Solar Photovoltaic Program Impact Evaluation for 2011-2016

Final Report

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1 Executive Summary

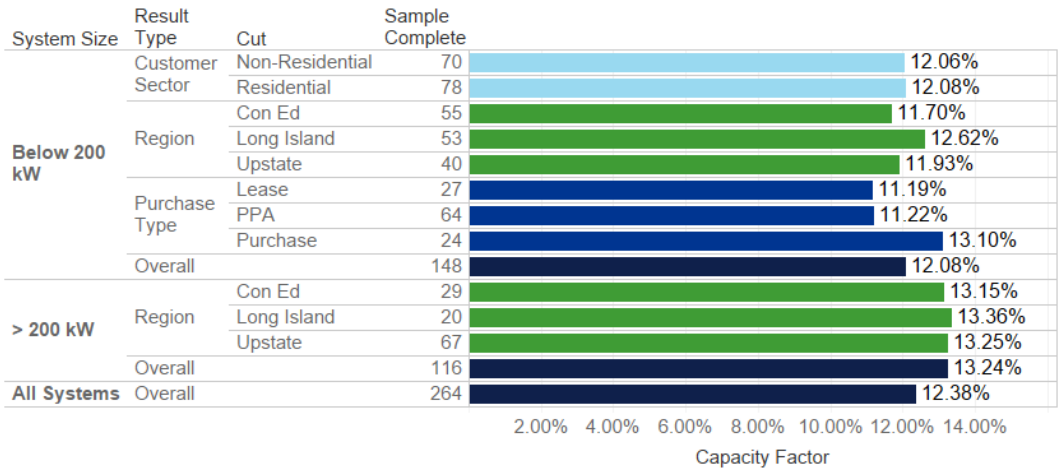
This report presents the impact evaluation of projects installed in 2008 and from 2011 to May 2016 under NYSERDA solar photovoltaic (PV) programs. The evaluated projects were installed under three program opportunity notices (PONs), #716, #1050, and #2112.

Capacity factor results are the primary impact results for this evaluation. As such, the accuracy of these estimates are reviewed for different categories relative to the 90/10 precision target.[1] All results presented in the executive summary met the 90/10 precision target.

Weather normalized capacity factor results are presented in Figure 1. Each result type is a different aggregation of the data collected. For example, the total sample completes for the two strata within the size category below 200 kW is 148, as is the total of the three region strata results for the category below 200 kW. The figure shows that

- large sites have higher capacity factors than small
- there is not a significant difference in capacity factors between small residential and small non-residential systems
- Long Island appears to have higher capacity factors than other regions due to higher average solar insolation (not statistically significant for large or small systems)
- purchased small (below 200 kW) systems have higher capacity factors than small lease/PPA systems. It is inconclusive whether this outcome is due to purchase type or variation in contractor performance.

Figure 1: Capacity Factor Results



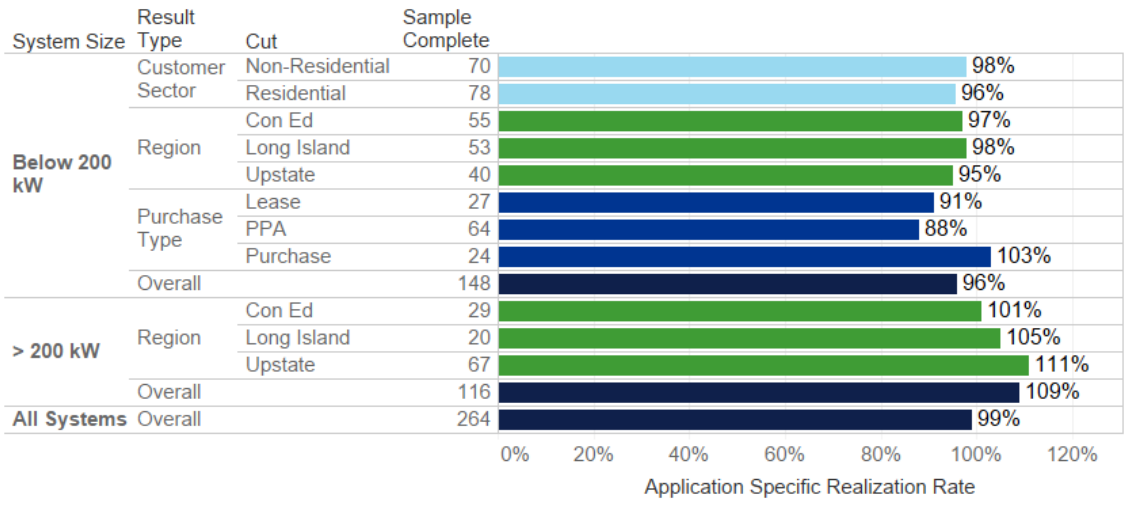
[1] 90/10 precision means that the result has a 90% probability of being within ± 10% of the complete population result.

The Application-Specific realization rate is the ratio of actual evaluated system production to the estimated system production (referred to as "Application-Specific" production), as received on NY-Sun application documents and NYSERDA database inputs. This rate assesses how well individual system estimates based on contractor provided information is predicting the production of PV systems.

Application-Specific realization rate results are presented in Figure 2. As discussed previously, each result type is a different aggregation of the data collected. For example, the total sample completes for the two strata within the size category less than 200 kW results is 148, as is the total of the three region strata within the less than 200 kW size category. The figure shows that

- large sites have an overall realization rate of 109% indicating that the actual production-, while small sites overall have a realization rate of 96% indicating that the Application-Specific production overestimates the actual production
- there is not a significant difference in realization rates between residential and small non-residential systems or among regions for small systems
- purchased small (below 200 kW) systems have higher realization rates than small lease/PPA systems indicating that Application-Specific production overestimates overall are dominated by the lease/PPA systems. It is inconclusive whether this is due to purchase type or variation in contractor performance.
- for large systems, Upstate systems have the greatest degree of underestimation with an actual production realization rate of 111%

Figure 2: Application Specific Realization Rate Results



2 Introduction

This report presents the impact evaluation of projects installed in 2008 and from 2011 to May 2016 under NYSERDA solar photovoltaic (PV) programs.

2.1 Program Description

The solar PV programs encompassed in the evaluation period described above are for projects installed under three program opportunity notices (PONs) summarized in Table 1. Their primary goal was to "build a robust, sustainable installer/practitioner infrastructure for the New York State solar PV market." All programs require installation of new, grid-connected end-use PV systems by approved installers. The incentive caps (provided in the table) are defined for residential, commercial, not-for-profit, and small and large commercial and industrial (C&I, or non-residential) customers.

Table 1: Evaluated Solar PV Program Summaries

PON #	Purchase Type	Dates	Incentive[a]	Incentive Cap (kW[b])
716	Purchase	October 28, 2002 to February 14, 2008	$4.00 to $5.00 per Watt	• Residential ≤ 5 kW • Commercial ≤ 50 kW • Not-for-profit ≤ 25 kW
1050	Purchase	February 14, 2008 to June 30, 2010	$1.75 per Watt	• Residential ≤ 5 kW • Commercial ≤ 50 kW • Not-for-profit ≤ 25 kW
2112	Lease, Power Purchase Agreement (PPA), or Purchase	August 12, 2010 through December 29, 2023	Up to $1 per Watt, varying by MW Block (Block #, Region, and Sector)	• Residential < 25 kW • Small C&I < 200 kW (< 500kW in LI)[c] • Large C&I ≥ 200 kW
3082	Lease, Power Purchase Agreement (PPA), or Purchase	May 4, 2015 through December 29, 2023	Up to $0.40 per Watt, varying by MW Block (Block #, Region, and Sector)	• Large C&I ≥ 200 kW[c]
2956	Lease, Power Purchase Agreement (PPA), or Purchase	Proposals due July 14, 2014	Competitive Bid[d]	• Large C&I ≥ 200 kW
2860	Lease, Power Purchase Agreement (PPA), or Purchase	Proposals Due December 30, 2013	Competitive Bid[d]	• Large C&I ≥ 200 kW
2589	Lease, Power Purchase Agreement (PPA), or Purchase	Proposals Due December 5, 2012, March 14, 2013, August 29, 2013	Competitive Bid[d]	• C&I ≥ 50 kW
2484	Lease, Power Purchase Agreement (PPA), or Purchase	Proposals Due May 24, 2012	Competitive Bid[d]	• C&I ≥ 50 kW
2156	Lease, Power Purchase Agreement (PPA), or Purchase	Proposals Due May 24, 2011 and August 10, 2011	Competitive Bid[d]	• C&I ≥ 50 kW

[a] All incentives were paid to the contractor.
[b] Direct current (DC) module ratings at standard test conditions
[c] As of June 18, 2018 PON 2112 and 3082 underwent program changes that adjusted the system size caps. The table displays the pre-June 2018 caps.
[d] For competitive bid PONs, proposers submit their own bid price to determine the amount of incentive they need to build the project. Selection for awards begins with the proposal with the lowest incentive bid, working sequentially through the next lowest incentive bid until the proposal with the highest incentive bid which does not exceed the maximum acceptable incentive bid is reached, or until the funding allocation is depleted, whichever is reached first.

In 2014, NYSERDA launched the NY-Sun initiative, which included an expansion to PON 2112's scope and budget. NY-Sun provides cash incentives and/or financing for Megawatt (MW) block targets per defined sector and geographic region and is active on a rolling basis until fulfilled.

The program structure is meant to "provide certainty and transparency to the solar industry and their customers," and "eliminate cash incentives more quickly in regions where market penetration, demand, and payback are greatest."

2.2 Summary of Evaluation Objectives and Methods

Table 2 summarizes the impact evaluation objectives, associated research questions, and methods employed to satisfy these objectives.

Table 2: Evaluation Objectives, Research Questions, and Data Sources

Energy Impact	Research Question(s)	NYSERDA Reported Data	Evaluated (M&V) Data Source[a]
First-year energy production (kWh)	What is the annualized first-year evaluated energy production of solar PV at the customer site?	Expected kWh annual production, from contractor-modelled estimates recorded in program tracking databases	Measurement and verification (M&V) using on-site logged data (inverter data) from a representative sample of program participants. First-year annualized production data was collected from participants, contractors, and NYSERDA.
Capacity factor (%)[d]	What is the ratio of actual output over time (including variations due to weather), to potential output if it were possible for the system to operate at continuous full nameplate capacity?	n/a	No additional data collection. Calculated from verified annual production data.
Reporting Realization Rate	What is the ratio of weather normalized actual first year output to the production NYSERDA estimated production for external program level progress and benefits reporting to the Public Service Commission (PSC)	NYSERDA reported system production using capacity factors	No additional data collection. Calculated from verified annual production data.
Application Specific Realization Rate	What is the ratio of weather normalized actual first year output to individual system estimates based on contractor provided estimates of the production of PV systems?	Installers' estimates of system production, as received on NY-Sun application documents and Salesforce inputs	No additional data collection. Calculated from verified annual production data.
Performance persistence	What is the long-term persistence of evaluated energy production of solar PV at the customer site? Do PV systems installed in 2008 demonstrate significant system underperformance compared to predictions and to newer systems (2011-2016)? What are the factors contributing to system persistence and underperformance?	n/a	No additional data collection. Calculated from verified annual production data.

[a] Detailed data-collection methods described in Section 3.1: Data Collection Methods.
[b] DC module ratings at standard test conditions.
[c] NYSERDA internally verified a portion of installations through onsite visits.
[d] Calculation defined in Section 3.2.1: Production Analysis.

3 Results, Findings, and Recommendations

3.1 Results

This section provides quantitative results of the data collection and analysis activities.

3.1.1 Data Collection Results and Observations

NYSERDA's goal for this evaluation was to achieve an estimate of production capacity factors with ±10% relative precision and 90% confidence (90/10 precision) for four segmentations of program data: Region (Con Ed, Long Island, and Upstate), Purchase Type (Lease, PPA, and Purchase), Customer Sector (Residential and Non-residential), and Year of Completion (2008 and 2011−2015).

The achieved sample of first-year production data collection is shown in Table 3. To achieve the target precisions for each segmentation, the sample design is stratified by a combination of project completion year (not shown: 2008 or 2011-2016), customer sector (not shown: residential or non-residential), region, system size (kW), and purchase type. The resulting sample design has 52 strata and a total target sample of 523 sites, where a site is a single installed solar PV system enrolled through a NYSERDA program. Program sites might share a single premise, such as when multiple solar PV systems are installed at a single address.

Table 3: Data Collection Results

Region	System Size (kW)	Purchase Type	Population Size (N)[a]	Target Sample[a]	Initial Evaluated Sample (n)[b]	Final Evaluated Sample (n)[b]
Con Ed	Below 200 kW	Lease	3,292	26	12	12
		PPA	477	31	15	15
		Purchase	1,751	67	30	28
	Above 200 kW	All	34	34	29	29
Upstate	Below 200 kW	Lease	7,835	24	8	8
		PPA	3,691	26	22	22
		Purchase	10,401	80	35	10
	Above 200 kW	All	115	115	67	67
Long Island	Below 200 kW	Lease	3,948	24	7	7
		PPA	1,653	29	27	27
		Purchase	3,677	39	20	19
	Above 200 kW	All	28	28	20	20
Overall			**36,902**	**523**	**292**	**264**

[a] The population size (N), and target sample each include projects from both the 2008 and 2011-2016 time periods. Several projects from the NY Green Bank (NYGB) are part of the target sample for 2011-2016, and follows trends consistent for the sample segmentations. Additional NYGB projects will be sampled in a future evaluation.

[b] The initial evaluated sample (n) only includes projects completed during the 2011-2016 time period, while the final evaluated sample (n) that only includes projects completed during the 2011-2016 time period that also passed file review.

3.1.1.1 Data Collection Challenges

The evaluation team encountered several challenges in the effort to collect production data, including limitations to sites available from the DG (Distributed Generation) Integrated Database[2], lack of availability of 2008 site data, and obstacles to participant and contractor contact.

Sites in the $\geq$ 200 kW size domain were selected with certainty during sample design, because all sites $\geq$ 200 kW were expected to be connected through the publicly available DG Integrated Database. However, only 118 of the selected 177 sites in this size level (66%) were available online. This challenge was of minimal impact to the evaluation outcome, because the production estimate for the $\geq$ 200 kW group is within precision requirements. Another 34 sites in the < 200 kW group were unexpectedly found in the DG Integrated Database.

Participants and contractors with sampled sites installed in 2008 were largely unable to provide production data, either because of non-response to outreach or lack of available data once calls were completed. For this reason, a long-term (10 years or more) persistence study was not possible. The 2008 sites ultimately were not combined with the 2011-2016 pool in the final evaluated sample used to determine capacity factors and realization rates.

The largest factors influencing data collection delays and failures were contact information limitations and unavailable or unresponsive contractors. Owner contact information was not available for a number of systems that were purchased by homeowners or small business owners. Rather, installation contractor contact information was provided. For many other purchase sites for which owner contact information was available, site owners were often unable to provide production data, frequently recommending that evaluators contact the installation contractor.

Data collection from contractors was of moderate success. Of those contractor companies from whom the evaluation team was unable to collect data, two were closed businesses for which new site ownership was not found, four declined to participate in the study, and 34 were either non-responders or unable to provide knowledge of or data for the requested site(s). Sites in the sample with viable data include a total of 76 contractors.

[2] http://dg.nyserda.ny.gov/home/index.cfm?

3.1.2 Analysis Results and Observations

3.1.2.1 File Review Results

The evaluation team collected production data for a total of 310 of the 523 sampled projects. Of this number, 62 were flagged for additional file review due to performance criteria outside of the expected range.[3] Based on this review, a total of 18 sites were dropped from the analysis based on results of the file review: 12 are due to incomplete first-year data, and six are due to inaccurate or net-metered data. Another three sites were corrected for differences in reported and evaluated production due to more than one installation at a single address. The evaluated sample contained data for 292 sites, of which 264 were included in the analysis of 2011-2016 installations.

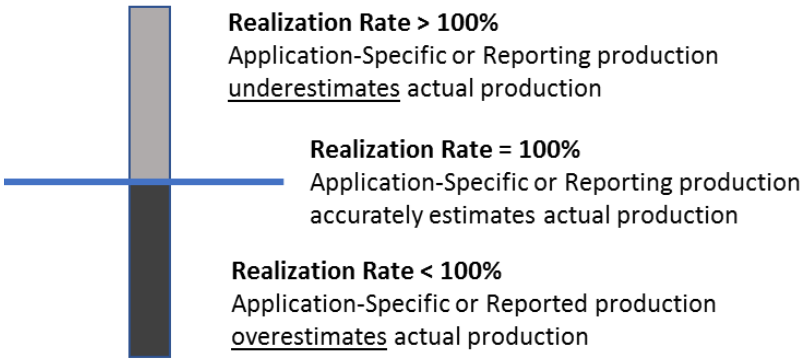
In sites with low (but accurate) system capacity production, low production was commonly attributed to poor system location (high shading, non-ideal orientation), particularly for small residential sites. A few low-producing sites had downtime in their first year due to inverter replacement.

3.1.2.2 Production Analysis Results

This section provides results of the program first-year capacity factors and production realization rates analyses. In each table, the categories shown (other than "Overall") are independent of one another. Each table of results uses the same weights based on a single stratification, sample, and sample frame. See Section 4.2 for explanation of analysis approach and weighting factor calculation.

Figure 3, below, illustrates how realization rates are interpreted for overestimation or underestimation of actual production for a given set of data.

Figure 3: Realization Rate Interpretation



[3] Sites with realization rates above 110% or below 70% or capacity factors above 14% or below 9% were flagged for file review.

Capacity Factor Results

Capacity factor results are primary impact results for this evaluation. As such, we review the accuracy of these estimates for different categories relative to the 90/10 precision target.[4]

Table 4 shows results for the two system size categories and overall. The 90/10 precision target was achieved for each segment. Smaller systems had lower overall capacity factors, consistent with expectations that residential and small business systems experience more performance-reducing conditions (i.e. shading) and are often designed with less favorable orientation than larger, freestanding systems designed for maximum production and unconstrained by pre-existing architecture.

Table 4: Capacity Factor Results by System Size

System Size	Sample Complete	Capacity Factor	Relative Precision @90%
Below 200 kW	148	12.08%	5%
$\geq$ 200 kW	116	13.24%	1%
Overall	**264**	**12.38%**	**4%**

Table 5 shows higher capacity factors for large (above 200 kW) sites. The results also show that small residential sites and small non-residential sites have virtually identical capacity factors.

Table 5: Capacity Factor Results by Customer Sector

Customer Sector		Sample Complete	Capacity Factor	Relative Precision @90%
Below 200 kW	Residential	78	12.08%	6%
	Non-Residential	70	12.06%	5%
$\geq$ 200 kW	Non-Residential	116	13.24%	1%
Overall		**264**	**12.38%**	**4%**

Table 6 provides capacity factor results by region. The 90/10 capacity factor precision target was achieved for all segments. The highest capacity factors are found in Long Island for both large and small systems, as expected, due to higher average solar insolation than the Upstate region, and fewer physical obstructions than those in Con Ed territory (especially for smaller sites with less ideal orientations).

[4] 90/10 precision means that the result has a 90% probability of being within $\pm$ 10% of the complete population result.

Table 6: Capacity Factor Results by Region

Region		Sample Complete	Capacity Factor	Relative Precision @90%
Below 200 kW	Con Ed	55	11.70%	8%
	Upstate	40	11.93%	8%
	Long Island	53	12.62%	6%
≥ 200 kW	Con Ed	29	13.15%	0%
	Upstate	67	13.25%	2%
	Long Island	20	13.36%	1%
Overall		**264**	**12.38%**	**4%**

Table 7 shows the capacity factor results for different system purchase types. The 90/10 precision target was achieved for each segment, except for the power purchase agreement (PPA) category for larger sites (where only two sites provided data). Small purchased systems have a higher capacity factor than small leased/PPA sites (although not statistically significant). There was not enough information on purchase types for large systems to ensure clear findings.

Table 7: Capacity Factor Results by Purchase Type

Purchase Type		Sample Complete	Capacity Factor	Relative Precision @90%
Below 200 kW	Lease	27	11.19%	6%
	PPA	64	11.22%	3%
	Purchase	24	13.10%	9%
≥ 200 kW	PPA	2	14.09%	13%
	Purchase	4	14.25%	6%
	Unknown	143	13.00%	1%
Overall		**264**	**12.38%**	**4%**

Application-Specific Realization Rates

The Application-Specific realization rate is the ratio of actual evaluated system production to the installers' estimates of system production (referred to as "Application-Specific" production), as received on application documents and NYSERDA database inputs. This rate assesses how well individual system estimates based on contractor-provided information is predicting the actual production of PV systems. For the period of 2011-2016, most of these estimates were determined by modeling completed by the contractor.

NYSERDA program staff have reported:

Over the years, the NY-Sun program has evolved and standardized its modeling requirements in order to improve installer estimates of production. Starting in Fall 2016, all residential and small-commercial systems are modeled in Salesforce via a link to PV Watts, with inputs provided by the contractor. The PV Watts model has set NREL-recommended assumptions for system hardware losses, including 3% for soiling/snow load.

Contractor inputs to Salesforce include:

- Equipment, which determines project nameplate capacity (kW DC)
- Site address, which drives the selection of localized weather data for the purpose of calculating annual solar potential
- Total Solar Resource Fraction (TSRF)

Table 8 shows results for the two system size categories and overall. The realization rate for small systems provides some evidence that Application-Specific modeled production is slightly overestimating actual production, though the result is not statistically different from 100%. To the extent installers use these same production estimates in their discussion with customers, the accuracy of the values should help promote market confidence. For large systems there is clear evidence that Application-Specific modeled production is underestimating actual production by 9%, a result that is statistically different from 100%.

Table 8: Application-Specific Realization Rate Results by System Size

System Size	Sample Complete	Application-Specific Realization Rate	Relative Precision @90%
Below 200 kW	148	96%	5%
≥ 200 kW	116	109%	1%
Overall	**264**	**99%**	**3%**

Results by customer sector are provided in Table 9. There was not a significant difference between results for small residential and small non-residential sites, which is likely due to similarities in purchase type and contractor pool for this size category. There is however a significant difference between small non-residential and large non-residential sites. Neither small residential, nor small non-residential have Application-Specific realization rates that are statistically different from 100%.

Table 9: Application-Specific Realization Rate Results by Customer Sector

Customer Sector		Sample Complete	Application-Specific Realization Rate	Relative Precision @90%
Below 200 kW	Residential	78	96%	5%
	Non-Residential	70	98%	4%
≥ 200 kW	Non-Residential	116	109%	1%
Overall		**264**	**99%**	**3%**

Table 10 shows the results per region. Installers in the upstate region produced estimates that were further from 100% than other those produced by installers in other regions. This difference among regions is statistically significant for large systems, but not for small systems. Further study is required to determine the underlying factors responsible for these differences.

Table 10: Application-Specific Realization Rate Results by Region

Region		Sample Complete	Application-Specific Realization Rate	Relative Precision @90%
Below 200 kW	Con Ed	55	97%	6%
	Upstate	40	95%	8%
	Long Island	53	98%	5%
≥ 200 kW	Con Ed	29	101%	1%
	Upstate	67	111%	2%
	Long Island	20	105%	3%
Overall		**264**	**99%**	**3%**

Results for different system purchase types are shown in Table 11. Application-Specific modeled production tends to overestimate actual production on small sites with lease or PPA purchase types. It is inconclusive whether this is due to purchase type or variation in contractor performance. The Application-Specific modeled production tends to underestimate actual production on large sites with unknown purchase types. Small purchased and large PPA or purchased sites all had realization rates that were not statistically different from 100% but showed some evidence of overestimation.

Table 11: Application-Specific Realization Rate Results by Purchase Type

Purchase Type		Sample Complete	Application Specific Realization Rate	Relative Precision @90%
Below 200 kW	Lease	27	91%	4%
	PPA	64	88%	4%
	Purchase	24	103%	9%
≥ 200 kW	PPA	2	105%	13%
	Purchase	4	106%	6%
	Unknown	143	109%	1%
Overall		**264**	**99%**	**3%**

Reporting Realization Rates

The Reporting Realization Rate is the ratio of actual evaluated system production to NYSERDA's estimate of system production (referred to as "Reporting" production) for purposes of program-level progress and benefits reporting to the PSC. The capacity factors used to calculate the Reporting production estimates were determined from a previous evaluation. The Reporting realization rate assesses the difference in Reporting production and actual evaluated system production.

For residential and small commercial solar PV systems (< 200 kW) between 2011-2016, the Reporting production estimates are based on a 13.4% capacity factor, which was the recommendation of the prior evaluation study on NYSERDA-supported solar PV[5]. This capacity factor has been used by NYSERDA to estimate and report system production.

For larger commercial/industrial PV systems (≥ 200 kW) installed between 2011-2016, the Reporting production is estimated using fixed capacity factors that are based on PON and technology. Capacity factors between 11% and 17.5% have been used by NYSERDA to estimate and Reporting production for these sites.

Table 12 shows results for the two system size categories and overall. The 90/10 precision target was achieved for each segment. Smaller systems had lower overall capacity factors, consistent with expectations that residential and small business systems are more subject to performance-reducing conditions and orientation than are larger, free-standing systems designed for maximum production and unconstrained by pre-existing architecture. The realization rates for both large and

[5] Cadmus Group, Inc. (2013), NYSERDA Renewable Portfolio Standard Customer-Sited Tier Impact Evaluation Report: Solar PV and On-Site Wind Programs, https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2013ContractorReports/2013-Cadmus-RPS-Solar-PV.pdf

small systems are statistically different from 100%, indicating the NYSERDA Reporting production overestimates small system actual production by 10% and underestimates actual production by large systems by 4%.

Table 12: Reporting Realization Rate Results by System Size

System Size	Sample Complete	Reporting Realization Rate	Relative Precision @90%
Below 200 kW	148	90%	5%
≥ 200 kW	116	104%	1%
Overall	**264**	**94%**	**4%**

Table 13 shows that there was not a significant difference between results for small residential and small non-residential sites. There is, however, a significant difference between small non-residential and large non-residential systems. Small business systems tend to experience more performance-reducing conditions (i.e., shading) and are often designed with less favorable orientation than larger, freestanding systems designed for maximum production and unconstrained by pre-existing architecture.

Table 13: Reporting Realization Rate Results by Customer Sector

Customer Sector		Sample Complete	Reporting Realization Rate	Relative Precision @90%
Below 200 kW	Residential	78	90%	6%
	Non-Residential	70	91%	5%
≥ 200 kW	Non-Residential	116	104%	1%
Overall		**264**	**94%**	**4%**

Table 14 shows the results per region. There were no statistically significant reporting realization rate differences among regions for small systems; for large systems each region was statistically different from the other two.

Table 14: Reporting Realization Rate Results by Region

Region		Sample Complete	Reporting Realization Rate	Relative Precision @90%
Below 200 kW	Con Ed	55	88%	8%
	Upstate	40	89%	8%
	Long Island	53	94%	6%
≥ 200 kW	Con Ed	29	98%	1%
	Upstate	67	106%	2%
	Long Island	20	101%	2%
Overall		**264**	**94%**	4%

Table 15 shows the results for different system purchase types. The results show that the Reporting production tends to overestimate actual production of small sites with lease or PPA purchase types and underestimate large sites. The sites with small lease or PPA purchase type systems tended to have more shading, less favorable orientation, and more variation in contractor performance than the small purchased sites. Small purchased sites were statistically different from the other small sites. However, a 98% realization rate for the purchased systems is not statistically different than 100%,

Table 15: Reporting Realization Rate Results by Purchase Type

Purchase Type		Sample Complete	Reporting Realization Rate	Relative Precision @90%
Below 200 kW	Lease	27	83%	6%
	PPA	64	84%	3%
	Purchase	24	98%	9%
≥ 200 kW	PPA	2	105%	13%
	Purchase	4	106%	6%
	Unknown	143	104%	1%
Overall		**264**	**94%**	**4%**

3.1.2.3 Performance Persistence

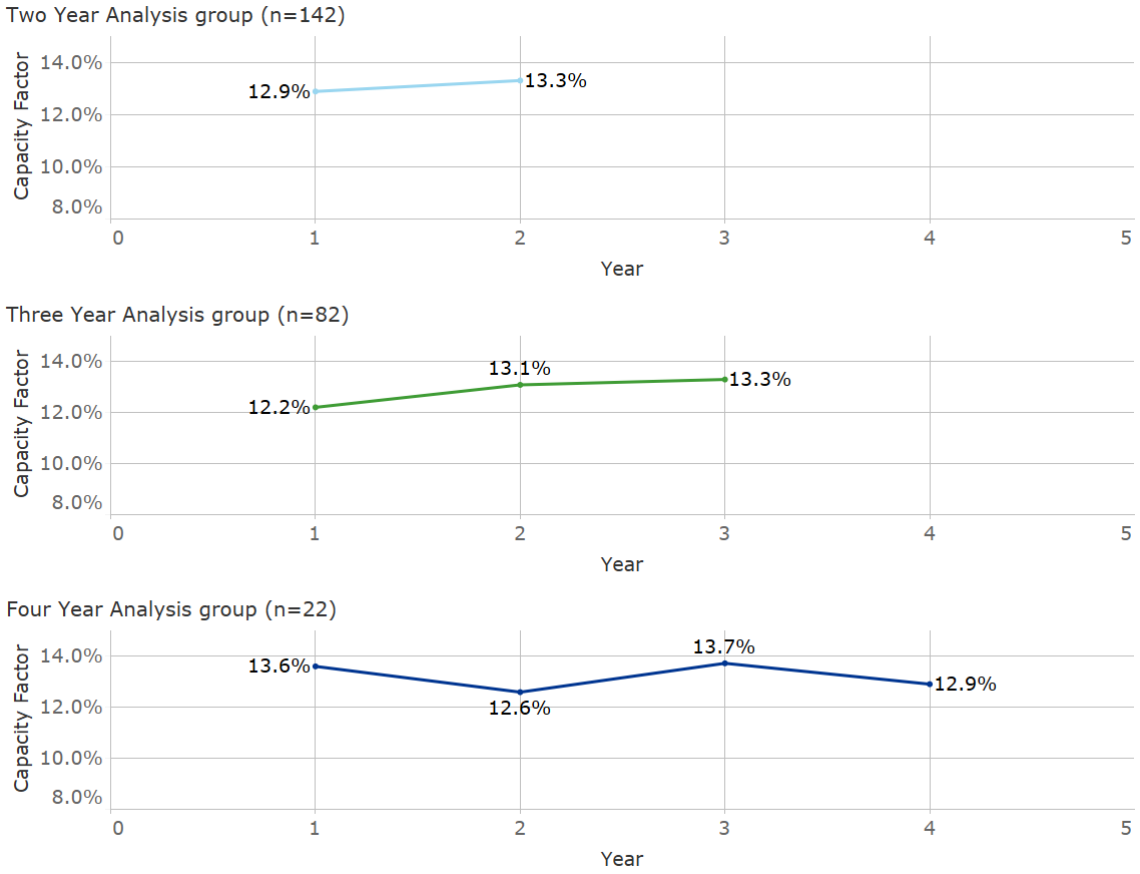
DNV GL investigated performance persistence by comparing weather-adjusted capacity factors from the first year of system production to the capacity factors in later years. Out of a total sample of 264 systems included in the first year of the degradation analysis, 142 had complete data within the screening criteria, described in Section 3.1.2.1, for year two. A total of 82 systems had three years or more of data, 22 had four or more years of data. As mentioned in Section 3.1.1.1, participants and contractors with sampled sites installed in 2008 were largely unable to provide production data, either because of non-response to outreach or lack of available data once calls were completed. For this reason, a long-term (10 years or more) persistence study was not possible and a shorter term persistence was pursued. To compare a consistent set of sites in the analysis across years, the evaluation team looked at trends in the capacity factor for fixed sets of sites. For example, evaluation of the persistence of year 3 reviewed the trend in capacity factor for year 1, year 2, and year 3 for only the 82 sites that had 3 or more years of data.

The production persistence analysis indicated no evidence of degradation within the first three years after PV system installation. Production data sample sizes declined significantly after the

first year and were limited to the first four years of production, a period within which significant degradation is not expected.

Figure 4 shows weather normalized capacity factors for each analysis group across the years of analysis. The year-by-year capacity factor values shown are not as important as the trend over time. Capacity factors vary by year, increasing in the two and three year analysis, but do not trend in a consistent direction across analysis groups. This was also true when different sub-groups (locations, system sizes, etc) were analyzed within the population.

Figure 4. Capacity Factor Persistence Over Evaluation Periods (2, 3, and 4 Years)



3.2 Conclusions

The findings from the impact evaluation of NYESRDA Solar PV program installations in 2011 through May 2016 are summarized in Table 16 on the next page.

Production realization rates for the program overall (99% for Application-Specific and 94% for Reporting) show that both methods are providing relatively accurate estimation of generation for the program population. The program realized an overall 12.4% capacity factor during the

evaluation period. The capacity factors for smaller sites tend to be lower than average, and larger sites tend to be above average, reflecting common installation scenarios of smaller sites on existing buildings, and larger sites at more ideal locations and orientations.

The lease and PPA purchase types show lower capacity factors in all regions, and Reporting production tends to overestimate actual production more dramatically. The overestimation of production is most acute in the Upstate region, where estimations may not be accurately accounting for differences in snowfall or other shading factors.

Conversely, Reporting production tends to underestimate actual production for smaller purchased sites in the Con Ed region and above 200 kW in Upstate and Long Island, perhaps more conservatively sizing installations to serve load throughout variations in weather.

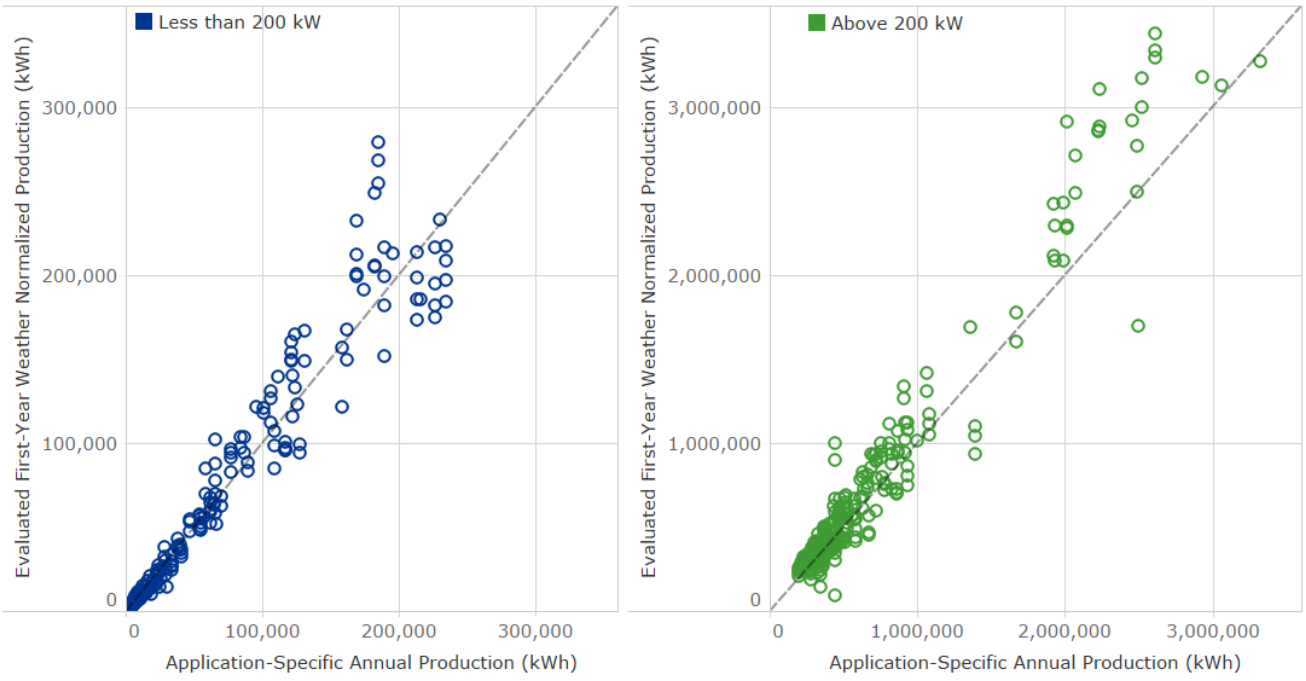
Table 16: Summary of Program Evaluation Findings

Region	System Size (kW)	Purchase Type	Sample Frame (N)	Evaluated Sample (n)	Total System Size MW	Reporting Production MWh	Evaluated Production MWh	Reporting Realization Rate	Application Specific Realization Rate	Capacity Factor
Con Ed	Below 200 kW	Lease	3,292	12	25.0	219,098	169,571	0.77	0.86	0.10
		PPA	477	15	3.9	33,985	24,933	0.73	0.80	0.10
		Purchase	1,700	28	23.0	201,751	202,658	1.00	1.11	0.13
	≥ 200 kW	All	34	29	17.6	153,758	151,168	0.98	1.01	0.13
Upstate	Below 200 kW	Lease	7,835	8	62.7	549,134	468,736	0.85	0.92	0.11
		PPA	3,691	22	48.2	422,650	349,293	0.83	0.87	0.11
		Purchase	10,028	10	111.5	976,816	923,048	0.94	1.00	0.13
	≥ 200 kW	All	115	67	78.1	684,449	726,831	1.06	1.11	0.13
Long Island	Below 200 kW	Lease	3,948	7	27.3	239,185	205,386	0.86	0.93	0.12
		PPA	1,653	27	12.3	107,638	96,892	0.90	0.93	0.12
		Purchase	3,668	19	42.4	371,688	384,304	1.03	1.04	0.14
	≥ 200 kW	All	28	20	10.5	91,703	92,614	1.01	1.05	0.13
Overall			**36,469**	**264**	**462.5**	**4,051,857**	**3,796,071**	**0.94**	**0.99**	**0.12**

Figure 5 displays plots of evaluated production vs. application-specific production for all sampled sites, as a representation of how well production was estimated by installers. Note that the two plots have different scales: 0 to 300,000 kWh for smaller sites and 0 to 3,000,000 kWh for larger sites. The plots show the relationship between evaluated production and application specific production for each site. The dashed line in each plot corresponds to a realization rate of 100%. The vertical distance from a point on the plot to the line is the error associated with the site. Sites

above the line have realization rates above 100% and sites below have realization rates below 100%. In the plots we can see that only two of the sites with application-specific kWh over 2,000,000 kWh have realization rates below 100% while many have realization rates above 100%. For sites under 200 kW only two sites above 200,000 kWh have realization rates at or above 100% while many have realization rates below.

Figure 5. Plot of Evaluated Production vs. Application-Specific Production



3.3 Recommendations

DNV GL's six key recommendations from this impact evaluation are provided in the table below.

Table 17: Recommendations

#	Finding	Recommendation
1	Realization rates for small (less than 200 kW) sites are more accurate for the application specific estimates than the reporting estimates.	Consider using application specific production estimates in the NYSERDA reporting system for small (less than 200 kW sites). This should prove more accurate over time as the program continues to evolve and standardize its modeling requirements for application specific estimates of production.
2	For large (greater than 200 kW) sites, the current reporting method is providing more accurate realization rate estimates than the application specific method.	Continue to use the current reporting production method and consider adjusting the reporting production estimates from large sites using the realization rates or capacity factors by category from this study.
3	Realization rates for small (less than 200 kW) sites are much less than realization rates for large (greater than 200kW) sites, especially for lease and PPA sites.	• Continue review of Application-Specific production models • Consider amending requirements to include not only shading analysis, but also snowfall averages for the specific location. • Consider periodic (internal only) evaluation sampling to help understand and adjust for factors that influence performance and reporting of production for the <200 kW sites.
4	There are mismatches between program records in the DG Integrated database and the program tracking database.	Ensure that there are unique project ID/identifiers in both the DG Integrated database and in Salesforce that will aid identification of added system capacity. This would simplify mapping of sites. Likewise, Salesforce records should provide information on project IDs for added capacity or sister sites at the same location.
5	There insufficient data to study long-term (10 years or more) persistence over time	As the production from 2008-installed sites cannot be measured remotely, consider conducting an additional data collection effort, wherein inverter readings are collected from a sample of all 2008 participants, across a minimum 13-month period. Oversample 2008 participants to account for dropouts.
6	Collecting good data from participants and contractors is difficult and there is a lack of available data in general.	• Establish expectations for periodic, sampled evaluation and data collection among participants with smaller sites in program outreach information and Salesforce data entry certification. • Internally archive internet-connected meter data downloads. • List owner, installer, and solar developer contact information in Salesforce and flag the responsible contact for data connection verification and updates.

4 Methods

This section summarizes the methods employed to collect production data for sampled sites and analyze program performance.

4.1 Data Collection Approach

The evaluation team worked with NYSERDA to establish a data collection plan, reviewing the location, level of aggregation, completeness, and quality of data likely from each potential source. Table 18 outlines the final data collection sources mapped to evaluation objectives.

Table 18: Reported Data and Evaluated Data Sources per Evaluation Objective

Evaluation Objective	NYSERDA Reported Data	Evaluated (M&V) Data Source
Supplied power per site and region (Nameplate kW DC)	MW Block Dashboard reports	NYSERDA Tracking Databases: • NY Sun Database • Metrics Database
Energy impact (First-year production, kWh)	Expected kWh annual production, from contractor-modelled estimates recorded in program tracking databases	Residential and Small Commercial: • Obtained production data from participants and contractors through hard-wired PV production meters, on-line monitoring systems, or inverter display recorded production (self-reported). • Obtained first-year data for all sites. In addition, sought to obtain 2016 data for 2008-installed sites.
		Large Commercial: • Obtained data from DG Integrated Data System website[6], which is fed by internet enabled electric meters that transmit recorded readings. • Obtained first-year data for all sites. No 2008 data available.
Capacity Factor	n/a	No additional data collection. Calculated from verified annual production data.

NYSERDA tracking databases, the NY Sun and Metrics databases, provided site-level program account information, including installed capacity (kW), NYSERDA reported kWh, NYSERDA estimated capacity factors, system completion date, customer name and contact information, purchase type, installation contractor, region and system size. The evaluation sample frame was built from project information in these two databases.

[6] http://chp.nyserda.ny.gov/ reports/index.cfm

The production data collection effort was completed by separate means for the two major size domains in the sample design. Large Commercial/Industrial (≥200 kW non-residential) site production data was obtained through the publicly available online DG Integrated database[7]. Production data for Residential/Small Business (< 200 kW) sites was collected primarily by customer and contractor phone surveys and electronic data transfers. Finally, NYSERDA provided inverter data collected in the prior evaluation of 2008 sites (released in 2013). The data was mapped to the current study sample of 2008 sites.

4.1.1 Participant and Contractor Data Collection

The Impact Evaluation Team worked with NYSERDA to develop advance letters for initial communication to participants and contractors, including a of instructions to assist participants and contractors in understanding the data request and obtaining the data from their system(s). The residential and small business owner advance letter is provided in Appendix C, and the contractor letter in Appendix D.

In parallel, NYSERDA launched a program evaluation website[8] to encourage participation in the study, list names of the evaluator and project manager, and provide a medium for email communication. Feedback from program participants suggest that the site was very helpful in validating the study, and simplified communication with the project manager (previously managed via phone and direct email).

Finally, the evaluation team developed a recruitment script, survey script, and data collection instrument to inventory and track collected data and standardize the communication from multiple evaluators. The survey script is provided in Appendix B.

Data collection surveys and communication were conducted by experienced program evaluators with expertise in solar photovoltaic systems. Outreach was directed to those contact persons expected to have the best access to and permission to provide production data. In the case of leased and PPA systems, the Impact Evaluation Team conducted outreach to the lease and PPA holders who participated in the program. Homeowners or small business owners were the first point of contact for systems which had been directly purchased and enrolled in the program by

[7] http://dg.nyserda.ny.gov/home/index.cfm?

[8] https://www.nyserda.ny.gov/About/Publications/Program-Planning-Status-and-Evaluation-Reports/Solar-Photovoltaic-Impact-Evaluation

these owners. If owner contact was unsuccessful, outreach continued with contractors who had installed enrolled systems.

4.2 Analysis Approach

The analysis of program data included annualization of production data, calculation of case weights for expansion of site data to the program population, and ratio estimation to generate capacity factors with appropriate standard errors. Once the data collection was complete, the Impact Evaluation Team conducted a file review for sites with particularly high or low capacity factors and/or realization rates. A weather normalization of all production results enabled comparison of site performance across installation years. Finally, a degradation analysis was performed to determine whether performance declined across the years of the study.

4.2.1 Production Data Analysis

The analysis calculated two key values from the production data for each evaluated site: Capacity factor (CF), and realization rate (RR). CF provides a measure of system performance relative to rated capacity. Many factors can influence capacity factor, such as installation direction and angle, shading, temperature, and insolation. CF is calculated as:

$$CF = \frac{\sum_j^V kWh\_eval_j w_j}{\sum_j^V CAP_j * 8{,}760\ hrs * w_j}$$

Where:

kWh_eval_j = First-year evaluated production for system *j* (kWh)

CAP_j = System rated DC capacity *j*

W_j = Weighting factor for system *j*

V = Evaluation sample

Realization rates provide a measure of the degree to which program estimates of production predict first year generation.

$$RR = \frac{\sum_j^V kWh\_eval_j w_j}{\sum_j^V kWh\_rep_j w_j}$$

Where:

kWh_eval_j = Evaluated first-year production for system *j* (kWh)

kWh_rep_j = Program production for system j (kWh)

In the application specific realization rate, kWh_rep_j is based on the individual system estimates based on contractor provided information. In the reporting realization rate, kWh_rep_j is based on NYSERDA estimated solar PV system production for purposes of external, program-level progress and benefits reporting to the PSC.

The method for calculating the sample weights, w_j , for each stratum is described below. In lay terms, the weight is simply the number of units in the sample frame (N) divided by the number of completed units in the sample (n). The interpretation of the weight is that each completed sample unit represents N/n units in the sample frame.

The weight W_x is calculated as

$$W_x = N_x / n_x$$

Where:

N_x = Number of units of analysis in stratum X

n_x = Number of completed sample units of analysis in stratum X

4.2.2 File Reviews

The evaluation team conducted a file and QC data review to determine reasons for capacity factors and realization rates outside of the expected range (RRs above 110% or below 70%; CFs above 14% or below 9%), and subsequently clean the production data. NYSERDA provided production model files, applications, site documentation, and QC data for these systems, for comparison to collected production data and system details collected through customer surveys. The team reviewed shading analysis and production estimation files from the system design to both the program reported generation and the actual generation collected for this study, to determine whether inaccurate modelled generation or metered data[9] cause the unreasonably high or low capacity factors/ realization rates. Finally, the team reviewed QA/QC documentation,

[9] Inaccurate metered data could be caused by metering of multiple projects on a single meter, net metered data, or poorly captured data/ meter failure.

where available, to determine if differences between the designed and built systems are the source of unreasonably high or low realization rates.

4.2.3 Weather Normalization

The evaluation team normalized production and capacity factors for weather differences (solar insolation, temperature, etc.) across installation years. The weather-normalized values represent performance under typical weather conditions and provide a more meaningful basis for comparison against the reported/expected production that was based on modeling.

The normalization approach was to model a set of representative solar PV sites, in PVSyst production estimation software, using common characteristics and weather data, including precipitation, solar insolation, temperature, and snow accumulation. For each month of each year in the evaluation period (2008-2016), the model results were used to calculate the ratio of estimated production for the TMY3 month to the estimated production using actual weather. The observed production quantity for each site and month was then adjusted to TMY3 conditions by multiplying each observed monthly quantity by the normalization ratio for that region and month.

4.2.4 Expansion of Production Results to Sample Frame

The final weather normalized production results were expanded to the sample frame through a set of sample weights based on the sample design stratification. Each weight is specific to an individual stratum and calculated as the number of units in the sample frame (N) for the stratum divided by the number of completed units in the sample (n) for the stratum. The interpretation of the weight is that each completed sample unit represents N/n units in the sample frame.

4.2.5 Degradation Analysis

The objective of the degradation analysis was to provide information relating to degradation of PV Systems over time using weather normalized production data to estimate degradation factors for systems with multiple years in service. The analysis estimated ratios of subsequent years of production relative to first-year production, in the form of:

$$\text{Degradation rate} = 1 - \frac{\text{Total Production Year X (kWh/yr)}}{\text{Total Production Year 1 (kWh/yr)}}$$
$$= 1 - \frac{\sum_j (\text{Year X Production})_j * w_j}{\sum_j (\text{Year 1 Production})_j * w_j}$$

Appendix A Sample Frame, Design, and Selection

This Appendix provides a detailed on the sample design and selection for this study.

Sample Frame

As shown in Table 19, the sample frame is built from two datasets, with a combined 51,734 unique observations: the NYSERDA PV projects housed in the NYSun database, with 51,535 unique observations, and Solar PV Metrics dataset, with 199 unique observations. This study evaluates the first year of production for sites installed and functioning in 2008 and between the years of 2011 to 2016. The sample was selected in May 2017, therefore sites completed after May 2016 did not have a full year of data available for analysis and were removed from the sample frame (13,037 records). The final sample frame had 36,902 observations.

Table 19: Program Tracking Database Records and Sample Frame

Tracking Database	Projects as of May 2017	Projects between 2009-10	Projects completed after May 2016	Final Sample Frame
NY Sun	51,535	1,795	12,993	36,747
Solar PV Metrics	199	0	44	155
Total	**51,734**	**1,795**	**13,037**	**36,902**

Sample Design

NYSERDA's goal for this evaluation was to achieve an estimate of $\pm$ 10% relative precision with 90% confidence (90/10 precision) for four segmentations of the program data based on the categorization above and the date of system installation. The segments for which 90/10 precision was targeted were:

- Region (Con Ed, Long Island, Upstate)
- Purchase Type (Lease, Power Purchase Agreement, Purchase)
- Customer Sector (Residential, Non-residential)
- Year of Completion (2008, 2011-2016)

To achieve the target precisions for each segmentation, the sample design is stratified by a combination of customer sector, region, purchase type, and size of site. The resulting sample design has 52 strata and a total target sample of 523 sites, where a site is a single installed solar photovoltaic system enrolled through a NYSERDA program. Program sites might share a single premise, in the case of multiple solar photovoltaic systems installed at a single address.

Each stratum has a target sample count in the sample design, and all sites in each stratum were randomly assigned a priority between 1 to n, where n is the number of sites in that stratum in the population. A site with a priority number less than or equal to the stratum target is in the sample. If the priority of a site is greater than the stratum target and less than the backup multiplier (1.5, 1.1, or 1.3 times the strata target based on 2008/Lease/PPA/Purchase) then a site is assigned to a backup sample.

Sample Selection

For this study, the key estimates are ratios, including the primary study goal, capacity factor (production/capacity), and the secondary study goal, realization rate (verified production/modelled production). The corresponding 90/10 requirement is for 90% confidence bounds that are ±10% of the estimate. The sample design formula for ratio estimation is given below:

$$sample\ size = \frac{z^2 CV^2 / e^2}{1+\left(\frac{z^2 CV^2}{e^2 N}\right)}$$

where

N = Population size

E = Relative error

Z = Z-score for a 90% confidence interval

CV = Coefficient of variation

For a ratio estimator, the CV used is the ratio CV, also called the error ratio. The ratio CV is the root-mean-square deviation around the ratio line, as a percent of the average value.

Based on experience with similar data, as well as the results of the 2013 evaluation of these programs, a CV assumption of 0.35 for the 2011-2016 installations is reasonable. A more conservative CV = 0.5 was assumed for the set of 2008 sites, since data is older, and collected through more manual methods that introduce more error. The final sample selection based on these assumptions is shown in Table 20.

Table 20: Final Sample Design

Region	System Size (kW)	Purchase Type	Population Size (N)	Population Reported Production (kWh)	No. of Strata	Target Sample (n)
Con Ed	Below 200 kW	Lease	3,292	25,011	3	26
		PPA	477	3,880	3	31
		Purchase	1,751	23,634	8	67
	Above 200 kW	All	34	17,552	4	34
Upstate	Below 200 kW	Lease	7,835	62,687	2	24
		PPA	3,691	48,248	2	29
		Purchase	10,401	113,815	6	39
	Above 200 kW	All	115	78,133	6	28
Long Island	Below 200 kW	Lease	3,948	27,304	3	24
		PPA	1,653	12,287	3	26
		Purchase	3,677	42,543	8	80
	Above 200 kW	All	28	10,468	4	115
Overall			**36,902**	**465,565**	**52**	**523**

Appendix B Production Data Collection Survey

Hello, this is _____ from DNV GL, calling on behalf of NYSERDA. May I speak with <Name of Participant>?

If this is a prescheduled call, skip to Section B.

Section A: Introduction

I'm calling in reference to the solar photovoltaic system that was installed at <Site Address> under NYSERDA's <Program Name> Program. Are you aware of that installation?

No	Do you know of a better contact person for information on this system? (Gather name, phone number, email, and relationship to the system)
Yes	Continue

Great. NYSERDA has commissioned us (DNV GL) to verify the energy production for PV systems that participated in the program. You should have received a letter or email from NYSERDA verifying this study. [If more information is requested, offer to fax or email a copy of the letter or, if they prefer, give them the NYSERDA contact phone number. Emails were delivered June 28, 2017. Letters were mailed June 29, 2017.].

To complete the study, we are requesting historical energy production data from your system, and would like to ask a few questions about your system.

Are you available to talk about your system now, or would you like to schedule a future phone call?

No	What would be a good day and time for an evaluation engineer to call you back to conduct the short survey? Scheduled Day for Survey: _____Time: _____ AM / PM Ok, thanks so much for your time and help with our study. Can I answer any questions before I go? Have a nice day. [STOP]
Yes	Great, thank you. Continue

Section B: Production Data Collection

The NYSERDA NY Sun program required that each PV system have the capability of recording system energy production in kWh. You and your contractor had the option of providing this information in one of three ways: an online monitoring system, a hard-wired PV production meter, or as monthly recorded production from your inverter display.

B1. Online monitoring system

Do you have access to a website (provided by your contractor) where you can see the basic system information, historical energy production (kWh) and load profile (kW) of your system?

No	Continue
Yes	Could you please provide me with the URL (web address) of this website? (record website address, or provide email where the URL can be delivered and ask that DNV GL site ID be included with the email) Skip to Section C.

B2. Production meter

Does your production meter allow you to download data from the meter, connected software, or a website?

No	Continue
Yes	Do you know if the meter records production or net metered data? (record answer, explaining the difference if necessary). We'd like to ask for the data from your production meter. Please download the monthly energy production (kWh) of your system over the lifetime of the system, and the lifetime total kWh. You can then email the data directly to us at <email>. Please provide the following site ID with your email: <DNVGL site ID>. Skip to Section C.

B3. Monthly inverter readings

If your system has neither of the other capabilities, you have likely been providing monthly readings of energy (kWh) production from your inverter and providing them to your utility. Do you recall providing this data to your utility?

No	Okay, we may need to talk to your contractor or the utility to gather the production data from your system. Could you please confirm that this information is correct? (Confirm contractor name, phone number, email address as available.) Continue to Section C.
Yes	We'd like to ask for the complete set of monthly kWh readings that you have recorded (preferably in Excel format), and the total lifetime kWh with the date of that recording. Please note the units with the readings (kWh or MWh). You can email the data directly to us at Robin.Norris@DNVGL.com. Please

	provide the following site ID with your email: <DNVGL site ID>. Continue to Section C.

Section C: System Information

Now I'm going to ask a few questions about your PV system. You might need to refer to design documentation or the system itself to answer some of these questions.

Go through data matrix, asking for information on the system. Once complete, thank the customer for all of their time and help in providing information, and offer to answer any final questions.

FAQ's

How long will this take?

The call with our engineers should take no longer than 15 minutes, and will help to identify the data we are requesting.

Who are you?

We are professional energy program evaluators working for a consulting firm called DNV GL, and we have been hired by NYSERDA to conduct this survey under the authority of NYSERDA.

What is the purpose of the study/ How will the data be used?

NYSERDA will use the results of this study to measure the effectiveness of the NY Sun and MW Block Programs and to inform decisions on future solar PV energy programs. The information you provide will be kept private to the extent permitted by law. The analysis will only use summary level data and will not identify individual respondents or firms.

How do I know what you are doing is legitimate?

You can contact NYSERDA by calling Dana Nilsson at NYSERDA [(518) 862-1090 x3262] Monday - Friday 8am – 5pm EST to authenticate this study.

Am I required to provide the data?

You should have received a contract addendum that stipulated the requirement to provide NYSERDA or its representative with reasonable access to the PV System in order to conduct site inspections or remote monitoring services. We are attempting to gather this data remotely to avoid onsite visits to customer facilities.

How do I find my system's historical energy production data?

The NYSERDA program required that each PV system have the capability of recording system energy production in kWh. You and your contractor had the option of providing this information from an online monitoring system, hard-wired PV production meter, or monthly recorded production from your inverter display. These data sources are defined below in terms of how they should be available to you.

Online monitoring system

If you have an online monitoring system, you have access to a website (provided by your contractor) where you can see the basic system information, historical energy production (kWh) and load profile (kW) of your system. **Please provide the URL (web address) of this website.**

Production meter

If your production meter allows you to download data from the meter, connected software, or a website, **please download the monthly energy production (kWh) of your system over the lifetime of the system, and the lifetime total kWh.**

Monthly inverter readings

If your system has neither of the above capabilities, you have been providing monthly readings of energy (kWh) production from your inverter and providing them to your utility. **Please provide the complete set of monthly kWh readings that you have recorded (preferably in Excel format), and the total lifetime kWh with the date of that recording. Please note the units with the readings (kWh or MWh).**

Appendix C Residential Customer Advance Letter

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

ANDREW M. CUOMO
Governor

RICHARD L. KAUFFMAN
Chair

JOHN B. RHODES
President and CEO

June 29, 2017

Dear NY Sun Program Participant,

Thank you for your participation in the NY Sun program. In an effort to continuously improve the program, NYSERDA has initiated a plan to verify customers' energy production for a sample of program participants. **Your solar photovoltaic installation has been selected as an important site for this research.**

A highly respected, independent engineering firm, DNV GL, is conducting this evaluation on behalf of NYSERDA, and will be contacting you to request the information listed below.

1. Historical PV system production data (kWh) in one of three forms:
    a. Website connection
    b. Web-connected or downloadable data from production meter
    c. Monthly inverter readings
2. A short survey lasting less than 15 minutes

The information you provide will be kept private to the extent permitted by law. The analysis will only use summary level data and will not identify individual respondents or firms.

We appreciate your support, feedback, and cooperation. If you have any questions or concerns regarding this initiative, please feel free to contact the appropriate person(s) listed in the following table.

If you…	Who to Contact	Contact
have questions about the data request or are ready to provide the data	Robin Norris, DNV GL	Robin.Norris@dnvgl.com (518) 992-5506
have questions about the study, the contractors or the purpose of the inspection	Dana Nilsson, NYSERDA	Dana.Nilsson@nyserda.ny.gov (518) 862-1090 x3262

Sincerely,
Dana Nilsson, PE
NYSERDA Project Manager

New York State Energy Research and Development Authority

Albany
17 Columbia Circle, Albany, NY 12203-6399
(P) 1-866-NYSERDA | (F) 518-862-1091
nyserda.ny.gov | info@nyserda.ny.gov

Buffalo
726 Exchange Street
Suite 821
Buffalo, NY
14210-1484
(P) 716-842-1522
(F) 716-842-0156

New York City
1359 Broadway
19th Floor
New York, NY
10018-7842
(P) 212-971-5342
(F) 518-862-1091

West Valley Site Management Program
9030-B Route 219
West Valley, NY
14171-9500
(P) 716-942-9960
(F) 716-942-9961

Energy production data

The NYSERDA program required that each PV system have the capability of recording system energy production in kWh. You and your contractor had the option of providing this information from an online monitoring system, hard-wired PV production meter, or monthly recorded production from your inverter display. These data sources are defined below in terms of how they should be available to you.

1. Online monitoring system

If you have an online monitoring system, you have access to a website (provided by your contractor) where you can see the basic system information, historical energy production (kWh) and load profile (kW) of your system:

Please provide the URL (web address) of this website.

2. Production meter

If your production meter allows you to download data from the meter, connected software, or a website:

Please download the monthly energy production (kWh) of your system over the lifetime of the system, and the lifetime total kWh.

3. Monthly inverter readings

If your system has neither of the above capabilities, you have been providing monthly readings of energy (kWh) production from your inverter and providing them to your utility.

Please provide the complete set of monthly kWh readings that you have recorded (preferably in Excel format), and the total lifetime kWh with the date of that recording. Please note the units with the readings (kWh or MWh).

New York State Energy Research and Development Authority

Albany
17 Columbia Circle, Albany, NY 12203-6399
(P) 1-866-NYSERDA | (F) 518-862-1091
nyserda.ny.gov | info@nyserda.ny.gov

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(F) 716-842-0156

New York City
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(F) 518-862-1091

West Valley Site Management Program
9030-B Route 219
West Valley, NY
14171-9500
(P) 716-942-9960
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Appendix D Contractor Advance Letter

July 26, 2017

Dear NY-Sun Solar PV Program contractor/ lease holder,

Thank you for your participation in the NY-Sun Solar PV Program. In an effort to continuously improve the program, NYSERDA has initiated a plan to verify customers' energy production for a sample of program participants.

https://www.nyserda.ny.gov/About/Publications/Program-Planning-Status-and-Evaluation-Reports/Solar-Photovoltaic-Impact-Evaluation

A highly respected, independent engineering firm, DNV GL, is conducting this evaluation on behalf of NYSERDA, and will be contacting you to request historical PV system production data (kWh) and system design information.

The NYSERDA program required that each PV system have the capability of recording system energy production in kWh. Participants and contractors have the option of providing this information from an online monitoring system, hard-wired PV production meter, or monthly recorded production from your inverter display.

We appreciate your support, feedback, and cooperation. If you have any questions or concerns, please feel free to contact the appropriate person(s) listed below. You may also visit the website above for additional confirmation of this evaluation.

If you…	Who to Contact	Contact
have questions about the data request or are ready to provide the data	Robin Norris, DNV GL	Robin.Norris@dnvgl.com (518) 992-5506
have questions about the study or the purpose of the evaluation	Dana Nilsson, NYSERDA	Dana.Nilsson@nyserda.ny.gov

Sincerely,
Dana Nilsson, PE
NYSERDA Project Manager

FAQ's

How long will this take?
The call with DNV GL evaluator should take no longer than 15 minutes, and will help to identify the data we are requesting.

Who is DNV GL?
DNV GL is a professional energy program evaluator and has been hired by NYSERDA to conduct this survey under the authority of NYSERDA.

What is the purpose of the study/ How will the data be used?

NYSERDA will use the results of this study to measure the effectiveness of the NY Sun and MW Block Programs and to inform decisions on future solar PV energy programs. The information you provide will be kept private to the extent permitted by law. The analysis will only use summary level data and will not identify individual respondents or firms.

Am I required to provide the data?
You should have received a contract addendum that stipulated the requirement to provide NYSERDA or its representative with reasonable access to the PV System in order to conduct site inspections or remote monitoring services. We are attempting to gather this data remotely to avoid onsite visits to customer facilities.

How do I find my system's historical energy production data?
The NYSERDA program required that each PV system have the capability of recording system energy production in kWh. You and your contractor had the option of providing this information from an online monitoring system, hard-wired PV production meter, or monthly recorded production from your inverter display. The evaluation engineer will talk with you more about how to share the data you may have when they call.

4. Online monitoring system
If you have an online monitoring system, you have access to a website (provided by your contractor) where you can see the basic system information, historical energy production (kWh) and load profile (kW) of your system. The engineer will be asking for access to the URL (web address) of this website.

5. Production meter
If your production meter allows you to download data from the meter, connected software, or a website, the engineer will ask you to download the monthly energy production (kWh) of your system over the lifetime of the system, and the lifetime total kWh.

6. Monthly inverter readings
If your system has neither of the above capabilities, you have been providing monthly readings of energy (kWh) production from your inverter and providing them to your utility. The engineer will ask you for the complete set of monthly kWh readings that you have recorded (preferably in Excel format), and the total lifetime kWh with the date of that recording. Please note the units with the readings (kWh or MWh).