2020 Energy Storage Market Evaluation

Annual Report

Prepared for:

New York State Energy Research and Development Authority

Albany, New York

Dana Nilsson
Senior Project Manager

Prepared by:

Guidehouse

Boulder, Colorado

Rachel Marty
Managing Consultant

Caitlin McDonnell
Managing Consultant

Brent Barkett
Director

NYSERDA Contract 104546 September 2021

NYSERDA Record of Revision

Document Title
2020 Energy Storage Market Evaluation September 2021

Revision Date	Description of Changes	Revision on Page(s)
9/9/2021	Original Issue	Original Issue

Notice

This report was prepared by Guidehouse Inc. (Guidehouse) in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter "NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

NYSERDA makes every effort to provide accurate information about copyright owners and related matters in the reports we publish. Contractors are responsible for determining and satisfying copyright or other use restrictions regarding the content of reports that they write, in compliance with NYSERDA's policies and federal law. If you are the copyright owner and believe a NYSERDA report has not properly attributed your work to you or has used it without permission, please email print@nyserda.ny.gov.

Information contained in this document, such as webpage addresses, are current at the time of publication.

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Program Description

This report presents results from the 2020 market evaluation for the following two NYSERDA energy storage initiatives:

1. Reducing Barriers to Deploying Distributed Energy Storage (DES) Investment Plan:[1] Energy storage is a multifaceted technology that cuts across many sectors, including clean energy production, energy efficiency, various types of customers and buildings, and both established technologies and those still in development. NYSERDA's energy storage strategy targets key barriers limiting energy storage adoption in three areas: customer-sited (behind-the-meter [BTM] systems), transmission and distribution (T&D) system needs, and the transportation system. This initiative originally sought to reduce soft costs related to permitting, customer acquisition, and interconnection for customer-sited energy storage systems by 25% per kilowatt-hour (kWh) in 3 years and 33% or more in 5 years based on a 2015-2016 baseline of $200/kWh. This goal has been recalibrated to the broader objectives described in the Public Service Commission (PSC)[2] Energy Storage Order, which references estimates in the New York State Energy Storage Roadmap.[3] The Roadmap states that New York State can reduce total soft costs by up to $50 per kWh for a distribution/bulk storage system and up to $150 per kWh for a customer-sited system by 2025 compared with 2017-2018 costs. The initiative's soft cost reductions now include all use cases; permitting, interconnection, customer acquisition, and engineering and construction costs; and tools to support market replication. This initiative works in conjunction with NYSERDA's market acceleration storage incentives.[4]

[1] NYSERDA. 2020. *Clean Energy Fund: Energy Storage Chapter*. Portfolio: Market Development. Matter Number 16-00681, In the Matter of the Clean Energy Fund Investment Plan. Revised June 15, 2020. https://www.nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Energy-Storage.pdf.

[2] Case 18-E-0130, In the Matter of Energy Storage Deployment Program, Order Establishing Energy Storage Goal and Deployment Policy. Issued December 13, 2018.

[3] Case 18-E-0130, In the Matter of Energy Storage Deployment Program, New York State Energy Storage Roadmap, Issued June 21, 2018.

[4] NYSERDA. 2020. "Developers Contractors and Vendors." Energy Storage, Developers & Contractors. https://www.nyserda.ny.gov/All-Programs/Programs/Energy-Storage/Developers-Contractors-and-Vendors.

2. Energy Storage Technology and Product Development Investment Plan:[5] There are many grid and consumer benefits from the increased use of renewable energy assets and energy storage. Optimizing the energy output and uptime of renewable resources will provide near-term economic benefits and decrease the total cost to deploy renewable technologies in the future. Energy storage can reduce the intermittency of solar and wind energy, helping these resources to be flexible assets deployed when needed. Energy storage can also avoid the need for new electric system infrastructure, increase system efficiency and resiliency, and reduce the need for fossil fuel plants to meet periods of peak electric demand. To meet these goals, NYSERDA is undertaking the following activities:

- Provide competitive funding opportunities in support of technology companies to use existing capabilities, validate technologies, create innovative products and applications, and otherwise facilitate energy storage development in New York State. NYSERDA will issue broad competitive solicitations for project proposals to identify teams and approaches to address innovations focusing on:
    - Reduced hardware cost for energy storage components and devices, including reduced power electronics cost for energy storage systems
    - Improved performance (efficiency, safety, energy density) of storage devices, especially for New York State-specific applications and duty cycles—e.g., building demand response, EV charging, solar PV, and large-scale wind
    - Load-side and generation-side energy storage applications to reduce peak load, store and reuse solar PV and wind energy to help firm up these resources, and provide ancillary services.
- Facilitate strategic corporate partnerships among small- and medium-size companies and large OEMs to speed up the path to commercialization.
- Explore viability of establishing technical performance specifications that can serve as a market-relevant stretch goal to drive innovation. If appropriate, use the stretch goal as a technology challenge in one or more competitive solicitations.

[5] NYSERDA. 2020. *Clean Energy Fund: Renewables Optimization Chapter*. Portfolio: Innovation & Research. Matter Number 16-00681, In the Matter of the Clean Energy Fund Investment Plan. Revised June 15, 2020. https://www.nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Renewables-Optimization-chapter.pdf

1.2 Summary of Evaluation Objectives and Methods

The evaluation design is longitudinal in nature and is structured to capture data over multiple years. This design allows program stakeholders to compare current market conditions with the baseline market conditions established in 2017 and to observe market trends over time. The time-series data developed over the course of the evaluation will help NYSERDA and other program stakeholders better understand the factors that drive the energy storage market in New York State as the market grows.

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.

Primary data was collected for front-of-the-meter (FTM) and BTM systems. For FTM systems, the primary data collection differentiates between bulk and retail use cases:

- Bulk: systems larger than 5 MW, provide wholesale market energy, ancillary services, and capacity services
- Retail: capped at 5 MW, grid-connected energy storage systems located either with load or connected directly into the distribution system

The primary data collection analysis includes systems located at commercial and industrial (C&I) customer and utility sites and excludes residential systems. Table 1 shows the evaluation objectives and select results from the 2020 primary data collection completed by the market evaluation team.

Table 1: Evaluation questions mapped with 2020 primary data collection results

The objective of primary data collection is to develop a reliable, detailed, New York State-based estimate of current soft costs ($/kWh) of DES systems as a component of the total installed cost ($/kWh, duration).

Source: Market evaluation team analysis

Evaluation Question(s)	2020 Findings[a]
What is the current estimate of soft costs ($/kWh capacity) of DES systems?[b]	**BTM:** Average = $89/kWh Median = $88/kWh *n=5* **FTM:** Average = $92/kWh Median = $85/kWh *n=9*
What is the installed cost per kilowatt-hour capacity for energy storage systems by duration?[c]	**Bulk:** Average = $370/kWh Median = $333/kWh *n*=13 **BTM:** Average = $970/kWh Median = $881/kWh *n=12* **FTM:** Average = $464/kWh Median = $424/kWh *n=68*
How many ownership models (e.g., third-party ownership, end-user ownership, performance contracting) are being used?	Half of FTM use cases are exclusively third party-owned, and half use site or end-user ownership (n=8). Half of BTM use cases use site or end-user ownership, though other ownership models were reported (n=5).
What is the percent conversion rate (%) of prospective installations from proposal to installed projects?	The average conversion rate for FTM energy storage projects was 30% (n=4). The BTM project conversion rate was 26% (n=4).
What is the cycle time (months) of projects from customer proposal to commissioning?	BTM: 18 months *n=5* FTM: 23 months *n=7*

Evaluation Question(s)	2020 Findings[a]
What is the current cycle time (months) for the permitting process?	BTM: 3 months *n=5* FTM: 6 months *n=8*
Are there challenges with siting and permitting requirements?	• 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. • Unforeseen delays in the permitting process can easily delay projects and revenue generation. • The loss of the only equipment provider certified to FDNY's standards from the market created uncertainty and time delays in the FDNY permitting process. • Challenges with the FDNY permitting process can add up to 6 months for the permitting timeframe of a project.

[a] The cost data presented in this table reflects a blend of estimated installed costs and invoiced costs.

[b] Includes a combination of 0.2- to 12-hour systems.

[c] Duration is defined as the ratio of the storage system's energy capacity to power capacity, which indicates the length of the system's full discharge.

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,[6] 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. Not all companies answered all survey questions, however, so the evaluator presents the number of responses for each set of results. 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. Section 5.1.5 provides additional detail regarding the companies that responded to the evaluation survey.

2.1.1 System Costs

The survey asked responding companies to provide information on average installed costs for their primary use case DES systems and secondary use case DES systems, if applicable.[7] 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.[8]

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

[6] This data includes all survey attempts, regardless of the number of questions answered.

[7] No respondents provided secondary use case information as defined in the survey document (see Appendix B).

[8] While the surveys asks if respondents have a secondary use case and if they would be willing to share cost information on their secondary use case, no 2020 survey respondents provided secondary use case cost information. Therefore, all 2020 survey data reflects primary use cases.

research activities represent the market and capture the companies implementing the most projects in the state.[9]

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.[10]

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. The compiled data provided geographic information for 102 DES systems, presented in Table 2.

Table 2: Geographic locations of installed or planned DES systems, 2020

Source: Market evaluation team analysis of survey data

Geography	Bulk	BTM	FTM (Retail)	Total
New York City	3	3	13	19
Long Island	0	3	3	6
Westchester	0	3	8	11
Other New York State	10	6	50	66

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)

[9] A database of all distributed energy resources projects installed throughout New York State is available on NYSERDA's website: https://der.nyserda.ny.gov/.
[10] 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. Since the completed project data superseded application data, projects with completed project data are not included in the application data counts.

- **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 3 (BTM), Table 4 (FTM Retail), and Table 5 (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. The 2019 survey collected average system duration for the first time, and the market evaluation team analyzed average system cost data by system duration where possible.

Table 3 presents cost data for BTM retail storage projects collected over the past 4 years.[11] 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, not broken out by duration, due to limited number of survey responses received.

[11] 2017 and 2018 data does not include incentive program application data. 2019 average installed system cost includes incentive program application data.

Table 3: 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**
Customer acquisition	*%*	*3*	*3*	*3*	*5*	*2*	*2*	*5*	*5*	*3*	*4*	*4*	*7*
Permitting	*%*	*3*	*8*	*10*	*5*	*6*	*8*	*5*	*12*	*10*	*5*	*3*	*4*
Interconnection	*%*	*3*	*5*	*5*	*5*	*10*	*10*	*5*	*7*	*10*	*5*	*3*	*4*
Financing	*%*	*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 3 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 4 and Table 5 present 2020 FTM and bulk DES project average installed system costs in aggregate, not broken out by duration, due to the limited number of responses received. 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 4: 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**
Customer/site acquisition	*%*	*11*	*2*	*1*	*7*	*4*	*5*
Permitting	*%*	*11*	*5*	*3*	*9*	*5*	*5*
Interconnection	*%*	*11*	*8*	*8*	*9*	*8*	*9*
Financing	*%*	*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 4 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 5 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 5: 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).

2.1.2 Value Proposition and Alternative Ownership Models

Survey respondents cited several benefits of DES systems that were important in closing the deal for potential customers. As Table 6 shows, the most frequently cited benefit in 2020 remained the same as in 2018 and 2019, with 75% of responding companies citing distributed generation integration most frequently. Slightly fewer companies, 63%, cited investment tax credit and demand charge management as important for deal closure. Non-wires alternative services

continued to decrease in importance from 2018, with only 25% of companies citing this benefit as important for deal closure in 2020. Demand response payments remained somewhat important, cited by 38% of respondents. No respondents mentioned resilience/backup power as an important benefit.

Table 6: DES system benefits important for deal closure by percentage of respondent companies,[a] 2017-2020

Source: Market evaluation team analysis of survey data

Benefit	2017	2018	2019	2020
Investment tax credit	63%	50%	73%	63%
Distributed generation integration	38%	75%	80%	75%
Non-wires alternative services	38%	75%	33%	25%
Demand charge management	63%	50%	13%	63%
Demand response payments	63%	50%	20%	38%
Resilience/backup power	38%	25%	7%	0%
Other	25%	0%	47%	50%

[a] Survey respondents could select more than one answer to this question. 2017 n=9, 2018 n=4, 2019 n=19, 2020 n=8.

One of NYSERDA's objectives is to increase the number of alternative ownership models (e.g., third-party ownership, end-user ownership, performance contracting) for DES projects. As Table 7 shows, 2020 saw a slight shift toward site or end-user ownership. An equal number of FTM use cases were exclusively third-party owned or used site- or end-user ownership in 2020. Three BTM use cases were site- or end-user owned.

Table 7: Ownership models for FTM and BTM projects, 2018-2020

Source: Market evaluation team analysis of survey data

	2019		2020	
Ownership Model	**FTM (n=9)**	**BTM (n=5)**	**FTM (n=8)**	**BTM (n=5)**
Third party	8	4	4	2
Site or end user	2	2	4	3
Performance contracting or shared savings	1	1	0	1

Responses in 2018 mentioned third-party performance contracting models and end-user ownership for both BTM and FTM projects. Table 7 does not include a summary for 2018 due to the low number of respondents.

2.1.3 Barriers in the New York State Market

The NYSERDA incentive program launched in early 2019, and NYSERDA expected the program to positively influence the number of DES installations in New York State in 2019 and beyond. The market evaluation team received an increase in survey responses in 2019 (n=40), supporting this expectation. Survey responses decreased somewhat in 2020 (n=32), but application data (n=84) and completed project data (n=3) provided additional data on active projects in New York State in 2020.

From the in-depth interviews, the market evaluator learned that the impacts from COVID-19 varied across projects. It is possible that some projects were delayed in 2020, contributing to the decrease in conversion rate. Additionally, supply chain interruptions may similarly have caused project delays and affected the conversion rate.

NYSERDA aims to increase the percent conversion rate for DES projects receiving a proposal to projects receiving a contract. As Table 8 shows, the average conversion rate for 2020 BTM retail projects was 26%, a slight increase from 2019 (25%) and an increase from 2018 (18%), though lower than 2017 (45%). The average conversion rate for 2020 FTM projects was 30%, lower than 2019 (47%).

Table 8: Conversion rate, proposal to contract,[a] 2017-2020

Source: Market evaluation team analysis of survey data

System Type	2017 n	2017 Average	2018 n	2018 Average	2019 n	2019 Average	2020 n	2020 Average
BTM	6	45%	5	18%	5	25%	4	26%
FTM (Retail)	N/A	N/A	N/A	N/A	3	47%	4	30%

[a] The 2017 and 2018 data is reported in aggregate and did not distinguish between FTM and BTM.

Table 9 presents the average percentage of projects awaiting permit approval. BTM retail projects awaiting permit approval decreased in 2020 to 3%, significantly lower than in 2019 (47%), 2018 (25%), or 2017 (42%). FTM projects awaiting permit approval decreased in 2020 to 46%, lower than in 2019 (60%).

Table 9: Percentage of projects awaiting permit approval,[a] 2017-2020

Source: Market evaluation team analysis of survey data

System Type	2017 n	2017 Average	2018 n	2018 Average	2019 n	2019 Average	2020 n	2020 Average
BTM	9	42%	5	25%	7	47%	6	3%
FTM (Retail)					11	60%	6	46%

[a] The 2017 and 2018 data is reported in aggregate and did not distinguish between FTM and BTM.

Respondents indicated that a similar percentage of projects that received a proposal went on to complete a contract in 2020 (26%) and 2019 (25%). However, companies reported a considerably lower average of BTM projects waiting for permits to be approved in 2020 (3%) compared with 2019 (47%). Five of the six survey respondents that provided responses to this question indicated that 0% of their projects were awaiting permit approval, driving this average down from 2019. Note the number of permits awaiting approval in 2020 is considerably lower than in previous years. The survey did not collect specific reasons for this shift. FTM projects showed a lower conversion rate of 30% and a lower percentage of projects awaiting permit approval at 46% compared with 2019 (47% and 60%, respectively).

Respondents reported a shorter average cycle time from customer proposal to system commissioning for BTM projects (18 months) than for FTM retail projects (23 months). Respondents likewise reported shorter average length of time to obtain electrical, building, or fire department permits for BTM projects (3 months) and FTM retail projects (6 months). Table 10 and Table 11 present these results.

Table 10: Average cycle time from customer proposal to system commissioning, 2019-2020

Source: Market evaluation team analysis of survey data

Energy Storage Project Type	n	2019 (months)	n	2020 (months)
Retail - BTM	4	20	5	18
Retail - FTM	10	22	7	23

Table 11: Average length of time to obtain electrical, building, or fire department permits, 2019-2020

Source: Market evaluation team analysis of survey data

Energy Storage Project Type	n	2019 (months)	n	2020 (months)
Retail - BTM	5	6	5	3
Retail - FTM	10	5	8	6

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.

2.2.4 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.

Though not asked directly, some interviewees provided comments on successes of the program and suggestions for program improvement. These findings are based on individual feedback. NYSERDA's involvement with planning boards, town boards, and fire departments can help a project succeed, as NYSERDA provides a non-financially-motivated, trusted source of expert information.

Interviewees also made the following suggestions for the program:

- Instead of maturity requirements, NYSERDA could use a good faith deposit to reduce the burden of requirements on customers while maintaining assurance that incentive funds will be allocated to real, viable projects.
- To help during the permitting process, NYSERDA could provide more information on the benefits of energy storage. This guidance should be non-technical, basic information on the benefits and rationale for adding energy storage in New York State.
- NYSERDA could continue to provide resources by hosting recurring webinars on various topics, such as new technologies and the state of the market.

2.2.5 Solar Plus Storage Project Challenges

The market evaluation team considered impacts specific to solar plus storage projects, which account for 65% of retail and bulk projects reported by NYSERDA since 2019.[12] Key barriers in solar plus storage projects arise from the additional complexity and time needed for permitting and interconnection if storage is added to a solar project. Although solar projects have standard protocols that can accelerate permitting approval, battery storage projects vary widely based on use cases and technologies used. As each case is unique and has its own specific considerations, adding storage to a solar project often increases the time needed for permitting and interconnection processes.

2.3 Year-Over-Year Observations

As discussed in Section 2.1.1 and shown in Table 3, 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

[12] New York Open Data. Retail and Bulk Energy Storage Incentive Programs Reported by NYSERDA: Beginning 2019. Accessible at https://data.ny.gov/Energy-Environment/Retail-and-Bulk-Energy-Storage-Incentive-Programs-/ugya-enpy

(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 2.2.4*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.

2.4 Indirect Benefits

As part of the market evaluation, NYSERDA sought to assess data available to support research into quantifying indirect impacts. The definition of indirect impacts as defined by the Clean Energy Fund: Energy Storage Chapter 13 is "indirect benefits representing projects deployed without NYSERDA funding which are expected to be enabled by the combination of soft cost reductions from deploying market acceleration funds and the associated technical assistance supported by this investment plan."

The first step in assessing indirect benefits is to answer the question: is market adoption of energy storage happening without NYSERDA program funding in New York State? To go about answering this research question, the evaluation team identified possible data sources, which included interconnection application data,[14] and NYSERDA's DER Portal Database.[15] The evaluation team determined that the NYSERDA DER Portal data comprises data pulled from interconnection queues, NYSERDA's program tracking data, and other sources, and is a reliable and comprehensive list of completed energy storage projects in New York State. From this data source, the team was able to visualize all NYSERDA-funded and non-NYSERDA-funded energy storage projects completed since 2016 (see Figure 1 and Figure 2.).

This analysis helps demonstrate the volume of all energy storage projects that comes through the NYSERDA program, both in terms of project count and size. As of May 2021, NYSERDA-funded projects represented 17 of the 58 projects in the database and comprised 44.6 MW of the 71 MW installed capacity tracked in the database.

[13] NYSERDA. 2020. *Clean Energy Fund: Energy Storage Chapter*. Portfolio: Market Development. Matter Number 16-00681, In the Matter of the Clean Energy Fund Investment Plan. Revised June 15, 2020. https://www.nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Energy-Storage.pdf.

14 New York State Department of Public Service. June 2021. SIR Inventory Information. Accessible at https://www3.dps.ny.gov/W/PSCWeb.nsf/All/286D2C179E9A5A8385257FBF003F1F7E.

15 NYSERDA. DER Portal Database. Accessible at https://der.nyserda.ny.gov/download/metric-data-short.

Figure 1. Total energy storage projects by month

Source: Guidehouse Analysis

Completed projects from NYSERDA DER Metric Data Short Excel File available at https://der.nyserda.ny.gov/download/metric-data-short.

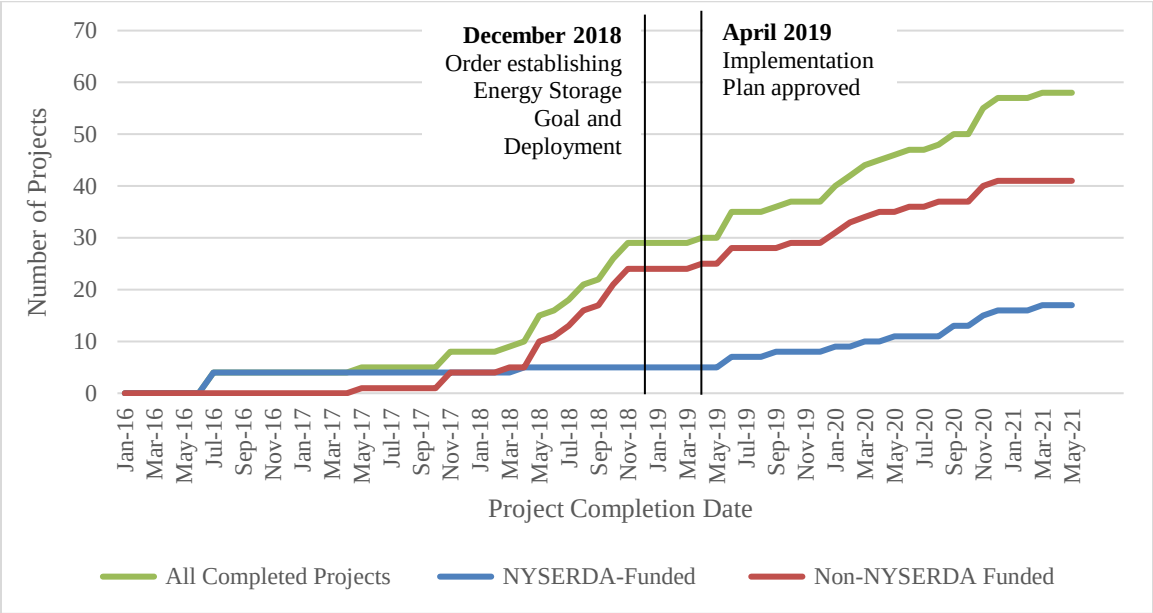
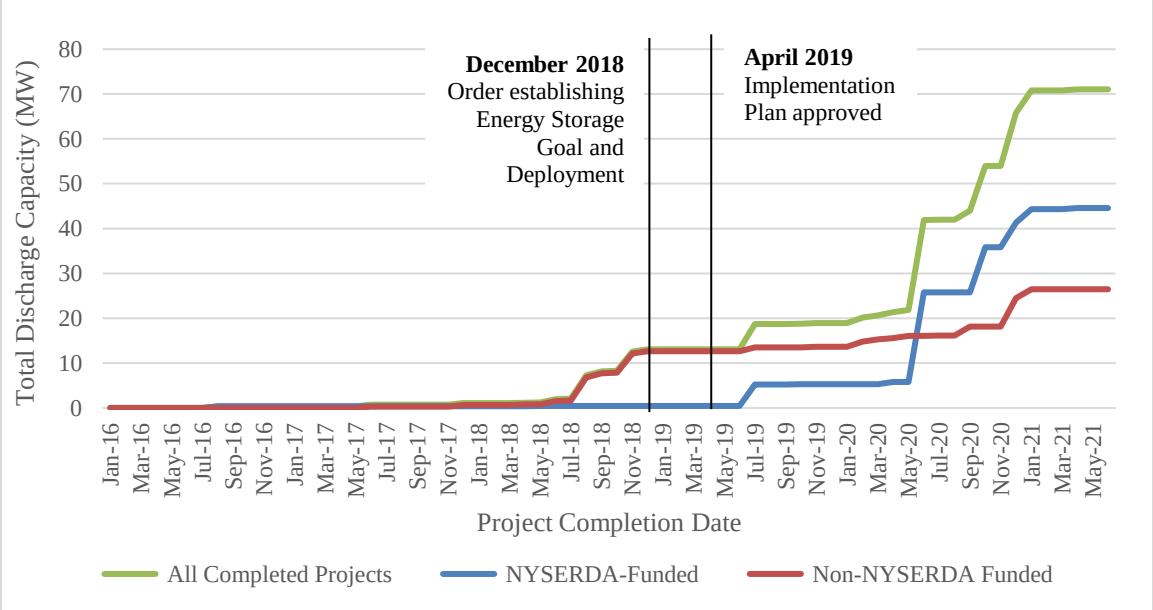


Figure 2. Total energy storage discharge capacity by month

Source: Guidehouse Analysis

Completed projects from NYSERDA DER Metric Data Short Excel File available at https://der.nyserda.ny.gov/download/metric-data-short.



An additional research question within the indirect benefits assessment was: what is the flow of interconnection applications and completed projects over time? This research required compiling interconnection data from the six utility interconnection queues and filtering down to non-residential projects by setting a minimum project size limit. Figure 3. and

Figure 4. show the results of this analysis. The black line shows all project applications, taken from the interconnection queues. There were 392 applications by May 2021, but only 58 completed projects. Note that this difference is partially due to the lag time between application and project completion; the average time between project application and completion among all completed projects in the interconnection queues is 532 days.

Figure 3. Cumulative non-residential energy storage applications and completed projects by month

Source: Guidehouse Analysis

Interconnection applications from https://www3.dps.ny.gov/W/PSCWeb.nsf/All/286D2C179E9A5A8385257FBF003F1F7E (from six utility interconnection queue databases).

Completed projects from NYSERDA DER Metric Data Short Excel File available at https://der.nyserda.ny.gov/download/metric-data-short.

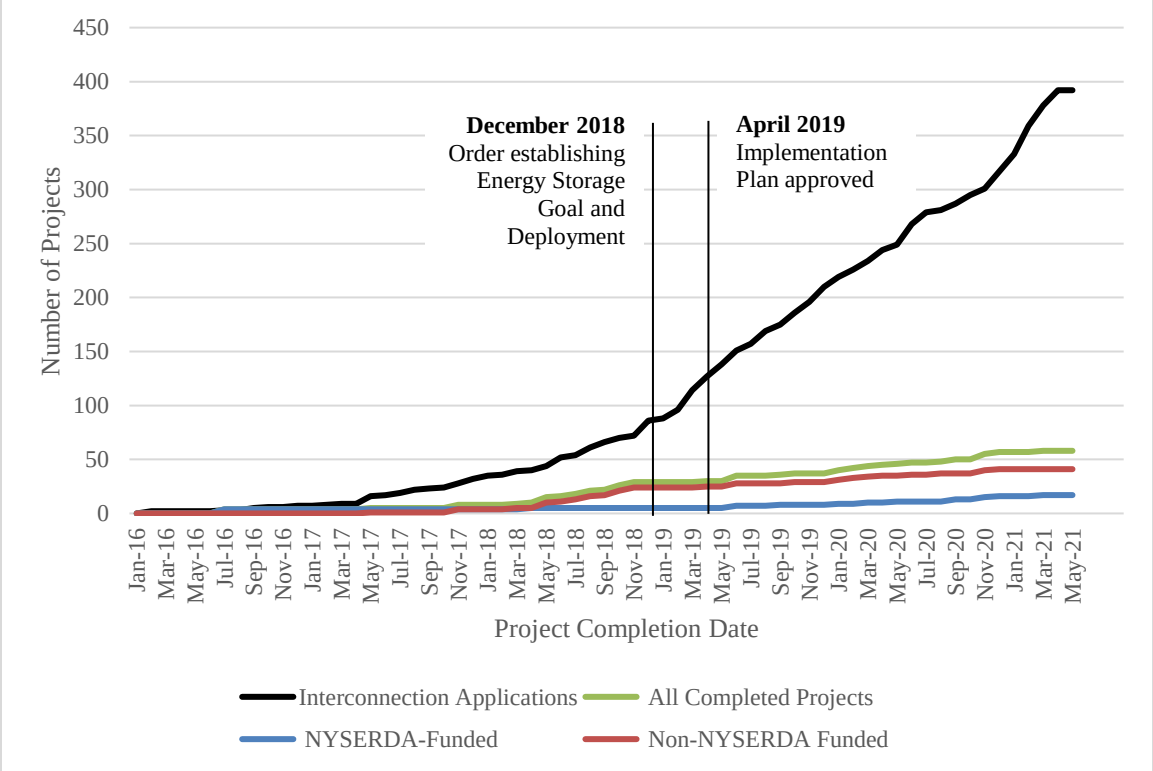
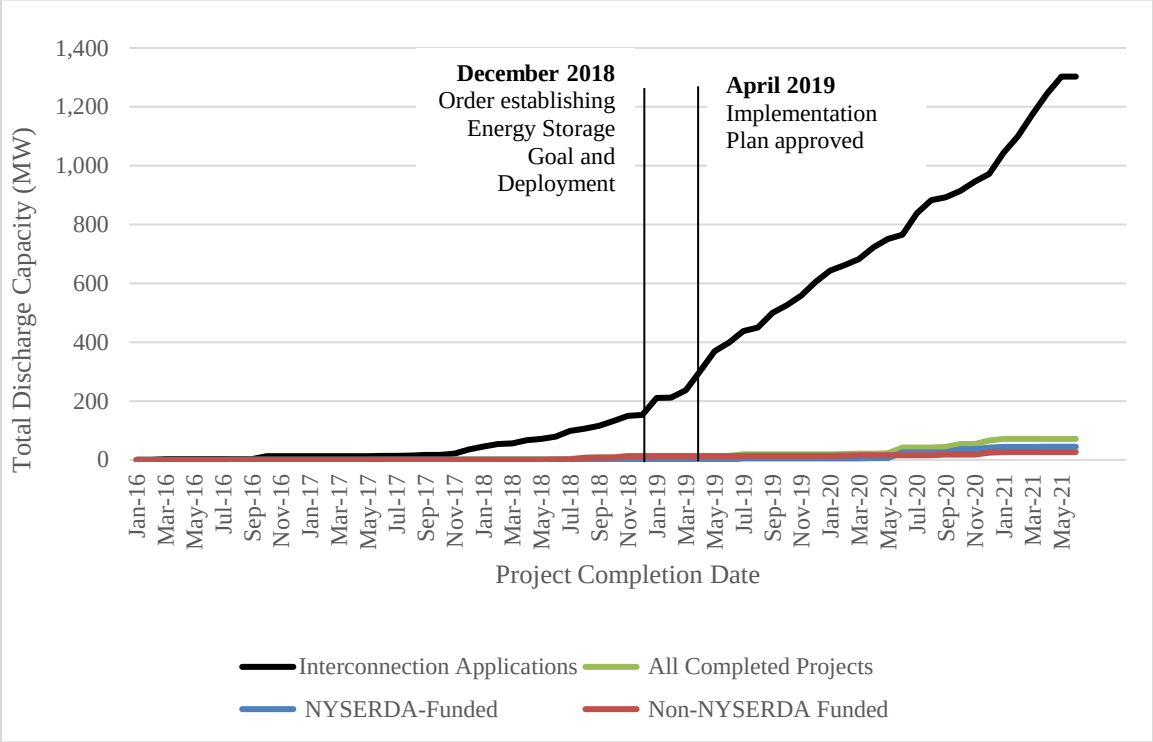


Figure 4. Cumulative non-residential energy storage applications and completed projects, discharge capacity by month

Source: Guidehouse Analysis

Interconnection applications from https://www3.dps.ny.gov/W/PSCWeb.nsf/All/286D2C179E9A5A8385257FBF003F1F7E (from six utility interconnection queue databases).

Completed projects from NYSERDA DER Metric Data Short Excel File available at https://der.nyserda.ny.gov/download/metric-data-short.



A future area of research in the indirect impacts of the NYSERDA energy storage incentives program include identifying and contacting project developers of non-NYSERDA funded projects to understand the impacts of the program on their projects, if any.

3 Findings

3.1 Finding 1

After increasing for two years, total installed system costs and soft costs for BTM DES projects decreased in 2020. FTM DES project total installed costs and soft costs in 2020 remained similar to those in 2019, while bulk project total installed costs decreased slightly.

3.2 Finding 2

Project permitting and interconnection present barriers to energy storage in New York State. These barriers center on uncertainty, lack of standardization, and project timeline impacts. Developers have become more familiar with the permitting process and can better estimate the permitting timeline for their projects. However, lack of standardization and multiple iterations on design during the interconnection process can delay projects by roughly 3 months.

4 Recommendations

4.1 Recommendation 1

NYSERDA should consider revisions to the market evaluation survey to capture quantitative data on external forces affecting the energy storage market in New York State. This data would help NYSERDA to better understand short- and long-term impacts. Key areas to consider include supply chain impacts (e.g., short-term and long-term impacts due to COVID-19 supply chain interruptions), permitting process development (e.g., current and anticipated impacts due to increasing familiarity with energy storage at the local level), and technology development (e.g., standardization and implementation of protocols for energy storage expected in the future). NYSERDA's market evaluator should continue to conduct in-depth interviews to gather qualitative information on these impacts.

4.2 Recommendation 2

To help reduce the uncertainty and time impacts of the permitting process, NYSERDA should continue to provide information on the benefits of energy storage, particularly to local jurisdictions, including non-technical, basic information on the benefits and rationale for adding energy storage in New York State. NYSERDA should work to expand efforts to support the permitting process through the siting team (e.g., hosting informational sessions with permitting agencies, working to increase standardization of permitting processes across jurisdictions) to provide a neutral third-party rationale and justification for energy storage projects in New York State. The siting team could further reduce permitting and siting barriers by expanding awareness and use of the New York State Battery Energy Storage System Guidebook[16].

[16] NYSERDA. New York State Battery Energy Storage System Guidebook, accessible at: https://www.nyserda.ny.gov/all-programs/programs/clean-energy-siting/battery-energy-storage-guidebook

5 Methods

5.1 Primary Data Collection Methods

This section describes the methods the market evaluation team used to complete the primary data collection activities.

5.1.1 Survey Design and Data Collection

NYSERDA fielded a survey to 80 energy storage companies in January and February 2021. Due to a low initial response rate, the market evaluation team collaborated with NYSERDA to target key respondents for enhanced communication including outbound phone calls and email follow-up. The market evaluation team closed the survey in the second week of February. The market evaluation team also received incentive program application data and completed project data from NYSERDA. Application data included estimations of average total costs, while completed project data included project characteristics, cost breakdowns, and cycle times. All data represented in this analysis is for real projects, but it includes projects installed in 2020 and projects contracted in 2020 with anticipated commissioning dates in 2021-2023. The data from the projects not yet installed necessitate estimates.

The survey gathered data on the following items:

- Percentage of DES project costs spent on hardware, engineering and construction, and soft costs for primary use case and secondary use case, if applicable
- Characteristics of DES projects in New York State
- Characteristics of each company's primary DES use case and secondary use case, if applicable
- Length of DES project sales and implementation cycles
- Key selling points for DES projects
- Differences between the DES market in New York State and other markets
- Company characteristics

Thirty-two companies responded to the survey (40% response rate) with 15 answering all questions in the survey. Nine respondents provided cost information for BTM, FTM retail, or bulk projects. Four companies installed residential projects, which the market evaluation team excluded from analysis. Five companies did not install, commission, or have any projects in the

pipeline with an executed contract in New York State in 2020, so they were not asked many questions, such as those relating to cost, cycle time, or conversion rate.

5.1.2 NYSERDA Energy Storage Incentive Program Application Data Collection

In 2019, NYSERDA launched an energy storage incentive program that provides funding to accelerate energy storage deployment in New York State. To apply for NYSERDA energy storage incentives, applicants must provide an estimated cost of their proposed project. NYSERDA provided this cost data to the market evaluation team to include in the analysis. The market evaluation team appended total cost data from these applications to the survey data prior to analysis.

5.1.3 In-Depth Interviews

The market evaluation team conducted 10 in-depth interviews with survey respondents in January and February 2021. These interviews served to gather additional information on survey open-ended responses and obtain quantitative and qualitative information on barriers faced in 2020. The interviews lasted approximately 30 minutes and topics varied dependent on the interviewee and the barriers they faced in 2020.

5.1.4 Analysis

The market evaluation team fielded the survey using Qualtrics and downloaded the data to analyze in Excel. The market evaluation team conducted all data analysis, excluding instances where missing information could not be resolved.

The market evaluation team excluded responses from companies that indicated they installed residential projects, as this analysis and report focused on non-residential projects only. The market evaluation team also excluded responses from companies that indicated they did not install, commission, or have any projects in the pipeline with executed contracts in New York State in 2020, except those related to respondent characteristics and system benefits. The market evaluation team did not weight results due to a concern that weighting would add bias.

The market evaluation team synthesized key findings from the in-depth interviews. One interviewee asked that their interview remain confidential and therefore their interview is not included in the analysis.

5.1.5 Respondent Characteristics

Surveyed companies reported what roles they filled in the energy storage market. Mirroring 2017, 2018, and 2019, respondents most frequently indicated they fulfilled the role of developer (n=13) in 2020. Similarly to 2019 respondents, 2020 respondents reported the second most commonly fulfilled role in 2020 as installer (n=9) followed by integrator (n=6). The number of companies reporting roles as manufacturer continued to decrease (n=0) from prior years. Table 12 shows results.

Table 12: Company roles in energy storage market (multiple responses), 2017-2020

Source: Market evaluation team analysis of survey data

Company Type	Number of Companies (2017, n=20)	Number of Companies (2018, n=23)	Number of Companies (2019, n=36)	Number of Companies (2020, n=16)
Developer	13	14	29	13
Integrator	8	5	10	6
Installer	8	4	16	9
Manufacturer	6	5	3	0
Sales	4	3	8	4
Financier	4	1	6	3
Distributor	3	2	0	0
Operator	1	0	3	1
Other	2	2	0	3

5.1.6 Statewide DES Projects

In addition to providing metrics on their primary and secondary use cases, if applicable, energy storage companies reported on all projects installed, commissioned, or in the pipeline with an executed contract in New York State in 2020. Survey respondents (n=27) reported 51 projects installed, commissioned, or contracted in New York State in 2020. This total included 37 FTM projects and 14 BTM projects. All respondents (n=19) except for one indicated reported use cases used Li-ion technology. One respondent reported “other” technology. Four respondents reported on residential projects, so the market evaluation team removed their responses from this calculation. Five companies indicated they did not implement any projects in New York State in 2020.

Eleven companies provided information on the sectors they serve, shown in Table 13. Slightly more than half of respondents indicated their companies serve the commercial sector. This table

excludes respondents who indicated their primary use case is residential. Two of the "other" responses referenced distributed generation.

Table 13: Sectors served in New York, 2020

Source: Market evaluation team analysis of survey data

Sector Served	Number of Companies (n=11)
Single family to fourplex residential	1
Multifamily	0
Commercial (not utility)	6
Industrial (not utility)	1
Utility	2
Municipal, university, school, or healthcare (MUSH)	1
Other	3

The evaluation team made an effort to assess the number of projects that lie within disadvantaged communities (DAC) as identified by NYSERDA's internal geospatial dashboard. The team observed that energy storage projects are not independently tracked on NYSERDA's internal geospatial dashboard. The team identified an incomplete list of energy storage projects co-located with solar installations. Future energy storage projects funded by the NYSERDA program should provide relevant data to allow geospatial tracking.

5.2 Indirect Benefits Assessment Methods

Two data sources were used in the indirect benefits assessment: interconnection application data and NYSERDA DER Portal data.[17] Both were downloaded in July 2021. The Interconnection application data was aggregated from six utility interconnection queue files. To limit the projects to non-residential-scale projects only, all projects under 30 kW in size were removed, as described below.

The completed project data was taken from the NYSERDA DER Portal Database. This data was filtered and completed using several data cleaning steps, enumerated below. All data cleaning

[17] Interconnection applications from https://www3.dps.ny.gov/W/PSCWeb.nsf/All/286D2C179E9A5A8385257FBF003F1F7E (from six utility interconnection queue databases). NYSERDA's DER Portal data from https://der.nyserda.ny.gov/download/metric-data-short.

steps and assumptions were vetted by the manager of the data portal, Carina Paton, of Frontier Energy:[18]

- Removed all projects listed as Residential, Single Family Detached
- Removed one project listed as Residential, Multifamily due to size and naming, which indicated it was s single-family home
- Removed all projects with an operation date before 1/1/16
- Assigned all projects with an ambiguous operation date to the last month of that year (i.e., "2016" to "December 2016")
- For projects missing Commercial Operation Date but including Reporting Start Date, assigned the latter date to former missing input
- Excluded projects with no Commercial Operation Date
- For thermal storage projects, used the storage kilowatt equivalent from cooling sources

The evaluation team faced challenges presenting data from the two data sources on the same graph, as there is not a unique identifier for each project in the data. The team learned that Frontier Energy maintains a lookup list with identifiers that tie the DER Portal Database completed projects to the interconnection data, though this information is not publicly available. Future efforts to track interconnection applications to completed projects should engage Frontier Energy to use this lookup list and ensure the data are synced.

[18] Telephone interview, August 6, 2021.