NYSERDA Technology and Market Development Program

Annual Report through December 31, 2020

Final Report | August 2021

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

NYSERDA's Promise to New Yorkers:

NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

Our Vision:

New York is a global climate leader building a healthier future with thriving communities; homes and businesses powered by clean energy; and economic opportunities accessible to all New Yorkers.

Our Mission:

Advance clean energy innovation and investments to combat climate change, improving the health, resiliency, and prosperity of New Yorkers and delivering benefits equitably to all.

NYSERDA Record of Revision

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NYSERDA Technology and Market Development Program Annual Report through December 31, 2020

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NYSERDA Technology and Market Development Program

Annual Report through December 31, 2020

Final Report

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Table of Contents

List of Tables

1 Introduction

1.1 Technology and Market Development Program Timeline, Mission, and Objectives

The Technology and Market Development (T&MD) Program was authorized by the Public Service Commission (PSC) to run from January 1, 2012 through December 31, 2016. The program closed approximately one year early, with the final year subsumed into New York State Energy Research and Development Authority's (NYSERDA) current Clean Energy Fund portfolio. For more of the procedural history, see Appendix A: Public Policy Context.

The mission of the T&MD Program was to test, develop, and introduce new technologies, strategies, and practices to build a statewide market infrastructure to reliably deliver clean energy to New Yorkers.

Specifically, objectives designed to support this mission are as follows:

- Moving new/underused technologies and services into the marketplace to serve as a feeder to help achieve Energy Efficiency Portfolio Standard (EEPS) and Renewable Portfolio Standard (RPS) goals.
- Validating emerging energy efficiency, renewable, and smart grid technologies/strategies and accelerate market readiness in New York State.
- Stimulating technology and business innovation to provide more clean energy options and lower cost solutions, while growing the State's clean energy economy.
- Spurring actions and investments to achieve results distinct from incentive-based programs.

The nine initiatives that comprise the T&MD portfolio (detailed in section 3) will be assessed based on their ability to support these objectives. Evaluation reports present these findings and are summarized in section 4.

Achievement of T&MD portfolio goals is dependent on long-term or multiphase investments, and for this reason, several of the T&MD initiatives build on the experience and success of programs funded by previous rounds of the System Benefits Charge (SBC) program or other funding sources. Although this desired and necessary continuity of effort makes it difficult to attribute performance results and outcomes to a specific phase of funding, NYSERDA recognizes the importance of attempting to clearly delineate progress made in the T&MD portfolio from earlier or alternate funding sources. Toward this

end, NYSERDA includes outputs and outcomes supported at least in part by T&MD funds toward program performance milestones and results. Prior SBC or other funded activities are highlighted to help convey a more complete picture of possible program benefits, but these achievements are not tallied toward the T&MD goals unless they were supported by program funds. Commercialization benefits from projects started in 2012 under T&MD will continue to materialize and will be reflected as they do.

1.1.1 Acknowledging COVID-19 Impact

During 2020, the COVID-19 pandemic and the resulting New York on PAUSE Executive Order, along with subsequent executive orders, placed a priority on the safety and health of every New Yorker. In response, NYSERDA paused all on-site work conducted by contractors for all clean energy programs through May 15, 2021. Even as field work resumed, the pandemic has had far-reaching impacts on the economy significantly affecting both residents and businesses, with the full extent of this impact still unknown. NYSERDA is committed to driving continued progress toward NYS's clean energy goals and is examining ways that its active programs can support those goals while also aiding in the State's economic recovery.

1.2 Organization of the Report

This report, filed pursuant to the October 24, 2011 PSC Order, describes how the T&MD Portfolio is progressing toward its mission and objectives. The report is divided into the following sections:

- Section 1: Introduction
- Section 2: Portfolio-Level Reporting
- Section 3: T&MD Initiatives
- Section 4: T&MD Program Evaluation Activities
- Appendix A: Evaluation Report Summaries
- Appendix B: T&MD Targets

The T&MD programs are closed to new applicants, completing final project commitments, and working toward final out-year benefits. It is anticipated that all T&MD programs will be closed and final expenditures completed by the end of 2022. Therefore, the content in this report has evolved to reflect the entirety of activities undertaken within each of the initiatives, including how accomplishments relate to the T&MD portfolio's mission and the output and outcome metrics established in the operating plan as the portfolio concludes.

2 Portfolio-Level Reporting

Table 1 provides a summary of anticipated T&MD portfolio benefits for the five-year funding period (2012–2016) and out years (2017–2020), and the sum of all expected benefits as well as achievements to date for applicable metrics. A column labeled "Thru Selected Period" provides achievements to date, through December 31, 2020, for each metric.

The T&MD portfolio has progressed as expected toward attainment of long-term goals:

- Energy Efficiency benefits (on-site electricity, fossil fuel, and demand reductions) include savings from both directly funded projects and technology installations. Electricity and demand savings goals for directly funded projects have been met. Notably, savings from the Advanced Codes and Standards and Advanced Buildings programs were evaluated in 2020 and results summarized in the applicable section of this report.
- The portfolio has met or exceeded many of its non-energy goals ("Other T&MD Benefits") in this area, including the number of advanced technologies reaching commercial availability, leveraged funds, number of clean energy businesses graduating from incubators, number of clean energy companies receiving support, businesses partnering with NYSERDA, and training related goals.

A substantial amount of 2016 T&MD funding was repurposed into the Clean Energy Fund (CEF). Given the corresponding early end to the T&MD portfolio, the 2016 T&MD goals presented in this report are the goals that were established in the second revision of the operating plan (2012–2016) dated February 15, 2013, adjusted in proportion to the reduction of funds that occurred in 2016.[1] Adjusted targets should still be viewed with caution since the approach to prorate targets may not align with how each individual program would have accrued benefits. For example, in some cases the later programmatic investments and activities that were foregone might have achieved higher benefits per dollar due to momentum and diffusion into the market. Other noteworthy program implementation and progress milestones are detailed in Section 3.

Table 1. Summary of Anticipated Cumulative T&MD Benefits

Through December 31, 2020 (at full implementation) for Energy Efficiency, CHP, and Other Benefits

See endnotes for more information [2,3,4,5]

Energy Efficiency

Benefit Description	2012-2016	Out Years	Total	Thru Selected Period
On-site Electricity Savings from Energy Efficiency Projects, Technologies, Replications, and Codes & Standards (Cumulative Annual GWh)	470.20	225.44	695.64	598.2
GWh Savings from Funded Project and Technology Installations	100.20	0.00	100.20	96.2
GWh Savings from Anticipated Replications not Directly Funded by Program		13.11	13.11	0.0
GWh Savings from Codes & Standards Activities supported by the Program	370.00	212.33	582.33	502.0
On-site Fossil Fuel Savings from Energy Efficiency Projects, Technologies, Replications, and Codes & Standards (Cumulative Annual MMBtu)	2,920,370	647,382	3,567,752	610,744
MMBtu Savings from Funded Project and Technology Installations	562,370	0	562,370	294
MMBtu Savings from Anticipated Replications not Directly Funded by Program		101,992	101,992	0
MMBtu Savings from Codes & Standards Activities supported by the Program	2,358,000	545,390	2,903,390	610,450
On-site Demand Reduction from Energy Efficiency Projects, Technologies, Replications, and Codes & Standards (Cumulative Annual MW)	132.01	114.28	246.30	272.7
Demand Reduction from Funded Project and Technology Installations	42.01	3.62	45.63	130.7
Demand Reduction from Anticipated Replications not Directly Funded by Program		25.43	25.43	0.0
Demand Reduction from Codes & Standards Activities supported by the Program	90.00	85.23	175.23	142.0

CHP Projects

Benefit Description	2012-2016	Out Years	Total	Thru Selected Period
On-site Electricity Generated from CHP Projects, Technologies, and Replications (Cumulative Annual MW)	11.00	14.40	25.40	51.06
MWs Installed from Funded Project and Technology Installations	11.00	12.00	23.00	51.06
MWs Installed from Anticipated Replications not Directly Funded by the Program		2.40	2.40	0.00
On-site Electricity Generated from CHP Projects, Technologies, and Replications (Cumulative Annual GWh)	78.30	114.64	192.94	365.8
GWhs Generated from Funded CHP Project and Technology Installations	78.30	100.00	178.30	365.8
GWhs Generated from Anticipated Replications not Directly Program Funded by Program		14.64	14.64	0.0
Primary Energy Savings from CHP Installations (Cumulative Annual MMBtus)	101,790	149,032	250,822	929,792
MMBtu Consumed from Funded Project and Technology Installations	101,790	130,000	231,790	929,792
MMBtu Consumed from Anticipated Replications not Directly Funded by Program		19,032	19,032	0

Table 1 continued

Other T&MD Benefits

Benefit Description	2012-2016	Out Years	Total	Thru Selected Period
System-wide CO2 Emission Reductions, Energy Efficiency - On-site and Central Station (Annual Tons)	443,762	168,674	612,436	382,754
Advanced Technologies Reaching Commercial Availability	42	19	61	102
Improved Technologies Deployment Programs Adopted by the Market or Further Supported by Deployment Programs	8	2	10	30
Commercial Sales of New and Improved Supported Technologies (millions)	$24.60	$109.07	$133.67	$152.87
Funding Leveraged (co-funding and outside investment) by Investment (millions)	$481.43	$19.93	$501.36	$1,679.17
Clean Energy Businesses Graduating from Incubators	90	4	94	116
Clean Energy Companies Receiving Support	466	30	496	495
Retail and Supply Chain Businesses Partnering with NYSERDA to increase Market Share of Energy Efficient Products	1,033		1,033	1,327
Clean Energy Training for Practitioners (Trainees)	19,219	8	19,227	54,074
Supply Chain Training to Facilitate Adoption of Energy Efficient Products (Partner Employees)	900		900	2,376

2.1.1 Budget and Spending Status

Table 2 shows the T&MD program budget and financial status through December 31, 2020. Committed and spent funds are also shown as a percent of the total 2012–2016 budget. At the end of 2020, the T&MD portfolio has approximately $20 million in project commitments remaining unspent. The remaining projects and payments are largely comprised of larger builds, longer term demonstrations and final measurement and verification work. It is anticipated that the majority of these projects will be completed by the end of 2021 with the remainder completed in 2022, at which point there will be no further T&MD spending.

Table 2. Budget and Financial Status for T&MD Programs through December 31, 2020[6]

	2012-2016 Budget [a]	Spent Funds	Percent of 2012-2016 Budget Spent	Committed Funds [b,c]	Percent of Budget 2012-2016 Committed
Power Supply and Delivery					
Smart Grid/Electric Vehicle	$33,890,562	$26,113,313	77%	$29,097,592	86%
Advanced Clean Power	$31,396,343	$25,551,862	81%	$27,687,104	88%
Combined Heat and Power[c]	$46,055,354	$18,653,824	41%	$29,721,182	65%
Total Power Supply & Delivery	*$111,342,259*	*$70,318,999*	*63%*	*$86,505,878*	*78%*
Building Systems					
Advanced Buildings	$48,393,575	$26,041,456	54%	$27,503,903	57%
Advanced Energy Codes & Standards	$9,785,964	$8,767,558	90%	$8,767,558	90%
Total Building Systems	*$58,179,539*	*$34,809,014*	*60%*	*$36,271,461*	*62%*
Clean Energy Infrastructure					
Market Development	$44,255,742	$40,739,719	92%	$41,073,522	93%
Clean Energy Business Development	$25,287,254	$24,901,196	98%	$24,901,196	98%
Environmental Monitoring, Evaluation and Protection (EMEP)	$16,428,580	$15,303,206	93%	$15,638,028	95%
Workforce Development[c]	$15,945,695	$13,446,673	84%	$13,446,673	84%
Total Clean Energy Infrastructure	*$101,917,271*	*$94,390,794*	*93%*	*$95,059,419*	*93%*
EV Fast Chargers Order[d]	*$0*	*$21,616,000*	100%	*$21,616,000*	100%
Total of All Program Areas	***$271,439,069***	***$221,134,807***	***81%***	***$239,452,758***	***88%***
Administration (8%)	$39,765,533	$39,604,737	100%	$39,765,533	100%
NYS Cost Recovery Fee (1.7%)	$7,175,497	$4,817,980	67%	$5,117,435	71%
Evaluation (5%)	$22,363,455	$8,724,816	39%	$10,209,702	46%
Grand Total - Portfolio	***$340,743,554***	***$274,282,340***	***80%***	***$294,545,428***	***86%***

* Totals may not sum exactly due to rounding.

[a] Pursuant to the January 21, 2016 CEF Order, the budget figures include reclasses to the CEF of $182.7 million of uncommitted funds as of February 29, 2016.

[b] Committed funds include amounts spent plus remaining funding obligated under a contract, purchase order, or incentive award. In addition, committed funds include planned funding for contracts awarded and under negotiation and planned funding under active development through solicitations with specific due dates.

[c] Committed funds may decrease from period to period as a result of the disencumbrance/cancellation of contracts, or due to the actual award amount(s) resulting from a due date solicitation being less than the planned award. The Commission's January 21, 2016 Order Authorizing the Clean Energy Fund Framework directed that any uncommitted program funds after February 29, 2016 would be retained for future ratepayer benefits. Those amounts are included in this table and will be retained for future ratepayer benefits in accordance with the January order.

[d] Pursuant to the 2/7/2019 Order (Case 18-E-0138, Establishing Framework for Direct Current Fast Charging Infrastructure Program), $21,616,000 of uncommitted funds was used for the EV Fast Chargers program.

3 T&MD Initiatives

This section provides a status update on each of the nine T&MD initiatives, including budget status and highlights achievements.

An Output/Leading Indicator describes the anticipated immediate results associated with initiative activities. An Outcome/Impact describes expected achievements in the near, intermediate, and longer term.

3.1 Power Supply and Delivery Initiatives

Table 3 shows committed and spent funds for this initiative as a percentage of the total 2012–2016 budgets. Later sections describe progress for each area of this initiative.

Table 3. Power, Supply, and Delivery Budget and Financial Status through December 31, 2020

	2012-2016 Budget [a]	Spent Funds	Percent of 2012-2016 Budget Spent	Committed Funds [b,c]	Percent of Budget 2012-2016 Committed
Smart Grid/Electric Vehicle					
Smart Grid	$25,629,750	$21,431,420	84%	$23,961,512	93%
Electric Vehicle	$8,260,815	$4,681,893	57%	$5,136,080	62%
Total Smart Grid/Electric Vehicle	*$33,890,565*	*$26,113,313*	*77%*	*$29,097,592*	*86%*
Advanced Clean Power					
Technology Innovation	$24,228,401	$19,006,122	78%	$21,023,020	87%
Resource Development	$1,256,016	$1,115,238	89%	$1,233,582	98%
Solar Cost Reduction	$5,911,926	$5,430,502	92%	$5,430,502	92%
Total Advanced Clean Power	*$31,396,343*	*$25,551,862*	*81%*	*$27,687,104*	*88%*
Combined Heat & Power[c]					
CHP Aggregation & Acceleration	$5,974,523	$5,025,804	84%	$5,441,070	91%
CHP Performance	$40,080,831	$13,628,020	34%	$24,280,112	61%
Total Combined Heat & Power	*$46,055,354*	*$18,653,824*	*41%*	*$29,721,182*	*65%*
Grand Total - Power, Supply, & Delivery Initiatives	***$111,342,262***	***$70,318,999***	***63%***	***$86,505,878***	***78%***

* Totals may not sum exactly due to rounding.

[a] Pursuant to the January 21, 2016 CEF Order, the budget figures presented herein include reclasses to the CEF of $182.7 million of uncommitted funds as of February 29, 2016.

[b] Committed funds include amounts spent plus remaining funding obligated under a contract, purchase order, or incentive award. In addition, committed funds include planned funding for contracts awarded and under negotiation and planned funding under active development through solicitations with specific due dates.

[c] Committed funds may decrease from period to period as a result of the disencumbrance/cancellation of contracts, or due to the actual award amount(s) resulting from a due date solicitation being less than the planned award. The Commission's January 21, 2016 Order Authorizing the Clean Energy Fund Framework directed that any uncommitted program funds after February 29, 2016 would be retained for future ratepayer benefits. Those amounts are included in this table and will be retained for future ratepayer benefits in accordance with the January order.

3.1.1 Smart Grid and Electric Vehicle Infrastructure

3.1.1.1 Smart Grid

The Smart Grid Program promotes product development and demonstrations targeted at ensuring high levels of security, quality, reliability, and availability of electric power; improving economic productivity; and minimizing environmental impacts while maximizing safety and sustainability. A smarter grid will be characterized by the widespread application of advanced sensing, communication and control devices, and other uniform diagnostic systems to support real-time visualization of electric grid operating conditions. This smarter grid is expected to reduce energy losses, extend equipment life, reduce operating costs, increase system resiliency to disruptions, support quicker restoration after disruptions, support the integration of distributed energy resources, and increase the throughput or transfer of electric energy among regions in the State. A smarter grid will also be essential to accelerating adoption of grid powered electric vehicles (GPV) and associated infrastructure. Projects funded through program activity must demonstrate significant statewide public benefit and quantify all energy, environmental, and economic impacts. Technology demonstrations, product development, research studies, and engineering studies are all eligible for funding support through periodic program solicitations.

The following key program activities and accomplishments have occurred during this reporting period:

- The NYSERDA Smart Grid Program co-leads the NY Interconnection Technical Working Group alongside the Department of Public Service. The technical working group is comprised of New York State's investor-owned utilities, solar and energy storage developers and was created to build consensus solutions to the myriad of technical challenges facing distributed energy resources connecting to the distribution grid. The group made several advancements to make the interconnection process more certain and rational. In 2020, the group continued the momentum and made further progress on several important topics, such as effective grounding, Coordinated Electrical Standard Interconnection Requirements cost drivers, Smart Inverter functions and new Institute of Electrical and Electronic Engineers standard analysis, monitoring and control of Distributed Energy Resources (DERs), energy storage roadmap, and metering configurations.
- In 2020, Micatu completed the design and manufactured 69 kilovolt (kV) sensor prototypes and sensing platform, followed by testing at Clarkson University. A case study of the Micatu Real-time Voltage Sensor project was completed in the reporting period. This case study is summarized in section 4 and available on NYSERDA's website.[7]

Table 4 shows performance milestones and results for the Smart Grid Program through December 31, 2020. Outputs/Leading Indicators measure immediate results; outcomes/impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Signed contracts and completed projects are for technology development, demonstration, and pilot projects, including several large flagship projects. Signed contracts and completed projects for research studies include studies on technologies, market barriers, and policies related to increased smart grid implementation in New York State. The program performed as expected, exceeding most targets and only missing the projects completed target by a small margin.

Table 4. Smart Grid Performance Milestones and Results through December 31, 2020

See endnotes for more information[8,9]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
Technology, development, demonstration or pilot projects	Projects Contracted - Target	7	9			16
	Projects Contracted - Progress	8	6	4	1	19
	Projects Completed - Target		5	9	2	16
	Projects Completed - Progress	0	4	1	10	15
Research Studies	Projects Contracted - Target	2	2			4
	Projects Contracted - Progress	13	15	4	0	32
	Projects Completed - Target		2	2		4
	Projects Completed - Progress	0	13	6	11	30
All Projects	Supported Companies - Target	8	10			18
	Supported Companies - Progress	21	15	6	1	43

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$18.00	$42.00	$0.50		$60.50
	Leveraged Funds Amount (millions) - Progress	$13.82	$58.37	$10.10	$33.70	$115.99
	Products and Technologies Commercialized - Target			1	1	2
	Products and Technologies Commercialized - Progress	0	2	0	1	3
	Product Revenue Amount (millions) - Target				$3.24	$3.24
	Product Revenue Amount (millions) - Progress	$0.00	$1.25	$0.50	$1.92	$3.68
	Market Adoption - Target			2	1	3
	Market Adoption - Progress	0	0	5	1	6

3.1.1.2 Electric Vehicle Infrastructure

The electric vehicle (EV) infrastructure efforts include engineering studies, product development, demonstration projects, and pilot programs to validate technology that minimizes negative grid impacts from grid-powered vehicle (GPV) charging, develops GPV-to-grid communication technologies and control processes, and promotes new business models that enable the benefits of vehicle storage for the distribution system.

The following key program activities and accomplishments were performed during this reporting period:

- As of December 31, 2020, more than 4,000 EV charging stations had been installed through NYSERDA programs.
- NYSERDA met periodically with stakeholders, including auto manufacturers, environmental groups, EV infrastructure providers, site owners, and installers to solicit input for the design of new EV-related programs.
- Vermont Energy Investment Corporation (VEIC) submitted a final report on its pilot of a car dealer incentive program, which tested the concept of providing a benefit to the salespeople who sell Evs when they make a sale. The project worked with car dealers in the Hudson Valley and Capital District. The project had mixed results in increasing EV sales at the participating dealerships.
- Re:Charge-e neared completion of a prototype for an inductive electric docking station supporting electric micro-mobility devices such as e-bicycles and e-scooters. The project team aims to have a working prototype to demonstrate to operators of shared mobility programs in early 2021.
- The Center for Sustainable Energy is analyzing survey data from recipients of NYSERDA's Drive Clean Rebate to identify ways to better target the rebate to high-priority populations, such as residents of disadvantaged communities and people whose purchase decisions are most likely to be swayed by a rebate.
- Long Road Enterprises tested its high-efficiency switched reluctance motor and continued to make engineering updates to the design. They expect to complete testing in 2021.

Table 5 shows performance milestones and results for Electric Vehicle Infrastructure Program through December 31, 2020. Outputs/Leading Indicators measure immediate results; Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Research studies focus on technologies, market barriers, and policies related to increased grid-powered vehicle implementation in New York State. Leveraged funds include co-funding and outside investments for EV infrastructure. Every output/outcome metric has been met or exceeded, except the product revenue metric.

Table 5. Electric Vehicle Infrastructure Performance Milestones and Results through December 31, 2020

See endnotes for more information[10]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
Technology, development, demonstration or pilot projects	Projects Contracted - Target	4	9	2		15
	Projects Contracted - Progress	1	15	2	2	20
	Projects Completed - Target		3	6	6	15
	Projects Completed - Progress	0	3	5	8	16
Research Studies	Projects Contracted - Target	4	1			5
	Projects Contracted - Progress	1	12	2	3	18
	Projects Completed - Target		4	1		5
	Projects Completed - Progress	0	2	7	8	17
All Projects	Supported Companies - Target	5	10	3		18
	Supported Companies - Progress	3	21	6	2	32

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$4.00	$14.00	$6.80		$24.80
	Leveraged Funds Amount (millions) - Progress	$7.86	$21.64	$5.03	$59.51	$94.04
	Products and Technologies Commercialized - Target		1	1		2
	Products and Technologies Commercialized - Progress	0	0	2	0	2
	Product Revenue Amount (millions) - Target				$5.31	$5.31
	Product Revenue Amount (millions) - Progress	$0.00	$0.00	$1.75	$1.74	$3.48
	Market Adoption - Target			1	1	2
	Market Adoption - Progress	0	1	0	23	24

3.1.2 Advanced Clean Power

3.1.2.1 Clean Power Technology Innovation Program

The Clean Power Technology Innovation Program works to advance smart grid technology, assist New York State innovators in product development, and overcome barriers and institutional impediments to the widespread use of renewable and clean power and storage technologies. Technologies eligible under this program include innovative renewable-electric and other advanced clean power technologies for grid-connected applications, storage technologies for sub-utility-scale stationary applications, or technologies that improve grid-power quality and reliability. Subsystems and components, as well as improved innovative manufacturing methods for these technologies, are included. Examples of technologies include fuel cells, batteries, solar electric power, wind power, hydropower, power conditioning equipment, waste heat to electricity, biomass to electricity, and innovative control or monitoring technologies.

The following key program activities and accomplishments were performed during this reporting period:

- Helix power has finished the non-recurring engineering with the suppliers for the procurement and the build will be substantially complete with the flywheel late in 2021 or early in 2022. Testing will be complete in 2022.

Table 6 shows performance milestones and results for the Technology Innovation and Energy Storage programs through December 31, 2020. Commercialization metrics for projects that only received SBC III funding are not reported here. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Leveraged funds include co-funding and outside investments for clean power technology projects. Progress toward output and outcome metrics was mixed, with some targets such as leveraged funds and products/technologies commercialized exceeding targets while other metrics fell short.

Table 6. Clean Power Technology Innovation (Top Two Sections) and Energy Storage Commercialization Center (Bottom Section)

Performance Milestones and Results through December 31, 2020

See endnotes for more information[11,12]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Contracted - Target	15	26	3		44
	Projects Contracted - Progress	12	20	3	0	35
	Projects Completed - Target		10	15	19	44
	Projects Completed - Progress	1	7	9	15	32
	Supported Companies - Target	19	32	5		56
	Supported Companies - Progress	12	20	3	0	35

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$20.00	$32.00	$4.60		$56.60
	Leveraged Funds Amount (millions) - Progress	$19.53	$94.60	$36.47	$298.70	$449.30
	Products and Technologies Commercialized - Target		1	2	4	7
	Products and Technologies Commercialized - Progress	3	2	1	4	10
	Product Revenue Amount (millions) - Target	$1.00	$1.00	$3.00	$42.85	$47.85
	Product Revenue Amount (millions) - Progress	$0.53	$24.72	$0.93	$2.49	$28.66

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$2.00	$2.00	$1.00	$1.10	$6.10
	Leveraged Funds Amount (millions) - Progress	$0.50	$0.98	$0.51	$0.97	$2.95
	Products and Technologies Commercialized - Target	1	4	4	13	22
	Products and Technologies Commercialized - Progress	0	0	0	0	0
	Revenue Amount (millions) - Target	$0.15	$2.20	$1.40	$4.99	$8.74
	Revenue Amount (millions) - Progress	$0.00	$1.03	$0.44	$3.89	$5.35
	Product Development Tests - Target	2	8	6	20	36
	Product Development Tests - Progress	0	19	11	84	114

3.1.2.2 Resource Development Program

The Resource Development Program is focusing on activities to stimulate the development of new renewable energy supplies, technologies, and businesses in the renewable energy industry with the greatest potential to meet near- to intermediate-term energy and environmental goals. Similar to previous efforts to address market barriers that helped develop land-based wind energy in Upstate New York, this program concentrates on the gap in understanding offshore wind energy. Marine resource and site assessment activities will increase knowledge of coastal marine energy assets and their suitability for power development and improve understanding of the capacity in New York State to manufacture, construct, and service new marine-based electrical generation projects and components.

NYSERDA is the lead agency coordinating offshore wind opportunities in New York State, which will support the ambitious Climate Leadership and Community Protection Act (Climate Act) goals to meet 70 percent Renewable Energy by 2030 and a Zero-Carbon Emission Electric Sector by 2040. On January 29, 2018, the New York Offshore Wind Master Plan was released, representing a comprehensive roadmap that encourages the development of offshore wind in a manner that is sensitive to environmental, maritime, economic, and social issues, while addressing market barriers and aiming to lower costs. Two CEF Investment Plans now support NYSERDA's continuing work, originally initiated under the T&MD Program, to advance offshore wind. With work in this area now progressing under CEF, the previous 90-megawatt (MW) site development potential target set for this program, noted in Tables 3 to 5, has been superseded by the current State offshore wind goal of 9 GW by 2030. Remaining committed funding for the Resource Development program has been used to contract with Cornell University to support the development of renewable energy through the application of anaerobic digestion.

The following key program activities and accomplishments were performed during this reporting period:

- Through the Anaerobic Digestion Assistance Initiative (ADAI) contract, Cornell provides technical assistance to farms and others in the digester marketplace to support the establishment of new—as well as improve the operation of existing—anaerobic digester systems. Part of the ADAI work has also included assisting marketplace participants in understanding the potential environmental benefits of digester systems. ADAI work has included assisting NYSERDA with its program that offered cost sharing for refurbishing existing farm digester systems. The ADAI will be extended through May of 2021 so that Cornell can continue to offer assistance and information to NYSERDA, farms with interest in digester systems, and other participants in the digester marketplace. In addition to assistance and information about using digester biogas to generate electricity, the ADAI team will continue to offer information about the potential for cleaning-up digester biogas to produce renewable natural gas and possibly injecting such renewable natural gas into the utility pipeline for delivery to various customers.

Table 7 shows performance milestones and results for the Resource Development Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Signed contracts and completed projects include studies, surveys, and plans. Stakeholder engagements include engagements with stakeholder organizations and consortia in support of developing a research/program agenda. Leveraged funds include co-funding and outside investment. All output metric targets have been exceeded. Progress on outcome metrics will not be achieved as these activities were undertaken in the Clean Energy Fund.

Table 7. Resource Development Performance Milestones and Results through December 31, 2020

See endnotes for more information[13]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Contracted - Target	1				1
	Projects Contracted - Progress	3	0	0	0	3
	Projects Completed - Target	1				1
	Projects Completed - Progress	0	2	0	1	3
	Stakeholder Engagements - Target					
	Stakeholder Engagements - Progress	2	1	0	0	3

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target		$0.20			$0.20
	Leveraged Funds Amount (millions) - Progress	$0.00	$0.00	$0.00	$0.00	$0.00
	Site Development Potential (MW) - Target				90.00	90.00
	Site Development Potential (MW) - Progress	0.00	0.00	0.00	0.00	0.00

3.1.2.3 Solar Cost Reduction

The Solar Cost Reduction program[14] helped achieve the goals of the NY-Sun initiative[15] through activities that reduced the balance-of-system (BOS) costs of solar electric installations and supported priority solar electric technology development in New York State. BOS costs included non-module hardware, labor, design, permitting, and interconnection, and can amount to approximately one-half of the installed cost of a solar electric system. A dialogue with representatives of the industry, permitting authorities, and various stakeholders was conducted through workshops and other means to develop a thorough understanding of the solar electric project development process and the elements that constitute BOS cost components.

The following key program activities and accomplishments were performed during this reporting period:

- All activities have been completed.

Major Project Accomplishments:

- **The Photovoltaic Trainers Network (PVTN)** contract concluded in March 2018. A total of 12,988 individuals participated in courses offered through the PV Trainers Network. Courses included solar electric training for code officials, first responders, municipal personnel, architects, and engineers.
- **Train-the-Trainer** designed and implemented the train-the-trainer program to teach instructors at five academic institutions across New York State to independently deliver trainings. All academic instructors were independently teaching safety and fire considerations for Solar PV and seven out of 10 were independently teaching Solar PV Permitting and Inspection Methods by program conclusion.
- **Technical Assistance** provided highly responsive, free, on-call technical assistance to local government officials on various solar PV topics via the "Ask the Expert" portal and the PVTN email account. Through this portal and direct email communication, PVTN provided a concierge service that helped government officials better understand solar PV technology and more effectively manage the solar PV development and approval process. In all, PVTN answered over 170 technical assistance requests ranging from procuring solar for municipal facilities, reviewing zoning laws, and interpreting code language.
- **Resource Development** created 11 complementary resources to provide deeper guidance to local government officials on best practices for solar PV planning, zoning, procurement, taxation, inspection, safety, and other topics in the form of factsheets, guidance documents, and frequently asked questions. Many of these resources are now included in NY-Sun's Solar Guidebook for Local Governments.
- **Online Portal** developed an online portal that served as a one-stop shop for local government officials on solar PV. Officials could view the trainings offered, search and register for upcoming trainings, browse the relevant resources and FAQs for answers and further guidance on specific topics, view webinars and podcasts, and request technical assistance or a training. Over the course of the program the portal had 45,188 sessions, 129,230 page views, and a total of 28,688 users.
- **Lasting Impact** can be seen in the academic partner instructors who have continued to teach training courses despite the ending of some PVTN programs. For instance, a PVTN partner from Bronx Community College is teaching a safety and fire course to the area's country fire department chiefs. In addition, academic partner Erie Community College received grant funding from State University of New York (SUNY) to turn the Solar PV for Engineering course into an online module for SUNY Erie Community College students.

Table 8 shows performance milestones and results for the Solar Cost Reduction program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Signed contracts and completed projects for development tools, practices, studies, surveys, and engagements are projects that reduce solar electricity costs. Signed contracts and completed projects for technology, development, demonstration, or pilot projects are for BOS projects. The meetings, workshops, and

conferences are a result of BOS projects. The training sessions focus on aspects of solar electricity for authorities having jurisdiction, local officials, and trainers. Leveraged funds include co-funding and outside investment for BOS projects. Most output/outcome metrics were met or exceeded, except the technology, development, and demonstration projects contracted and completed and product revenue and market adoption.

Table 8. Solar Cost Reduction Performance Milestones and Results through December 31, 2020

See endnotes for more information[16,17]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
Technology, development, demonstration or pilot projects	Projects Contracted - Target	6				6
	Projects Contracted - Progress	0	4	0	0	4
	Projects Completed - Target		2	4		6
	Projects Completed - Progress	0	0	0	4	4
Develop tools, practices, studies, surveys, engagements	Projects Contracted - Target	6				6
	Projects Contracted - Progress	0	8	1	0	9
	Projects Completed - Target		5	1		6
	Projects Completed - Progress	0	1	2	6	9
All Projects	Supported Companies - Target	5				5
	Supported Companies - Progress	0	12	1	0	13
	Solar (PV) Trainees - Target	1,180				1,180
	Solar (PV) Trainees - Progress	0	4,521	4,666	3,801	12,988
	Training Sessions - Target	118				118
	Training Sessions - Progress	0	155	142	88	385
	Meetings, Workshops, Conferences - Target	1	4	1		6
	Meetings, Workshops, Conferences - Progress	0	27	26	15	68

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$5.50	$2.30			$7.80
	Leveraged Funds Amount (millions) - Progress	$2.00	$16.45	$1.69	$7.72	$27.85
	Products and Technologies Commercialized - Target				1	1
	Products and Technologies Commercialized - Progress	0	1	0	0	1
	Product Revenue Amount (millions) - Target				$4.25	$4.25
	Product Revenue Amount (millions) - Progress	$0.00	$0.04	$0.12	$0.05	$0.21
	Market Adoption - Target		3	1		4
	Market Adoption - Progress	0	0	1	1	2

3.1.3 Combined Heat and Power

3.1.3.1 CHP Aggregation and Acceleration Program

The CHP Aggregation and Acceleration Program began with T&MD funds by developing and transforming the marketplace for CHP systems from 50 kilowatts (kW) to 1.3 MW, the nameplate capacity range of a majority of NYSERDA's previous CHP projects. It also serves as the foundation for transition to the CEF-funded program in 2016, which expanded to support CHP systems of 3 MW and smaller with no minimum size. The program will accomplish this transformation by compiling a vetted catalog of prequalified equipment and creating and validating rules of thumb for simplifying

the analysis used to determine the capacity needs of a given site. This focus on prepackaged CHP modules that include all major components will reduce the need for equipment-integration engineering and assembly (and thus reduce the costs of and opportunities for errors); nevertheless, site-specific engineering regarding placement of equipment at the site and tie-ins to the site's infrastructure will still be necessary.

The following key program activities and accomplishments were performed during this reporting period:

- Continued programmatic outreach to assist projects to completion.
- Fifty projects are complete and operational

Table 9 shows performance milestones and results for the CHP Aggregation and Acceleration Program, through December 31, 2020. Energy savings reported in Table 9 are the evaluated program savings. In early 2020, a third-party contractor, West Hill Energy and Computing, completed an impact evaluation to determine the savings for projects completed from 2016–2018. A summary of the study can be found in the Appendix B. Project count, peak load demand, electric generation, and primary energy savings targets are established for projects installed through a particular time period. Progress refers to the cumulative savings that are installed, contracted, or accepted through a particular time period. For example, T&MD savings for 2012–2013 are the energy and demand savings/generation achieved or expected as of December 31, 2013 as a result of activity from January 2012 through December 2013. Outputs/Leading Indicators measure immediate results and Outcomes/ Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Achievement of output and outcome metrics was mixed, with some targets, such as leveraged funds and projects already completed, exceeding their target, while other metrics fell short. Based on surveys of CHP professionals, the market assessment portion of the evaluation found that there were very few or no projects completed without involvement from NYSERDA. As a result, there are no evaluated savings for the replication projects.

Table 9. CHP Aggregation and Acceleration Performance Milestones and Results through December 31, 2020

See endnotes for more information[18]

Outputs/Leading Indicators

		2012-13	2012-15	2012-16	2012-20
All Projects	Projects - Target	3	9	9	9
All Projects	Applications Approved but not yet Contracted - Progress	0	2	0	0
	Projects Contracted but not yet Completed - Progress	4	33	30	2
	Projects Completed - Progress	0	16	28	50
	Total Progress	4	51	58	52
All Projects	Peak Load Electric Generation (MW) - Target	1.00	3.00	3.00	3.00
	Peak Load Electric Generation Applications Approved but not yet Contracted (MW) - Progress	0.00	0.13	0.00	0.00
	Peak Load Electric Generation Projects Contracted but not yet Completed (MW) - Progress	0.02	0.60	0.76	0.00
	Peak Load Electric Generation Projects Completed (MW) - Progress	0.00	1.26	1.43	1.40
	Total Progress	0.02	1.99	2.19	1.40
All Projects	Electric Generation (GWh) - Target	6.10	18.30	18.30	18.30
	Electric Generation Applications Approved but not yet Contracted (GWh) - Progress	0.00	0.81	0.00	0.00
	Electric Generation Projects Contracted but not yet Completed (GWh) - Progress	0.09	3.65	4.62	0.00
	Electric Generation Projects Completed (GWh) - Progress	0.00	7.69	8.71	7.82
	Total Progress	0.09	12.15	13.33	7.82
All Projects	Primary Energy Savings (MMBtu) - Target	7,930	23,790	23,790	23,790
	Primary Energy Savings Applications Approved but not yet Contracted (MMBtu) - Progress	0	1,051	0	0
	Primary Energy Savings Projects Contracted but not yet Completed (MMBtu) - Progress	119	4,742	6,011	182
	Primary Energy Savings Projects Completed (MMBtu) - Progress	0	9,996	11,324	26,147
	Total Progress	119	15,789	17,335	26,329

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Pre-Packaged Systems - Target	5				5
	Pre-Packaged Systems - Progress	64	111	90	0	265
	Knowledge/Technology Transfer Activities - Target	2				2
	Knowledge/Technology Transfer Activities - Progress	19	82	27	0	128

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$12.00				$12.00
	Leveraged Funds Amount (millions) - Progress	$3.43	$18.55	$10.46		$32.44
	Leveraged Funds Replicated (millions) - Target				$9.60	$9.60
	Leveraged Funds Replicated (millions) - Progress	$0.00	$0.00	$0.00	$0.00	$0.00
	Peak Load Electric Generation Replicated (MW) - Target				2.40	2.40
	Peak Load Electric Generation Replicated (MW) - Progress	0.00	0.00	0.00	0.00	0.00
	Electric Generation Replicated (GWh) - Target				14.64	14.64
	Electric Generation Replicated (GWh) - Progress	0.00	0.00	0.00	0.00	0.00
	Primary Energy Savings Replicated (MMBtu) - Target				19,032	19,032
	Primary Energy Savings Replicated (MMBtu) - Progress	0	0	0	0	0

3.1.3.2 CHP Performance Program

The CHP Performance Program funds installations of CHP systems using energy, summer peak demand, efficiency, and environmental performance-based payments. The program funds clean, efficient, cost effective, gas-fired systems using site-specific designs. In accordance with the PSC

Order, systems are required to meet a minimum fuel conversion efficiency of 60 percent and a maximum of 1.6 pounds/megawatt-hour (MWh) of NO_x emissions.[19] To quantify the performance-based payments, the program applies rigorous, multiyear system performance measurements, which is a groundbreaking approach for energy efficiency program administrators.

Additional incentives are geared toward projects that:

- Offer greater potential value to the distribution system.
- Operate at higher overall efficiency levels.
- Are located at critical infrastructure, including facilities of refuge.

Additional incentives for projects that offer greater potential value to the distribution system were limited to the Con Edison service territory.

The following key program activities and accomplishments were performed during this reporting period:

- Two projects, representing an approximate 17 MW of installed nameplate capacity, cancelled their contracts in 2020.

Table 10 shows performance milestones and results for the CHP Performance Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Energy savings reported are evaluated program savings. In early 2020, a third-party contractor, West Hill Energy and Computing, completed an impact evaluation to determine the savings for projects completed from 2016–2018. A detailed summary of the study can be found in Appendix B and the 2020 Annual T&MD reflects the evaluated savings. Project count, peak load demand, electric generation, and primary energy savings targets are established for projects installed through a particular time period. Progress refers to the cumulative savings that are installed, contracted, or accepted through a particular time period. For example, T&MD savings for 2012–2013 are the energy and demand savings/generation achieved or expected as of December 31, 2013 as a result of activity from January 2012 through December 2013. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Every output/outcome metric has been exceeded except for the number of projects completed. Although the number of projects completed will not meet the target, the projects yielded greater results that expected.

Table 10. CHP Performance Program Performance Milestones and Results through December 31, 2020

See endnotes for more information[20]

Outputs/Leading Indicators

		2012-13	2012-15	2012-16	2012-20
All Projects	Projects - Target		1	5	13
	Applications Approved but not yet Contracted - Progress	4	5	2	1
	Projects Contracted but not yet Completed - Progress	0	8	10	1
	Projects Completed - Progress	0	1	1	7
	Total Progress	4	14	13	9
All Projects	Peak Load Electric Generation (MW) - Target		2.00	8.00	20.00
	Peak Load Electric Generation Applications Approved but not yet Contracted (MW) - Progress	24.27	24.86	8.34	6.00
	Peak Load Electric Generation Projects Contracted but not yet Completed (MW) - Progress	0.00	29.59	39.89	18.70
	Peak Load Electric Generation Projects Completed (MW) - Progress	0.00	2.80	2.80	24.96
	Total Progress	24.27	57.25	51.03	49.66
All Projects	Electric Generation (GWh) - Target		10.00	60.00	160.00
	Electric Generation Applications Approved but not yet Contracted (GWh) - Progress	187.22	172.51	49.12	37.69
	Electric Generation Projects Contracted but not yet Completed (GWh) - Progress	0.00	272.08	359.10	146.00
	Electric Generation Projects Completed (GWh) - Progress	0.00	25.00	25.00	174.30
	Total Progress	187.22	469.60	433.22	357.99
All Projects	Primary Energy Savings (MMBtu) - Target		13,000	78,000	208,000
	Primary Energy Savings Applications Approved but not yet Contracted (MMBtu) - Progress	243,389	224,265	63,854	48,993
	Primary Energy Savings Projects Contracted but not yet Completed (MMBtu) - Progress	0	353,709	466,828	189,800
	Primary Energy Savings Projects Completed (MMBtu) - Progress	0	32,500	32,500	664,670
	Total Progress	243,389	610,475	563,182	903,463

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$30.00	$110.00	$60.00		$200.00
	Leveraged Funds Amount (millions) - Progress	$11.47	$106.95	$82.40	$161.42	$362.24

3.2 Building Systems Initiative

Table 11 shows the Building Systems budget and financial status through December 31, 2020. Committed and spent funds are also shown as a percentage of the total 2012–2016 budget. The following sections describe progress for each area of this initiative.

Table 11. Building Systems Budget and Financial Status through December 31, 2020

	2012-2016 Budget [a]	Spent Funds	Percent of 2012-2016 Budget Spent	Committed Funds [b,c]	Percent of Budget 2012-2016 Committed
Advanced Buildings					
Emerging Technology/Accelerated Commercialization	$14,366,925	$7,603,592	53%	$8,492,927	59%
Technology Development	$25,007,131	$12,822,941	51%	$13,396,053	54%
Demand Response	$9,019,519	$5,614,923	62%	$5,614,923	62%
Total Advanced Buildings	*$48,393,575*	*$26,041,456*	*54%*	*$27,503,903*	*57%*
Advanced Energy Codes & Standards	$9,785,964	$8,767,558	90%	$8,767,558	90%
Grand Total - Building Systems Initiatives	***$58,179,539***	***$34,809,014***	***60%***	***$36,271,461***	***62%***

* Totals may not sum exactly due to rounding.

[a] Pursuant to the January 21, 2016 CEF Order, the budget figures presented herein include reclasses to the CEF of $182.7 million of uncommitted funds as of February 29, 2016.

[b] Committed funds include amounts spent plus remaining funding obligated under a contract, purchase order, or incentive award. In addition, committed funds include planned funding for contracts awarded and under negotiation and planned funding under active development through solicitations with specific due dates.

C Committed funds may decrease from period to period as a result of the disencumbrance/cancellation of contracts, or due to the actual award amount(s) resulting from a due date solicitation being less than the planned award. The Commission's January 21, 2016 Order Authorizing the Clean Energy Fund Framework directed that any uncommitted program funds after February 29, 2016 would be retained for future ratepayer benefits. Those amounts are included in this table and will be retained for future ratepayer benefits in accordance with the January order.

3.2.1 Advanced Building Technologies

3.2.1.1 Emerging Technology/Accelerated Commercialization—Buildings

The Emerging Technology/Accelerated Commercialization (ETAC)—Buildings component employs a deliberate approach to accelerating commercial introduction of emerging or underused building technologies and strategies. ETAC will serve both as a feeder effort to support State clean energy programs and encourage market adoption without additional ratepayer support. This effort focuses on three market sectors: commercial/institutional, multifamily, and residential.

ETAC-Commercial/Institutional

NYSERDA's ETAC-Commercial/Institutional (CI) program is targeted to technology developers and owners of multiple buildings wishing to gain independent validation of performance for a product, technology, or approach that is commercially available, yet not in widespread use, and accelerates market acceptance. Projects receive a NYSERDA-funded performance measurement and verification (M&V) study tailored to each project. Performance validation considers factors such as energy savings and other benefits and pathways to overcome market challenges. Project results and validated performance information is shared through targeted, deliberate outreach to the market, other New York Program Administrators, and Department of Public Service staff. Support is offered through both competitive

and open-enrollment solicitations. The ETAC-CI open enrollment program, launched in May 2013, consists of two program tracks: Energy Performance Validation and Focused Demonstrations. Projects in the Focused Demonstration track receive NYSERDA funding to support installation and project costs, but they must fall within one of NYSERDA's identified priority categories of technologies or approaches and provide prior independently verified performance data.

The following key program activities and accomplishments were performed during this reporting period:

- One project will remain open until 2021:
  - R3 Energy Management, Audit & Review, LLC will be active through 12/31/21 until technology transfer is completed.
  - Stem is installing three indoor battery storage projects under this ETAC contract at three commercial customer sites for the purpose of peak load reduction. The first project was installed and commissioned in 2018 and the second installation and commissioning occurred in January 2020. The third and final installation expected for Q3 2021.
  - All other commercial projects have been completed and paid out.

ETAC-Multifamily

The goal of this program was to identify energy efficiency methodologies, technologies, or strategies that are commercially available, but underused in the multifamily market and to address the market barriers preventing their broader adoption. This goal was accomplished through selected projects that demonstrated the technologies and strategies, identified barriers to their implementation, and developed strategies to address identified barriers. Project contractors have provided transfer technology via a combination of published papers and presentations.

The following key program activities and accomplishments were performed during this reporting period:

- All three projects are complete.

ETAC-Residential

ETAC-Residential targets the low-rise residential market, typically buildings with three stories or less. ETAC-RES demonstration projects are intended to validate improved energy efficiency performance under real-world conditions, overcome current market barriers, and accelerate market uptake of proven, but underutilized, energy-saving technologies. The current projects are focused on high efficiency HVAC equipment.

The following key program activities and accomplishments were performed during this reporting period:

- Contracts for all demonstrations and M&V have been fully executed and over 90% of the installations and M&V work have been completed. The goals of these project demonstrations include determining what information the market needs regarding technical and economic performance; collecting performance information/data that can be communicated accurately and confidently; disseminating the information to the market and making data available to create change. The air source heat pump (ASHP) demonstrations include 20 each residential replacements and displacements, five residential air-to-water systems, five residential low-capacity gas furnace/ASHP hybrids, and a variable refrigerant flow system. Over 30 ground source heat pump systems are also being evaluated. Final reports will be completed and published in 2021 and the applicable savings will be reported.

Table 12 shows performance milestones and results for the ETAC Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Energy savings reported are program-reported; evaluation activities focusing on electricity savings are in development and future reports will present findings from those studies as they are finalized. Project count, peak load demand, electric generation, and primary energy savings targets are established for projects installed through a particular time period. Progress refers to the cumulative savings that are installed, contracted, or accepted through a particular time period. For example, T&MD savings for 2012–2013 are the energy and demand savings/generation achieved or expected as of December 31, 2013 as a result of activity from January 2012 through December 2013. Blank cells indicate the lack of a target in a particular time period. All output metric targets have been exceeded, while a few outcome metrics will fall short of the targets.

Table 12. Emerging Technology/Accelerated Commercialization Performance Milestones and Results through December 31, 2020

See endnotes for more information[21]

Outputs/Leading Indicators

		2012-13	2012-15	2012-16	2012-20
All Projects	Projects - Target	1	6	7	7
	Applications Approved but not yet Contracted - Progress	0	1	8	0
	Projects Contracted but not yet Completed - Progress	0	13	17	16
	Projects Completed - Progress	1	4	5	9
	Total Progress	1	18	30	25
All Projects	Peak Load Reduction (MW) - Target	0.55	1.01	1.01	1.01
	Peak Load Reduction Applications Approved but not yet Contracted (MW) - Progress	0.00	0.02	0.95	0.00
	Peak Load Reduction Projects Contracted but not yet Completed (MW) - Progress	0.00	1.10	1.60	2.03
	Peak Load Reduction Projects Completed (MW) - Progress	0.00	0.25	0.25	0.67
	Total Progress	0.00	1.36	2.80	2.70
All Projects	Energy Savings (GWh) - Target	2.00	4.62	4.62	4.62
	Electric Savings Applications Approved but not yet Contracted (GWh) - Progress	0.00	0.07	1.82	0.00
	Electric Savings Projects Contracted but not yet Completed (GWh) - Progress	0.00	15.94	17.83	13.27
	Electric Savings Projects Completed (GWh) - Progress	0.00	0.75	0.75	5.39
	Total Progress	0.00	16.76	20.41	18.66
All Projects	Primary Energy Savings (MMBtu) - Target	5,000	34,320	34,320	34,320
	Primary Energy Savings Applications Approved but not yet Contracted (MMBtu) - Progress	0	0	0	10,952
	Primary Energy Savings Projects Contracted but not yet Completed (MMBtu) - Progress	0	75,684	41,857	73,479
	Primary Energy Savings Projects Completed (MMBtu) - Progress	1,053	1,614	14,949	16,821
	Total Progress	1,053	77,297	56,806	101,252

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Stakeholder Engagements - Target	6				6
	Stakeholder Engagements - Progress	20	5	0	0	25
	Knowledge/Technology Transfer Activities - Target	8	9			17
	Knowledge/Technology Transfer Activities - Progress	0	7	0	0	7

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$1.00	$1.86			$2.86
	Leveraged Funds Amount (millions) - Progress	$0.09	$4.44	$2.88	$2.91	$10.32
	Leveraged Funds Replicated (millions) - Target				$9.24	$9.24
	Leveraged Funds Replicated (millions) - Progress	$0.00	$0.00	$0.00	$0.00	$0.00
	Peak Load Reduction Replicated (MW) - Target				3	3
	Peak Load Reduction Replicated (MW) - Progress	0	0	0	0	0
	Energy Savings Replicated (GWh) - Target				13	13
	Energy Savings Replicated (GWh) - Progress	0	0	0	0	0
	Primary Energy Savings Replicated (MMBtu) - Target				101,992	101,992
	Primary Energy Savings Replicated (MMBtu) - Progress	0	0	0	0	0
	Market Adoption - Target			3		3
	Market Adoption - Progress	0	0	0	0	0

3.2.1.2 Technology Development

Under the Technology Development area, NYSERDA will undertake targeted building technology development activities that address the barriers and opportunities for new or emerging products. As a complement to Technology Development, NYSERDA plans to establish an Advanced Building Consortium to guide and conduct targeted high-priority technology development and demonstration projects and help accelerate the introduction of emerging technologies to New York State markets.

From 2013 to 2015, six solicitation rounds were issued to support the development and commercialization of solutions in the following technology areas: construction materials, strategies, and practices: heating and cooling; lighting; demand response, smart buildings and demand-side resources; and other technologies or opportunities.

Activities supported included: applied research aimed at early-stage development of a new product or technology, policy, business and/or regulatory model; development and commercialization of products/services for improving the energy performance of either new or existing buildings in New York State; and demonstrations of new or underutilized technologies or practices that advance the energy performance of either new or existing buildings in New York State.

The output from these activities resulted in the commercialization of OLED (Organic LED) lighting, light disinfection technology, advanced construction and framing techniques, higher efficiency heating and cooling appliances, and demand management and response solutions; and informative information on improving steam distribution systems, minimizing energy losses associated with elevator shafts, and best practices guides on oil-fired tankless coil boilers and integrated control of heat pumps and fossil-fuel fired system.

Companies receiving NYSERDA support have leveraged other investments (both public and private) and increased staffing/employment.

A solicitation for an Advanced Building Consortium was issued and proposals received. After review of the proposals and other considerations, a decision was made not to pursue the establishment of an Advanced Building Consortium at this time.

Behavior Research Program

NYSERDA works with Action Research, Inc. (Action Research), Behavioral Ideas Lab (ideas42), Research into Action (RIA), and clean energy programs in New York State to design, implement, and evaluate clean energy pilots that integrate behavioral strategies to improve clean energy program outcomes. The behavior research pilots are documented and shared in public presentations, case study reports, and published articles. Funding to demonstrate successful pilot interventions at a larger demonstration scale was allocated to three demonstration projects through NYSERDA's Behavior Demonstration Program (PON 2646). These projects are reported under Education to Change Behavior and Influence Choices section of this report.

The following key program activities and accomplishments were performed during this reporting period:

- All activities have been completed.
- Six behavior pilot case studies were completed during the last reporting period and the case study summaries are now posted on NYSERDA's website.[22]
- No new behavior pilots were initiated during this reporting period.

Table 13 shows performance milestones and results for the Technology Development Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Anticipated achievements and results are estimates based on savings per program dollar invested in projects. Blank cells indicate the lack of a target in a particular time period. Signed contracts and completed projects are for clean power technology projects. Supported companies are clean energy companies. Products and technologies commercialized are clean power technologies that have reached commercial availability. Product revenue includes commercial sales of supported clean power technologies. Leveraged funds include both co-funding and outside investment for clean power technology projects. Every output/outcome metric has been met or exceeded, except the product revenue metric.

Table 13. Advanced Buildings Technology Development Performance Milestones and Results through December 31, 2020

See endnotes for more information[23,24]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Contracted - Target	23	11			34
	Projects Contracted - Progress	25	48	8	5	86
	Projects Completed - Target		23	11		34
	Projects Completed - Progress	0	14	12	55	81
	Supported Companies - Target	12	5			17
	Supported Companies - Progress	19	42	8	2	71

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$7.00	$3.40			$10.40
	Leveraged Funds Amount (millions) - Progress	$36.24	$82.15	$24.96	$107.16	$250.51
	Products and Technologies Commercialized - Target		1	3		4
	Products and Technologies Commercialized - Progress	2	4	3	5	14
	Product Revenue Amount (millions) - Target			$8.00	$53.42	$61.42
	Product Revenue Amount (millions) - Progress	$0.44	$14.28	$6.70	$14.02	$35.45

3.2.1.3 Enabling Demand Response and Load Management

Under the Enabling Demand Response (DR) Load Management Program, NYSERDA helped increase participation and reliability of performance in utility and New York State Independent System Operator programs. These outcomes suppress wholesale energy costs, reduce congestion costs, increase reliability, and provide other benefits. The development of enabling DR technologies and new demand management models through this program increased the technical potential of DR in the State.

The Existing Facilities Program (PON 1219) is no longer offering open-enrollment incentives for DR projects across New York State as of September 1, 2015.

SBC IV and Indian Point Energy Center Reliability Contingency Plan funding is no longer available for new DR projects, but existing projects are still in the process of implementation and benefits from these projects continue to accrue.

The following key program activities and accomplishments were performed during this reporting period:

- All Existing Facilities Program DR projects are closed.

Table 14 shows performance milestones and results for the DR Program through December 31, 2020. Energy savings reported in Table 14 are program-reported; evaluation activities are in development and future reports will present findings as the studies finalized. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. The sole output metric has been exceeded while the outcome metric, megawatt Registered Evaluated was not met.

Table 14. Demand Response Performance Milestones and Results through December 31, 2020

See endnotes for more information[25]

Outputs/Leading Indicators

		2012-13	2012-15	2012-16	2012-20
All Projects	MW Registered - Target	9.00	23.00	41.00	44.62
	MW Registered Applications Approved but not yet Contracted (MW) - Progress	2.05	1.44	0.01	0.00
	MW Registered Projects Contracted but not yet Completed (MW) - Progress	5.44	7.84	3.16	0.00
	MW Registered Projects Completed (MW) - Progress	40.22	115.59	126.17	127.98
	Total Progress	47.71	124.87	129.34	127.98

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	MW Registered Evaluated - Target				22.31	22.31
	MW Registered Evaluated - Progress	0.00	0.00	0.00		0.00

3.2.1.4 Advanced Energy Codes and Standards

The Advanced Codes and Standards Initiative consists of two components: a set of code activities targeted at State commercial and residential building sectors, and a set of standards activities directed at influencing State and national appliance and equipment standards and specification setting processes for various equipment types. Activities in these areas are described in the following sections.

3.2.1.5 Annual Statewide Compliance Assessments

Statewide compliance assessment studies provide a means to track compliance trends associated with changing codes and standards. These assessment studies help identify where program intervention may be needed. Compliance assessments will occur as a phased effort.

The following key program activities and accomplishments were performed during this reporting period:

- All statewide compliance assessment activities will be undertaken in the Clean Energy Fund.
- To complete code evaluation activities on the T&MD portfolio, NYSERDA undertook an evaluation to assess energy savings from code compliance activities. Energy savings associated with this study are summarized in the table below.

Training to support new and advanced codes and standards is critical, particularly at points of adoption. Training efforts will build on those developed using American Recovery and Reinvestment Act of 2009 (ARRA) funds, with new or enhanced approaches and topics that address areas of low compliance or code change.

The following key program activities and accomplishments were performed during this reporting period:

- All activities have been completed.
- Over 2,100 building design, construction, and enforcement professionals were trained in 2019 through T&MD funding and no further trainings are expected. In total, nearly 21,000 were trained.

3.2.1.6 Technical Support, Studies, and Resources

Technical consulting and other research firms will be competitively selected to provide technical and administrative support for Advanced Codes and Standards program efforts, including new strategies to improve compliance and enforcement.

The following key program activities and accomplishments were performed during this reporting period:

- All activities have been completed.
- In June 2019, NYSERDA published the Energy Code Enforcement Manual for Code Enforcement Officers.

3.2.1.7 Pilots and Expanded Implementation Assistance

Pilot testing strategies for improved code compliance and enforcement strategies and stretch, as well as green planning efforts developed for competitive selection. NYSERDA also will support the construction and code enforcement communities by strategically providing implementation assistance to increase compliance with new and advanced codes and standards.

The following key program activities and accomplishments were performed during this reporting period:

- No pilots or expanded implementation assistance activities were planned in 2018 and no further activity is expected.

Table 15 shows performance milestones and results for the Advanced Energy Codes and Standards Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Energy savings reported in Table 15 are program-reported; evaluation activities are in development and future reports will present findings from those studies as they are finalized. Blank cells indicate the lack of a target in a particular time period. The training sessions are for new or expanded code training modules. The program support solicitations will competitively hire consulting and market research firms to provide program support. The support solicitations are for pilots and program implementation assistance. Progress toward output and outcome was mixed, with some targets such as code requirement trainees, training sessions, GWh and GW installed exceeding goals, while others fell short.

Table 15. Advanced Energy Codes and Standards Performance Milestones and Results through December 31, 2020

See endnotes for more information [26]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
Code compliance efforts	Annual Code Compliance Assessments - Target	2	1			3
	Annual Code Compliance Assessments - Progress	1	1	1	0	3
	Training Sessions - Target	6	1			7
	Training Sessions - Progress	0	7	7	2	16
	Code Requirement Trainees - Target	7,000	1,850			8,850
	Code Requirement Trainees - Progress	0	2,411	3,863	14,518	20,792
Equipment and appliance standards efforts	State/Federal Standards Conformance Assessments - Target	1	1			2
	State/Federal Standards Conformance Assessments - Progress	0	0	0	0	0
All Projects	Program Support Solicitations - Target	1				1
	Program Support Solicitations - Progress	0	0	0	0	0
	Implementation Support Solicitations - Target	1				1
	Implementation Support Solicitations - Progress	1	2	0	0	3

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
Code compliance efforts	Energy Savings Installed (GWh) - Target	84.00	140.00	90.00	58.29	372.29
	Energy Savings Installed (GWh) - Progress	0.00	117.00	79.00	306.00	502.00
	Energy Savings Installed (MMBtu) - Target	575,000	1,057,000	726,000	545,390	2,903,390
	Energy Savings Installed (MMBtu) - Progress	0	135,400	106,560	368,490	610,450
	Peak Load Reduction Installed (MW) - Target	18.00	28.00	19.00	11.11	76.11
	Peak Load Reduction Installed (MW) - Progress	0.00	33.00	23.00	86.00	142.00
Equipment and appliance standards efforts	Energy Savings Installed (GWh) - Target		5.00	51.00	154.04	210.04
	Energy Savings Installed (GWh) - Progress	0.00	0.00	0.00	0.00	0.00
	Peak Load Reduction Installed (MW) - Target		2.00	23.00	74.12	99.12
	Peak Load Reduction Installed (MW) - Progress	0.00	0.00	0.00	0.00	0.00

3.3 Clean Energy Infrastructure Initiatives

Table 16 shows the Clean Energy Infrastructure budget and financial status through December 31, 2020. Committed and spent funds are also shown as a percent of the total 2012–2016 budget. Progress for each area of this initiative is described in following sections.

Table 16. Clean Energy Infrastructure Budget and Financial Status through December 31, 2020

	2012-2016 Budget [a]	Spent Funds	Percent of 2012-2016 Budget Spent	Committed Funds [b,c]	Percent of 2012-2016 Budget Committed
Market Development					
Market Research	$4,435,370	$4,312,136	97%	$4,312,136	97%
Market Pathways	$32,694,001	$29,889,146	91%	$29,936,465	92%
Education/Behavior	$7,126,371	$6,538,437	92%	$6,824,921	96%
Total Market Development	*$44,255,742*	*$40,739,719*	*92%*	*$41,073,522*	*93%*
Clean Energy Business Development					
Innovation Entrepreneurial Capacity	$21,356,497	$21,000,045	98%	$21,000,045	98%
Market Intelligence	$988,978	$902,293	91%	$902,293	91%
Direct Support for Business	$2,350,975	$2,411,475	103%	$2,411,475	103%
Marketing	$590,804	$587,383	99%	$587,383	99%
Total Clean Energy Business Development	*$25,287,254*	*$24,901,196*	*98%*	*$24,901,196*	*98%*
EMEP	$16,428,580	$15,303,206	93%	$15,638,028	95%
Workforce Development					
Renewable Energy/Advanced Technologies	$5,843,483	$5,105,277	87%	$5,105,277	87%
Energy Efficiency	$10,102,212	$8,341,396	83%	$8,341,396	83%
Total Workforce Development	*$15,945,695*	*$13,446,673*	*84%*	*$13,446,673*	*84%*
Grand Total - Clean Energy Infrastructure	***$101,917,271***	***$94,390,794***	***93%***	***$95,059,419***	***93%***

* Totals may not sum exactly due to rounding.

[a] Pursuant to the January 21, 2016 CEF Order, the budget figures presented herein include reclasses to the CEF of $182.7 million of uncommitted funds as of February 29, 2016.

[b] Committed funds include amounts spent plus remaining funding obligated under a contract, purchase order, or incentive award. In addition, committed funds include planned funding for contracts awarded and under negotiation and planned funding under active development through solicitations with specific due dates.

[c] Committed funds may decrease from period to period as a result of the disencumbrance/cancellation of contracts, or due to the actual award amount(s) resulting from a due date solicitation being less than the planned award. The Commission's January 21, 2016 Order Authorizing the Clean Energy Fund Framework directed that any uncommitted program funds after February 29, 2016 would be retained for future ratepayer benefits. Those amounts are included in this table and will be retained for future ratepayer benefits in accordance with the January order.

3.3.2 Market Development

The Market Development initiatives help to create the foundation for long-term changes in the market for the delivery of products and services that address energy efficiency and the adoption of renewable energy technologies. Strategies address the supply chain, consumer behavior, market barriers, and education.

Market Development activities identify new market opportunities and keep the supply chain informed about technological innovations. They also provide the technical tools, resources, and training necessary to promote energy efficiency and renewable options to consumers.

3.3.2.1 Market Research

The Market Research component identifies market and institutional barriers to technology and product adoption, obtains critical early-stage information and insights to guide investment decisions, and further advances the reach of T&MD and EEPS programs and other public policy goals. Its goal is to amass specific market intelligence and identify program opportunities to increase implementation efficiency and effectiveness. Since the start of the program in 2012, 20 projects have been completed, covering a variety of technologies and topics, including lighting, data centers, solar, and NYSERDA-wide corporate strategy. These various studies offered insights on how NYSERDA can best position its programs and overall organizational structure to advance key energy efficiency and renewable energy technologies.

The following key program activities and accomplishments were performed during this reporting period:

- No studies have been conducted or completed since 2016 and the program does not anticipate any further program activities. NYSERDA plans to continue to evaluate various aspects of the Clean Energy Economy of New York State; however, future activities will occur outside of TM&D.

Table 17 shows performance milestones and results for the Market Research Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. The sole output metric was exceeded.

Table 17. Market Research Performance Milestones and Results through December 31, 2020

See endnotes for more information[27]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Completed - Target	2	1	1		4
	Projects Completed - Progress	3	13	4	0	20

3.3.2.2 Market Pathways

The Market Pathways component works across the supply chain and sectors to promote the stocking, specification, sales, installation, maintenance, and use of energy-efficient products and strategies. NYSERDA provides tools, business strategies, and business and marketing materials to manufacturers, suppliers, distributors, retailers, service providers, designers, specifiers, contractors, and builders. The following sections describe progress in key areas.

Products Team

The Products Team conceptualizes, drives, and implements strategies and interventions that accelerate the adoption of emerging or underutilized energy-relevant products by working to develop supply chains and service networks. Interventions include support for product availability in relevant channels, channel and customer awareness, and capacity development in key service networks (e.g., installation and maintenance).

The following key program activities and accomplishments were performed during this reporting period:

- The Air Source Heat Pump Program launched in 2017 was transitioned under NYSERDA's Clean Heating and Cooling (CH&C) portfolio of renewable technologies. In 2020, the heat pump incentive program was transitioned over to the utilities.

Business Partners Programs

The Business Partners Programs were designed to accelerate the adoption of energy efficiency products and services within the commercial sector. Activities help service providers (contractors, vendors, installers, distributors, and designers) in the commercial midmarket supply chain develop business models to address the primary factors affecting their customers' operations and energy decisions. New market opportunities are identified, and the supply chain is informed of technological innovations and provided the technical tools, resources, and training necessary to promote profitable energy efficiency options to their customers.

Technical and sales training is provided for the network of service providers (Business Partners) focusing on quality and efficient design practices and maintenance, repair, and replacement services for energy products in commercial and industrial buildings. Tools and resources are available for Business Partners to design projects, demonstrate cost-benefit information, and help customers develop and implement energy efficiency plans. These tools and resources enable Business Partners to differentiate their business models within the marketplace, make it easier to demonstrate the value of clean energy solutions, increase

customer confidence in project benefits, improve project performance, streamline the procurement of energy services, and help integrate energy efficiency information into the decision-making processes for buyers and sellers. Incentives are provided to help Business Partners overcome risk, understand new technologies, and encourage the expansion of new clean energy solutions for their customers.

Business Partner programs focused on commercial lighting design, rooftop HVAC service and maintenance, and motor inventories. ICF Resources is the implementation contractor for the Commercial Lighting Business Partners Program. The core elements of the lighting program provide educational and technical support and resources to Lighting Business Partners (lighting contractors, distributors, manufacturer representatives, architects, engineers, and energy service companies) that incorporate lighting quality elements into their interior energy-efficient lighting projects. DNV GL is the implementation contractor for the HVAC Business Partners Program that provides HVAC Business Partners (primarily commercial HVAC firms and refrigeration firms) with quality maintenance strategies and tools in accordance with the American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE) and Air Conditioning Contractors of America (ACCA) Quality Maintenance Standard 180. Partners learn to evaluate and upgrade commercial roof top units beyond what is typically offered as standard practice. There are no updates for this program due to the closing of the Commercial Lighting and HVAC Program Business Partners programs effective December 31, 2015.

The Motors Program was intended to focus on providing educational and technical support to NYSERDA's Partners (motor suppliers, repair shops, electrical companies, manufacturers, and distributors). However, the program was discontinued prior to market launch.

Innovative Strategies

Innovative Strategies supported the identification and demonstration of sector-specific approaches, tools, and strategies for demonstrating and verifying energy savings and to broadcast the energy efficiency message to building owners, operators, and the financial sector. Efforts were standardized where appropriate, and credibility was provided to approaches that reduced barriers to financing energy efficiency projects not addressed by EEPS programs.

High-Performance Tenant Demonstration Projects

The High-Performance Tenant Demonstration Projects (HPDP) were launched as part of a partnership effort with Natural Resource Defense Council (NRDC). NYSERDA committed to identifying five pilot tenant projects by May of 2015 to test methods of influencing the design process for incorporating energy efficiency in tenant spaces. NYSERDA targeted tenant projects in Class A buildings in the early stages of the lease negotiation process. Using the lessons drawn from the initiative, NYSERDA sought to target the unrealized energy savings potential of commercial tenants while assessing the potential for developing Energy Efficiency Packages through energy modeling, as tools for influencing commercial tenant space design. The initiative also involved measurement and verification of the savings resulting from installed Energy Efficiency Packages, along with the development of case studies for each one of the tenant space fit-out projects.

The five customers that received support through this initiative are Gensler, MetLife, Paul Hastings LLP, White & Case LLP, and Rudin Management. All customers received energy modeling and energy efficiency package development technical assistance, implementation incentives, measurement and verification (M&V), as well as a case study (except for MetLife that did not comply with the M&V requirement or the case study development). All other projects have resulted in the publishing of a case study, highlighting lessons learned, and the benefits associated with designing and building out highly efficient workspaces.

A technical review firm (EME Consulting Engineers) was retained to perform the M&V and produce an M&V report for each customer, comparing projected energy savings from the Energy Efficiency Packages, and actual realized savings. All M&V reports were completed in Q1 2021. Results from the M&V activities will be reported in next year's T&MD annual report. Table 18 shows performance milestones and results for the Market Pathways Program through December 31, 2020. Energy savings reported for the Business Partners program in Tables 3 to 16 are program reported. Evaluation activities have not been conducted on these programs. Energy savings for the Product Partners program in 2012–2013 are evaluated savings. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. While most output and outcome metric targets were exceeded, a few metrics fell short of the targets.

Table 18. Market Pathways Performance Milestones and Results through December 31, 2020

See endnotes for more information[28]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
Market Pathways - RES	Energy Smart Product Partner Participants - Target	732.0				732.0
	Energy Smart Product Partner Participants - Progress	610.0	281.0	0.0	0.0	891.0
	Product Partner Trainees - Target	200.0	95.0			295.0
	Product Partner Trainees - Progress	130.0	353.0	0.0	0.0	483.0
Market Pathways - Midstream Support	Midstream Partner Participants - Target	301				301
	Midstream Partner Participants - Progress	95	341	0	0	436
	Midstream Partner Trainees - Target	375	230			605
	Midstream Partner Trainees - Progress	1,103	790	0	0	1,893
	Factsheets - Target	4	1			5
	Factsheets - Progress	0	0	0	0	0
	Seminars/Webinars - Target	4	1			5
	Seminars/Webinars - Progress	12	12	0	0	24
Market Pathways - C/I	Innovative Energy Efficiency Investment Strategy Participants - Target	18				18
	Innovative Energy Efficiency Investment Strategy Participants - Progress	12	12	0	0	24
	EAL Evaluations - Target	4	2			6
	EAL Evaluations - Progress	0	0	0	0	0
	EAL Seminars/Webinars - Target	4	2			6
	EAL Seminars/Webinars - Progress	48	0	0	0	48
	Factsheets - Target	3	1			4
	Factsheets - Progress	0	0	0	0	0
	Seminars/Webinars - Target	4	2			6
	Seminars/Webinars - Progress	0	0	0	0	0

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
Market Pathways - RES	Energy Savings Installed (GWh) - Target	50.00	23.75			73.75
	Energy Savings Installed (GWh) - Progress	5.91	4.30	0.00	0.00	10.21
	Energy Savings Installed (MMBtu) - Target	254,000	274,050			528,050
	Energy Savings Installed (MMBtu) - Progress	142,610	94,132	0	0	236,742
Market Pathways - Midstream Support	Energy Savings Installed (GWh) - Target	15.00	6.83			21.83
	Energy Savings Installed (GWh) - Progress	4.64	62.74	0.00	0.00	67.38
	Market Adoption - Target	1	1			2
	Market Adoption - Progress	0	0	0	0	0
Market Pathways - C/I	Projects Completed - Target	5	7			12
	Projects Completed - Progress	0	7	1	5	13

3.3.3 Education to Change Behavior and Influence Choices

Economic Development Growth Extension Program

The Economic Development Growth Extension (EDGE) Program is facilitated by Regional Outreach Contractors who perform outreach, education, and promotion of NYSERDA program opportunities to residents, businesses, institutions, and local governments across the State. Formerly known as the Energy $mart Communities Program, EDGE educates New Yorkers about the role energy efficiency and renewable power can play in reducing energy costs and providing clean, reliable energy for homes, schools, and workplaces. The EDGE Program was designed to include support for Governor Andrew M. Cuomo's Regional Economic Development Council initiative by aligning the program

territories geographically and providing direct support to advance the strategic priorities and regionally significant projects identified in each region. Through this alignment with the Regional Councils, NYSERDA provides a greater level of education and adoption of energy efficiency practices at the community level. NYSERDA contracted with the New York State Economic Development Council and Solar One, a team that includes regionally based economic development organizations to provide on-the-ground outreach support.

The following key program activities and accomplishments were performed during this reporting period:

- NYSERDA's Economic Development Growth Extension program closed in 2016.

Behavioral Demonstrations

Projects selected under the Behavioral Demonstrations program will test the efficacy, persistence, and cost-effectiveness of behavioral interventions designed to encourage consumers to use less energy and invest in energy efficiency services. Implementation contractors are partnered with utilities who will specify metrics and cost-effectiveness criteria that, if met, will compel them to invest in further expansion of these interventions without NYSERDA funding.

The following key program activities and accomplishments were performed during this reporting period:

- All three contracted demonstrations (EIC, Oracle and ThinkEco) have been completed:
  - The EIC demonstration completed one full year of implementation activities; implementation activities were completed in Q2 2018, leading into the persistence analysis phase. A preliminary evaluation of the results was conducted; based on the lackluster results, it was decided that no further persistence evaluation activities were necessary, and the project was closed.
  - The Oracle demonstration (formerly Opower) with Con Edison was launched in May 2017. The program was successfully implemented and evaluated. The evaluation of the program showed the intervention to be positive and the persistence analysis and cost-effectiveness analysis was completed in June 2021.
  - The ThinkEco demonstration completed one full year of implementation and the evaluation of the first year of implementation yielded positive results. The last phase of the persistence and cost-effectiveness evaluation was completed in May 2021.
- Nexant, the oversight evaluation contractor, worked with each demonstration project to collect the appropriate data to conduct the savings analysis. Nexant conducted the persistence evaluation and a cost-effectiveness analysis to determine the benefits and impacts of scaling up each demonstration.

- Action Research, Inc., a behavior-change design consultant for clean energy behavior-change pilots in the State, helped design the Ecobee smart thermostat pilot for EmPower-eligible households in Western New York National Grid territory. Due to low-participation rates, the pilot was not conducted during the reporting period.

Low-Income Forum on Energy

The Low-Income Forum on Energy (LIFE) is the longest running statewide low-income energy dialogue in the United States. LIFE brings together a diverse range of parties committed to addressing the challenges and opportunities facing low-income New Yorkers as they seek safe, affordable, and reliable energy. Guided by a steering committee composed of State agencies, utilities, contractors, and community-based organizations, the forum undertakes several initiatives to increase awareness of low-income energy issues.

The following key program activities and accomplishments were performed during this reporting period:

- On August 18, 2016, NYSERDA launched the LIFE initiative in the Clean Energy Fund. All program activities will continue under this initiative.

Table 19 shows performance milestones and results for the Education/Behavior Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Signed contracts represent the sponsorship of behavioral pilots. The meetings, workshops, and conferences are the sponsorship of annual LIFE conferences. Completed projects include completing and evaluating behavioral pilots. Progress toward output and outcome metrics was been mixed; however, certain activities associated with this program were moved and reported in the Clean Energy Fund.

Table 19. Education/Behavior Performance Milestones and Results through December 31, 2020

See endnotes for more information[29]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Contracted - Target	5	1			6
	Projects Contracted - Progress	0	0	4	0	4
	Meetings, Workshops, Conferences - Target	2	2			4
	Meetings, Workshops, Conferences - Progress	1	1	1	0	3
	Community Partnership Participants - Target	250	158			408
	Community Partnership Participants - Progress	465	560	21	0	1,046

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Completed - Target		4	5		9
	Projects Completed - Progress	0	0	0	0	0

3.3.4 Clean Energy Business Development

3.3.4.1 Innovation/Entrepreneurial Capacity Building

There are three proof-of-concept centers (POCC): (1) New York University, in partnership with the City University of New York, (2) Columbia University, in partnership with Stony Brook University, and (3) Cornell NYC Tech and Brookhaven National Laboratory are co-branding the two programs as PowerBridgeNY. Another POCC is run through NextCorps (formerly High-Tech Rochester) as NEXUS-NY. The mission of the POCCs is to accelerate the translation of clean energy research into marketable products and services. This translation is primarily accomplished by fostering successful prestart-up companies. Generally, the next step for these companies is to participate in a business mentoring or incubation program. NYSERDA is investing approximately $5 million in seed money at each center over a five-year period. NextCorps successfully completed the contract for NEXUS-NY at the end of 2018 after running five annual cohorts. New York University and Columbia University planned to continue operating PowerBridgeNY in 2019 with the addition of a sixth cohort.

The objectives of the POCC initiative are as follows:

- Accelerate the commercialization of innovations out of research institutions and into the marketplace, particularly through startups.
- Early in the research and development phase, match emerging clean energy technologies with scalable commercialization potential, based on real market need, with the investment community.
- Establish sustainable regional innovation ecosystems of potential investors and entrepreneurs in clean energy technologies and solidify the POCC linkages to them.

The following key program activities and accomplishments were performed during this reporting period:

- Teams from 18 academic institutions and multiple private research organizations participated in the program.
- Eighty teams worked through the extensive bootcamp process, and there are 50 new businesses actively pursuing their target markets.
- Program participants and alumni have raised a combined $76 million in private investment and non-NYSERDA grants.
- Program participants and alumni have generated a combined $1.4 million in revenue.

Given the nature of the POCC program, the new businesses formed during the first cohort have raised the most funding and generated the most revenue. It can be expected that the new businesses from subsequent cohorts will demonstrate similar accomplishments over the next few years.

Emerging Clean Energy Business Development

The Clean Energy Business Incubator program was established in 2009 with funding from SBC III. The purpose of these incubators is to foster the viability and growth of the State's most promising cleantech start-up companies. Most of these companies are still in the process of commercializing technologies and have yet to earn revenue from commercial operation and product sales. The six incubators are strategically located across the State from Buffalo to Long Island and assist companies by providing ready access to investors, mentors, development partners, and commercialization resources.

The following key program activities and accomplishments were performed during this reporting period:

- The Clean Energy Business Incubator program is now funded through the Clean Energy Fund. The six incubators are currently located in Western New York, Finger Lakes, Central New York, Southern Tier, New York City, and Long Island. These incubators continue to grow New York State's clean energy economy by providing early stage cleantech companies with access to essential resources that catalyze company growth.

Table 20 shows performance milestones and results for the Innovation/Entrepreneurial Program through December 31, 2020. The metrics only reflect results from the incubators that received T&MD funding. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Leverage funds include co-funding and outside investments to help clean energy businesses. Product revenue includes commercial sales of new and improved supported technologies. The following key program metrics and accomplishments have been tracked and achieved by companies working with the NYSERDA-sponsored incubators during this reporting period: private capital raised, non-NYSERDA grants awarded, new commercial products developed, revenue generated, jobs created and retained, strategic partnerships formed, and mergers and acquisitions completed. Every output/outcome metric has been met or exceeded, except the Incubator/POCC participant metric, which fell slightly short of the target.

Table 20. Innovation/Entrepreneurial Milestones and Results through December 31, 2020

See endnotes for more information[30,31,32]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Incubators or POCCS Participants - Target	65	90	50	30	235
	Incubators or POCCS Participants - Progress	29	76	17	93	215

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$40.00	$45.00	$2.00		$87.00
	Leveraged Funds Amount (millions) - Progress	$40.15	$83.35	$24.72	$133.20	$281.42
	Products and Technologies Commercialized - Target	5	10	8		23
	Products and Technologies Commercialized - Progress	1	6	10	55	72
	Product Revenue Amount (millions) - Target	$2.50	$5.00	$4.10		$11.60
	Product Revenue Amount (millions) - Progress	$0.00	$0.00	$0.00	$81.40	$81.40
	Businesses Graduated from Incubators - Target	36	36	18	4	94
	Businesses Graduated from Incubators - Progress	12	49	9	46	116
	FTEs Associated with Incubator Graduates - Target	108	108	54	12	282
	FTEs Associated with Incubator Graduates - Progress	185	124	14	240	563

3.3.4.2 Market Intelligence

New York State Clean Energy Technology Innovation Metrics

Reports have been completed every three years and concluded in 2018 when NYSERDA worked with SRI International to research and prepare the 2018 report update on clean energy technology metrics.[33] To determine the metrics for the first report, focus groups involved nearly 100 individuals including entrepreneurs affiliated with cleantech start-up companies, cleantech investors, executives, and other representatives of larger, more established technology companies, directors of cleantech incubators, representatives from cleantech industry consortia, universities conducting cleantech research, and other cleantech organizations. The third and final report tracks those same metrics three years later, but it was not published for external distribution. Six factsheets for 2018 are presented on the website.[34]

Table 21 shows performance milestones and results for the Market Intelligence Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Signed contracts include creating annual benchmark reports on clean energy business and financial indicators for the State. Website downloads support the dissemination of clean energy benchmark information. Progress toward the website downloads target was excellent even though the number of projects contracted was one less than expected.

Table 21. Market Intelligence Performance Milestones and Results through December 31, 2020

See endnotes for more information[35]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Contracted - Target	2	1			3
	Projects Contracted - Progress	0	2	0	0	2
	Website Downloads - Target	100	195			295
	Website Downloads - Progress	0	109	167	204	480

3.3.4.3 Direct Support for Business Acceleration Program

NYSERDA's Entrepreneurs-In-Residence (EIR) program offers experienced entrepreneurial mentoring to NYSERDA contractors, incubator clients, startups in other NYSERDA programs, and startups not yet in NYSERDA programs, where those startups are expected to help New York State achieve its Climate Act goals. Observations from the program show companies struggle with customer delivery and engagement, the development of an overall business strategy, and development and execution of a strategy to secure private investments. Most of these companies are founded by technical entrepreneurs who initially lack the business skills required to successfully bring a clean energy product to market.

During 2020, the program continued placing experts with start-up clean energy companies who were moving into a new stage in their lifecycle, required a mentor to help them take advantage of unexpected opportunities such as a strategic partnership, or were confronting significant business challenges such as not enough funding. The program continued to maintain strict standards for mentors with comprehensive interviews and a continuous review process. This was done to ensure only those mentors that fit NYSERDA's requirements were retained and to more clearly understand the specialties and strengths of each mentor so that they could be effectively matched with companies to achieve the specific goals set for engagements.

Additionally, the program made structural changes to enhance each engagement and to efficiently provide expert information to more companies. These changes included (1) reducing the scope and amount of time of initial engagements to help founders learn how to effectively leverage the expertise of their mentor and to allow the program administrator to adjust quickly and (2) developing a webinar series based on topics asked for by startups and clean energy incubators.

In 2020, the EIR program began an online network (the Climate Leadership Network) for startups and other ecosystem participants to easily network and share valuable information. It also launched a grant writing mentoring service to help startups discover appropriate grants from the federal government and elsewhere and write compelling proposals. Another initiative begun by the EIR program was discovering C-level executives and matching them with startups with gaps in their management team. Finally, the EIR program launched an initiative to match these companies with investors targeting the startups' sectors and stages.

NY Clean Start, part of New York University's Advanced Diploma program, targets experienced business people with a concentrated course about the markets, financing models, permitting requirements, technology solutions, and other unique aspects of the cleantech industry necessary to start a successful clean energy business. NY Clean Start is expected to increase the number of clean energy entrepreneurs, create well-paying jobs in communities, and provide solutions for addressing the long-term challenge of energy independence.

The StartupGPS Commercialization Toolkit addresses a very common need of new startups: the struggle to understand the big picture as a new company and its development in the journey from product ideation to commercial deployment. The toolkit is designed to provide a framework for guiding company business development, an easy way to assess overall business readiness, and a curated suite of resources tailored to the specific needs of clean economy entrepreneurs as they pursue successful commercialization of their offerings.

The following key program activities and accomplishments were performed during this reporting period:

- All projects were completed in 2018 and no additional activity is expected.

Table 22 shows performance milestones and results for the Direct Support for Business Acceleration Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Companies supported include companies with new and improved products serving State markets. Business executives transitioned include the transition of business executives to the clean energy technology industry. Progress toward output metrics was mixed, while the program supported less companies than expected, it exceeded expectations in terms of the business executives' transitioned outcome.

Table 22. Direct Support for Business Acceleration Performance Milestones and Results through December 31, 2020

See endnotes for more information[36]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Companies Supported - Target	59	59	29		147
	Companies Supported - Progress	41	33	10	0	84

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Business Executives Transitioned - Target		18	18	8	44
	Business Executives Transitioned - Progress	0	23	28	0	51

3.3.5 Workforce Development Initiative

New York State's ambitious energy and environmental goals require trained workers with applied skills in energy efficiency, renewable energy, and advanced technologies. The Workforce Development Initiative is designed to address the ongoing need for workers with skills that will result in quality installations, services, and maintenance for clean energy technologies.

The following key program activities and accomplishments were performed during this reporting period:

- NYSERDA has concluded the training partnership agreement with Green City Force (GCF), a Brooklyn-based provider of training and job placement support to disadvantaged young adults. Through this agreement, a total of 121 students participated in Green City Force's training program. The first cohort of 35 students graduated in June 2017 and two cohorts completed in February (18) and June (19) 2018. The most recent cohort of 17 members finished in mid-February 2019 with another 32 members finishing in April 2019.

Tables 23 and 24 show performance milestones and results for the Workforce Development Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Community colleges may offer renewable energy, advanced technology, and energy efficiency courses. While most output and outcome metric targets were exceeded, a few did not meet their targets.

Table 23. Workforce Development—Renewable Energy Performance Milestones and Results through December 31, 2020

See endnotes for more information[37]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Renewable Energy Technical Trainees - Target	500	280			780
	Renewable Energy Technical Trainees - Progress	0	2,738	1,220	0	3,958
	Entry Level Trainees - Target	90	97			187
	Entry Level Trainees - Progress	0	460	122	0	582
	OJT, Hands-On Training - Target	150	115			265
	OJT, Hands-On Training - Progress	39	90	2	0	131
	Training Organizations - Target	2				2
	Training Organizations - Progress	2	2	1	0	5
	Certifications Developed - Target		1			1
	Certifications Developed - Progress	0	0	0	0	0
	Course Development - Target	2	1			3
	Course Development - Progress	0	16	1	0	17

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$0.80	$0.90			$1.70
	Leveraged Funds Amount (millions) - Progress	$1.11	$1.55	$0.02	$0.00	$2.67

Table 24. Workforce Development—Energy Efficiency Performance Milestones and Results through December 31, 2020

See endnotes for more information[38]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Energy Efficiency Technical Trainees - Target	3,448	2,345			5,793
	Energy Efficiency Technical Trainees - Progress	96	9,414	4,975	71	14,556
	Entry Level Trainees - Target	800	544			1,344
	Entry Level Trainees - Progress	0	721	152	0	873
	OJT, Hands-On Training - Target	467	317			784
	OJT, Hands-On Training - Progress	48	95	0	0	143
	Training Organizations - Target	2	1			3
	Training Organizations - Progress	4	2	0	0	6
	Certifications Developed - Target		1			1
	Certifications Developed - Progress	0	0	0	0	0

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$1.30	$1.70			$3.00
	Leveraged Funds Amount (millions) - Progress	$0.40	$6.24	$1.40	$0.00	$8.04

3.3.6 Environmental Monitoring, Evaluation, and Protection

Environmental Monitoring, Evaluation, and Protection (EMEP) provides knowledge to reduce the adverse impacts associated with electricity generation—that damages the State's ecosystems and residents' health—and assists planning efforts for cleaner alternative options. Additionally, informing the clean energy technology industry about life-cycle environmental impacts early in the development

stage can minimize unanticipated negative effects and document the energy and environmental attributes of products. EMEP also provides critical energy-related environmental research to help support the regulatory responsibilities of a range of other agencies in the State, including the Department of Environmental Conservation, Department of Health, Department of State, and the Office of the Attorney General.

The following key program activities and accomplishments were performed during this reporting period:

- The program deployed two floating LiDAR (light detection and ranging) buoys in the New York Bight to better characterize the wind, wave, ocean current, and wildlife in the Bight. A full year of data was collected during 2020 and made available via the project website. Similarly, a reconnaissance-level geophysical survey was conducted in the Bight to collect seabed soil conditions data. The goal of both investigations is to reduced timelines and uncertainty for offshore wind developers, which is expected to result in decreased offshore wind procurement costs.
- The New York State Climate Assessment commenced in 2020. The Assessment will include new projections and an assessment of climate implications, developing a range of products that help to support climate adaptation by sectors across New York State, including reports, summaries, briefings, and online tools.
- NYSERDA is supporting Northeast States for Coordinated Air Use Management (NESCAUM) and others in studies of the persistently high ozone downwind of New York into Long Island Sound. The program (Long Island Sound Troposphere Ozone Study—LISTOS) has partnered with SUNY Albany, SUNY Stonybrook, CUNY and Columbia University, Yale University, and others to understand the complex meteorological and photochemical processes in and downwind of New York City.
- Several environmental research projects were completed and their reports were posted to the NYSERDA website and/or published in peer-reviewed journals.
- Several NYSERDA led stakeholder meetings were conducted to engage and coordinate scientists and policy makers in the areas of air quality, offshore wind, and terrestrial renewables.

Table 25 shows performance milestones and results for the EMEP Program through December 31, 2020. Outputs/Leading Indicators measure immediate results and Outcomes/Impacts measure achievements; evaluation activities are in development and future reports will present findings from those studies as they are finalized. Blank cells indicate the lack of a target in a particular time period. Signed contracts include several large flagship projects. The meetings, workshops, and conferences are sponsored by NYSERDA. Briefings are on research projects convening with policymakers or other stakeholders. Leveraged funds include co-funding and outside investment to support projects and sponsored research. Progress toward output and outcome metrics was mixed, while most output and outcome metric targets have been exceeded, a few did not meet their targets.

Table 25. Environmental Monitoring Performance Milestones and Results through December 31, 2020

See endnotes for more information[39,40]

Outputs/Leading Indicators

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Projects Contracted - Target	23	28	2		53
	Projects Contracted - Progress	21	36	3	2	62
	Projects Completed - Target	5	23	23	2	53
	Projects Completed - Progress	0	14	5	30	49
	Program Advisory Group Meetings - Target	2	2			4
	Program Advisory Group Meetings - Progress	3	0	0	0	3
	Science Advisory Committee Meetings - Target	2	2			4
	Science Advisory Committee Meetings - Progress	3	0	0	1	4
	Meetings, Workshops, Conferences - Target	5	6	1		12
	Meetings, Workshops, Conferences - Progress	7	13	6	18	44
	Briefings - Target	12	12	3		27
	Briefings - Progress	5	5	2	0	12

Outcomes/Impacts

		2012-13 with Adjustments	2014-15 with Adjustments	2016 with Adjustments	2017-20	Total
All Projects	Leveraged Funds Amount (millions) - Target	$3.50	$4.50	$1.80		$9.80
	Leveraged Funds Amount (millions) - Progress	$2.53	$31.18	$7.10	$0.56	$41.38
	EMEP Research Citations - Target			2,670		2,670
	EMEP Research Citations - Progress	47	38	18	41	144
	Peer-reviewed Scientific Journal Articles - Target	10	35	45	16	106
	Peer-reviewed Scientific Journal Articles - Progress	15	40	48	53	156

4 T&MD Program Evaluation Activities

This section summarizes evaluation work completed, underway, and planned for the T&MD programs. Some evaluations are program-specific, while others are done at a higher level to inform and optimize the portfolio-level results.

4.1 Program Theory and Logic Models

Program Theory and Logic Model (PTLM) reports are typically developed early in the program timeline and updated as changes are made. PTLM reports inform evaluation work by documenting the relationships between program activities, outputs, and short/medium/long-term outcomes the program intends to induce.

Prior to December 2020, PTLM activities were completed, and reports posted to NYSERDA's website for the following programs/areas:

- Smart Grid[41]
- Advanced Codes and Standards[42]
- EDGE[43]
- New York Products[44]
- Clean Energy Business Development[45]
- Workforce Development[46]
- CHP Aggregation and Acceleration[47]
- Advanced Buildings: ETAC[48]
- Advanced Buildings: Technology Development[49]
- Solar Cost Reduction[50]
- Clean Power Technology Innovation[51]
- Transportation[52]

During this reporting period, given the maturity of T&MD programs, no PTLMs were completed.

4.2 Process Evaluation

Process Evaluation reviews oversight and operations, gauges customer satisfaction, and recommends process and efficiency improvements. The goal of Process Evaluation is to inform real-time adjustments and maximize program efficiency and effectiveness through actionable recommendations. The T&MD Operating Plan identified that formative process evaluations would be conducted on most programs

during the early stages of implementation and repeated periodically to examine program efficiency and effectiveness considering the program's stated outcomes and impacts. Process evaluations are typically conducted through in-depth interviews resulting in a qualitative assessment and will be supported by secondary research, such as review of program documents, as appropriate. Evaluations of NYSERDA's organizational processes (e.g., competitive solicitation) may also be conducted.

Prior to December 2020, focused process evaluations were completed for the following T&MD programs. Each of the following process evaluation reports is available on the NYSERDA website:

- Smart Grid[53]
- Workforce Development[54]
- EMEP[55]
- Solar Cost Reduction[56]
- EDGE[57]
- Advanced Codes and Standards[58]
- Advanced Buildings Technology Development[59]
- Advanced Codes and Standards Behavioral Study[60]

During this reporting period, given the maturity of T&MD programs, no process evaluation activities were completed.

4.3 Market and Impact Evaluation

T&MD near- and long-term impacts are assessed through full-scale impact and market evaluations. Early evaluation activities have included collecting baseline information to identify the program effects on the number and knowledge base of market participants, and whether barriers to more widespread technology adoption are being effectively addressed. Later evaluation activities have examined longer-term impacts, such as technology commercialization and replication. Some methods used in assessing program impacts include surveys and interviews with program participants and nonparticipants, Delphi panels, case studies, on-site measurement and verification of energy savings for certain technologies, technology commercialization tracking, technology transfer, bibliometric tracking, and citation analysis.

This evaluation includes the following three primary activities, which are briefly described as intended to apply to the T&MD programs:

- **Market characterization** will describe a specific market or market segments, including size of the market, key market actors, distribution channels, market actor awareness and knowledge, key market drivers and opportunities, and market barriers. The market characterization assesses the market before or early in the commencement of a specific intervention or program, for the purpose of guiding the intervention and/or facilitating future evaluation of effectiveness.
- **Market impact assessment** is used to analyze the extent to which a market has been transformed by specific program interventions or programs. Market impact assessment describes changes in market actor awareness and knowledge, key market drivers and opportunities, and market barriers, as well as the value of the program perceived by key market actors. Market assessment also collects and tracks information on key indicators the program is expecting to influence (i.e., the adoption of clean energy and energy-efficient products, services, or practices). Market impact assessments may require a previous market characterization study.
- **Energy impact evaluation** will address program-specific, directly induced quantitative changes (e.g., kWh, kW, and Btu) attributable to the T&MD programs. This evaluation is distinguished from market impact assessments, which assess other program outcomes distinct from energy and demand savings.

Prior to December 2020, focused market evaluations were completed for the following T&MD programs:

- NY Products Program[61]
- NYSERDA and National Customer Awareness of ENERGY STAR® for 2014 (Analysis of Consortium for Energy Efficiency Household Survey)[62]
- Smart Grid Market Characterization[63]
- Transportation Market Characterization Assessment[64]
- Transportation: Six Impact/Market Evaluation Case Studies[65,66,67,68,69,70]
- Clean Energy Business Development Market Assessment[71]
- Combined Heat and Power Market Assessment[72]
- ETAC/Advanced Buildings Technology Development Solid State Lighting and Controls Market Characterization and Assessment[73]
- Environmental Monitoring, Evaluation, and Protection (EMEP)

Prior to December 2020, impact evaluations were completed for the following programs/areas:

- Advanced Codes and Standards Impact Evaluation, Phase 1[74]
- Market Pathways: Business Partners[75]
- Combined Heat and Power Impact Evaluation

During this reporting period, evaluations were completed for the following programs/areas:

- CHP Impact and Market Evaluations (Q1 2020)
- Smart Grid Case Studies (Q2 2020)
- T&MD Demonstration Project Impact Evaluation (Q2 2020)
- Advanced Codes and Standards (Q3 2021)

There are no market or impact evaluations planned or underway for this reporting period.

Brief summaries of the completed evaluations completed in this period are provided below. Detailed summaries of the evaluations can be found in appendix B.

Combined Heat and Power Impact Evaluation

The objective of the Combined Heat and Power (CHP) Impact evaluation is to conduct a final savings assessment of NYSERDA's CHP Program. CHP systems are fossil fuel-fired engines that generate electricity while, at the same time, waste heat from the combustion process is captured and used to offset thermal loads at the host site. NYSERDA's Combined Heat and Power (CHP) intervention has worked to advance a modular CHP market with the intention of reducing soft costs and development time and increasing penetration of CHP. The major activity focuses on continuing to provide cost-shared incentives to support the installation of CHP equipment at eligible host site locations. The incentive program is a continuation/modification of NYSERDA's previous Technology and Market Development (T&MD) CHP Acceleration and Aggregation (A&A) and CHP Performance Program.

The table below presents a summary of Generation for the Aggregation and Acceleration CHP sites with DERIDS data.

Table 26. Summary of Generation for the Aggregation and Acceleration CHP Sites with DERIDS Data

	All Evaluated Projects (n=40)			Total Program (n=52)	
	Program Reported	Evaluated Gross Savings	Realization Rate	Program Contracted	Evaluated Gross Savings
Electric Generation (MWh)	48,770	32,668	67%	72,163	48,338
Utilized Heat (MMBtu)	63,400	136,084	215%	93,812	201,360
Peak kWa	7,995	5,922	74%	11,830	8,762

[a] The reported peak kW is the rated kW of the facility with an adder for sites with absorption chillers. The evaluated kW is the maximum kW produced at any time during the available data. No information on cooling performance of the absorption chillers was available to calculate the evaluated savings.

The table below presents a summary of generation for the performance CHP sites with DERIDS data.

Table 27. Summary of Generation for the Performance CHP Sites with DERIDS Data

	All Evaluated Projects (n=4)			Total Program (n=5)	
	Program Contracted[a]	Evaluated Gross Savings	Realization Rate	Program Contracted	Evaluated Gross Savings
Electric Generation (MWh)	90,577	72,915	84%	150,577	126,202
Utilized Heat (MMBtu)	117,750	527,088	448%	195,750	876,241
Peak kWb	10,840	12,978	120%	13,840	16,570

a The program contracted only part of the total CHP generation for three of the four evaluated projects, because of this it was possible for the evaluated peak kW to be greater than the contracted peak kW.

b The evaluated kW is the maximum kW produced at any time during the available data.

The Performance sites have higher realization rates than the A&A sites across all three metrics. These sites are large non-catalog projects, unlike the A&A portion of the program which is primarily based on catalog systems. These also do not use prescriptive equations for estimating CHP generation and heat use, although the values appear to be within a similar range depending on system capacity. In addition, two of the three sites only contracted part of their generation capacity with NYSERDA, and as the DERIDS system measures the entire system, not just the contracted portion that skews the results for Performance projects.

The full evaluation report is available on the NYSERDA website.[76]

Smart Grid Case Studies

NYSERDA's Smart Grid program promotes modernization of New York State's electric grid by funding research and technology development projects that can be implemented at the utility scale. NYSERDA, in consultation with independent evaluation consultants, developed case studies highlighting projects under the Smart Grid program.

An evaluation of grid modernization investments at Central Hudson: Central Hudson Gas & Electric (Central Hudson) is one of New York State's seven electric utilities; its service territory includes the Mid-Hudson River Valley from north of New York City to Albany County. Since 2008, NYSERDA's Smart Grid program has funded eight Central Hudson grid modernization projects through a competitive solicitation process. This case study quantifies the key benefits that resulted from Central Hudson's and NYSERDA's funding for Central Hudson's grid modernization improvements, including improved grid reliability, economic cost savings, and avoided CO_2 emissions. Information for this case study was collected through interviews with Central Hudson and National Grid and Con Edison staff, review of NYSERDA's and Central Hudson's project materials, and supplementary research.

Micatu's Real-Time Voltage Sensors: Beginning in 2015, NYSERDA's Smart Grid program provided a series of awards to Micatu, Inc., through a competitive solicitation process that, in more recent years, was funded by the Clean Energy Fund (CEF). Micatu received approximately $6 million in NYSERDA funding across four project awards. This case study summarizes the key benefits that resulted or are expected to result from NYSERDA's projects with Micatu, including business development, economic benefits, avoided CO_2 emissions, and increased safety. The information for this case study was collected through interviews with Micatu and two New York utilities (Orange and Rockland and Con Edison), review of Micatu's project materials, and research conducted by one of NYSERDA's independent evaluation consultants, Industrial Economics.

Innovation and Research Demonstration Project Impact Evaluation

A summary of the Innovation and Research Demonstration Project Impact Evaluation was provided in the previous report. This evaluation is now final, and a detailed summary is provided in appendix B. The final report is posted to NYSERDA's website.[77]

Advanced Codes and Standards

The objective of this evaluation is to update NYSERDA's Advanced Energy Codes and Standards program savings estimation, providing results for 2015 through 2020. In 2020, evaluators reviewed the methodology NYSERDA applied to estimate the impacts of its Advanced Energy Codes and Standards program (delivered under the Technology and Market Development program [T&MD]) for 2012 through 2018. As part of this review, the evaluator provided recommendations for potential improvements to the savings estimation data sources and methodologies.

In its original methodology, NYSERDA estimated the overall program energy impacts by combining building square footage and residential dwelling unit estimates, energy use intensities (EUI) for various code versions, and code compliance rates. NYSERDA's methodology to determine savings for the residential sector was very similar to its methodology for the commercial sector—relying on an estimated compliance rate for savings relative to a fixed base case. Following a review of the original NYSERDA method for calculating savings for the Advanced Energy Codes and Standards program, the evaluator made several adjustments to that methodology.

Appendix A. Evaluation Report Summaries

A.1 Combined Heat and Power, Market Evaluation Summary

Evaluation Completed by: Opinion Dynamics

EVALUATION OBJECTIVES

This evaluation had three key tasks:

1. Update the Combined Heat and Power Baseline Assessment done in 2015
2. Conduct a baseline assessment of the market awareness of and interest in an On-site Resilient Power (ORP) offering
3. Provide data to estimate replication to support the impact team

DETAILED MARKET EVALUATION FINDINGS AND RECOMMENDATIONS

Task 1 Findings

CHP systems occur in many types of buildings and almost one-third of all CHP installations in New York State are in multifamily buildings and almost two-thirds are in "vulnerable populations." Table A-1 shows the number of CHP systems, totals, and average capacity of systems by market sector.

Table A-1. Number and Capacity of CHP Systems in New York State, by Market Sector

Source: DOE CHP database downloaded May 28, 2019.

	2015	Through 2015	2018	Through 2018
Multifamily Buildings				
Number of CHP Systems	23	144	18	219
Total Capacity (kW)	4,095	117,450	4,880	130,317
Average Capacity (kW)	178	816	271	595
Median Capacity (kW)	150	100	200	100
Assisted Living/Nursing Homes				
Number of CHP Systems	2	56	2	63
Total Capacity (kW)	240	11,906	275	12,541

Table A-1 continued

	2015	Through 2015	2018	Through 2018
Average Capacity (kW)	120	816	138	199
Median Capacity (kW)	120	145	138	120
Hospitals				
Number of CHP Systems	0	36	2	42
Total Capacity (kW)	N/A	56,550	1,305	68,980
Average Capacity (kW)	N/A	1,571	653	1,642
Median Capacity (kW)	N/A	580	653	560
Colleges/Universities/Schools				
Number of CHP Systems	2	88	0	104
Total Capacity (kW)	5,075	169,743	N/A	175,867
Average Capacity (kW)	2,538	1,691	N/A	1,691
Median Capacity (kW)	2,538	233	N/A	225
Hotels				
Number of CHP Systems	3	21	5	33
Total Capacity (kW)	940	22,340	1,080	24,370
Average Capacity (kW)	313	1,064	216	738
Median Capacity (kW)	130	500	130	200
Offices/Commercial Buildings				
Number of CHP Systems	3	24	1	27
Total Capacity (kW)	1,513	31,769	1,200	33,144
Average Capacity (kW)	504	1,324	N/A	1,228
Median Capacity (kW)	500	735	N/A	720
Restaurants				
Number of CHP Systems	0	2	0	2

Table A-1 continued

	2015	Through 2015	2018	Through 2018
Total Capacity (kW)	N/A	390	N/A	390
Average Capacity (kW)	N/A	195	N/A	195
Median Capacity (kW)	N/A	195	N/A	195
Other b				
Number of CHP Systems	8	223	4	247
Total Capacity (kW)	18,830	5,127,383	15,225	5,149,836
Average Capacity (kW)	2,354	22,993	3,806	20,850
Median Capacity (kW)	480	500	813	456
Total				
Number of CHP Systems	41	594	32	737
Total Capacity (kW)	30,693	5,537,531	23,965	5,595,445
Average Capacity (kW)	749	9,322	749	7,592
Median Capacity (kW)	200	300	233	225

[a] The NYSERDA CHP baseline study for 2015 used data for 1995–2015, assuming an average 20-year lifespan of CHP systems. However, this was not necessary since the DOE has attempted to include systems in the CHP database that are operational and to exclude systems that are no longer operational. It can be assumed that some CHP systems in the database are likely no longer operational and that there are some operational CHP systems not included in the database. Given that the DOE database mostly includes operational CHP systems, the research team updated the 2015 baseline results from the DOE CHP database using all CHP systems installed in New York State through 2015, not just those installed from 1995 through 2015.

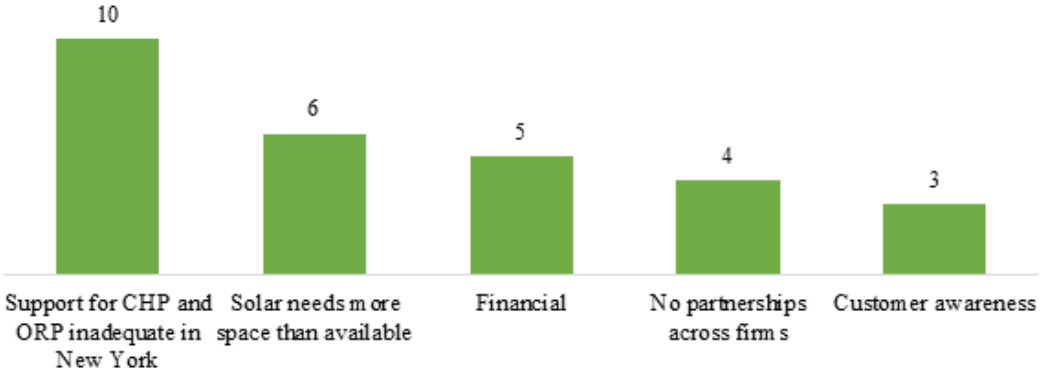
[b] Other includes Agriculture, Air Transportation, Amusement/Recreation, Carwashes, Chemicals, Communications, Community Services, Data Centers, District Energy, Fabricated Metals, Food Processing, Food Sales, Furniture, General Government, Ground Transportation, Households, Instruments, Justice/Public Order, Laundries, Machinery, Miscellaneous Manufacturing, Miscellaneous Services, Oil/Gas Extraction, Other/Unknown, Primary Metals, Printing/Publishing, Pulp & Paper, Rubber & Plastics, Solid Waste Facilities, Stone/Clay/Glass, Textiles, Transportation Equipment, Utilities, Warehouses, Wastewater Treatment, Wholesale/Retail, Wood Products, and Zoos/Museums.

Task 2 Findings and Recommendations

Few professionals had experience installing any element of an ORP system and those that did installed the systems outside of New York State. Three of the 17 indicated experience installing any of these measures and none of these respondents reported doing an ORP system in the State.

CHP Professionals reported multiple barriers to adopting ORP. They noted barriers related to a lack of support for CHP and ORP, physical space limitations, financial limits, a lack of relationships across firm types (CHP, solar, storage), and customer awareness (Figure A-1).

Figure A-1. Barriers to Adoption (N=15)



CHP professionals offered many detailed suggestions for how NYSERDA could support the ORP market. Most commonly reported suggestions pertained to how NYSERDA could develop programmatic support for ORP systems followed closely by suggestions related to financial support. Figure 3 depicts all the ways respondents suggested NYSERDA could support the ORP market with detailed suggestions provided below.

Recommendation 1: Continue to engage CHP, solar, battery storage, and other related professionals about ways to create an ORP network of professionals. A strong engaged network of professionals that know how to develop ORP systems will be critical to designing and using any developed program. Continuing to offer opportunities like the Onsite Resilient Power Conference held in Brooklyn will be critical to developing this network. The network will be critical in assisting NYSERDA in designing an ORP program. Additionally, firms other than CHP professional firms developed the few ORP projects we heard about in New York State. Identifying these ORP early adopters and getting feedback from them could help NYSERDA develop an ORP program and network of ORP professionals.

Recommendation 2: Investigate how other program administrators, states, and countries support ORP-type work. Respondents indicated three locations where they had been involved with ORP systems: California, Puerto Rico, and the Netherlands. Conducting research to see if there has been government or other agency support for ORP systems in these places and how they supported ORP could provide NYSERDA with ideas for how best to support the effort in the State.

Task 3 Findings

There are few, if any, CHP systems installed in New York State that did not receive NYSERDA support over the last four years. The team sought to determine the extent to which end-users with CHP systems were influenced to install CHP systems without NYSERDA support by surveying these end-users. However, as outlined in section 4.3.2, the team determined there were at most 13 CHP systems installed without NYSERDA support over the last four years and survey efforts with those 13 were unsuccessful. To verify that there are few, if any, instances of replication, the team reached out to the three CHP professional firms that installed more than two-thirds of all systems in the State since 2015 and asked them how many systems they installed in 2018 that did not receive NYSERDA support. Two of the three professionals, representing half of all CHPs installed since 2015 as reported in the NYSERDA database, responded to our requests and both indicated there were no unsupported systems installed.

EVALUATION METHODS

There were three key data collection activities: Review of secondary data, interviews with CHP Professionals, and interviews with end-users.

A.2 Combined Heat and Power—Aggregation and Acceleration, Impact Evaluation Summary

Evaluation Completed by: West Hill Energy and Computing

EVALUATION OBJECTIVES

The primary objective is to determine the savings impact from the CHP Aggregation and Acceleration and Performance programs. These impacts include electric generation, natural gas savings due to waste heat utilization, and peak electric generation. For the purpose of this evaluation the peak electric generation refers to the maximum electric generation of the CHP system, not to the grid peak period.

The evaluation plan called for calculating the impacts for both program-initiated and replication projects. Replication projects refers to CHP projects installed in the State that did not receive NYSERDA support. However, based on surveys of CHP professionals the market assessment portion of the evaluation found that there were very few or no projects completed without involvement from NYSERDA. As a result, there are no evaluated savings for the replication projects.

DETAILED IMPACT EVALUATION FINDINGS AND RECOMMENDATIONS

The evaluated gross savings results are shown in the tables below, separated by program as the two programs were analyzed separately. The total evaluated savings are calculated by applying the realization rate from the sites with complete data to the total program reported savings. Table B-2 shows a summary of the total results for the Aggregation & Acceleration (A&A) sites.

Table A-2. Summary of Generation for the Aggregation & Acceleration CHP Sites

	All Evaluated Projects (n=40)			Total Program (n=52)	
	Program Reported	Evaluated Gross Savings	Realization Rate	Program Reported	Evaluated Gross Savings
Electric Generation (MWh)	48,770	32,668	67%	72,163	48,338
Utilized Heat (MMBtu)	63,400	136,084	215%	93,812	201,360
Peak kWa	7,995	5,922	74%	11,830	8,762

[a] The reported peak kW is the rated kW of the facility with an adder for sites with absorption chillers. The evaluated kW is the maximum kW produced at any time during the available data. No information on cooling performance of the absorption chillers was available to calculate the evaluated savings.

The program reported electric generation and utilized heat were calculated using a prescriptive formula based on the rated kW of the system. The electric generation is overestimated with these equations, while utilized thermal energy is being underestimated.

There were only three Performance CHP sites completed during the evaluation period with data available. Table A-3 shows the summary and site-specific results for the Performance CHP. The total evaluated savings are calculated by applying the realization rate from the sites with complete data to the total program reported savings.

Table A-3. Summary of Generation for the Performance CHP sites with DERIDS Data

	All Evaluated Projects (n=4)			Total Program (n=5)	
	Program Contracted[a]	Evaluated Gross Savings	Realization Rate	Program Contracted	Evaluated Gross Savings
Electric Generation (MWh)	90,577	72,915	84%	150,577	126,202
Utilized Heat (MMBtu)	117,750	527,088	448%	195,750	876,241
Peak kWb	10,840	12,978	120%	13,840	16,570

[a] The program contracted only part of the total CHP generation for three of the four evaluated projects, because of this it was possible for the evaluated peak kW to be greater than the contracted peak kW.

[b] The evaluated kW is the maximum kW produced at any time during the available data.

The performance sites have higher realization rates than the A&A sites across all three metrics. These sites are large non-catalog projects, unlike the A&A portion of the program which is primarily based on catalog systems. These also do not use prescriptive equations for estimating CHP generation and heat use, although the values appear to be within a similar range depending on system capacity. In addition, two of the three sites only contracted part of their generation capacity with NYSERDA, and as the DERIDS system measures the entire system, not just the contracted portion, that skews the results for performance projects.

Key Findings

- The forecasted electric generation of the CHP systems is consistently overstated, with lower- than-expected capacity factors.
- The low-realization rate of the electric generation suggests that systems may be oversized for site loads, as is supported by findings of lower-than-expected electric loads in the ERS inspections. The program staff suggested oversizing could be a result of design objectives including the following:
    - Sizing systems for resiliency purposes to accommodate inrush currents during a utility grid outage as opposed to sizing for daily loads.
    - Mischaracterization of addressable loads during the design phase (e.g., failing to account for utility-required forward power draw buffering).
    - The “lumpiness” of sizes of available equipment (e.g., for a given site where 60 kW might be the ideal size, the closest size generator available in the project developer’s product line might be 100 kW).
    - In new construction projects, the building may not have reached full occupancy and thus may not yet have the expected electric and thermal loads .

- The CHP systems take a long time to traverse the start-up/shakedown phase based on the time between the start of data collection and the time of the inspection when the site determines any start-up issues have been resolved.

Based on these findings, the evaluation team has several recommendations for further investigation and improvement of future CHP programs.

1. The consistent overstatement of savings suggests further investigation into the reasons for underperformance is warranted. Additional site inspections or discussion with site contacts may provide insight into why particular sites may not be performing as expected. Based on the range of results, if prescriptive savings functions are used for future CHP installations, they should be adjusted based on the results presented here.
2. Additional effort should be spent on properly sizing the CHPs to each site. In addition to site calculated loads, the assessment should also consider other changes on site, such as other planned energy conservation measures could impact future loads. The ERS report also mentioned a need for minimum import amounts, averaging 10 percent of the CHP capacity, to avoid tripping relay protection devices as the CHP systems are operating behind the meter. A 10 percent under sizing factor may be appropriate to allow for the minimum imports.
3. Discussions with contractors and site operators to investigate the obstacles to CHP system start-up/shakedown would allow future programs to decrease the time between project initiation and the CHP becoming fully operational and reduce turnaround time with any evaluation efforts of future programs.

EVALUATION METHODS

Program participation required the collection of the generation and utilized heat data for all sites over 50 kW. Because of this no sampling was needed. All sites with data available were included in the analysis. As listed in Table 3, the attrition is only related to sites with insufficient data available, either because it was not yet transmitted to NYSERDA or an insufficient time had passed since the CHP was fully operational (as annual savings were only evaluated for projects with at least a year of data). A few of the program projects occurred at the same address, all projects at the same address are considered the same site.

Table 3: Aggregation and Acceleration Project Attrition

	Remaining Project Count	Projects Removed	Remaining Site Count
Total Program Projects	52	N/A	N/A
No Data available	47	5	45
Insufficient Data	40	7	38

Hourly data was available for 47 of the 52 A&A projects in the NYSERDA DERIDS database. The projects without data available had not yet begun transmitting or were below the size requirement for data collection (<50 kW). Of the 47 projects with available data, two projects were installed at the same location therefore the data was combined in the DERIDS database and they were analyzed as one site with combined savings. This resulted in 45 sites with data available.

The final population analyzed accounts for 73 percent of the projects and 68 percent of the total program reported savings. The percent is the same across kW, kWh, and MMBtu as the kWh and MMBtu are calculated proportionally to kW. There are only five performance projects in the list provided by NYSERDA that had been completed as of 2017.

A.3 Combined Heat and Power—Impact Evaluation (2020)

Evaluation Completed by: West Hill Energy and Computing

EVALUATION OBJECTIVES

The objective of this impact evaluation is to conduct a final savings assessment of NYSERDA's Combined Heat and Power (CHP) Program. CHP systems are fossil fuel-fired engines that generate electricity while, at the same time, waste heat from the combustion process is captured and used to offset thermal loads at the host site. NYSERDA's Combined Heat and Power (CHP) intervention has worked to advance a modular CHP market with the intention of reducing soft costs and development time and increasing penetration of CHP. The major activity focuses on continuing to provide cost-shared incentives to support the installation of CHP equipment at eligible host site locations. The incentive program is a continuation/modification of NYSERDA's previous Technology and Market Development (T&MD) CHP Acceleration and Aggregation and CHP Performance Programs. These two programs were merged into a single offering, NYSERDA PON 25682: CHP Program.

In 2016 NYSERDA conducted an evaluation of the CHP Program, the Combined Heat and Power Baseline Assessment. This assessment is the final impact evaluation of the CHP Acceleration and Aggregation (A&A) and CHP Performance Programs.

The evaluation plan called for calculating the impacts for both program-initiated and replication projects, as shown in the Table below. Replication projects refers to CHP projects installed in the State that did not receive NYSERDA support. However, based on surveys of CHP professionals the market assessment portion of the evaluation found that there were very few or no projects completed without involvement from NYSERDA. As a result there are no evaluated savings for the replication projects.

Table A-4. Evaluation Objectives

Objective	Purpose	Method
Estimate final gross impacts of the CHP program	**Determin**e the savings impacts for participating CHP	**Billing** analysis
Estimate any replication impacts of the CHP program	**Determine any impacts of the** CHP program from non participants	**No non-participants** based on market evaluation

Program Data Collection

All CHP Systems larger than 50 kW installed with assistance from NYSERDA were instrumented such that the CHP System performance (including thermal use) could be measured on 1-hour intervals. In addition, NYSERDA sampled the performance of small CHP Systems (50 kW and less) by accessing monitoring systems included within the CHP System by the installer or operator, or, in some instances, by installing monitoring equipment at NYSERDA's expense at select CHP project sites. All performance data is uploaded automatically to NYSERDA's Distributed Energy Resources Integrated Data System (DERIDS) Website, where the data is available to the public. Installations are required to upload performance data daily for at least 3 years. A number of key variables are metered at a 1-hour interval, allowing direct measurement of gross savings. Typical measurements collected for CHP systems installed through the program included monitoring and verification on the following points:

- Gross electric generation (kWh) - The aggregate electric output of the CHP system.
- Parasitic loads (kWh): Electric loads necessary to operate CHP system, including circulating pumps on the DER side of the building load heat exchanger, heat rejection equipment, natural gas compressors, etc. These appear to be included in the field with electric generation as the net CHP kWh.
- Fuel input (cf): The volume of natural gas consumed by the CHP system.
- Useful heat (MMBtu): Heat provided to the host facility for beneficial use that displaces heat from other sources, such as domestic hot water, space heating, make-up air heating, pool heating, snow melt, thermal energy supplied to absorption chillers, and steam production.
- Rejected heat (MMBtu): Heat that is recovered from the CHP system but rejected to the atmosphere; it does not offset a thermal load on-site.

DETAILED IMPACT EVALUATION FINDINGS AND RECOMMENDATIONS

Aggregation and Acceleration Results

Table A-5. Summary of Generation for the Aggregation and Acceleration CHP sites with DERIDS data

	All Evaluated Projects (n=40)			Total Program (n=52)	
	Program Reported	Evaluated Gross Savings	Realization Rate	Program Reported	Evaluated Gross Savings
Electric Generation (MWh)	48,770	32,668	67%	72,163	48,338
Utilized Heat (MMBtu)	63,400	136,084	215%	93,812	201,360
Peak kWa	7,995	5,922	74%	11,830	8,762

[a] The reported peak kW is the rated kW of the facility with an adder for sites with absorption chillers. The evaluated kW is the maximum kW produced at any time during the available data. No information on cooling performance of the absorption chillers was available to calculate the evaluated savings.

The program reported electric generation and utilized heat were calculated using a prescriptive formula based on the rated kW of the system. The electric generation is overestimated with these equations, while utilized thermal energy is being underestimated. On average the electrical systems are only operating at 45% of their rated capacity. The overestimation of the electric generation is linked to this low capacity factor, as the kWh assumption is based on the rated kW multiplied by 6,100, the equivalent of a 70% capacity factor. The program reported MMBtu used was based on a more conservative estimate, resulting in a substantially higher realization rate. As the electric generation has a low capacity factor, utilized heat is a higher percentage of energy consumed, partially explaining the high realization rate of utilized heat shown in the results.

Performance Results

There were only three Performance CHP sites completed during the evaluation period with data available. The table below shows the summary and site-specific results for the Performance CHP. The total evaluated savings are calculated by applying the realization rate from the sites with complete data to the total program reported savings.

Table A-5. Summary of Generation for the Aggregation and Acceleration CHP sites with DERIDS data

	All Evaluated Projects (n=4)			Total Program (n=5)	
	Program Contracteda	Evaluated Gross Savings	Realization Rate	Program Contracted	Evaluated Gross Savings
Electric Generation (MWh)	90,577	72,915	84%	150,577	126,202
Utilized Heat (MMBtu)	117,750	527,088	448%	195,750	876,241
Peak kW[b]	10,840	12,978	120%	13,840	16,570

[a] The program contracted only part of the total CHP generation for 3 of the 4 evaluated projects, because of this it was possible for the evaluated peak kW to be greater than the contracted peak kW.

[b] The evaluated kW is the maximum kW produced at any time during the available data.

Key Findings

As no site visits were conducted as a part of this evaluation, the exact reasons for the low performance of the CHP systems is unclear. The report on inspections completed by ERS as part of the program showed a range of issues that could be causing the low performance.4 Some of these issues are discussed as they relate to key findings from this evaluation.

- The forecasted electric generation of the CHP systems is consistently overstated, with lower-than-expected capacity factors.
- The low realization rate of the electric generation suggests that systems may be oversized for site loads, as is supported by findings of lower-than-expected electric loads in the ERS inspections. The program staff suggested oversizing could be a result of design objectives including the following:
    - Sizing systems for resiliency purposes to accommodate inrush currents during a utility grid outage as opposed to sizing for daily loads.
    - Mischaracterization of addressable loads during the design phase, e.g., failing to account for utility-required forward power draw buffering.
    - The "lumpiness" of sizes of available equipment, e.g., for a given site where 60 kW might be the ideal size, the closest size generator available in the project developer's product line might be 100 kW.
    - In new construction projects, the building may not have reached full occupancy and thus may not yet have the expected electric and thermal loads.
    - The CHP systems take a long time to traverse the start-up/shakedown phase based on the time between the start of data collection and the time of the inspection when the site determines any startup issues have been resolved.

Based on these findings, the evaluation team has several recommendations for further investigation and improvement of future CHP programs.

- The consistent overstatement of savings suggests further investigation into the reasons for underperformance is warranted. Additional site inspections or discussion with site contacts may provide insight into why particular sites may not be performing as expected. Based on the range of results, if prescriptive savings functions are used for future CHP installations, they should be adjusted based on the results presented here.
- Additional effort should be spent on properly sizing the CHPs to each site. In addition to site calculated loads, the assessment should also consider other changes on site, such as other planned energy conservation measures could impact future loads. The ERS report also mentioned a need for minimum import amounts, averaging 10% of the CHP capacity, to avoid tripping relay protection devices as the CHP systems are operating behind the meter. 10% under-sizing factor may be appropriate to allow for the minimum imports.
- Discussions with contractors and site operators to investigate the obstacles to CHP system startup/shakedown would allow future programs to decrease the time between project initiation and the CHP becoming fully operational and reduce turnaround time with any evaluation efforts of future programs.

The full report study is available on the NYSERDA website.[78]

A.4 Smart Grid Program Case Studies

Case Studies Completed by: Industrial Economics, Inc.

A.4.1 Case Study: Grid Modernization Investments at Central Hudson

NYSERDA's Smart Grid program promotes modernization of New York State's electric grid by funding research and technology development projects that can be implemented at the utility scale. Through these projects, the program aims to:

- Increase grid efficiency by encouraging real-time data collection and management.
- Reduce costs associated with integrating renewable energy sources.
- Improve the ability of the grid to predict, withstand and recover from power outages.

Examples of smart grid technologies include remote sensing devices for monitoring grid conditions in real-time, tools enabling two-way communication between a utility's operations center and various points on the grid, and automated controls for optimizing grid performance. These technologies and devices are relatively new and are evolving quickly.

Central Hudson Gas & Electric (Central Hudson) is one of New York State's seven electric utilities; its service territory includes the Mid-Hudson River Valley from north of New York City to Albany County. Since 2008, NYSERDA's Smart Grid program has funded eight Central Hudson grid modernization projects through a competitive solicitation process. Central Hudson received approximately $6 million from NYSERDA across the eight awards.

NYSERDA funding supported a range of projects, including development of a microgrid to prevent outages in Denning, NY, and multiple phases of research and development related to NYSERDA contracted with IEc to evaluate the impacts of NYSERDA's investments in grid modernization at Central Hudson and to present the results in this case study.

Key Results

- $6 million awarded to Central Hudson by NYSERDA for grid modernization
- $52.9 million invested by Central Hudson
    - $8.80 committed by Central Hudson for every $1 of NYSERDA funding
- Reliability benefits valued at $7.3 million due to distribution automation investments
- Economic benefits of $41.7 million from reduced electricity generation to meet customer demand and avoided capital upgrades over 20 years
- 741,188 metric tons of CO_2e emissions avoided over 20 years
- $28.0 million environmental benefits of avoided CO_2e
- Total benefit of NYSERDA's and Central Hudson's funding: $77.0 million
- $12.83 in benefits for every $1 of NYSERDA funding

Qualitative benefits: NYSERDA's funding influenced Central Hudson's follow-on smart grid investments and supported knowledge sharing among utilities that influenced other New York State utilities to undertake grid modernization upgrades grid automation and the integration of renewable resources. Specifically, Central Hudson received support for the development and demonstration of:

- Automated transmission and distribution management systems.
- Superconducting fault current limiters, which prevent problems associated with faults in power lines by detecting and rerouting power flow around the fault.
- Sensors, smart inverters and other monitoring and power controls to aid the efficient integration of renewable energy resources into the power grid.

Four of the eight projects are completed, while the others, which relate to the integration and optimization of renewable energy, are ongoing.

The projects supported by NYSERDA funding helped Central Hudson to modernize its grid and achieve significantly greater efficiencies in grid operations. Following the NYSERDA-funded demonstration of a distribution management and automation system, Central Hudson invested in full-scale transmission and distribution automation. This technology allows Central Hudson to optimize the operation of its transmission and distribution systems – thus avoiding unnecessary generation, reducing fossil fuel consumption and emissions – and eliminate and/or defer costly capital upgrades. The Denning, NY microgrid has also demonstrably improved the reliability of electric service for customers in that area by reducing the number of outages.

The full case study, which quantifies the key benefits that resulted from Central Hudson's and NYSERDA's funding for Central Hudson's grid modernization improvements, is available on the NYSERDA website.[79]

A.4.2 Case Study: Micatu's Real-Time Voltage Sensors

Beginning in 2015, NYSERDA's Smart Grid program provided a series of awards to Micatu, Inc., through a competitive solicitation process that, in more recent years, was funded by the Clean Energy Fund (CEF).

NYSERDA's Smart Grid program promotes modernization of New York State's electric grid by funding research and technology development projects that can be implemented at the utility scale. Through these projects, the program aims to:

- Increase grid efficiency by encouraging real-time data collection and management.
- Reduce costs associated with integrating renewable energy sources.
- Improve the ability of the grid to predict, withstand and recover from power outages.

Examples of smart grid technologies include remote sensing devices for monitoring grid conditions in real-time, tools enabling two-way communication between a utility's operations center and various points on the grid; and automated controls for optimizing grid performance. These technologies and devices are relatively new and are evolving quickly.

Key results of this research include:

- $6 million awarded by NYSERDA
- Pilot project with Con Edison demonstrated a new application of Micatu's sensor
- Distribution contract signed with global distribution company Eaton

- Employment growth from 18 to 60 employees expected in 2020
- Multiplier effect of 78 additional jobs in the New York State economy
- $19.5 million in total value added to the New York State economy
- Potential CO_2e benefits of a utility-scale installation at a large New York utility:
    - Over 75,000 metric tons of CO_2e emissions avoided annually; 1.5 million metric tons of CO_2e emissions avoided over 20 years.
    - $3.8 million in environmental damages avoided annually; $68.5 million in damages avoided over 20 years.
- Increased safety for electric utility line workers

The full case study, which summarizes the key benefits that resulted or are expected to result from NYSERDA's projects with Micatu, including business development, economic benefits, avoided CO_2 emissions, and increased safety, is available on the NYSERDA website.[80]

A.5 Innovation & Research Demonstration Project Impact Evaluation

Evaluation Completed by: DNV GL

Many of NYSERDA's T&MD programs include technology demonstration projects as a means to test the efficacy, performance, and application of new technologies prior to their scale to commercialization. An evaluation of NYSERDA demonstration projects completed between 2014 and 2018 was undertaken to verify and quantify impacts from the funded demonstrations and their associated replication activity.

Data sources for this evaluation study included web-based surveys, in-depth telephone interviews, and project documentation. A standardized set of impact metrics and valuation methods was used across all projects sampled so that the impacts of both the direct demonstration projects and their subsequent replications could be monetized. Evaluation results indicate that $47 million in NYSERDA demonstration project funding led to $155 million of annual monetized benefits from demonstrations and replications, or an annual return of $3.30 for every NYSERDA dollar invested.

Though the lifetime of benefits is somewhat uncertain, a 10-year lifetime would lead to more than $1.5 billion in monetized benefits. The majority of monetized benefits come from replication projects, specifically "other impacts," which were mainly driven by operations and maintenance benefits but also include knowledge creation, labor, marketability, and power quality/reliability. Only two respondents indicated O&M savings; however, these were very significant and when multiplied across associated replications and yielded a very high dollar impact.

The evaluation also examined the frequency of reported replications by program. The most reported replications come from Advanced Buildings followed by Renewable Optimization and Energy Storage Innovation. In all programs, the replications are coming from a small proportion of funded demonstration projects; out of 150 total demonstration projects, 20 projects drove the 601 replications that occurred, with replication happing more frequently in the Advanced Building Program.

The full evaluation report is available on the NYSERDA website[81].

A.6 Behavior Research Program Case Studies

Six behavior pilot case studies were completed and posted on the NYSERDA website. The link to each case study is provided below.

A summary of each behavioral case study is summarized below.

- Influencing Co-op boards to install LEDs[82]
  Brockport Research Institute teamed with SUNY Brockport, First Service Residential's energy management subsidiary (FS Energy), and NYSERDA to investigate strategies to encourage co-op and condo boards in New York City to install energy-efficient light emitting diode (LEDs) in co-op and condo common areas. Custom "energy report cards" were developed for co-op/condo boards that described the cost and energy benefits of installing LED lighting in common areas, and board members were invited to evening social events at a Manhattan restaurant where co-op/condo board members whose buildings had already installed LEDs presented their LED upgrade outcomes. Despite low attendance at the events (26%), 28% of buildings whose board members attending a social event upgraded their common area lighting to LEDs compared to 7% of the control group who were not invited to a social event and were not provided an energy report card. After the pilot was completed, FS Energy continued to provide customized energy report cards presenting the cost and energy benefits of common area LED upgrades to co-op/condo building managers at their regular board meetings where the reports were well received and where attendance was less challenging.

- Reducing Energy and Water Usage in Smart Student Campus Housing[83]
  Clarkson University in Potsdam, NY teamed with IBM and NYSERDA to investigate whether real-time electronic or monthly written feedback and motivational workshops could influence students living in campus housing to reduce their electricity and water usage. The project installed end-use sensors that provided hot water and energy use data, and air quality measures in 77 smart housing apartments. Students who attended the motivational workshop that explored personal and socioenvironmental reasons for reducing energy and water usage used 21% less electricity than students in the control group but did not reduce their hot water usage. Students who received real-time feedback on electricity and water usage, but did not attend a motivational workshop, did not reduce their electricity or hot water usage. Students who attended a motivational workshop and received monthly reports on their energy and water usage reduced their hot water usage by 20% but did not reduce their electricity usage.
- Encouraging the use of programmable thermostats[84]
  Fraunhofer USA, Inc. teamed with the Albany Housing Authority and NYSERDA to investigate whether providing low-income residents in duplex apartments custom-programmed thermostats with setbacks at night and when no one was home would save residents energy. The pilot did not try to influence household temperature preferences. Half of the households were asked to sign a commitment statement agreeing to maintain their custom settings. Residents who did not sign a commitment statement most consistently maintained their settings and used 1.8% less energy compared to a control group. Residents who signed the commitment used 1.1% less energy. Future pilots should consider requesting households use 7-10° Fahrenheit setbacks at night and when no one is home to achieve greater energy savings.
- Educating homeowners about energy efficiency in advance of the Home Energy Assessment[85]
  Ithaca College, NY teamed with Snug Planet and NYSERDA to investigate whether a visit by an Energy Educator from Snug Planet (a Home Performance with Energy Star® (HPwES) contractor) to inform homeowners about low- and no-cost energy efficiency improvements in advance of an energy assessment would lead to greater conversion rates. The Energy Educator compared homes to average and efficient comparable homes and homeowners were provided customized recommendations for no- and low-cost measures to reduce energy use in four key areas: lighting, appliances, electronics, and hot water, and homeowners were asked to sign a commitment to complete the recommended actions. The average conversion rate of the HPwES recommendations was 28% for both the households who received the Energy Educator visit and for the control group that did not receive the Educator visit. This was 10% lower than the rate Snug Planet recorded before the pilot. Because friends, employees, and families of Snug Planet staff requesting HPwES energy assessments were removed from the pilot, this may have explained the overall lower conversion rates, but in either case, a visit by an Energy Educator did not influence conversion rates.

- Influencing employees to turn out lights in offices[86]
  Rensselaer Polytechnic Institute's (RPI) Lighting Research Center (LRC) teamed with NYSERDA to use dynamic messaging to encourage office workers at a State University of New York office building to turn off their fluorescent office lights when sufficient daylight was present during the day and whenever leaving their offices. Dynamic (changing) messages were displayed on small LCD screens adjacent to light switches. When lights were on and workers approached to the door to leave their offices, the screen provided prompts about saving energy, asking workers to turn off lights before leaving. Other messages asked workers to turn off their fluorescent lights when sufficient daylight was present. The evaluation showed that the average wasted light per hour offices were occupied was reduced from 18 minutes per hour to 15 minutes per hour. The evaluation revealed that office workers often leave their lights on to signal they were "at work" for the day and think it is better for economic or energy efficiency reasons not to turn off fluorescent lights for short periods of time. The results show the need for communications from office managers about reducing all unnecessary light usage.
- Inspiring Customers to Choose Clean Energy[87]
  Texas A&M teamed with InfoGroup, ClearlyEnergy and NYSERDA to inspire customers to choose clean, renewable sources of electricity. ClearlyEnergy is a market facilitator for residential green energy (wind-, solar- and hydro-powered electricity). InfoGroup contacted more than a million New York State electricity customers via email invitation to visit ClearlyEnergy's website and learn more about "greening up" their electricity with renewable sources. One group of customers was given a small number of choices for energy providers offering different levels of renewable energy (50% or 100%) and a second group was given a larger number of providers offering similar options. The evaluation showed customers who received the smaller number of choices were no more likely to click online for more information from ClearlyEnergy's landing page than those who received the larger number. There were only two households that showed interest in "greening up" their electricity, one for 50% renewable power and the other for 100% renewable power, and only one customer actually purchased renewable power (at the 100% level). A post-pilot survey indicated that the average willingness to pay (WTP) is $12.77/month for 100% renewable power and $9.10/month for 50% renewable power, and that New Yorkers' WTP does not depend on whether the source of renewable generation is local or national. The survey also found that higher income households are willing to pay more than lower income households and younger heads of households (under age 40) are willing to spend 30% more than older heads of households (over age 40). Because customers' WTP in New York State is less than the cost of renewable energy options sold by New York utilities at the time of the study, researchers concluded that customers were unwilling to purchase renewable power at the prevailing market prices and that offering few or greater clean energy choices was not able to be tested under this pilot.

Appendix B. T&MD Targets

Pursuant to the January 21, 2016 CEF Order, the CEF received a transfer of $182.7 million of uncommitted funds from T&MD as of February 29, 2016. The T&MD program also ended nearly a year early. In the uncommitted funds transfer, individual programs lost between 2 and 91 percent of their budgets, and considering the early sunset of this portfolio, the T&MD targets for each program have been adjusted in this report proportional to the budget reductions each program received. Original targets from the February 15, 2013 Operating Plan are included in this appendix for reference.

Table B-1. Original Targets from the February 15, 2013 Operating Plan

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Advanced Buildings Technology Development	Outputs/Leading Indicators	All Projects	Projects Completed	46	34	26%
Advanced Buildings Technology Development	Outputs/Leading Indicators	All Projects	Projects Contracted	46	34	26%
Advanced Buildings Technology Development	Outputs/Leading Indicators	All Projects	Supported Companies	23	17	26%
Advanced Buildings Technology Development	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	14	10	26%
Advanced Buildings Technology Development	Outcomes/Impacts	All Projects	Product Revenue Amount (millions)	83	61	26%
Advanced Buildings Technology Development	Outcomes/Impacts	All Projects	Products and Technologies Commercialized	6	4	26%
Advanced Energy Codes and Standards	Outputs/Leading Indicators	All Projects	Implementation Support Solicitations	2	1	41%
Advanced Energy Codes and Standards	Outputs/Leading Indicators	All Projects	Program Support Solicitations	2	1	41%
Advanced Energy Codes and Standards	Outputs/Leading Indicators	Code compliance efforts	Annual Code Compliance Assessments	5	3	41%
Advanced Energy Codes and Standards	Outputs/Leading Indicators	Code compliance efforts	Code Requirement Trainees	15,000	8,850	41%
Advanced Energy Codes and Standards	Outputs/Leading Indicators	Code compliance efforts	Training Sessions	12	7	41%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Advanced Energy Codes and Standards	Outputs/Leading Indicators	Equipment and appliance standards efforts	State/Federal Standards Conformance Assessments	3	2	41%
Advanced Energy Codes and Standards	Outcomes/Impacts	Code compliance efforts	Energy Savings Installed (GWh)	631	372	41%
Advanced Energy Codes and Standards	Outcomes/Impacts	Code compliance efforts	Energy Savings Installed (MMBtu)	4,921,000	2,903,390	41%
Advanced Energy Codes and Standards	Outcomes/Impacts	Code compliance efforts	Peak Load Reduction Installed (MW)	129	76	41%
Advanced Energy Codes and Standards	Outcomes/Impacts	Equipment and appliance standards efforts	Energy Savings Installed (GWh)	356	210	41%
Advanced Energy Codes and Standards	Outcomes/Impacts	Equipment and appliance standards efforts	Peak Load Reduction Installed (MW)	168	99	41%
CHP Aggregation and Acceleration	Outputs/Leading Indicators	All Projects	Knowledge/Technology Transfer Activities	10	2	76%
CHP Aggregation and Acceleration	Outputs/Leading Indicators	All Projects	Pre-Packaged Systems	20	5	76%
CHP Aggregation and Acceleration	Outcomes/Impacts	All Projects	Electric Generation Replicated (GWh)	61	15	76%
CHP Aggregation and Acceleration	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	50	12	76%
CHP Aggregation and Acceleration	Outcomes/Impacts	All Projects	Leveraged Funds Replicated (millions)	40	10	76%
CHP Aggregation and Acceleration	Outcomes/Impacts	All Projects	Peak Load Electric Generation Replicated (MW)	10	2	76%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
CHP Aggregation and Acceleration	Outcomes/Impacts	All Projects	Primary Energy Savings Replicated (MMBtu)	79,300	19,032	76%
CHP Aggregation and Acceleration	Outputs/Leading Indicators	All Projects	Electric Generation (GWh)	76	18	76%
CHP Aggregation and Acceleration	Outputs/Leading Indicators	All Projects	Peak Load Electric Generation (MW)	13	3	76%
CHP Aggregation and Acceleration	Outputs/Leading Indicators	All Projects	Primary Energy Savings (MMBtu)	89,125	21,390	76%
CHP Aggregation and Acceleration	Outputs/Leading Indicators	All Projects	Projects	37	9	76%
CHP Performance	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	250	200	20%
CHP Performance	Outputs/Leading Indicators	All Projects	Electric Generation (GWh)	200	160	20%
CHP Performance	Outputs/Leading Indicators	All Projects	Peak Load Electric Generation (MW)	25	20	20%
CHP Performance	Outputs/Leading Indicators	All Projects	Primary Energy Savings (MMBtu)	260,000	208,000	20%
CHP Performance	Outputs/Leading Indicators	All Projects	Projects	16	13	20%
Clean Power Technology Innovation	Outputs/Leading Indicators	All Projects	Projects Completed	51	44	13%
Clean Power Technology Innovation	Outputs/Leading Indicators	All Projects	Projects Contracted	51	44	13%
Clean Power Technology Innovation	Outputs/Leading Indicators	All Projects	Supported Companies	64	56	13%
Clean Power Technology Innovation	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	65	57	13%
Clean Power Technology Innovation	Outcomes/Impacts	All Projects	Product Revenue Amount (millions)	55	48	13%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Clean Power Technology Innovation	Outcomes/Impacts	All Projects	Products and Technologies Commercialized	8	7	13%
Demand Response	Outcomes/Impacts	All Projects	MW Registered Evaluated	23	22	3%
Demand Response	Outputs/Leading Indicators	All Projects	MW Registered (MW)	46	45	3%
Direct Support for Business	Outputs/Leading Indicators	All Projects	Companies Supported	150	147	2%
Direct Support for Business	Outcomes/Impacts	All Projects	Business Executives Transitioned	45	44	2%
Education/Behavior	Outputs/Leading Indicators	All Projects	Community Partnership Participants	575	408	29%
Education/Behavior	Outputs/Leading Indicators	All Projects	Meetings, Workshops, Conferences	5	4	29%
Education/Behavior	Outputs/Leading Indicators	All Projects	Projects Contracted	8	6	29%
Education/Behavior	Outcomes/Impacts	All Projects	Projects Completed	12	9	29%
Electric Vehicle	Outputs/Leading Indicators	All Projects	Supported Companies	30	18	41%
Electric Vehicle	Outputs/Leading Indicators	Research Studies	Projects Completed	8	5	41%
Electric Vehicle	Outputs/Leading Indicators	Research Studies	Projects Contracted	8	5	41%
Electric Vehicle	Outputs/Leading Indicators	Technology, development, demonstration or pilot projects	Projects Completed	25	15	41%
Electric Vehicle	Outputs/Leading Indicators	Technology, development, demonstration or pilot projects	Projects Contracted	25	15	41%
Electric Vehicle	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	42	25	41%
Electric Vehicle	Outcomes/Impacts	All Projects	Market Adoption	3	2	41%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Electric Vehicle	Outcomes/Impacts	All Projects	Product Revenue Amount (millions)	9	5	41%
Electric Vehicle	Outcomes/Impacts	All Projects	Products and Technologies Commercialized	4	2	41%
Emerging Technology/Accelerated Commercialization	Outputs/Leading Indicators	All Projects	Knowledge/ Technology Transfer Activities	38	17	56%
Emerging Technology/Accelerated Commercialization	Outputs/Leading Indicators	All Projects	Stakeholder Engagements	13	6	56%
Emerging Technology/Accelerated Commercialization	Outcomes/Impacts	All Projects	Energy Savings Replicated (GWh)	30	13	56%
Emerging Technology/Accelerated Commercialization	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	7	3	56%
Emerging Technology/Accelerated Commercialization	Outcomes/Impacts	All Projects	Leveraged Funds Replicated (millions)	21	9	56%
Emerging Technology/Accelerated Commercialization	Outcomes/Impacts	All Projects	Market Adoption	7	3	56%
Emerging Technology/Accelerated Commercialization	Outcomes/Impacts	All Projects	Peak Load Reduction Replicated (MW)	7	3	56%
Emerging Technology/Accelerated Commercialization	Outcomes/Impacts	All Projects	Primary Energy Savings Replicated (MMBtu)	231,800	101,992	56%
Emerging Technology/Accelerated Commercialization	Outputs/Leading Indicators	All Projects	Primary Energy Savings (MMBtu)	78,000	34,320	56%
Emerging Technology/Accelerated Commercialization	Outputs/Leading Indicators	All Projects	Projects	17	7	56%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Emerging Technology/Accelerated Commercialization	Outputs/Leading Indicators	All Projects	Energy Savings (GWh)	11	5	56%
Emerging Technology/Accelerated Commercialization	Outputs/Leading Indicators	All Projects	Energy Savings (MW)	2	1	56%
Energy Efficiency	Outputs/Leading Indicators	All Projects	Certifications Developed	3	1	58%
Energy Efficiency	Outputs/Leading Indicators	All Projects	Energy Efficiency Technical Trainees	13,793	5,793	58%
Energy Efficiency	Outputs/Leading Indicators	All Projects	Entry Level Trainees	3,200	1,344	58%
Energy Efficiency	Outputs/Leading Indicators	All Projects	OJT, Hands-On Training	1,867	784	58%
Energy Efficiency	Outputs/Leading Indicators	All Projects	Training Organizations	6	3	58%
Energy Efficiency	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	7	3	58%
Energy Storage Commercialization Center	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	7	6	13%
Energy Storage Commercialization Center	Outcomes/Impacts	All Projects	Product Development Tests	41	36	13%
Energy Storage Commercialization Center	Outcomes/Impacts	All Projects	Products and Technologies Commercialized	25	22	13%
Energy Storage Commercialization Center	Outcomes/Impacts	All Projects	Revenue Amount (millions)	10	9	13%
Environmental Monitoring, Evaluation, Protection	Outputs/Leading Indicators	All Projects	Briefings	30	27	11%
Environmental Monitoring, Evaluation, Protection	Outputs/Leading Indicators	All Projects	Projects Completed	60	53	11%
Environmental Monitoring, Evaluation, Protection	Outputs/Leading Indicators	All Projects	Meetings, Workshops, Conferences	14	12	11%
Environmental Monitoring, Evaluation, Protection	Outputs/Leading Indicators	All Projects	Program Advisory Group Meetings	5	4	11%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Environmental Monitoring, Evaluation, Protection	Outputs/Leading Indicators	All Projects	Science Advisory Committee Meetings	5	4	11%
Environmental Monitoring, Evaluation, Protection	Outputs/Leading Indicators	All Projects	Projects Contracted	60	53	11%
Environmental Monitoring, Evaluation, Protection	Outcomes/Impacts	All Projects	EMEP Research Citations	3,000	2,670	11%
Environmental Monitoring, Evaluation, Protection	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	11	10	11%
Environmental Monitoring, Evaluation, Protection	Outcomes/Impacts	All Projects	Peer-Reviewed Scientific Journal Articles	119	106	11%
Innovation Entrepreneurial Capacity	Outputs/Leading Indicators	All Projects	Incubators or POCCS Participants	405	235	42%
Innovation Entrepreneurial Capacity	Outcomes/Impacts	All Projects	Businesses Graduated from Incubators	162	94	42%
Innovation Entrepreneurial Capacity	Outcomes/Impacts	All Projects	FTEs Associated with Incubator Graduates	486	282	42%
Innovation Entrepreneurial Capacity	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	150	87	42%
Innovation Entrepreneurial Capacity	Outcomes/Impacts	All Projects	Product Revenue Amount (millions)	20	12	42%
Innovation Entrepreneurial Capacity	Outcomes/Impacts	All Projects	Products and Technologies Commercialized	40	23	42%
Market Intelligence	Outputs/Leading Indicators	All Projects	Projects Contracted	5	3	41%
Market Intelligence	Outputs/Leading Indicators	All Projects	Website Downloads	500	295	41%
Market Pathways - C/I	Outputs/Leading Indicators	All Projects	EAL Evaluations	10	6	41%
Market Pathways - C/I	Outputs/Leading Indicators	All Projects	EAL Seminars/ Webinars	10	6	41%
Market Pathways - C/I	Outputs/Leading Indicators	All Projects	Factsheets	6	4	41%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Market Pathways - C/I	Outputs/Leading Indicators	All Projects	Innovative Energy Efficiency Investment Strategy Participants	30	18	41%
Market Pathways - C/I	Outputs/Leading Indicators	All Projects	Seminars/ Webinars	10	6	41%
Market Pathways - C/I	Outcomes/Impacts	All Projects	Projects Completed	20	12	41%
Market Pathways - Midstream Support	Outputs/Leading Indicators	All Projects	Factsheets	9	5	41%
Market Pathways - Midstream Support	Outputs/Leading Indicators	All Projects	Midstream Partner Participants	510	301	41%
Market Pathways - Midstream Support	Outputs/Leading Indicators	All Projects	Midstream Partner Trainees	1,025	605	41%
Market Pathways - Midstream Support	Outputs/Leading Indicators	All Projects	Seminars/ Webinars	9	5	41%
Market Pathways - Midstream Support	Outcomes/Impacts	All Projects	Energy Savings Installed (GWh)	37	22	41%
Market Pathways - Midstream Support	Outcomes/Impacts	All Projects	Market Adoption	3	2	41%
Market Pathways - RES	Outputs/Leading Indicators	All Projects	Energy Smart Product Partner Participants	1,240	732	41%
Market Pathways - RES	Outputs/Leading Indicators	All Projects	Product Partner Trainees	500	295	41%
Market Pathways - RES	Outcomes/Impacts	All Projects	Energy Savings Installed (GWh)	125	74	41%
Market Pathways - RES	Outcomes/Impacts	All Projects	Energy Savings Installed (MMBtu)	895,000	528,050	41%
Market Research	Outputs/Leading Indicators	All Projects	Projects Completed	4	4	4%
Renewable Energy and Advanced Technologies	Outputs/Leading Indicators	All Projects	Certifications Developed	3	1	61%
Renewable Energy and Advanced Technologies	Outputs/Leading Indicators	All Projects	Course Development	8	3	61%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Renewable Energy and Advanced Technologies	Outputs/Leading Indicators	All Projects	Entry Level Trainees	480	187	61%
Renewable Energy and Advanced Technologies	Outputs/Leading Indicators	All Projects	OJT, Hands-On Training	680	265	61%
Renewable Energy and Advanced Technologies	Outputs/Leading Indicators	All Projects	Renewable Energy Technical Trainees	2,000	780	61%
Renewable Energy and Advanced Technologies	Outputs/Leading Indicators	All Projects	Training Organizations	6	2	61%
Renewable Energy and Advanced Technologies	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	4	2	61%
Resource Development	Outputs/Leading Indicators	All Projects	Projects Completed	6	1	91%
Resource Development	Outputs/Leading Indicators	All Projects	Projects Contracted	6	1	91%
Resource Development	Outputs/Leading Indicators	All Projects	Stakeholder Engagements	3	-	91%
Resource Development	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	3	-	91%
Resource Development	Outcomes/Impacts	All Projects	Site Development Potential (MW)	1,000	90	91%
Smart Grid	Outputs/Leading Indicators	All Projects	Supported Companies	34	18	46%
Smart Grid	Outputs/Leading Indicators	Research Studies	Projects Completed	8	4	46%
Smart Grid	Outputs/Leading Indicators	Research Studies	Projects Contracted	8	4	46%
Smart Grid	Outputs/Leading Indicators	Technology, development, demonstration or pilot projects	Projects Completed	29	16	46%
Smart Grid	Outputs/Leading Indicators	Technology, development, demonstration or pilot projects	Projects Contracted	29	16	46%
Smart Grid	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	112	60	46%
Smart Grid	Outcomes/Impacts	All Projects	Market Adoption	6	3	46%

Table B-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
Smart Grid	Outcomes/Impacts	All Projects	Product Revenue Amount (millions)	6	3	46%
Smart Grid	Outcomes/Impacts	All Projects	Products and Technologies Commercialized	3	2	46%
Solar Cost Reduction	Outputs/Leading Indicators	All Projects	Meetings, Workshops, Conferences	10	6	41%
Solar Cost Reduction	Outputs/Leading Indicators	All Projects	Solar (PV) Trainees	2,000	1,180	41%
Solar Cost Reduction	Outputs/Leading Indicators	All Projects	Supported Companies	9	5	41%
Solar Cost Reduction	Outputs/Leading Indicators	All Projects	Training Sessions	200	118	41%
Solar Cost Reduction	Outputs/Leading Indicators	Develop tools, practices, studies, surveys, engagements	Projects Completed	10	6	41%
Solar Cost Reduction	Outputs/Leading Indicators	Develop tools, practices, studies, surveys, engagements	Projects Contracted	10	6	41%
Solar Cost Reduction	Outputs/Leading Indicators	Technology, development, demonstration or pilot projects	Projects Completed	10	6	41%
Solar Cost Reduction	Outputs/Leading Indicators	Technology, development, demonstration or pilot projects	Projects Contracted	10	6	41%
Solar Cost Reduction	Outcomes/Impacts	All Projects	Leveraged Funds Amount (millions)	13	8	41%
Solar Cost Reduction	Outcomes/Impacts	All Projects	Market Adoption	7	4	41%
Solar Cost Reduction	Outcomes/Impacts	All Projects	Product Revenue Amount (millions)	7	4	41%
Solar Cost Reduction	Outcomes/Impacts	All Projects	Products and Technologies Commercialized	1	1	41%

* The actual percent target reduction may vary from the percent budget reduction due to rounding.

Endnotes

[1] Pursuant to the January 21, 2016 CEF Order, the CEF received a transfer of $182.7 million of uncommitted funds from T&MD as of February 29, 2016. The T&MD program ended nearly a year early. Individual programs lost between 2% and 91% of their budgets as a result of this budget transfer and, given the early end to the T&MD portfolio, the T&MD goals for each program have been adjusted in this report proportional to the budget reductions each program received. Original goals from the February 15, 2013 Operating Plan are included in appendix D for reference.

[2] To report certain underlying data on progress with an appropriate number of significant digits, targets are shown with more precision (significant digits) than exist in most of the target estimates. None of the targets changed by showing additional significant digits. Consistent with the Operating Plan for Technology and Market Development Programs (2012–2016), where a target was originally a range, minimum value of the range was used.

[3] Electricity, fossil fuel, and demand savings/generation targets and progress refer to the cumulative annual savings that have been achieved through a particular time period from all measures installed.

[4] With the submittal of its Clean Energy Fund Investment Plan Budget Accounting and Benefits Chapter on February 22, 2016, NYSERDA adopted the NYS Public Service Commission's recommendation in its January 21, 2016 Order Establishing the Benefit Cost Analysis Framework that New York's GHG emissions factor methodology shift from an average grid emission profile to a marginal grid emission profile. Due to this shift, New York's factor to calculate GHG emissions reductions has changed from 625 pounds CO2e/MWh to 1,160 pounds CO2e/MWh. The emissions reductions calculated for this report reflect the new factor of 1,160 pounds CO2e/MWh

[5] Primary energy savings for CHP systems (expressed in MMBtu) is based on the difference between the amount of energy displaced at grid-level generators and the energy used on-site by the CHP installations, accounting for both the avoided energy losses over the transmission and distribution system and the energy saved due to replacement of the on-site boiler with more efficient equipment. The energy displaced at grid-level generators is estimated based on the electricity system simulation model used in the development of the State Energy Plan process.

[6] As of August 13, 2021, the T&MD portfolio has expended $276,122,286 and has $15,017,494 in remaining commitments. All commitments will be expended by the end of 2022.

[7] https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/NYSERDA-GridModernization-Micatu-EvaluationCaseStudyReport-July2020.pdf

[8] Adjustments made to data in previously reported periods is due to lagged data and/or QA/QC.

[9] Current reporting period is subsumed in the column 2017-20

[10] Current reporting period is subsumed in the column 2017-20

[11] Current reporting period is subsumed in the column 2017-20

[12] Current reporting period is subsumed in the column 2017-20

[13] Current reporting period is subsumed in the column 2017-20

[14] The September 13, 2012, Order in Case 10-M-0457, *Order Authorizing the Reallocation of Uncommitted System Benefits Charge III Fund,* included $10 million for a new initiative within the Advanced Clean Power Program focused on reducing the BOS costs for solar electric installations and the development of priority solar electric technology.

[15] In his 2012 State of the State Address, Governor Cuomo announced the NY-Sun initiative, designed to install, in 2013, four times the customer-sited solar electric capacity installed in 2011, while protecting the ratepayer by keeping costs under control.

[16] Adjustments made to data in previously reported periods is due to lagged data and/or QA/QC.

[17] Current reporting period is subsumed in the column 2017-20

[18] Current reporting period is subsumed in the column 2017-20

[19] PSC. Case 07-M-0548 - Proceeding on Motion of the Commission Regarding an Energy Efficiency Portfolio Standard and Case 10-M-0457 – In the Matter of the System Benefits Charge IV. Issued and effective December 17, 2012.

[20] Current reporting period is subsumed in the column 2017-2020

[21] Current reporting period is subsumed in the column 2017-20

[22] https://www.nyserda.ny.gov/About/Publications/Case-Studies-and-Features

[23] Adjustments made to data in previously reported periods is due to lagged data and/or QA/QC.

[24] Current reporting period is subsumed in the column 2017-20

[25] Current reporting period is subsumed in the column 2017-20

[26] Current reporting period is subsumed in the column 2017-20

[27] Current reporting period is subsumed in the column 2017-20

[28] Current reporting period is subsumed in the column 2017-20

[29] Current reporting period is subsumed in the column 2017-20

[30] Adjustments made to data in previously reported periods is due to lagged data and/or QA/QC.

[31] Due to lag required to collect and compile annual data after year end from research partners, contractors and others, 2017 progress is incomplete. NYSERDA will update 2017 progress, adding lagged data, in its next report.

[32] Current reporting period is subsumed in the column 2017-20

[33] See the 2012,2015,2018 reports, infographic and factsheet at nyserda.ny.gov/Partners-and-Investors/Clean-Energy-Startups/NYS-a-National-Leader-in-Cleantech

[34] nyserda.ny.gov/Partners-and-Investors/Clean-Energy-Startups/NYS-a-National-Leader-in-Cleantech

[35] Current reporting period is subsumed in the column 2017-20

[36] Current reporting period is subsumed in the column 2017-20

[37] Current reporting period is subsumed in the column 2017-20

[38] Current reporting period is subsumed in the column 2017-20

[39] Adjustments made to data in previously reported periods is due to lagged data and/or QA/QC.

[40] Current reporting period is subsumed in the column 2017-20

[41] The Motors Program was intended to focus on providing educational and technical support to NYSERDA's Partners (motor suppliers, repair shops, electrical companies, manufacturers, and distributors). However, the program was discontinued prior to market launch.

[42] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2013ContractorReports/2013-PLM-Advanced-Codes-Standards.pdf

[43] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2013ContractorReports/2013-PLM-Advanced-Codes-Standards.pdf

[44] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-New-York-Products-Program-Evaluation.pdf

[45] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2013ContractorReports/2013-PLM-Clean-Energy-Business-Development.pdf

[46] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2013ContractorReports/2013-PLM-Workforce-Development.pdf

[47] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-PLM-CHP-Acceleration.pdf

[48] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-PLM-Advanced-Buildings.pdf

[49] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-PLM-Advanced-Buildings.pdf

[50] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-SCR-logic-model.pdf

[51] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-CPTI-Logic-Model-Report.pdf

[52] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2015ContractorReports/2015-Transportation-LM-Report.pdf

[53] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2013ContractorReports/2013-PLM-EPTD-Smart-Grid-Program.pdf

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[55] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-EMEP-Citation-Analysis.pdf

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[58] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Codes-Process-Evaluation-Report.pdf

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[60] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/AEC-Phase-II-report.pdf

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[62] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2015ContractorReports/NYSERDA%20-and-National-Awareness-of-ENERGY-STAR.pdf

[63] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Smart-Grid-MCA-Report.pdf

[64] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/Clean-Transportation-Market-Characterization-Study-Vol2.pdf

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[72] nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/CHP-Baseline-assessment.pdf

[73] nyserda.ny.gov/About/Publications/Program-Planning-Status-and-Evaluation-Reports/Evaluation-Contractor-Reports/2017-Reports

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[77] https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2020-Innovation-Research-Impact-Evaluation-Final-Report.pdf

[78] https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/NYSERDA/2020-CHP-Impact-Evaluation-Report_.pdf

[79] https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/NYSERDA-GridModernization-CentralHudson-EvaluationCaseStudyReport-July2020.pdf

[80] https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/NYSERDA-GridModernization-Micatu-EvaluationCaseStudyReport-July2020.pdf

[81] https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2020-Innovation-Research-Impact-Evaluation-Final-Report.pdf

[82] https://www.nyserda.ny.gov/-/media/Files/Publications/Case-Studies/Behavior-Research/GEN-BR-brockport-cs.pdf

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[86] https://www.nyserda.ny.gov/-/media/Files/Publications/Case-Studies/Behavior-Research/GEN-BR-rpi-cs.pdf

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