

2020 Energy Storage Market Evaluation

Executive Summary

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1 Executive Summary

This report presents the results from the evaluation of two of NYSERDA's initiatives related to energy storage: Energy Storage Technology and Product Development Investment Plan,¹ and Reducing Barriers to Deploying Distributed Energy Storage Investment Plan.²

The market evaluation had three main objectives:

1. Develop a reliable, detailed, New York based estimate of current soft costs (\$/kWh) of distributed energy storage systems as a component of the total installed cost (\$/kWh, duration)
2. Develop a reliable, detailed estimate of current hardware and hardware balance of system costs (\$/kWh) of energy storage systems
3. Develop a reliable, detailed estimate of the current performance of energy storage systems

This 2020 market evaluation provides updated results for the first objective listed above.

Hardware costs, hardware balance of system costs, and performance of energy storage systems were not updated in this year's report.

¹Clean Energy Fund Investment Plan: Renewables Optimization Chapter. Portfolio: Innovation & Research. Matter Number 16-00681, In the Matter of the Clean Energy Fund Investment Plan. September 7, 2018. <https://www.nyserra.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Renewables-Optimization-chapter.pdf>

² Clean Energy Fund Investment Plan: Energy Storage Chapter. Portfolio: Market Development. Matter Number 16-00681, In the Matter of the Clean Energy Fund Investment Plan. September 6, 2018. <https://www.nyserra.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Energy-Storage.pdf>

2 Market Characterization and Assessment Results

2.1 Primary Data Collection Results

This section summarizes DES system installation costs, project cycle times, characteristics of projects statewide, value propositions, ownership models, and barriers in the New York State market. The data included in this analysis combines information from 32 companies that responded to the evaluation survey,³ 84 projects that provided NYSERDA with energy storage incentive program application data in 2020, and three projects that provided completed project data. The survey was intended for all companies that contracted or completed DES projects in New York State in 2020. All data in this analysis represents real projects, but it includes a mix of projects installed in 2020 and projects contracted in 2020 with anticipated commissioning dates in 2021-2023. The data from the contracted projects not yet installed necessitated estimates.

2.1.1 System Costs

The survey asked responding companies to provide information on average installed costs for their primary use case DES systems. The market evaluation team collected cost information from seven C&I BTM use cases, nine utility FTM (retail) use cases, and no bulk use cases. The market evaluation team excluded four residential use cases, as this analysis and report focused on non-residential projects only. Of the 32 respondents who attempted the survey, nine provided cost data.

While the survey sample includes a small number of respondents, NYSERDA tracks operational projects in New York State and has confirmed the survey responses collected by the primary research activities represent the market and capture the companies implementing the most projects in the state.⁴

The NYSERDA incentive program application data provided data on an additional eight BTM systems, 63 utility FTM systems, and 13 bulk systems. The completed project data provided data on an additional two FTM systems and one BTM system.⁵

³ This data includes all survey attempts, regardless of the number of questions answered.

⁴ A database of all distributed energy resources projects installed throughout New York State is available on NYSERDA's website: <https://der.nysesda.ny.gov/>.

⁵ Prior to receipt of the completed project data, NYSERDA had incentive program application data for the completed projects. The completed project data updates information captured in the application data and provides additional data.

Survey respondents reported that 18 use cases or completed projects were lithium ion (Li-ion) installations. One survey respondent indicated a use case was “other” technology. Reported retail system size ranged from 129 kWh to 20,600 kWh, with an average size of 6,042 kWh and a median size of 9,600 kWh. Reported bulk retail system size ranged from 16,500 kWh to 800,000 kWh, with an average size of 84,464 kWh and a median size of 80,000 kWh.

The market evaluation team asked companies to estimate what percentage of total system cost constituted hardware, engineering and construction, and soft costs. These categories are defined as follows:

- **Hardware costs:** Battery module, inverter, and balance of system (BOS) costs such as fire controls, power electronics, communication system, containerization, insulation, HVAC system, meter, control system, and outdoor containerization (when necessary)
- **Engineering and construction costs:** Design, site preparation, transportation, siting, professional engineer approval, testing and commissioning, electrician and installation labor, wiring, fencing, and other overhead
- **Soft costs:** Customer acquisition, permitting, interconnection, and financing

The collected survey data provided soft cost information for 14 use cases, including five BTM and nine FTM retail use cases. The incentive program application data provided average cost information in addition to data collected via the survey and completed project data. Table 1 (BTM), Table 2 (FTM Retail), and Table 3 (bulk) present all cost data available to the market evaluation team, with n counts to designate the number of use cases and systems that informed each calculation.

Table 1 presents cost data for BTM retail storage projects collected over the past 4 years.⁶ The final or anticipated commissioning dates for the 2020 projects represented are from 2020 to 2023. The table presents average installed system costs in aggregate.

⁶ 2017 and 2018 data does not include incentive program application data. 2019 average installed system cost includes incentive program application data.

Table 1: Average costs of BTM DES projects by component,^a 2017-2020

Source: Market evaluation team analysis of survey and incentive program data

Cost	Unit	2017			2018			2019			2020		
		n	Average	Median	n	Average	Median	n	Average	Median	n	Average	Median
Average installed system cost	\$/kWh	3	\$883	\$850	5	\$1,000	\$1,000	7	\$1,279	\$833	12	\$970	\$881
Hardware costs	%	3	62	60	5	55	50	5	45	40	5	64	70
Engineering and construction costs	%	3	22	20	5	24	20	5	30	25	5	27	29
Soft costs	%	3	17	15	5	21	20	5	25	30	5	9	10
<i>Customer acquisition</i>	%	3	3	3	5	2	2	5	5	3	4	4	7
<i>Permitting</i>	%	3	8	10	5	6	8	5	12	10	5	3	4
<i>Interconnection</i>	%	3	5	5	5	10	10	5	7	10	5	3	4
<i>Financing</i>	%	3	1	0	5	3	0	5	1	0	4	0	0

^a The percent sum of average hardware costs, engineering and construction costs, and soft costs should sum to 100; any variance is due to rounding. The median values do not necessarily sum to 100 because of the variance within data points. Soft costs are a sum of the average customer acquisition costs, permitting, interconnection, and financing costs. These also sum to 100 for average columns but not the median columns.

The market evaluation team considered correlations between geographic location and costs and found that 2020 BTM retail projects in New York City, Long Island, and Westchester counties are roughly 17% less expensive than BTM retail projects in the rest of the state. This finding does not account for differences in project size or duration.

As Table 1 shows, average installed system cost increased from 2017 (\$883), 2018 (\$1,000), and 2019 (\$1,279), and then decreased in 2020 (\$970). Average percentage of soft costs similarly increased from 2017 (17%), 2018 (21%), and 2019 (25%), and then decreased in 2020 (9%). Potential reasons for this fluctuation are discussed in Section 2.3.

Table 2 and Table 3 present 2020 FTM and bulk DES project average installed system costs in aggregate. The 2017 and 2018 reports do not provide cost estimates beyond average installed costs for FTM projects because of the limited number of survey responses.

Table 2: Average costs of FTM retail DES projects by component,^a 2019-2020

Source: Market evaluation team analysis of survey and incentive program data

Cost	Unit	2019			2020		
		n	Average	Median	n	Average	Median
Average installed system cost	\$/kWh	61	\$434	\$405	68	\$464	\$424
Average system costs; <3 hr duration	\$/kWh	15	\$489	\$503	15	\$539	\$493
Average system costs; ≥3 hr duration	\$/kWh	46	\$416	\$392	53	\$442	\$422
Hardware costs	%	11	72	70	9	61	65
Engineering and construction costs	%	11	11	13	9	18	12
Soft costs	%	11	18	18	9	20	20
<i>Customer/site acquisition</i>	%	11	2	1	7	4	5
<i>Permitting</i>	%	11	5	3	9	5	5
<i>Interconnection</i>	%	11	8	8	9	8	9
<i>Financing</i>	%	11	3	2	7	5	5

^a The percent sum of average hardware costs, engineering and construction costs, and soft costs should sum to 100; any variance is due to rounding. The median values do not necessarily sum to 100 because of the variance within data points. Soft costs are a sum of the average customer acquisition costs, permitting, interconnection, and financing costs. These also sum to 100 for average columns but not the median columns.

Table 2 presents FTM retail storage projects, sized up to 5 MW. The final or anticipated commissioning dates for the projects represented are from 2020 to 2023. On average, systems

with durations shorter than 3 hours are roughly 22% more expensive than systems with durations longer than 3 hours.

Again, the market evaluation team considered correlations between geographic location and costs and found that FTM retail projects in New York City, Long Island, and Westchester counties are roughly 25% more expensive than FTM retail projects in the rest of the state. This finding does not account for differences in project size or duration.

The percentage of costs attributable to soft costs for FTM retail projects was 20% in 2020, similar to the reported 18% in 2019. The percentage of costs attributable to soft costs for FTM retail projects was higher than that of BTM retail projects in 2020 (9%).

Table 3 presents FTM bulk storage projects sized greater than 5 MW. This report categorizes such projects as bulk energy storage. The anticipated commissioning dates for the projects represented are 2021-2022.

Table 3: Average costs of bulk DES projects, 2019-2020

Source: Market evaluation team analysis of survey and incentive program data

Cost	Unit	2019			2020		
		n	Average	Median	n	Average	Median
Average installed system cost	\$/kWh	8	\$416	\$463	13	\$370	\$333

All 2020 bulk project cost data represents data collected in the NYSERDA incentive program application process. 2019 bulk project cost data includes one point collected via the survey. The application collected only total project costs, not component costs. Average installed system costs for FTM retail projects and bulk projects in 2020 were \$464 and \$370 per kWh, respectively, both significantly lower than the average installed system costs for BTM projects (\$970).

2.2 In-Depth Interview Results

The market evaluation team conducted 10 in-depth interviews with survey respondents who provided open-ended responses on barriers faced in 2020. This section summarizes key findings from the in-depth interviews.

2.2.2 Interview Key Findings

Interviewees discussed a range of barriers and challenges faced in 2020. Interviewees noted the following challenges:

- Permitting varies across jurisdictions, creating uncertainty. Though the process remains challenging and delays occur, developers have become more familiar with the permitting process and can better estimate the permitting timeline for their projects. However, unforeseen delays in the permitting process can easily delay projects and revenue generation.
- The loss of the only equipment provider certified to the New York Fire Department (FDNY) standards created uncertainty and time delays in the FDNY permitting process. Challenges with the FDNY permitting process can add up to 6 months to the permitting timeframe of a project.
- Lack of standardization and multiple iterations on design during the interconnection process can delay projects roughly 3 months.
- Supply chain disruptions affecting battery supplies are increasing the costs of batteries and delaying delivery time, though the extent of the challenge is unclear. Interviewees noted that the increase in cost is likely to remain an issue in 2021.
- The NYSERDA incentive encourages and makes feasible energy storage projects in New York State that would not otherwise be economically viable. Maturity requirements of the incentive program can be difficult to manage due to the risk of missing incentives or receiving a lower incentive than was originally planned.
- Impacts of COVID-19 varied depending on the stage of the project. Projects in the construction phase may have faced delays due to COVID-19 restrictions on in-person work. Projects that had already acquired hardware may not have been affected, whereas others may have been affected by supply chain interruptions.

2.3 Year-Over-Year Observations

As discussed in Section 2.1.1 and shown in Table 1, average installed system cost for BTM projects increased between 2017 (\$883), 2018 (\$1,000), and 2019 (\$1,279), and then decreased in 2020 (\$970). Average percent of soft costs for BTM projects similarly increased between 2017 (17%), 2018 (21%), and 2019 (25%), and then decreased in 2020 (9%). There are likely several factors contributing to this shift. These comments are not meant to explain the observed data but rather to provide context on possible influences. Data from future years may help identify trends in cost data:

- Though the samples are representative, the relatively low number of respondents, particularly in previous years, provides an opportunity for outliers to skew averages.
- As NYSERDA's data collection effort has progressed over the years, developers may have become better at estimating project costs as they work through real projects. It is possible that the 2020 data better reflects the true state of the market, though this is speculative.
- As learned through the interviews and discussed in Section 2.2.2 *Interview Key Findings*, developers have become more familiar with permitting processes. It is possible this familiarity has contributed to the reduction in soft costs as a percentage of total installed system costs.

Unlike BTM projects, average total cost and average soft costs for FTM projects remained similar in 2020 compared with 2019. Average total cost of bulk projects decreased slightly in 2020 compared with 2019. The market evaluation team will continue to collect time-series data regarding these metrics in the coming years so that NYSERDA and other program stakeholders can monitor these trends as the market matures and more DES projects are installed in New York State.

Since market data collection began in 2017, investment tax credits have remained important for value proposition, while distributed generation integration has increased in importance. The low number of responses to this survey question precludes the market evaluation team from drawing strong conclusions.

Interestingly, survey respondents indicated the lowest percentage of projects awaiting permit approval in 2020 of all years of the survey. Reported average cycle time from customer proposal to system commissioning similarly decreased from 2019. Reported average length of time to obtain electrical, building, or fire department permits decreased for BTM projects but increased for FTM projects from 2019.