Clean Energy Communities

Impact Evaluation

2016–2018

Prepared for:

New York State Energy Research and Development Authority

Albany, NY

Tracey DeSimone

Project Manager, NYSERDA

Prepared by:

DNV Energy Insights USA Inc.

Michelle Marean, Bradley Campbell, Benjamin Jones

DNV Energy Insights USA Inc.

NYSERDA Contract 104536

November 2021

NYSERDA Record of Revision

Document Title
NYSERDA Clean Energy Communities Impact Evaluation Final Report November 2021

Revision Date	Description of Changes	Revision on Page(s)
11/1/2021	Original Issue	Original Issue

Notice

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

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

Information contained in this document, such as web page addresses, is current at the time of publication.

TABLE OF CONTENTS

LIST OF TABLES

1 Introduction

1.1 Program Description

NYSERDA's Clean Energy Communities program offers an opportunity for local governments to earn recognition and grant funding by demonstrating leadership in the area of clean energy.[1] NYSERDA has identified 10 high-impact actions (HIAs) that local governments can take to save money, create jobs, and improve the environment.

HIAs include tracking energy use in municipal buildings, training for improved energy code enforcement, and policies to support solar energy, among others. By completing four HIAs, communities earn the Clean Energy Community designation and a grant of between $5,000 and $250,000 with no required local cost-share to support additional clean energy projects. To earn the Clean Energy Community designation, at least two of the HIAs must have been completed after August 1, 2016. Funding is set aside to provide grants to 18 communities in each of New York State's Regional Economic Development Council (REDC) regions except for the New York City region, where only New York City is eligible for a grant. To help municipal staff prioritize and implement the HIAs and navigate the program, expert guidance is provided by local Clean Energy Communities Coordinators, at no cost to the local government.[2] Up-to-date information on the initiative's progress can be found in the Clean Energy Fund quarterly report.[3]

Table 1-1. Clean Energy Communities High Impact Actions

Clean Energy Communities HIAs
Benchmarking is a policy that a local government adopts requiring the annual reporting of energy used in municipal buildings. In large communities, local governments may require the annual disclosure of energy used in large private buildings. Benchmarking is important because buildings account for over 60% of the energy used in New York State.[4]
Clean Energy Upgrades are energy efficiency and renewable generation projects in municipal buildings and facilities. By replacing outdated equipment with new smart and efficient technology, municipalities are well-positioned to save energy and money over time.
LED Street Lights incentivize municipalities to convert at least half of the municipal cobra-head style street lights to energy-efficient light-emitting diode (LED) technology.

[1] PON 3298 Clean Energy Communities Program - NYSERDA

[2] New York State Energy Research and Development Authority (NYSERDA) Clean Energy Communities Program Guidance Document, Program Opportunity Notice (PON) 3298, Revised September 15, 2019.

[3] Clean Energy Fund Performance Reports 2016–2018.

[4] NYSERDA Clean Energy Communities Program Guidance Document, Program Opportunity Notice (PON) 3298, revised September 15, 2019

Clean Energy Communities HIAs
In the **Clean Fleets program**, municipalities increase the deployment of alternative fuel vehicles by installing electric vehicle charging stations or other alternative fuel infrastructure.
The **Solarize** HIA incentivizes communities to adopt the existing NYSERDA "Solarize, Clean Heating and Cooling," or "Solar for All" campaigns to increase the number of New York State residents that benefit from clean energy. Eligible Clean Heating and Cooling technologies include ground source heat pumps, air source heat pumps, solar heating and cooling, and biomass.[5]
To qualify for the **Unified Solar Permit** HIA, municipalities adopt the existing New York State Unified Solar Permitting process to reduce costs and delays for solar projects in the jurisdiction.[6] The unified solar permit is a standardized permit application designed to streamline the solar system permitting approval process.
To qualify for the **Energy Code Enforcement Training** HIA, municipalities train code compliance officers and other municipal officials in best practices in energy code enforcement through training, collaborative plans reviews, and joint onsite inspections of local construction projects.
Municipalities earn **Climate Smart Communities** (CSC) certification for adopting actions within the Climate Smart Communities Program framework to guide their climate actions and to enable high-performing communities to achieve recognition for their leadership. Designed around CSC pledge elements, the certification program recognizes communities for their accomplishments.[7]
In **Community Choice Aggregation** (CCA), municipalities transition to a cleaner, more affordable energy supply by passing an ordinance to allow for the aggregated purchase of electric supply for residential and small commercial customers.
Property Assessed Clean Energy Financing (PACE) allows property owners to access secure funds from the Energy Improvement Corporation PACE Program (EIC NY PACE), and finance the costs associated with clean energy upgrades and renewable generation projects to commercial or non-profit properties.[8]

[5] See the Solarize, Clean Heating and Cooling, or Solar for All Campaigns website for more information.

[6] See the Unified Solar Permit website for more information

[7] The Climate Smart Communities program is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. Municipalities are certified through the New York State Department of Environmental Conservation.

[8] See the EIC NY PACE website for more information.

1.2 Summary of Evaluation Objectives

The evaluation objectives and main research topics are summarized in Table 1-2 below. [9]

Table 1-2. Clean Energy Communities evaluation objectives

Evaluation Objectives	Indicator
What is the ratio, or realization rate, of the gross program energy impacts to the verified gross annual impacts?	Verified gross impact realization rate (percentage)
What are the normalized verified gross annual impacts and realization rates achieved for each HIA considering the variation across communities (e.g., population)? [10]	Normalized verified gross impact (MWh, MMBtu, MW); Normalized verified gross impact realization rate (percentage)
What are the first-year verified gross annual impacts for the ten HIAs completed between 2016 and December 2018 for the Clean Energy Communities initiative?	First-year verified gross impact (MWh, MMBtu, and MW); First-year verified gross impact realization rate (percentage)
What are the indirect impacts associated with each HIA and for the Clean Energy Communities initiative overall?	Indirect impact (MWh, MMBtu, MW)
Produce sample designs that are expected to meet 90% confidence and 10% precision for the bottom-up estimates of verified gross annual impacts for the initiative.	Final confidence/precision of verified gross impact and realization rates

[9] Definition of terms per New York State Department of Public Service, Gross Savings Verification Guidance (CE-08) Version 1, August 23, 2019.

[10] If normalized savings cannot be achieved, average or median savings were accepted.

2 Results, Findings, and Recommendations

The first part of this section (2.1) presents results, findings, and recommendations as a summary of all HIAs combined—a summary of the Clean Energy Communities Program as a whole. This includes program-reported and verified gross annual impacts, and indirect impacts for portfolio metrics, followed by the two primary findings and recommendations that apply across HIAs.

Next, Section 2.2 provides results for each HIA including verified gross annual impacts, indirect impacts, total annual impacts, and the numbers of participating communities and their combined population. Finally, Section 2.2 presents findings and recommendations by each HIA.

2.1 High-level Results, Findings, and Recommendations for the Clean Energy Communities Program

Table 2-1 shows the realization rates for program reported and verified gross annual impacts for each HIA. Table 2-2 shows the program-reported and verified gross annual impacts resulting from this evaluation for all the HIAs combined. In summary, the impact evaluation of the Clean Energy Communities program showed that program activities were associated with verified gross annual impacts of 110,781 MWh of electricity savings, 311,346 MMBTU of natural gas savings, and 71,719 MWh of renewable energy generation in the program years 2016–2018. The evaluation also verified gross annual impacts from delivered fuels; 69,401 MMBTU of fuel oil and 32,427 MMBTU of gasoline.[11]

Indirect impacts associated with the program, but occurring in non-participating communities, were estimated to be 21,007 MWh of electricity impacts, 19,179 MMBtu of natural gas impacts, 478,683 MWh renewable energy generation, 2,667 MMBTU of fuel oil impacts, and 10,711 MMBTU gasoline impacts.

For Climate Smart Communities, a top-down model attempted to compare gas and electric energy consumption trends of the 13 certified Climate Smart Communities with communities that did not complete HIAs over 3.5 years. The analysis found that electric and gas impacts for this HIA were too low to quantify using this evaluation method. A bottom-up evaluation was also conducted in an attempt to quantify savings from CSC and supported the findings of the top-down model. The bottom-up evaluation also found that these communities were early adopters whose results are not generalizable to later cohorts of participating communities. Therefore, although CSC has generated impacts for those communities, the current program realization rate for this action is 0%.

[11] Gasoline impacts were claimed and verified for the Clean Fleets HIA. Propane impacts were not claimed by the program.

Table 2-1. Clean Energy Communities: Program realization rates by HIA

High-impact Action	Electric Impacts (MWh)	Natural Gas (MMBTU)	Renewable Generation (MWh)	Renewable Capacity (MW)	Fuel Oil (MMBTU)	Gasoline (MMBTU)	Beneficial Elect (MWH)
Benchmarking	33%	86%			64%		
Clean Energy Upgrades	59%	31%	81%		0%		
LED Street Lights	116%						
Solarize			71%	*			
Unified Solar Permit			90%	*			
Energy Code Enforcement Training	33%	167%			172%		
Community Choice Aggregation			122%	17%			
Property Assessed Clean Energy Financing	8%	0%	9%	11%	*		
Clean Fleets		22%				123%	149%
Climate Smart Communities**	0%	0%			0%		

*Solarize and Unified Solar Permit did not claim renewable capacity. Verified renewable capacity for these programs is included in the program totals, but the realization rate for each is infinite. Property Assessed Clean Energy Financing did not claim fuel oil savings. Verified gross impacts are included in the program totals, but the realization rate is also infinite.

**The communities who completed this HIA were early adopters whose results are not generalizable to later cohorts of participating communities.

Table 2-2. Clean Energy Communities: Program reported, verified, and indirect gross annual impacts

Clean Energy Communities Program Impacts by Source	Program Reported Gross Annual Impacts[12]	Verified Gross Annual Impacts*	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Electric Impacts (MWh)	140,028	89,135	64%	21,007	110,141
Beneficial Electrification (MWh)	-1,266	-1,885	149%	-730	-2,615
Natural Gas Impacts (MMBTU)	341,760	76,869	22%	19,179	96,048
Gasoline Impacts (MMBTU)	26,370	32,427	123%	10,711	43,138
Fuel Oil (MMBTU)	73,464	19,361	26%	2,686	73,195
Renewable Generation (MWh)	68,126	50,073	74%	478,683	528,756
Renewable Capacity (MW)	47	11.99	26%	58	71
Total MMBTU	**1,000,176**	**577,841**	**58%**	**1,732,343**	**2,310,181**

There are two programs that may see improvements in performance metrics in the next evaluation cycle due to increases in program activity in future years. The realization rate was low for Property Assessed

[12] Gross annual program impacts were calculated for 1,208 direct and 1,146 indirect communities

Clean Energy Financing, but program participation doubled from 2018 to 2019. There is also evidence for communities that undertake the Benchmarking action that there may be a delay between the benchmarking activity itself and implementation of energy savings measures. In this scenario, some benchmarking communities may not have realized energy savings within the timeframe of this evaluation, but could still realize savings in the future.

The evaluation identified the following overarching, comprehensive findings and recommendations that apply across all HIAs.

The Clean Energy Communities program used HIA-specific approaches to develop total program impact estimates. While most of these methods were reasonable for forecasting purposes, they were not appropriate for claiming program reported gross annual impacts. Using forecasted estimates to report gross annual impacts led to low realization rates for some HIAs. Second, insufficient measure-level documentation resulted in a challenging verification process.

Program Recommendations are as follows:

1. Future forecasting/planning efforts should adopt the per-capita verified gross annual impacts resulting from this evaluation. Following project completion, program-reported gross annual impacts should be based on implemented measures rather than the Investment Plan forecast/planning estimates.
2. For the majority of completed measures, the data submitted to Salesforce did not inform savings estimates. To improve documentation, consider increasing the level of detail in the post-installation documentation submitted to NYSERDA and for the key impact parameters used to claim gross annual impacts. Priority should be given to HIAs that produce the highest future anticipated contribution of savings for the program overall.
3. Program indirect impacts were assessed using the verified per-unit estimates developed in this study and applied to findings from a separate market study. Given the magnitude of indirect impacts found, an independent, integrated study of impacts from a sample of indirect communities is recommended to verify that per capita savings in indirect communities is comparable to the magnitude of savings per capita from participating (direct) communities.
4. The majority of indirect impacts result from the growth of CCA in the state of New York and the Clean Energy Communities program's position as a primary information source that helps communities get started on the path to CCA. A follow-on study of CCA is recommended that focuses primarily on CCA's impacts (both direct and indirect) to confirm that all projects provide 100% renewable energy on an opt-out basis, and to understand the renewable mix within the HIA.

2.2 High-Level Findings and Recommendations by HIA

This section provides details of high-level findings and recommendations for each HIA. Detailed results for each HIA, including quantification of energy impacts, where applicable, follow in Section 2.3.

Benchmarking

Finding: There is a delay between when the Benchmarking HIA is completed and when impacts are realized. Benchmarking in itself does not produce energy impacts, but it drives the communities to undertake energy-saving projects (such as capital improvements, retro-commissioning, or energy management) after the benchmarking results are available. Communities reported challenges completing this HIA because of the level of effort required to collect and report benchmarking data using Portfolio Manager®.

Recommendations:

- Enforce the program requirement that communities submit annual benchmarking data to NYSERDA and post annual Portfolio Manager data for each municipal building that is 1,000 square feet or larger .
- Provide additional support to communities to help them collect billing data and provide guidance on how to input the data into Portfolio Manager so that the data can be shared publicly, as per program requirements.[13]
- Because there is evidence that communities that undertake benchmarking are likely to implement energy-saving projects sometime in the future, consider waiting 24 to 36 months from the HIA completion date to begin claiming annual impacts, and/or develop a reporting approach that enables savings to be phased in as actions are taken as a result of benchmarking and as they are reported.
- Investment Plan impact estimates should be developed by applying per-capita verified gross annual impacts for small, medium, and large communities from this evaluation.

Finding: Program-reported results used estimates of savings by fuel based on NYPA studies that were not representative of completed CEC projects. These factors produced low realization rates for electricity and fuel oil.

- To more accurately capture the savings of all fuels, consider conducting a project-level measure identification and adoption rate study to quantify impacts and the post-benchmarking timing of installed energy-saving projects.

[13] EPA's Portfolio Manager software is an interactive tool that enables benchmarking calculations and reporting.

Clean Energy Upgrades

Finding: Half of the communities had insufficient project data to verify impacts.

Recommendation: Enforce existing data submission requirements such as audit and engineering reports, contracts, or agreements, and the Portfolio Manager data.

Finding: The Program accounting of gross savings assumed the CEU action would reduce municipal energy consumption by 10% and that municipal consumption was 1.2% of average community consumption. These assumptions proved to be overly ambitious based on the gross savings evaluation which resulted in low realization rates for electricity (59%) and gas (31%).

Recommendation

Reconsider the assumption that one project or measure, on average, will reduce municipal consumption by 10%, and instead adopt the per-capita or per-community verified gross impacts resulting from this evaluation.

Finding: The forecasting approach for CEU assumes that impacts are split 50/50 between renewables, gas, and electric energy efficiency projects.

Recommendation: Recent historic program activity and project mix between energy efficiency and renewables provides better forecasting assumptions and should be used to develop Investment Plan impact estimates.

LED Street Lights

Findings:

- The current population-based forecasting approach is well-founded, as evidenced by the realization rates and confirmed through secondary research by the U.S. DOE.[14]
- Project data were generally sufficient to verify impacts.

Recommendation: No changes in market sizing methods, reporting approaches, or data submission requirements are recommended beyond considering adopting the verified per-lamp impact value, which was somewhat higher than the program assumption used in reporting gross savings.

[14] Public Street and Area Lighting Inventory: Phase I Survey Results, Report Number E-AC05-76RL01830 (2014)*, U.S. Department of Energy.

Clean Fleets Program

Finding: Impacts from vehicle and fueling infrastructure were not tracked separately in Salesforce.

Recommendation: Track community participation by vehicle or fueling infrastructure in Salesforce, including quantities of installed equipment to track and verify impacts.

Finding: The baseline data of the vehicles being replaced is not tracked in Salesforce.

Recommendation: Track the baseline of the vehicle being replaced by adding a field to the certification form.

Finding: Impacts vary by vehicle type, such as battery electric vehicle (BEV), plug-in hybrid electric vehicle (PHEV), and compressed natural gas (CNG).

Recommendations:

- Track vehicle type acquired (e.g., BEV, PHEV, or CNG).
- Consider promoting BEVs if greater gasoline MMBtu unit impacts are desired.

Finding: HIA direct and indirect impacts are driven and scaled by pieces of equipment, rather than per capita or community size.

Recommendation: Future market evaluations that support the calculation of indirect impacts should consider collecting data on the number of vehicles and chargers acquired by the replicating communities instead of relying on population-based estimates.

Solarize

Finding: Verified gross annual impacts were close to program-reported gross annual impacts. Installations were verified using the NY-Sun database, leading to high reliability in system sizes and calculated savings.

Recommendation: Investment Plan impact estimates and gross annual impacts should adopt the per-capita verified gross annual impacts resulting from this evaluation.

Finding: The Solarize customer lists did not include system size or verification of installation.

Recommendations:

- Consider including a field in the existing required customer list or tracking system that is common with the NY-SUN data so that the Solarize data can be matched and verified using the NY-Sun database.
- Consider adding a field to the existing required customer list to track system size so it can be claimed by the program, included in program-reported gross annual savings, and tracked in communities that are no longer eligible for NY-Sun incentives.

Unified Solar Permit

Finding: The comparison of NY-Sun data for participating and non-participating communities showed a downward trend in the overall installation rates of smaller individual solar projects. However, there is less of a downward trend in these system types in communities that adopted the Unified Solar Permit than in communities that had not, indicating that the HIA is influencing installation rates.

Recommendation: Continue using statewide data and comparison groups to track solar HIAs in this program. Consider the statewide trends in solar installations for future Investment Plan impact estimates.

Energy Code Enforcement Training

Findings:

- Direct verification of the NYSERDA program reported gross annual impacts proved to be challenging and the analysis used a top-down approach leveraging data from NYSERDA market sizing assumptions, code enforcement interviews, and similar energy code training and evaluation studies to develop realization rates.
- Based on available information, the evaluators were unable to document the savings methodology used to estimate impacts for this HIA. Additionally, no changes were made to the program reported impact estimation approach when program delivery changed in April 2018 for small communities.
- Participating communities were not required to provide any documentation of achieved impacts or improved practices since attending training; only documentation of training attendance and completion was provided for savings justification.
- For all large communities and for small communities prior to April 2018, program participation required two collaborative plan reviews and field inspections, but no documentation was provided on the buildings reviewed and resulting inspection findings.

Recommendations:

- Provide additional documentation of impacts achieved directly from participation for more concrete context for program reported gross annual impact estimates.
- Consistently apply impact assumption methods to the participant population. For example, our understanding is that NYSERDA calculated impacts separately for different sizes of communities (small, medium, large, etc.) but then applied the impacts from medium communities to the entire population.
- Require improved documentation of HIA participants to quantify the total number of individuals attending training and the impacts achieved by direct program implementation.
- In order to estimate savings for this program it is necessary to compare compliance in participating and non-participating communities. The two most applicable evaluation options are a Delphi panel approach or a primary research building level review for a sample of sites. Each option has challenges. Statewide Delphi panels are effective at estimating compliance for all code related initiatives statewide over time, but require a program-focus to segment out the effect of individual programs or initiatives, which adds time and complexity. Primary research to inform and evaluate energy code enforcement training impacts enables explicit comparison of participating and nonparticipating communities, but often has recruitment barriers and significantly higher cost.

Findings:

- Participant recall of training was not complete, and the program's effect was hard for participants to quantify.
- Interviewees consistently cited education in the construction trades as being the key action necessary to improve compliance with the energy code throughout New York State.

Recommendation: Consider continuing to deliver and expand energy code training beyond the code enforcement community to include the building trades. As builders typically work in multiple communities, this would have the potential to further increase NYSERDA's impact.

Climate Smart Communities Certification

Finding: The per capita based approach used to develop the Investment Plan impact estimates for this HIA did not align with the historical mix of actions taken by the certified communities. Communities are certified based on a mix of climate actions, including those not anticipated to save significant energy. This will result in high variability in the energy impacts of certified communities.

Finding: The initial cohort of participating communities consisted of early adopter communities with a history of taking climate actions before the CSC and CEC program offerings existed.

Recommendation: The evidence from the initial communities suggests that participant savings in early years are likely to be minimal. Later participants may have more savings associated with the program than early participants, but until savings are demonstrated the program should temper expectations for savings potential..

Recommendation: Additional research is required on communities participating after 2018 to support the development of a reasonable planning approach

Finding: Grid-connected energy impacts from this HIA were too small to be detectable and measurable through a community-wide top-down model.

Recommendation: The recommendation to conduct a bottom-up study to quantify the incremental impacts of the program above and beyond the HIAs was completed in early 2021.

Finding: The results of the bottom-up study corroborated the top-down model. The 13 communities that were certified between 2016–2018 were early adopters. Most began working with the CSC program as early as 2009 with some actions preceding the 2009 CSC start date, and with the vast majority of relevant measures prior to commencement of the CEC program. For these communities, the CEC associated savings were near zero due to timing of implementation, but this finding is not necessarily applicable to future program participants.

Recommendation: This HIA serves a role in pushing certified Clean Energy Communities to do more HIAs and to take additional climate actions, but beyond encouraging more HIAs, energy impacts appear limited. If the HIA continues to claim the same magnitude of gross annual impacts, consider increasing the number of required actions that affect energy savings directly.

Finding: Documentation does not include specifics regarding the scale of actions taken.

Recommendation: To support the development of program-reported annual impacts, the program team should consider ongoing follow-up and/or increasing documentation requirements for energy savings actions, such as audit or engineering analyses, and should consider submitting records of installed equipment and key impact parameters.

Recommendation: Following HIA approval, record installed project savings estimates, not forecasted impacts, into the Salesforce tracking data to monitor the scale of energy impacts between now and the next evaluation.

Community Choice Aggregation

Finding: Administrators are required to provide reports to communities, but not to NYSERDA.

Recommendation: Enforce the requirement that administrators submit annual reports to NYSERDA. These reports are required for eligibility but are not currently collected in Salesforce. Requiring the administrator to submit these documents to NYSERDA will allow the Program to track program-reported gross annual impacts and confirm compliance.

Finding: Eligibility requirements stipulate that a community choice aggregator must provide 100% renewable energy. The evaluation found that some participants opted out of or opted down to a standard resource mix. Both scenarios decrease delivered renewable energy.

Recommendation: Consider tracking opt-outs and opt-downs over time as they could provide early indication of declining impacts and signal a need to revitalize community participation.

Property Assessed Clean Energy Financing

Finding: This HIA was slow to start in 2016 but is now seeing increased activity due to changes in the program design.

Recommendation: Now that more project data is available, consider reviewing the 2018–2020 projects and update the program-reported gross annual impacts by considering project size, the mix of affected fuels, and renewable resources.

Finding: Only a small sample of projects could be verified.

Recommendation: Require that project developers submit the Energy Improvement Corporation (EIC) project documents to Salesforce before granting HIA approval. The opportunity to review project data will provide realistic estimates of program-reported gross annual impacts and will support bottom-up project reviews to verify savings.

2.3 Results by HIA

Energy impacts for each HIA are presented in this section.

2.3.1 Benchmarking

The Benchmarking HIA claims gross annual impacts for electric (MWh), natural gas (MMBtu), and fuel oil (MMBtu). The evaluation verified gross annual impacts, calculated verified gross realization rates, and developed normalized per-unit verified gross annual impacts values to quantify indirect savings for electricity, gas, and fuel oil (Table 2-3).

First-year verified gross annual impacts were lower than program-reported gross annual impacts, likely due in part to the observed time lag between when a community completes the Benchmarking HIA and when energy-saving projects are installed.

To calculate indirect impacts, verified gross annual impacts were converted to verified gross annual impacts per-capita (Table 2-4 below), then multiplied by the number of replication communities.[15] The NYSERDA market evaluation estimated 23 small replication communities.

Table 2-3. Benchmarking program reported, verified, and indirect gross annual impacts

Benchmarking Impacts by Source	Program Reported Gross Annual Impacts[16]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Electric Savings (MWh)	31,177	10,224	33%	7	10,231
Natural Gas Savings (MMBTU)	43,342	37,077	86%	27	37,104
Fuel Oil (MMBTU)	13,038	8,280	64%	25	8,305

Table 2-4. Benchmarking per capita and community size impacts

Benchmarking Impacts by Source	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Electric Savings (MWh)	0.00069	0.32	2.07	19.94
Natural Gas Savings (MMBTU)	0.00249	1.15	7.50	72.33
Fuel Oil (MMBTU)	0.000555	0.26	1.68	16.15

Following the benchmarking activity, it takes time to prioritize buildings for efficiency improvements and conduct audits to identify specific energy-saving opportunities. In addition, interviews with the participants indicated that once a project is identified, it often takes 1.5 to 2.5 years to progress to installation. Participants explained that delays are caused by municipal and legislative funding processes and/or a desire to leverage additional funding sources or grants. Due to the delays described by participating communities, limited installations and therefore limited savings would be expected for up to 3 years after completing the HIA.

[15] The number of communities completing actions outside of the initiative was provided to DNV for this evaluation by Opinion Dynamics, which completed that analysis as a part of a separate evaluation. Replication communities are categorized by small, medium, and large; small communities have less than 5,000 residents, medium communities range from 5,000–39,999, and large communities have more than 40,000 residents.

[16] Benchmarking gross annual impacts were calculated for 296 direct communities (combined population 14,905,953) and 23 small indirect communities (combined population 44,666).

Communities described challenges to completing the benchmarking tasks, but the most significant was the level of effort required to compile data across multiple fuels, meters, accounts, and departments. Despite meeting the requirement of passing the local benchmarking ordinance, six of the 25 sampled communities had not completed an annual benchmarking report. The revised program guidelines require communities to share the benchmarking report with NYSERDA to ensure compliance. Although the specific reasons varied, communities cited the time and effort burden of data collection and using Portfolio Manager, confusion about units of measurement in Portfolio Manager, a lack of urgency, and limited perceived value given the lack of funding sources needed to implement energy-saving projects. Several communities were not aware of the requirement to publish and post their benchmarking results, or believed that because it was an online tool, the results were already public.

Communities that successfully completed benchmarking indicated that the activity had started conversations regarding building energy use and that the effort had introduced their planners or energy managers to the Portfolio Manager tool. This evaluation also collected information from the communities.

This study found a correlation between the length the benchmarking program has been in place and decreased energy use. For example, New York City's benchmarking program has been in place since 2011 and accounts for approximately half of the HIA's reported savings.

2.3.2 Clean Energy Upgrades

The Clean Energy Upgrades HIA claims gross annual impacts for electricity (MWh), natural gas (MMBtu), fuel oil (MMBtu), and renewable generation (MWh). This study determined verified gross annual impacts and calculated verified gross realization rates for electricity, natural gas, and renewable generation.

Results for Clean Energy Upgrades are provided in Table 2-5. The verified gross realization rates for electric savings and natural gas savings are quite low, at 59% and 31%, respectively. The renewable generation verified gross realization rate is higher, at 81%. Low realization rates were impacted by differences between program reported measures by fuel type and installed measures. The use of alternative forecasting methods described in Appendix Section 2.3 could also contribute to improved realization rates. For example, although the program reported gross impacts for fuel oil for sampled projects, no fuel oil measures were included in the project data.

To calculate indirect impacts, verified gross annual impacts and renewable impacts were converted to per-capita verified gross annual impacts (below), then multiplied by the number of replication communities.

The NYSERDA market evaluation estimated that 164 small communities, 98 medium communities, and 2 large communities were replication communities.

Table 2-5. Clean Energy Upgrades program reported, verified, and indirect gross annual impacts

Clean Energy Upgrades Impacts by Source	Program Reported Gross Annual Impacts[17]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Electric Savings (MWh)	5,803	3,408	59%	3,062	6,470
Natural Gas Savings (MMBTU)	41,296	12,898	31%	11,588	24,486
Fuel Oil (MMBTU)	4,055	0	0%	*	*
Renewable Generation (MWh)	4,193	3,399	81%	3,054	6,453
Renewable Capacity (MW)	0	3	*	2	5

*Although the program claimed gross impacts for fuel oil for sampled projects, no fuel oil measures were included in the project data.

Table 2-6. Clean Energy Upgrades per capita and community size impact

Clean Energy Upgrades Impacts by Source	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Electric Savings (MWh)	0.00644	3.30	21.49	207.21
Natural Gas Savings (MMBTU)	0.00000	12.50	81.32	784.14
Fuel Oil	0	0	0	0
Renewable Generation (MWh)	0.00000	3.29	21.43	206.66
Renewable Capacity (MW)	0.00000	0.00	0.02	0.16

2.3.3 LED Street Lights

The LED Street Lights HIA claims gross annual impacts for electricity (MWh). This study determined verified gross annual impacts and verified gross realization rates for electricity.

The results for LED Street Lights are presented in Table 2-7. The LED Street Lights HIA returned a 116% verified gross realization rate, an indication that NYSERDA's population-based methods for

[17] Clean Energy Upgrades gross annual impacts were calculated for 25 direct communities (combined population 2,003,570) and 264 indirect communities (combined population 1,800,142).

forecasting gross impacts are well-founded, if not somewhat conservative. These methods have also been validated in DOE's street lighting research.[18]

To calculate indirect impacts, verified gross annual impacts were converted to per-capita verified gross annual impacts (Table 2-8), then multiplied by the number of replication communities. The NYSERDA market evaluation estimated that 94 small communities, 29 medium communities, and 12 large communities were replication communities.

Table 2-7. LED Street Lights program reported, verified, and indirect gross annual impacts

LED Street Lights Impacts by Source	Program Reported Gross Annual Impacts[19]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Electric Impacts (MWh)	59,194	68,848	116%	16,120	84,969

Table 2-8. LED Street Lights per capita and community size impacts

LED Street Lights Impacts by Source	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Electric Impacts (MWh)	0.00802	15.57	101.28	976.60

2.3.4 Clean Fleets

The Clean Fleets HIA claims gross annual impacts for gasoline and natural gas (negative value MMBtu due to increased alternative fuel consumption), and beneficial electrification (negative value MWh due to increased use). This study determined verified gross annual impacts, verified gross realization rates, and developed normalized verified gross annual impacts to quantify indirect savings.

Table 2-9 below presents results for Clean Fleets. Verified gross gasoline savings were greater than program-reported gross annual impacts, driven by the fueling infrastructure pathway (EV chargers). Fueling infrastructure accounted for approximately 75% of gasoline savings. Savings per charging port were greater than reported by the program, indicating that on average, the chargers delivered more kWh

[18] Public Street and Area Lighting Inventory: Phase I Survey Results, Report Number E-AC05-76RL01830 (2014), U.S. Department of Energy

[19] LED Street Lights gross annual impacts were calculated for 47 direct communities (combined population 8,587,359) and 135 indirect communities (combined population 2,010,625).

and thus offset more gasoline-driven miles than anticipated. Annual miles traveled were fewer than reported, reducing the verified gross annual savings from that pathway. Additionally, the original market sizing analysis assumed that all vehicles acquired under the program would be pure battery electric vehicles (BEV). Findings showed that over 80% of vehicles acquired were plug-in hybrid electric vehicles (PHEV), which can use both electricity and gasoline. Although these vehicles can save gasoline from both electrified miles and a more efficient hybrid gasoline engine, they generally do not have large enough batteries for fully electric driving, resulting in some gasoline consumption.

Verified beneficial electrification impacts were also greater than program-reported gross annual impacts due to the increased gasoline miles offset. Verified gross natural gas impacts were lower than program-reported gross impacts (and negative) due to very few CNG vehicles observed.

To calculate indirect impacts, verified gross annual impacts were converted to unit energy impacts (per vehicle or per charging port) shown in Table 2-10, then multiplied by the number of replication communities. The replication study did not provide the number of vehicles or ports acquired by the replication communities, which would have improved the accuracy of indirect impacts. The NYSERDA market evaluation estimated that 117 small communities, 4 medium communities, and 25 large communities were replication communities.

Table 2-9. Clean Fleets program reported, verified, and indirect gross annual impacts[20]

Clean Fleets Impacts by Source	Program Reported Gross Annual Impacts[21]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Gross Annual Impacts
Beneficial Electrification (MWh)	-1,266	-1,885	149%	-730	-2,615
Natural Gas Savings (MMBTU)	-4,539	-992	22%	-55	-1,047
Gasoline Savings (MMBTU)	26,370	32,427	123%	10,711	43,138

[20] Beneficial electrification and natural gas savings are negative due to increased consumption to displace gasoline. No CNG fueling ports were observed through the evaluation.

[21] Clean Fleets gross annual impacts were calculated for 162 direct communities (combined population 14,034,165) and 146 indirect communities (combined population 3,322,996). New York City was a direct community contributing to the large population of the direct communities.

Table 2-10. Clean Fleets per capita and community size impacts

Clean Fleets Impacts by Source	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Beneficial Electrification (MWh)	-0.00013	-0.26	-1.70	-16.36
Natural Gas Savings (MMBTU)	-0.00007	-0.14	-0.89	-8.61
Gasoline Savings (MMBTU)	0.00231	4.49	29.19	281.45

2.3.5 Solarize

The Solarize HIA claims gross annual impacts for renewable generation (MWh) and capacity (MW). This study determined verified gross annual impacts and calculated verified gross realization rates for renewable generation.

The results for Solarize are presented in Table 2-11, showing a 71% verified gross realization rate for renewable generation. Differences between gross and verified gross renewable generation are driven by differences between the capacity of solar installations between projects listed in the customer list versus those verified to have been installed.

Not all projects could be matched to the NY-Sun database, but the program reported system sizes did not vary greatly across projects and communities. If at least 46% of community projects were identified in the NY-Sun database, the average of known system sizes was applied to all projects.

To calculate indirect impacts, verified gross annual impacts were converted to per-capita verified gross annual impacts (Table 2-12), then multiplied by the number of replication communities. The NYSERDA market evaluation estimated that 23 small communities, 51 medium communities, and 4 large communities were replication communities.

Table 2-11. Solarize, Clean Heating and Cooling, or Solar for All Campaign program reported, verified, and indirect gross annual impacts

Solarize, Clean Heating and Cooling, or Solar for All Campaign Impacts by Source	Program Reported Gross Annual Impacts[22]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Renewable Generation (MWh)	2,461	1,755	71%	665	2,420
Renewable Capacity (MW)	0	1.2	*	.46	1.68

Table 2-12. Solarize, Clean Heating and Cooling, or Solar for All Campaigns per capita and community size impacts

Renewable Impacts Solarize	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Renewable Generation (MWh)	0.00057	1.10	7.15	68.92
Renewable Capacity (MW)	0.00000	0.00	0.00	0.05

*Solarize did not claim renewable capacity. Verified renewable capacity is included in the program totals, but the realization rate is infinite.

2.3.6 Unified Solar Permit

The Unified Solar Permit HIA claims gross annual impacts for renewable generation (MWh) and installed capacity (MW). This study determined verified gross annual impacts and calculated verified gross realization rates for renewable generation and installed capacity.

Results for Unified Solar Permit are presented in Table 2-13. Verified gross renewable energy generation (MWh) was relatively high at 90% for the HIA. This result suggests that the per-capita Investment Plan forecasting method, which is also used for Salesforce reporting, is relatively sound, but could be further improved by using the per-capita verified gross annual impacts of this evaluation.

To calculate indirect impacts, verified gross renewable generation impacts were converted to per-capita energy impacts (Table 2-14), then multiplied by the number of replication communities. The NYSERDA market evaluation estimated that 117 small communities, 47 medium communities, and 6 large communities were replication communities.

[22] Solarize gross annual impacts were calculated for 18 direct communities (combined population 3,101,809) and 78 indirect communities (combined population 1,176,189).

Table 2-13. Unified Solar Permit program reported, verified, and indirect gross annual impacts

Unified Solar Permit Impacts by Source	Program Reported Gross Annual Impacts[23]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Renewable Generation (MWh)	3,816	3,419	90%	1,597	5,016
Renewable Capacity (MW)	0	3	*	2	5

*Unified Solar Permit did not claim renewable capacity. Verified renewable capacity is included in the program totals, but the realization rate is infinite.

Table 2-14. Unified Solar Permit per capita and community size impacts

Renewable Impacts Unified Solar Permit Impacts by Source	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Renewable Generation (MWh)	0.00103	2.00	13.00	125.34
Renewable Capacity (MW)	0.00000	0.00	0.00	0.00

2.3.7 Energy Code Enforcement Training

Energy Code Enforcement Training claims gross annual impacts for electricity (MWh) and natural gas (MMBtu) savings. This study determined verified gross annual impacts and calculated verified gross realization rates for electricity and natural gas.

Results for Energy Code Enforcement Training are provided in Table 2-16. The verified gross realization rate for electricity savings is shown at 31%, and for natural gas is very high, at 167%. The low and high realization rates respectively are likely due to the large differences in consumption between residential and commercial in the program reported gross annual impacts and the difference between savings from the prior to the current code. The gas consumption is higher for the residential sector than commercial and this is reflected in the realization rate for gas.

The verified gross impact results have a high degree of uncertainty that could be improved with additional data collection and primary research. It proved challenging to interpret the program methodology for generating the Investment Plan impact estimates and gross impact estimates due to inconsistencies in the approach and its application to the participant communities. Additionally, when interviewed, some

[23] Unified Solar Permit gross annual impacts were calculated for 230 direct communities (combined population 3,322,758) and 170 indirect communities (combined population 1,551,825).

participants had difficulty recalling the NYSERDA training and the extent to which it influenced their code enforcement practices. The data submitted to Salesforce did not inform savings estimates.

To calculate indirect impacts, verified gross annual impacts savings were converted to per-capita verified gross annual impacts (Table 2-17), then multiplied by the number of replication communities. The NYSERDA market evaluation estimated that 189 large, 47 medium, and 23 small communities were replication communities for this HIA.

Table 2-15. Energy Code Enforcement Training program reported, verified, and indirect gross annual impacts

Energy Code Enforcement Training Impacts by Source	Program Reported Gross Annual Impacts[24]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Electric Savings (MWh)	20,008	6,653	33%	1,818	8,470
Natural Gas Savings (MMBTU)	16,748	27,886	167%	7,619	35,505
Fuel Oil (MMBTU)	5,223	8,998	172%	2,458	11,456

community size impacts

Table 2-16 Energy Code Enforcement Training per capita and community size impacts

Energy Code Enforcement Training Impacts by Source	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Electric Savings (MWh)	0.00048	0.94	6.10	58.85
Natural Gas Savings (MMBTU)	0.00203	3.93	25.58	246.67
Fuel Oil (MMBTU)	0.00065	4.63	0.71	0.07

2.3.8 Climate Smart Communities Certification

Impacts were estimated using a top-down model and corroborated with a bottom-up evaluation described in the Appendix in Section 8.2. The top-down model could not detect energy benefits associated with incremental impacts beyond what is already quantified in the bottom-up estimates for the individual

[24] Energy Code Enforcement Training gross annual impacts were calculated for 409 direct communities (combined population 13,770,762) and 259 indirect communities (combined population 3,762,419).

HIAs. As a result, the evaluation found that there were no savings associated with the CEC CSC HIA for the 13 participant communities. The bottom-up evaluation supported the top-down models findings and found that the 13 communities included in the analysis were early adopters whose results are not necessarily predictive of future participant community impacts. The 13 communities have been very active in taking climate action, even before the start of the CSC program in 2009, and thus well before the 2016 start of the CEC program with the CSC high impact action. Recruiting these leading communities to participate in the CSC HIA has served to help drive participation and action in other communities. Additionally, excluding communities due to actions preceding either the 2009 CSC start or the 2016 CEC start would have acted as a disincentive or penalty for these vanguards. While important goals were met through these communities' participation in the program, there are two notable consequences relevant to the analysis:

- **Non-applicable impacts:** The vast majority of energy impacts associated with CSC participation in these communities preceded the CEC program start and thus were not applicable; a program cannot influence actions prior to its existence.
- **Non-generalizable communities**: Results from these early-adopter communities ("loss leaders") are not applicable to later cohorts of communities. Later cohorts, with progressively later dates starting work on the CSC certification, would be expected to have increases in applicable impacts–both in execution and documentation of the actions.

2.3.9 Community Choice Aggregation

CCA reported renewable energy generation (MWh) and renewable capacity (MW). This study estimated verified gross annual impacts, indirect impacts, and verified gross realization rates for both.

The results for CCA are presented in Table 2-17. Verified gross renewable energy generation was much greater than the program-reported gross renewable energy generation (122% verified gross realization rate) because the assumptions and discounts used in the program-reported gross impacts were conservative. However, the verified gross renewable energy capacity was much lower than what was reported by the program, at 17% verified gross realization rate, and is not in alignment with the generation. However, capacity factors vary by resource. For example, 1 MW of solar will not result in the same generation as 1 MW of wind, and thus the two are not directly comparable. The retired RECs can be accredited to several eligible renewable resources, including wind, hydro, and solar, each with differing capacity factors. A capacity factor of 1 was used in the analysis to account for the multiple generation sources identified in the evaluation.

Additionally, although the HIA requirements stipulate a CCA must provide 100% renewable energy on an opt-out basis, it was not clear if all replication communities adopted an opt-out 100% renewable CCA. These challenges are only expected to increase as community size grows. Large replication communities were reclassified as medium-sized communities to account for these factors when developing the indirect impacts.

To calculate indirect impacts, verified gross annual impacts were converted to per-capita verified gross annual impacts (Table 2-18), then multiplied by the number of replication communities. The market study estimated that 23 small communities and 25 large communities were replication communities, which is high compared to the 3 HIA communities reported by the program. As a result, indirect impacts were more than 10 times direct impacts. Indirect impacts were high relative to direct impacts, which was driven by a high number of replication communities categorized as "large."

Table 2-17. Community Choice Aggregation program reported, verified, and indirect gross annual impacts

Community Choice Aggregation Renewable Impacts	Program Reported Gross Annual Impacts[25]	Verified Gross Annual Impacts	Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Renewable Generation (MWh)	33,812	41,297	122%	473,347	514,644
Renewable Capacity (MW)	28	5	17%	54	59

Table 2-18. Community Choice Aggregation per capita and community size impacts

Community Choice Aggregation Renewable Impacts	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Renewable Generation (MWh)	1.313	2,550	16,588	159,944

2.3.10 Property Assessed Clean Energy Financing

The results for Property Assessed Clean Energy Financing (PACE) are presented in Table 2-17. The PACE HIA claims gross annual impacts for electricity (MWh) and natural gas (MMBtu), as well as

[25] CCA gross annual impacts were calculated for 3 direct communities (combined population 31,451) and 48 indirect communities (combined population 360,491).

renewable generation (MWh) and renewable capacity (MW). This study determined verified gross annual impacts and calculated verified gross realization rates for each of these metrics.

Verified gross annual impacts were converted to unit verified gross annual impacts for extrapolation to the replication communities. The market study estimated that 23 medium communities were replication communities.

The verified gross realization rate is zero for fuel and electric savings, and low for renewable generation (9%) and renewable capacity (11%). Fuel oil savings were not claimed for Property Assessed Clean Energy Financing but are reported here. All fuel oil equipment was replaced by heat pumps which offset other electric measures and resulted in low electricity impacts. The other two PACE projects had renewable generation impacts only and did not contribute to either electric or gas impacts.

These results may also be influenced by high reported savings relative to completed projects, the forecasted measure mix (and associated fuel mix), or the measure mix of the projects with enough data to be verified. Increasing levels of activity in the PACE HIA, collecting project data, and using estimated impacts instead of Investment Plan impact estimates to report gross impacts should improve the evaluability of PACE projects, and show a more complete picture of program activity.

Table 2-19. Property Assessed Clean Energy Financing program reported, verified, and indirect gross annual impacts

Energize NY Finance Program Impacts by Source	Program Reported Gross Annual Impacts[26]	Verified Gross Annual Impacts	Direct Verified Gross Realization Rate	Indirect Impacts	Total Annual Impacts
Electric Savings (MWh)	2,198	1	0%	.1	1
Natural Gas Savings (MMBTU)	10,433	0	0%	0	0
Fuel Oil (MMBTU)	0	2,083	*	203	2286
Renewable Generation (MWh)	2,198	203	9%	20	223
Renewable Capacity (MW)	1	0.108	11%	0.01	0.12

*Property Assessed Clean Energy Financing did not claim fuel oil savings. Verified savings are included in the program totals but the realization rate is infinite.

[26] Energize NY Finance gross annual impacts were calculated for 18 direct communities (combined population 2,986,913) and 23 indirect communities (combined population 290,559).

Table 2-20. Property Assessed Clean Energy Financing per capita and community size impacts

Energize NY Finance Impacts by Source	Per-capita Verified Gross Annual Impacts	Per Small Community Verified Gross Annual Impacts	Per Medium Community Verified Gross Annual Impacts	Per Large Community Verified Gross Annual Impacts
Electric Savings (MWh)	0.000000	0.00056	0.00367	0.03534
Natural Gas Savings (MMBTU)	0.000000	0.00000	0.00000	0.00000
Fuel Oil (MMBTU)	0.000697	1.0726	0.1649	0.0171
Renewable Generation (MWh)	0.000068	0.13210	0.85933	8.28586
Renewable Capacity (MW)	0.000000	0.00007	0.00046	0.00442

For additional details on each HIA, see "Clean Energy Communities Impact Evaluation 2016–2018 Appendix."