

Residential Homes Retrofit Programs Evaluation Plan (January 2012-December 2016)

Impact Evaluation

Final

Judeen Byrne

Project Manager, NYSERDA

Lisa Wilson-Wright, Director, Project Contact

Lynn Hoefgen, President, Contract Contact

NMR Group, Inc.

September 19, 2018

NYSERDA Contract #: 104535

Program/Initiative Background

This evaluation condenses into a singular, comprehensive effort the evaluation of NYSERDA's two umbrella¹ existing homes retrofit programs: Home Performance with ENERGY STAR® (HPwES),² and EmPower New York (EmPower)³ along with National Fuel Gas Distribution Corporation's (NFGDC) Low Income Usage Program⁴ (LIURP), which is administered through EmPower.

The basic goals for NYSERDA's existing homes programs and LIURP are to reduce energy consumption within one to four family residential buildings across the state and to capture heating fuel and electricity-related savings. Programs' incentives are based on household income level.

The programs require the use of Building Performance Institute (BPI)-Gold Star (accredited) contractors to perform a comprehensive home energy assessment and install energy-efficient improvements and technologies. The comprehensive home assessment identifies all of the opportunities for energy efficiency improvements within the home, however, the final scope of work undertaken may only reflect a subset of the recommendations. In rental units, certain improvements require permission of the building owner or manager. In low-income housing, improvements that provide the most cost-effective savings are prioritized.

Effective March 1, 2016, the primary funding source for NYSERDA's residential programs changed from the Energy Efficiency Portfolio Standard^{5, 6} (EEPS) to the Clean Energy Fund⁷ (CEF). While EEPS program offerings tended to focus on resource acquisition⁸ activities, the new initiatives implemented under the CEF are intended to spur market transformation⁹ with more targeted interventions. However, NYSERDA will continue to offer incentive-based programs for

¹ See Appendix A for breakout of programs and fundings that fall under the umbrella programs.

² For visual representation of Home Performance with ENERGY STAR strategy see logic model in Appendix B.

³ For visual representation of EmPower strategy see logic model in Appendix C.

⁴ NFGDC is a natural gas utility located in western New York, and as such, the Company's primary goal is to capture heating fuel savings. NFGDC works closely with NYSERDA to offer its customers electricity-related savings, alongside the Company's residential natural gas programs.

⁵ In May 2007 the New York Public Service Commission (PSC) issued an order instituting a proceeding to develop an Energy Efficiency Portfolio Standard (EEPS). In October 2011, the PSC issued a further order reauthorizing EEPS programs through December 31, 2015. On December 2015, the PSC issued an order extending the Energy Efficiency Portfolio Standard (EEPS2) through Feb 29, 2016.

⁶ For the most updated EEPS2 information see:

<https://www.nysenda.ny.gov/About/Publications/Program-Planning-Status-and-Evaluation-Reports/EEPS-and-other-Status-Reports>

⁷ For the most up to date CEF information see:

<https://www.nysenda.ny.gov/About/Publications/Program-Planning-Status-and-Evaluation-Reports/Clean-Energy-Fund-Reports> also <https://www.nysenda.ny.gov/About/Clean-Energy-Fund>

⁸ Resource acquisition program models work to acquire energy efficiency as a predictable and reliable resource for meeting existing and future energy demands.

⁹ Market transformation is the strategic process of intervening in a market to create lasting change in market behavior by removing identified barriers and/or exploiting opportunities to accelerate the adoption of all cost-effective energy efficiency as a matter of standard practice.

the low-to-moderate income sector and make changes over time during the transition period for the market rate sector initiative.

Under CEF the market rate initiative will continue as HPwES and low income will continue as EmPower, however the moderate-income initiative will be a component of EmPower whereas previously it was a component of HPwES. Over time, the three initiatives are aligning in their technical and programmatic requirements and are merging to a single administrative process and platform, while incentives will still be based on income eligibility. The analysis of CEF-funded initiatives shall be considered an interim progress report for staff and findings will be presented in an internal memo to NYSERDA.

Effective January 1, 2016, the primary funding source for NFGDC's LIURP changed from EEPS to NFGDC's Energy Efficiency Transition Implementation Plan ("ETIP").¹⁰ NFGDC has retained NYSERDA and its contractors to operate LIURP on a day-to-day basis, and to fully fund installed natural gas measures in the Company's service territory using ETIP funding.

To ensure clarity and avoid misunderstanding for Consultant bidders, NYSERDA's CEF initiatives will be referred to in this document as Single Family Market Rate, Single Family Moderate-Income, and Single Family Low Income (see Table 1) with all three being referred to collectively as Single Family.

Table 1: One-to-Four Family Existing Homes Programs by Household Income Level

Market Rate	Moderate Income¹	Low Income²
HPwES	Assisted Home Performance with Energy Star (AHPwES) [a component of HPwES]	EmPower
		NFGDC's LIURP (administered by NYSERDA using the EmPower program design)
Single Family ³ Market Rate (CEF-funded HPwES)	Single Family ³ Moderate Income (CEF-funded AHPwES) [a component of EmPower]	Single Family ³ Low Income (CEF-funded EmPower)
¹ Moderate Income: Households with up to 80% of the State or Area Median Income, whichever is higher. ² Low Income: Households with up to 60% of the State Median Income. ³ To ensure clarity in this document, Single Family indicates a CEF-funded initiative.		

For additional program information, such as timeframe and incentives, see Appendix A.

Roles of Project Team

NMR Group, Inc. ("Consultant") was selected as part of the RFQ 3183 mini-bid process and shall execute this impact evaluation plan in consultation with NYSERDA and NFGDC. The primary responsibility of the Consultant will be to carry out the analysis; additional responsibilities are summarized in the Task, Budget, and Schedule section below.

¹⁰ For the most up to date NFGDC ETIP information see:
<http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=07-g-0141&submit=Search>

The role of NYSDERDA evaluation staff will be to provide program data and utility billing data, facilitate any necessary conversations between Consultant and program staff and/or NFGDC staff, participate in model selection for the billing analysis, and manage the project budget and timeline.

Anticipated Direct Impacts and Budget

Direct impacts are defined as those impacts expected from pilots/projects directly funded by NYSDERDA, either immediate or lagged.

Targeted savings and budgets are shown in Table 2, Table 3, and Table 4.

Table 2: EEPs2 Targeted Energy Savings & Budgets¹

Program	Electric Savings Target (MWh)	Gas Savings Target (MMBTu)	Electric Budget	Gas Budget
HPwES	13,167	667,615	\$7,555,295	\$33,282,033
AHPwES	1,705	315,562	\$1,673,210	\$30,234,604
EmPower	47,405	1,004,545	\$48,119,637	\$97,341,146
LIURP ¹¹	N/A	42,580	N/A	\$4,919,791

Table 3: CEF Single Family initiatives 2016 Targeted Savings & Budgets

Program	Electric Savings Target (MWh)	Fuel Savings Target (MMBTu)	Budget (Fuel Neutral)
Single Family Market ¹ (HPwES)	1,290	67,100	\$7,884,100
Single Family Moderate Income ² (AHPwES)	1,190	57,400	\$7,905,680
Single Family Low Income ² (EmPower)	3,760	111,000	\$23,296,877

¹ Single Family Market Rate: CEF Resource Acquisition Transition Chapter, Section 5.2 <https://www.nysderda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Resource-Acquisition-Transition-Chapter.pdf>

² Single Family LMI Residential: Low- to Moderate-Income Chapter, Section 15.3.1

<https://www.nysderda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Low-to-Moderate-Income.pdf>

Table 4: NFGDC Residential ETIP Programs 2016 Targeted Savings & Budgets

Program	Electric Savings Target (MWh)	Gas Savings Target (MMBTu)	Budget (Fuel Neutral)
LIURP ¹	N/A	57,365	\$5,490,000

¹ NFGDC's Conservation Incentive Program, Updated 2017 Energy Efficiency Transition Implementation Plan for the 2017-2020 Program Years, was filed with the New York State Public Service Commission on December 20, 2017. This document contains detailed information and descriptions of NFGDC's LIURP. It should be noted that the savings target is in gross Dth, and both the savings target and budget numbers are annual numbers.

<http://documents.dps.ny.gov/search/Home/ViewDoc/Find?id=%7B13DFC637-1C3B-45E9-A96C-8B112D4EFBF3%7D&ext=pdf>

¹¹ It should be noted that NFGDC's gas savings target, outlined in Table 2, is measured and reported in gross Dth. Both the savings target and budget numbers in Table 2 are annual numbers. (A dekatherm (DTH) is a unit of energy equal to one million British thermal units (MMBTu)).

Outputs/Outcomes/Indicators

Table 5 below lists the outputs identified for the current study.

Table 5: Outputs, Outcomes, and Indicators

Outputs/Outcomes	Indicators	Data Source(s)	Data Collector/Provider
Program reported energy savings	kWh, MMBtu, Dth	CRIS Database and NFGDC Program Tracking Information	Program Staff
Evaluated gross energy savings	kWh, MMBtu, Dth	Utility bills	Evaluation Staff and Consultant
Realization rates	kWh, MMBtu	Derived from CRIS data & utility bills	Consultant
One dekatherm (DTH) is equal to one million British thermal units (MMBtu)			

The program-reported savings shown in Table 6 reflect estimated projects' savings determined by the modeled energy savings submitted by participating contractors. The majority of projects and savings were supported by EEPS2 funding, while a small portion of the totals were supported by RGGI, CEF, and ETIP funds. This study will serve as a close out/wrap up impact evaluation for residential single-family EEPS2 activities, and as an early indicator of program achievement for CEF-funded and ETIP-funded projects.^{12,13}

Table 6: Program-reported kWh and MMBtu Savings Estimates (January 2012 - December 31, 2016)

Umbrella Programs	Project Count	Electric (kWh)	Fuel (MMBtu) ¹
Single Family (includes Market, Moderate & Low Income)	8,242	4,530,332	172,911
HPwES (Includes AHPwES)	31,001	1,324,987	1,059,320
EmPower (includes NFG)	55,435	48,378,616	1,084,291
Totals	94,678	54,233,935	2,316,522
¹ EEPS2 funded electric and gas projects. CEF funding is fuel neutral.			

¹² The consultant recognizes that some projects, such as a portion of those completed on the Fort Drum Army Reservation, may have occurred in low-rise multifamily buildings.

¹³ Some projects received funding through the Regional Greenhouse Gas Initiative (RGGI). A subset of RGGI funded projects were located on Long Island, an area not typically covered by NYSERDA programs.

EM&V Approach

The Consultant, will conduct a billing analysis¹⁴ for NYSERDA and NFGDC projects installed between January 1, 2012 and December 31, 2016 with primary stratifications by program, NDGDC's LIURP, and fuel and post-stratifications by funding source, component/administered programs, contractor, and other possible breakouts to be determined by NYSERDA and NFGDC; drill downs of the post-stratification categories are anticipated, e.g., year of installation.

The approach described below (Table 7) applies to both NYSERDA and NFGDC, unless otherwise noted.

Table 7: Evaluation Objectives and Main Research Questions

Objective	Evaluation Question(s)	Data Source(s) & Analytic Method(s)
Evaluate energy impacts	What are the first-year energy savings based on the electric (kWh) and fuel(MMBtus) savings at the customer site?	NYSERDA and NFGDC Program data, and utility billing data Billing analysis – IPMVP Option C
Develop realization rates (RRs)	What is the ratio of estimated evaluated savings to the Program-reported savings?	Calculations using NYSERDA and NFGDC Program data and modeled billing data
Assess contractor performance	How do contractor-estimated savings compare to evaluated savings?	NYSERDA and NFGDC program data and billing analysis results.
NOTE: Program-reported savings are defined as the total NYSERDA-claimed project kWh/year savings for electric efficiency measures and MMBtu/year of savings for natural gas.		

Evaluation Methodology

This evaluation will focus on estimating the per-household first year energy savings for projects installed in 2012 through 2016. The Consultant will conduct a billing analysis¹⁵ of all completed projects¹⁶ (i.e., a census of projects) whose utility usage data meets the requirements of the analysis method (e.g., adequate number of actual meter reads during the pre- and post-installation periods). The purpose is to provide robust and reliable estimates of energy savings.

Where population sizes are adequate, the Consultant will provide estimated savings by major measure group and assess whether specific measure groups are more or less likely to achieve estimated savings.

Three types of data are required for the billing analysis:

- Program data on measures installed in each home

¹⁴ Billing analysis is an effective tool for impact evaluation of retrofit programs when savings are estimated from the existing condition in the home prior to the installation and the savings are of sufficient magnitude to be found.

¹⁵ Option C of the *International Performance Measurement and Verification Protocol: Volume I*, 2012.

¹⁶ It will not be possible to conduct a billing analysis for the heating-related measures for homes with an oil or propane primary heating system due to the complexity of obtaining and interpreting the billing and delivery/storage records. However, it may be possible to reasonably estimate the order of magnitude and benefits accruing from such conversions.

- Utility consumption history (pre- and post-retrofit)
- Weather data
 - Source to be decided in consultation with NYSERDA and NFGDC; the; the Consultant suggests using the National Oceanic and Atmospheric Administration's (NOAA) Global Summary of the Day (GSOD) database)

The Consultant will use the same methods used in previous NYSERDA studies to weather normalize consumption data.

Methodology for Primary Data Collection

Table 8 provides an overview of the study approach. The Consultant will perform the analysis on a census of all participants, adjusted for attrition due to inadequate billing data, closed accounts, or other reasons. The Consultant will stratify the results when population sizes and analysis techniques allow.

Table 8: Overview of Study Approach

Research Approach	Target Group/ Population	Expected Start Date	Estimated Population Size	Estimated Project Attrition	Sampling Method	Primary Sampling Unit	Primary Stratification ¹
Pre/Post Billing Analysis (IPMVP-Option C)	All projects installed 2012-2016	August 2018	~116,000	30-60%	Census	Project	Fuel type, Umbrella Programs, & NFGDC broken out separately
¹ Stratifications depend on data availability and population sizes. .							

Note that the evaluation will be unable to provide a billing analysis of oil, propane, or other delivered fuels, even though homes who heat space or water with these fuels took part in the programs and may have adopted measures that resulted in unregulated fuel savings. The Consultant believes that the larger population of households using unregulated fuels in New York will prohibit the cost-effective, timely, and accurate collection of oil data. Moreover, NYSERDA recently completed an impact evaluation of unregulated fuels in the *Home Performance with ENERGY STAR Program* that relied on primary data collection for oil, propane, and kerosene.¹⁷ The study concluded that per household estimated savings from unregulated in 2011 to 2013 exceeded those of two previous natural gas evaluations (2007 to 2008 and 2010 to 2011). Although the final decision will be made by NYSERDA and NFGDC, given the recency of this study and the challenges and cost of collecting and analyzing data for unregulated fuels, the Consultant proposes using an adjustment factor based on the 2011 to 2013 study of unregulated fuels savings and the 2010 to 2011 study of natural gas savings to estimate oil, propane, and kerosene savings for the impact evaluation of all residential home retrofit

¹⁷ *Home Performance with Energy Star: Unregulated Fuels Impact Evaluation (2011-2013)*. Prepared for NYSERDA by ERS and West Hill Energy and Computing, 2016. <https://www.nyserdera.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/HPwES-unregulated-fuels-impact-evaluation.pdf>.

programs. The Consultant will not provide estimates of savings for any other delivered fuels (e.g., wood pellets).

Conducting the billing analysis requires the use of customer utility account numbers to collect pre- and post-retrofit energy use billing data; and the Consultant will comply with the DPS guidance¹⁸ for the proper collection and handling of customer energy consumption data for program evaluation purposes.

In addition to fuel type, upper level stratification will be by the HPwES and EmPower umbrella programs, and Single Family. NFGDC LIURP results will also be broken out separately:

Upper/Primary stratifications:

- Fuel type
- Program (HPwES and EmPower; CEF/ETIP as a whole)
- NFGDC's LIURP, both as funded under EEPS2 and ETIP

Lower/Post-stratifications will include the following:

- Assisted HPwES from HPwES under EEPS2
- Single Family initiatives (HPwES, Assisted HPwES, and EmPower under CEF)
- Regional Greenhouse Gas Initiative (RGGI)¹⁹
- Contractor overview
- Measure or measure groups
- Use of financing

Additional post-stratification may be considered as the evaluation progresses, including sub-stratifications, such as year and measure group. If precision falls below 10% (at the 90% confidence level) for any breakdown, the Consultant will discuss potential mitigation strategies with NYSERDA and NFGDC (e.g., merging the results for smaller measure groups).

The Consultant will also consider program changes (e.g., eligibility criteria), changes in the tools or assumptions used by HPwES, EmPower, or LIURP contractors to estimate savings, measure changes (e.g., CFLs to LEDs), and regional variations when describing and interpreting results. Global Information System (GIS) maps will denote where projects were completed throughout the state. Maps will be created by fuel type, program, and funding stream and could also touch on broad categories of measures or contractor characteristics, depending on the results.

Direct Impacts Calculation Methodology

A reduction in consumption of electricity and/or natural gas is expected from the Program's projects. Although a year's worth of pre-installation and a year's worth of post-installation billing data is preferable,²⁰ at a minimum, nine months pre- and post- installation is needed if

¹⁸ Contracts of consultants qualified to conduct billing analysis under RFQ 3183 include a Confidentiality of Utility Customer Data Addendum that required consultant signature; the addendum referenced the Revised December 12, 2012, Customer Data Guidelines set forth by the Department of Public Service.

¹⁹ Will include projects on Long Island.

²⁰ The timeframe between application and installation is usually 3 to 4 months but may take longer.

the billing data also includes two complete heating seasons (for natural gas) or two complete cooling seasons (for electric). This approach allows for the inclusion of additional homes in the model without compromising the ability to estimate savings for seasonal measures.

Based on previous impact evaluations of NYSERDA's HPwES²¹ and EmPower²² programs that employed billing analyses, it is expected that 30% to 60% of projects will not make it into the final billing analysis. The Consultant will conduct an analysis of attrition, tracking reasons for attrition by program. This analysis will also attempt to assess the impact on the number and diversity of measure groups included in the billing analysis. The Consultant will examine whether attrition creates bias in the analysis or limits the ability to answer critical research questions, such as savings by year. If the Consultant finds substantial bias in attrition, the Consultants will work with NYSERDA and NFGDC to identify possible approaches to mitigate results.

Billing Analysis Modeling Approach

Prior to modeling, the Consultant will conduct data cleaning of program data and billing data. Possible billing data-related issues include:

- Sufficient period of billing records, pre- and post- measure installation billing records (at least nine months pre- and post-participation data are needed)
- Breaks in billing history, such as lapses in service or changes in residence
- Extended vacancies or periods of limited occupancy, indicated by low usage for numerous consecutive months
- Consecutive estimated meter readings
- Other anomalies in billing data, such as spikes and dips in billing history that might suggest incorrect or adjusted meter readings

The Consultant will develop separate gas and electric models. The billing analysis models will be determined jointly by NYSERDA, NFGDC, and the Consultant based on review of the programs, tracking data, and billing data. NYSERDA and the Consultant will also assess the impact on comparability to other current and previous billing analyses. After receiving the billing data and merging it with NYSERDA's program tracking data, the Consultant will weather normalize the results by using heating degree days in the natural gas models and both heating and cooling degree days in the electric models, reflecting the most common uses of those fuels. The models will also control for groups of program measures to isolate measure-specific effects and identify measure groups with the highest potential to achieve estimated savings. Natural gas measures with large potential savings include envelope upgrades, water heating system repair, and heating system replacement. Electric measures that are likely to show high savings include major appliances, lighting (assuming numerous bulbs were installed), heat pumps, and envelope upgrades. Results from this study will be compared to findings from prior program billing analyses.

²¹ Home Performance Impact Evaluation Report (PY2010–2013) Final Report Vol. 2: Phase 1 Billing Analysis, November 2016; also 2007-2008 Impact Evaluation Report, September 2012 (see Reference Section for links)

²² EmPower & NFGDC Low Income Usage Reduction Program Impact Evaluation (2010–2011), May 2015; also 2007-2008 EmPower NewYorkSM Program Impact Evaluation Report, April 2012.

The Consultant will identify potential outliers in the dataset that could cause erroneous interpretation of results. For example, households that may have switched their primary space or water heating fuel as a direct or indirect effect of program participation can cause the pre- or post-period measurement values to skew upwards for the new fuel type, even if the overall efficiency of the household has increased. The Consultant will work to identify potential fuel switching by examining natural gas and electricity consumption patterns prior to and after measure installation, cross checking with the types of measures installed in the home, and make appropriate adjustments in the analysis.²³

Realization Rate Calculation

The Consultant will use the following equation to calculate realization rates (RRs):

$$RR = \frac{\text{Savings (evaluated)}}{\text{Savings (reported)}}$$

RR = Realization rate

Savings (evaluated) = Savings as per measurement and verification (M&V) evaluation

Savings (reported) = Savings as reported by the Program

Realization rates will be calculated for each year included in the analysis. In analyzing realization rates, the Consultant will investigate the results for possible issues that can be addressed through programmatic changes. The Consultant will examine the annual realization results for consistency and robustness in the face of programmatic changes. In addition, the Consultant will review with NYSERDA and NFGDC the impact of any changes to estimated savings for measures due to revisions in the engineering models or tools that may have occurred over the course of the period under evaluation. After vetting the realization rates with NYSERDA and NFGDC, the Consultants will develop an aggregated realization rate equal to the weighted average (based on annual participation counts) of the annual realization rates. These aggregated realization rates will be calculated at the post-stratified levels for public reporting.

Ethics and Operational Standards

NYSERDA and NFGDC's respective EM&V functions are organizationally separate from program implementation. Steps are taken to eliminate opportunities for bias in conducting EM&V activities and contracts with independent third-party consultants who exhibit a high degree of evaluation ethics.

As appropriate, in the table below, the consultant shall identify any real or perceived conflicts of interest applicable to their conduct of this work and how any conflict of interest shall be resolved.

²³ Note that fuel switching may occur even if the participant did not install space or water heating measures through the NYSERDA residential retrofit programs, as they could have installed them through a utility program or outside of a program. The Consultant will still flag households with substantial increases in fuel usage pre- and post-participation even if the measures do not appear in the NYSERDA database.

Table 9: Conflict of Interest

Real or Perceived Conflict of Interest	Proposed Resolution
The Contractor has no known real or perceived conflicts of interest in conducting this research.	N/A

Tasks, Budget, and Schedule

Task 1: Project Kick-Off and Evaluation Plan Finalization

The Consultant will complete a background review of the programs. The Consultant will work with NYSERDA and NFGDC to schedule a Project Kick-off Meeting via webinar in August or September 2018. The Consultant will prepare an agenda for the kick-off meeting; discussion topics will likely include refining of research questions and scope; program data and availability; value to Program staff; roles and responsibilities of NYSERDA, NFGDC, and Consultant staff members; and project schedule and budget. After the kick-off, the Consultant will work with NYSERDA and NFGDC to finalize the evaluation plan.

- Deliverables:
 - Draft and Final evaluation plan with schedule
 - Kick-off meeting draft and final agenda
 - Draft and finalized slide deck to guide discussion at the kick-off meeting (draft to be sent to evaluation staff for review no later than 3 days before meeting)
 - Minutes/notes from kick-off meeting

Following successful completion of Task 1, the NYSERDA project manager will notify NFGDC and the Consultant in writing that the evaluation plan has been finalized.

Task 2: Review, and Preparation of Program Data Set

After receipt of the program data, the Consultant will review the data to catalog which data fields are tracked, and assess the data for possible anomalies (e.g., data entry errors, duplicated records) and issues (e.g., missing, incomplete, or inconsistently tracked data). The Consultant will work with NYSERDA and NFGDC to discuss any anomalies and issues and identify possible ways to mitigate them. (NYSERDA prepares data and works directly with the utilities for the data request.)

- Deliverables:
 - Advise NYSERDA and NFGDC (where applicable) via email of any issues that may impact the validity or analysis of data at the project or program level

Task 3: Clean Utility Data and Merge with NYSERDA Program Data

This task involves formatting utility-provided data and merging it with NYSERDA program data for billing analysis. As described above, the Consultant will clean the data to ensure participants 1) have sufficient months of usable pre- and post-participation data, 2) do not have extended vacancies, and 3) do not exhibit outlying usage or anomalies (e.g., usage is too high for

residences or exhibits spikes that could suggest an incorrect meter read). The Consultant will track data attrition, which will be reported in regular communications to NYSERDA and NFGDC, as well as in sections of the overall report.

- Deliverables:
 - Memo describing the final results of data cleaning, that will outline project attrition and final sample sizes available for primary stratifications (program, fuel, NFGDC)
 - Discussion during regular calls and e-mailed status reports to NYSERDA and NFGDC on the progress of data cleaning and mitigation strategies for any issues that arise.

Task 4: Billing Data Analysis and Post-Stratification of Results

After review of the program designs, tracking data, and billing data the Consultant will confer with NYSERDA and NFGDC on the model(s) and specifications to be used and conduct the billing analysis accordingly. The analysis will stratify primarily by fuel, program (HPwES, EmPower, and CEF), and NFGDC's LIURP program, with post-stratification including Assisted HPwES from HPwES under EEPs2, RGGI, various single-family initiatives under CEF, and contractor. Other post-stratifications are also possible, depending on evaluation needs and adequate usable records.

Deliverables:

- After consulting with NYSERDA and NFGDC, send an email or memo confirming agreed upon billing analysis model(s) to be used
- Regular correspondence (e.g., bi-weekly meetings and bi-weekly and monthly status reports) with NYSERDA regarding the progress of modeling, any issues encountered, and suggestion to resolve these issues

Task 5: Internal Interim Memo (the position of this task does not indicate its delivery schedule or order of completion).

NYSERDA and NFGDC have particular interests in real-time assessment of program performance for ongoing CEF-funded and ETIP-funded initiatives. The Consultant will perform a pre/post analysis of CEF-funded and ETIP-funded program participants through at least June 2017 (and possibly later) who also have nine months of post-program billing data available for analysis.

- Deliverables:
 - Draft internal memos to NYSERDA and NFGDC on CEF and ETIP interim findings for Program Staff and Evaluation staff review
 - Incorporate NYSERDA and NFGDC edits and finalize the respective memos

Task 6: Preliminary Findings Presentation and Draft Report

The Consultant shall create a draft PowerPoint presentation summarizing the preliminary results for NYSERDA and NFGDC evaluation staff's review. The Consultant will revise the PowerPoint

based on NYSERDA's feedback and deliver the summary presentation to NYSERDA and NFGDC via a webinar. In parallel, the Consultant will also prepare a draft report of the findings, with a separate section for NFGDC, Home Performance, and EmPower.

Following the presentation webinar with NYSERDA and NFGDC, the Consultant will revise the draft report to incorporate feedback and changes resulting from the meeting discussion.

- Deliverables:
 - Draft presentation slide deck (to be provided to NYSERDA and NFGDC evaluation staff at least one week prior to the scheduled meeting)
 - Revised slide deck for presentation meeting with NYSERDA and NFGDC staff
 - Draft report with separate section for NFGDC, Home Performance, and EmPower savings estimation
 - Formally conduct a presentation of findings meeting with NYSERDA and NFGDC staff
 - Within three days of presentation, edit draft report to incorporate meeting discussion points and send to NYSERDA and NFGDC for review

Task 7: Final Report

NYSERDA and NFGDC evaluation and program staff will review the draft report and provide feedback to the Consultant. The Consultant will revise the report based on the feedback and prepare a final report in accordance with the NYSERDA Evaluation Report Guidelines.

- Deliverables:
 - Final report and final version of presentation materials

Task 8: Data Transfer

Transfer data files and associated analysis files to NYSERDA via SharePoint. Includes tasks to prepare data for dissemination. The Consultant will do the same for NFGDC, in accordance with its procedures. The Consultant will provide separate files for each program evaluated.

- Deliverables:
 - All project-related data files

Task 9: Data Destruction

Upon conclusion of the project, and after transferring all data files to NYSERDA, any confidential utility customer data used as part of the project must be destroyed by the Contractor and the Contractor must countersign a letter to NYSERDA and NFGDC certifying this has occurred. All other data associated with the project must also be destroyed by the Contractor and the Contractor shall send NYSERDA an e-mail stating this has occurred.

- Deliverable:
 - Countersigned letter sent to NYSERDA and NFGDC upon destruction of utility data; email sent to NYSERDA and NFGDC upon destruction of all other project data.

Task 10: Project Management

Management of this study will require attendance at conference calls and meetings with NYSERDA and NFGDC staff and designated parties. It may also involve presentations to such groups (other than the reporting presentation described above). Participation in bi-weekly calls with NYSERDA project manager, as well as development of memoranda stating any issues, project status and actions items discussed during the calls shall be provided by the Consultant. These calls will be scheduled in consultation with NYSERDA. The Consultant shall also provide bi-weekly progress reports demonstrating activity over the prior two weeks. These reports shall be submitted to NYSERDA in advance of the bi-weekly status calls. Monthly progress reports should be submitted with invoices. Note that during critical evaluation periods, the Consultant and NYSERDA may opt to hold weekly calls and receive weekly progress reports to ensure timely decision making and a smooth evaluation process.

- Deliverables:
 - Written bi-weekly and monthly progress reports

Budget Summary

The total budget for this study is \$146,146

Invoicing Guidelines

The Consultant will structure invoices to clearly delineate the staff hours and costs associated with each of the individual tasks included in this section. Any potential deviations from the agreed-upon task budgets must be discussed with the NYSERDA project manager as soon as possible and prior to the continuation of work. In general, small changes to original task-level budgets will be acceptable following discussion with NYSERDA, while larger task-level budget changes that substantially affect the overall study budget will require written justification and NYSERDA approval.

References

- Agnew, K.; Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68564.
<http://www.nrel.gov/docs/fy17osti/68564.pdf>.
- Byrne, J. and E. Shusas. 2016. *Home Performance with Energy Star: Unregulated Fuels Impact Evaluation (2011-2013)*. Prepared for NYSDERDA by ERS and West Hill Energy and Computing. <https://www.nysderda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/HPwES-unregulated-fuels-impact-evaluation.pdf>.
- NYSDERDA EmPower Program and National Fuel Gas Distribution Corporation's Low Income Usage Reduction Program Impact Evaluation (2010–2011), May 2015
<https://www.nysderda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2015ContractorReports/2015-EmPower-National-Fuel-Gas-Evaluation-Report.pdf>
- NYSDERDA 2007-2008 EmPower New YorkSM Program Impact Evaluation Report April 2012 <https://www.nysderda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2012ContractorReports/2012-EmPower-New-York-Impact-Report.pdf>

APPENDIX A: One-to-Four Family Existing Homes Retrofit Programs: Funding Sources, Timeframes, Customer Costs, and Incentives

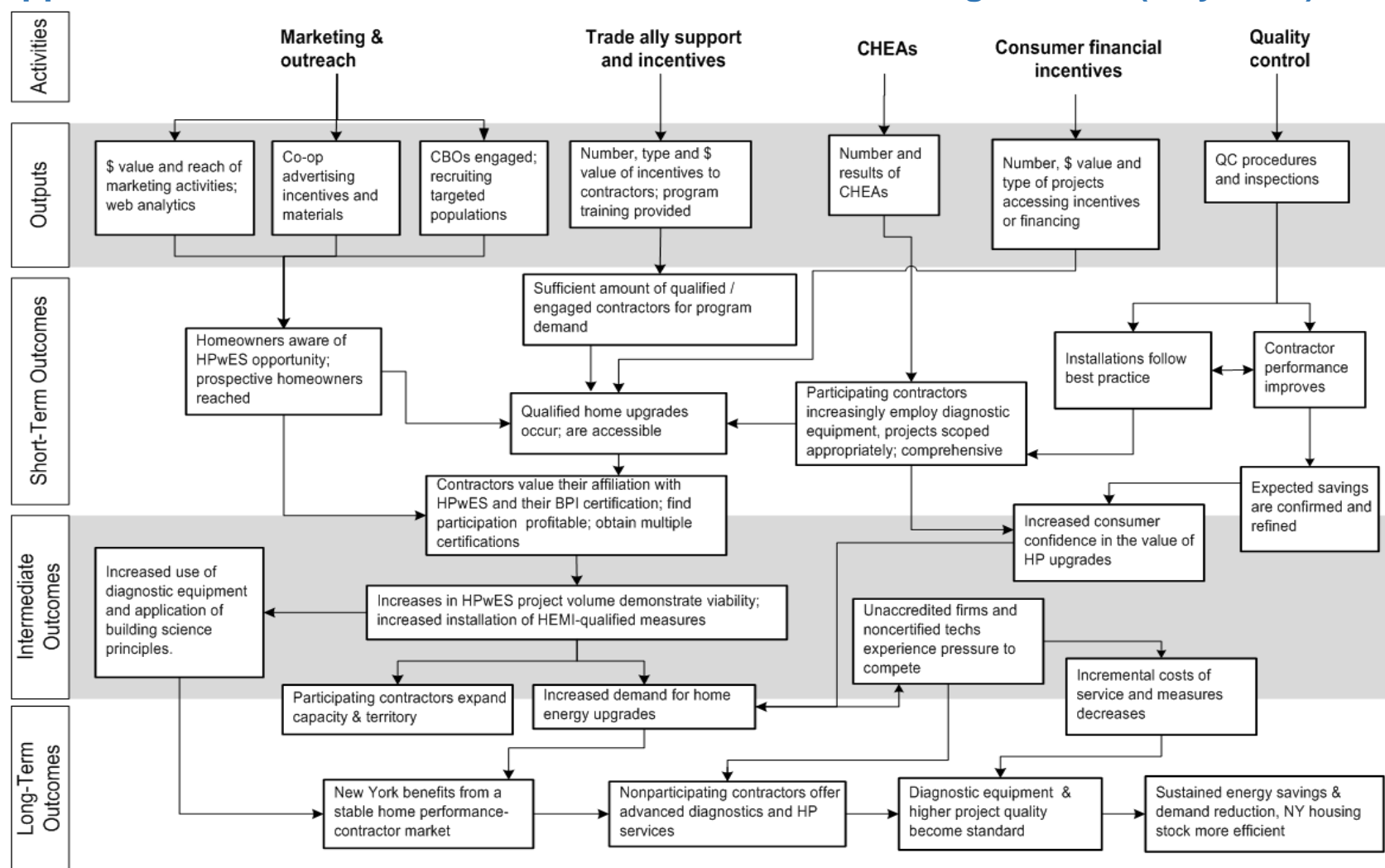
Residential Programs: Funding Sources, Timeframes, Income Qualifications, Customer Costs, & Incentives

Program Name	Funding Source(s)	Program Timeframe	Income Level	Customer Income Qualification	Cost to Customer	Incentives to Contractor ¹
Home Performance with ENERGY STAR® (HPwES)	EEPS2 RGGI	1-1-2012 through 2-28-2016	Market Rate	None	90% of full project cost	5% of the cost of the approved energy efficiency measures
Assisted Home Performance with ENERGY STAR® (AHPwES) (component of HP)	EEPS2 RGGI	1-1-2012 through 2-28-2016	Moderate Income	Households up to 80% of the State or Area Median Income, whichever is higher	Reduction through contractor of 50% of the cost of the approved energy efficiency measures (up to \$5,000 for a single-family unit, or \$10,000 for a qualified building with two to four units)	Contractor: 5% of the cost of the approved energy efficiency measures
EmPower New York	EEPS2 RGGI	1-1-2012 through 2-28-2016	Low Income	Households less than 60% of the State Median Income	No cost for program-approved measures	No incentive Free referral to customer
Home Performance with ENERGY STAR® (HPwES)	CEF	3-1-16 through 12-31-18	Market Rate	None	90% of full project cost for projects submitted through August 31, 2016; then Full cost of project	5% of the cost of the approved energy efficiency measures through August 31, 2016 10% of the cost of the approved energy efficiency measures
Assisted Home Performance with ENERGY STAR® (AHPwES) (component of EmPower)	CEF	3-1-16 through 12-31-21	Moderate Income	Households up to 80% of the State or Area Median Income, whichever is higher	Reduction through contractor of 50% of the cost of the approved energy efficiency measures (up to \$5,000 for a single-family unit, or \$10,000 for a qualified building with two to four units) for subsidy applications submitted through August 31, 2016; after that date the maximum incentive decreased to \$5,000 for a single-family home or \$8,000 for a two to four unit home.	Contractor: 5% of the cost of the approved energy efficiency measures
EmPower New York	CEF	3-1-16 through 12-31-21	Low Income	Households 60% or less of the State Median Income	No cost for program-approved measures	No incentive. Free referral to customer
NFGDC Low Income Usage Reduction Program (LIURP) ²	EEPS2 ETIP	1-1-2012 through 12-31-2020	Low Income	Households less than 60% of the State Median Income	No cost for program-approved measures	No incentive Free referral to customer

¹ See LMI CEF Investment Plan – Section 15.3 for more detailed, historic information; incentive structure changed effective September/October 2016

² National Fuel Gas Distribution Corporation's low-income program administered by NYSEDA through EmPower.

Appendix B: Home Performance with ENERGY STAR® Logic Model (May 2014)



Appendix C: EmPower New York Program Logic Model (November 2009)

