of project savings. Two to four size categories were defined per upper-level stratification category. Cutoffs were established using the method described in the *2004 California Evaluation Framework*.<sup>1</sup>

For each upper-level stratification category, the project size was defined based on the program-reported project electric or natural gas savings. The largest size stratum in each segment is a census stratum (all projects are evaluated). Additional strata were defined to allow for random sampling of the medium- and smaller-sized projects in each upper-level stratification category. Table A-3 and Table A-4 show the evaluation electric and natural gas participant samples, broken out by upper- and lower-level stratification variables.

Projects in the lowest size stratum that accounted for less than 2% of the total energy savings for the upper-level stratification categories were not evaluated. While there are many of these small projects, they

<sup>1</sup> TecMarket Works, et al. *The California Evaluation Framework*. Project Number: K2033910. Prepared for the California Public Utilities Commission and the Project Advisory Group. June, 2004. Pages 327 to 339 and 361 to 384. <http://www.cpuc.ca.gov/NR/rdonlyres/F14E59AF-25B9-45CE-8B3C-D010C761BE8D/0/CAEvaluationFramework.pdf>

account for a small part of the overall program-reported savings and have little effect on the realization rate (RR). The RR developed for the sample frame was applied to these smaller projects.

**Table A-3. Electric Projects – Upper- and Lower-Level Stratification Results**

Upper-Level Stratum	Sampling Method	No. of Projects N	Maximum Savings MWh	% of Total Electric Savings in the Stratum	Sample Projects with Electric Savings n	Sample Projects % Total Electric Savings	Stratum Weight (N/n)
Non-process	Census	4	4,228,037.8	25%	4	26%	1.00
	Large	10	2,753,748.1	17%	4	6%	2.50
	Medium	25	2,713,899.7	16%	4	2%	6.25
	Small	70	2,919,382.2	18%	10	3%	7.00
	Exclude	26	266,016.3	2%	0	N/A	N/A
	<b>Subtotal</b>		<b>135</b>	<b>12,881,084.1</b>	<b>77%</b>	<b>22</b>	<b>37%</b>
Industrial process	Census	5	715,049.6	4%	5	4%	1.00
	Large	8	444,226.9	3%	5	3%	1.60
	Small	20	404,166.6	2%	7	2%	2.86
	Exclude	6	17,748.3	0.1%	0	N/A	N/A
	<b>Subtotal</b>		<b>39</b>	<b>1581,191.4</b>	<b>9%</b>	<b>17</b>	<b>9%</b>
Data center process	Census	4	1,168,104.5	7%	4	8%	1.00
	Large	6	536,284.1	3%	3	2%	2.00
	Small	14	456,021.1	3%	9	4%	1.56
	Exclude	5	24,449.9	0.1%	0	N/A	N/A
	<b>Subtotal</b>		<b>29</b>	<b>2,184,859.6</b>	<b>13%</b>	<b>16</b>	<b>14%</b>
<b>Electric Totals</b>		<b>188</b>	<b>16,647,135.0</b>	<b>100%</b>	<b>30</b>	<b>60%</b>	<b>N/A</b>

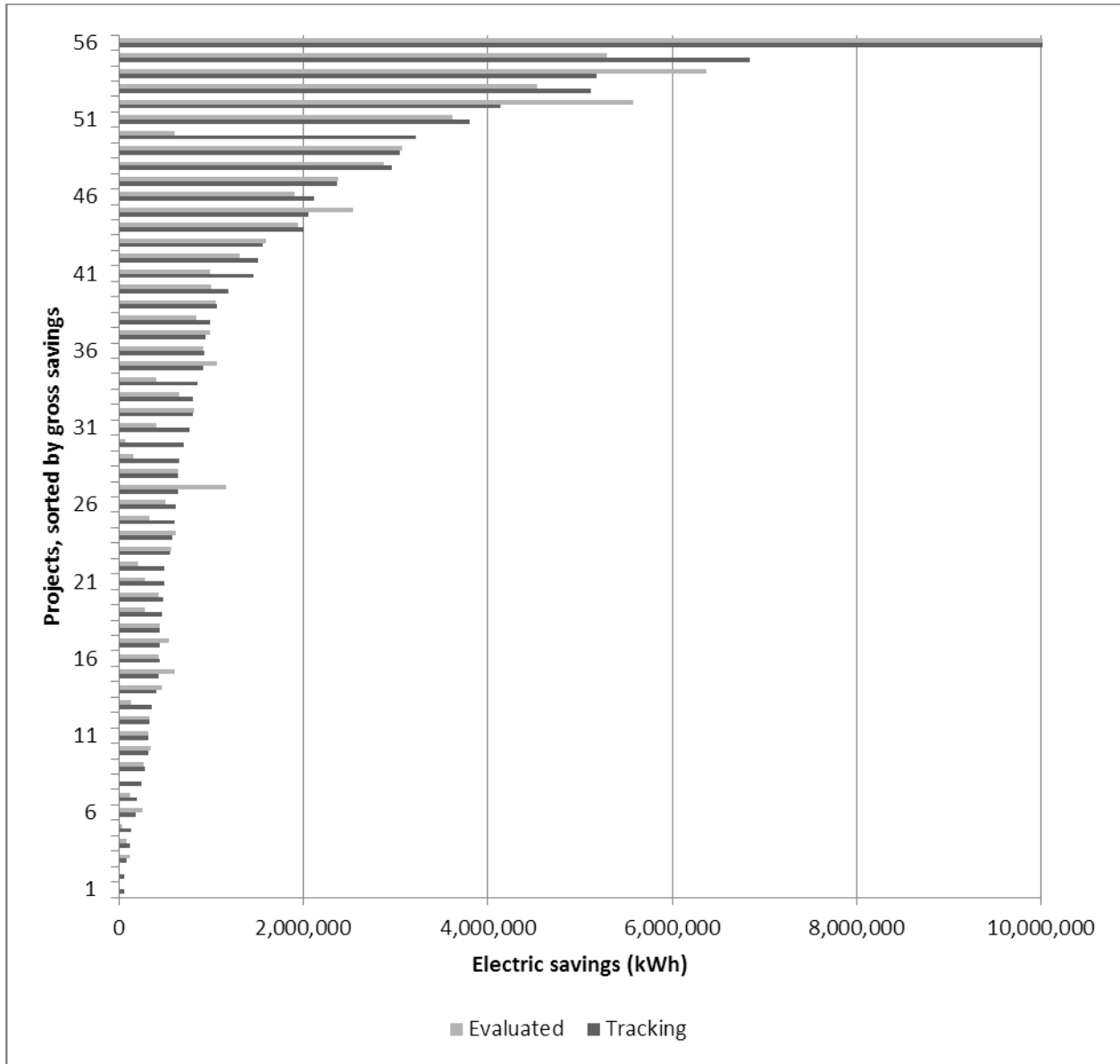


**Table A-4. Natural Gas Projects – Upper- and Lower-Level Stratification Results**

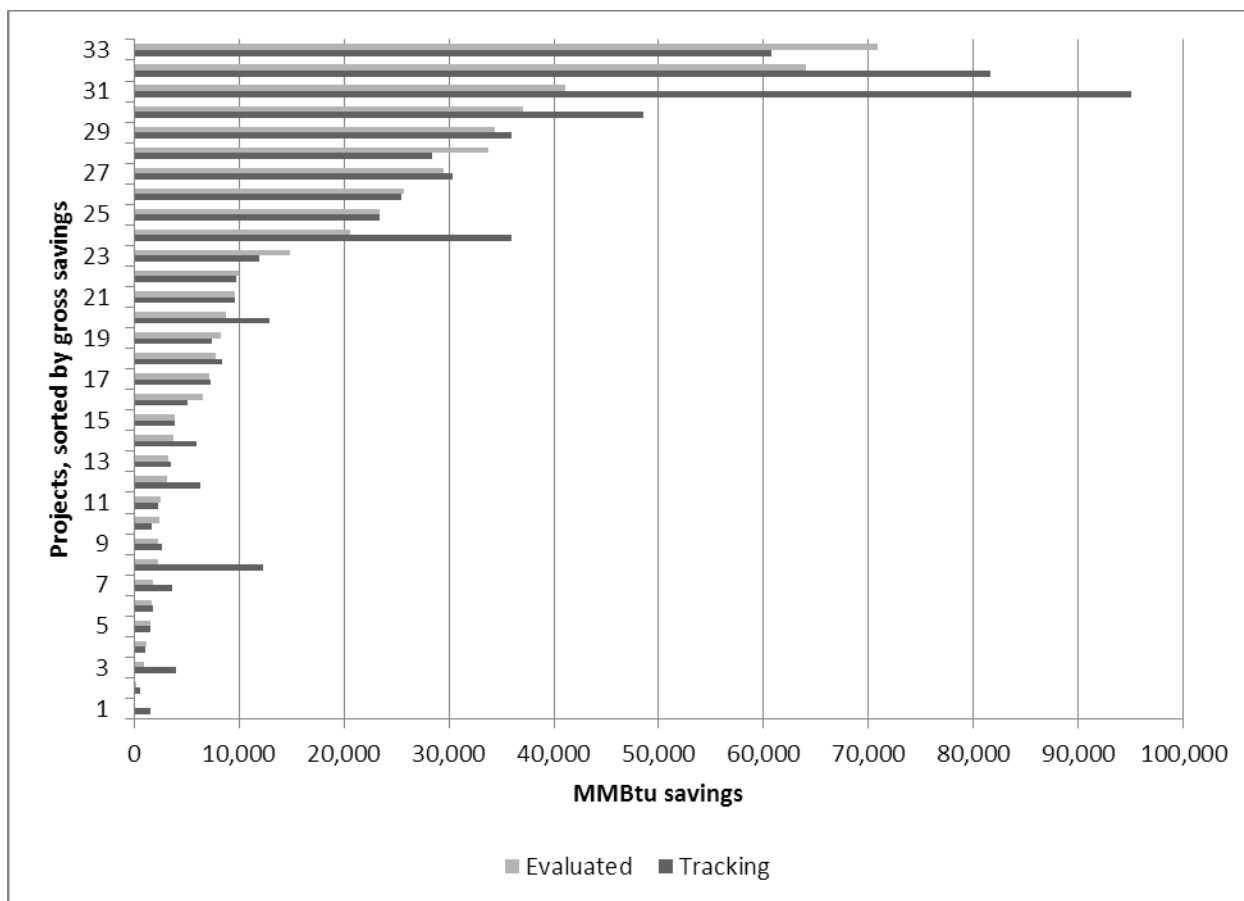
Upper-Level Stratum	Sampling Method	No. of Projects N	Maximum Savings MMBtu	% of Total Natural Gas Savings in the Stratum	Sample Projects with Natural Gas Savings n	Sample Projects % Total Natural Gas Savings	Stratum Weight (N/n)
Non-process	Census	9	207,125	30%	9	30%	1.00
	Random	10	21,691	3%	5	1%	2.00
	Exclude	11	1,947	0.1%	0	N/A	N/A
	<b>Subtotal</b>	<b>30</b>	<b>230,763</b>	<b>33%</b>	<b>14</b>	<b>31%</b>	<b>N/A</b>
Industrial process	Census	10	404,781	58%	10	59%	1.00
	Random	12	58,867	8%	7	5%	1.71
	Exclude	5	5104	1%	0	N/A	N/A
	<b>Subtotal</b>	<b>25</b>	<b>463,648</b>	<b>66%</b>	<b>16</b>	<b>64%</b>	<b>N/A</b>
<b>Natural Gas Totals</b>		<b>55</b>	<b>701,440</b>	<b>100%</b>	<b>30</b>	<b>95%</b>	<b>N/A</b>

The resulting sample design is presented graphically in Figures A-1 and A-2. Figure A-1 presents the reported and evaluated savings for the sampled electric projects, and Figure A-2 presents the reported and evaluated savings for natural gas projects.

Figure A-1. Distribution of Electric Projects in the Final Sample



**Figure A-2. Distribution of Natural Gas Projects in the Final Sample**



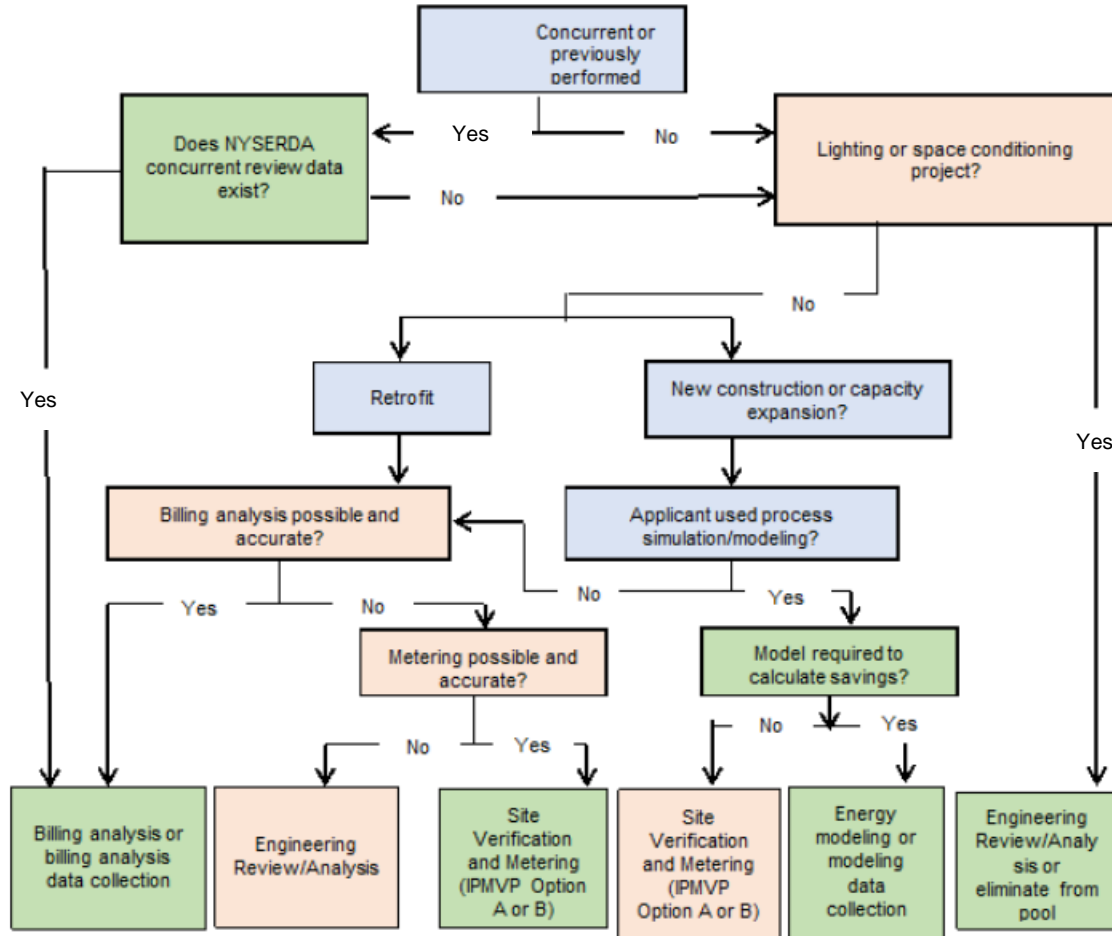
### 1.A.2 CEF Funded Projects

At the start of the evaluation, no CEF projects were complete, and therefore none were included in the initial sample design. During the course of the evaluation, a selection of CEF funded projects were completed and were eligible for inclusion in the evaluation. The Impact Evaluation Team and NYSERDA reviewed the completed projects and determined that four CEF projects were complete and eligible for evaluation; all four of those projects were added to the scope. Since the four completed projects represented all of the completed CEF projects on record during the evaluation, and as all four were included in the evaluation, the sample for CEF projects represents a census of the entire eligible population at the time of evaluation. Table A-5 summarizes the sample of CEF projects included in the evaluation. None of the CEF projects had reported or evaluated natural gas savings.

**Table A-5. Summary of CEF Funded Project Sample**

Upper-Level Stratum	Sampling Method	No. of Projects N	Maximum Savings MWh	% of Total Electric Savings in the Stratum	Sample Projects with Electric Savings n	Sample Projects % Total Electric Savings	Stratum Weight (N/n)
Industrial process	Census	1	62,280.6	4%	1	0.4%	1.00
	<b>Subtotal</b>	<b>1</b>	<b>62,280.6</b>	<b>4%</b>	<b>1</b>	<b>0.4%</b>	<b>N/A</b>
Data center process	Census	3	91,195.6	4%	3	0.5%	1.00
	<b>Subtotal</b>	<b>3</b>	<b>91,195.6</b>	<b>4%</b>	<b>3</b>	<b>0.5%</b>	<b>N/A</b>
<b>Electric Totals</b>		<b>4</b>	<b>153,476.2</b>	<b>4%</b>	<b>4</b>	<b>0.9%</b>	<b>N/A</b>

# Appendix B: IPMVP Flowchart for Determining Evaluation Rigor



## Appendix C: Savings Thresholds for Program Measurement and Verification

Savings Threshold for M&V <sup>a</sup>				
	>500,000 kWh	>1,000,000 kWh	>10,000 MMBtu	>20,000 MMBtu
Before June 2004	Electric (except lighting)	Lighting	Natural gas	
June 2014–March 2016 <sup>b</sup>	Custom electric improvements	Standard electric improvements  No M&V on lighting unless LED	Natural gas	
March 2016–December 2017	Electric			Fossil fuel

<sup>a</sup> At NYSERDA’s discretion, M&V may be required or waived for any project.

<sup>b</sup> Lighting and space conditioning (unrelated to IT or process) improvements are ineligible for IPE incentives starting September 2015.