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NYSERDA Technology and Market Development Program

Semiannual Report through December 31, 2017

Final Report

March 2018

NYSERDA's Promise to New Yorkers:

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

Mission Statement:

Advance innovative energy solutions in ways that improve New York's economy and environment.

Vision Statement:

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

NYSERDA Record of Revision

Document Title
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NYSERDA Technology and Market Development Program

Semiannual Report through December 31, 2017

Final Report

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1 Introduction

1.1 T&MD Program Timeline, Mission, and Objectives

The T&MD Program was authorized by the Public Service Commission to run from January 1, 2012 through December 31, 2016. The Program closed approximately one year early, with the final year being subsumed into NYSERDA's 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/under-used technologies and services into the marketplace to serve as a feeder to help achieve 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. Future evaluation reports will present these findings as programs are assessed.

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 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. Where 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.

1.2 Organization of the Report

This semiannual 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 : Public Policy Context
- Appendix B: T&MD Program Advisory Committee Members
- Appendix C: T&MD Program Logic Models
- Appendix D: Evaluation Report Summaries
- Appendix E: T&MD Targets

The T&MD programs are now fully mature, with some working toward final out-year benefits and closing. Therefore, the content in this report has evolved to reflect the entirety of activities undertaken within each of the initiatives, including how accomplishments to date relate to the T&MD portfolio's mission and the output and outcome metrics established in the Operating Plan.

2 Portfolio-Level Reporting

2.1 Portfolio-Level Progress

To establish and implement the T&MD portfolio, NYSERDA previously engaged in an intensive outreach process with stakeholders, developed and released competitive solicitations to implement the initiatives, and conducted other activities to put the T&MD initiatives into operation. These activities are outlined in the following sections.

2.1.1 Solicitations Released

NYSERDA's commitment of funds to T&MD ceased in 2016; therefore, no new solicitations were released in 2017.

2.1.2 Implementation of T&MD Initiatives

Table 2-1 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 total 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, 2017, for each metric.

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

- Energy Efficiency benefits (on-site electricity, fossil fuel and demand reductions) include savings from both directly-funded projects and technology installations, as well as from replications and codes and standards related impacts not directly funded by the program. Electricity and demand savings goals for directly-funded projects have been met, but the remaining energy efficiency metrics expected to accrue from activities not directly funded by the program are not yet reflective of evaluation activities that are required to quantify savings. Specifically, the Advanced Codes and Standards and Advanced Buildings programs anticipated most of their savings to be achieved in latter portion of the T&MD funding period or afterward in the out years, and evaluation activities to verify these savings are in development. Future reports will present findings from evaluation studies as they are completed.[1]
- CHP Projects have performed well in comparison to expected benefits, with nearly all the expectations having been exceeded.

[1] The energy savings for the Market Pathways Products Partners Program are adjusted for the evaluation findings from the following market/impact evaluation that was completed in 2014: nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-New-York-Products-Program-Evaluation.pdf.

- The portfolio has also performed well against the suite of Other T&MD Benefits. The portfolio has met or exceeded many of its goals 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. As expected, more time and out-year progress measurement are needed to attain total goals related to market adoption of improved technologies and commercial sales of new and improved technologies.

The CEF proposal recommended repurposing a substantial amount of 2016 T&MD funding for CEF work. 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.[2] Other noteworthy program implementation and progress milestones are detailed in Section 3.

[2] 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.

Table 2-1. Summary of Anticipated Cumulative T&MD Benefits through December 31, 2017 (at full implementation) for Energy Efficiency, CHP, and Other Benefits[3,4,5,6,7]

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	101.0
GWh Savings from Funded Project and Technology Installations	100.20	0.00	100.20	101.0
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	0.0
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	334,875
MMBtu Savings from Funded Project and Technology Installations	562,370	0	562,370	334,875
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	0
On-site Demand Reduction from Energy Efficiency Projects, Technologies, Replications, and Codes & Standards (Cumulative Annual MW)	132.01	114.28	246.30	133.5
Demand Reduction from Funded Project and Technology Installations	42.01	3.62	45.63	133.5
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	0.0

[3] 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.

[4] 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.

[5] 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

[6] 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. data, in its next report. In certain programs, the progress for the 2012–2013, 2014–2015 and 2016 time periods have been adjusted in this report to capture changes in that period due to lags in data collection or cancellation of projects.

[7] 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.

Table 2-1 continued

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	50.47
MWs Installed from Funded Project and Technology Installations	11.00	12.00	23.00	50.47
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	434.7
GWhs Generated from Funded CHP Project and Technology Installations	78.30	100.00	178.30	434.7
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	565,172
MMBtu Consumed from Funded Project and Technology Installations	101,790	130,000	231,790	565,172
MMBtu Consumed from Anticipated Replications not Directly Funded by Program		19,032	19,032	0

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	78,192
Advanced Technologies Reaching Commercial Availability	42	19	61	89
Improved Technologies Deployment Programs Adopted by the Market or Further Supported by Deployment Programs	8	2	10	6
Commercial Sales of New and Improved Supported Technologies (millions)	$24.60	$109.07	$133.67	$125.96
Funding Leveraged (co-funding and outside investment) by Investment (millions)	$481.43	$19.93	$501.36	$986.71
Clean Energy Businesses Graduating from Incubators	90	4	94	94
Clean Energy Companies Receiving Support	466	30	496	533
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	45,674
Supply Chain Training to Facilitate Adoption of Energy Efficient Products (Partner Employees)	900		900	2,376

2.1.3 Budget and Spending Status

Table 2-2 shows the T&MD program budget and financial status through December 31, 2017. Committed and spent funds are also shown as a percent of the total 2012–2016 budget.

Table 2-2. Budget and Financial Status for T&MD Programs through December 31, 2017

	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	$22,948,627	68%	$31,048,124	92%
Advanced Clean Power	$31,396,343	$22,785,462	73%	$29,868,082	95%
Combined Heat and Power[c]	$46,055,354	$10,749,751	23%	$37,889,874	82%
Total Power Supply & Delivery	*$111,342,259*	*$56,483,840*	*51%*	*$98,806,080*	*89%*
Building Systems					
Advanced Buildings	$48,393,575	$20,726,904	43%	$37,062,420	77%
Advanced Energy Codes & Standards	$9,785,964	$7,365,326	75%	$9,174,664	94%
Total Building Systems	*$58,179,539*	*$28,092,230*	*48%*	*$46,237,084*	*79%*
Clean Energy Infrastructure					
Market Development	$44,255,742	$39,585,296	89%	$42,510,769	96%
Clean Energy Business Development	$25,287,254	$22,411,860	89%	$25,025,563	99%
Environmental Monitoring, Evaluation and Protection (EMEP)	$16,428,580	$11,164,804	68%	$16,407,994	100%
Workforce Development[c]	$15,945,695	$13,173,938	83%	$13,451,361	84%
Total Clean Energy Infrastructure	*$101,917,271*	*$86,335,898*	*85%*	*$97,395,686*	*96%*
Total of All Program Areas	***$271,439,069***	***$170,911,969***	***63%***	***$242,438,851***	***89%***
Administration (8%)	$39,765,533	$39,708,685	100%	$39,765,533	100%
NYS Cost Recovery Fee (1.7%)	$7,175,497	$4,188,183	58%	$7,175,497	100%
Evaluation (5%)	$22,363,455	$6,886,183	31%	$22,363,455	100%
Grand Total - Portfolio	***$340,743,554***	***$221,695,020***	***65%***	***$311,743,336***	***91%***

* 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 Order.

3 T&MD Initiatives

This section provides a status update on each of the nine T&MD initiatives, including budget status and highlights of 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 3-1 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 3-1. Power, Supply, and Delivery Budget and Financial Status through December 31, 2017

	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	$18,690,136	73%	$25,478,235	99%
Electric Vehicle	$8,260,815	$4,258,491	52%	$5,569,889	67%
Total Smart Grid/Electric Vehicle	*$33,890,565*	*$22,948,627*	*68%*	*$31,048,124*	*92%*
Advanced Clean Power					
Technology Innovation	$24,228,401	$17,095,173	71%	$22,804,491	94%
Resource Development	$1,256,016	$693,480	55%	$1,233,582	98%
Solar Cost Reduction	$5,911,926	$4,996,809	85%	$5,830,009	99%
Total Advanced Clean Power	*$31,396,343*	*$22,785,462*	*73%*	*$29,868,082*	*95%*
Combined Heat & Power[c]					
CHP Aggregation & Acceleration	$5,974,523	$4,209,881	70%	$5,899,609	99%
CHP Performance	$40,080,831	$6,539,870	16%	$31,990,265	80%
Total Combined Heat & Power	*$46,055,354*	*$10,749,751*	*23%*	*$37,889,874*	*82%*
Grand Total - Power, Supply, & Delivery Initiatives	***$111,342,262***	***$56,483,840***	***51%***	***$98,806,080***	***89%***

* 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 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 between State regions. 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's investor-owned utilities and solar 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 early 2017, NYSERDA was notified by a solar developer that their portfolio of 2017—build projects underwent rereview by the utility resulting in a reduction of the interconnection costs by 48% on this portfolio of projects. This positive outcome was directly attributed to the work of the Interconnection Technical Working Group and stems from new technical criteria created by the group for anti-islanding mitigation and monitoring and control criteria.
- The Potsdam Microgrid project endeavors to provide an oasis of power during widescale grid outages to benefit the residents of Potsdam, NY and the surrounding area. The idea to create a community microgrid in Potsdam predates the NY Prize program, stemming from the 1998 Northeast ice storm, and NYSERDA funded the preliminary design study for this microgrid which was completed in 2017. The Potsdam microgrid project has continued through a REV Demonstration project with National Grid. Project partners continue to be heavily NY-based including Clarkson University, the Town of Potsdam, General Electric, Nova Energy Specialists and National Grid.

- Micatu, Inc. is a developer of optical sensors for power system applications. Micatu completed a successful NYSERDA innovation-funded demonstration of their overhead voltage sensor product with Orange and Rockland Utilities. Micatu sensors were deployed in the field with Orange and Rockland Utilities and their performance measured over the course of a one-year evaluation period. The success of the field deployment with Orange and Rockland Utilities led to deployment of a Micatu sensors with ConEdison beginning in 2017. NYSERDA collaboration with Micatu led to a productive relationship between Micatu and Clarkson University for independent third-party laboratory testing of Micatu's products as well as an expansion of Micatu's product line.

Table 3-2 shows performance milestones and results for the Smart Grid Program through December 31, 2017. 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.

Table 3-2. Smart Grid Performance Milestones and Results through December 31, 2017[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	3	8
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	5	24
All Projects	Supported Companies - Target	8	10			18
	Supported Companies - Progress	21	15	6	0	42

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	$13.15	$63.97	$10.10	$0.81	$88.03
	Products and Technologies Commercialized - Target			1	1	2
	Products and Technologies Commercialized - Progress	0	2	0	0	2
	Product Revenue Amount (millions) - Target				$3.24	$3.24
	Product Revenue Amount (millions) - Progress	$0.00	$1.25	$0.50	$0.00	$1.75
	Market Adoption - Target			2	1	3
	Market Adoption - Progress	0	0	5	0	5

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

9 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.

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, 2017, more than 820 EV charging stations had been installed through NYSERDA programs.
- NYSERDA's contractor, Energetics, Inc., compiled updated reports on the use of NYSERDA-supported EV charging stations installed through the EV Charging Station Demonstration Program. The reports show quarterly use of the stations broken down by geographic region, type of location, and business model.
- NYSERDA made progress on a project to conduct a benefit-cost analysis of EV impacts for utilities and ratepayers in New York State, which should be completed in Q1 2018.
- 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.
- Long Road Enterprises continues development of their innovative switched-reluctance motor. To develop early markets, they entered into an agreement with a major supplier of HVAC systems. Refining the technology on smaller motors for HVAC systems will help build toward delivering the motors for cars and trucks. They are currently procuring components and seeking out contract manufacturers to assist in building a prototype.
- The Coalition for Green Capital completed a study investigating a range of purchasing options to improve the economics of public fleet purchases of EVs. The study found that while there was no clearly superior approach to purchasing at this time, new approaches like transportation-as-a-service show promise as the market grows and adapts.
- Energetics, Inc. has been analyzing use statistics at long dwell-time parking lots and investigating potential options for new low-cost EV charging station installations at these locations to try to identify ways to improve the economics of installing charging stations, especially at workplaces.
- Clean Communities of Central New York completed a project focused on increasing the adoption of EVs through the expansion of workplace charging programs. The project team met with dozens of workplaces across the State to discuss the value of workplace charging and was able to move several workplaces forward to install charging stations for employees.
- Energetics, Inc. worked with planning organizations statewide to develop resources for planning boards on how to incorporate EV charging stations into new site approvals. They provided a wide range of trainings to practitioners around the State and their documents will be published on NYSERDA's website as reference documents.

- Vermont Energy Investment Corporation (VEIC) launched a pilot of a car dealer incentive program to test the concept of providing a benefit to the salespeople who sell EVs when they make a sale. The project is working with dealers in the Hudson Valley and Capital District

Table 3-3 shows performance milestones and results for Electric Vehicle Infrastructure Program through December 31, 2017. 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.

Table 3-3. Electric Vehicle Infrastructure Performance Milestones and Results through December 31, 2017 [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	0	18
	Projects Completed - Target		3	6	6	15
	Projects Completed - Progress	0	3	5	6	14
Research Studies	Projects Contracted - Target	4	1			5
	Projects Contracted - Progress	1	12	2	2	17
	Projects Completed - Target		4	1		5
	Projects Completed - Progress	0	2	7	3	12
All Projects	Supported Companies - Target	5	10	3		18
	Supported Companies - Progress	3	21	6	0	30

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	$0.57	$0.13	$30.20
	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	$0.00	$1.75
	Market Adoption - Target			1	1	2
	Market Adoption - Progress	0	1	0	0	1

[10] 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 the next report.

3.1.2 Advanced Clean Power

3.1.2.1 Clean Power Technology Innovation Program

The Clean Power Technology Innovation Program works to advance clean power 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 of these technologies, 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:

- Cadenza Innovation, a pioneering provider of energy storage solutions based on disruptive architectures for lithium-ion battery packs, completed a collaborative research project with NYSERDA demonstrating a path to achieving the cost, performance, and safety targets of their high-density "Super-Cell" design. Cadenza is now embarking on the next phase of their product development, a complete battery pack and module incorporating prototype Super-Cells. The company is presently contracting with NYSERDA to demonstrate a complete prototype system integrated with a commercial building. The prototype system will provide peak saving benefits and gather real-world use-case data highly relevant to New York's commercial power market.
- NOVOROCS, a catalyst and product developer in batteries, fuel cells, and reformers, began business development activities that included increasing the fuel cell catalyst and reformer customer base by three additional customers, including one customer from outside the fuel cell industry. They have now obtained seven repeat orders from customers who have taken delivery of an initial prototype, resulting in a > 50% customer retention rate for new customers. NYSERDA agreement 35063 provided the anchor project for NOVOROCS. Leveraging progress in the project, NOVOROCS raised additional capital from a Department of Energy (DOE) Phase 1 project ($150K), and a ARPA-E project ($225K), They have the potential for another $750K funding if they satisfy objectives to advance to DOE Phase II funding.
- LC Drives, a developer of innovative DC Drives, developed modeling tools and test fixtures to assemble a commercially viable 20" electric motor with a patented cooling technique. This motor has interest from multiple customers with diverse applications; i.e. mass transit, wind energy, marine propulsion, drill rigs, etc. The contractor secured an additional $550K award from NYSERDA's Advanced Clean Energy program—funding will be used to fully develop stator, rotor, and testing rig manufacturing for 20" electric motor. LC Drives secured three purchase orders from target customers and have attracted external investment capital from both State and private entities, expected to lead to a Series A round of fund raising in 2018.

Table 3-4 shows performance milestones and results for the Technology Innovation and Energy Storage programs through December 31, 2017. Commercialization metrics for projects that only received SBC III funding are not reported here. Outputs/Leading Indicators measure immediate results; 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.

Table 3-4. Clean Power Technology Innovation (top two sections) and Energy Storage Commercialization Center (bottom section) Performance Milestones and Results through December 31, 2017[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	5	22
	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	$71.62	$42.36		$133.50
	Products and Technologies Commercialized - Target		1	2	4	7
	Products and Technologies Commercialized - Progress	3	2	1	0	6
	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	$0.00	$26.17

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	$0.16	$2.14
	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	$0.93	$2.40
	Product Development Tests - Target	2	8	6	20	36
	Product Development Tests - Progress	0	19	11	6	36

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

12 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.

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 Clean Energy Standard to meet 50% of New York's electricity needs with renewable sources by 2030. On January 29, 2018, the New York Offshore Wind Master Plan was released, 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 to advance offshore wind, originally initiated under the T&MD Program. With work in this area now progressing under CEF, the previous90 MW site development potential target, noted in Table 3-5, has been superseded by the current State offshore wind goal of 1.5 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 this Anaerobic Digestion Assistance Initiative (ADAI) contract, Cornell is providing technical assistance to farms seeking to develop new digester to electricity systems and/or improve the operation of existing digester systems. Part of the ADAI work has also been including assisting marketplace participants in understanding new tariff provisions evolving under initiatives for Reforming the Energy Vision. For the remaining year of the ADAI, ending March 1, 2019, Cornell will be working with marketplace participants to assist in the development of proposals for the forthcoming anaerobic digestion solicitation designed to demonstrate new business models leading to a self-sustaining anaerobic digestion marketplace.

Table 3-5 shows performance milestones and results for the Resource Development Program through December 31, 2017. 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 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.

Table 3-5. Resource Development Performance Milestones and Results through December 31, 2017

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[13]

This program helped achieve the goals of the NY-Sun initiative[14] 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.

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13 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.

14 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.

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

- BOS program activities are complete and New York experienced significant Solar PV adoption, with greater than 800 MW installed in State.
- Through December 2017, 3,801 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.

Table 3-6 shows performance milestones and results for the Solar Cost Reduction program through December 31, 2017. 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 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.

Table 3-6. Solar Cost Reduction Performance Milestones and Results through December 31, 2017[15,16]

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	2	2
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	4	7
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	0	53

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	$0.00	$20.14
	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	$0.00	$0.16
	Market Adoption - Target		3	1		4
	Market Adoption - Progress	0	0	1	0	1

3.1.3 Combined Heat and Power (CHP)

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 kW to 1.3 MW, the nameplate capacity range of a majority of NYSERDA's previous CHP projects, and serves as the foundation for transition to the CEF-funded program in 2016, which expanded to support CHP systems 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

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

16 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.

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 during); 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:

- Marketing and outreach activities continued under the CHP Program funded by IPEC/CEF.
- Twelve projects were completed and are now operational.

Table 3-7 shows performance milestones and results for the CHP Aggregation and Acceleration Program through December 31, 2017. Energy savings reported in Table 3-7 are program-reported; evaluation activities 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; e.g., 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; Outcomes/ Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period.

Table 3-7. CHP Aggregation and Acceleration Performance Milestones and Results through December 31, 2017

Outputs/Leading Indicators

		2012-13	2012-15	2012-16	2012-20
All Projects	Projects - Target	3	9	9	9
	Applications Approved but not yet Contracted - Progress	0	2	0	6
	Projects Contracted but not yet Completed - Progress	4	33	30	15
	Projects Completed - Progress	0	16	28	41
	Total Progress	4	51	58	62
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	0.39
	Peak Load Electric Generation Projects Completed (MW) - Progress	0.00	1.26	1.43	1.75
	Total Progress	0.02	1.99	2.19	2.14
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	2.41
	Electric Generation Projects Completed (GWh) - Progress	0.00	7.69	8.71	10.65
	Total Progress	0.09	12.15	13.33	13.05
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	3,128
	Primary Energy Savings Projects Completed (MMBtu) - Progress	0	9,996	11,324	13,842
	Total Progress	119	15,789	17,335	16,970

		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% and a maximum of 1.6 pounds/MWh of NO_x emissions.[17] To quantify the performance-based payments, the program applies rigorous, multi-year 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 will initially be limited to the Con Edison service territory.

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

- Various projects have financial partnerships with the New York Green Bank, the Dormitory Authority of the State of New York, as well as the New York City Energy Efficiency Corporation. Such arrangements have bridged financing gaps for applicants who seek an opportunity in replacing existing infrastructure with cleaner, resilient, more efficient CHP systems thus generating substantial energy and greenhouse gas savings throughout the 20+ year lifetime of their equipment.
- Seven projects, representing more than 30MW of installed nameplate capacity, are under construction. As they prepare for their respective measurement and verification periods, the aggregated peak load reduction commitments exceed 20MW.

[17] 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.

Table 3-8 shows performance milestones and results for the CHP Performance Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; Outcomes/Impacts measure achievements. Energy savings reported in Table 3-8 are program-reported; evaluation activities 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; e.g., 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; Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period.

Table 3-8. CHP Performance Program Performance Milestones and Results through December 31, 2017

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	7
	Projects Completed - Progress	0	1	1	4
	Total Progress	4	14	13	12
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	35.20
	Peak Load Electric Generation Projects Completed (MW) - Progress	0.00	2.80	2.80	7.13
	Total Progress	24.27	57.25	51.03	48.33
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	322.51
	Electric Generation Projects Completed (GWh) - Progress	0.00	25.00	25.00	61.50
	Total Progress	187.22	469.60	433.22	421.69
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	419,262
	Primary Energy Savings Projects Completed (MMBtu) - Progress	0	32,500	32,500	79,946
	Total Progress	243,389	610,475	563,182	548,201

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	$112.55	$82.40	$7.40	$213.82

3.2 Building Systems Initiative

Table 3-9 shows the Building Systems budget and financial status through December 31, 2017. 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 3-9. Building Systems Budget and Financial Status through December 31, 2017

	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	$4,703,594	33%	$14,109,211	98%
Technology Development	$25,007,131	$10,876,416	43%	$16,337,242	65%
Demand Response	$9,019,519	$5,146,894	57%	$6,615,967	73%
Total Advanced Buildings	*$48,393,575*	*$20,726,904*	*43%*	*$37,062,420*	*77%*
Advanced Energy Codes & Standards	$9,785,964	$7,365,326	75%	$9,174,664	94%
Grand Total - Building Systems Initiatives	***$58,179,539***	***$28,092,230***	***48%***	***$46,237,084***	***79%***

* 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 Order.

3.2.4 Advanced Building Technologies

3.2.4.1 Emerging Technology/Accelerated Commercialization (ETAC) – Buildings

The 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-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 accelerate 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:

- NYSERDA's ETAC-C/I program offering remains closed, effective as of December 31, 2015.

ETAC-Multifamily

The goal of this program is to identify energy efficiency methodologies, technologies, or strategies that are commercially available, but under-used in the multifamily market and to address the market barriers preventing their broader adoption. This goal will be accomplished through selected projects that will demonstrate the technologies or strategies, identify barriers to their implementation, and develop strategies to address identified barriers. Project contractors will transfer technology via a combination of published papers and presentations.

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

- Contractors have completed installation of equipment for all three ETAC projects:
  - Supply side orifice steam plates
  - Domestic hot water controls
  - LED lighting with occupancy sensors in common areas
- All three projects are reporting energy savings.
- Contractors are in the process of identifying installation and market barriers for each technology.
- Projects will be completed and closed in 2018.

- All three contractors have submitted, and approved, the M&V plan for their ETAC projects.
- Two Contractors completed project installation:
  - The Centralized Domestic Hot Water Controls project is now reporting savings.
  - The Supply Side Steam Orifice Plates project will report savings at the end of the 2016–2017 heating season.
- The LED Lighting and Controls project installation is anticipated to begin spring 2017.

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 three current projects are focused on LED lighting. The subsequent solicitation under ETAC-RES focused on high-efficiency HVAC equipment.

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

- Lighting systems were installed at all the 18 demonstration sites under Program Opportunity Notice (PON) 2752.
- All the sites have completed the M&V phase and data acquisition equipment has been removed and final energy usage and savings data has been compiled for these sites.
- PON 3127 Emerging Technology Demonstration Projects—Residential HVAC was issued in January 2016. Eligible technologies under this solicitation include air-source and ground-source heat pumps, and low-capacity natural gas furnaces. Of the eight proposals that were received on April 21, 2016, five demonstration projects were approved for $1,806,860 in cost-share funding. Contracts for all demonstrations and M&V have been fully-executed and work is being completed.

Table 3-10 shows performance milestones and results for the ETAC Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; Outcomes/Impacts measure achievements. Energy savings reported in Table 3-10 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; e.g., 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.

Table 3-10. Emerging Technology/Accelerated Commercialization Performance Milestones and Results through December 31, 2017

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	1
	Projects Contracted but not yet Completed - Progress	0	13	17	19
	Projects Completed - Progress	1	4	5	7
	Total Progress	1	18	30	27
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	0.02
	Peak Load Reduction Projects Contracted but not yet Completed (MW) - Progress	0.00	1.10	1.60	2.45
	Peak Load Reduction Projects Completed (MW) - Progress	0.00	0.25	0.25	1.09
	Total Progress	0.00	1.36	2.80	3.56
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	0.07
	Electric Savings Projects Contracted but not yet Completed (GWh) - Progress	0.00	15.94	17.83	21.96
	Electric Savings Projects Completed (GWh) - Progress	0.00	0.75	0.75	1.38
	Total Progress	0.00	16.76	20.41	23.41
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	70,221	73,479
	Primary Energy Savings Projects Completed (MMBtu) - Progress	1,053	1,614	27,913	16,821
	Total Progress	1,053	77,297	98,133	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	$0.08	$4.45	$2.88	$3.09	$10.50
	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

3.2.4.2 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 to help accelerate the introduction of emerging technologies to New York State markets.

A number of technology development projects in this time period commercialized a product or received additional follow-on private investment. Examples include:

- LED Specialists (Kings Park, NY) commercialized a low-profile driver and OLED frame holder enabling fixture manufacturers to design and offer energy efficient OLED lighting,
- OLEDWorks (Rochester, NY) commercialized a Brite Amber OLED light panel. The OLEDWorks amber product, at >50 lumens/watt, is an efficient solution that provides amber lighting free of blue wavelengths which are disrupted to natural sleep patterns. Consequently, amber has increased interest in health care, senior living centers, public facilities such as prisons, and sleeping areas in residences. OLEDWorks also commercialized a Brite 2 FL300 OLED panel. With a luminous flux of up to 300 lumens the FL300 is still the brightest OLED panel in warm white commercially available worldwide. OLED Devices, LLC, using OLEDWorks lighting panels commercialized the Ascend OLED desk lamp.
- Steven Winter Associates (New York, NY) successful demonstrated the benefits of retrofitting linkageless controls onto existing boilers in multifamily buildings in NY. Demonstration showed a 2 to 5% efficiency improvement over a well-tuned mechanical linked control. The information will be used to inform policy and future code requirements.
- An initial funded feasibility study of a fuel cell technology to enable the production of electricity from post combustion exhaust gas in furnaces, boilers, or hot water heaters has led to the formation of a start-up company FirePower (Syracuse, NY). The technology offers to enable self-powered residential furnaces, hot water heaters, and boilers. Follow-up funding was provided to further the technology.
- A successful demonstration of Hudson Fisonic's device in NYC buildings produced market interest and sales of the fisonic device. The fisonic device uses steam pressure to pump steam heated water throughout the building eliminating the need for a mechanical pump saving energy.

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 with the public in public presentations, case study reports, and published articles. Funding to demonstrate successful pilot interventions at larger demonstration scale was allocated to three demonstration projects through NYSERDA's Behavior Demonstration Program (PON 2646). These projects are under contract development.

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

- Under RFP 3072 funding, ideas42 prioritized three of NYSERDA's 10 strategies identified during the first half of the year, and began planning the design of the three pilots, with the aim of incorporating behavioral strategies into existing NYSERDA programs or integrating such strategies in a way to increase impact in certain market sectors, including the low and moderate-income segment of the population. The three pilots are currently under development with launch dates ranging from Q2 to Q4 2017. Separate contracts under this RFP were completed with KEMA (for independent evaluation services) and Action Research (for behavior design services). KEMA is providing evaluation oversight services for the pilots being developed by ideas42.
- Under PON 2631 funding, 11 behavior research pilots were contracted, of which 7 behavior pilots were completed (3 within this reporting period), three were terminated for lack of viable implementation partners (during the previous reporting period), and an eighth behavior research pilot that will be completed Q2 2018.
- Sara Silverstone, Brockport Research Institute and FS Energy successfully used a social event and custom light emitting diode (LED) proposals to influence New York City co-op and condo board members to upgrade their building common area lighting to LEDs. Board members who attended a social dinner event and received a custom LED lighting proposal were 18% more likely to upgrade their common area lighting to LEDs than other board members. Influenced by the success of the pilot, FS Energy is providing custom LED lighting proposals to all of the buildings it manages in New York City.
- Carnegie Mellon University demonstrated that homeowners in Ithaca NY are reluctant to use their homes to host Do-It-Yourself home energy workshops to encourage their friends and neighbors to implement low- and no-cost energy-efficiency improvements to their homes, proving that this is not a viable outreach strategy.
- Ithaca College and Snug Planet showed that sending an energy educator to visit homes in advance of a home energy assessment (audit) did not results in greater conversion rates of audit recommendations. Households visited by the energy educator were more likely to do easy, one-time things like cleaning clothes dryer ducts and adjusting refrigerator and freezer temperatures, but they were not influenced to invest in more expensive but more effective energy-efficiency upgrades.

- Texas A&M and ClearlyEnergy are using choice architecture to determine the optimal number and relative characteristics of renewable power options to influence residential customers to "green up" their electricity purchases. More than 1 million New York residents were invited to enroll in renewable energy plans varying by renewable content and the evaluation will be completed Q4 2017.

Table 3-11 shows performance milestones and results for the Technology Development Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; 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.

Table 3-11. Advanced Buildings Technology Development Performance Milestones and Results through December 31, 2017[18,19]

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	4	85
	Projects Completed - Target		23	11		34
	Projects Completed - Progress	0	14	12	26	52
	Supported Companies - Target	12	5			17
	Supported Companies - Progress	19	42	8	4	73

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	$0.30	$143.65
	Products and Technologies Commercialized - Target		1	3		4
	Products and Technologies Commercialized - Progress	2	4	3	0	9
	Product Revenue Amount (millions) - Target			$8.00	$53.42	$61.42
	Product Revenue Amount (millions) - Progress	$0.44	$14.28	$6.70	$0.00	$21.42

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

19 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.

3.2.4.3 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:

- Four demand response enablement projects have been implemented that save 470 kW, representing more than $2 million in private investment.

Table 3-12 shows performance milestones and results for the DR Program through December 31, 2017. Energy savings reported in Table 3-12 are program-reported; evaluation activities are in development and future reports will present findings as the studies finalized. Outputs/Leading Indicators measure immediate results; Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period.

Table 3-12. Demand Response Performance Milestones and Results through December 31, 2017

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	2.03
	MW Registered Projects Completed (MW) - Progress	40.22	115.59	126.17	127.95
	Total Progress	47.71	124.87	129.34	129.98

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

3.2.4.4 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 within these areas are described in the following sections.

3.2.4.5 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:

- There were no compliance assessments conducted or completed in 2017. The last assessment conducted under this program will begin in 2018.

3.2.4.6 Development and Delivery of Advanced Training and Tools

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:

- Codes Team successfully collaborated with the Communities and Local Governments Team through the Energy Code Enforcement Training High Impact Action, one of 10 associated with the Clean Energy Communities Program. Through this Action, the Codes Team provided project-specific Energy Code plan review and inspection training to 220 municipalities, demonstrating best practices for Energy Code enforcement and the value of third-party services.
- In 2017, 442 Energy Code plan reviews were performed, 276 of which came through Clean Energy Communities.
- In 2017, 280 Energy Code on-site inspections were performed, 218 of which came through Clean Energy Communities.

3.2.4.7 Technical Support, Studies, and Resources

Technical consulting and other research firms will be competitively selected to provide technical and administrative support 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:

- NYSERDA, through a contract with the International Code Council, published the *Code & Commentary to the Energy Conservation Construction Code of New York State-2016 (Commentary).* This is the only single volume that combines both elements of the NYS Energy Conservation Construction Code (the IECC-2015 and NYS Supplement to the IECC-2015). Copies of the Commentary were distributed to every code enforcement office in the State, as well as design and construction professionals.
- A Gap Analysis and Action Plan was completed in 2017. Through this effort, NYSERDA received valuable market feedback from key stakeholders and segments of the building design, construction and enforcement professions, which informed ongoing T&MD initiatives as well as Clean Energy Fund investment planning.

3.2.4.8 Pilots and Expanded Implementation Assistance

Pilots testing strategies for improved code compliance and enforcement strategies and stretch, and green planning efforts were 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:

- NYStretch Code—Energy 2015, the State's first above-minimum Energy Code, was developed and went through public comment in 2017. A toolkit and strategy to support municipal adoption is underway. In late 2017, as a result of the NYStretch Code—Energy 2015 development efforts, New York City expressed interest in potentially adopting NYStretch as a basis of its future codes for 2019 and 2022.
- Development began—with contributions from residential, commercial, and multifamily technical advisory groups—on NYStretch Code-Energy 2018, which will improve efficiency requirements above the International Energy Conservation Code-2018 (IECC-2018). The IECC-2018 is expected for statewide adoption in Q3 2019. New York City Council approved Local Law 32, requiring Department of Buildings to match this and future stretch codes in 2019 and 2022. Public comment on NYStretch Code-Energy 2018 will occur in Q1 2018.

Table 3-13 shows performance milestones and results for the Advanced Energy Codes and Standards Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; Outcomes/Impacts measure achievements. Energy savings reported in Table 3-13 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.

Table 3-13. Advanced Energy Codes and Standards Performance Milestones and Results through December 31, 2017

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	6,189	12,463
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	0.00	0.00	0.00	0.00
	Energy Savings Installed (MMBtu) - Target	575,000	1,057,000	726,000	545,390	2,903,390
	Energy Savings Installed (MMBtu) - Progress	0	0	0	0	0
	Peak Load Reduction Installed (MW) - Target	18.00	28.00	19.00	11.11	76.11
	Peak Load Reduction Installed (MW) - Progress	0.00	0.00	0.00	0.00	0.00
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 3-14 shows the Clean Energy Infrastructure budget and financial status through December 31, 2017. 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 3-14. Clean Energy Infrastructure Budget and Financial Status through December 31, 2017

	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	$4,295,868	97%	$4,312,639	97%
Market Pathways	$32,694,001	$29,251,524	89%	$31,131,969	95%
Education/Behavior	$7,126,371	$6,037,904	85%	$7,066,160	99%
Total Market Development	*$44,255,742*	*$39,585,296*	*89%*	*$42,510,769*	*96%*
Clean Energy Business Development					
Innovation Entrepreneurial Capacity	$21,356,497	$18,598,771	87%	$21,027,120	98%
Market Intelligence	$988,978	$902,293	91%	$960,663	97%
Direct Support for Business	$2,350,975	$2,323,413	99%	$2,446,975	104%
Marketing	$590,804	$587,383	99%	$590,804	100%
Total Clean Energy Business Development	*$25,287,254*	*$22,411,860*	*89%*	*$25,025,563*	*99%*
EMEP	$16,428,580	$11,164,804	68%	$16,407,994	100%
Workforce Development					
Renewable Energy/Advanced Technologies	$5,843,483	$4,979,887	85%	$5,109,965	87%
Energy Efficiency	$10,102,212	$8,194,051	81%	$8,341,396	83%
Total Workforce Development	*$15,945,695*	*$13,173,938*	*83%*	*$13,451,361*	*84%*
Grand Total - Clean Energy Infrastructure	***$101,917,271***	***$86,335,898***	***85%***	***$97,395,686***	***96%***

* 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 Order.

3.3.5 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.

3.3.5.1 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 were conducted or completed in 2017 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 3-15 shows performance milestones and results for the Market Research Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period.

Table 3-15. Market Research Performance Milestones and Results through December 31, 2017

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

3.3.5.2 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).

During this reporting period, the products team continued to investigate and develop strategies around three emerging and underutilized technologies: air source heat pumps (ASHPs), home energy management systems (HEMS) and advanced rooftop units (ARTUs). Strategies in the promotion of ASHPs made the greatest advancement with the launch of the ASHP Program, which is providing incentives to participating installers. The Products team continued to research the opportunities for HEMS and ARTUs in the State as well as communicating extensively with stakeholders on the key stall points and barriers that prevented those stakeholders from moving these markets.

The team also continued to develop project components of NYSERDA's agreement with Vermont Energy Investment Corporation (VEIC). This project was awarded under NYSERDA's PON 3125 "Accelerating Availability of Targeted Residential Products" and allows for VEIC to implement a residential upstream ASHP pilot in the Con Edison (Con Ed) utility service territory. This pilot seeks to influence ASHP manufacturers and distributors with various approaches while complementing downstream ASHP rebates offered by Con Ed. The pilot launched during the first quarter of 2017, with a final evaluation report anticipated for the first quarter of 2018.

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 ASHRAE/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 Commercial Lighting and HVAC Program Business Partners programs closing 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.

Table 3-16 shows performance milestones and results for the Market Pathways Program through December 31, 2017. Energy savings reported for the Business Partners program in Table 3-16 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; Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period.

Table 3-16. Market Pathways Performance Milestones and Results through December 31, 2017

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	0	8

3.3.5.3 Education to Change Behavior and Influence Choices Component

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 offering 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) are underway. Each demonstration is in a different stage of completion:
- The EIC demonstration completed one full year of implementation activities; after Q2 2018, implementation will finish, and the persistence analysis phase will begin and determine if savings continue to accrue once the intervention is lifted.
- The Oracle demonstration (formerly Opower) with Con Edison was launched in May 2017. The program is successful and implementation is slated for one full year, after which the persistence analysis phase will begin.

- The ThinkEco demonstration completed one full year of implementation and is now entering the two year-persistence phase.
- Nexant, the oversight evaluation contractor, is working with each demonstration project to collect the appropriate data to conduct the savings analysis. They will then conduct the persistence evaluation and a cost-effectiveness analysis to determine the benefits and impacts of scaling up each demonstration.
- NYSERDA contracted with Action Research to provide behavior design consulting services for clean energy behavior change pilots in the State.

Low-Income Forum on Energy (LIFE)

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 within the Clean Energy Fund. All program activities will continue under this initiative.

Table 3-17 shows performance milestones and results for the Education/Behavior Program through December 31, 2017. 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 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.

Table 3-17. Education/Behavior Performance Milestones and Results through December 31, 2017

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

3.3.6 Clean Energy Business Development

3.3.6.1 Innovation/Entrepreneurial Capacity Building

There are three Proof-of-Concept Centers (POCC): New York University, in partnership with the City University of New York, and Columbia University, in partnership with Stony Brook University, Cornell NYC Tech, and Brookhaven National Laboratory, are co-branding the two programs as PowerBridgeNY. Another POCC is run through 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 pre-startup 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. The centers are expected to operate independently after NYSERDA funding ends.

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:

- Three NEXUS-NY teams were selected for awards as part of the 76West Clean Energy Competition.
- A team from the second NEXUS-NY cohort won a contract from the Bill and Melinda Gates Foundation.
- Two teams from the third NEXUS-NY cohort and one team from the second cohort successfully completed due diligence and were negotiating investment agreements with the Shell Game Changer innovation program.
- As a spin-off from the PowerBridgeNY program, Columbia University launched a Hacking for Energy graduate course in January 2017. As of the application deadline at the end of 2016, industry hosts provided seven problem statements that attracted 23 applications. Teams of four graduate students worked with an industry mentor in a Lean LaunchPad-focused graduate course. As a result of initial success in the pilot year of Hacking for Energy, PowerBridgeNY continued to offer the program in the 2017–2018 academic year.
- As of the end of 2017, at least eight PowerBridgeNY teams received either private investment or non-NYSERDA grant funding to continue business and product development.

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 startup 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:

- Rochester Institute of Technology's Venture Creations incubator graduate ClearCove Systems, a Victor-based renewable energy company, raised additional capita from investors and strategic partners to commercialize its water treatment process that harvests organic matter from wastewater, providing energy and cost reductions in wastewater treatment processes.
- Stony Brook University's Clean Energy Business Incubator Program client ThermoLift, a Stony Brook-based clean energy company, raised additional private capital from its lead investor to further develop its natural gas air-conditioner and heat pump technology that combines heating, air-conditioning, and water heating into a single appliance.
- New York University's ACRE incubator graduate Anellotech, a Pearl River-based clean energy company, closed out its Series D investment with funds from a new strategic investor and existing investors to further scale up production of its cost competitive renewable chemicals from nonfood biomass.

Table 3-18 shows performance milestones and results for the Innovation/Entrepreneurial Program through December 31, 2017. The metrics only reflect results from the incubators that received T&MD funding. Outputs/Leading Indicators measure immediate results; 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.

Table 3-18. Innovation/Entrepreneurial Milestones and Results through December 31, 2017[20,21]

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	13	69	187

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	9	37	2	46	94
	FTEs Associated with Incubator Graduates - Target	108	108	54	12	282
	FTEs Associated with Incubator Graduates - Progress	185	124	14	240	563

3.3.6.2 Market Intelligence

New York State Clean Energy Technology Innovation Metrics

Reports are done every three years. In the past, NYSERDA worked with SRI International to research and prepare the 2015 report update on clean energy technology metrics.[22] To determine the metrics for the first report, focus groups involved nearly 100 individuals including entrepreneurs affiliated with cleantech startup 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 report will track those same metrics three years later.

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

21 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.

22 See the 2015 report, infographic and factsheet at nyserda.ny.gov/Partners-and-Investors/Clean-Energy-Startups/NYS-a-National-Leader-in-Cleantech

Table 3-19 shows performance milestones and results for the Market Intelligence Program through December 31, 2017. 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 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.

Table 3-19. Market Intelligence Performance Milestones and Results through December 31, 2017

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

3.3.6.3 Direct Support for Business Acceleration Program

NYSERDA's Entrepreneurs-In-Residence (EIR) program offers experienced entrepreneurial coaching to NYSERDA contractors and incubator clients. Some of the general outcomes and observations from the program show companies struggle with customer delivery and engagement and the development of an overall business strategy. Most of these companies are founded by technical entrepreneurs who initially lack the business skills to bring a high-impact clean energy product to market.

During 2017, the program continued placing experts with startup 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 also created stricter standards for EIRs and went through a comprehensive interview and review process. This was done to ensure only those EIRs that fit NYSERDA's requirements were retained and more clearly understand the specialties and strengths of each EIR so that company matches would achieve the specific goals set for engagements.

Additionally, the program created a reporting mechanism that reduced administrative time for the administrator while saving NYSERDA money and providing better and more timely information. Other changes included adding services that met specific needs of companies where the needs could not be efficiently addressed using the standard mentoring service normally provided in the program.

The New York Executive Clean Energy Leadership (NY EXCEL) program at Skidmore College included visits to the New York Independent System Operator and a full-day visit to NYSERDA to learn about 14 energy segments and well as seminars by renewable experts, legal, and regulatory entities. The students also traveled around the State for weekend classes and to visit companies and support centers in Syracuse, Saratoga, White Plains, New York City, Long Island, and Rochester.

NY Clean Start at 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: their struggle to understand the big picture of their company's 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. NYSERDA contracted with Northeast Clean Energy Council Institute (NECEC) to develop this online tool.

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

- NY EXCEL (Skidmore College) completed its second cohort in with 16 students in January 2016. In 2017, Skidmore informed NYSERDA of the difficulty in attracting students to the that second year program despite extensive joint marketing efforts by Skidmore and NYSERDA. Several alternative programs were researched and reviewed with NYSERDA. Ultimately, NYSERDA decided not to pursue a pivot since the proposals by Skidmore were too disassociated from the original intended NYSERDA objectives. The program was amicably terminated with Skidmore before the third cohort.
- The fourth cohort of the NY Clean Start program to the New York University Advanced Diploma in Clean Energy will start February 5, 2018. For the third cohort (February through June 2017), the shift in branding of the NY Clean Start program to the New York University Advanced Diploma in Clean Energy greatly improved the number of applicants, which resulted in a richer diversity of students.
- In 2017 the Startup GPS Commercialization Toolkit (www.startupGPS.org) was presented at several incubator sites around the State and an informational webinar was held. Usage has topped more than 700 unique users, with 67% new sessions from June through December 2017.

Table 3-20 shows performance milestones and results for the Direct Support for Business Acceleration Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; Outcomes/Impacts measure achievements. Blank cells indicate the lack of a target in a particular time period. Companies supported includes companies with new and improved products serving State markets. Business executives transitioned includes the transition of business executives to the clean energy technology industry.

Table 3-20. Direct Support for Business Acceleration Performance Milestones and Results through December 31, 2017[23,24]

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

3.3.7 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 entered into an agreement with Green City Force, a Brooklyn-based provider of training and job placement support to disadvantaged young adults, in April 2017. The first cohort of 35 students under this agreement graduated on June 1, 2017. A new cohort of 23 members began their training on November 1, with an anticipated completion date of mid-February. Targeted recruitment has been from the Mayor's Action Plan sites, the 15 highest-crime New York City Housing Authority developments. To date, 32 graduates have been placed in clean energy sector jobs, two have been placed in jobs outside the clean energy sector, and one is still searching for work.

[23] During the December 31, 2017 reporting period, the EIR program commenced 18 new engagements with companies referred by NYSERDA project managers and NYSERDA affiliated incubators. Detail will be provided in future reports.

[24] 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.

Workforce development efforts for high-efficiency, low-emissions biomass heating systems in 2017 included:

- Trainings for contractors, installers, designers, and engineers
  - In-person, all-day trainings
    - "Hydronics for High Efficiency Biomass Boilers"
  - Web-based training
    - "Replacing an outdoor wood furnace with a cordwood gasification boiler—design and installation considerations"
    - "Integrating Thermal Storage with Biomass Boilers"
    - "Best practices for venting and chimneys on cordwood gasification and pellet boilers"
- Technical support for contractors, installers, designers, and engineers
  - System design reviews
  - On-site/one-on-one assistance
  - Creation of a System Design Guidance Manual

Table 3-21 and Table 3-22 show performance milestones and results for the Workforce Development Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; 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.

Table 3-21. Workforce Development—Renewable Energy Performance Milestones and Results through December 31, 2017

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 3-22. Workforce Development—Energy Efficiency Performance Milestones and Results through December 31, 2017

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	35	14,520
	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

3.3.8 Environmental Monitoring, Evaluation, and Protection (EMEP)

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:

- A digital aerial baseline Survey of Marine Wildlife in support of New York State offshore wind energy development was continued, and four additional seasonal surveys were completed. The project is the largest aerial digital survey of marine wildlife ever undertaken. The project will reduce costs and accelerate the environmentally responsible development of offshore wind energy.
- Outreach activities included sponsoring the Northeast Ecosystems Research Cooperative Conference and the 13th International Conference on Mercury as a Global Pollutant (ICMGP).
- Several environmental research projects were completed and their reports were posted to the NYSERDA website and/or published in peer-reviewed journals.

Table 3-23 shows performance milestones and results for the EMEP Program through December 31, 2017. Outputs/Leading Indicators measure immediate results; 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.

Table 3-23. Environmental Monitoring Performance Milestones and Results through December 31, 2017[25,26]

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	9	28
	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	0	3
	Meetings, Workshops, Conferences - Target	5	6	1		12
	Meetings, Workshops, Conferences - Progress	7	13	6	2	28
	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	$0.13	$40.94
	EMEP Research Citations - Target			2,670		2,670
	EMEP Research Citations - Progress	0		0	0	0
	Peer-reviewed Scientific Journal Articles - Target	10	35	45	16	106
	Peer-reviewed Scientific Journal Articles - Progress	15	40	48	0	103

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

26 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.

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 time line 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 2017, PTLM activities were completed and reports posted to NYSERDA's website for the following programs/areas:

- Smart Grid[27]
- Advanced Codes and Standards[28]
- EDGE[29]
- New York Products[30]
- Clean Energy Business Development[31]
- Workforce Development[32]
- CHP Aggregation and Acceleration[33]
- Advanced Buildings: ETAC[34]

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27 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.

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

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

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

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

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

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

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

- Advanced Buildings: Technology Development[35]
- Solar Cost Reduction[36]
- Clean Power Technology Innovation[37]
- Transportation[38]

During this reporting period, 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 2017, focused process evaluations were completed for the following T&MD programs. Each of these process evaluation reports is available on the NYSERDA website:

- Smart Grid[39]
- Workforce Development[40]
- EMEP[41]

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

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

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

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

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

40 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-EMEP-Workforce-Development.pdf

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

- Solar Cost Reduction[42]
- EDGE[43]
- Advanced Codes and Standards[44]

During this reporting period, two process evaluation were completed for the following programs/areas:

- Advanced Buildings Technology Development[45]
- Advanced Codes and Standards Behavioral Study[46]

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.

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42 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2015ContractorReports/Solar-Cost-Reduction-process-evaluation.pdf

43 .nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2015ContractorReports/2015-economic-development-growth-extension-process-evaluation.pdf

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

45 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/Advanced-Buildings-Technology-Development-Process-Evaluation.pdf

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

- **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 2017, focused market evaluations were completed for the following T&MD programs:

- NY Products Program[47]
- NYSERDA and National Customer Awareness of ENERGY STAR® for 2014 (Analysis of Consortium for Energy Efficiency Household Survey)[48]
- Smart Grid Market Characterization[49]

Prior to December 2017, impact evaluations were completed for the following programs/areas:

- Advanced Codes and Standards Impact Evaluation, Phase 1[50]
- Market Pathways: Business Partners[51]

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

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

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

50 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/2016-advanced-energy-codes.pdf

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

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

- Transportation Market Characterization Assessment[52]
- Transportation: Six Impact/Market Evaluation Case Studies[53,54,55,56,57,58]
- Clean Energy Business Development Market Assessment[59]
- Combined Heat and Power Market Assessment[60]
- ETAC/Advanced Buildings Technology Development Solid State Lighting and Controls Market Characterization and Assessment[61]

During this reporting period, no impact evaluations were completed. Market/Impact evaluations are planned or are underway for the following programs/areas with expected completion date in parentheses:

- Advanced Codes and Standards Impact Evaluation, Phase 2 (Q4 2018)

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

53 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/Transportation-Case-Study-Report-Leviton.pdf

54 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/2016-Transportation-Case-Study-Buffalo-Niagara-Medical-Campus.pdf

55 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/2016-transportation-case-study-electric-refrigeration.pdf

56 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Alstom-Transportation-cs.pdf

57 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Saab-Sensis-Advanced-Airport-Departure-Manager-Transportation-cs.PDF?la=en

58 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Adaptive-Control-Decision-Support-System-Traffic-Management-Transportation-cs.pdf

59 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/ICBD-MCA-Final-Report.pdf

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

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

4.4 Higher-Level Studies

In addition to evaluation activities, NYSERDA conducts studies organized around one or more high-level research questions that focus on data, impacts, and processes across programs. The studies reflect a range of evaluation activities, including market characterizations, process evaluations, and market and energy impact assessments. The list of high-level studies is likely to evolve over time to meet NYSERDA's needs. This list includes, but is not necessarily limited to, the following activities:

- **Data and resources:** How can the NYSERDA R&D Metrics Database and the existing data from prior evaluations best support evaluation efforts for the T&MD portfolio?
- **Solicitation process and markets:** How well is NYSERDA's current solicitation process reaching intended markets and soliciting high-quality proposals?
    - During the first half of 2016, a Solicitation Process Benchmarking Assessment was completed. It provided best practices and lessons for NYSERDA based on the solicitation processes relied upon by other peer organizations.
- **NYSERDA's reputation:** What is the effect of NYSERDA's reputation on support for products and innovations, and how can NYSERDA best use its institutional credibility to support products and innovations?
    - During the first half of 2016, a NYSERDA Reputation Effect study was completed that provided information on how well recognized NYSERDA and its programs are among its stakeholders, how the brand is perceived, the effect of the reputation on projects, and other opportunities for NYSERDA's reputation to help the market.
- **Portfolio performance:** What are the effects of NYSERDA's shift from focus on technology development to its newer, broader focus on technology and business development?
    - During the first half of 2017, an Integrated Strategy study was completed that looked at NYSERDA's integrated business and technology development strategy. Investment data was used to identify any important patterns or potential opportunities.
- **R&D demonstration project impacts:** What are the direct and replication impacts of NYSERDA demonstration projects and how do these evolve and accumulate over time?
    - During the first half of 2014, the R&D demonstration project impact study was completed.[62] This study updated a prior similar evaluation and addressed R&D demonstration projects completed in 2008–2010. An update to this study was completed in the first half of 2017.[63]

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62 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-RD-Demo-Survey-Report.pdf

63 nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/RD_Demonstration_Project_Survey_Report.pdf

- **Informing decisions and policy:** How can NYSERDA and external organizations effectively incorporate experience from past NYSERDA projects into decisions about the design of programs and policies?
    - During the first half of 2016, the Learning from Experience project was completed that provided information on NYSERDA's current approach to learning from experience, best practices in organizational learning implemented by peer organizations, and recommendations for improvement.

Appendix A: Public Policy Context

The System Benefits Charge (SBC) was established by Order of the New York State Public Service Commission (PSC) in 1998. The PSC established the ratepayer-supported SBC and designated the New York State Energy Research and Development Authority (NYSERDA) as the administrator of the program. The program was reauthorized in 2001 and 2006 for five-year terms. For the period 2006 through 2011, program funding was $154 million per year, of which approximately half focused on energy efficiency resource acquisition/deployment activities and half on technology and market development activities.

In its September 20, 2010 petition to the PSC to continue the SBC, NYSERDA proposed modifications to the program, including consolidating and transferring the resource acquisition and deployment activities within the Energy Efficiency Portfolio Standard (EEPS) Program and requesting to extend the current SBC by six months to coincide with the December 31, 2011 conclusion of the current EEPS Program. The petition also summarized the history and accomplishments of the SBC and described a proposed Technology and Market Development (T&MD) portfolio to serve as the next iteration of the SBC.

The PSC issued a Notice of Proposed Rulemaking on October 6, 2010 (Case 10-M-0457) and asked for comments on NYSERDA's proposal to be submitted by November 22, 2010. NYSERDA and the Department of Public Service (DPS) also conducted a technical conference on November 4, 2010, to provide stakeholders and interested parties with more information on the potential use of SBC funds for the T&MD Program. The PSC issued an order on December 30, 2010, which "reaffirmed its high-level commitment to the continuation of SBC programs and to the important State policy goals they support."[64] The December 30, 2010 order continued SBC through the end of 2011 but deferred a decision on the proposed T&MD Program pending a more robust stakeholder input process and submission of an operating plan.

NYSERDA submitted the T&MD Operating Plan on May 16, 2011. On June 8, 2011, PSC issued a Notice of Proposed Rulemaking requesting public comment on the operating plan by July 25, 2011, with reply comments due August 15, 2011. The operating plan requested average annual program funding of $70 million for seven initiatives, plus $15 million for an incremental Combined Heat and Power (CHP) initiative.

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[64] PSC. Case 10-M-0457 and Case 05-M-0090. *Order Continuing System Benefits Charge Funded Programs.* Issued and effective December 30, 2010.

In a PSC order issued on October 24, 2011, NYSERDA's T&MD Operating Plan was approved, including a CHP initiative for five years (January 1, 2012 through December 31, 2017). The average annual funding rate of $93.8 million represented $80 million in program costs and $13.8 million for administration, evaluation, and New York State Cost Recovery Fees.[65] This plan included $65 million in program costs ($76.2 million total) for NYSERDA's "base" T&MD initiatives and $15 million in program costs ($17.6 million total) for a CHP Initiative. Of the $15 million for CHP, $5 million in SBC funds was approved in the order to be used for the CHP Aggregation and Acceleration Program, and at NYSERDA's option, for feasibility studies. The remaining $10 million for the CHP Performance Program was to be derived from a source other than the SBC funds approved in the October 24, 2011 order. NYSERDA was directed to submit a plan for funding the balance of the CHP Initiative by March 31, 2012. By March 31, 2012, NYSERDA was also directed by the order to submit an accounting of SBC III funds that were uncommitted as of December 31, 2011 with the option to submit a proposal for use of those funds, as well as SBC III funds that may become uncommitted in the future.

A revised T&MD Operating Plan was filed with PSC on December 22, 2011, updating NYSERDA's May 16, 2011 submittal to comport with the October 24, 2011 order.[66]

On March 9, 2012, NYSERDA submitted a full accounting of uncommitted SBC III funds as directed in the October 24, 2011 order. On March 30, 2012, NYSERDA submitted a petition proposing ways to allocate those uncommitted SBC III funds among three primary activities:

- Develop and implement programs to reduce solar (also known as solar photovoltaic or PV) balance-of-system costs and support priority solar electric technology development ($10 million).
- Provide cost-sharing support as part of a Brookhaven National Laboratory proposal to the U.S. Department of Energy solicitation for a New York State Energy Storage Innovation Hub ($10 million, with $2.5 million allocated to the New York Battery and Energy Storage Technology Consortium [NY-BEST]).
- Expand NYSERDA's Advanced Buildings Program ($5.76 million, including $3 million for an Advanced Buildings Consortium and $3.76 million for a deep energy savings initiative in commercial buildings).

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65 PSC. Case 10-M-0457 – *In the Matter of the System Benefits Charge IV*. Issued and effective October 24, 2011.

66 NYSERDA, 2011. Technology and Market Development Program Operating Plan for 2012–2016, System Benefits Charge, December 22 and revised November 13, 2012 and February 15, 2013 nyserda.ny.gov/-/media/Files/About/System-Benefits-Charge/SBC-Five-Year-Operating-Plan.pdf

NYSERDA requested to apply $1.75 million in uncommitted SBC III funds to New York State Cost Recovery Fee assessments applicable to SBC III. In addition, NYSERDA requested approval to allocate uncommitted SBC III funds to projects committed as of December 31, 2011. A notice was issued on May 11, 2012 and requested comments by August 3, 2012.

In addition, on March 30, 2012, NYSERDA submitted petitions to provide funding for the CHP Program and to provide continued funding and expansion of NYSERDA's workforce development initiatives as directed in the October 24, 2011 order.[67] PSC issued a Notice of Proposed Rulemaking on May 9, 2012 and requested comments by August 3, 2012.

On September 13, 2012, the PSC issued an order and approved, with modifications, NYSERDA's requests in its petition regarding uncommitted SBC III funds.[68] The PSC approved the reallocation of SBC III funds into the T&MD portfolio to support T&MD solar electric activities ($10 million) and Advanced Buildings activities ($5.76 million) as well as NYSERDA's support of the BNL proposal and NY-BEST ($10 million, with $2.5 million allocated to NY-BEST).[69] Also approved was NYSERDA's allocation of SBC III funds to New York State Cost Recovery fee assessments. The PSC did not approve NYSERDA's request to reallocate uncommitted SBC III funds to projects committed as of December 31, 2011 in advance but directed NYSERDA to submit for review and approval any proposals separately. The Order directed NYSERDA to submit, within 60 days, a supplemental revision to its T&MD Operating Plan to account for the approved initiatives. A revised T&MD Operating Plan was filed with PSC on November 13, 2012 to comport with the September 13, 2012 Order. This plan included $75.15 million in average annual program funding plus $12.06 million in average annual funding for administration, evaluation, and cost recovery.

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67 Petitions related to adjusting the goals and funding for EEPS programs were also submitted on this date.

68 PSC. Case 10-M-0457 – *In the Matter of the System Benefits Charge IV*. Issued and effective September 13, 2012.

69 Per the September 13, 2012 Order, if the BNL proposal was not selected by U.S. DOE, NYSERDA had seven days to notify the DPS Office of Energy Efficiency and the Environment (OEEE) of this decision and 60 days to submit a proposal on how those funds should be reallocated. On December 5, 2012, NYSERDA notified DPS OEEE of the proposal denial and designated February 5, 2013 as the date for NYSERDA to submit an alternative proposal to use the funds. The due date for this submission was subsequently extended three times and on September 5, 2013, NYSERDA submitted a petition to transfer $7.5 million in uncommitted SBC III funds to a Power Electronics Manufacturing Consortium proposal in response to a U.S. DOE solicitation. In an order issued December 20, 2013, the PSC approved use of these funds with the same requirements regarding proposal acceptance and denial as described above.

The PSC issued an Order on December 17, 2012 and approved, with modifications, the requests described in the balance of NYSERDA's March 30, 2012 petitions.[70] In this order, the PSC approved NYSERDA to reallocate $35.9 million from the Benchmarking and Operations Efficiency and the Electric Reduction in Master-Metered Buildings (EEPS) programs and $22.7 million in uncommitted EEPS-1 funds to support the T&MD CHP Initiative. In addition, the Order approved NYSERDA reallocating $24 million in EEPS-1 funds ($12 million in electric funding and $12 million in natural gas funding) to support T&MD workforce development initiatives. PSC also directed NYSERDA to submit a supplemental revision to its T&MD Operating Plan by February 15, 2013 to comport with the December 17, 2012 order.[71] On June 16, 2014, NYSERDA submitted a petition to the PSC to add $7.5 million to the CHP initiative. This petition was withdrawn on November 14, 2014[72] with the recommendation that the uncommitted funds be considered within the overall context of the Clean Energy Fund (CEF).

The CEF proceeding was initiated by the PSC in a May 8, 2014 Order Commencing Proceeding.[73] PSC noted in the order that NYSERDA's CEF proposal "should refocus on market and technology transformative strategies designed to provide temporary intervention and support to overcome specific barriers and produce self-sustaining results." In response, NYSERDA filed its CEF Proposal on September 23, 2014 (Proposal).[74] In its proposal, NYSERDA provided information regarding the four portfolios of activity that would constitute the CEF: market development; technology and business innovation (subsequently recast as innovation and research in the CEF Information Supplement); NY Green Bank; and the NY-Sun initiative. Also, in that filing, NYSERDA advanced both budget and benefit information regarding the proposed market development and business and technology innovation portfolios, among other issues. On June 25, 2015, NYSERDA filed a CEF Information Supplement to supplement and replace the original proposal to assist the stakeholder comment process and to provide more detailed information for PSC deliberation.

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70 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.

71 NYSERDA was also directed to submit a supplemental revision to its EEPS Operating Plan by February 15, 2013 and did so on that date.

72 Case 10-M-0457, *In the Matter of the System Benefits Charge IV*, Withdrawal of Petition for Allocation of Uncommitted T&MD Funds, November 14, 2014.

73 Case 14-M-0094 – *Proceeding on Motion of the Commission to Consider a Clean Energy Fund*, Order Commencing Proceeding. Issued and effective May 8, 2014.

74 Case 14-M-0094 – *Proceeding on Motion of the Commission to Consider a Clean Energy Fund*, Clean Energy Fund Proposal, September 23, 2014.

In these filings, NYSERDA proposed the CEF comprise both market development and innovation and research activities and was intended to supersede the final year (calendar 2016) of the current T&MD portfolio. A PSC order approved the CEF in January 2016, subsuming the final year of T&MD.[75]

[75] Case 14-M-0094 – *Proceeding on Motion of the Commission to Consider a Clean Energy Fund*, Ordering Authorizing the Clean Energy Fund Framework. Issued and effective January 21, 2016.

Appendix B: T&MD Program Advisory Committee Members

The last meeting of the T&MD Advisory committee was in 2014. The committee has been replaced by advisory structures under the Clean Energy Fund and/or program specific advisory groups.

RichardAdams
Manager
NREL Innovation and Entrepreneurship
Center, Center for Renewable Energy
Economic Development

Anthony Collins
President
Clarkson University

Mark Duvall
Director
Electric Transportation and Energy Storage
Electric Power Research Institute (EPRI)

Kate Fish
Executive Director
Adirondack North Country Association

Colleen Gerwitz
Director
Office of Clean Energy
NYS Department of Public Service

Maria Gotsch
President and CEO
NYC Investment Fund

Jeff Harris
Senior Policy & Tech Advisor
Alliance to Save Energy

Dave Hewitt
Consultant
ZNE and Market Transformation

Brook S. Jackson
Vice President
Policy Partnership for New York City

James Misewich, Ph.D.
Associate Laboratory Director for Basic Energy Sciences
Brookhaven National Laboratory (BLN)
Energy Sciences and Technology Department

Steven Nadel
Executive Director
American Council for an Energy-Efficient Economy (ACEEE)

Christopher Raup
Director, Distrusted Resource Integration
Consolidated Edison Company of New York, Inc.

Robert Simpson
President and CEO
CenterState Corporation for Economic Opportunity

Susan Stratton
Executive Director
Northwest Energy Efficiency Alliance (NEEA)

David Terry
Executive Director
National Association of State Energy Officials/ASERTTI

Sue Tierney
Senior Advisor
Analysis Group, Inc.

Cheri Warren
Vice President, Asset Management
National Grid

Jane Weissman
Former Executive Director
Interstate Renewable Energy Council, Inc. (IREC)

Ed Wisniewski
Executive Director
Consortium for Energy Efficiency (CEE)

Appendix C: T&MD Program Logic Models

No logic models were completed during this period.

Appendix D: Evaluation Report Summaries

Advanced Buildings Technology Development Program

Process Evaluation

Industrial Economics, Incorporated (IEc), June 2017

Executive Summary

The Advanced Buildings Technology Development (Tech Dev) Program, a NYSERDA Building Systems initiative, promotes targeted technology development activities that address the technical and economic barriers, and opportunities, for new or emerging building technologies and products. The most recent Tech Dev project solicitation (PON 2606) combined single technology specific solicitations into a broad, multi-round single solicitation (an "omnibus" solicitation) that includes all relevant technology areas of focus (i.e., construction materials, strategies and practices; lighting; heating and cooling; demand response, smart buildings and demand-side resources; and other technologies and opportunities).

In the Technology and Market Development Program (T&MD) Operating Plan for 2012–2016, NYSERDA introduced a stage-gate process to the Tech Dev Program to support new product development from concept idea to commercialization. Stage-gating is a formalized phased R&D approach consisting of a series of distinct phases: discovery and concept development, including scoping/analysis; product development and testing; and commercial launch. The goals of this process evaluation were to assess the effectiveness of recently implemented changes to the Tech Dev Program, and to formatively assess potential changes to program offerings and administration.

Project Scope and Methods

The evaluation focuses on the following five evaluation topics:

- Evaluation Topic 1: How is stage-gating currently being implemented in the Tech Dev Program, and how can that implementation be improved moving forward?
- Evaluation Topic 2: What are the advantages and disadvantages associated with the current solicitation approach?

- Evaluation Topic 3: What is the potential value of a Technology Readiness Level (TRL) or Commercial Readiness Level (CRL) calculator to the Tech Dev Program, and if a calculator is developed, what are the design and feasibility issues program staff should consider?[76]
- Evaluation Topic 4: Did the TRL/CRL calculator implemented in round six of the PON assist proposers in completing their applications?[77]
- Evaluation Topic 5: What are the potential advantages and disadvantages of changing the Tech Dev Program's current approach to proposal scoring (categorizing as technically meritorious and not technically meritorious) to adopt a three "bin" system (must fund, may fund, do not fund)?

This evaluation used an interview-based methodology, in which IEc conducted in-depth interviews with six Tech Dev Program staff, five TEP members, two NYSERDA Legal staff, one NYSERDA Contracts staff, 27 program participants, and 17 program proposers. To identify these individuals, the evaluation team employed the following methods:

- Tech Dev Program staff: All six Tech Dev Program staff were selected for interviews.
- TEP members: Tech Dev Program and evaluation staff identified five TEP members with experience in TEPs across the technology areas of PON 2606.
- Legal and Contracts staff: NYSERDA evaluation staff identified NYSERDA Legal and Contracts staff members with experience working with the Tech Dev Program.
- Program participants: The evaluation team conducted priority sampling, in which program staff identified participants that were most likely to have relevant experience and insights to inform the evaluation questions. However, the evaluation team ensured that an array of different technology types and project types were represented in the sample.
- Program proposers: The evaluation team attempted to sample evenly across technology types.

Recommendations

IEc's recommendations for improving program processes include:

1. Program staff should discuss the goals and meaning of stage-gating, ensure it is consistent with any corporate definition of stage-gating, and create guidance clarifying how stage-gating works within the Tech Dev Program. This evaluation found significant inconsistency among and between program staff and participants regarding the definition and implementation of stage-gating. If implementing stage-gating is a priority for the Tech Dev Program, consistent

[76] TRLs and CRLs are used to assess the maturity level of a given technology (not necessarily the quality of the technology) as it moves from concept to final commercialization. A TRL or CRL calculator provides information about a technology generally in checklist form and contains a scoring approach to determine the readiness level of the technology.

[77] This topic was added after all other evaluation topics had been analyzed.

2. understanding and clear guidelines for implementation are critical. Program staff should create an outreach piece to accompany the next solicitation to clarify the agency's approach to stage-gating for the Tech Dev Program. Once there is an internal understanding of stage-gating in the Tech Dev Program, NYSERDA needs to ensure current and future participants have a common understanding as well.
3. Continue to use an omnibus solicitation approach where possible and appropriate, with clear defined rounds. Participants appreciate the consolidated approach, and the multiple rounds (announced early on) allow them to better plan for and prepare their submissions. If possible, to reduce the burden on Legal and Contracts staff, move to a pooled approach rather than assigning these staff to programs, or implement templates and checklists for SOWs to ensure they have all the required elements before review.
4. Include language within future solicitations clarifying that if a proposer declines to sign off on NYSERDA's terms and conditions, the proposal will not be disqualified, nor will its evaluation be affected. This evaluation found some participants believed negative consequences would result from not agreeing to the terms and conditions, when this is not the case, resulting in some proposers indicating agreement with the terms and conditions up front, but later indicating that compliance would be difficult. Clarifying the language regarding terms and conditions up front may help to alleviate some of the delays in contracting after award and remove a barrier to participation in the Tech Dev Program.

Clean Transportation Program: Market Characterization Report

Industrial Economics, Incorporated (IEc), May 2017

Program Summary:

In 2014, the New York's transportation sector consumed more than 1,073 trillion Btus of energy, or 39% of net energy consumption in the State. In that same year, the transportation sector was responsible for 41% of the State's fuel-borne greenhouse gas emissions, largely due to the sector's reliance on petroleum fuel.[78]

Within this context, NYSERDA's Transportation Program identified several objectives:

- Reduce and diversify the energy consumed by the transportation sector
- Minimize greenhouse gas emissions
- Create economic development opportunities in New York State[79]

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[78] The remaining 59% of emissions from fuel consumption are associated with the residential (20 percent), commercial (12 percent), industrial (6%), and electric generation (21%) sectors. NYSERDA. 2016. Patterns and Trends – New York State Energy Profiles: 2000–2014. October 2016. nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Patterns-and-Trends

[79] NYSERDA. 2015. Transportation Program: Product Development, Product Demonstration, and Product Deployment, Program Theory and Logic Model Report. August 2015. nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2015ContractorReports/2015-Transportation-LM-Report.pdf

The current Transportation Program, as implemented under NYSERDA's Clean Energy Fund (CEF), works toward these objectives by focusing on three areas: electric vehicles (EVs), public transportation, and mobility management. Mobility management encompasses a variety of strategies designed to reduce transportation demand and congestion, including intelligent and adaptive transportation systems and transportation demand management (TDM).

Evaluation Research Questions:

1. Identify companies and organizations that comprise the current "clean transportation market" operating in the State, with a focus on companies and organizations that could benefit from or partner with NYSERDA's Transportation Program.
2. Assess the extent to which these companies and organizations already interact with the Transportation Program or have adopted new technologies or products supported by the Transportation Program.
3. Identify recent trends in the market adoption of key transportation-related technologies and more broadly, to inform subsequent evaluations of the Transportation Program's performance.
4. Characterize the ways in which NYSERDA's Transportation Program interacts with different parts of the broader markets producing and adopting transportation goods and services.

Methodology:

New York Transportation Market

To reach as many companies and organizations as possible with the survey, IEc employed a "snowball" survey method that began with companies directly connected to the Transportation Program (Stage 1) and expanded to include those companies' professional contacts (Stage 2).[80] In addition, this study validates and supplements the survey data with information from two NYSERDA databases:

- A recently developed inventory of clean energy companies, which includes companies (primarily for-profit) focused on clean transportation.
- NYSERDA's research and development (R&D) Metrics Database, which includes information on funded projects.

[80] A "snowball" survey is a survey conducted in at least two, and sometimes multiple, rounds, in which respondents in each round identify respondents for the subsequent round from among their professional acquaintances. If, after one or more rounds of snowball sampling, respondents are largely referring individuals that have already been surveyed, this indicates that the "market" (or network) is well characterized, and that additional sampling may not provide new information. Thus, for this market characterization, the Stage 1 and Stage 2 populations are assumed to be part of a single, interconnected market.

Electric Vehicles

Using a variety of quantitative and qualitative methods, including literature review, stakeholder interviews, and review of data from several recent surveys, this study:

- Assesses the extent to which consumers are aware of the value proposition of EVs
- Identifies the most significant barriers to increasing EV adoption in the State
- Describes existing programs that attempt to increase consumer adoption of EVs
- Characterizes the types of market actors working on or interested in EVs in the State
- Compiles baseline data on the program's progress toward EV adoption goals.

Transportation Demand Management

Using a variety of quantitative and qualitative methods, including literature review, stakeholder interviews, and geospatial analysis, this study:

- Identifies conditions necessary and sufficient for TDM adoption, and identifies locations in the State where these conditions can be found (i.e., "priority areas" for TDM)
- Identifies the most significant barriers to increasing TDM adoption in the State
- Characterizes the types of market actors needed for successful TDM adoption
- Compiles baseline data on the program's progress toward TDM adoption goals

To identify TDM priority areas in New York State, IEc conducted a geospatial analysis of factors necessary for a successful TDM program, as identified through literature review and in-depth interviews.

Conclusions:

Overall, this MCA demonstrates the supply-side market for clean transportation technologies and services in the State is large and encompasses a wide range of companies and organizations, in terms of size, age, type, and sector. A few key sectors are expected to emerge as particularly important to industry operations over the next five years; these include intelligent transportation systems, EVs and alternative fuel/EV infrastructure, and non-public transit infrastructure. These sectors align well with the Transportation Program's focus under the CEF on mobility management and EVs. The Program's third CEF focus area, public transportation, was identified by respondents as relatively less important to their companies' operations currently, although they expected the sector to increase slightly in importance over the next five years.

In addition, this MCA shows NYSERDA is generally well-connected among the companies and organizations active in the supply-side transportation market. However, NYSERDA could strengthen its partnerships with some market actors.

- R&D in general: Primarily in the western half of the State, for-profit companies focused on technology development and manufacturing, R&D, and analysis and testing.
- The EV market specifically: Automobile dealerships, consumer outreach organizations, and utilities.
- The TDM market specifically: Public transit agencies, potential TDM hosts (e.g., developers, employers), and outreach organizations.

Both target market segments evaluated—EVs and TDM—show potential for increased technology/strategy adoption, although adoption is currently hindered by a few key market barriers. NYSERDA is well-positioned to address several of these barriers to ensure continuing progress toward State and Transportation Program goals.

- **Conduct additional outreach to engage the key market actors.** For EVs, consumer outreach may benefit from a focus on ride-and-drives and similar events that allow drivers to interact directly with EVs. For TDM, NYSERDA should work closely with DOT to leverage its existing relationships with transit agencies and employer partners.
- **Maintain R&D and deployment focus on technologies that will become increasingly important in the future or have the potential to reduce key barriers.** Specifically, NYSERDA should continue to support R&D and deployment of intelligent transportation systems, real-time transportation data tracking, EVs, and EV charging stations.
- **Continue providing, and consider expanding, business development and networking support.** Several remaining gaps and barriers, such as a lack of supportive State policies and low engagement from key market actors, could be improved by facilitating connections among market actors. This type of business development support was cited as particularly valuable by survey respondents.

Clean Transportation Program: Six Market and Impact Evaluation Case Studies

Energy and Resource Solutions, Inc. (ERS) and Industrial Economics, Incorporated (IEc), 2016-2017

D-1. Public Transit Research and Development Funding for Alstom Transportation

Progress Achieved	Gaps in Achievement
Evaluation Question 1: To what extent was the Alstom Gearbox commercialized both within the NYCT and in urban subway systems throughout the United States?	
• Alstom won the NYCT contract to deliver more than 1,000 R160 cars using the gearbox that was developed with NYSERDA funding. • Beyond New York, Alstom has not won additional contracts to deliver railcars using the gearbox technology.	• The gearbox is only applicable for passenger subway/metro applications. Alstom has bid on, but not won, any subway contracts in other U.S. cities.
Evaluation Question 2: What were the energy impacts from this project? What fossil fuel and/or emissions reductions were achieved?	
• There were no direct energy impacts from the Alstom Gearbox project. The NYCT had already been purchasing AC propulsion railcars. Without the Alstom gearbox, the R160 project would likely still have been awarded to Alstom or another manufacturer using the incumbent gearbox on the market. • The project was about economic development – increasing New York State content of subway cars and enabling Alstom to better compete in subway car manufacturing.	• Direct energy efficiency improvements via gearbox design are small to negligible as the gearbox does not differ appreciably from previous gearbox designs. However, there are future energy savings opportunities achievable using AC propulsion, such as harnessing energy from regenerative braking.
Evaluation Question 3: What benefits – beyond financial – did NYSERDA contribute to the project?	
• Relationships/connections – NYSERDA's existing relationships helped Alstom connect with suppliers and manufacturers for gearbox components. • New York State economic development – Engineering jobs to design the gearbox and related components • Local (New York State) manufacturing – Alstom employed eight hundred workers in two shifts throughout the NYCT contract, producing two NYCT subway cars per day.	• The project was valuable in establishing relationships with the MTA and its related companies, leading to additional project work for NYSERDA's transportation and CPTI programs. Some of these connections have diminished with the retirement of the NYSERDA project manager who led this project.

D-2. Transportation Demand Strategies at the Buffalo Niagara Medical Campus

Progress Achieved	Gaps in Achievement
Evaluation Question 1: To what extent did the TMA's activities continue after the end of NYSERDA's support?	
The TMA continues to operate, and several aspects of the TMA's strategy have expanded since 2013: • Alternative transportation incentive programs • Improved bicycle routes and infrastructure • Parking management • Marketing and website • Zoning and land use change	Two key areas of the TMA's strategy remain underdeveloped: • Need for a residential parking permit program adjacent to BNMC (recently approved by the state legislature; development underway) • Ridesourcing programs, like Lyft and Uber, and e-bikes are restricted in NYS
Evaluation Question 2: Which TDM strategies employed at BNMC are likely to be most replicable and impactful at other workplaces?	
Strategies employed by the TMA can be expanded and applied to TDM efforts elsewhere. Strategies include: • Establishing key partnerships • Targeting a critical mass • Offering a diverse portfolio of TDM programs • Ensuring public safety	Additional short-term and long-term TDM strategies can supplement ongoing options: • Short-term: Promote telecommuting if job allows and continue to improve technology to ease use of non-SOV options • Long-term: Integrate TDM efforts with land use planning and address job access and transportation affordability
Evaluation Question 3: What benefits – beyond financial - did NYSERDA contribute to the project?	
NYSERDA's support and funding provided benefits to the TMA at BNMC. Examples of benefits include: • Connected BNMC with key players • Allowed BNMC flexibility	NYSERDA's support did not, however, lead to the creation of a self-sustaining TDM program: • Resources are required to keep TDM strategies in place and improve the program

D-3. Saab Sensis Advanced Airport Departure Manager

Progress Achieved	Gaps in Achievement
Evaluation Question 1: To what extent was the product commercialized after NYSERDA's funding?	
• DMAN was commercially implemented in 2012 and continues to operate at JFK. • The success and relationships resulting from the DMAN shadow testing at JFK that was funded by NYSERDA were a large factor in Saab Sensis winning the 2012 contract. Without NYSERDA's support, Saab Sensis would not have pursued this project.	• The R&D team at Saab Sensis that developed the tool has been decommissioned, limiting future product development.
Evaluation Question 2: How many airports within and beyond New York State are using the commercialized product?	
• No other airports in New York State are using DMAN, and without major changes to airport infrastructure, none are eligible for the benefits from advanced departure management. • San Francisco airport temporarily used DMAN while renovating runways; it was successful in managing the surface traffic, but the contract was not continued after the construction was completed. • Dublin International Airport contracted Saab Sensis for continuous departure metering using DMAN in 2015.	• The layout of airport and ability to maneuver outside of the FAA's jurisdiction on the surface dictates the feasibility of DMAN implementation. • Diversity and cooperation of airlines at other airports are a major factor in the functionality of DMAN.
Evaluation Question 3: What were the fossil fuel and emissions reductions?	
• Independently verified (MIT) emissions reduction of 10,000 tons of CO_2 per year. • MIT-verified savings are relative to the PASSUR system that was in place in 2011. NYSERDA savings were relative to no departure management in 2009.	• More cooperation and more information in real time from the FAA would allow DMAN to be more effective at saving time and fuel.

D-4. Electric Refrigeration Transportation Network

Progress Achieved	Gaps in Achievement
Evaluation Question 1: To what extent did NYSERDA-funded demonstrations build an eTRU network across NYS?	
NYSERDA directly supported the purchase of 40 eTRUs and installation of 37 power supply connections: • **2005** – eTRU demonstration at Maines Paper & Food Services in Conklin, NY • **2006** – eTRU demonstration at Willow Run Foods in Kirkwood, NY • **2008** – eTRU energy management system at correctional facility in Rome, NY • **2011** – eTRU pilot with Hannaford Brothers at Schodak distribution center and retail location in East Greenbush, NY • **2011-2013** – DOE's Interstate Electrification Improvement Project, for which Shorepower installed eTRU power supply units in Champlain, Pembroke, and West Coxsackie, NY	The demonstrations do not – and were not intended to – support widespread eTRU use. Remaining market barriers are discussed in the context of the following evaluation questions.
Evaluation Question 2: Have NYSERDA's project partners expanded their use of eTRUs and eTRU infrastructure?	
• Maines Paper & Food Services, Inc. expanded eTRU fleet in Conklin, NY and adopted eTRUs and PSE in Terrell, TX. • Shorepower installed 150 high-voltage eTRU plugs at 29 truck stop locations. • SafeConnect has expanded deployment to 18 states.	Interviews indicate that PSE is no longer regularly used at one former demonstration site.
Evaluation Question 3: How widely adopted are eTRUs and eTRU infrastructure across New York State and the U.S.?	
Multiple news articles indicate evidence of fleets purchasing eTRUs and installing power supply units in NY and the U.S. • Both major manufacturers (Carrier Transicold and Thermo King) have multiple eTRU models for sale. • Evidence suggests 15 percent of trailers on the road in 2016 may have plug-in capabilities. • The eTRU PSE market has also experienced growth: Shorepower and SafeConnect have expanded into additional states.	Barriers hindering further growth in the eTRU and PSE markets include: • Corporate management buy-in • Lack of fleet manager and driver engagement • Lack of expertise for on-site system management • Insurance and investment risk • Recovery of on-site energy costs at distribution centers • The current low price of diesel

D-5. Leviton's Electric Vehicle Charging Station Demonstration

Progress Achieved	Gaps in Achievement
Evaluation Question 1: How many charging stations were installed through the Leviton Workplace Initiative, and how were they distributed across the state?	
Leviton installed 88 charging stations, surpassing its original goal of 82. Stations were installed by 57 site owners at a variety of workplaces across all 10 regions of New York State: • Western New York: 2 (2%) • Finger Lakes: 3 (3%) • Southern Tier: 3 (3%) • Central New York: 3 (3%) • North Country: 7 (8%) • Mohawk Valley: 3 (3%) • Capital District: 8 (9%) • Hudson Valley: 20 (23%) • New York City: 7 (8%) • Long Island: 32 (36%)	Some employers remain hesitant to invest in charging stations. Reasons include: • High installation costs • Lack of understanding of the value proposition • Potential space-use or policy conflicts
Evaluation Question 2: To what extent was information disseminated regarding the benefits of EVs and EV charging station use?	
Leviton provided each site with information on: • Total expected electricity cost • Cost to charge various models of EVs, compared to gasoline costs for comparable vehicles • Potential emissions reductions • Reputation effects associated with visibly improving workplace sustainability • Potential for transportation technology leadership • Available federal, state, and utility tax and rebate incentives for EVs	Employers could benefit from additional information on common operational issues (e.g., maintenance of outdoor charging stations in rain and snow conditions, fee-based charging systems). Employees could benefit from testimonials or "Ride and Drive" events with their peers.
Evaluation Question 3: What strategies most effectively increase demand for EVs?	
Workplace charging station installation is an essential strategy for increasing EV demand. Key workplaces to target: • Technology startups, universities, and employers in the healthcare, pharmaceutical, and finance industries • Suburban and office park locations not served by convenient public transit opportunities	EV adoption is limited by: • Lack of familiarity with EVs among consumers and dealerships • Lack of infrastructure and services for EV drivers • Limited coverage in the mainstream media • Market factors, including high purchase prices and low gas prices

D-6. KLD's Adaptive Control Decision Support System for Traffic Management

Progress Achieved	Gaps in Achievement
Evaluation Question 1: To what extent did KLD leverage non-NYSERDA investment?	
Midtown in Motion demonstrated KLD's ability to leverage external investment for adaptive control technologies. Since then: • NYSERDA connected KLD with TransCore, allowing KLD to leverage TransCore's sales network to deploy ACDSS. • NYSERDA's funding provided KLD with the credibility needed to become a key market player. KLD has since expanded its work to include connected vehicles.	The crowded market for adaptive controls, which includes competitor technologies also marketed by TransCore, limits the potential deployment of ACDSS.
Evaluation Question 2: How many ACDSS installations are there within and beyond New York State?	
More than 370 intersections across the U.S. currently use ACDSS, and an additional 395 intersections, both in the U.S. and internationally, will install ACDSS by the end of 2016. These installations are or will be located in.: • New York City, NY • Flushing, NY • Arcadia, CA • St. Louis, MO • Overland Park, KS • Riyadh, Saudi Arabia	Remaining barriers to deployment, which are not specific to ACDSS, include: • High cost - Installation requires significant investment for licensing and maintenance. DOT estimated average cost per intersection of $40,000 in 2010; RPI's 2016 decision-making tool analysis estimates average cost of $20,000 to $80,000 for various systems. • Benefits and costs accrue to different parties - Although the benefits of adaptive control systems have been proven, these benefits generally accrue to drivers, not municipalities. • Multi-jurisdiction collaboration - Traffic signal management is not standardized across jurisdictions, requiring coordination between multiple stakeholders across municipalities. Barriers specific to ACDSS deployment include the highly competitive and quickly evolving market for adaptive and connected infrastructure.
Evaluation Question 3: To what extent are decision-makers aware of adaptive traffic control technologies, including ACDSS, and their benefits?	

Decision-makers are generally aware of the benefits and challenges associated with adaptive control systems:
 	
• Adaptive controls are understood to work best in locations with:
  ○ Highly variable traffic patterns
  ○ Difficulty maintaining conventional signal timing sequences
  ○ Safety concerns (e.g., high pedestrian volumes)
  ○ A centralized traffic operator
• To address cost and interoperability challenges, transportation agencies are beginning to design systems to be modular ("plug-and-play").
	Decision-makers could benefit from additional knowledge sharing in three areas:
	
	• Using adaptive traffic controls may require time for training to learn how to operate the system.
	• The effectiveness of adaptive control systems depends on the reliability of detection systems used (e.g., sensors, video).
	• Emerging technologies (e.g., connected vehicles) are changing market conditions and may influence long-term planning.

Combined Heat and Power (CHP) Baseline Assessment

Industrial Economics, Incorporated (IEc), April 2017

Program Summary:

NYSERDA's Combined Heat and Power (CHP) program seeks to advance the modular CHP market by reducing soft costs and development time and increasing the penetration of CHP. Major program activities focus on providing cost-shared incentives to support the installation of CHP equipment at eligible host site locations. Additionally, and to a lesser extent, the program provides cost-shared incentives to support site-specific feasibility studies. NYSERDA procured a variety of technical outreach services to raise awareness of the opportunity for CHP among good-prospect candidate sites.

NYSERDA's CHP market transformation efforts include several strategies, including technical assistance for customers during the screening phase, demonstrating the value proposition of CHP recommissioning, providing replication support, and conducting market research into opportunities to reduce costs.

Evaluation Objectives:

1. Determine the current penetration rate of CHP systems within defined target markets, including multifamily residential buildings, educational institutions, hotels, hospitals, offices, assisted living facilities, and restaurants.
2. Determine the number of vendors (and installers) active in the State, their revenues, number, size, and cost of projects, and the degree of concentration in the market.
3. Characterize soft costs, including whether each category of soft costs is incurred consistently or inconsistently (i.e., only incurred by certain firms and/or in certain types of projects), and whether vendors and installers employ consistent definitions for each category of soft costs.
4. Quantify soft costs, including total (aggregate) soft costs, and costs associated with the permitting and approval process specifically. This study also provides additional quantitative data regarding how much each category of soft costs contributes to total costs.
5. Explore access to financing during the purchase/sale of a building, and whether the cadence at which the real estate transaction occurs enables or prohibits bundling the financing of CHP into that larger transaction.

Methodology:

- **Initial Review of Literature and Secondary Data:** IEc completed an Evaluation Readiness Review (ERR) of NYSERDA's CHP Aggregation and Acceleration Program. In this ERR, and in subsequent scoping activities undertaken for the current study, IEc conducted meetings with NYSERDA and ERS and reviewed documents from the NYSERDA CHP program and other sources that informed the current evaluation.

- **Vendor Survey and Follow-up:** The primary data collection effort for this market study consisted of a web-based survey of CHP vendors active in the State. For the survey sample, IEc developed a list of all CHP vendors active in the State, based on two criteria:
    - All vendors that had pre-approved systems in the then-current NYSERDA CHP Catalog.
    - Vendors that had installed CHP systems in 2015 or 2016 based on NYSERDA's DG-IDS database.

The survey covers three primary areas:

1. Basic company information and CHP installations in the State, including by target market
2. Characterizing and quantifying balance-of-system (BOS) costs
3. Other factors influencing CHP adoption

Table D-7. Survey Disposition

Status	Count
Initial Sample	22
Removed from Sample (no CHP installation in New York State in 2015)	4
Remaining Sample	*18*
Not Responsive	6
Incomplete	3
Largely Complete (fully complete with phone follow-up)	2
Fully Complete	7
Response Rate (9 completions out of 18 firms in sample frame)	*50%*

- **Expert Interviews:** IEc met with CHP experts during NYSERDA's On-Site Power Conference and Expo in December 2016. Experts were asked to explore market factors that affect CHP project timing and identify whether bundling the financing of CHP into a larger transaction could provide opportunities to increase the penetration of CHP in the State. Other issues and opportunities regarding CHP were discussed with these experts.
- **Review of Additional Data Sources:** In addition to the initial data review previously noted, IEc reviewed additional specific data sources for the purposes of calculating market penetration rates and validating and expanding on the cost quantification data collected through the survey.

For the penetration rate, IEc reviewed market potential studies and databases listing the systems installed. For cost data, IEc reviewed commissioning reports submitted to NYSERDA by vendors. These reports were required for the vendors to receive the final portion of the financial incentive offered by NYSERDA for qualifying installed systems.

Conclusion:

- The penetration rate for CHP remains relatively low among NYSERDA's target markets. This indicates there is still significant opportunity for increased use of CHP across sectors. Sectors with the greatest penetration rates are educational institutions and multifamily buildings, which reached 12–15% of technical potential. Penetration rates in other target markets range from 0–8% in capacity terms. The overall penetration rate is 12% of technical potential.
- The market is dominated by a few players and demonstrates a high degree of concentration. According to NYSERDA's DG-IDS database, four vendors completed CHP systems in 2015 and seven vendors completed systems in 2016. A single vendor also provided a strong majority of the commissioning reports NYSERDA received for projects completed in 2016. No other firm had more than two projects completed in 2016, according to either the DG-IDS database or the commissioning reports.
- Each category of soft costs is fairly consistent across projects and firms. Vendors consistently identified major categories of soft costs as installation labor/materials; engineering; rigging and coordination; and project and construction management. While some vendors indicated lower average costs for certain categories of soft costs for non-Catalog systems, this appears to be driven by size differences (non-Catalog systems are, on average, larger than Catalog systems).
- Survey data indicate that soft costs average 56% of total CHP system costs for Catalog systems. Soft costs accounted for 53% of total CHP system costs in the commissioning report data. For non-Catalog systems, survey data show soft costs average 35% of total system costs. This is likely due to system size differences; it appears that soft costs are similar for similarly sized Catalog and non-Catalog systems.
- There is limited information regarding possible links between real estate financing and CHP financing. However, based on a small number of interviews with market participants, it appears there is little if any opportunity to combine real estate and CHP financing into a single transaction, due to the complexities involved.

Advanced Codes and Standards Behavioral Study

Industrial Economics, Incorporated (IEc), May 2017

To increase compliance with the Energy Conservation Construction Code of New York State (the "Energy Code") and to reduce energy consumption, the New York State Energy Research and Development Authority (NYSERDA) provides training and support services through the Codes initiative of its Advanced Energy Codes and Standards program. NYSERDA contracted with multiple training contractors, including Newport Ventures (Newport) and the Urban Green Council (UGC), to develop and conduct a portfolio of training courses on updates to the Energy Code that take effect on October 3, 2016. These trainings target three audiences—code officials, design professionals, and members of the construction trades—and cover both commercial and residential buildings.

Project Scope and Methods

The primary goal of this process evaluation is to assess reactions to training and learning among participants in the NYSERDA Energy Code trainings, focusing on the subset led by Newport and UGC between April 2015 and June 2016. A secondary goal is to gather trainee feedback on the value and quality of course offering to inform future course improvements. Evaluation objectives and methods are summarized in Table D-8.

Table D-8. Summary of Objectives and Methods

Objective	Purpose	Method	
		Pre-/Post-Training Survey	Interviews with NYSERDA, Training Contractors
Evaluate trainees' reactions to the training program	Assess trainees' satisfaction with and the value of the training program	✓	
Measure the change in trainees' level of knowledge of the Energy Code following training	Assess training quality	✓	✓
Determine whether trainees plan to enact changes as a result of training	Assess the extent to which trainings may increase code compliance	✓	✓
Examine perceptions of training's effectiveness at increasing code compliance	Assess the extent to which trainings may increase code compliance, and inform improvements to NYSERDA's Energy Code initiative		✓
Solicit suggestions for other activities that trainees think would be effective at increasing code compliance	Inform improvements to NYSERDA's Energy Code initiative	✓	✓

Key Findings

Overall, the NYSERDA Energy Code trainings have been well-received and very successful in increasing participant knowledge, as shown in Figures D-1 and D-2. Trainees also indicated they intend to make changes to how they do their jobs as a result of the training (Figure D-3). Finally, NYSERDA program staff and training contractors indicated trainings are meeting their objectives.

Figure D-1. Trainee Understanding of the Energy Code

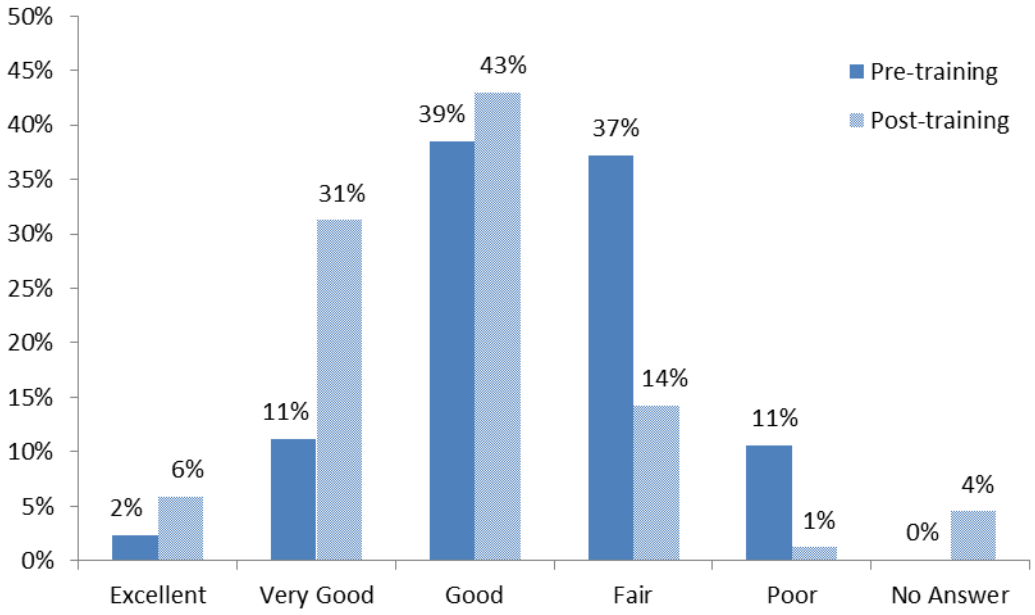


Figure D-2. Trainee Satisfaction

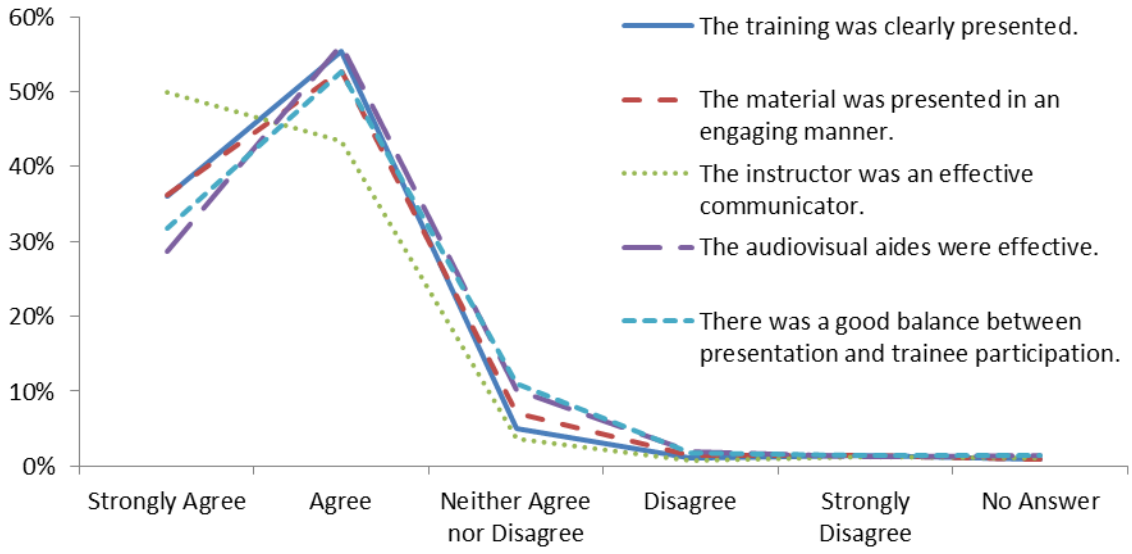
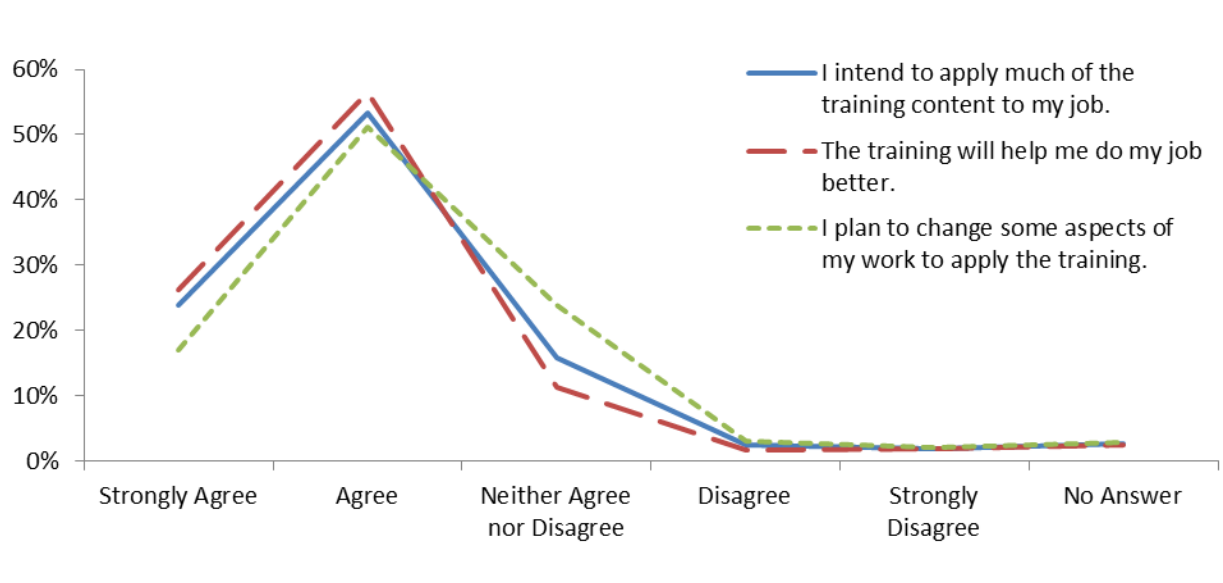


Figure D-3. Trainee Plans to Apply Training



Most trainees (73%) did not recommend covering additional topics as part of the training, either because they believed the training was complete as-is or there was no time to cover additional topics. Only 22% provided feedback on the course, and many of those responses were positive comments such as "thank you." The two most common categories of suggestions were changes to course materials (e.g., requests for more handouts and sample documents) and additional courses or content (e.g., requests for advanced training). Suggestions for other ways to increase code compliance included incorporating more case studies into the trainings, extending training time, and offering trade-specific trainings.

Recommendations

While the trainings have largely been successful, IEc offers four recommendations for future trainings:

1. **Build on introductory trainings by incorporating additional topics or courses that go into greater depth regarding specific elements of the code and code compliance.** When asked about ways to improve the trainings or increase code compliance, some trainees requested more advanced training. This could be a natural follow-on to the current introductory trainings.
2. **Consider changes to training exercises, materials, and class format.** Many trainees suggested increasing the use of sample projects and case studies and experimenting with alternative class formats. Trainees also frequently requested copies of the presentation slides, the Energy Code, and other resources; training contractors should consider providing a web link for participants to download at least the training slides.

3. **Focus on increasing participation by the construction trades.** Engaging members of the construction trades remains a key challenge. According to NYSERDA, trade-specific trainings, which were requested by some trainees, can help attract members of the construction trades, and may, therefore, be an effective strategy in the short term.
4. **Follow up with trainees to determine whether they have applied knowledge from the trainings to their jobs.** NYSERDA program staff and training contractors identified several provisions that trainees are likely to struggle with in practice. Follow-on surveys could help determine the extent to which participants are applying information from the trainings to their jobs and would provide context for the results of any future code compliance studies.

Clean Energy Business Development Market Assessment

Industrial Economics, Incorporated (IEc), May 2017

Introduction

This research provides the key findings a market characterization analysis (MCA) of early-stage cleantech companies and the entrepreneurial ecosystem supporting cleantech in New York State. It informs an evaluation of the New York State Energy Research and Development Authority (NYSERDA) Innovation Capacity and Business Development (ICBD) program, which aims to help entrepreneurs and companies develop business skills and capacities that will enable them to advance technologies to market more rapidly and with greater success rates.[81]

In the context of a broader entrepreneurial ecosystem, ICBD programs aim to encourage entrepreneurs to form successful cleantech companies and accelerate commercialization efforts, generate revenue, grow employment, and apply their clean technologies to achieve system-wide benefits.[82] ICBD directs most of its financial resources toward partner organizations, including six Incubators, two Proof of Concept Centers (POCCs) and one Entrepreneurs in Residence (EIR) program. These organizations then invest resources into a wide range of entrepreneurial, early-stage and growth cleantech companies in the State.

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81 NYSERDA, Jan. 2017, Clean Energy Fund Investment Plan: Innovation Capacity and Business Development Chapter. Accessed online Jan. 28, 2017 at: nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Innovation-Capacity-Business-Development.pdf.

82 Entrepreneurial ecosystem is defined as “dynamic group of highly interconnected actors, resources, and a range of institutional and infrastructural supports that promote an innovation economy.” Isenberg Daniel, May 25, 2011, "Introducing the Entrepreneurship Ecosystem: Four Defining Characteristics" Forbes Magazine, accessed September 25, 2015.

The MCA research represents a snapshot of the State's current cleantech ecosystem in 2015 and 2016, describing the "market" for ICBD services (nascent and early-stage cleantech companies) and characterizing NYSERDA's role in that ecosystem. The research included desktop research and a literature review; 68 interviews with a range of stakeholders; an online survey completed by 311 stakeholders (emphasizing ICBD participants); and an analysis of secondary data sources with quantitative metrics that help to characterize the entrepreneurial ecosystem. In the center of the ecosystem are the early-stage cleantech companies in the State—the group of actors that ICBD programs mainly focus on serving. These companies are selected in the report if they are less than 20 years old, primarily focused on cleantech as their main line of business or the main market application of their technology and have a significant operating presence in the State.

Overview of the State's Cleantech Entrepreneurial Ecosystem

Population and Distribution of Early-Stage Cleantech Companies in New York

By combining data from eight different sources and conducting additional research and validation, at least 649 early-stage and 305 more mature cleantech companies were identified with a significant presence (Figure ES-1). Of the early-stage cleantech companies, 50% are in working in energy-related segments; and 53% participated in at least one NYSERDA program. Companies are concentrated in New York City, but other regions such as in Western New York and the Capital Region also have many active early-stage cleantech companies, many of which are proximate to large research universities and/or large companies.

Figure ES-1 describes the elements that make up this ecosystem; black text identifies the key elements that are supported with quantitative data in this MCA, and gray text indicates elements that are described qualitatively.

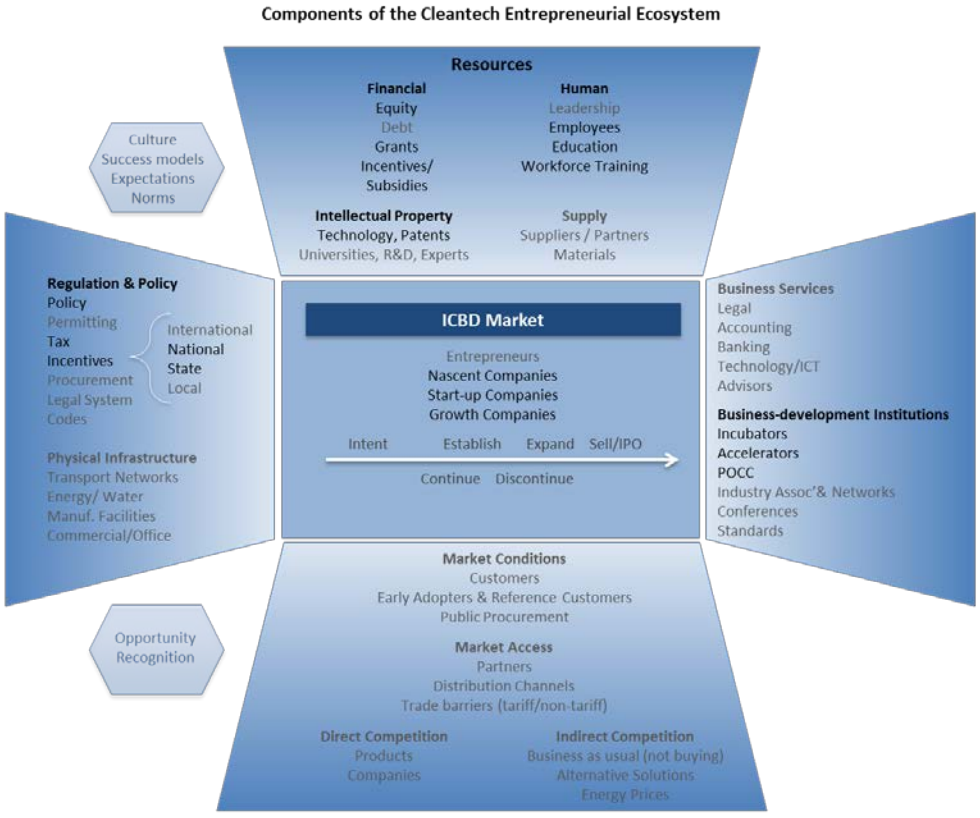
In the center of the ecosystem are the early-stage cleantech companies—the group of actors that ICBD programs mainly focus on serving. These companies are selected in the report if they are less than 20 years old, primarily focused on cleantech as their main line of business or the main market application of their technology and have a significant operating presence in the State.

Overview of the State's Cleantech Entrepreneurial Ecosystem

Population and Distribution of Early-Stage Cleantech Companies in New York

By combining data from eight different sources and conducting additional research and validation, at least 649 early-stage and 305 more mature cleantech companies were identified with a significant presence in the State (Figure D-4). Of the early-stage cleantech companies, 50% are in working in energy-related segments; and 53% participated in at least one NYSERDA program.[83] Companies are concentrated in New York City, but other regions such as in Western New York and the Capital Region also have many active early-stage cleantech companies, many of which are proximate to large research universities and/or large companies.

Figure D-4. Overview of Components (Factors and Resources) Comprising the Cleantech Entrepreneurial Ecosystem[84]



83 NYSERDA programs included were: ICBD programs (incubators, POCCs or EIRs), a Program Opportunity Notice (PON), and/or another research and development program as tracked in the NYSERDA R&D Metrics database.

Overview of the State's Cleantech Entrepreneurial Ecosystem

Population and Distribution of Early-Stage Cleantech Companies in New York

By combining data from eight different sources and conducting additional research and validation, at least 649 early-stage and 305 more mature cleantech companies were identified with a significant presence (Figure D-5). Of the early-stage cleantech companies, 50% are in working in energy-related segments; and 53% participated in at least one NYSERDA program.[85] Companies are concentrated in New York City, but other regions such as in Western New York and the Capital Region also have many active early-stage cleantech companies, many of which are proximate to large research universities and/or large companies.

Figure D-5. Number of New York State Early-Stage Cleantech Companies by Stage of Growth

NASCENT COMPANIES (<1-YEAR-OLD)	START-UP COMPANIES (1-5 YEARS OLD)	GROWTH COMPANIES (6-20 YEARS OLD)	MATURE COMPANIES (>21 YEARS OLD)
10	241	398	305
649 early-stage cleantech companies incorporated between 1997 and 2016			**305**
954 cleantech companies identified (all stages)			
Source: Combined IEc dataset.[86]			

Critical Resources Supporting the State's Cleantech Companies

The success of entrepreneurs and technological innovations relies in part on the surrounding conditions and the ability to harness needed resources. The MCA focuses on four sets of resources critical to entrepreneurs and early-stage companies: financial resources, human resources, intellectual resources, and business-development resources targeted at this population of entrepreneurs and early-stage companies.

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85 NYSERDA programs included were: ICBD programs (incubators, POCCs or EIRs), a Program Opportunity Notice (PON), and/or another research and development program as tracked in the NYSERDA R&D Metrics database.

86 Sources were: the CEI Inventory Database (produced by Meister Consulting Group for NSYERDA in 2016); CBI Insights; Cleantech i3; EIR client data; lists of companies participating in five of the six NYSERDA-sponsored incubators (provided by incubator managers in July 2016); relevant companies that received R&D demonstration project funding from NYSERDA; contacts provided by NYSERDA for the IEc interviews; and relevant contacts suggested by Stage One participants of the IEc survey. Each of these companies were checked to verify that they were still in operation (such as an up-to-date website) and excluded several that appeared to be out of business.

- Entrepreneurs and early-stage companies are accessing a wide-range **of financial resources,** from grants to venture capital (VC) investments, sourced from within and outside of the State. An indicator of the ability of companies to attract such funding is the amount and number of VC investments made—some 44% of the 649 early-stage cleantech companies identified had successfully attracted VC. The proportion of seed stage rounds went from zero in 2004 to more than 50% of the deals in 2016, which is a positive indicator that investors are focusing on the potential of early-stage cleantech companies.
- Intellectual property is being activity generated in the State, by individual entrepreneurial teams, universities, and large companies. Between 2012 to 2014, inventors registered 927 cleantech patents and New York is ranked in the top three states nationally in total number of cleantech patents awarded, especially in electric vehicle/hybrid/fuel cell vehicles and solar technology.[87] The vast majority of patents appear to be filed by large established companies, followed by universities.[88] POCC participants—typically entrepreneurs or nascent companies at a very early stage in their development—are also active in filing patents. Of the 87 companies IEc surveyed participating in POCCs, 58% either filed or were already awarded a patent based on the research conducted during their time with the POCC, and another 21% expected to file a patent in the future.
- In terms of human resources, the State is already a national leader in "clean jobs," with an estimated 85,198 "clean jobs" employed by around 7,500 business establishments statewide.[89] However, some gaps in human resources emerged in the MCA research, and many felt this was a major barrier to growth.
- New York has a rich landscape of business development resources for early-stage companies, including at least 119 incubators, accelerators, EIR programs and POCCs. Approximately 19 of these programs focus on cleantech and the other 100 programs are either open to any technology or open to technology fields that overlap with cleantech. Within the landscape of existing BD resources, the ICBD programs fill a gap by serving geographic regions (in the northern and western parts of the State), and by offering programming specific to building cleantech companies, for example, by connecting companies to experienced mentors, testing facilities, and investors.

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87 SRI International (2015) NYSERDA Clean Energy Technologies Innovation Metrics Report. Page 17, Data from 1790 Analytics (2015)

88 Ibid. Page 18.

89 The Clean Jobs Report of 2016 also found concentrations of clean jobs in the major urban areas of New York City, Long Island and the Lower Hudson Valley. BW Research Partnership and The Economic Advancement Research Institute. (May 2016). Clean Jobs New York Report.

Barriers and Drivers

Survey and interview respondents most often cited the following drivers as enabling cleantech in the State: availability of financial resources (including State and national incentives), research and development (technology), and human capital. Respondents to the interviews and survey noted the following key barriers for early-stage cleantech companies, all of which can delay time to market for innovative technologies:

- Lack of access to sufficient financial resources. Survey respondents and interviewees noted a lack of pre-seed funding, potentially filled by grants, and in later-stage expansion capital needed to build a production facility. Financial resources were harder to access for companies distant from the financial hub of New York City and/or for companies with capital-intensive "hardware" technologies. Even those able to access financial resources did so by combining multiple sources of capital and spoke of the significant time it took to access these funds.
- Problematic State regulatory framework and policies, lack of tax incentives and subsidies, and high State tax rates all rated as significant barriers for respondents and interviewees.
- The challenge of attracting and retaining "serial entrepreneurs" and cleantech to commercialize technologies and build sustainable businesses was often cited; skill gaps were noted in process and production engineering.
- Risk-averse customers, especially in segments targeting utilities and large industrial facilities that can be reluctant to adopt new technologies.
- Challenges in Capturing and commercializing intellectual capital. For example, some interviewees noted the challenge of unlocking the innovative research developed in universities, where technology transfer offices can be slow. Additional barriers noted by interviewees included the need for faster and more cost-effective testing and certification facilities, as well as help with filing and protecting patents.

These barriers appear to be more prevalent in non-urban locations, far from the central financial and population hub of New York City. Many of the barriers (and drivers) are interconnected. The drivers of having access to financial capital means skilled engineers and other key staff can be hired. Supportive State policies help to attract investors, and so on. A holistic approach to policy supporting entrepreneurship and cleantech in the State is needed.

NYSERDA's Role in the Ecosystem and ICBD Program Outcomes

Part of the scope of the MCA was to characterize the ICBD program's role in the State's cleantech ecosystem and identify areas of strength and potential areas for refined focus going forward. Stakeholders view NSYERDA as a reliable and valuable resource for early-stage companies and entrepreneurs, especially as the availability of other resources fluctuates. NYSERDA's resources are especially important and highly valued in regions that are less rich in resources, such as those in the northern and western parts of the State.

- NYSERDA has a considerable, but not universal, reach among early-stage cleantech companies. According to interview and survey participants, ICBD incubators helped them to realize first sales more quickly and/or increased their sales volume. ICBD programs are well-received by nearly all who participate, the services appreciated included: Mentoring/support; Feedback on business plan and/or strategy; Office space/lab space; Introductions to business contacts; and Participation in NYSERDA-sponsored networking.
- A limiting factor for the State's ecosystem is the ability to locate and access resources, and the time and effort it is taking companies to do so. ICDB can (and already does) help connect entrepreneurs and companies to relevant resources, and could help to further extend these connections, connecting them to the right resources at the right time in their development.

Conclusions and Recommendations for ICBD

The State's cleantech ecosystem is vibrant, with many active early-stage companies commercializing cleantech innovations, and a rich array of resources is available to support the entrepreneurial ecosystem. While there are many early-stage companies, they face significant hurdles in growing at the speed and scale that may be possible. Access to resources is uneven and can be time-consuming, which can impede company growth. For example, providers of business development services and equity funding tend to be concentrated in and around New York City, with other regions less well served. As a result, in regions such as Western New York and the Western Finger Lakes regions with strong potential generation of intellectual capital, are more heavily relying on ICBD programs.

The MCA analysis of the current entrepreneurial ecosystem provides some informal "actionable intelligence" for ICBD and NYSERDA that could help position programs to build on existing strengths of the State's marketplace, and address some of the key weak points in the entrepreneurial ecosystem.

A. The ICBD program should continue to focus on growing the State's cleantech market and ecosystem.

- Support of incubators, POCCs, and EIR programs should continue, with a focus on regions with concentrations of resources such as in and around major urban and university centers (Albany, Buffalo, New York City, Ithaca, Rochester, Stony Brook/Long Island, and Syracuse), and regions where there are fewer resources but strong signs of entrepreneurial activity. Given that New York is geographically very large and travel times are long, a focus on localized services is valuable, as is building up the local networks in each of these regions so they can be self-sufficient in the longer term.
- The success of ICBD client companies should continue to be promoted to key stakeholder groups that can help these companies thrive.

B. The ICBD program could expand and/or complement its work by helping New York cleantech companies connect to and access the resources they need to grow and succeed.

- Expanding the EIR program by providing financial support to proven, serial entrepreneurs to come to New York to commercialize technologies and build companies.
- Providing seed grants to nascent companies (as is already planned). Grants should be provided in a way that minimizes administrative burden to enable entrepreneurs to dedicate more time to develop and commercialize their innovation.
- Helping State early-stage cleantech companies build and capture the value of intellectual capital resources, for example providing more help with patenting, testing, and certifying technologies by adding capacity testing centers and/or by creating including a fast-track.
- Building connections to potential suppliers, manufacturers, customers, and clients in specific cleantech segments, helping cleantech companies find the best product/market fit for their innovation, and connecting clients to large corporations, banks, and large purchasers/buyers supportive of cleantech innovations
- Coordinating resources with other programs (both NYSERDA and other providers of business development services in the State); clarifying where possible funding amounts, deadlines, processes concur and where there are gaps; and optimizing administrative processes and provide resources to those who can make the best use of them.

ETAC/Advanced Buildings Technology Development Program:

Solid State Lighting and Controls Market Characterization Assessment

Industrial Economics, Incorporated (IEc) and EMI Consulting, June 2017

Introduction

The ETAC program funded five solid-state lighting (SSL) demonstration projects through solicitations in 2014, and these projects are currently in the field. The Advanced Buildings Technology Development program is also funding SSL technologies that are not yet widely available on the commercial market, specifically organic light-emitting diode (OLED) lighting and hybrid LED/OLED lighting systems. This market characterization and assessment (MCA) measured key market indicators to document a pre-demonstration point of comparison for assessing market impacts after the projects are completed.

The results of the overall MCA:

- Defined the structure of the supply chain for emerging SSL lighting applications
- Measured baseline market conditions for technologies funded through the two programs for use in future impact studies
- Provided NYSERDA program staff with up-to-date information on market conditions to optimize the market impact of solid-state lighting technology transfer activities

ETAC funds demonstration projects for a range of technologies in three building markets: residential, commercial and institutional, and multifamily. This MCA, however, focused specifically on SSL because ETAC funded several (a total of five) solid-state lighting projects across the three sector groups. Three projects are in the residential sector, one is in the multifamily sector and one is in the commercial sector; all five focus on integrating controls with LEDs.[90] Each of these projects includes demonstrations at multiple sites and all five include multiple SSL technologies or systems.

Similarly, while the Advanced Buildings Technology Development program is funding a diffuse set of projects, it has funded eight projects on OLED product research, development, and demonstration.[91]

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[90] The total number of SSL technologies demonstrated across the five projects is greater than five as some projects demonstrate multiple types of lighting or multiple combinations of lighting products integrated with various controls. Specific technologies and strategies will be defined in Task 2.

[91] NYSERDA may invest in additional market characterization and assessment data collection activities for other technologies later, depending on the evolution of program focus for these two programs, and available evaluation resources.

Project Scope and Methods

The MCA was completed in two phases: a market characterization that defined the proposed methods for impacting the market for the projects, and to better understand the SSL market structure in commercial, residential, and multifamily applications in the State; and an ex-ante market assessment that determined the baseline for key market indicators identified in the market characterization and collected additional data to support the development of business-as-usual and future market adoption curves for technologies funded through the programs.

For the first market characterization phase of the study, the research team worked with program staff to articulate the proposed methods for impacting the markets for SSL projects in the State and verified and defined key market metrics tied to expected program outcomes. EMI Consulting reviewed several relevant market and program studies to identify existing data on the market baseline for lighting (e.g., the size of the overall market in New York and the penetration of different technologies), and better understand the structure of the SSL market specifically in commercial, residential, and multifamily applications in New York. EMI Consulting conducted in-depth interviews with lighting and controls manufacturers and electrical distributors to document the key players in the SSL lighting and controls markets in the State and begin to assess key market indicators among supply-side actors. Finally, EMI Consulting shared these findings with Industrial Economics (IEc), who used them to inform data collection for the second phase of research and help construct market adoption curves for the specific technologies NYSERDA supports.

For the second market assessment phase of the study, EMI Consulting conducted surveys with installers (electrical contractors) and commercial end users to provide the primary inputs for the market adoption curves and to determine awareness, penetration, and saturation metrics among two key actors at the end of the value chain. They also conducted additional in-depth interviews with key market actors (residential builders, lighting specifiers, and property managers) to provide supplemental data from other market actors for key market indicators. Finally, IEc used the survey results to create market adoption curves based on the Bass Diffusion Model, a standard product adoption model that follows the s-curve shape to describe the total adoption of a technology or product within a population.

Phase 1 Key Findings

Program Staff Interviews and Document Review

- Nearly all the ETAC projects across the three sub-programs include lighting controls as part of the project, and the focus is on lighting control systems rather than simple controls.
- All the ETAC demonstration projects seek to raise awareness of the technology or strategy while changing negative perceptions of the technology's cost, quality, or other barriers.
- The Advanced Buildings Technology Development program funded research projects, product development projects, and information dissemination activities related to OLEDs over the past six years. These projects have primarily funded niche OLED applications within specific submarkets, but also included research and development of OLEDs more generally.

Literature Review

- As of 2014, overall market penetration of both LED and OLED was modest despite significant improvements in energy and cost savings over the past several years.
- One study notes that, despite huge gains in the installed base of LED luminaires in commercial and industrial applications from an estimated 6.5 million units in 2012 to nearly 20 million units in 2013, LED luminaires accounted for only about 1% of all luminaires installed in the U.S. in 2013 for commercial and industrial applications.
- The Department of Energy projects that across all markets and sectors, LEDs will reach 84% market share by 2030 (% of lumen-hour sales).
- LED penetration in the residential sector has increased in the State, with 2013 estimates for penetration at 18% Downstate and 11% in the overall NYSERDA service area.

In-Depth Interviews with Distributors and Manufacturers

- Manufacturers and distributors in the lighting industry, especially commercial lighting, are actively engaged with LED products and lighting controls, but there is still considerable opportunity to incorporate more controls into both new construction and retrofit projects. And cost savings over the past several years.
- There is a strong consensus that there has been drastic growth in the LED products and lighting controls markets over the past five years, and considerable agreement this trend will continue. However, interviewees agreed less on the rate of growth in these markets.
- Across most manufacturers and distributors, two primary market barriers were mentioned: the upfront cost of SSL and lighting controls and the lack of education about LEDs, OLEDs, and lighting control technologies. Although ETAC does not seek to directly reduce LED or lighting control costs, several market barriers that ETAC does address were mentioned, including awareness of the technologies and perceptions of the technologies.

Phase 2 Key Findings

Awareness of Technologies

As expected, awareness of LED lighting technologies is near universal across all key market actors and sectors—all the lighting contractors and commercial end users surveyed were aware of LED lighting options, as were all the residential builders, lighting specifiers, and property managers interviewed. Similarly, all manufacturers and distributors interviewed confirmed that all major market actors in the lighting industry, especially commercial lighting, are actively engaged with and aware of LED products and lighting controls. This indicates that the market for LED products is likely to continue growing rapidly in the near term.

On the other hand, OLED awareness is still low among most market actors, except for lighting specifiers and manufacturers. Among lighting contractors, 29% were familiar with OLED technologies generally, which was slightly higher than awareness among commercial and institutional end users (20%). Only one of the seven residential builders and one of six property managers interviewed had heard of OLEDs. Except for manufacturers and lighting specifiers, OLED awareness remains low.

Lighting specifiers (100%, n=6) and lighting contractors (81%, n=140) had high rates of awareness of networked lighting controls. More than two-thirds of commercial end users also heard of networked lighting controls. Five of the seven builders and two of the five property managers heard of networked lighting control strategies. Daylighting technologies had a similarly high rate of awareness among lighting contractors (77%) and end users (70%). For most of these technologies, commercial lighting contractors had a slightly higher rate of awareness than residential contractors, though none of these differences were statistically significant.

Knowledge of Technologies

Although awareness of LEDs and more advanced lighting control strategies was high among most market actors, for both contractors and end users, a knowledge gap still exists for some around LED technologies. A small but significant percent of lighting contractors are still not very knowledgeable of LED technologies, with one-fifth (20%) rating their knowledge a six or below. Some builders, lighting specifiers, and property managers also reported they were not particularly knowledgeable about LED technologies (five of 18), but most rated their knowledge above a six.

These same market actors had low knowledge of OLEDs—most builders, lighting specifiers, and property managers (10 of 18) reported they were not at all knowledgeable of OLEDs. Similarly, about two-thirds (66%) of the lighting contractors who were aware of OLED lighting technologies rated their knowledge of OLEDs below a six out of 10.

Perceptions of Technologies

Most contractors had positive perceptions of LEDs overall (an average rating of 8.9 out of 10) and somewhat positive perceptions of OLEDs (6.6). Commercial and institutional end users had slightly lower perceptions of both technologies (rating LEDs an average of 7.9 and OLEDs a 6.3). A small percentage of end users had negative to very negative perceptions of LEDs, with 11% rating their perceptions of LEDs below a six. Both end users and contractors expressed high confidence in claims that LED lighting is more efficient and longer lasting than other lighting options, which suggests most markets actors across the value chain understand those two key features of LED products.

On lighting quality and willingness to pay extra, not all commercial end users rated LEDs as high, indicating that for some commercial customers, cost, and quality may still be a barrier to installation. Finally, lighting contractors rated the claim, "it makes sense to pay extra money for LED lighting because it will save money in the long run" significantly higher than end users, which could indicate that contractors can still play a role in promoting LED lighting among some commercial and institutional customers.

Marketing and Promotion of Technologies

All but a handful (12%) of lighting contractors are actively promoting LEDs to customers, but only about one-third (35%) are promoting networked or more advanced lighting control systems. Although contractors believe that barriers exist for customers when considering both advanced lighting and lighting control upgrades, they are willing to promote LEDs at a much higher rate than networked controls. This indicates contractors either believe that barriers to networked controls are more significant than barriers to LED lighting or they need more education to be able to actively promote networked systems.

Barriers to Adoption

For both commercial and residential customers, lighting contractors overwhelmingly reported barriers still exist for both SSL technologies and more advanced lighting control strategies—more than three-quarters of contractors reported barriers for both commercial (79% of contractors) and residential

(86% of contractors) customers. Nearly all contractors said residential customers face barriers to installing networked control systems (91%) and approximately three-quarters said commercial customers face barriers (76%). Most contractors believe the primary barrier to LEDs is an initial capital investment or other cost barrier. A handful of contractors also said customers needed certain dimmable bulbs or lamps.

For networked controls, cost or upfront investment was the main barrier for more than three-quarters of respondents (81%). But other primary barriers were cited by different contractors, including lack of awareness or knowledge of the systems (9% and 3%, respectively), compatibility concerns (4%), and complexity of the systems (2%). These results largely align with the two primary barriers identified by manufacturers and distributors: limited knowledge of LED lighting technologies and controls and relatively higher upfront cost of LED lighting technologies. Most market actors at the end of the value chain still hold the perception that LED lighting and control technologies are too expensive and more education around performance and long-term cost efficiencies may be useful.

Penetration and Saturation of Technologies

Among commercial and institutional end users, 43% of all buildings owned or leased by survey respondents had at least one LED bulb or fixture. Of all the lighting in facilities that had at least one LED bulb, approximately 6% of lighting was LED. This translates to an overall market saturation roughly 3% of all lighting in all commercial/institutional buildings is LED. To better understand the long-term market potential for LED lighting, end users were asked to estimate the maximum amount of lighting that could be LED in their facilities—and end users estimated that 86% of all lighting could eventually be upgraded to LED.

Lighting contractors estimated the highest penetration of LED lighting in residential new construction projects, with approximately 81% of buildings they worked on recently including at least one LED. Among retrofit projects, commercial buildings had the highest penetration of LEDs at 78%, followed by multifamily buildings (74%) and residential buildings (70%). Overall, contractors estimated that roughly one-half (53%) of all lighting in residential new construction homes was LED. As expected, retrofit projects were again lower than new construction, with saturation of LEDs in residential retrofit projects at 27%, commercial at 37%, and multifamily at 30%.

End users estimated that less than 1% of all LED lighting at their facilities was currently being controlled by networked control systems. Saturation of networked LED lighting across all buildings was estimated to be 0.04%. When end users were asked to estimate the maximum possible saturation of LED lighting with networked controls, they estimated that overall, 78% of all lighting could potentially be upgraded to LED lighting with networked controls. End users thought it would be about a decade until the maximum amount of LED lighting and networked controls would be installed in their facilities. Among lighting contractors, saturation of networked LEDs (out of all lighting) ranged from a low of 5% in recent residential new construction and multifamily retrofit projects up to 11% in residential retrofit projects. Contractors thought the maximum percent of lighting that could be LED lighting and controlled by a networked lighting control was somewhat lower than end user estimates of their facility's potential. Contractors' estimates of the maximum potential for networked LED lighting was lowest in multifamily retrofit buildings at 50% of all lighting.

Finally, among all lighting contractors who were aware of OLED technologies (only 29% overall), the estimated current penetration of OLED fixtures was between 1% and 4%. When taking this low rate of awareness into consideration, this corresponds to an OLED saturation value of between 0.2% and 0.8%.

Market Adoption Curves

The market adoption curves analysis provided three key findings:

- There appears to be a general trend of optimism regarding market adoption of LEDs in the commercial / institutional sector among end users. Rapid adoption is anticipated; therefore, NYSERDA's opportunity to impact this market may be limited.
- Contractor survey responses suggest a pattern of very rapid adoption approaching near-term (i.e., within approximately three to four years) saturation in the 75th percentile curves for LEDs across all segments, suggesting that any action by NYSERDA in this market should be immediate, and in some segments of the LED market (e.g., residential new construction) action may be unnecessary. However, responses in the 25th and 50th percentile curves for LEDs within retrofit segments identify a delay in market adoption of LEDs beyond current levels in those segments, (i.e., saturation may be achieved in five-plus years instead). Retrofit segments may, therefore, represent a specific opportunity to increase the speed of LED adoption, as it appears that many contractors do not expect substantial gains in adoption of LED technologies in retrofit projects until at least 2019 and beyond.

- The market adoption curves for LEDs with networked controls feature considerably lower current saturation of this technology, and lower maximum saturation, than comparable curves for LEDs. Adoption of LEDs with networked controls is also expected to proceed much more gradually than adoption of LEDs according to end users, even in the 75th percentile scenario. It is possible that a lack of awareness, familiarity, or understanding of LEDs with networked controls is presenting a challenge or barrier to increased adoption and use of this technology. To the extent that this is the case, NYSERDA actions targeted at increasing knowledge of LEDs with networked controls may expedite adoption of this technology and/or increase its potential maximum saturation as a proportion of all lighting.

It is unclear whether NYSERDA market interventions (e.g., additional financial incentives, etc.) could increase a given market adoption curve's maximum limit (i.e., the maximum possible or feasible saturation of LED technologies relative to all lighting), or whether the maximum saturation as provided by survey respondents represents a technical upper limit not driven by market considerations. However, the survey data indicate that respondents disagree substantially as to the maximum possible saturation for a given technology (LEDs, or LEDs with networked controls); therefore, it is possible that NYSERDA market interventions may effectively grant some "late adopter" respondents greater confidence about LED technologies, potentially increasing the maximum saturation threshold for these technologies.

There appear to be greater opportunities to further accelerate and drive adoption of SSL technologies in terms of LEDs with networked controls, as survey respondents generally indicate adoption of LEDs approaching maximum saturation in the immediate future. Based on contractor respondents' replies, multifamily and residential retrofit projects may represent two sectors where NYSERDA market interventions may have the most impact based on current and expected future installation of LEDs with networked controls across the array of survey responses.

Figure D-6. Market Adoption Curves – LEDs – End User Survey Data

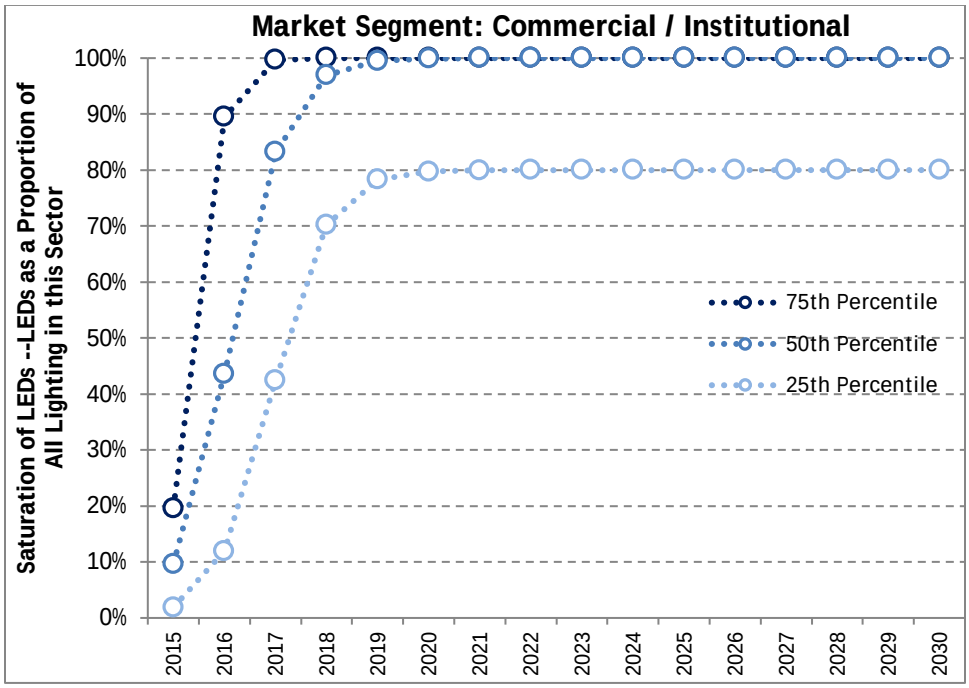


Figure D-7 Market Adoption Curves – LEDs – Contractor Survey Data

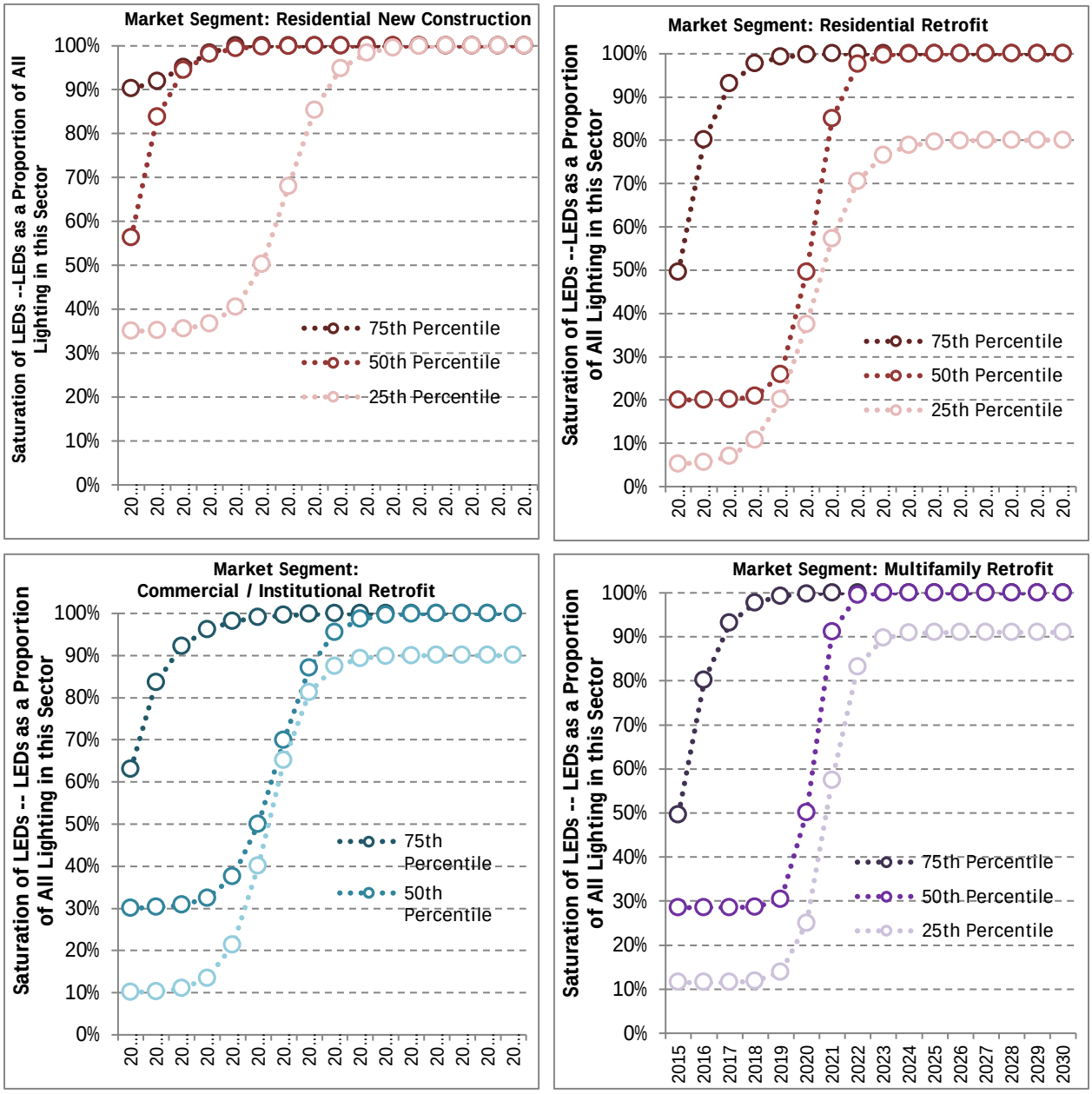


Figure D-8 Market Adoption Curves – LEDs with Networked Controls – End User Survey Data

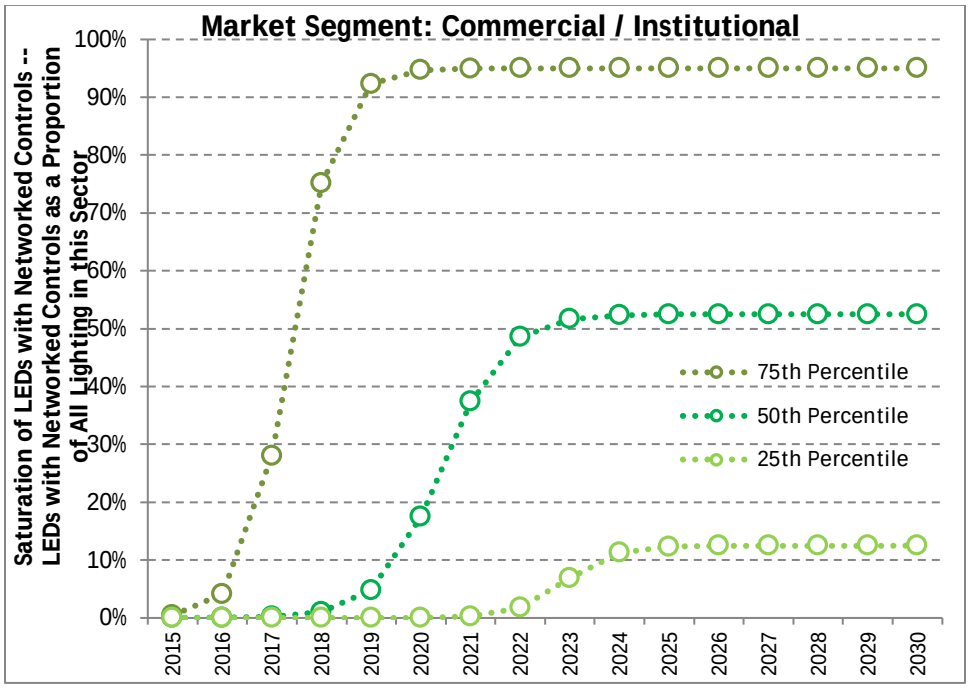


Figure D-9 Market Adoption Curves – LEDs with Networked Controls – Contractor Survey Data

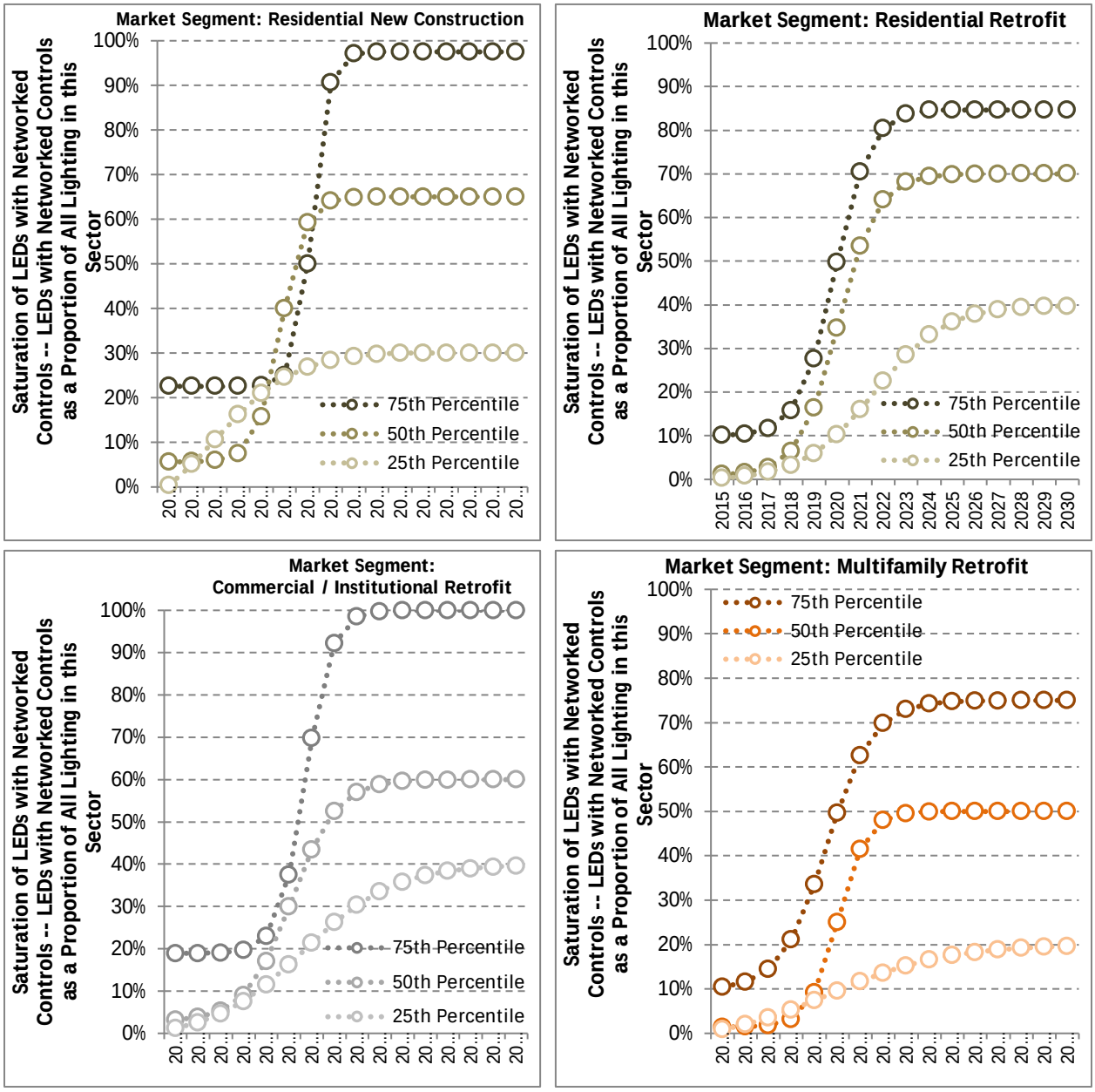
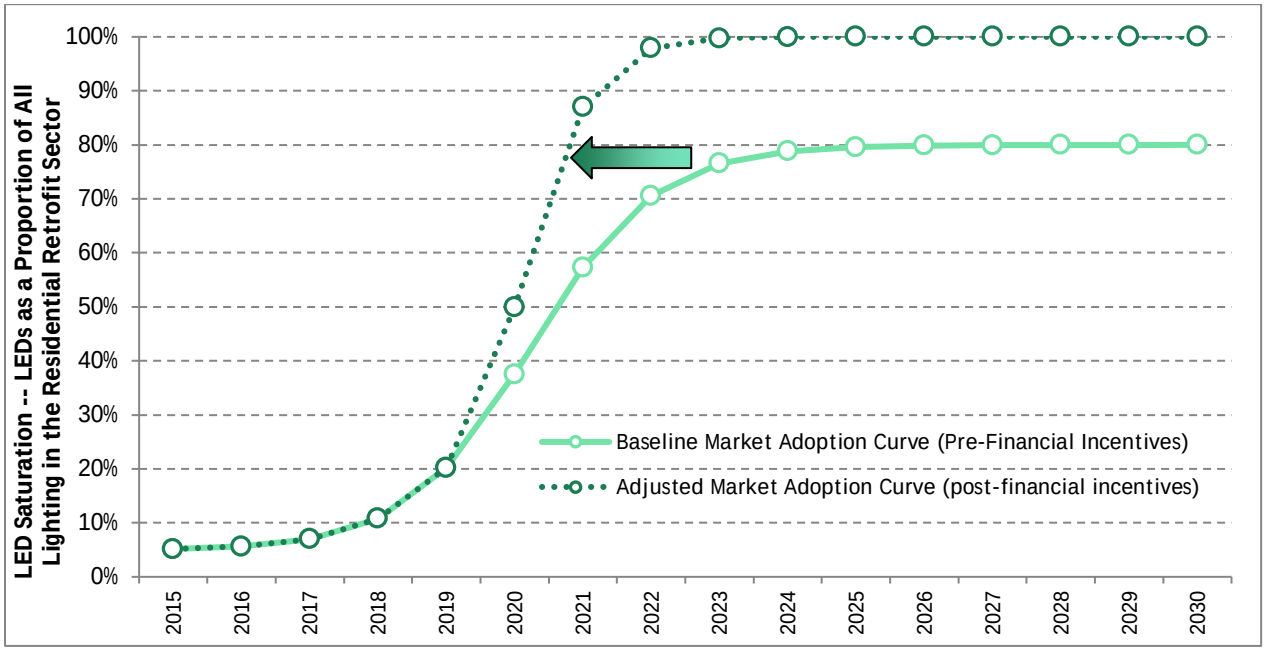


Figure D-10 Hypothetical Effect of Financial Incentives on Future Adoption of LEDs in Residential Retrofit Sector



Appendix E: 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% 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 E-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%
Advanced Energy Codes and Standards	Outputs/Leading Indicators	Equipment and appliance standards efforts	State/Federal Standards Conformance Assessments	3	2	41%

Table E-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	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%
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%

Table E-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
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%
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%

Table E-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
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%
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%

Table E-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
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%
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%

Table E-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	Meetings, Workshops, Conferences	14	12	11%
Environmental Monitoring, Evaluation, Protection	Outputs/Leading Indicators	All Projects	Program Advisory Group Meetings	5	4	11%
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 E-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%
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%

Table E-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	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%
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%

Table E-1 continued

T&MD Initiative	Milestone / Result Type	Project Type	Metric	Original Target Total	Revised Target Total	Percent Budget Reduction*
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.

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