

NYSERDA 2007-2008 NEW YORK ENERGY STAR[®] Homes Program Impact Evaluation Report

FINAL

Prepared for
**The New York State
Energy Research and Development Authority**

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ABSTRACT

The New York ENERGY STAR® Homes Program was designed to transform the new home construction industry in the State of New York through the encouragement of building homes that use at least 20% less energy than homes built to simply meet the energy code. From inception in 2001, the Program resulted in certification of over 14,700 ENERGY STAR homes. The Program is targeted toward residential new construction market, i.e., builders of one- to four-unit residential buildings.

This impact evaluation consisted of a rigorous analysis with multiple components. The evaluated gross program savings for natural gas were estimated through energy simulation modeling calibrated to actual energy consumption, conducted on a sample of program participants. Evaluated gross electric savings were verified through a combination of energy modeling and review of deemed savings values, including a comparison of per household savings to total energy consumption from billing records. Homeowner surveys were used to make necessary adjustments to the models to reflect as-is conditions in the home. Evaluated net savings were estimated through enhanced self-reports from participating, non-participating and formerly-participating builders.

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GLOSSARY OF ACRONYMS AND DEFINITIONS¹

AAPOR - American Association for Public Opinion Research – A leading association of public opinion and survey research professionals.

Attrition - Loss of participants in an analysis; attrition in a billing analysis can occur for a variety of reasons, such as length of tenure at the residence.

Billing Analysis - Analysis of utility billing records; billing analyses may be conducted for a variety of reasons; in this evaluation, the billing analysis was used to determine annual consumption for calibrating heating and cooling savings estimates.

Climate Zone – The climate zones referenced in this report are those defined and recognized by the International Code Council (ICC), New York Energy Conservation Code and the EPA and New York ENERGY STAR Home Programs.

Construct Validity - The extent to which an operating variable/instrument accurately taps an underlying concept/hypothesis, properly measuring an abstract quality or idea.

Contact Rate - This is one of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR).² The contact rate has all outcomes where an eligible respondent was reached and the interview attempted divided by these plus those not contacted. The three contact rate outcomes are: completes, refusals and break-offs (the numerator of the contact rate).

Cooperation Rate – This is one of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR).³ The proportion of all cases interviewed of all eligible units ever contacted. Those contacted (the denominator) includes completes, refusals and break-offs.⁴

DHW - domestic hot water

Free Riders, Free Ridership (FR) - A program participant who would have implemented the program measure or practice in the absence of the program.

Net Savings – The total savings that is attributable to an energy efficiency program, including, implicitly or explicitly, the effects of spillover and free riders.

Net-to-Gross, Net-to-Gross Ratio (NTG, NTGR) – The relationship between net energy and/or demand savings, where net is measured as what would have occurred without the program, what would have occurred naturally, and gross savings (often evaluated savings). The NTGR is the ratio of net savings to gross savings. For NYSERDA programs the NTGR is defined as one minus free ridership plus spillover ($1 - FR + SO$).

¹ Much of this report's Glossary is taken from the *2004 California Evaluation Framework*, which was prepared for the California Public Utilities Commission and the Project Advisory Group in September 2004 by a Team led by TecMarket Works and included a lead role by one of the authors of this report from Megdal & Associates.

² American Association for Public Opinion Research (AAPOR) 2011. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, Revised 2011. Each of the rates presented here has multiple more specific categories and definitions provided by AAPOR. *Standard Definitions* is available on AAPOR website: www.aapor.org

³ *Ibid.*

⁴ *Ibid.*

Refusal Rate – This is one of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR).⁵ The proportion of all cases in which an eligible respondent refuses to be interviewed, or breaks-off an interview, of all potentially eligible cases.

Realization Rate (RR) - The ratio of the field of evaluation energy savings to the program’s claimed savings. The RR represents the percent of program-estimated savings that the Impact Evaluation Team estimates as being actually achieved based on the results of the evaluation. The RR calculation is shown below:

$$RR = \frac{kWh_{evaluation}}{kWh_{program}}$$

where *RR* is the realization rate, *kWh_{evaluation}* is the evaluated kWh savings and *kWh_{program}* is the program reported kWh.

Response Rate - This is one of the final disposition and outcome rates for surveys defined by the American Association for Public Opinion Research (AAPOR).⁶ The response rate estimates the fraction of all eligible working numbers where a request for an interview was made. The denominator of this ratio is inclusion of all possible components where a request for an interview could be attempted. More specifically the response rate is the number of completed interviews divided by the sum of: completes, refusals, break-offs, not contacted and the figure estimated for unknown eligibility. Response rate = (Completes)/(Completes+refusals+break-offs+not contacted+(e*(unknown eligibility))).

Spillover (SO): Includes **Participant Inside Spillover (ISO)** and **Participant Outside Spillover (OSO)** and **Non-Participant Spillover** -- Reductions in energy consumption and/or demand caused by the presence of the energy efficiency program, beyond program related gross savings of participants.

“Inside” spillover occurs when, due to the project, additional actions are taken to reduce energy use at the same home, but these actions are not included as program savings.

Outside spillover occurs when an actor participating in the program initiates additional actions that reduce energy use at other sites that are not participating in the program.

Non-participant spillover is the reductions in energy consumption and/or demand from measures installed and actions taken or encouraged by non-participating vendors or contractors because of the influence of the program.

⁵ *Ibid.*

⁶ *Ibid.*

EXECUTIVE SUMMARY

This report provides a detailed description of the impact evaluation conducted for the New York ENERGY STAR[®] Homes Program (NYESH or the Program) for program years 2007 and 2008. The Executive Summary provides a brief overview of the evaluated savings, followed by a description of the Program, the evaluation approach, a discussion of the evaluation components, a summary of results and conclusions and recommendations.

ES.1 PROGRAM DESCRIPTION

The New York ENERGY STAR Homes Program was designed to transform the new home construction industry in the State of New York through the encouragement of building homes that use at least 20% less energy than homes built to simply meet the energy code. The Program is targeted toward residential new construction market using enhanced EPA ENERGY STAR guidelines and builders are the primary participants. Each home receives an energy rating (HERS rating) performed by a Residential Energy Services Network (RESNET)-certified home energy rater (HERS rater). In addition to meeting the federal EPA guidelines, NYESH include mechanical ventilation and must yield a minimum of 500 kilowatt-hours electric saving via light fixtures, compact fluorescent lamps (CFLs), appliances and mechanical measures. The Program uses REM/Rate[™] software to ascertain if the overall efficiency of the home meets the program standard.

ES.2 EVALUATION APPROACH

The goal of this impact evaluation was to establish rigorous and defensible estimates of the realization rates for program reported energy and demand savings that can be attributed to the NYESH Program for program years 2007 and 2008. A primary focus of this impact evaluation was to verify the inputs needed for modeling savings and comparing the as-built homes to an appropriate baseline. An equally important element of assessing impacts is to construct solid and defensible estimates of all impacts that are program-induced (rather than naturally-occurring). This assessment of net effects includes numerous potential sources of spillover, including both participant and non-participant spillover.

The evaluation design was complex and required many steps, as described below:

- A telephone survey of participating homeowners was conducted to determine the as-built characteristics of the homes (140 homeowners), supplemented with an on-site survey of a small number of these homes (30) to verify the telephone responses.
- Baseline home characteristics were developed for comparison purposes.
- Utility billing records were obtained and cleaned to assess heating loads and overall consumption.
- Energy modeling and analysis using REM/Rate[™] was conducted on a sample of participating homes.
- Net effects were estimated through enhanced self-reports relying primarily on telephone surveys of participating, formerly-participating and non-participating builders.

The participation of one builder who exclusively constructs government housing and completed a large number of homes in the Program presented challenges for this evaluation. This participating builder was found to be working under substantially different conditions than the other participating builders. Though the net-to-gross (NTG) approach was the same for all builders (including this large one), this

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builder was assigned to a separate stratum to ensure that the NTG results from the builder of government homes were applied only to these homes.

Results of the realization rates and net-to-gross adjustments were presented to NYSERDA staff. There were concerns expressed regarding the builder of government housing and how the net-to-gross were developed. The proposed further research into this issue would have required a change to the evaluation design for this stratum only, and may have introduced bias to study. While evaluation plans can change in certain circumstances, The Impact Evaluation Team concluded that applying consistent methods across all builders as specified in the work plan was critical to developing robust and defensible results, and that changing the method in reaction to a specific respondent's answers is counter to standard evaluation practices.

NYESH has been working with builders since its inception in 2001, and one of the complicating factors in estimating net-to-gross factors for longer running energy efficiency programs is that participating builders or contractors may have internalized the energy efficiency practices over time and no longer attribute the change in practices to the program although the program may have contributed to the initial decision to adopt efficient practices. The large builders also have the highest likelihood of having an internal validity issue from a testing effect, which occurs when respondents know what to expect, may know the consequences of their answers and answer according to these understandings rather than providing a true response. These factors could introduce a bias to the net-to-gross factors, either upward or downward. To the extent possible, these issues should be considered in the design of future evaluations.

In addition, if the large scale participation of the builder of government housing continues in future program years, the Impact Evaluation Team recommends that implementation policies be tailored to target additional savings above what are achieved through compliance with the EPA ENERGY STAR Home guidelines. A separate implementation track could be developed for government housing which would utilize a different baseline for homes completed through this track.

ES.2.1 Data Sources and Evaluation Components

This evaluation required data gathered from many sources, such as weather-related information from the National Oceanic and Atmospheric Administration (NOAA), surveys conducted among homeowners and builders, utility bills, baseline studies and technical manuals. These data sources went into evaluation components such as energy modeling and net-to-gross calculations. The data sources, evaluation components and outcomes are summarized in Figure ES-1.

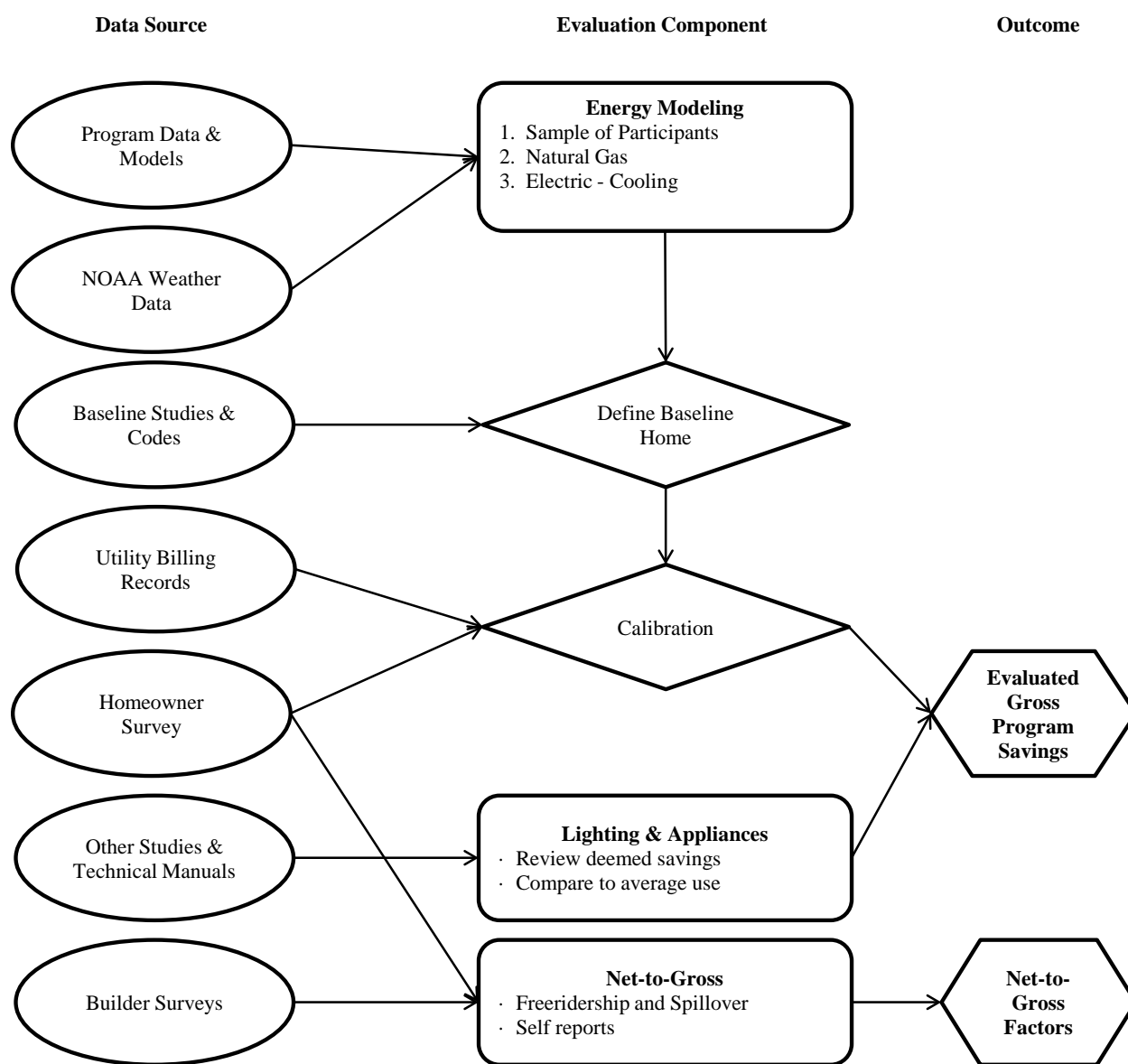


Figure ES-1: Evaluation Components, Data Sources and Outcomes

ES.2.2 Energy Modeling

The energy modeling began with the REM/Rate files developed through the Program to estimate savings for the specific homes in the sample, with the following modifications to address as-built conditions:

- the homeowner survey was used to model changes in occupancy, heating and/or cooling systems, conditioned areas and miscellaneous equipment
- the on-site survey allowed corrections to the original modeling (if necessary) and addressed changes in building use (utilizing basements), conditioned space and heating and/or cooling systems

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- utility billing records were used to calibrate heating consumption; the calibrated heating fuel use from the REM/Rate model was within 2% of actual usage for space heating for each home

The purpose of the modeling was to estimate savings from heating, hot water and cooling measures, which required development of baseline home characteristics. Other electric measures, including lighting and appliances, were based on deemed savings or findings from other recent evaluations. Energy modeling was conducted on 154 homes and the evaluated savings were based on the results of this analysis.

ES.2.3 Baseline Home Development

Savings estimates for new construction programs have greater engineering uncertainty than retrofit programs. Whereas in retrofit programs it is possible to compare energy consumption before and after treatment in the program to verify savings, in new homes there is only a record of post-installation consumption and the pre-installation energy use must be estimated. Thus, establishing a reasonable and defensible baseline to estimate pre-installation use was a critical component of this impact evaluation. In the absence of a baseline study, a number of approaches to defining the baseline were pursued.

The development of the baseline homes was based on a review of best available secondary sources based on data collected through other studies conducted in New York as well as other baseline studies and technical reference manuals used in other northeastern states. Research was supplemented with primary data collection efforts through the non-participating builder survey. Using the energy codes in effect at the time that homes were built was discussed. However, as is the case in many jurisdictions, builders do not always adhere to code requirements in some areas of construction and sometimes exceed code in others. Therefore, the impact evaluation team determined that simply assuming code as a baseline would not be an accurate reflection of the true baseline.

Because builders generally use larger framing lumber to construct exterior walls in climates further to the north (Climate Zones 6 and higher), they also incorporate higher levels of insulation in exterior walls as standard practice. Therefore, two baseline homes were developed; one for Climate Zones 4 and 5 and the second for Climate Zone 6 with the only critical difference being the exterior walls. These baselines were applied to homes depending on their location and used for all projects in this evaluation. The Impact Evaluation Team learned through the course of this evaluation that by executive order at the federal level, all new government housing projects are required to meet the national EPA ENERGY STAR standards, which are more efficient than the baseline developed and applied in this evaluation, as discussed above.

ES.2.4 Other Electric Measures

The savings for lighting and electric appliances were reviewed in the context of the deemed savings used in New York and other states in the Northeast. Research was conducted to ensure that the savings claimed for these measures are reasonable in the context of the available information. The electric savings were compared to average annual consumption from the billing records and the results indicated that the program reported savings per home are within a reasonable range.

ES.2.5 Net-to-Gross Factors

Net effects were estimated based on enhanced self-reports from participating, non-participating and formerly-participating builders and current occupants of the New York ENERGY STAR Homes (homeowners). The surveys were designed to follow prior NYSERDA free ridership and spillover inquiries and measurements used in previous evaluations of the NYESH Program. Fielding of the non-participating builder survey was particularly problematic due to the low response rate, which was partly due high number of builders who were found to be ineligible or had unusable contact information and may also be related to the fielding of the survey during the summer months when builders tend to be

busier. In addition, Hurricanes Irene and Lee also struck the Northeast during the fielding period and may have had some impact on the response rate.

ES.3 OVERVIEW OF EVALUATED SAVINGS

The realization rates for all homes (including government housing) are 80% for electric and 87% for fossil fuel savings. The previous evaluation completed in 2006 found realization rates of 101% for electric savings and 167% for fossil fuel savings.¹ NYSERDA adjusted its savings methodology as recommended by Nexant in the 2006 evaluation, and thus, there is no direct comparison between the findings of the two evaluations.² In the current evaluation, the evaluated fossil fuel savings were developed from detailed modeling of energy use for a sample of participating homes and are calibrated to actual billing use.

The deemed values used to estimate the remaining electric measures were verified against the savings used in other northeast states and the per-home savings were also compared to average household electric use as determined from the billing records. The energy modeling for electric space and water heating was hindered by the low number of homes in the sample with these electric end-uses; however, these two measures also represent a small proportion of the total program reported electric savings (7%). The sampling precision of the final evaluated gross savings estimates exceeded the requirements and the overall reliability of the gross savings results is high.

The net-to-gross estimates are uncertain due to the potential for bias created by the current environment in the residential new construction market. The complexity of the net-to-gross calculations makes it difficult to calculate the sampling precision. However, the reliability for attribution relies more on construct validity than on sampling precision. The alternative of what would have occurred cannot be known with certainty and survey inquiry can be complicated in that it asks about conjecture of a theoretical alternative. While the net-to-gross ratio is presented as a point value, it must be acknowledged that the various approaches to estimating the net-to-gross factors may produce substantially different values.

The results of the net-to-gross analysis indicate that free ridership is substantially higher than prior evaluation results. The current estimates of 64% free ridership and 28% spillover result in an overall net-to-gross factor of 0.65, which is much lower than the previous factor of 1.17³. In addition to the increase in free ridership, spillover from formerly-participating builders was also lower than found in 2006.

A key input into the calculation of the spillover is the number of new home starts. From the previous NYESH impact evaluation in 2005 to the current evaluation of program years 2007 and 2008, the number of new home starts dropped from about 62,000 to 20,800 per year for 2007 and 2008 on average, a reduction of almost two-thirds. This precipitous decrease in residential new construction activity is most likely due to the economic downturn and completely unrelated to NYESH Program activity. However, it substantially reduced the potential magnitude of the non-participant spillover rate as estimated in this evaluation.

The major shift in the residential new construction market during 2007 and 2008 may have had serious repercussions for the net-to-gross components of the NYESH Program. All net-to-gross components are derived as rates and these rates are added or subtracted to calculate the final net-to-gross ratio. Thus, the

¹ "M&V Evaluation: ENERGY STAR Labeled Homes," Final Report, prepared for NYSERDA by Nexant, May 2006.

² During the timeframe when the previous NYESH M&V evaluation was conducted by Nexant, evaluation budgets could not exceed 2% of a program's budget; thus limiting the extent and the rigor of work. Current evaluations are at 5%, a considerable increase that permits significantly more effort.

³ Program implementation staff has raised concern over high free ridership rates concluded in this current study due to the way in which the one large government housing builder was evaluated.

large reduction in new home-starts substantially reduces potential for non-participant spillover. Program participation in general is also affected by the level of activity in the overall residential new construction market as much as by program marketing and promotion. As the housing market rebounds, future estimates of the non-participant spillover rate may be higher than found in this evaluation.

The final results from the evaluation are summarized in Table ES-1. The net-to-gross factor is presented in two ways: first, with all builders included and second, with the government housing removed. This approach was taken as the survey responses from the builder of the government housing had a large influence on the free rider rate (moving it from 56% to 64% at the program level). The final net evaluated savings are estimated with the higher free rider rate, as it reflects all program activity during program years 2007 and 2008.

Table ES-1. Summary of Evaluated and Program Reported Savings

	Annual Electric Savings (kWh/Year)	Annual Non-Electric Savings (MMBtu/Year)
NYSERDA Program Reported Gross Savings	7,964,862	283,260
Realization Rate ¹	80%	87%
Evaluated Gross Savings ²	6,406,841	246,436
Net-to-Gross Rate (All Homes)	65%	65%
Evaluated Net Savings for PY 2007-2008	4,164,447	160,183
Net- to-Gross Factor (excluding government housing)	0.72	0.72

¹ The 90% confidence interval on realization rates for kWh and MMBtu savings are ±1.3% and ±2.2%, respectively.

² The lower and upper 90% confidence limits for kWh Savings are 6,268,346 and 6,371,890, respectively, and the lower and upper 90% confidence limits for MMBtu savings are 243,037 and 249,269, respectively.

ES.4 PROGRAM AND EVALUATION RECOMMENDATIONS

The results of this evaluation suggest that substantial changes have occurred in the residential new construction market and the Program may need to make some adjustments to respond to these changes. Recommendations are divided into program and evaluation issues.

ES.4.1 Program Recommendations

- Establish program threshold requirements to account for changing energy codes; the Impact Evaluation Team understands that NYSERDA has already moved to ENERGY STAR v2.5, and is planning to implement v3.0 with added prescriptive requirements. While “raising the bar” may result in a reduction in program participation, the incremental savings per home can be expected to increase when thresholds are designed to ensure a certain percent savings over the to-be-identified baseline home. The expected decrease in participation may be offset by a reduction in free riders, given the adoption of more stringent energy codes.
- Review the method used for estimating savings from heating, water heating, and cooling measures. It appears that the current method does not correctly account for baselines that vary by climate zone and also understates heating savings while dramatically overstating water heating savings. An alternative approach used in other states is to develop one user-defined reference home (UDRH) for each climate zone reflecting baseline practices and estimate savings from the

REM/Rate results. By implementing a URDH all program homes would be compared to the UDRH for the appropriate climate zone.

- Establish one method of tracking and recording those deemed savings that overlap with energy-modeled savings (i.e. ECM motors, central air conditioning, refrigerators and lighting). This can be addressed from within the developed UDRH.
- Consider the establishment of a separate development track for projects that are required to meet higher baseline standards. Some developers may be working under mandates to build toward certain level of efficiency (e.g. EPA ENERGY STAR) to comply with federal directives or satisfy funding requirements set by certain lenders and/or government agencies (e.g. HUD, NY state-housing agencies). This separate track may utilize a baseline (UDRH) that is different than the UDRH used for more traditional projects. This track may also have different program incentive structure that encourages certain end uses or certain savings goals over the baseline for this track.
- Consider whether changes need to be made to the process for installing screw-in CFLs as a program measure. The responses to the homeowner telephone survey indicated that hardwired ENERGY STAR light fixtures installed during construction remained in place.⁴ However, over a third of the homeowners with reported program savings for screw-in CFLs stated that there were no screw-in CFL bulbs in the home when they moved in.⁵ All of these respondents were the original owners of the new home. This may imply that the screw-in CFLs were removed prior to the homeowners' residency in the new homes.
- Review all program databases and data collected through program Quality Assurance (QA) activities to ensure the program data is obtained and maintained in a way that allows for accurate evaluations, including reliable contact information to the extent possible, ways to link builders with projects, former builders and contact information for all projects. The Program should maintain a database of the REM/Rate results or develop a systematic procedure for obtaining these datasets easily or develop a procedure to obtain requested REM/Rate results and all related program data. It is understood that there are scores of records in the database and this will require some effort and a commitment of time. However, a systematic approach to generating links to merge the data and generate unique identifier fields should allow for improved data management going forward.

ES.4.2 Evaluation Recommendations

- Conduct a baseline study to establish a defensible standard for establishing program savings. The lack of an independent, comprehensive baseline study added substantial complexity to this evaluation. The baseline study should take into account that building practices vary by region and climate zone and account for those builders that are required to construct buildings to a higher standard of energy efficiency (e.g. government housing). This baseline study should assess the need for different baselines for different program tracks.
- Consider alternative strategies for estimating net savings and market effects. The self-report approach used in this evaluation suggests that market transformation may already be well underway. However, the results could also be confounded by the upheaval in the residential new construction market since 2008. Future studies could be designed to assess the accuracy of the builder self-report surveys and to further investigate market effects. The process may include

⁴ Most hardwired ENERGY STAR labeled light fixtures (not plug in lamps) require the use of a pin-based compact fluorescent light bulb (CFL) so that the fixture cannot be outfitted with an incandescent light bulb which has a screw-base.

⁵ Screw-in CFLs can be installed in any light fixture or lamp that accepts standard incandescent bulbs.

Executive Summary

reviewing and conducting an on-site survey of a sample of homes constructed by selected builders.

- Improve methods for transferring required program data to evaluators. For this evaluation, the Impact Evaluation Team was not able to obtain contact information for most of the formerly-participating builders and had to download REM/Rate files for the telephone survey respondents individually from the implementer's web site. These difficulties in obtaining program records are time-consuming and increase the cost of the evaluation.

Section 1:

INTRODUCTION

The **New York Energy \$martSM** programs are funded by an electric distribution System Benefits Charge (SBC) paid by customers of Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric and Gas Corporation, National Grid, Orange and Rockland Utilities, and Rochester Gas and Electric Corporation. The programs are available to all electric distribution customers that pay into the SBC. The New York State Energy Research and Development Authority (NYSERDA), a public benefit corporation established in 1975, began administering the SBC funds in 1998 through NYSEDA's **New York Energy \$martSM** Program.

The goal of the NYESH Program is to implement and promote an enhanced version of the U.S. Environmental Protection Agency's (EPA) ENERGY STAR[®] Program in New York State. The NYESH Program provides technical assistance and targeted financial incentives to residential builders and income eligible homeowners¹ to encourage the adoption of energy efficient design features and the selection and installation of more energy efficient equipment. A more detailed description of the program can be found in Section 2.

The goal of this impact evaluation was to establish rigorous and defensible estimates of the realization rates for gross energy and demand savings that can be attributed to the NYESH Program for program years 2007 and 2008. A primary focus of this impact evaluation is to verify the inputs needed for modeling savings and comparing the as-built homes to an appropriate baseline. An equally important element of assessing impacts is to construct solid and defensible estimates of all impacts that are program-induced (rather than naturally-occurring). This assessment of net effects includes numerous potential sources of spillover, including both participant and non-participant spillover.

The Impact Evaluation Team conducting this evaluation includes Megdal & Associates, Inc., West Hill Energy & Computing, and GDS Associates, Inc (GDS). APPRISE, Inc. managed the telephone screening and survey data collection efforts under a separate contract with NYSEDA. GDS managed the on-site data collection effort and conducted in-person the builder and homeowner surveys for the builder of government housing units (who also manages the property).

In developing this evaluation, the Impact Evaluation Team has incorporated feedback by NYSEDA Evaluation and NYESH Program staff, the Department of Public Service (DPS) and the EEPS Evaluation Advisory Group (EAG). The remainder of this section covers the evaluation objectives, the research approach, the data sources and the format of this report.

1.1 EVALUATION OBJECTIVES

The primary purpose of this evaluation was to estimate the net program savings achieved during program years 2007 and 2008. The evaluation objectives are described below:

- establish the realization rate for program reported gross savings attained through program implementation
- estimate net effects by applying the net-to-gross factor

¹ Homeowners are eligible for incentives only if they participate in NYSEDA's Assisted Energy Star Homes Program. To be eligible for this program participants' household income is 80% or less than the state median income. For more information on the Assisted Energy Star Homes Program see *System Benefits Charge, Proposed Plan for New York Energy \$martSM Programs (2006-2011)*, as amended March 2, 2006.

Introduction

Activity in program years 2007 and 2008 was defined as homes with completed ratings in those two calendar years.

1.2 RESEARCH APPROACH

This section describes the approach used to estimate gross and net savings attributable to the NYESH in program years 2007 and 2008. It explains the components of the evaluation for estimating the realization rate and the net-to-gross factor.

1.2.1 Evaluated Gross Savings

This section presents the approach used to estimate the realization rates for electricity, electric demand and fossil fuel (e.g. natural gas). For this evaluation, the primary focus was on verifying the inputs used for modeling savings and comparing the as-built home to a baseline. Evaluated gross savings were verified through energy modeling of a sample of homes that were completed through the Program in PY 2007 and 2008. This approach was used for all fossil fuel savings and for electric space heating, water heating and cooling.

The energy modeling files (from REM/Rate™ software) used by the Program for key measures (HVAC, shell, etc.) were updated to reflect the as-built conditions and calibrated to billing history; the difference is the evaluated program gross savings. For the other electric measures (lighting and appliances), the program estimated savings using deemed values and these values were compared to the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs² and deemed savings used in other jurisdictions to assess whether they are within a reasonable range.

The evaluation required the following steps:

1. a telephone survey of participating homeowners to determine the as-built characteristics of the homes
2. an on-site survey of a small number of homes to verify the telephone responses
3. development of the baseline home for comparison purposes
4. obtaining and analyzing the utility billing records to assess actual heating and cooling consumption
5. energy modeling and analysis

1.2.2 Net Effects

This section describes the approach used to construct estimates of all impacts that are program-induced, rather than naturally occurring in the market. This research of net savings incorporated surveys of market actors who may have contributed to the net-to-gross effects, including: participating homeowners, participating builders, non-participating builders and formerly-participating builders. Net effects were estimated through enhanced self-reports relying primarily on telephone surveys of participating, formerly-participating and non-participating builders.

For the NYESH Program, free ridership represents homes that would have been built to the NYESH standard without the assistance of the Program. Free ridership was estimated utilizing the information collected from the survey of participating NYESH builders.

² TecMarket Works: New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs: Selected Residential & Small Commercial Measures; Prepared for New York Department of Public Service; December 28, 2008

The spillover rate is the ratio of savings that occur outside the NYESH Program but are a result of the program influence, or due to the program (compared to program savings). The spillover rate is comprised of three types of spillover: participant inside spillover, participant outside spillover and non-participant spillover.

1. Participating Homeowner Inside Spillover – Savings achieved through actions taken by participating homeowners to increase efficiency in their post-program adoption of highly efficient equipment or actions that they attribute to their purchase of, and experience in, a NYESH Program home.
2. Participant Outside Spillover – Savings achieved through the construction of non-program energy efficient homes that were certified (or qualified to be certified and met the standards of NYESH) by participating builders.
3. Non-participant Spillover – Savings achieved through the adoption of energy efficient practices by builders who did not participate or formerly participated in the NYESH Program and attribute the high efficiency measures to energy efficiency programs in New York State.
4. The estimation of spillover required surveys of the following market actors:
 - participating builders
 - formerly-participating builders
 - non-participating builders
 - participating homeowners

The types of surveys and net-to-gross factors estimated from each one are provided in the table below.

Table 1-1. Type of Survey for Estimation of Net-to-Gross Factors

Type of Survey	Net-to-Gross Factor
Participating Homeowners	Participant Spillover and Free-Riders
Participating Home Builders	Participant Spillover and Free-Riders
Non-participant Builders	Non-participant Spillover
Previously-participating Builders	Non-participant Spillover

1.3 DATA SOURCES

This evaluation required data gathered from many sources including NYESH Program staff and third party resources. The data sources and their contribution to the evaluation components and outcomes are described below and presented in Figure 1-1.

- NYESH Program Data

This process included a review of the detailed project files available from the NYESH Program for PY 2007 and 2008. The information obtained from program database includes project- and measure-level information, as described below.

1. Project-level information: property address, builder name and contact information), size of home (square feet), fuel types.
2. Measure level information: description of the measure, quantity installed energy savings (electric, natural gas, and other fuels), demand savings and measure life.

Introduction

The original energy modeling files (REM/*Rate*) for homes included in the telephone survey were downloaded individually from the NYESH Program Web site by the Impact Evaluation Team.

- Utility Billing Data from 2007 through 2010
Five natural gas and four electric utilities provided energy consumption data for the homeowners who completed a screening survey administered as a part of this evaluation. The screener survey explained the scope of the study and requested that the homeowner provide NYSERDA with a signed waiver allowing access to utility account information. For the specific government housing units included in this evaluation, utility usage was provided by the property management company. The utility billing data were used to estimate heating consumption and to calibrate the energy models.
- National Oceanic and Atmospheric Administration (NOAA) Weather Data
Data from five weather stations in New York were used to estimate the average natural gas annual consumption and to normalize the results. The weather stations were Albany, Buffalo, Massena, Rochester and Syracuse.
- Baseline Studies and NYS Energy Code
Baseline studies from other jurisdictions in the Northeast (e.g. MA, ME, VT), NYS Energy Code and other relevant documentation, such as technical reference manuals from other northeastern states, were used to define the baseline home.
- External Studies and Technical Manuals
The following studies and manuals were used to determine per unit savings for some electric measures:
 - Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures (2011);
 - United Illuminating Company and Connecticut Light & Power Company Program Savings Documentation for 2011 Program Year;
 - Efficiency Maine Technical Reference User manual (TRM) No. 2007-1; and
 - Efficiency Vermont Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions (2010)
- Homeowner Telephone and On-Site Surveys
Primary data collection was conducted to determine the as-built characteristics of the newly constructed homes between 2007 and 2008 through surveys of homeowners.
- Builder surveys
Primary research was conducted to estimate net effects (free riders and spillover).
- Auxiliary Information
Prior to performing either of the two homeowner surveys a significant effort was undertaken to acquire contact information for the occupants of these units. The program data did not always include the actual address (in some cases just the original subdivision lot number) and there was no information about the current occupant for most homes. Therefore, research was performed to look-up phone numbers via on-line databases based on known addresses.

Phone number look-ups were also used to identify contact information for the formerly-participating builders survey (performed by NYSERDA's Survey Contractor, APPRISE). It was

also necessary to perform GIS research to identify the natural gas utility for the homes (conducted by NYSERDA).

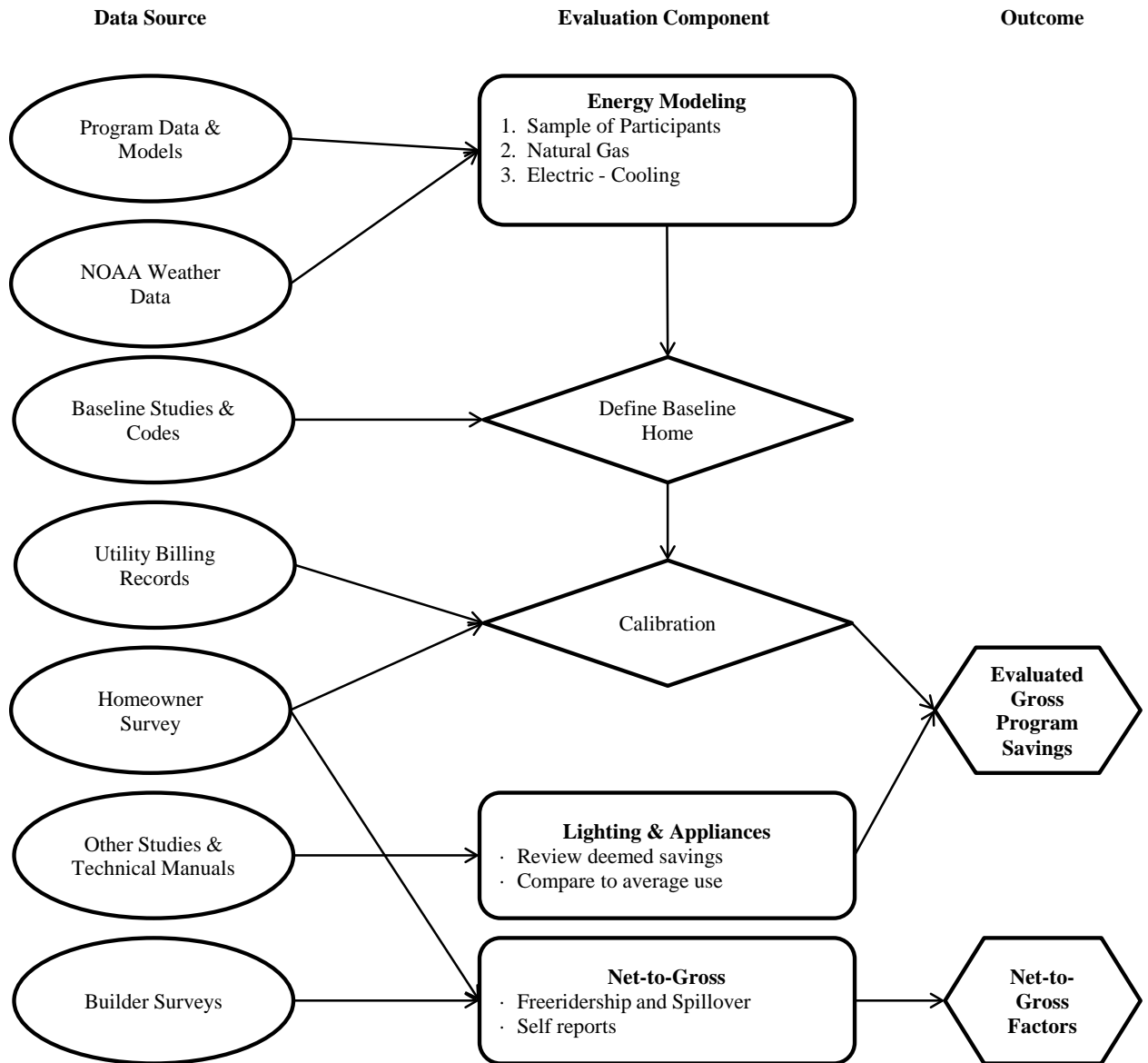


Figure 1-1. Evaluation Components, Data Sources and Outcomes

Introduction

1.4 SUMMARY OF EVALUATION COMPONENTS AND SURVEYS

The key component of the research design was the energy modeling of 140 participating homes, accounting for house-specific characteristics and calibrated to actual energy use. The modeling was used to estimate the evaluated gross savings, which were then compared to the program reported savings to determine the realization rate. The software used to perform the energy modeling in this evaluation was the same software used by the Program to perform the initial home energy ratings (HERS). Please refer to Section 3.1.5 for more information about the modeling software and process.

The development of the baseline home was a critical part of this process, as the evaluated savings were calculated from baseline to actual consumption. Two baselines were developed, one for Climate Zone 4 and 5 and the second for Climate Zone 6. These baselines were applied to homes depending on their location.

By executive order at the federal level, all new government housing projects are required to meet the national EPA ENERGY STAR standards, which are more efficient than the baseline developed and applied in this evaluation.

The homeowner surveys were designed to provide information to support the energy modeling and to estimate inside spillover. The screening survey was required as it was necessary to obtain signed waivers to request billing data from the utilities. The builder surveys were conducted to collect the information required to estimate free ridership and outside and non-participant spillover. The targets, completions, dates and purpose of the surveys are summarized in Table 1-2 below. For more information on the survey details, please refer to Sections 3.1 and 3.2.

Table 1-2. Summary of Survey Targets, Completes, Dates and Purpose

Survey Type	Initial Target	Number of Completed Surveys	Dates of Data Collection	Purpose
Homeowner Screening Survey	750	587	12/7/10 to 1/21/11	Obtain utility waiver forms from participantg homeowners
Homeowner Telephone Survey	110	197	4/27/11 to 5/4/11	Collect information on house characteristics to update models Estimation of inside spillover
Homeowner Survey - Government Housing (in-person survey)	30	30	6/5/11 to 6/10/11	Collect information on house characteristics to update models Estimation of inside spillover
Homeowner On-Site Survey	25	25	6/5/11 to 6/10/11	Confirm telephone responses
Homeowner On-Site Survey for Government Housing	5	25	6/5/11 to 6/10/11	Confirm telephone responses
Participant Builder Telephone Survey	69	70	5/5/11 to 6/1/11	Estimation of participant spillover and free riders
Participant Builder Survey Government Housing (in-person survey)	1	1	6/5/11 to 6/10/11	Estimation of participant spillover and free riders
Formerly-Participant Builder Telephone Survey	60	18	5/26/11 to 9/30/11	Estimation of non-participant spillover
Non-Participant Builder Telephone Survey	100	58	5/26/11 to 9/30/11	Estimation of non-participant spillover

The evaluation design called for 140 NYESH projects with complete homeowner survey data and utility billing records to be included in the energy modeling and calibration. Including all homes, both governmental and non-governmental housing, this target was met. The non-participant builder surveys were found to be extremely difficult to field and ultimately the target number of completed could not be obtained within the time frame and budget.

1.5 REPORT FORMAT

The balance of this impact evaluation report is organized as follows:

- Section 2 provides a description of the Program and its activities.
- Section 3 covers the evaluation approach and methods.
- Section 4 presents the evaluation results.
- Section 5 contains the conclusions and recommendations.

Section 2:

PROGRAM DESCRIPTION AND ACTIVITIES

2.1 PROGRAM DESCRIPTION

The New York ENERGY STAR Homes Program (NYESH or Program) was designed to transform the new home construction industry in the State of New York through the encouragement of building homes that use at least 20% less energy than homes built to simply meet the energy code. On the supply side, the NYESH initiative is designed to support market development through recruitment and training of builders in order to encourage them to offer energy-efficient options. On the demand side, the NYESH initiative markets the benefits of energy efficiency, in addition to health and safety factors, to residential consumers. These efforts are intended to assist in reducing barriers to participation in the Program and increase the demand for efficient products and services.

From inception in 2001, the Program resulted in certification of over 14,700 ENERGY STAR homes. The following is a summary of the NYESH Program as implemented in program years 2007 and 2008.

- The Program is targeted toward residential new construction market (i.e., builders of one- to four-unit residential buildings including units built through government housing programs, affordable (i.e. low income) housing and other local, state and federal housing initiatives).
- EPA ENERGY STAR guidelines are the basis for the Program; NYSERDA added enhancements to the EPA's guidelines, e.g., ventilation requirements and a minimum electric savings threshold¹
- Each home receives an energy rating (HERS rating) performed by a participating RESNET-certified home energy rater (HERS rater). The rating process includes the following components:
 - ongoing correspondence and coordination between participating HERS raters and builders
 - preliminary rating (based upon plans)
 - mid-construction pre-drywall inspection
 - final inspections
 - diagnostic testing, such as blower door and duct leakage testing
- The Program uses traditional RESNET "HERS score" and does not use RESNET's "HERS Index". The threshold program requirement is a HERS score of 84 or higher
- Homes must yield a minimum of 500 kilowatt-hours electric saving via light fixtures, CFLs, appliances and mechanical measures
- The NYESH Program provides targeted financial incentives to builders and technical assistance to builders and home energy system raters to encourage energy efficient residential design, equipment and materials. The program rebate structure in place at the time was incentivized in tiers so that builders were provided with a larger rebate for achieving higher savings (Tiers 1-3), and additional incentives for participating in specific marketing activities (Tiers 4 and 5). By agreeing to "display" their homes through sanctioned events (e.g., Parade of Homes, Showcase

¹ The EPA allows programs to add additional embellishments to the EPA's guidelines as long as they act only to improve the homes' efficiency, indoor air quality and durability, and do not weaken the EPA's guidelines. Programs using the EPA's ENERGY STAR label cannot make exceptions that reduce the requirements for ENERGY STAR Home labeling.

Program Description and Activities

Homes, etc.), Tier 4 rebates are available and for agreeing to have their homes publically available as a “Model” for at least 60 days following the home being branded as a New York ENERGY STAR Home builders are eligible for Tier 5 incentives. The following table illustrates the incentive structure:

Table 2-1. New York ENERGY STAR Homes Program Incentive Structure

Tier		HERS Score	kWh Requirement	Standard Incentive	Downstate Incentive ²
Performance	1	84.0 - 86.9	500	\$750	\$1,000
	2	87.0 - 88.9	500	\$1,000	\$1,250
	3	89.0 or higher	500	\$1,250	\$1,500
Marketing ³	4	Display Home (any HERS >84)	650	\$2,500	\$2,500
	5	Model Home (any HERS >84)	650	\$3,000	\$3,000

On January 1, 2007, RESNET adopted a revised rating standards for the home energy rating index (HERS index) for each rated home. To avoid market confusion by changing a scoring system that participating builders were just beginning to understand, NYSERDA decided to maintain the use of the traditional HERS score (higher number is more efficient) rather than the HERS Index (lower number is more efficient).⁴

With more recent revisions of the home energy rating software (REM/Rate™), a traditional HERS Score is now provided in addition to the nationally used HERS Index. The traditional HERS Score is referred to as the “NY HERS Score” as it was specifically added back into the software to accommodate the New York ENERGY STAR Homes Program.

Table 2-2 below displays program unit and savings goals from the SBC III Operating Plan and achievements to date.⁵ These goals apply to the five year funding period from July 1, 2006 to June 30, 2011.

² Downstate incentives apply to homes built in the counties of Westchester, Bronx, Queens, New York, Kings, and Richmond.

³ NYSERDA Terms and Conditions apply

⁴ The index number represents the amount of energy that the rated home uses as compared to the reference home (a home built to code) and is expressed as a proportion. For example, a home with an index of 80 uses only 80% of the energy used by a comparable code- built home. Hence, a lower HERS Index indicates a more efficient home. Prior to January 1, 2007, a traditional HERS score was used where each percentage point of energy savings represented a score of 5 points. So a home that was 20% more efficient than a home building to code would have a HERS score of 84. And therefore, a higher HERS Score represented a more efficient home.

⁵ *System Benefits Charge, Proposed Plan for New York Energy SmartSM Programs (2006-2011)*, as amended March 2, 2006.

Table 2-2. New York ENERGY STAR Homes Program Goals and Reported Activity

Program Metric	Five-Year Goal (July 1, 2006 – June 30, 2011)	Program Reported Activity (July 1, 2006 - March 31, 2009)
NYESH Projects (All New Homes)	10,750	6,350
Electricity Savings (GWh)	8.9	13.8
Fuel savings (MMBtu)	518,500	339,052

2.2 SUMMARY OF PROGRAM ACTIVITY

Table 2-3 and Figure 2-1 show the electric savings claimed by the Program during program years 2007 and 2008. This analysis indicates that 55% of the lighting savings are associated with the installation of screw-in CFL bulbs and 15.5 bulbs on average were installed in each home.

Table 2-3. Program Reported Electric Savings per Home by Measure (Program Years 2007-2008)

Measure	Number of Homes	Total Quantity	Quantity per Home	Savings per Home (kWh/Year)	Savings per Measure (kWh/Year) ²
CFL Screw-in Bulbs	4,359	67,660	15.5	1,008	65
CFL Fixtures	3,021	12,718	4.2	440	104
ENERGY STAR Dishwasher	4,172	4,205	1.0	46	46
ENERGY STAR Refrigerator	1,913	1,977	1.0	82	79
ENERGY STAR Clothes Washer	685	692	1.0	91	90
ECM Motors	301	334	1.1	439	396
ENERGY STAR Freezer	20	20	1.0	39	39
ENERGY STAR Central Air Conditioning	2,001	2,035	1.0	548	539
Electric Heat Efficiency	26	26	1.0	15,768	15,768
Electric Hot Water	31	31	1.0	6,125	6,125
Total Homes ¹	4,598				

¹ "Total Homes" does not add up to the total in the column due to multiple measures installed in each home.

² "Savings per Measure" column does not calculate exactly due to rounding in previous columns.

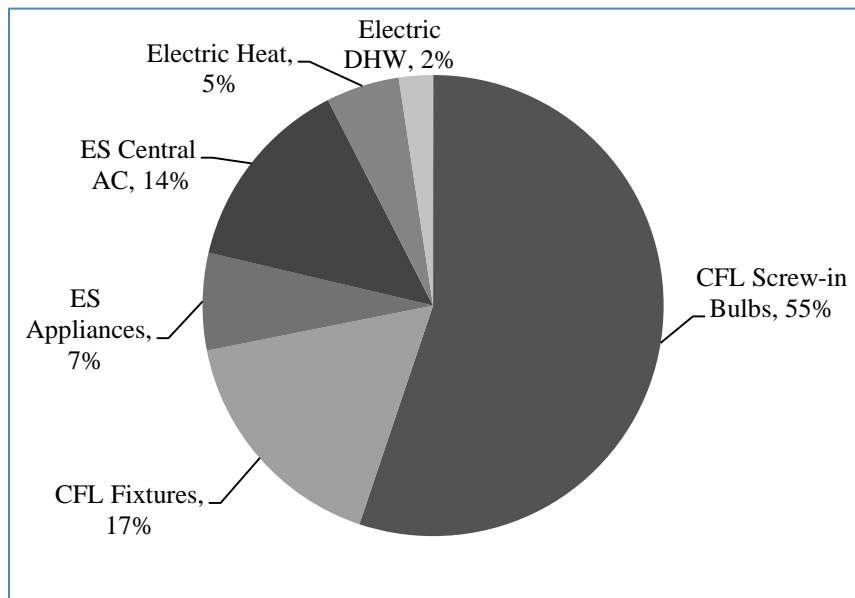


Figure 2-1. Program Reported Electric Savings by Measure Category, PY 2007-2008

Table 2-4 shows the fossil fuel savings claimed by the Program during program years 2007 and 2008. According to Program records, water heating savings account for 40% of the total Program savings and heating measures account for the remaining 60%.

Table 2-4. Program Reported MMBtu Savings per Home by End Use (PY 2007 and 2008)

End Use	Number of Homes ¹	Savings per Home (MMBtu/Year)	Total Savings (MMBtu/ Year)	% of Program Savings
Space Heating	3949	43.3	170,910	60%
Water Heating	3987	28.2	112,350	40%
Total Homes ¹	4132	68.6	283,260	

¹ "Total Homes" does not add up to the total in the column due to measures associated with multiple end uses installed in each home

This evaluation segmented the projects into three strata according to the number of program homes built per participating builder. A few large builders are responsible for a high percentage of the total homes completed through the Program. Over a third of the homes were constructed by the largest four builders, and three of the largest four builders are associated with one company that has multiple offices in different parts of the state. For the purposes of this analysis, each office was defined as an individual builder. The other large builder constructs housing under an exclusive contract with the federal government. An executive order directed all federal agencies that develop government housing to build the homes to meet the EPA ENERGY STAR Home guidelines.

Table 2-5. Distribution of NYESH Projects by Size of Builder

Stratum	Number of Projects per Participating Builder	Number of Participating Builders	Number of Projects Built
1	1 to 50	337	1568
2	51 to 250	12	1339
3	Over 250	4	1692

Section 3:

METHODS

The Impact Evaluation Team estimated annual consumption from energy modeling and compared the results to the baseline home to determine the evaluated gross savings. These savings were calibrated to utility billing records and normalized using NOAA weather data. Telephone interviews with owners of program homes were conducted and a sample of these homes received an on-site inspection. Telephone interviews with participating, formerly-participating and non-participating builders of residential new construction were conducted for determining the free ridership and spillover calculations. The methods to calculate evaluated gross savings and net-to-gross analysis are described in detail below.

3.1 EVALUATED GROSS SAVINGS

Evaluated gross savings were verified through energy modeling of a sample of participating homes. This approach was used for all fossil fuel savings and for electric space heating, water heating and cooling. The energy modeling (HERS ratings) used by the Program were updated to reflect the as-built conditions and calibrated to billing history. For the other electric measures (lighting and appliances), the Program estimates savings using deemed values and these values were compared to other jurisdictions to assess whether they are in a reasonable range.

Evaluating program reported savings required the following steps:

1. a telephone survey of participants to determine the as-built characteristics of the homes (140 homeowners), supplemented with an on-site survey of a small number of homes (30) to verify the telephone responses
2. development of the baseline home for comparison purposes
3. obtaining and analyzing the utility billing records to assess heating and cooling loads
4. energy modeling and analysis

Each of these steps is discussed in more details below.

3.1.1 Overview of Homeowner Surveys

There were three surveys of homeowners conducted as part of this impact evaluation:

1. screening survey of participating homeowners (587 completes)
2. telephone survey of participating homeowners (197 completes)
3. on-site survey of homes built through the Program (30 completes)

The screening survey was conducted to obtain signed waivers for NYSERDA to request billing records from the utilities, and this step was only necessary for non-governmental homes as the property manager provided all of the billing records for the governmental housing units. The sample frame for the screening survey was developed from the program tracking data provided by NYSERDA. All homes with natural gas or electric space heat and available contact information were included in the sample frame. The entire list of 1,880 non-governmental homes was used to obtain the 587 completed screening surveys.

The homeowner survey was conducted to provide additional information for the energy modeling. The respondents to the screening survey became the initial list to construct the sample frame for the homeowner telephone survey. Starting with the screening survey respondents, the sample frame was restricted to homes with natural gas or electric space heat and complete billing records, and participants

Methods

were randomly selected for the telephone survey from the sample frame. As the number of completes for the homeowner telephone survey (197) exceeded the target (110), participants included in the energy modeling were randomly selected from the respondents to the telephone survey. For the governmental housing, the homeowner survey for the 30 units was conducted in person with the property manager, who had complete information about all of the units.

The sample frame for the on-site survey consisted of the participants selected for energy modeling, as the intention was to verify the information gathered through the telephone survey. These homes were stratified by region. For the governmental housing units, the on-site surveys could only be conducted in unoccupied units.

The process for developing the sample frames for the surveys is summarized in Figure 3-1 and more detail on the surveys is provided below.

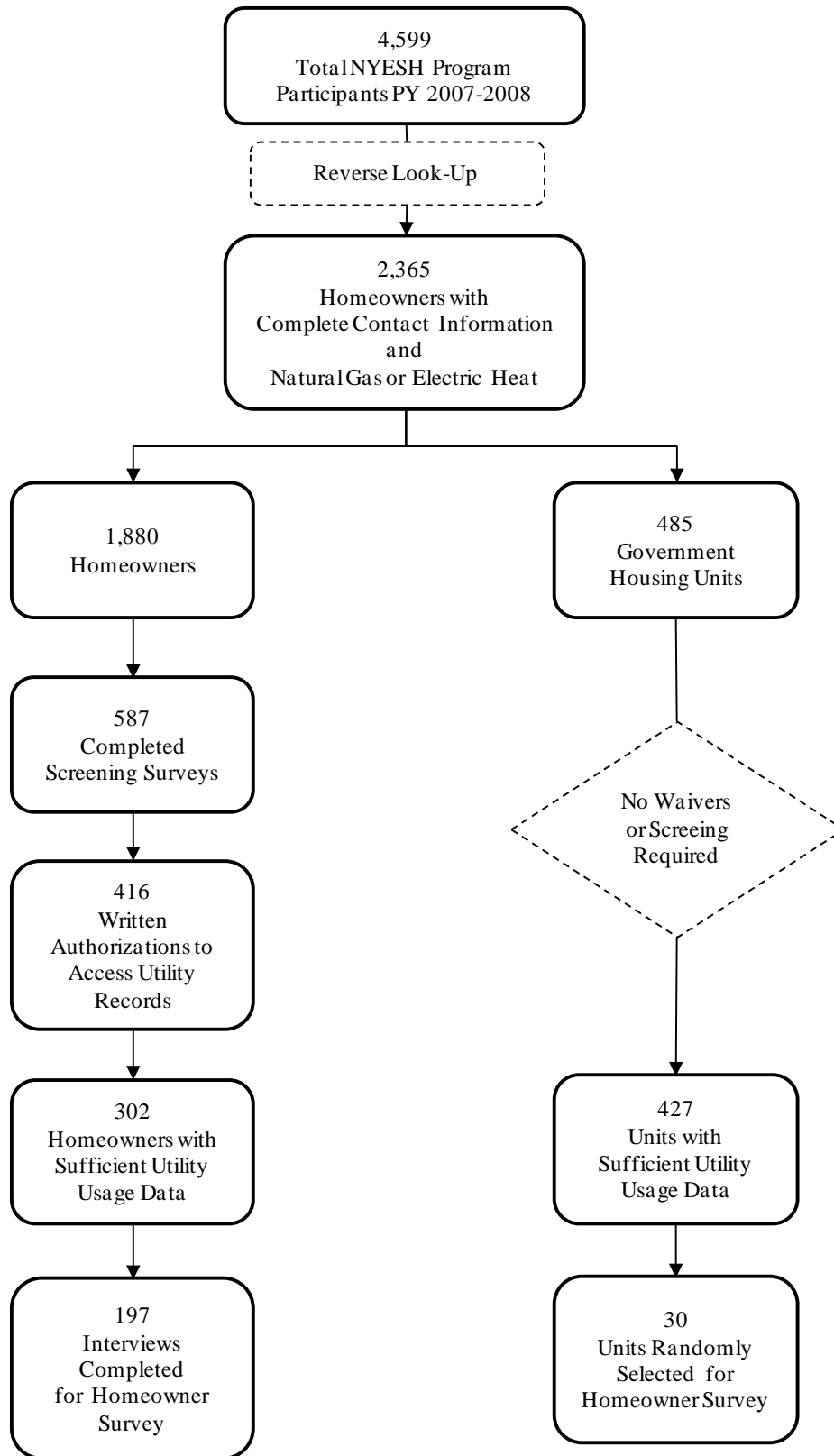


Figure 3-1. Summary of Screener and Homeowner Survey

3.1.2 Homeowner Telephone Surveys

The telephone surveys conducted as components of this evaluation were managed by APPRISE and used computer-assisted telephone interview (CATI) survey instruments. The on-site reviews were conducted by certified HERS raters employed by GDS Associates. Each of the surveys implemented as part of this evaluation is described below.

Survey instruments for the screener and telephone survey were designed and drafted by the Impact Evaluation Team with review by NYSERDA and the DPS. Instruments were tested prior to full launch to address any issues that arise (e.g., skip patterns, wording issues and other key survey design modifications necessary). As is common with similar residential surveys, incentives were offered to ensure that the target number of completed surveys could be met and to minimize response bias. Incentives were offered to survey respondents as follows:

- \$25 for completion of the screening survey and return of the waiver to allow NYSERDA to request billing data from the utilities
- \$25 per completion of the full telephone survey
- \$100 for completion of the on-site survey

Through the process of preparation and fielding the screening survey, the Impact Evaluation Team discovered that one of the largest builders was solely dedicated to constructing government housing. The Impact Evaluation Team determined that 799 of the 4,598 homes (and 485 homes in the sample frame for the screening survey) were built by a single builder of government housing.

The government housing provided some unique challenges and opportunities with regard to data collection. The detailed utility billing records and energy usage information for all government housing units in the sample frame was provided to the Impact Evaluation Team directly by the property manager. Although the utility billing records were available for the government housing, collecting information about individual housing units i.e., household size, usage patterns, and the like, was not possible due to occupancy changes and restricted access to the current residents.

While some changes had to be made to the process of conducting the homeowner surveys, the methodology and survey instruments remained consistent throughout this evaluation. The key changes made to the process to adapt to the government housing projects are described below:

- the screener survey was unnecessary as the billing data were made available for 427 of the 485 homes; 30 government housing units were randomly selected from the homes with billing records to include in the energy modeling sample
- it was not possible to conduct the homeowner telephone survey with residents of selected units; rather, the property manager of the government housing was interviewed to obtain the required information for all 30 units; the interview was conducted in person by GDS
- access was restricted for the five on-site surveys allocated to the government housing, and they could only be conducted in vacant units; the Impact Evaluation Team constructed a randomly-ordered list of available units made available by the property manager, and the Impact Evaluation Team was able to select available units from this list.

Since the 30 homes included in the energy modeling were randomly selected and the units are very similar, the restricted access to some units for the on-site survey is unlikely to introduce bias into the evaluation results. For both the homeowner telephone and the on-site surveys, the distribution of the

sample to government and non-government housing was determined proportionally based on the number of homes completed through the Program.

The table below lists the surveys, the original target sample size and the actual number of completions for non-government and government homes.

Table 3-1. Summary of Surveys and Sample Sizes

	Non-Government Homes	Government Housing	Total Number of Homes
Screening Survey			
Sample Frame	1,880	485	2,365
Completed Surveys	587	0a	587
Homes with Complete Billing Records	302	427	729
Homeowner Telephone Survey			
Sample Frame	302	427	729
Completed Surveys	197b	30c	227
Homes in Energy Modeling Sample	110	30	140
On-Site Survey			
Sample Frame	110	30	140
Completed Surveys	25	5	30

a The utility billing records were supplied for all of the governmental housing units by the property manager; thus, it was unnecessary to conduct a screening survey for these participants.

b The number of completed homeowner telephone surveys was higher than the target, and a random sample of 110 homes was selected from the 197 for the energy modeling.

c The homeowner survey for the government housing units was conducted in-person with the property manager at the time of the on-site visit.

The following sections describe the survey activity for the non-government homes. The general descriptions of the survey instruments apply to both the non-government and government housing.

Participating Homeowner Screening Survey

Since Program participants are builders, not homeowners, available information regarding the owners of ENERGY STAR Homes was very limited. The screening survey was designed for the following purposes:

- to identify and recruit eligible owners of homes built through the NYESH Program in PY 2007 and 2008 to participate in this study
- to verify addresses and sites of NYESH projects
- to acquire the homeowner's permission to access utility billing records from January 2007 through April of 2011.

NYSERDA is required to obtain explicit permission from each participating homeowner prior to requesting billing and consumption data from each of the utilities. As a result, this impact evaluation included a screener survey and efforts to obtain a signed waiver from the homeowner granting NYSERDA permission to request, collect, and analyze the energy consumption data. Because each builder is essentially the owner until the property is sold to an individual homeowner the contact

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information for each homeowner is not generally known until well after involvement in the Program. As a result, to identify the contact information for the homeowner, APPRISE conducted a reverse look-up based upon the property address, which yielded names and phone numbers for approximately 46% of the owners of homes built through the Program. Of the 3,799 non-government housing served during program years 2007 and 2008, there were 1,880 in the sample frame for the screening survey.

The telephone survey was restricted to participants with either natural gas or electric heat and sufficient billing history, since these are regulated fuels and the billing records could be readily obtained from the utilities. Since the vast majority of the homes (96%) built through the NYESH Program during PY 2007 and PY 2008 used natural gas for heating and hot water, the sample is representative of the overall population. Homes in Central Hudson Gas and Electric's territory were also removed from the sample frame because that utility was unable to provide billing data within the time frame needed for this evaluation.

A review of the data established that most homes were constructed by a small group of large builders (those that constructed over 25 homes). To avoid the possibility of selecting a sample that was heavily weighted toward a single builder, the sample frame was initially stratified by the size of the builder. Of the non-government housing, the entire sample frame of 1,880 homes was released; resulting in 587 completed screening surveys and yielding a response rate of 38%. Although the initial intention had been to stratify by the size of the participating builders, ultimately the entire sample frame was released. Since the final respondents corresponded very closely to the desired number of completions in each of the strata, the final list of respondents who completed screening survey was a good representation of the population.

The 587 completed screening surveys resulted in 416 homeowners who returned the signed waiver. During the fielding of the screening survey each homeowner there were a minimum of 10 phone call attempts and calls were attempted on a rotating basis so that each contact would receive at least 2 calls on weekdays, weeknights, and weekends to minimize non-response bias.

Following the screening survey and return of the waivers, requests were made for billing data for each respondent. For the non-government housing, there were a total of 302 homes with waivers and sufficient billing records to use in the calibration of the models. These 302 homes formed the sample frame for the homeowner telephone survey, as described in more detail in the following section. The property manager of the government housing authorized the release of utility billing and consumption data and provided this data directly to NYSERDA evaluation staff for use in this impact evaluation.

A copy of the screening survey instrument is included in Appendix A.

Participating Homeowner Telephone Survey

The homeowner telephone survey was primarily designed to provide additional information regarding the as-built condition of the homes in the sample. The objectives of the homeowner telephone survey are listed below:

- to confirm or determine the presence and use of major energy-using appliances and unusual plug loads
- to assess whether the measures installed through the NYESH Program are still in place and operational
- to assess non-program-related changes that occurred within the home during the analysis period that may affect the energy consumption (e.g. changes in occupancy, additional heating appliances, expansion of conditioned areas)
- to estimate the effects of homeowner free ridership and spillover

The topics covered in the survey included 1) occupancy and schedule, 2) the presence and use of heating and cooling equipment and other energy-intensive appliances, 3) the presence and use of measures installed through the NYESH Program, 4) the presence and use of unusual plug loads (e.g. pool heaters, spas), 5) the length and timing of periods of vacancy of the home (e.g., vacations, etc.) and 6) self reports of free ridership and spillover. Ninety-seven percent of the non-government housing respondents to the homeowner telephone survey reported being the original owner of the home. Therefore, they would be aware of any changes that have occurred since the construction of the home was completed and could provide accurate responses to the survey questions.

The property manager of the government housing units provided the responses to the homeowner survey for these housing units. The property management company maintains close oversight of the energy usage of these homes. They utilize their own incentive program where occupants are rewarded for using less energy than predicted in the HERS rating report. Any large discrepancies between predicted and actual use is researched by the property management. They restrict alterations to the units by the tenants and therefore are fully aware of any alterations made to the units after initial construction was completed. Also, their maintenance crews regularly review each unit as 50% of the units are turned over every year. Through the close oversight of the dwelling units that is required the property manager maintains occupancy patterns, receives and pays the utility bills, monitors the energy usage, and can confidently respond to the questions posed in the homeowner survey. The property manager also provided the net-to-gross response for the government housing units collectively.

A simple random sample of the 302 homeowners with sufficient billing history in non-government housing resulted in 197 completed telephone interviews. The number of completions was substantially higher than the initial target of 110 as the actual response rate for these homeowners was higher than expected. (Please refer to the following section for an explanation of how the initial screening survey completes with signed utility waivers of 416 was reduced to 302 participants with sufficient billing records.)

The initial sample size of 110 non-government homes with completed surveys, billing data and energy modeling, was designed to meet the 90/10 precision on a statewide basis. A total of 197 homeowner telephone surveys were completed, with a response rate of 66% for the non-government homes. This high response rate is due to the screening process. Table 3-2 shows the disposition of the homeowner telephone survey.

Table 3-2. Participating Homeowner Screening and Telephone Survey Disposition

		Participating Homeowner Screening Survey ¹		Participating Homeowner Telephone Survey ¹	
		Number of Homes ³	Percent of Homes	Number of Homes	Percent of Homes
TOTAL SAMPLE USED		1,873a	100%	302	100%
Excluded Sample	Not working/Unusable number	282	15%	2	1%
Not Contacted	Respondent never available	0	0%	0	0%
	Answer Machine	292	16%	52	17%
	Call back/ left 800#	61	3%	33	11%
Unknown Eligibility	No Answer/Busy	87	5%	12	4%
Excluded cases	Not Eligible/Not Qualified	44	2%	0	0%
Refused/ Break-off	Refused	511	27%	5	2%
	Break-off	9	1%	1	1%
COMPLETED INTERVIEWS		587	31%	197	65%
Contact rate²			75.8%		70.5%
Cooperation rate²			53.0%		97.0%
Response rate²			38.3%		65.7%

¹ This table excludes the government housing.

² See the Glossary for definitions of contact rate, cooperation rate and response rate as defined by AAPOR.

³ The Impact Evaluation Team records indicate that there were 1,880 homes eligible for the screening survey. The reason for the small discrepancy between this value and the 1,873 homes provided by APPRISE is unknown.

This process and the number of homes included at each step are shown in Figure 3-1 in Section 3.1.1. A copy of the homeowner survey instrument is included in Appendix B.

Homeowner On-Site Survey

The purpose of conducting on-site surveys for a small subset of participating homeowners from the telephone survey was to assess the accuracy of the inputs into the original energy ratings and to document any changes to the home, including any additional usage occurring on the premises that would not be included in a typical energy rating. Such additional factors include uncommon plug loads, spas, pool heaters, and additional conditioned areas that were not including within the original modeling.

The sample frame for the on-site surveys was participating homeowners with completed telephone surveys. For logistical reasons, homes were selected in two specific geographic regions where a majority of the PY2007 and PY2008 homes are concentrated: Finger Lakes and Western New York. These two regions were chosen as the only regions that included a combination of small, medium and large builders. Also, the Finger Lakes region had 35% (107) and Western New York had 26% (80) of the screened homes. An additional stratum including only the government housing was created

The original REM/Rate files were identified and individually downloaded from the program implementer's website by the Impact Evaluation Team and these files served as the basis for the inspections. Homes were assigned a random number and sorted, and recruitment of homeowners for the on-site survey was conducted from the sorted list. Thirty-five homeowners were called to complete the

twenty-five non-government housing site visits. This approach was not feasible at the government housing and those five inspections were conducted on unoccupied units as allowed by the property manager but randomly selected by the Impact Evaluation Team based upon unit availability.

All inspections conducted as part of the on-site survey were performed by RESNET-certified HERS raters with a minimum of four years of experience. Every home in the survey received an air infiltration test (i.e. blower door test) and any home that uses ductwork for heating or cooling received a duct leakage test.

The checklist used for the on-site inspection is attached as Appendix E.

3.1.3 Estimation of Actual Energy Use from Utility Bills

The primary purpose of obtaining billing records from utilities was to calibrate the energy modeling (predicted energy use) to actual energy use on a house-by-house basis. The list of participants with complete utility billing records and estimated annual use became the sample frame for the homeowner telephone survey, and energy modeling was conducted for the respondents to the homeowner survey. The review of billing records for the sample frame development and the method for estimating the annual use are discussed in more detail below.

Review of Billing Records for the Sample Frame Development

After the screener survey was conducted to obtain the signed waivers allowing NYSERDA to request billing records from the utilities and the utility billing data was received for these participants, a review of the utility data was conducted to identify homes that could be included in the sample frame. This process involved a number of distinct activities, as described below.

- The billing data were reviewed to ensure that there was both gas and electric billing data for all participants with natural gas space heat and at least electric billing data for homes with primary electric space heating.
- The billing data were summed for each participant to ascertain whether there were enough records for the model. Each participant was required to have at least one year's worth of billing records.
- The billing data were reviewed for anomalies, such as negative or no consumption and missing information

The results of this preliminary analysis are presented in Table 3-1. As mentioned in the previous section of this report, of the 416 non-government housing units with waivers, there were 302 homes with sufficient billing records that became the sample frame for the homeowner telephone survey.

Table 3-3. Development of the Sample Frame for the Homeowner Telephone Survey

Row		Homes with Natural Gas Space Heat	Homes with Electric Space Heat	Total Number of Homes ¹
A	Waivers received	410	6	416
B	Account number not usable/space heat fuel is propane	18	0	18
C	Did not receive billing data for space heat fuel and electricity	37	1	38
D	Billing data were not sufficient for space heat fuel and electricity	58	0	58
E	Total number of homes removed from sample frame (B+C+D)	113	1	114
F	% of all homes with waivers removed from sample frame (E/A)	28%	17%	27%
G	Homes in sample frame for homeowner telephone survey (A-E)	297	5	302

¹. This table only includes non-government households.

A similar process was used for the governmental housing units. Billing data was provided by the property manager for all of the units completed during the period. This data was reviewed in the same manner as described above, yielding a total of 427 units with sufficient billing data to estimate annual use.

Estimation of Annual Use

The natural gas heat loads were estimated from the billing records. A regression analysis was used for each home, with the monthly gas consumption as the response (dependent) variable and heating degree days (from NOAA data) as the predictor (independent) variable. For the most part, the R-squared values were at or above 0.70, indicating the strong positive relationship between natural gas consumption and outside temperature. The heating slope from these calculations was then multiplied by the normalized heating degree days (base of 65°F) for the climate zone.

The same process was attempted to estimate electricity consumption used for air conditioning, using the cooling degree days (base of 75°F). However, the results from this analysis were highly uncertain. Since there was not a strong positive relationship between electricity consumption and cooling degree days, the predicted cooling usage was not calibrated to actual use. Both the reported cooling savings and evaluated cooling savings were derived from the energy modeling and were not adjusted for actual use. Since the cooling savings are only 14% of the total electric savings, this approach should have little effect on the final realization rate. Electric data were also used to determine the average annual consumption for homes with complete billing data as an overall check on the per-household electric savings.

3.1.4 Development of the Baseline Home

Savings estimates for new construction programs have greater engineering uncertainty than retrofit programs. Whereas in retrofit programs it is possible to compare energy consumption before and after treatment in the program to verify savings, in new homes there is only a record of post-installation consumption and the pre-installation use must be estimated. Thus, establishing a reasonable and defensible baseline to estimate pre-installation use was a critical component of this impact evaluation. In the absence of a baseline study, a number of approaches to defining the baseline were pursued, as described below.

The development of the baseline homes was based on a review of best available secondary sources. These data were collected through other studies conducted in New York as well as other baseline studies and technical reference manuals used in other northeastern states. Research was supplemented with primary data collection efforts through the non-participating builder survey.

Because builders generally use larger framing lumber to construct exterior walls in climates further to the North (Climate Zones 6 and higher) they also incorporate higher levels of insulation in exterior walls as standard practice. Therefore, two baseline homes were developed, one for Climate Zones 4 and 5 and the second for Climate Zone 6, with the only critical difference being the exterior walls. These baselines were applied to homes depending on their location.

By executive order at the federal level, all new government housing projects are required to meet the national EPA ENERGY STAR standards. A separate EPA ENERGY STAR baseline was not developed in this evaluation. However, all of the government housing units were located in Climate Zone 6 which incorporates the higher levels of wall insulation as described above.

The resulting primary building components are commonly addressed through residential new construction programs and are also the primary data entry fields into the REM/Rate software and include the following:

- Thermostat – Programmable or Non-Programmable
- Active Solar – Solar domestic hot water or solar hydronic heat
- Foundation Walls – Insulation levels (R-values); definition of location (e.g. either between conditioned space and ambient/ground, or between unconditioned space and ambient / ground)
- Slab Floors – Insulation levels (R-values) at perimeter (slab edge) and under slab
- Framed Floor – Insulation levels and installation grade for floors over ambient space, unconditioned basement or garages
- Above Grade Wall – Insulation levels and installation grade for walls between conditioned and ambient areas, walls between conditioned and unconditioned spaces (e.g. attics, garages, unconditioned stairwells)
- Ceilings - Insulation levels and installation grade for flat and vaulted ceilings
- Door - Insulation level (R-value)
- Windows – U-value and Solar Heat Gain Coefficient (SHGC)
- Skylights – U-value and SHGC
- Air Infiltration – Building air leakage rates measured in various units of measure such as cubic feet per minute at -50 pascals of test pressure (CFM₅₀), air changes per hour at -50 pascals (ACH₅₀), natural air changes per hour (ACH_{nat}), or effective leakage area (CFL per 100 square feet of shell area)
- Equipment Location – Whether heating, cooling and water heating equipment is located within conditioned or unconditioned space
- Heating System – Fuel type, equipment type, heating capacity (btu/hr), heating efficiency in either annual fuel use efficiency (AFUE) or heating season performance factor (HSPF)
- Central Air Conditioning – Seasonal Energy Efficiency Ratio (SEER)
- Water Heating – Type of water heater (e.g. stand-alone conventional tank, indirect-fired with space heating boiler, instantaneous)
- HVAC Ductwork – Duct Leakage, Insulation, and location (within conditioned or unconditioned space).

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To the extent possible the Impact Evaluation Team tried to use New York-specific information. However, if more accurate and more reliable information was available from other studies or gathered from the non-participant builder survey, the latter information was used.

Some of the documents and data sources that informed the baseline are described below.

1. "Reference Design Guide for Highly Efficient Residential Construction", VEIC/CSG, July 2007 (VEIC)
2. "Massachusetts ENERGY STAR Homes: 2005 Baseline Study, Part I: Inspection Data Analysis Final Report", Nexus Market Research, Inc. May 8, 2006 (MA Baseline)
3. "ENERGY STAR® Homes Program – Market Assessment and Baseline Study for Massachusetts and Rhode Island, Final Report, Prepared for The Joint Management Committee, Delta Technologies Group, LLC, Marietta, GA September 1999 (MA/RI Baseline, 1999)
4. 2006 Mortgage Industry National Home Energy Rating Systems Standards, Residential Energy Services Network and National Association of State Energy Officials, 2006 (RESNET)
5. "Energy Conservation Construction Code of New York State", International Code Council, Inc./New York State Department of State, August 2007 (NYS ECC)
6. Maine Residential New Construction Technical Baseline Study, VEIC et al, Final Report, 2008 (Maine Baseline)
7. The baseline efficiency of shell components used by the New Hampshire residential new construction program were compared and found to have wall assembly U-values which equate to the findings from the other studies (NH ENERGY STAR Home Program data, 2007). This information helped to guide assumptions about home construction in Climate Zone 6.
8. Results of non-participating builder survey conducted as part of this evaluation

Although not as reliable as a comprehensive baseline study, this approach incorporates a combination of methods that offer the highest reliability without the cost of conducting a full baseline study for residential new construction. This information was used to develop two user-defined-reference-homes (UDRH), one for homes in Climate Zones 4 and 5, and a second for homes in Climate Zone 6 with the only difference being that homes built in Climate Zones 4 and 5 were predominately constructed with 2"x4" wall-studs and insulated with an R-13 fiberglass batt and homes built in Climate Zone 6 were usually built using 2"x6" wall studs and insulated with R-19 fiberglass batts. The Impact Evaluation Team recommends that a full residential baseline study be conducted prior to the next impact evaluation.

The summary of the baseline homes is provided in Table 3-4 and Table 3-5, and additional detail about the development of the baseline home is included in Appendix F.

Table 3-4. Baseline Envelope Characteristics for All Homes in the Sample¹

Building Element	Description /	Unit Of Measure	Baseline	Criteria Description	Source
Thermostat	Thermostat type	Heating Zone	Non-Programmable Thermostat	Cooling Setpoint 75; Heating Setpoint maintained from model	VEIC
Solar	No Solar in Baseline	n/a	n/a	n/a	n/a
Foundation Walls	Conditioned Basement (R-Value)	R Value	R13	Conventional Concrete insulated with 2x4 frame wall interior - R13 Fiberglass Grade II installation	VEIC
Slab Floors	On Grade Not Radiant (R Value)	R Value	R10 Perimeter, R0 Under	Slab insulation is defined in the models only if the slab is a boundary of a conditioned space; for example conditioned basement or Slab on Grade construction.	VEIC, NYS ECCC
	On Grade Radiant (R Value)	R Value	R15 Perimeter, R0 Under		
	Below Grade Not Radiant (R Value)	R Value	Uninsulated		
	Below Grade Radiant (R Value)	R Value	Uninsulated		
Framed Floor	Over Ambient (R-Value)	R Value	R30 Cavity, Grade III	Floor R-Value of R30. In modeled homes no frame floor over unconditioned basement was defined.	NYS ECCC
	Over unconditioned basement or garage (R-Value)	R Value	R30 Cavity, Grade III		
Above Grade Wall	Climate Zones 4 and 5	R Value	2x4 16 o.c. Fiberglass Batt R13 Grade II	The VEIC study defined the AG wall insulation as Grade III installation. The Non-Participant Builder Survey described the percentage of homes with high performance insulation to be 76% of homes - resulting in a defined Grade II installation. It is important to note that RESNET classification for grade III in a wall cavity is the worst possible installation grade and allows for up to 2% gaps and 10% compression.	VEIC and Non-Part Survey
	Climate Zone 6	R Value	2x6 16 o.c. Fiberglass Batt R18 Grade II		NYS ECC and Non-Part Survey
Ceilings	Flat (Insulation R-Value)	R Value	R35 Grade II	R30 fiberglass batt insulation in 2x10 is defined to be R29	VEIC
	Vaulted (Insulation R-Value)	R Value	R29 Grade II		
Door	Assembly R-Value	R Value	R-4	Typical insulated doors range from R3 – R10 for the most efficient doors.	VEIC
Window	Assembly U-Value	U-Value	0.35	The Non-Participant Building Survey response of 96% ENERGY STAR Windows Installed. For CZ4, CZ5 and CZ6 ENERGY STAR windows have a U-factor of 0.35.	Non-Part Survey
Skylights	Assembly U-Value	U-Value	0.60		NYS ECCC

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Building Element	Description /	Unit Of Measure	Baseline	Criteria Description	Source
Air Infiltration	Air Infiltration Rate under standard test pressure	Air Changes per Hour at 50 Pascals (ACH50)	6.65	VEIC average infiltration of 0.50 ACH _{nat} converted to equivalent ACH ₅₀ for a 2 story home on an exposed site (n factor = 13.3); And the MA Baseline Study was 6.72 ACH 50	VEIC

¹ The only difference between Climate Zones 5 and 6 was in the configuration of the above-grade walls. Climate Zone 5 used a 3 ½” wall (2x4 studs) and Climate Zone 6 used a 5 ½” wall (2x6 studs).

Table 3-5. Baseline for Mechanical Systems for All Homes in the Sample

Building Element	Description	Unit Of Measure	Baseline	Criteria Description	Source
Mechanical Ventilation	Maintain the ventilation rate of the modeled home and default to exhaust only	CFM	Same as model	The MA Baseline had only 2 homes with ERV/HRV systems.	MA Baseline
Equipment Location	Whether heating, cooling and water heating equipment is located in or out of conditioned space	n/a	Same as model	Typically located in unconditioned (or semi conditioned) basement	VEIC
Heating System	Natural Gas and Propane(LP)	Hot Air Furnace (AFUE)	90	Furnaces and Boilers were adjusted to reflect the results of the Non-Participating Builder Survey - 92% of respondents installed ENERGY STAR furnaces/boilers	NYS ECCC, Non-Part Survey
		Hot Water Boiler (AFUE)	82		
	Electric	Air Source Heat Pump (HSPF)	8.5		NYS ECCC
Air Conditioning	Centralized Air Conditioning System	Seasonal Energy Efficiency Ratio (SEER)	12	In 2006 SEER 13 was the new federal minimum efficiency standard for manufacturing; however, the 2005 MA Baseline Study showed the average SEER was less than 11.	MA Baseline
Water Heating	Conventional Gas/LP	Energy Factor (EF)	0.56	NG, EF 56%, 40 gallon	VEIC
	Instantaneous Gas/LP	Energy Factor (EF)	0.56	Instant water heater efficiency is compared to a baseline home with a conventional 40 gallon water heater.	
	Indirect-fired Nat Gas or LP	Energy Factor (EF)	0.75	Efficiency and Recovery Efficiency defined by Boiler efficiency	NYS ECCC, Non-Part Survey
		Recovery Efficiency	0.82		
Conventional Electric	Energy Factor (EF)	0.86	Electric Resistance Water Heater is 0.86 EF (40 gallon)	MA Baseline	

Building Element	Description	Unit Of Measure	Baseline	Criteria Description	Source
	Geothermal Electric	Energy Factor (EF)	0.86	Baseline for a home with Geothermal water heating is compared to a baseline home with a conventional 40 gallon electric tank.	MA Baseline
Duct Leakage	Leakage to Outside	CFM ₂₅ / 100 sq of conditioned floor area	14.1	VEIC typical 2300 sq ft home with 325 duct leakage CFM 25 to outside is equivalent to 14.1 CFM 25 per 100 square feet	VEIC
Duct Insulation	Supply	R-Value	4.66	The MA Baseline Study - Supply Duct Insulation in Attic	MA Baseline

3.1.5 Whole House Modeling

The whole house modeling approach compared the as-built conditions (as determined through the homeowner surveys described above) to the baseline home as defined by the Impact Evaluation Team through a variety of types of research. To implement this approach, a user-defined reference home (UDRH) was established with the proper syntax and formatted to be used with the REM/Rate software. The UDRH is independent of the HERS Reference Home (used as the base for the HERS Index/Score), which remains based on the International Residential Code (IRC) 2004.

The UDRH methodology is used in other residential new construction programs in the region including Massachusetts, New Jersey, Vermont, and New Hampshire. It involves creating a reference home that has the same non-energy characteristics as the as-built home and the baseline energy characteristics. Savings are derived from the difference between the projected energy consumption of the UDRH home and the as-built home modeled in REM/Rate. This methodology allows for more specific adjustments to certain building components in the energy modeling and provides a more accurate per-home assessment of energy savings than using a generic baseline home model which simply assumes that all elements of a home are compliant (but do not exceed) code levels.

The software used to perform the energy modeling in this evaluation was the same software used by the Program to perform the initial home energy ratings (HERS). Designed by Architectural Energy Corporation, Inc. (AEC), REM/RateTM is a Windows-based residential energy analysis, code compliance and energy rating software developed specifically for the needs of HERS providers and the administrators of the U.S. EPA ENERGY STAR Home labeling guidelines. REM/Rate calculates estimated annual consumption and costs for various end-uses (i.e., heating, cooling, hot water, lighting, and appliances for new and existing homes. In addition, the home energy rating is calculated based on guidelines developed by the National Association of State Energy Offices (NASEO/RESNET).

3.1.6 Other Electric Measures

Other than cooling, the savings for electric measures were reviewed in the context of the deemed savings used by NYSERDA and other entities in the Northeast. Research was conducted to ensure that the savings claimed for these measures are reasonable in the context of the available information.

3.1.7 Model Calibration

The impact evaluation involves the analysis of detailed project files already available through the program to determine the estimated energy use for the home as it was built. To accurately estimate the energy use, this modeling is then calibrated to actual billing records to ensure incorporation of unique aspects of the home and its occupants' behavior and lifestyles. The models also needed to be adjusted to account for

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any changes to home that would affect energy usage (e.g. finishing previously un-finished portions of the home). The steps and information used to calibrate the model are detailed below.

Participating Homeowner Telephone Survey

Responses to the participating homeowner survey¹ were used to adjust the original *REM/Rate* modeling files received from program implementers to account for as-built conditions for all homes in the sample. Adjustments were made where necessary for occupancy, foundation type, heated basements, supplemental heat, mechanical equipment, programmable thermostats, mechanical ventilation, home modifications and lighting and appliances. The following is a summary of the changes made based on the participating homeowner survey as it relates to *REM/Rate* modeling.

- The number of people currently living in the home was used to calibrate the *REM/Rate* fuel usage consumption for domestic hot water. The *REM/Rate* software incorporates the assumption that the number of occupants is equal to the number of bedrooms plus one, and the hot water consumption is estimated based on occupancy. The Impact Evaluation Team reduced the number of bedrooms to match actual occupancy in over 70% of the homes.
- For the 11 homes that had “a walk-out basement,” nine homes required the floors on or above grade to be increased by one story.
- Supplemental heat was specified for 56% of the surveyed participant homes with natural gas fireplaces being the overwhelming majority of the supplemental heat sources. Supplemental heating from gas fireplaces and electric baseboards were weighted at 10% of the total heating load served. Even if these were in place at the time of construction, they were not included in the original modeling.
- Central air conditioning was added to 81 homes.
- For the sixteen homes noted as having “whole house fans,” the cooling season ventilation option required modification in 15 homes to be set to “whole house fan” instead of “no ventilation” or “natural ventilation.” Selection of this cooling system ventilation decreases the cooling load on the home.
- Survey responses to programmable thermostat usage required designation of over half the homes as not using the heating/cooling controls. If a respondent to the survey stated that they did not use the programming features of the thermostat, then the programmable thermostat was removed from the *REM/Rate* file. This adjustment affects the heating and cooling consumption for the home.
- Mechanical ventilation was adjusted in 23% of the homes; 28 homes had ventilation removed, three had ventilation set to 24 hours per day and 4 had ventilation hours decreased
- Appliance defaults were adjusted for refrigerators in 69% of the homes and for dishwashers in 38% of the homes. Original ratings used the default annual usage for refrigerators and dishwashers. If respondents noted that their refrigerator or dishwashers were ENERGY STAR, then modifications were made where *REM/Rate* defaults were left in place in the original model. The waste heat from the refrigeration affects the heating/cooling load for the home.
- The percent of fluorescent lighting in the home was adjusted to be consistent with the homeowner survey. The waste heat from the lighting affects the heating load for the home.
- The water heating fuel changed from propane to natural gas in one home and from natural gas to electric in two homes, based on the information provided by the homeowner. In two other

¹ This process was conducted for all homes in the survey, including the government housing.

homes, the type of water heating system was changed from natural gas fired conventional water heaters; one to an instantaneous water heater and one to an indirect-fired storage tank.

- Two homes that used the detailed light and appliances audit did not specify any water usage; dishwashers and showers were added to these models.
- There were 23 homes where the auxiliary electric use for the furnace was set to zero kWh in the original program model. For these homes, the auxiliary electric usage was updated to RESNET default values resulting in an average electric usage from heating of 465 kWh.

On-Site Survey

For the 30 homes that were selected for site visits (including the 5 at the government housing), the files were further adjusted where necessary for insulation grade², insulation values, additional heated spaces, window area, window orientation, mechanical equipment, duct leakage, infiltration, mechanical ventilation, lighting and appliances. The 30 homes selected for the site visits had an average HERS score of 87.4 based on the original REMs and an average HERS score of 86.8 based on the adjusted REMs. Adjustments made to the program models are discussed below.

- The mechanical equipment specifications were adjusted for capacity (21 homes), efficiency (two homes) and auxiliary electric usage (one home).
- Mechanical ventilation was removed from the REM/Rate file if the home was noted to have broken (one), missing (one) or disabled timers (five).
- Refrigerators rated annual energy usage (kWh) was added based upon look-ups of refrigerator model numbers and included the usage of additional refrigerators and freezers.
- The duct leakage testing and blower door testing was performed on the thirty homes. The original house-leakage (air infiltration) increased by an average of 6% and the duct leakage increased by 37%. However, the absolute duct leakage numbers are quite low, about 3.0% for the Program REM/Rate models and 3.3% from the on-site survey. This level of increased duct leakage is not likely to be caused by mere deterioration over time since the ducts were originally installed only three to four years ago. In three cases, the original duct leakage entries were set to “RESNET/HERS default” and were not included in the calculated average duct leakage.

Natural Gas Billing Data

The models were further calibrated to match the gas usage predicted in the energy model (REM/Rate) to the actual gas usage data, as described below.

- The natural gas usage from the billing data was used to calculate heating usage and normalized by heating degree days with base 65°F by weather station. This usage was recalculated using the heating degree days associated with TMY weather data included in REM/Rate based upon the weather site specified in the original REM/Rate files.
- The original REM files had various heating set points selected with the majority set at 68°F. The thermostat set points are ignored during compliance calculations such as HERS scores. In the calibration process, the heating set point was adjusted within the 60 to 75 degree range. When the billing consumption was still higher than the REM fuel usage at 75 degree set point, the heating equipment performance adjustment was decreased. If the calculated consumption was less than the REM fuel usage at 60 degree set point, the whole house infiltration was reduced.

² An assessment of insulation grade (I, II or III) was used by the certified HERS rater based upon those areas that were accessible to the rater. If no areas were able to be viewed there were no modifications made.

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3.1.8 Estimation of Evaluated Savings for All Homes in the Sample

Program estimated savings by comparing as-built use from the REM/*Rate* model to the user-defined baseline home (UDRH). The consumption associated with each major end use (space heating, cooling and water heating) was estimated from REM/*Rate* for the as-built and baseline homes in two ways:

1. incorporating modifications from the telephone and/or on-site surveys only
2. calibrating the heating use to actual billing records and also incorporating modifications from the telephone and/or on-site surveys (e.g. adjustments for occupancy, changes in home configuration etc).

Savings were estimated by comparing the as-built home to the baseline home (UDRH) for both scenarios. The lesser of the two savings estimates was used to compare with the program reported savings for each home. The lesser value was used to ensure that the heating calibration methodology did not inflate savings above normal baseline levels. Assuming that high use in the efficient case is due to high baseline use may introduce a bias into the analysis.

The realization rates for natural gas space and water heating and electric heating, cooling and water heating measures was calculated by comparing the evaluated savings with the reported savings from the program tracking system for each home. Only the heating use was calibrated to billing history due to the difficulties of estimating base natural gas use.

The natural gas realization rate was applied to all fossil fuel savings. The telephone and on-site surveys were restricted to natural gas to ensure that billing data would be available for calibration. However, the REM/*Rate* modeling of homes with fossil fuel heating is expected to be similar regardless of the fuel type and applying the realization rate from homes with natural gas would not be expected to introduce bias into the results. In addition, natural gas accounts for 96% of the total MMBtu program reported savings.

Electric measures (other than heating and cooling) were verified using deemed savings or evaluated savings from other studies.

3.2 NET-TO-GROSS FACTORS

The net-to-gross analysis was designed to estimate the effects of free ridership and spillover to arrive at an evaluated net savings. The Program is designed to improve the efficiency of residential new construction through working with builders, and consequently the net-to-gross analysis was designed to determine net effects from builders. A few questions were also included in the homeowner survey to assess whether living in a New York ENERGY STAR home encouraged homeowners to increase the efficiency of their homes. The primary vehicle for estimating net-to-gross factors were telephone surveys of participating, and non-participating (including formerly-participating) builders.

For both surveys, pretest interviews were conducted by APPRISE staff to assess the clarity, consistency and skip pattern logic of the draft survey instrument. Changes as a result of this pretest effort were discussed with the Impact Evaluation Team and implemented where necessary. APPRISE then formatted the survey instrument for use in the CATI system. The survey of the builder of the government housing was conducted in person by GDS staff at the time of the site visit using the same survey instrument used to interview the other participating builders in the survey. This information was later provided to APPRISE and incorporated into the data set containing the responses from the homeowner telephone survey.

Participating Builder Survey

The Participating Builder Survey was designed to assess the extent to which builders have constructed homes through the Program during program years 2007 and 2008 with as much detail toward energy

efficiency as they would have without being involved in the Program. It was also intended to assess the extent to which builders carry forward new building practices that were acquired through participation in the NYESH Program to other homes built without the assistance of the Program.

The target population for this survey was builders of homes that were labeled as ENERGY STAR Homes through the NYESH Program during the analysis period of 2007 or 2008. The sample frame for this study came from a list of 296 participating building firms with one or more completions in program years 2007 and 2008 from the program database. The 296 participating firms include the large builder of government housing units. The sample was stratified based on size of company where each firm was classified into one of three categories (small, moderate or large) based upon the number homes constructed during program years 2007 and 2008.

Table 3-6. Participating Builder Sample Frame Stratification

Strata	Number of Homes per Builder in PY 2007/08	Number of Builders ¹	Number of Homes	Target Sample Size	Number of Completed Surveys
Small Builders	1 to 50	280	1,511	54	64
Medium Builders	51 to 250	12	1,338	12	4
Large Builders ²	Over 250	4	1,692	4	3
Total		296	4,598	70	71

¹ Although the initial list contained 296 builders, the total number of builders in the final sample frame for the survey was 272. Four builders were removed because they were marked "do not call"; twenty builders were removed having been found to be duplicates (e.g., builders using different names for their company).

² This stratum includes the developer of government housing. For the purposes of calculating the free rider rate, the builder of government housing was placed in a separate stratum to ensure that the results were applied only to the government housing.

The targeted sample for this builder-group was 70 completed interviews. While the initial sample design was a stratified random sample as shown in Table 3-6 above, it was necessary to release the entire sample to reach the target of 70 interviews. The builder of the government housing was interviewed directly by GDS Associates using the same survey instrument rather than being included in the telephone survey implemented by APPRISE. Table 3-7 below shows the participating builder sample disposition and 25% completion rate and 83% cooperation rate.

Table 3-7. Participating Builder Sample Disposition

		Number of Builders	Percent of Builders
TOTAL SAMPLE USED		272	100%
Excluded Sample	Not working/Unusable number	29	10.7%
Not Contacted	Respondent never available	43	15.9%
	Answer Machine	101	37.3%
Unknown Eligibility	No Answer/Busy	8	2.9%
Excluded cases	Not Eligible/Not Qualified	6	2.2%
Refused/ Break-off	Refused	14	5.2%
	Break-off		
COMPLETED INTERVIEWS		71	25.8%
Contact rate¹ (70+14/70+14+144=.3684)			36.8%
Cooperation rate¹ (70/84=.833)			83.3%
Response rate¹ (70/70+14+144+ (.867*8) = .298)			29.8%

¹ See the Glossary for definitions of contact rate, cooperation rate and response rate as defined by AAPOR.

The sampling weights were developed based on the number of homes built through the Program represented by the builders in each stratum, and the weights were adjusted for non-response by stratum.³

It was not possible to determine from the program data whether a participating home was built on speculation (a "spec" home) or was a custom-built home. However, the participating builder telephone survey included a question asking the number of all homes built from 2007 through 2010 (both program and non-program homes) that were spec homes and the number that were custom. In the survey, "spec" and "custom" homes were defined to the builders as follows:

- ‘Spec’ means the home was either completed or under construction before the buyer became involved.
- ‘Custom’ means the buyer had their own land and hired a contractor to build on it or bought land from you and then you built a home for them.

The responses to this question indicated that a large majority (85%) of the non-government homes built by participating builders during this period were custom homes.

A copy of the participating builder survey instrument is included in Appendix C.

Non-participating and Formerly-participating Builder Survey

The purpose of the Non- and Formerly-participating Builders Surveys was to quantify the impacts of the NYESH Program by providing data to produce spillover estimates among non-participating and formerly-participating builders. Questions addressed builders' awareness of the HERS rating system and the Program, and inquired about decisions to implement high-efficiency measures. In addition, the Non-participating Builder Survey provided a general confirmation and/or refinement of the baseline home assumptions.

For this study, non-participating builders were defined as those builders who had built at least five single family homes⁴ in New York State (not including Long Island) and did not construct homes through the

³ Lohr, Sharon L. Sampling: Design and Analysis. Duxbury Press: Pacific Grove, California, 2009. p. 265 to 272.
3-20

NYESH Program or through other new construction programs using the EPA's ENERGY STAR Homes guidelines prior to the end of program year 2008. This survey did not target developers or builders of government housing. However, it is possible that some of the builders interviewed may have worked under contract to build certain government housing units (e.g. local public housing authorities).

The sample frame of non-participating builders was obtained from InfoUSA. The sample frame was shared with evaluators working on a separate NYSERDA evaluation, i.e., the list was split in half. Participating NYESH builders, builders located on Long Island and those with duplicate phone numbers were removed from the sample frame by APPRISE. The initial sample frame included 670 builders. After over three months in the field, a supplemental sample frame of 130 firms was provided from the sample used for the other NYSERDA evaluation in the spring of 2011. The sample frame was initially stratified by the size of the builder.

Formerly-participating builders were defined as homebuilders in NY State (not including Long Island) who participated in the New York ENERGY STAR Homes Program prior to 2007, but have not participated since then. This subset of participating builders was explicitly included, as has been done in previous evaluations, to recognize the possibility that these builders may be more likely to use the practices learned through participation in the Program on homes constructed outside of the Program. NYSERDA was unable to provide contact information for most of the formerly-participating builders, and APPRISE conducted a reverse look up, obtaining phone numbers for about 58% and yielding a sample frame of 205 builders. This sample frame was stratified by the size of the builders, in terms of the number of homes built through the Program prior to 2007. Stratification was intended to reflect the likelihood that those formerly-participating builders who had completed numerous homes through the Program would be more likely to have internalized the efficient building practices than builders who had only completed a few homes through the Program.

This survey group proved to be very difficult to reach. A total of 75 interviews were completed over a four month period; extra efforts were required to encourage participation, such as FedEx letters and incentives of \$100 to complete the survey. A high percentage of the sample frame (52%) had unusable contact information or was not eligible. While the initial sample design was a stratified random sample, the survey was implemented as if it were a simple random sample, due to the difficulties in reaching the target audience. Consequently, no sampling weights were applied.

These results suggest there is a potential for non-response bias. It is possible that the low response rate is partially due to the drop in residential new construction activity that occurred in 2008. Builders constructing homes during the 2007/2008 period may no longer be in business (given that 17% of the sample frame had unusable contact information) or may be involved in other activities (such as home repair or remodeling) and did not build the required number of homes (five over a four-year period) to be eligible for the survey (given the 35% ineligible). Table 3-8 below shows the disposition of the sample frame for formerly- and non-participating builders and the 55% contact rate and 48% cooperation rate.

⁴ Single-family homes are defined as homes with 1-4 units.

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Table 3-8. Formerly- and Non-Participating Builder Sample Disposition

		Number of Builders	Percent of Builders
TOTAL SAMPLE USED		1,005	100%
Excluded Sample	Not working/Unusable number	175	17.4%
Not Contacted	Respondent Never Available	128	12.7%
Unknown Eligibility	No Answer/Busy	44	4.4%
	Answering Machine	153	15.2%
Excluded cases	Not Eligible/Not Qualified	347	34.5%
Refused/ Break-off	Refused	83	8.3%
	Break-Off		
COMPLETED INTERVIEWS		75	7.5%
Contact rate¹ ((75+83)/(75+83+128)=0.552)			55.2%
Cooperation rate¹ (75/(75+83)=0.475)			47.5%
Response rate¹ (75/[75+83+128+(.354*197)]=0.211)			21.1%

¹See the glossary for definitions of contact rate, cooperation rate and response rate as defined by AAPOR.

The builder surveys were initially stratified by the size of the builder, as defined by the number of homes built through the Program for participating and formerly-participating builders, and the number of employees for non-participating builders. However, due to the difficulties in implementing these surveys, the target sample sizes for the medium and large builders were not achieved.

The survey included a question regarding the total number of homes built from 2007 through 2010, and *post hoc* stratification was conducted to compare the builders from the two surveys. This comparison of the non-participating and participating builder samples shows the final respondents are relatively comparable in builder size strata and number of homes built. This analysis is presented in Table 3-9.

Table 3-9. Comparison of Participating and Non-Participating Builder Surveys

Strata	Participating Builder Survey				Non- and Formerly-Participating Builder Survey	
	Number of Homes Built from 2007 to 2010 ¹	Number of Builders with Completed Surveys	% of Program Homes Built	% of All Homes Built	Number of Builders with Completed Surveys	% of All Homes Built
Small Builders	1 to 50	64	15%	14%	69	19%
Medium Builders	51 to 250	4	26%	22%	4	14%
Large Builders (including Government Housing) ²	Over 250	3	59%	64%	3	67%
Total ¹		71			76	

¹ The surveyed participating builders reported constructing 2,380 program homes and 5,140 homes in total, and non- and formerly-participating builders reported constructing 2,984 new homes.

² For the purposes of calculating the free rider rate, the builder of government housing was placed in a separate stratum to ensure that the results were applied only to the government housing.

A copy of the participating builder survey instrument is included in Appendix D.

3.2.1 Free Ridership

For this program, free ridership represents homes that would have been built to the NYESH standard in the absence of the Program. Free ridership was determined from the survey of participating builders. Free ridership is based on the number of 2007-2008 program homes that the participating builders would have built to the NYESH criteria (certified or qualified to be certified) but without the assistance of the NYESH Program.

The sample of participating builders was stratified by the size of the builder. Once the free ridership was estimated for the builders in the sample, the results were applied to the program population proportionally according to the percentage of homes constructed by the builders. This approach differs from the net-to-gross analysis conducted for other NYSERDA programs.

One of the 2007-2008 NYESH participating builders, the builder of government housing units, was found to be working under substantially different conditions than the other participating builders. This builder of government housing was required by a federal executive order to meet the EPA ENERGY STAR standards or install equipment that is in the upper 25% of efficiency for similar products. Consequently, this builder was placed in a separate stratum (*post hoc* stratification) to ensure that the free ridership results for this builder were applied only to this builder and not applied to all builders in the large size-stratum.

The steps and sequence of calculations in the final free ridership method are provided in Figure 3-2 and described below. The handling of the government housing is shown in the left column of Figure 3-2.

1. The telephone survey of 2007 and 2008 participating builders asked for the number of homes they built in 2007, one year prior to the recession, through 2010. This is the base number of homes for the initial step and was used to calculate the survey-based free ridership rate in a later step.

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2. The builders were asked for an estimate of the percentage of homes receiving an incentive through the NYESH Program. This number was multiplied by the base number of homes in step 1 above to produce the number of homes that received an incentive.⁵
3. Builders were asked the percentage of the homes with incentives that would have been NYESH certified or qualified for certification. This percentage was multiplied by the number of homes receiving an incentive (from step 2 above) to derive the number of homes built by participating builders in 2007 through 2010 that were NYESH qualified and would have been built without assistance from the Program.
4. The survey-based free ridership estimate (the light blue or shaded box on the right in Figure 3-2) is calculated by dividing the number of NYESH qualified homes built by participating builders without incentives from the Program divided by the number of homes these participating builders built in that same time period.
5. The survey-based free ridership rate is applied to the number of program homes built by the participating builders in the sampling frame, for the strata 1, 2 and 3. This produces the number of homes in the non-government housing program population that are free rider homes.
6. The number of free rider homes in the strata 1, 2 and 3 population plus the program homes for the builder of government housing is the total number of free rider homes calculated from this evaluation. These homes divided by the total number of program homes provides the overall program free ridership rate.

⁵ Asking participating builders the number of homes for which they received incentives keeps all the numbers and percentages as self-reported. This provides a consistency across the survey questions and allows us to also obtain from them their incentive number of homes for 2007 through 2010.

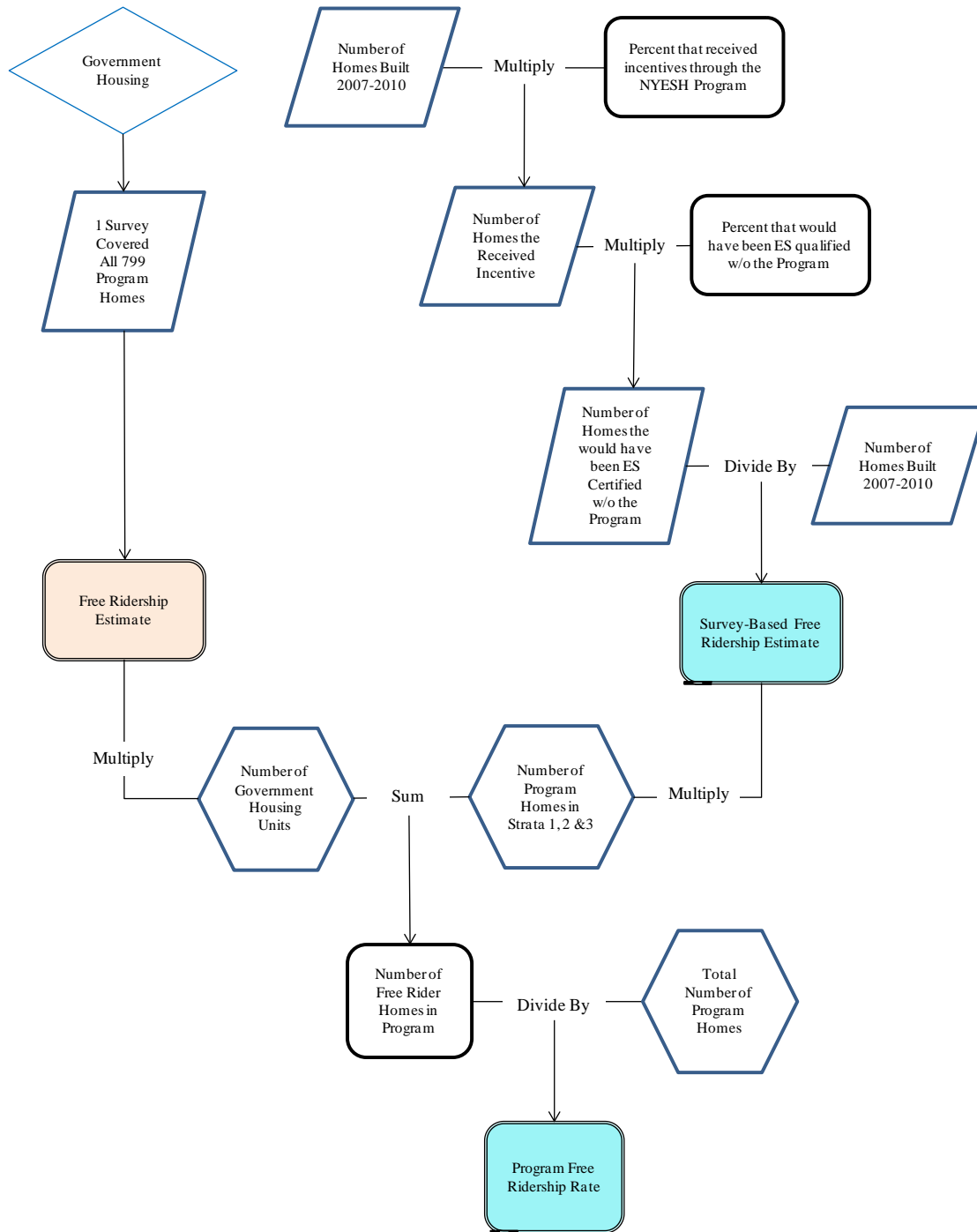


Figure 3-2. Free Ridership Methodology

3.2.2 Spillover

The spillover rate is the ratio of savings that occur outside the Program but due to the Program (compared to program savings). There are three types of spillover that are combined to calculate the spillover rate: participant inside spillover, participant outside spillover and non-participant spillover.

- Participating Homeowner Inside Spillover – Savings achieved by actions taken by participating homeowners by increasing efficiency in their post-program adoption of highly efficient equipment or actions that they contribute to their purchase and experience of a Program home, a NYESH.
- Participant Outside Spillover – Savings achieved through the construction of energy efficient homes that were certified or qualified to be certified and met the standards of NYESH by participating builders who did not submit them to the Program.
- Non-participant Spillover – Savings achieved through the construction of energy efficient homes or adoption of energy efficient practices by builders who did not participate in the Program and attribute the high efficiency measures to energy efficiency programs in New York State.
 - Non-participant spillover includes actions taken by formerly-participating builders and builders that have not participated in the NYESH Program.

The methodology for arriving at the spillover rate is very similar between participating and non-participating builders. Both groups were asked to estimate the number of homes they constructed during the years 2007-2010, then to break those down into the following percentages:

- Homes that would have qualified for the NYESH Program and certified with an EPA ENERGY STAR label, but not submitted to the NYESH Program
- Homes qualified for the NYESH Program but not rated and not submitted to the NYESH Program
- Homes that were not qualified for either the EPA ENERGY STAR or the NYESH Program

Participating builders were also asked about a fourth category, *i.e.*, homes which received incentives through the NYESH Program.

These categories were assigned to the types of spillover as follows.

- The homes which fell into the first two categories were considered candidates for outside spillover. Not all builders had such homes; in these cases, the spillover rate was considered to be zero.
- Non-participating builders were asked about their familiarity with the Home Energy Rating System (HERS). Those who stated that they were unfamiliar with the system were assumed to have no spillover.

To determine the influence of the NYESH Program on participating builders' practices, participating builders who had qualifying homes were asked to assess the importance, on a scale of zero to four, of the NYESH Program in their decision to build New York ENERGY STAR qualified homes that were not part of the Program. The scores from zero to four, a five-point scale, were used to assign the attribution to the Program in 25% increments from zero to 100, as shown in Table 3-10, and these values were applied to the number of homes constructed by each builder to arrive at the individual builder's number of

spillover homes. These factors were totaled for all respondents to the Participating Builder Survey and divided by the total number of homes constructed by builders having qualifying homes.⁶

Table 3-10. Non-participant Spillover Attribution based on NYSERDA Influence on Availability of HERS Raters in New York

Importance	Score	NYSERDA Attribution Percentage
Not at all important	0	0
	1	0.25
	2	0.50
	3	0.75
Very important	4	1

Three separate approaches were used to estimate program influence from non-participating builders.

- Non-participating builders who had qualifying homes and at least some familiarity with the HERS rating were asked to assess the importance of the NYESH Program on the availability of HERS raters in New York. The same five-point influence scale as described above for participating builders was used and applied to the number of certified and qualified homes as reported by the builders to obtain the number of spillover homes.
- The second approach was based on an analysis of two questions: 1) whether the percentage of homes constructed by the builder and built to NYESH certification standards has increased or decreased over the last four years and 2) the importance of energy efficiency programs in New York in bringing about this increase (survey question SP5). The same five-point influence scale as described above for participating builders was used and applied to the number of certified and qualified homes as reported by the builders to obtain the number of spillover homes.
- The third approach was developed from the measure-level questions, which consisted of two parts: 1) the percentage of their new homes that contained a high efficiency measure (SP8) and 2) the percent of their homes with the high efficiency measures that would have occurred even if there had been no efficiency programs in New York State (SP9). Two variations of this approach were analyzed and compared. The primary difference between the approaches was that the first approach estimated the increase in efficiency due to the Program for all homes and the second was restricted to efficient homes.

The ratio of the spillover homes to the total number of program homes yields the percentage of spillover (SO), as given in the equation below.

$$SO \% = \frac{\text{Total Number of SO Homes}}{\text{Total Homes Completed through the Program}}$$

The spillover homes and the total homes completed through the Program reflect activity during program years 2007 and 2008.

The number of spillover homes was calculated as follows for the each of the subsets of builders.

⁶ The builder of government housing was not included in the SO analysis as this builder was exclusively constructing government housing and all new units would be expected to be enrolled in the program.

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- Participating Builders (PB): the ratio of the number of spillover homes built by surveyed participating builders to all the homes built by surveyed participating builders provides the spillover rate.
- Formerly-Participating Builders (FPB): the ratio of spillover homes per builder was applied to the total number of formerly-participating builders, as shown below.

$$SO\ Homes_{FP} = \frac{SO\ Homes\ by\ All\ FPB\ in\ Survey}{Number\ of\ FPB\ in\ Survey} \times Total\ \#\ of\ FPB$$

- Non-participating Builders (NPB): the ratio of the estimated of spillover homes from the survey to the total number of homes built by non-participating builders from the survey was applied to the total number of homes built by non-participating builders in New York State as shown below.

$$SO\ Homes_{NP} = \frac{SO\ Homes\ by\ NPB\ in\ Survey}{All\ Homes\ by\ NPB\ in\ Survey} \times Total\ \#\ of\ Homes\ by\ NPB$$

The total number of homes built by non-participating builders was estimated from U.S. Census data⁷ of the number of permits for single family (one to four units) homes in New York State, not including areas serviced by the Long Island Power Authority.⁸

These numbers were divided by two since the survey covered a period of four years (2007-2010) and the program evaluation covers two years (2007-2008).

⁷ Source: [U.S. Census Bureau Building Permit Data](#)

⁸ Nassau and Suffolk Counties.

Section 4:

RESULTS

The results are presented in the following order: realization rates (fossil fuel and electric), net-to-gross factors, and evaluated net program savings.

4.1 REALIZATION RATES

4.1.1 Fossil Fuel Measures

The average HERS score for the calibrated models (87.3) was quite close to the results of the program modeling (87.5), using REM/Rate files version 12.95. However, some substantial differences were identified at the climate zone and end use levels.

As can be seen in Table 4-1, this analysis indicates that the savings for heating system measures are being underestimated in Climate Zones 4 and 5 and the savings from water heating measures are substantially overstated. The difference in realization rates between Climate Zones 6 and the other two zones (4 and 5) seems to be due to the method of estimating savings, which does not take into account the variation in baseline construction practices between Climate Zone 6 and the other two zones.

For domestic hot water savings (natural gas), the average reported program savings was 24.8 MMBtu and the impact evaluation estimate was 2.7 MMBtu, resulting in a realization rate of 11%. It should be noted that the entire baseline usage for the natural gas-fired domestic hot water was, on average, 18.4 MMBtu which is lower than the average reported program savings.¹ Average residential domestic hot water use for natural gas is about 20 MMBtu (2005), also smaller than the reported program savings per home for this end use.²

¹ The 2011 Massachusetts TRM shows savings of 0.9 MMBtu and the 2009 Vermont TRM has savings of 1.43 MMBtu for their DHW Natural Gas stand-alone measures.

² Patterns and Trends: New York State Energy Profiles: 1995 to 2009, NYSERDA, January, 2011, Appendix B.

Results

Table 4-1 Natural Gas Savings by End Use and Climate Zone¹

	Natural Gas Space Heating Measures Climate Zones 4 and 5 (n = 118)	Natural Gas Space Heating Measures Climate Zone 6 (n=35)	Natural Gas Water Heating Measures ² (n = 151)
Survey-Adjusted / REM-Calibrated Savings (MMBtu/year per home)	60.4	31.5	2.7
Program Reported Savings (MMBtu/year per home)	38.1	41.8	24.8
Realization Rate by Climate Zone and End Use	158%	76%	11%

¹ The above grade wall definition differs between the two the baseline for CZ4/5 and CZ6 (2x4,R13 vs 2x6, R19, respectively).

² Two of the 153 homes with natural gas space heating did not have natural gas water heating. Water heating savings did not vary by climate zone.

4.1.2 Electric Measures

The evaluated savings are discussed by major end use, covering lighting, appliances, cooling, and electric space and water heating.

Lighting

CFL screw-in bulbs account for 55% of the total program reported electric savings, and CFL fixtures contribute another 17% to the program electric savings. On average, 15.5 CFL bulbs and 4.2 CFL fixtures were installed in homes with these measures.

Table 4-2 shows the annual kWh savings per item installed claimed in various states throughout the Northeast. In the NYESH Program, savings for CFL fixtures were claimed at an average of 104 kWh/year per fixture.³ The CFL bulb savings averaged 65 kWh/year per bulb.

³ M&V Evaluation, ENERGY STAR Labeled Homes Final Report for NYSERDA, June 2007 by Nexant; Table 13 confirms the 115 kWh per CFL fixture and 95 per CFL bulb for program years 2001 – 2006. The values of 64 per fixture and 95 per CFL are effective for program years 2008 – 2010.

Table 4-2. kWh Savings Used for ENERGY STAR CFLs and CFL Fixtures in the Northeast

State	CFL Bulb Savings (kWh/Year)	CFL Fixture Savings (kWh/Year)	Source
New York	64	115	NYSERDA Deemed Savings Database (2008)
New York	54	N/A	"Results of the Multistate CFL Modeling Effort," NYSERDA Project Number 9875, September 2011 (Table 22, page 6-18)
Vermont	40.4	104	Vermont Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions, Efficiency Vermont, 12/31/2010
Massachusetts	47	44	Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures (2011)
Connecticut	48.8	60.6	UI and CL&P Program Savings Documentation for 2011 Program Year
New Hampshire	50.6	105.9	New Hampshire Core Electric Energy Efficiency Programs Cost-Effectiveness Models Review and Common Assumptions Assessment, PSNH, December 2002
Maine	62.6	64.4	Efficiency Maine Technical Reference User Manual No. 2007-1

As can be seen in Table 4-2, the recent NYSERDA evaluation of the CFL market assumed savings of 54 kWh per year, based on the DPS's Technical Manual and the recent impact evaluation of a residential markdown program.⁴ It is based on average daily use of 3.2 hours, which is likely to be high for the NYESH Program, given that an average of 15.5 CFL bulbs are installed in each home.

The results from the homeowner telephone survey were reviewed and compared to the on-site visits for additional information regarding the presence of the CFL bulbs and fixtures in the home. The results of this analysis are presented in Table 4-3 and discussed below. The comparison shown in Table 4-3 only covers homes with reported program savings and homeowners who responded that they found one or more CFL products in the home when they moved in.⁵

- Almost 90% of telephone respondents with CFL fixtures claimed by the Program stated that at least one CFL fixture was in the home.
- In contrast, only 62% of participating homeowners with reported CFL bulb savings reported that there was at least one CFL bulb in place at the time of purchase. Given that the Program is reporting 15.5 bulbs per home, this seems like a surprising outcome. Since only 3% of telephone survey respondents were not the original owner, turn over in housing stock does not explain this large discrepancy.

⁴ "Results of the Multistate CFL Modeling Effort," NYSERDA Project Number 9875, September 2011: 1) New York Evaluation Advisory Contractor Team. New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs: Selected Residential and Small Commercial Measures, submitted December 28, 2008. 2) New York Evaluation Advisory Contractor Team. New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs: Residential, Multi-family, and Commercial/Industrial Measures. Submitted October 15, 2010 Current Technical Manual). 3) Nexus Market Research, RLW Analytics, and GDS Associates. 2009. Residential Lighting Markdown Impact Evaluation. Submitted January 20, 2009 (NE Markdown).

⁵ While telephone survey respondents may have trouble reporting the exact number of CFL bulbs or fixtures installed, they are more likely to be able to report accurately whether the home had CFL products of any kind when they moved in. Government housing units are included in these numbers.

Results

To assess the reliability of the homeowner responses, the on-site survey data were reviewed and about 70 to 75% of the homes in the on-site survey had consistent responses between the auditor-reported values and the telephone surveys. Some of this discrepancy may be due to variations between the wording of the survey questions and on-site data collection approach.⁶

Table 4-3. CFL Products as Reported by Telephone Survey Respondents

	CFL Fixtures (Number of Homes)	CFL Screw-In Bulbs (Number of Homes)
All homes with program reported savings For CFL and valid responses	56	152
Respondents reporting one or more CFL's in place at time homeowner moved into the NYESH	49	94
Percent of NYESH with one or more CFL products in place	88%	62%

In the absence of better information, the Impact Evaluation Team recommends that annual savings of 54 kWh per bulb be used for estimating savings for CFL screw-in bulbs for this evaluation. The telephone survey results suggest that additional attention from program implementers regarding the use of CFL bulbs to meet the program target for electric savings is warranted. However, since this evaluation was not explicitly designed to determine in-service rates and the telephone survey responses are suggestive rather than definitive, the Impact Evaluation Team does not recommend that savings be adjusted to account for missing CFL bulbs at this time.

Appliances

Table 4-4 shows the comparison of the savings claimed by the NYESH Program in comparison to the deemed savings values used in the New York and other states in the Northeast. The Program reported savings used for the refrigeration and clothes washers are among the lowest savings in comparison to other jurisdictions. The dishwasher savings of 46 kWh is highest.

⁶ Data entry for on-site surveys was from the REM/Rate entry form, which requires the percent of the lighting that is CFL, not the number of CFL bulbs installed in the home. Consequently, the number of CFL's found in each on-site home was not recorded and it was not possible to calculate the average number of CFL's per home from the on-site survey.

Table 4-4. Program Reported kWh Savings Used for ENERGY STAR Appliances in the NYESH Program and in the Northeast

State	Refrigerator	Dishwasher (Natural Gas DHW)	Clothes Washer	ECM Motors
NYESH Program	82	46	91	396
New York (DPS Tech Manual)	79	43	88	396
Vermont	117	31	189	462
Massachusetts	107	33	N/A	600
Connecticut	N/A	37	64	285
New Hampshire	85	43	119	N/A
Maine	127	N/A	224	N/A

There were 14 homes with reported savings for ECM motors each at 396 kWh. When defining a furnace with an ECM motor in the modeling, it is possible to claim the savings by the adjustment of auxiliary electric usage. If the furnace is defined this way, the savings would be reflected in the HERS score and therefore would have been picked up in the original modeling. In other jurisdictions, the typical values for ECM blower motor savings ranged from 285 to 600, and the NYESH reported savings of 396 falls well within this range.

Since all of the appliance measures and the ECM motors, in aggregate, account for only 7% of the program electric savings and the NYESH values are in the general range of the deemed savings used for similar programs, the Impact Evaluation Team does not recommend any adjustments at this time.

Cooling

There seems to be little consistency in the Program savings claimed for central air conditioning, as described below.

- There were 61 homes with program reported savings associated with central air conditioning. Of those 61, only 48 were found to have central air conditioning modeled in original REM/Rate files.
- There were 10 homes with central air conditioning (A/C) in the REM/Rate model and no program reported savings in the program database.
- The results from the homeowner telephone survey indicate that almost all homes have central air conditioning, although it is clear from the billing records that at least in some cases, the central air conditioning was installed after the homeowner had moved in.
- The overwhelming majority of homes had 13 SEER air conditioners, which was required by federal standards as of January, 2006. Even though the baseline was assumed to be a SEER 12 for verification purposes, the modeled savings were substantially lower than the savings per home claimed by the Program.
- Central A/C savings were claimed for one home and the A/C was also modeled in the original REM/Rate file; however, the homeowner stated in the telephone survey that the house does not have central air conditioning.

The overall realization rate for savings from central air conditioners was 57%.

Results

Electric Space and Water Heating

Savings for electric space heating, cooling, and hot water heating were estimated from the energy models. There were very few homes in the sample with primary electric heat and/or electric water heating. The initial sample plan was designed with an attempt to ensure that at least some of the few homes with electric space heat (19) were included in the sample; however, despite these efforts, the final sample contained only one of these homes. For this home, the electric savings from the reported program savings was 16,897 kWh and the evaluated savings in comparison to baseline was 9,171 kWh, resulting in a realization rate of 54.3%. As this is the best information available, the few homes with electric space heating savings were adjusted according to these results.

Only two homes with electric water heating were included in the modeling, resulting in average savings of 972 kWh. In both cases, the reported program savings were claimed as natural gas domestic hot water savings. During program years 2007 and 2008, electric domestic hot water savings were claimed for 31 homes, at an average of 6,125 kWh per year per home. As with the natural gas hot water savings, the magnitude of the program reported savings is unrealistically high. Average residential use for electric water heating is about 2,526 kWh/year (2005), which is about one-third of the program reported savings per home for this end use.⁷

To calculate a realization rate for electric domestic hot water savings, the Impact Evaluation Team assumed an average savings per home of 972 kWh/year, as estimated for the two homes in the model. This value is in the upper range of deemed savings values used by NYSERDA and in other jurisdictions. In addition, the total number of homes with electric hot water savings was increased by two, since no program electric savings were claimed for the two homes with electric domestic hot water.

Summary of Electric Savings

The summary of the program reported and evaluated electric savings by measure for all homes rated in program years 2007 and 2008 is provided in Table 4-5

Table 4-5. Program Reported and Evaluated Electric Savings by Measure

Measure	Number of Homes	Total Savings (kWh/Year)	Evaluated Savings	Realization Rate
CFL Screw-in Bulbs	4,359	4,394,038	3,653,640	83%
CFL Fixtures	3,021	1,328,542	1,328,542	100%
ENERGY STAR Dishwasher	4,172	193,516	193,516	100%
ENERGY STAR Refrigerator	1,913	156,183	156,183	100%
ENERGY STAR Clotheswasher	685	62,426	62,426	100%
ECM Motors	301	132,264	132,264	100%
ENERGY STAR Freezer	20	772	772	100%
ENERGY STAR Central A/C	2,001	1,097,282	624,809	53%
Electric Heat	26	409,969	222,613	54%
Electric Domestic Hot Water	31	189,870	32,076	17%
Total¹	4,598	7,964,862	6,406,841	80%

¹ The "Total Number of Homes" does not add up to the total in the column due to multiple measures installed in each home.

⁷ Patterns and Trends: New York State Energy Profiles: 1995 to 2009, NYSERDA, January, 2011, Appendix B.
4-6

Since electric savings are largely based on deemed values, the Impact Evaluation Team conducted another level of verification to assess whether the savings are in a reasonable range. In this part of the analysis, the average annual electric use was calculated for the homes with complete billing analysis and compared to average residential use and the evaluated savings by home. This comparison is presented in Table 4-6 and suggests that the NYESH Program saved about 13% of the electric consumption, which seems to be within a reasonable range.

Table 4-6. Electric Savings in Comparison to Average Electric Consumption

NYESH Average Annual Electric Consumption (kWh/year)	Average Residential Electric Consumption in 2005 (kWh/Year) ¹	Average Electric NYESH Savings per Home (kWh/Year)	NYESH Savings Compared to NYESH Average Consumption ²
9,017	6,882	1,394	13%

¹ Patterns and Trends: New York State Energy Profiles: 1995 to 2009, NYSERDA, January, 2011, Appendix B.

² This column represents the estimated program savings and is calculated as follows: NYESH average savings/(NYESH average savings + NYESH average annual consumption). The denominator reflects the estimated average consumption without the program measures installed.

Summary of Fossil Fuel Savings

Table 4-7 shows the application of the realization rate by end use to the claimed fossil fuel savings (natural gas, propane and oil) to all projects, including government housing units, completed in program years 2007 and 2008. The overall realization rate is 87%.

Table 4-7. Program Reported and Evaluated Non-Electric MMBtu Savings by End Use

	Number of Homes	Program Reported Annual Non-Electric Savings (MMBtu/Year)	Evaluated Annual Non-Electric Savings (MMBtu/Year)	Realization Rate
Heating	4,369	170,910	235,132	138%
Domestic Hot Water	4,420	112,350	12,358	11%
Overall Non-Electric MMBtu	4,580a	283,260	249,298	87%

a The "Total Number of Homes" does not add up to the total in the column due to measures associated with multiple end uses installed in each home. Baseline Comparison

For comparison purposes, the analysis was conducted using the Energy Conservation Construction Code of New York State (2007) as the baseline. The results are presented in Table 4-8 below.

Table 4-8. Comparison of Report Baseline to Code as Baseline

Fuel Type	Evaluated Realization Rate	Realization Rate with Code as Baseline
Fossil Fuel Savings	87%	78%
Electric Savings	80%	76%

This analysis indicates that the baseline as estimated by the Impact Evaluation Team from the numerous documents and studies is somewhat lower than the New York State energy code enacted in 2007. It is entirely possible that construction practices were lower than code during this period. This analysis indicates that the evaluated realization rates do not underestimate program savings

Results

4.2 NET-TO-GROSS RESULTS

The net-to-gross factors estimated in this evaluation include free ridership, participating homeowner spillover, participating builder spillover and non-participant spillover. Each of these factors is discussed in more detail below, followed by a summary of the net-to-gross results and a discussion of the issues affecting net impacts given the recent upheaval in the new construction market.

4.2.1 Free Ridership

The free ridership method for the New York ENERGY STAR Homes Program, as described in Section 2, is based upon the following inputs:

- participating builders self-report on the number of homes built
- the number of homes built through the Program
- the number of homes that would have been built as certified or qualified for the New York ENERGY STAR Homes Program if the Program had not existed

A free ridership rate was derived for each surveyed participating builder.

The sample was stratified by the size of the builder, and the results indicate that free ridership is higher for larger builders than smaller builders. The free ridership rate for those builders with a smaller number of new homes is 47%. The medium sized builders had a free ridership of 56% and Strata 3 had a free ridership of 64%. These findings along with the number of respondents used in the calculation of these rates are presented in Table 4-9.⁸

Table 4-9. Free Ridership Rate by Survey Strata for Non-Government Homes

Strata	Builder Size	Number of Homes per Builder	Respondents with FR Estimates ¹	Free Ridership Rate
1	Small	1 to 50	55	47%
2	Medium	51 to 250	4	56%
3	Large	Over 250	1	64%
Weighted Survey Free Ridership ²				56%

¹ Strata 1: 64 respondents with 9 missing FR; Strata 2: 4 respondents with 0 missing FR; Strata 3: 2 respondents with 1 missing FR.

² The builder of government housing is not included in this table.

The survey based weighted free ridership estimate of 56% for all non-government is applied to the total number of the Program's non-government homes in Stratum 1 through Stratum 3. This provides the number of new homes built by the participating builders that are free rider homes.

High free ridership was found among the all large builders in the program. The non-government builders in Stratum 3 accounted for 19% of the homes built through the Program and the government housing component of the Program represented 17%. The free rider rate for Stratum 3(non-government) is quite high at 64%, as shown in Table 4-9. The builder of government housing had a free ridership rate of 100% from the survey, which is not unexpected given that government housing in the United States is required

⁸ As discussed in Section 3.2.1, the builder for the military housing was found to have been working under substantially different conditions and was placed in a separate stratum to ensure that the program results were unbiased.

by federal law to build to the higher efficiency standard of the EPA’s ENERGY STAR Homes guideline.⁹ The total number of homes that are part of free ridership divided by the number of program homes provides a program free ridership rate of 64%, as seen in Table 4-10. This analysis indicates that the builder of government homes has a large influence on the Program free rider rate, resulting in an increase from 56% to 64%. Since the government housing was placed in a separate stratum and the 100% free ridership is applied only to the government housing projects, it is correctly reflecting the net effects for the evaluated program year.

Stratum 3 non-government builders have been program participants for a number of years and participated in multiple evaluation interviews over the years. These builders did not answer all of the free rider questions and this group has the highest likelihood of having an internal validity issue from a testing effect, which occurs when respondents know what to expect, may know the consequences of their answers and answer according to these understandings rather than providing a true response. This threat to validity is virtually impossible to measure or avoid. In this case, the testing effects would tend to result in a downward bias to the free ridership, i.e., the actual free ridership for this stratum may well be higher than reported. Efforts were made to design the survey and sample to obtain an unbiased overall estimate knowing that there will be upward and downward variances for a variety of reasons, including potential bias from specific respondents.

Table 4-10. Program Free Ridership Rate

	Free Ridership Rate	# of Homes within Survey	# of Program Homes	# of Program Homes that are Free Riders
Final Survey-based Free Ridership	56%	1,581	3,799	2,127
Government Housing	100%	799	799	799
Total			4,598	2,926
Program Free Ridership Rate				64%

High efficiency windows and doors are the measures that participating builders would install most often without NYSERDA’s NYESH Program with a free ridership rate of 86%. Second and third most common are dish washers and furnaces. The lowest measure level free ridership rate is for ENERGY STAR® clothes washers with a rate of 22% and second lowest is ENERGY STAR lighting with a 42% free ridership rate. The measure-level free ridership rates are provided in Figure 4-1 below. The program free ridership rate of 64%, as presented above, is also on the graph for comparison.

⁹ There were concerns expressed by NYSERDA program staff regarding the builder of government housing and how the net-to-gross were developed. The proposed further research into this issues would have required a change to the evaluation design for this stratum only, and may have introduced bias to study. While evaluation plans can change in certain circumstances, the Impact Evaluation Team concluded that applying consistent methods across all builders as specified in the work plan was critical to developing robust and defensible results, and that changing the method in reaction to a specific respondent’s answers is counter to standard evaluation practices.

Results

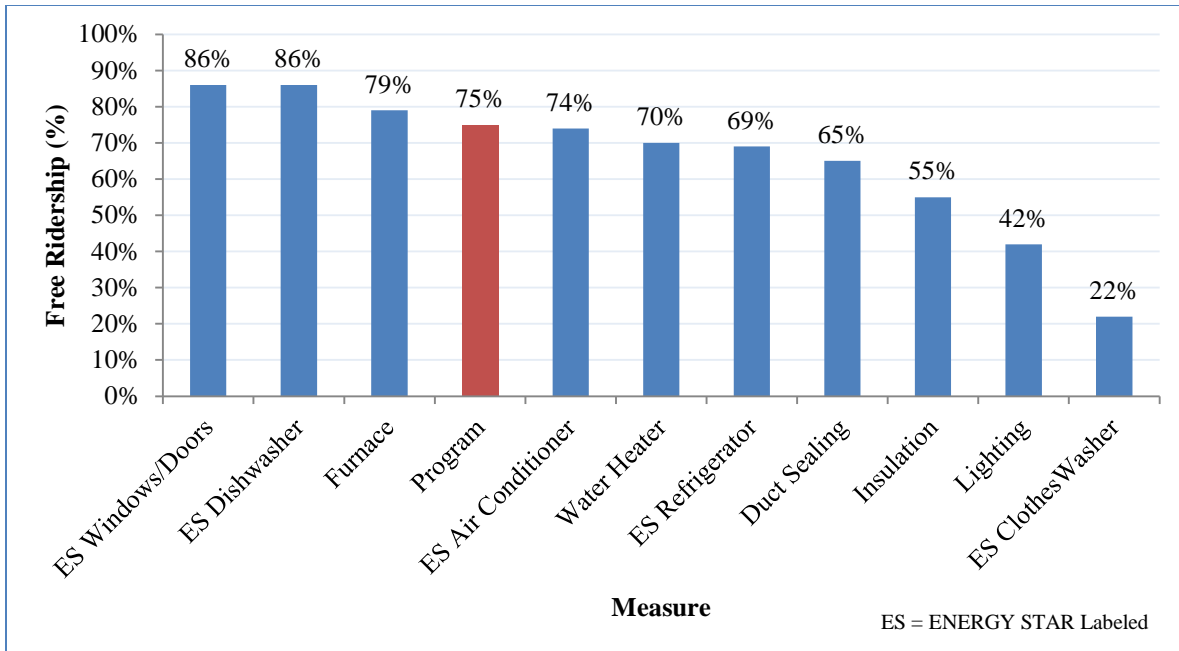


Figure 4-1: Free Ridership by Measure from the Participating Builder Survey

Free ridership is based on the builders' reports of the percentage of the homes with incentives that would have been NYESH certified or qualified for certification in the absence of the program. For free ridership, the measure-level response to the high performance insulation systems was very close to the free rider rate estimated for the program based on the percent of incentivized homes that would have met certification without the program. This result provides further support for the free ridership estimate.

4.2.2 Homeowner Inside Spillover

The estimate of participating homeowner inside spillover was based on the responses to the homeowner survey. Participant inside spillover is created when energy saving actions are taken by the homeowner and they take them because of the Program, their decision to purchase a program home and information that they received from living there (such as the energy savings they see they are obtaining from living in a high efficiency home).

The savings obtained from homeowner inside spillover would be expected to be small. The homeowners are in new high efficiency homes so there are fewer opportunities for them to gain additional savings as compared to homeowners of existing homes.

Surveyed homeowners were asked about additional measures they installed and the importance of their living in a NYESH in their selection of high efficiency equipment. The spillover proportion from survey responses and savings per measure was used to derive the total spillover savings from homeowners. This was changed to savings per home and then compared to evaluated savings per home to derive the homeowner inside spillover rate. That rate is 0.32%. These results by measure and the derivation of this rate are provided in Table 4-11.

Table 4-11. Deriving Homeowner Inside Spillover Rate

Measure/ Item	# of Surveyed Homeowners Adding this Measure	Average Spillover Attribution	Savings in MMBtu per Home/ Item
Programable Thermostat	1	0.75	-
ENERGY STAR Room Air Conditioner	2	1	0.25
ENERGY STAR Central Air Conditioner	17	0.74	2.11
Additional Insulation	24	0.71	35.18
ENERGY STAR Refrigerator	90	0.86	0.70
ENERGY STAR Dishwasher	41	0.83	0.38
ENERGY STAR Clothes Washer	83	0.83	0.76
Pin-Based Lighting	80 (count)	0.78	3.42
Compact Florescent CFLs	878 (lamp count)	0.77	3.84
# of homeowners surveyed			197
Spillover savings per surveyed home			0.22
Evaluated Program gross savings per home			67.98
Spillover %			0.32%

4.2.3 Participating Builder Spillover

The survey of participating builders included questions about how many of the homes they built were qualified for the Program but were not program homes. Then they were asked the Program's role in their decision to build those qualified homes. This set of questions resulted in a participating builder outside spillover rate of 1%. A primary reason for this low participant outside spillover rate is that 85% of the homes constructed by participating builders during this time period were NYESH projects. Table 4-12 shows the spillover rate derivation of participating builders.

Table 4-12. Deriving Participating Builder Outside Spillover Rate¹

	Spillover Rate Derivation
Number of Spillover Homes Built by Surveyed Participating Builders during 2007-2010 ²	67.5a
Number of Homes Built 2007-2010 by Surveyed Participating Builders	5,040
Participating Builder Outside Spillover Rate (1 st row / 2 nd row)	1%

¹ Spillover homes consist of those homes that were built to the NYESH Program standard but were not enrolled in the NYESH Program. The builders of these homes report that they would have not built to NYESH standards in the absence of the program.

² Potential spillover homes multiplied by attribution at surveyed formerly-participating builder level.

4.2.4 Non-participant Spillover

Non-participant spillover is measured separately for formerly-participating builders and builders that had never participated in the NYESH Program. The spillover rate is expected to be different between these two groups as they have different experiences concerning the Program and knowledge about the Program.

Results

The results from the previous NYESH evaluation¹⁰ and the three selected methods of estimating non-participant spillover in the current evaluation are discussed below. All of the house-level methods, as described in the first three bullets listed below, are based on the assumption that the savings from spillover homes are approximately equal to the savings from Program homes. The measure-level analysis indicates that the actual savings from spillover homes is substantially smaller than found in program homes.

- The 2006 NYESH M&V evaluation¹¹ study used a direct question for program attribution and obtained a result of 146% spillover for never participating builders through its house-level approach.¹²
- The first approach used the same method as the previous evaluation, except that influence was determined by the effect of the Program on the availability of HERS raters. This method resulted in a non-participant spillover for builders that never participated of 197%, also using a house-level approach.
- The second method was developed by using the importance of energy efficiency programs in New York on whether the builder is increasing their proportion of homes that meet the NYESH certification standards. Using these inquiries resulted in an estimate of 163% for the builders that never participated, at the house-level.
- The second alternative applied the measure-level inquiry to develop the percent of homes including the high efficiency measure and used evaluated Program savings to develop the percent of savings found in spillover homes as compared to Program homes. These results were then applied to all homes built and resulted in a spillover rate of 22%.
- The third alternative used a measure-level inquiry to develop the percentage of the homes that incorporated the efficiency measure due to the program and applied that to the number of homes built that were certified or meet NYESH Program qualifications. The spillover rate from this alternative was 26%.

¹⁰ M&V Evaluation, ENERGY STAR Labeled Homes, Prepared for NYSERDA by Nexant, May 2006

¹¹ *Ibid.*

¹² In the absence of confirming evidence, evaluators capped the spillover rate at 18.2%, as estimated from the formerly-participating builders.

Table 4-13. Measure Spillover from Non-participating Builders

Measure	2007-2008 Evaluated Source MMBtu Savings per Home ¹ (Column A)	% Measure Spillover Caused by Efficiency Programs in New York (Column B)
Insulation	32.29	1%
ENERGY STAR Windows/Doors	10.76	17%
ENERGY STAR Refrigerator	0.81	16%
ENERGY STAR Clothes Washer	0.91	2%
ENERGY STAR Dishwasher	0.46	14%
High-Efficient Furnace	10.76	16%
ENERGY STAR Air Conditioner	3.11	1%
Efficient Lighting	12.71	6%
Efficient Water Heater	2.80	7%
Overall Causality Percentage		7% ^a

¹ Savings from electric measures were converted to source MMBtu using the conversion factor of 9,949,20 Btu/kWh provided by NYSERDA.

^a The "overall causality percentage" is the weighted average of the spillover homes (Column B times Column A) divided by the verified Program savings per home (sum of Column A).

The survey questions for all three types of builders (participants, formerly-participating and non-participant) regarding the number and types of homes built were nearly the same. The survey provided the number of qualified non-Program homes built by the surveyed formerly-participating builders. The number of spillover homes per surveyed builder was then multiplied by the total number of formerly-participating builders (the sampling frame for the survey of these builders). Dividing this by the number of Program homes provides a spillover rate of 8% from formerly-participating builders.

Results

Table 4-14. Total Spillover from Formerly-Participating Builders ¹

	Spillover Rate Derivation
Number of Spillover Homes Built by Surveyed Formerly-Participating Builders during 2007-2010 ²	6.0
Number of Formerly-Participating Builders Surveyed	18
Number of Spillover Homes for 2007-2008 for Surveyed Formerly-Participating Builders ³	3.0
Number of Spillover Homes per Formerly-Participating Builders	0.167
Total Number of Formerly-Participating Builders	346
Number of Spillover Homes for All Formerly-Participating Builders (Number of spillover Homes per Formerly-Participating Builders * Number of Formerly-Participating Builders)	58
Number of 2007-2008 Program Homes	4,598
Total Formerly-Participating Builder (Non-participant) Spillover (All Formerly-Participating Builders' Spillover Homes ÷ Number of Program Homes)	1.3%

¹ Spillover homes consist of those homes that were built to the NYESH Program standard but were not enrolled in the NYESH Program. The builders of these homes report that they would have not built to NYESH standards in the absence of the program.

² Potential spillover homes was weighted by measure savings and multiplied by attribution at the measure-level.

³ Number of spillover homes for 2007-2008 assumed to be half of the number for 2007-2010.

The method for estimating non-participant spillover is explained in Section 3.2.2, and the results of the analysis are presented in Table 4-15. The spillover rate for non-participant builders is 26%.

Table 4-15. Total Spillover from Non-participating Builders

Item Identifier	Description	Spillover Rate Derivation
Row 1 (R1)	Number of Spillover Homes Built by Surveyed Non-participating Builders during 2007-2010	118a
R2	Number of Spillover Homes Built by Surveyed Non-participating Builders for 2007-2008 (Number of Spillover Homes Built by Non-participating Builders 2007-2010) [R1 / 2]	59
R3	Number of Non-participating Builders Surveyed	58
R4	Number of Homes Built by Surveyed Non-participating Builders for 2007-2008 ¹	1,445
R5	Ratio of the Number of 2007-2008 Spillover Homes Built by Surveyed Non-participating Builders to 2007-2008 the total Number of Homes Built by Surveyed Non-participating Builders [R2 / R4]	0.0408
R6	Number of New Residential Permitted Units (Homes) in New York State in 2007 that are not multi-family ^{2,3}	25,247
R7	Number of New Residential Permitted Units (Homes) in New York State in 2008 that are not multi-family ^{2,3}	16,332
R8	Number of New Residential Permitted Units (Homes) in the Boroughs of Long Island in 2007 that are not multi-family ^{3,4}	4,514
R9	Number of New Residential Permitted Units (Homes) Built in in the Boroughs of Long Island in 2008 that are not multi-family ^{2,3}	2,022
R10	Number of Homes Built by Surveyed Formerly-Participating Builders (n=18)	47
R11	Number of Surveyed Formerly-participating Builders	18
R12	Census Number of Formerly-participating Builders	346
R13	Number of Homes Built by Formerly-participating Builders = (R10 / Surveyed Formerly-participating Builders * Census Number of Formerly-participating Builders) [(R10 / R11) * R12]	903
R14	Number of Homes Permitted by non-surveyed Non-participating Builders for 2007-2008 in NYSEDA Territory [(R6 + R7) - (R8 + R9) - (R13 + R4) - R16]	28,097
R15	Number of Spillover Homes for the non -surveyed Non-participating Builders (2007-2008) [R14 * R5] (Assumes all permitted homes were built)	1,147
R16	Number of 2007-2008 Program Homes	4,598
R17	Total Non-participant Builder Spillover (All Non-participating Builders' Spillover Homes / Number of Program Homes) [(R15 + R2) / R16]	26%

^a Potential spillover homes was weighted by measure savings and multiplied by attribution at the measure-level.

¹ Number of homes built by Non-participating builders for 2007-2008 assumed to be half of the number for 2007-2010.

² Source: <http://censtats.census.gov/cgi-bin/bldgprmt/bldgdisp.pl>

³ Multifamily units are units in new residential structures with 5 or more units.

⁴ Source: <http://censtats.census.gov/cgi-bin/bldgprmt/bldgdisp.pl> Long Island permits approximated by permits of the boroughs of Suffolk and Nassau Counties.

Results

Evaluation Method and Measure-level Non-participant Spillover

There are wide disparities in the results from the different approaches, with an order of magnitude difference between the non-participant spillover rates from first two house-level estimates, as compared to the measure-level estimates. The difference between the two estimates is largely due to the self reports by non-participating builders who stated that they would have installed the highest savings measures (insulation and air sealing) even in the absence of efficiency programs.

The Impact Evaluation Team considered the potential for bias of the two approaches to estimating participating builder outside spillover, i.e., measure-level and household-level approaches. The spillover estimates are based on builder self-reports and the responses reflect the builders' understanding of the Program.

The NYESH Program is designed to improve the quality of the installation of insulation and the overall envelope as a primary focus of the ENERGY STAR Home certification and HERS rating processes. In addition, third party verification is a key element of the program design. Designing survey questions to address these issues is complex. As with any other survey, bias could be introduced if builders misinterpret the questions or have insufficient background to be able to provide an accurate response.

The primary difference between the measure-level and whole house estimates of non-participant spillover is the weight of the envelope measures (insulation and air sealing). In the whole house estimate, the full program savings for these measures are assumed to occur in every spillover home. In the measure-level estimate, the household savings are a weighted average reflecting the percent of spillover homes where builders reported installing the measure and also attributed the installation to the Program. The major issues associated with the whole house estimate are discussed below.

- While builders recognize the influence of the Program in a general sense, they also clearly indicate that they would be incorporating many efficiency measures into their new homes even in the absence of energy efficiency programs in New York State, as shown in Table 4-13 above. However, the whole house approach assumed that spillover homes have the same savings as program homes.
- This spillover estimate is based on the assumption that the non-participating builders are sufficiently familiar with the NYESH requirements to correctly characterize the percentage of homes they build that would have met the program requirements (but were not submitted to the Program for incentives). However, these homes are missing the third party verification and builders may easily overestimate the percent that would meet program standards.

Both of these factors suggest that the whole house approach may result in an upward bias to the spillover estimate.

The counterbalancing argument is that the measure-level spillover may be downwardly biased because non-participating builders may not be as familiar with the program measures and may not have the advantage of the HERS rating and third party review. Some of the key issues in assessing the validity of this argument are described below.

- The survey instrument was designed to correctly characterize the measures to try to ensure that builders would understand the questions as intended. The first measure on the list is "high performance insulation system" which was defined as spray foam insulation, dense-packed cellulose insulation and air sealing (caulking at certain framing locations, foam around windows and doors, etc.) This approach of asking about high performance insulation systems (as opposed to insulation levels) addresses the quality of insulation and air sealing that is a core component of the program. This is the primary measure within the ENERGY STAR Home program.
- Within the survey design, third-party verification does not fit into the measure-level questions. Accordingly, this issue was addressed in the survey through a series of questions regarding the

availability and use of energy raters. The non-participant spillover measure-level method used the program estimated savings by measure, which would include these savings derived from third party verification.

- The non-participating builders' survey results are similar to the participating builder survey, which indicates that the high performance insulation measure has a FR rate of over 50%.

The critical input into the non-participant spillover calculation is given below:

$$\% \text{ of SO Measure Savings} = \% \text{ of Homes w/Measure} \times \% \text{ of Measures Not Attributed to NYSEDA Programs}$$

If the builder interprets the insulation standard as something lower than a certified NYESH home, then they are likely to overstate the percentage of their homes with high performance insulation (essentially anything other than batt fiberglass). If other inputs are unbiased, this issue alone would result in an overstatement (rather than understatement) of the non-participant spillover.

However, if the standard (as interpreted by the builder) is lower, they may also attribute less influence to the Program. This would have the opposite effect and possibly mitigate some of the upward bias. Even if the builders report in a higher percent of homes with high performance insulation systems and lower attribution to the program, the key input of the percent of homes with the measure and attributed to the program may be quite similar.

Thus, it does not seem that misinterpretation of the definition of the insulation and air sealing measure would create a clear and substantial downward bias. Both the participating and non-participating builder surveys reported that the high performance insulation systems would have been installed in most homes even in the absence of energy efficiency programs, which seem to support the measure-level approach. In contrast, the whole building analysis could be biased upward since it is premised on the assumption that the non-program homes attributed to the program have the same mix of measures and average household savings as program homes.

The measure-level estimate of 25% non-participant spillover for never-participating and formerly-participating builders seems to be the most reliable given the additional information brought to the analysis through the measure-level approach and the clear indication from the builder surveys that SO homes achieve only a fraction of the savings found in program homes.

4.2.5 Overall Spillover

Aggregating the spillover rates provides a Program spillover rate of 28%, comprised of 0.03% homeowner inside spillover, 1.0% participating builder outside spillover, 1.3% a formerly-participating builder spillover and 26% never-participated builder spillover, as shown in Table 4-16.

Results

Table 4-16. Overall Spillover Estimate

Type of Spillover	Spillover Rate
Homeowner Inside Spillover (ISO)	0.3%
Participating Builder Outside Spillover (OSO)	1.0%
Formerly-participating Builder (Non-participant) Spillover (NPSO)	1.3%
Never-participated Builder Spillover (NPSO)	26%
Total Spillover	28%

4.2.6 Final Results

The free ridership rate (FR) and spillover rate (SO) are combined to produce a net-to-gross ratio (NTGR) that is applied to evaluation-estimated gross savings to produce net savings.

Net-to-Gross Ratio (NTGR) = $1 - FR + ISO + OSO + NPSO$ (formerly-participating) + NPSO (never participated)

The net-to-gross ratio from this evaluation was calculated as follows:

$$NTGR = 1 - 0.64 + 0.003 + 0.010 + 0.013 + 0.26 = 0.65$$

The complexity of the net-to-gross calculations makes it difficult to calculate the sampling precision. However, the reliability for attribution relies more on construct validity than on sampling precision. The alternative of what would have occurred cannot be known with certainty and survey inquiry can be complicated in that it asks about conjecture of a theoretical alternative. While the net-to-gross ratio is presented as a point value, it must be acknowledged that the various approaches to estimating the net-to-gross factors may produce substantially different values, as was illustrated in this evaluation with the non-participating builder spillover. In this case, the preponderance of evidence supports the use of the measure-level non-participant spillover.

The results of the net-to-gross analysis indicate that free ridership was higher than expected and spillover was in the same range as the previous evaluation. The current estimates of 64% free ridership and 28% spillover result in an overall net-to-gross ratio of 65%, which is lower than the previous value of 117%. Some of the differences are discussed in more detail below.

- In the previous market characterization and market assessment (MCAC) evaluation completed in 2006¹³, the free ridership was found to be 30%, which is substantially lower than the current value of 64%. The evaluators noted in the 2006 MCAC report that larger builders had a lower free rider rate, which they suggested may be related to the prevalence of “spec” home building among large builders. In contrast, the participating builder surveys for the current evaluation indicate that the free rider rate is higher among larger builders and 85% of the non-government housing stock was built as custom rather than spec homes.
- The 2006 evaluation found spillover rates of one percent each for homeowner and builder inside spillover, and 18% each for non-participant spillover from formerly-participating builders and who never participated, for a total spillover rate of 38%. In comparison, the major difference in the current evaluation is that the non-participant spillover from formerly-participating builders was found to be much smaller, at one percent as opposed to 18%, driving the spillover rate down to 26%.

¹³ “New York Energy Star® Labeled Homes Program Market Characterization, Market Assessment, And Causality Evaluation, Final Report”, Prepared for NYSERDA by Quantec LLC & Summit Blue Consulting, LLC, May 2006.

A key input into the calculation of the non-participant spillover is the number of new home starts. From the previous NYESH impact evaluation in 2005 to the current evaluation of program years 2007 and 2008, the number of new home starts dropped from about 62,000 to 20,800 per year for 2007 and 2008 on average, a reduction of almost two-thirds. While the precipitous decrease in residential new construction activity is due to the economic downturn and completely unrelated to NYESH Program activity, it substantially reduced the potential for non-participant spillover as estimated in this evaluation. As the housing market rebounds, future estimates of non-participant spillover may be higher than found in this evaluation.

The major shift in the residential new construction market during 2007 and 2008 may have had serious repercussions for the net-to-gross components of the NYESH Program. All net-to-gross components are derived as rates and these rates are added or subtracted to calculate the final net-to-gross ratio. Thus, the large reduction in new home starts substantially reduces the numerator in the measurement of the non-participant spillover rate. Program participation in general is also affected by the level of activity in the overall residential new construction market as much as by program marketing and promotion. Given the move toward custom homes and the decrease in the number of new home starts, it is possible that builders had to adjust their approach to meet market demands for higher quality and efficiency.

4.3 EVALUATED NET SAVINGS

Using the evaluated gross savings and this net-to-gross ratio provides the evaluated net savings. With this net-to-gross ratio the evaluated net annual electric savings are 4,164,447 kWh per year. The annual evaluated net savings for non-electric savings are 160,183 MMBtu per year. The components of these estimates and the final estimate are displayed in Table 4-17. The net-to-gross factor is presented in two ways: first, with all builders included and second, with the government housing removed. This approach was taken as the survey responses from the builder of the government housing had a large influence on the free rider rate (moving it from 56% to 64%). The final net evaluated savings are estimated with the higher free rider rate, as that best represents program activity during program years 2007 and 2008.

Table 4-17. Summary of Evaluated and Program Reported Savings

	Annual Electric Savings (kWh/Year)	Annual Non-Electric Savings (MMBtu/Year)
NYSERDA Program Reported Savings	7,964,862	283,260
Realization Rate ¹	80%	87%
Evaluated Gross Savings ²	6,406,841	246,436
Net-to-Gross Factor (All Homes)	65%	65%
Evaluated Net Savings	4,416,447	160,183
Net-to-Gross Factor (excluding government housing)	72%	72%

¹ The 90% confidence interval on realization rates for kWh and MMBtu savings are ±1.3% and ±2.2%, respectively.

² The lower and upper 90% confidence limits for kWh Savings are 6,268,346 and 6,371,890, respectively. And the lower and upper 90% confidence limits for MMBtu savings are 243,037 and 249,269, respectively.

Section 5:

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The evaluated gross savings realization rates are 80% for electric and 87% for fossil fuel. The evaluated fossil fuel savings developed from detailed modeling of energy use for a sample of participating homes and are calibrated to actual billing use. The deemed values used to estimate the remaining electric measures were verified against the savings used in other northeast states and the per-home savings were also compared to average household electric use as determined from the billing records. The energy modeling for electric space and water heating was hindered by the low number of homes in the sample with these electric end-uses; however, these two measures represent a small proportion of the total program reported electric savings (7%). The sampling precision of the final evaluated gross savings estimates is quite low and the overall reliability of the evaluated gross savings results is high.

The net-to-gross estimates are uncertain due to the potential for bias created by the current environment in the residential new construction market. The complexity of the net-to-gross calculations makes it difficult to calculate the sampling precision. However, the reliability for attribution relies more on construct validity than on sampling precision. The alternative of what would have occurred cannot be known with certainty and survey inquiry can be complicated in that it asks about conjecture of a theoretical alternative. While the net-to-gross ratio is presented as a point value, it must be acknowledged that the various approaches to estimating the net-to-gross factors may produce substantially different values.

The results of the net-to-gross analysis indicate that free ridership is substantially higher than prior evaluation results. The current estimates of 64% free ridership and 27% spillover result in an overall net-to-gross of 0.63, which is much lower than the previous value of 1.17. In addition to the increase in free ridership, spillover from formerly-participating builders was also lower than found in 2006.

Free ridership is based on the builders' reports of the percentage of the homes with incentives that would have been NYESH certified or qualified for certification in the absence of the program. For free ridership, the measure-level response to the high performance insulation systems was very close to the free rider rate estimated for the program based on the percent of incentivized homes that would have met certification without the program. Thus, the results for this important program measure provide further support for the free ridership estimate.

A key input into the calculation of the spillover is the number of new home starts. From the previous NYESH impact evaluation in 2005 to the current evaluation of program years 2007 and 2008, the number of new home starts dropped from about 62,000 to 20,800 per year for 2007 and 2008 on average, a reduction of almost two-thirds. While the precipitous decrease in residential new construction activity is due to the economic downturn and completely unrelated to NYESH Program activity, it substantially reduced the potential for non-participant spillover as estimated in this evaluation. As the housing market rebounds, future estimates of non-participant spillover may be higher than found in this evaluation.

The major shift in the residential new construction market during 2007 and 2008 may have had serious repercussions for the net-to-gross components of the NYESH Program. All net-to-gross components are derived as rates and these rates are added or subtracted to calculate the final net-to-gross ratio. Thus, the large reduction in new home starts substantially reduces the numerator in the measurement of the non-participant spillover rate. Program participation in general is also affected by the level of activity in the overall residential new construction market as much as by program marketing and promotion. Given the move toward custom homes and the decrease in the number of new home starts, it is possible that builders had to adjust their approach to meet market demands for higher quality and efficiency.

Conclusions and Recommendations

The final results from the evaluation are summarized in Table 5-1. The net-to-gross factor is presented in two ways: first, with all builders included and second, with the government housing removed. This approach was taken as the survey responses from the builder of the government housing had a large influence on the free rider rate (moving it from 56% to 64%). The final net evaluated savings are estimated with the higher free rider rate, as that best represents program activity during program years 2007 and 2008.

Table 5-1. Summary of Evaluated and Reported Savings

	Annual Electric Savings (kWh/Year)	Annual Non-Electric Savings (MMBtu/Year)
NYSERDA Program Reported Gross Savings	7,964,862	283,260
Realization Rate ¹	80%	87%
Evaluated Gross Savings ²	6,406,841	246,436
Net-to-Gross Factor	65%	65%
Evaluated Net Savings	4,164,447	160,183
Net-to-Gross Factor (excluding government housing freeridership rate)	72%	72%

¹ The 90% confidence interval on realization rates for kWh and MMBtu savings are $\pm 1.3\%$ and $\pm 2.2\%$, respectively.

² The lower and upper 90% confidence limits for kWh Savings are 6,268,346 and 6,371,890, respectively. And the lower and upper 90% confidence limits for MMBtu savings are 243,037 and 249,269, respectively.

5.2 PROGRAM AND EVALUATION RECOMMENDATIONS

The results of this evaluation suggest that substantial changes have occurred in the residential new construction market and the Program may need to make some adjustments to respond to these changes. Recommendations are divided into program and evaluation issues.

5.2.1 Program Recommendations

- Establish program threshold requirements to account for changing energy codes; the Impact Evaluation Team understands that NYSERDA has already moved to ENERGY STAR v2.5 and 3.0 and added prescriptive requirements. While “raising the bar” may result in a reduction in program participation, incremental savings per home can be expected to increase when thresholds are designed to ensure a certain percent (%) savings over the to-be-identified baseline home. The expected decrease in participation may be offset by a reduction in free riders, given that the bottom has also risen (adoption of more stringent energy codes).
- Review the method used for estimating savings from heating, water heating, and cooling measures. It appears that the current method does not correctly account for baselines that vary by climate zone and also understates heating savings while dramatically overstating water heating savings. An alternative approach used in other states is to develop a user-defined reference home (UDRH) reflecting baseline practices and estimate savings from the REM/Rate results.
- Consider the establishment of a separate development track for projects that are required to meet higher baseline standards. Some developers may be working under mandates to build toward certain level of efficiency (e.g. EPA ENERGY STAR) to comply with federal directives or satisfy funding requirements set by certain lenders and/or government agencies (e.g. HUD, NY state-housing agencies). This separate track may utilize a baseline (UDRH) that is different than the

UDRH used for a more traditional projects. This track may also have different program incentive structure that encourages certain end uses or certain savings goals over the baseline for this track.

- Consider whether changes need to be made to the process for installing screw-in CFLs as a program measure. The responses to the homeowner telephone survey indicated that hardwired ENERGY STAR light fixtures installed during construction remained in place.¹ However, over a third of the homeowners with reported program savings for screw-in CFLs stated that there were no screw-in CFL bulbs in the home when they moved in.² All of these respondents were the original owners of the new home. This may imply that the screw-in CFLs were removed prior to the homeowners' residency in the new homes.
- Establish one method of tracking and recording those deemed savings that overlap with energy-modeled savings (e.g. ECM motors, central air conditioning, refrigerators and lighting). This can be addressed from within the developed UDRH.
- Review all program databases to ensure the program data is obtained and maintained in a way that allows for accurate evaluations, including reliable contact information to the extent possible, ways to link builders with projects, former builders and contact information for all projects. The Program should maintain a database of the REM/Rate results or develop a systematic procedure for obtaining these datasets easily or develop a procedure to obtain requested REM/Rate results and all related program data.

5.2.2 Evaluation Recommendations

- Conduct a baseline study to establish a defensible standard for establishing program savings. The lack of an independent, comprehensive baseline study added substantial complexity to this evaluation. The baseline study should take into account that building practices vary by region and climate zone. This baseline study should also acknowledge the need for different baselines for different program tracks.
- Consider alternative strategies for estimating net and market effects. The self-report approach used in this evaluation suggests that market transformation may already be well underway. However, the results could also be confounded by the upheaval in the residential new construction market since 2008. Future studies could be designed to assess the accuracy of the builder self-report surveys and to further investigate market effects. The process may include reviewing and conducting an on-site survey of a sample of homes constructed by selected builders.
- Improve methods for transferring required program data to evaluators. For this evaluation, the Impact Evaluation Team ran into hurdles with acquiring program data, including obtaining contact information for formerly-participating contractors and having to download REM/Rate files for the telephone survey respondents individually from the implementer's website. These difficulties in obtaining program records are time-consuming and increase the cost of the evaluation.
- Homeowner inside spillover from the NYESH Program was found to be 0.32% in this impact evaluation. The prior evaluation found homeowner inside spillover to be 1%. This very low level of inside spillover is not surprising as these homeowners have just moved into a new home, leaving few opportunities and possibly less capital available for investing in further efficiency

¹ Most hardwired ENERGY STAR labeled light fixtures (not plug in lamps) require the use of a pin-based compact fluorescent light bulbs (CFL) so that the fixture cannot be outfitted with an incandescent light bulb which has a screw-base.

² Screw-in CFLs can be installed in any light fixture or lamp that accepts standard incandescent bulbs as long as it is compatible with the lighting control (i.e. dimmer switches).

Conclusions and Recommendations

upgrades. It is not anticipated that homeowner inside spillover will increase significantly in the future. Thus, it may not be worthwhile continue to include estimation of homeowner inside spillover in future impact evaluations, unless the homeowner surveys are conducted for other evaluation purposes.

NYSERDA 2007-2008 NEW YORK ENERGY STAR[®] Homes Program Impact Evaluation Report Appendices

FINAL

Prepared for
**The New York State
Energy Research and Development Authority**

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NYSERDA
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SCREENING SURVEY INSTRUMENT

New York ENERGY STAR[®] Homes: Homeowners Screening Survey

CONTACT INFORMATION SHEET

Respondent Name:	
Address:	
City/State/ZIP:	
Phone:	
CustomerID:	
Builder:	
Interview Date:	
Interviewer Initials:	

New York ENERGY STAR[®] Homes: Homeowners Screening Survey

IF A NAME IS PROVIDED, ASK TO SPEAK WITH NAMED SAMPLE MEMBER. OTHERWISE, ASK TO SPEAK TO AN ADULT (IF NECESSARY). WHEN PERSON COMES TO THE PHONE OR IF PERSON ANSWERING PHONE ASKS WHAT THIS IS ABOUT, READ:

Hello my name is _____ and I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. Your name is on our list of people who have recently (within the past three years) moved into new home built with the assistance of the New York ENERGY STAR Homes Program. We're calling today to ask you to participate in a study of this program to help us evaluate how the program might serve people better. We sent you a letter recently telling you that we would be calling and explaining the research we are conducting.

Q1. Do you remember receiving the letter?

1. YES
2. NO
- 96 REFUSED
- 97 DON'T KNOW

[IF YES, RECALLED LETTER]: Good. As the letter states, we're calling to see if you are interested in participating in our study of New York ENERGY STAR homes. You may be eligible for up to \$150 in incentives if you are selected to participate. Your participation in this study may involve three parts and incentives will be provided at each step:

[READ EACH NUMBER ALOUD]

- 1) **Electricity and Heating Fuel data review** (from your gas and electric utility companies). Your consent is needed in order to review your electric and gas usage data from the electric and gas companies. A **\$25** incentive will be mailed to you upon receipt of your signed consent form;
- 2) A **telephone survey**. This survey is expected to take less than 30 minutes. If you are selected for the telephone survey, another **\$25** incentive will be mailed upon completion of the telephone survey; and
- 3) An **in-home analysis** of the energy features of your home. A qualified home energy analyst will visit your home and perform a thorough review of the energy features of your home (e.g., insulation, windows, heating system, etc) including diagnostic testing to determine the level of heat loss through air-leakage. This process **may** take up to three hours but could likely finish in less time. If you are selected for the in-home analysis, you will be supplied with a **\$100** incentive when our analyst completes the review of your home.

[CONTINUE TO QUESTION Q2.]

[IF NO, DID NOT RECALL LETTER]: No problem. I will have letter re-sent to you so that you will have it your records **[RECITE MAILING ADDRESS AND OFFER TO EMAIL IF THEY WOULD PREFER]**. In the meantime, the letter is to inform you of the study and let you know that we might be calling to see if you were interested in participating in this important evaluation of newly constructed ENERGY STAR Homes. Your participation in this study may involve three parts and incentives will be provided for each step.

- 1) **Electricity and Heating Fuel data review** (from your gas and electric utility companies). Your consent is needed in order to review your electric and gas usage data from the electric and gas companies. A **\$25** incentive will be mailed to you upon receipt of your signed consent form;
- 2) A **telephone survey**. This survey is expected to take less than 30 minutes. If you are selected for the telephone survey, another **\$25** incentive will be mailed upon completion of the telephone survey; and
- 3) An **in-home analysis** of the energy features of your home. A qualified home energy analyst will visit your home and perform a thorough review of the energy features of your home including diagnostic testing to determine the level of heat loss through air-leakage. This process **may** take up to three hours but could likely finish in less time. If you are selected for the in-home analysis, you will be supplied with a **\$100** incentive when our analyst completes the review of your home.

[CONTINUE TO QUESTION Q2.]

[IF NECESSARY:] The New York ENERGY STAR Homes program provides assistance to builders and future owners of new homes to construct homes that are at least 20% more energy efficient than homes that are built only to minimum energy code levels.

Q2. Are you the appropriate person that can answer questions regarding the construction and efficiency of the home and agree to participate in our study?

1. YES – **[CONTINUE TO Q3]**
2. NO – **NEW RESPONDENT COMING TO PHONE [REINTRODUCE YOURSELF]**
3. NO – **RESPONDENT NOT AVAILABLE [SCHEDULE CALLBACK]**
- 96 **REFUSED [THANK AND TERMINATE]**
- 97 **DON'T KNOW [THANK AND TERMINATE]**

[ONCE CORRECT PERSON IS ON THE LINE, REINTRODUCE AND CONTINUE.]

Screening Survey Instrument

Our records show that the home located at [ADDRESS] in [TOWN] was built to New York ENERGY STAR Homes specifications by [BUILDER] in [YEAR].

Q3. Was your home built...

1. Between the beginning of 2006 and before the end of 2008 **CONTINUE WITH RESPONDENT**
 2. Home was built prior to 2006 or after 2008 – [THANK AND TERMINATE]
- 96 REFUSED [THANK AND TERMINATE]
-97 DON'T KNOW

Q4. I would also like to confirm your address as follows: [READ PROPERTY ADDRESS]

1. YES – [CONTINUE TO Q5]
2. NO – [OBTAIN CORRECTED ADDRESS, IF NEW ADDRESS IS NOT IN OUR DATABASE, THANK AND TERMINATE]

[READ TO ALL]

You were selected as part of a carefully designed sample and your feedback about your experience with this program is very important to future planning for energy efficiency programs in the State. Your responses to this survey will be kept confidential.

Q5. Are you willing to participate in this study?

1. YES [CONTINUE]
 2. NO [THANK AND TERMINATE]
- 96 REFUSED [THANK AND TERMINATE]
-97 DON'T KNOW

Thank you. We greatly appreciate your assistance in this study. I have a few questions right now that should take no more than five minutes of your time.

[SCHEDULE TIME TO CALL BACK AS REQUESTED]: (DATE) _____ (TIME) _____

(PHONE NUMBER, IF DIFFERENT): _____

[READ TO ALL]

In order to obtain data from the utilities to aid our program evaluation, NYSERDA and the utility companies need your consent to release your energy usage data. Again, this information will only be used to perform an evaluation of the New York ENERGY STAR Homes Program. All of the information about your home will be kept confidential.

- Q6. Will you agree to allow **[ELEC UTILITY]** and **[GAS UTILITY]** to release your electric and gas usage data?
1. YES **[CONTINUE]**
 2. NO **[THANK AND TERMINATE]**
 - 96 REFUSED **[THANK AND TERMINATE]**
 - 97 DON'T KNOW **[CONTINUE]**

Thank you.

- Q7. Are you willing to participate in the telephone survey?
1. YES **[CONTINUE]**
 2. NO **[THANK AND TERMINATE]**
 - 96 REFUSED **[THANK AND TERMINATE]**
 - 97 DON'T KNOW **[THANK AND TERMINATE]**

[IF Q7=2, 96,97: Thank you for your time and there is no need for you to return the data-consent form.]

[IF NECESSARY: The telephone survey will be conducted in January or February and will not take more than 30 minutes.]

- Q8. What is the best phone number and time of day to reach you for the purposes of conducting the survey?

_____ **[PHONE NUMBER IF DIFFERENT THAN ONE BEING USED FOR THIS CALL]**
_____ **[TIME OF DAY]**

- Q9. Are you willing to be available for the in-home energy analysis?
1. YES **[CONTINUE]**
 2. NO **[THANK AND CONTINUE]**
 - 96 REFUSED **[THANK AND CONTINUE]**
 - 97 DON'T KNOW **[THANK AND CONTINUE]**

[IF NECESSARY]: The in-home analysis involves conducting a comprehensive energy rating of your home a no cost. This is similar to the energy rating that was conducted at the time construction was completed. The inspection of your home may take up to three hours and will not require any special preparation on your part. The in-home analysis will be scheduled in January or February.

Thank you so much for being willing to participate in our evaluation.

Screening Survey Instrument

Again, the data-release form for the utility data was included with the letter that was sent. Once we receive your signed data-release form, we will send out a \$25 incentive check.

Q10. Do you still have the form?

1. YES [CONTINUE]
2. NO [THANK AND RESEND DATA-RELEASE FORM]
- 97 DON'T KNOW [CONTINUE]

[IF Q10=1: If possible, have the homeowner find the form and fill it out while on the phone.]

[IF Q10=2: I will send out the utility data release form for you to sign and return.]

[READ TO ALL]

Okay, so to quickly review the process...

At this time we are requesting your consent to review your utility billing data and the \$25 incentive will be mailed to you when your consent form is received. The electric and gas utilities will not release power and fuel usage data without your consent. Please return your consent form within two weeks. By returning your utility-data release form you **may** be randomly selected to participate in the telephone survey. If you are selected for the phone survey, \$25 will be mailed to you upon completion of the survey.

[IF AGREED TO PARTICIPATE IN THE IN-HOME ANALYSIS] After completing the phone survey you **may** then be randomly selected to participate in the in-home analysis and upon completion of the site visit you will receive \$100 on the spot. The telephone survey and in-home analysis are being scheduled for January and February.

Thank you again for your assistance with this study and we look forward to working with you.

If you have any questions in the meantime please feel free to call Carley Murray, New York State Energy Research and Development Authority (NYSERDA) at 518.862.1090 ext 3277.

HOMEOWNER SURVEY INSTRUMENT

**NYSERDA ENERGY STAR[®] Homes Program (NYESH)
Impact Evaluation 2010/2011
Participating Homeowners Survey**

Final Field Version

IF A NAME IS PROVIDED, ASK TO SPEAK WITH NAMED SAMPLE MEMBER. [NAME FROM SCREENER SURVEY].

OTHERWISE, ASK TO SPEAK TO AN ADULT (IF NECESSARY).

WHEN PERSON COMES TO THE PHONE OR IF PERSON ANSWERING PHONE ASKS WHAT THIS IS ABOUT, READ:

My name is _____ and I'm calling from Braun Research on behalf of the New York State Energy Research and Development Authority or NYSERDA. You recently submitted a utility billing data release form and agreed to participate in NYSERDA's study of ENERGY STAR homeowners. I'm calling today with a follow up telephone survey regarding your home's energy features. This survey should take about 20 minutes.

In appreciation for your time, we are offering a \$25 incentive payment for the completion of this survey.

[IF NECESSARY:] You were randomly selected as part of a carefully designed sample and your feedback about this program is very important to future planning for energy efficiency programs in the State. Your responses to this survey will be kept confidential to the extent permitted by law.

SCREENING [ASK SCR1 AND SCR2 IF THE RESPONDENT DID NOT COMPLETE THE INITIAL SCREENING SURVEY (COMPLETED SCREENER VARIABLE =2.) OTHERWISE, GO TO HO1.

Our records show that the home located at [ADDRESS] in [CITY] was built as an ENERGY STAR-home by [BUILDER_NA] in [YEAR].

SCR1. Was your home built...

1. Between the beginning of 2006 and before the end of 2008 CONTINUE WITH RESPONDENT
2. Home was built prior to 2006 or after 2008 – [THANK AND TERMINATE]
- 96 REFUSED [THANK AND TERMINATE]
- 97 DON'T KNOW

SCR2. I would also like to confirm your address as follows: [READ ADDRESS]

1. YES – [CONTINUE TO HO1]
2. NO – [OBTAIN CORRECTED ADDRESS, THANK AND TERMINATE]

Homeowner Survey Instrument

HOME OWNERSHIP

HO1. Do you own or rent this residence?

- 1. OWN
- 2. RENT [**GO TO HO3**]
- 96 REFUSED
- 97 DON'T KNOW

HO2. Are you the original owner of the home?

- 1. YES [**GO TO HO4a**]
- 2. NO [**GO TO HO4a**]
- 96 REFUSED [**GO TO HO4a**]
- 97 DON'T KNOW [**GO TO HO4a**]

HO3. Were you the first to rent the apartment or home when it was built?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

HO4a. When did you move into the home?

Month: _____

- 1. JANUARY
- 2. FEBRUARY
- 3. MARCH
- 4. APRIL
- 5. MAY
- 6. JUNE
- 7. JULY
- 8. AUGUST
- 9. SEPTEMBER
- 10. OCTOBER
- 11. NOVEMBER
- 12. DECEMBER

- 96. REFUSED
- 97. DON'T KNOW

Year: _____

1. 2006
2. 2007
3. 2008
4. 2009
5. 2010
6. 2011

-96 REFUSED

-97 DON'T KNOW

[ASK HO4b IF HO4a = 96 OR 97. OTHERWISE, SKIP TO HO5a.]

HO4b. Our records show that the home was occupied in [MONTH, YEAR]. Is this correct?

1. YES [GO TO HO5a]

2. NO

-96 REFUSED [GO TO HO5a]

-97 DON'T KNOW [GO TO HO5a]

HO4c. Did you move into your home before or after [MONTH, YEAR]?

1. BEFORE

2. AFTER

-96 REFUSED

-97 DON'T KNOW

HO5a. Is your home occupied throughout the year?

1. YES [GO TO HO6]

2. NO

-96 REFUSED [GO TO HO6]

-97 DON'T KNOW [GO TO HO6]

HO5b. How many weeks is your home occupied during the winter months of November through March?

-96 REFUSED

-97 DON'T KNOW

HO5c. How many weeks is your home occupied during the summer months of June through August?

-96 REFUSED

-97 DON'T KNOW

Homeowner Survey Instrument

HO6. Do you or members of your household operate a business out of your home or work from home?

1. YES
2. NO [GO TO NEXT SECTION]
- 96 REFUSED [GO TO NEXT SECTION]
- 97 DON'T KNOW [GO TO NEXT SECTION]

HO7. What type of business is run from your home?

-
- 96 REFUSED
 - 97 DON'T KNOW

HO8. Does this business require any energy-intensive equipment? **[IF NECESSARY:]** I am asking about equipment that is not found in typical homes. For example, copiers, electric dryers, air compressors, commercial cooking refrigerators or freezers, kilns, or other special tools appliances associated with your home-based business. Please do not include lights and computers.

1. YES
2. NO [GO TO NEXT SECTION]
- 96 REFUSED [GO TO NEXT SECTION]
- 97 DON'T KNOW [GO TO NEXT SECTION]

HO9. What type of energy-intensive equipment does the business require?

-
- 96 REFUSED
 - 97 DON'T KNOW

AWARENESS AND AVAILABILITY

AW1. Before receiving the introductory letter sent by NYSERDA in December, had you ever seen or heard of the ENERGY STAR label? **[IF NECESSARY:]** The introductory letter was sent by NYSERDA prior to the initial call to explain the survey. **[IF FURTHER REMINDER IS NECESSARY:]** During the initial call, you were asked to participate in this survey and you received a \$25 incentive for sending in your utility account information.

1. YES [GO TO AW3]
2. NO
- 96 REFUSED
- 97 DON'T KNOW

- AW2. The ENERGY STAR label has the word “energy” followed by a five-pointed star under a dome or half-circle. Some labels also show the continents and the oceans of the earth in a half circle. ENERGY STAR labels are used by the Environmental Protection Agency (EPA) and the Department of Energy to identify and label highly energy-efficient appliances for consumers. They may appear on some appliances and other products; retail stores may also post them at entrances and other locations; they may also appear on the yellow Energy Guide label. Before receiving the introductory letter from NYSERDA in December, had you ever seen or heard of such a label?
1. YES
 2. NO
 - 96 REFUSED
 - 97 DON’T KNOW
- AW3. Before receiving the introductory letter sent by NYSERDA in December, had you ever seen or heard of the ENERGY STAR label for new homes?
1. YES
 2. NO [GO TO NEXT SECTION]
 - 96 REFUSED [GO TO NEXT SECTION]
 - 97 DON’T KNOW [GO TO NEXT SECTION]
- AW4. To the best of your knowledge, is your home a New York ENERGY STAR home?
1. YES
 2. NO [GO TO NEXT SECTION]
 - 96 REFUSED [GO TO NEXT SECTION]
 - 97 DON’T KNOW [GO TO NEXT SECTION]
- AW5. Before receiving the introductory letter in December, did you know that your home was a New York ENERGY STAR home?
1. YES
 2. NO [GO TO NEXT SECTION]
 - 96 REFUSED [GO TO NEXT SECTION]
 - 97 DON’T KNOW [GO TO NEXT SECTION]
- AW6. Which of the following best describes when you become aware of the New York ENERGY STAR Homes Program? [READ LIST, RECORD ONE RESPONSE]
1. Before starting the home search,
 2. The realtor or sales agent brought it up, or
 3. The builder brought it up? [GO TO AW8]
 4. OTHER (specify: _____)
 - 96 REFUSED [GO TO NEXT SECTION]
 - 97 DON’T KNOW [GO TO NEXT SECTION]

Homeowner Survey Instrument

[IF HO1=1 AND HO2=1, THEN ASK AW7.]

AW7. Did the builder mention, as a selling point, that this home was a New York ENERGY STAR home?

1. YES
2. NO
3. NOT APPLICABLE, NO INTERACTION WITH THE BUILDER
- 96 REFUSED
- 97 DON'T KNOW

[IF AW6 <> 2, THEN ASK AW8.]

AW8. Did the sales agent or realtor bring up, as a selling point, that this home was a New York ENERGY STAR home?

1. YES
2. NO
3. NOT APPLICABLE, NO INTERACTION WITH A REALTOR
- 96 REFUSED
- 97 DON'T KNOW

AW9. How important a factor was the New York ENERGY STAR home label in your decision to buy or rent this particular home rather than another home? Would you say it was...? **[READ LIST, RECORD ONE RESPONSE]**

5. Very important
4. Somewhat important
3. Neither important nor unimportant
2. Somewhat unimportant
1. Not at all important
- 96 DON'T KNOW
- 97 REFUSED

BUILDING INFORMATION

BI1a. Which of the following types of housing units would you say best describes your home? Is it a . . ?
[READ LIST, RECORD ONE RESPONSE]

1. Single-family home **[GO TO BI2a]**,
2. Duplex **[GO TO BI2a]**,
3. Townhouse **[GO TO BIb]**, or
4. Part of a building with three or more units? **[GO TO BI1c]**
5. OTHER (specify: _____) **[GO TO BI2a]**
- 96 REFUSED **[GO TO BI2a]**
- 97 DON'T KNOW **[GO TO BI2a]**

BI1b. Is the home an end unit or a middle unit within the building? ~~Is it?~~ **[READ LIST, RECORD ONE RESPONSE]**

1. AN END UNIT **[GO TO BI2a]**
2. A MIDDLE UNIT **[GO TO BI2a]**
- 96 REFUSED **[GO TO BI2a]**
- 97 DON'T KNOW **[GO TO BI2a]**

BI1c. Where is your home located in the building? Is it? **[READ LIST, RECORD ONE RESPONSE]**

1. A top level home with a unit downstairs,
2. A middle level home with other units downstairs and upstairs, or
3. A bottom level home with a unit upstairs
4. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

[IF THE PROGRAM DATA HAS THE SQUARE FOOTAGE OF THE HOME, CONTINUE WITH BI12a. IF THE PROGRAM DATA HAS A BLANK OR "OTHER" FOR THE SQUARE FOOTAGE, PROCEED TO QUESTION BI2b.]

BI2a. Our records show that your home has approximately [HEATED SQUARE FEET] square feet of heated space. Is this correct?

1. YES **[GO TO BI3]**
2. NO
- 96 REFUSED **[GO TO BI3]**
- 97 DON'T KNOW **[GO TO BI3]**

Homeowner Survey Instrument

BI2b. Approximately how many square feet of heated space do you have in your home, not including the garage? Is it? **[READ LIST, RECORD ONE RESPONSE]**

1. Less than 1,000 square feet
2. Between 1000 and just under 1,500 square feet
3. Between 1,500 and just under 2,000 square feet
4. Between 2,000 and just under 2,500 square feet
5. Between 2,500 and just under 3,000 square feet
6. Between 3000 and 3,500 square feet, or
7. Over 3,500 square feet

-96 REFUSED

-97 DON'T KNOW

BI3. What type of foundation does your home have? Is it? **[READ LIST, RECORD ONE RESPONSE]**

1. a full basement below ground level **[IF NECESSARY:]** Basement is completely below ground level,
2. a walk-out basement **[IF NECESSARY:]** Some of the foundation walls are below ground level but some wall areas are above grade,
3. an enclosed crawlspace **[IF NECESSARY:]** Home is constructed over a crawl space that is completely enclosed on all sides,
4. an open crawlspace **[IF NECESSARY:]** Home is built on piers, or
5. Slab-on-grade **[IF NECESSARY:]** No basement - the home's lowest level floor is built right on ground level.
6. OTHER (specify: _____)

-96 REFUSED

-97 DON'T KNOW

BI4. Does your home have a heated basement? **[IF NECESSARY:]** Does your basement have heat registers, radiators or another heating source such as a woodstove?

1. YES
2. NO

-96 REFUSED

-97 DON'T KNOW

BI5a. Does the home have an attached garage? **[IF NECESSARY:]** This includes any garage area that is either connected to the house with a common wall or underneath the home.

1. YES
 2. NO **[GO TO BI6a]**
- 96 REFUSED **[GO TO BI6a]**
- 97 DON'T KNOW **[GO TO BI6a]**

BI5b. Is your attached garage heated?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

BI6a. Does your home have a detached garage or other building that uses the same electric **[EMPHASIZE ELECTRIC]** meter as the house?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

BI6b. Does your home have a heated detached garage or other building that uses the same gas meter **[EMPHASIZE GAS]** as the house?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

MECHANICAL EQUIPMENT

[IF THE PROGRAM DATA HAS THE HEATING FUEL TYPE, CONTINUE WITH ME1a. IF THE PROGRAM DATA HAS A BLANK OR "OTHER" FOR THE HEATING FUEL TYPE, PROCEED TO QUESTION ME1b.]

ME1a. Our records show that the home is heated with [HEATING FUEL]. Is this correct?

- 1. YES **[GO TO ME2a.]**
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

Homeowner Survey Instrument

ME1b. What is your primary heating fuel? Is it? **[READ LIST, RECORD ONE RESPONSE]**

1. Fuel Oil
2. Natural Gas (not Propane)
3. Propane (bottled LP gas)
4. Electric
5. Wood
6. Wood pellets, or
7. Coal
8. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

[IF THE PROGRAM DATA HAS THE HEATING SYSTEM TYPE, CONTINUE WITH ME2a. IF THE PROGRAM DATA HAS A BLANK OR "OTHER" FOR THE HEATING SYSTEM TYPE, PROCEED TO QUESTION ME2b.]

ME2a. Our records indicate that your heating system is a [HEATING SYSTEM TYPE], meaning that [INSERT DESCRIPTION BELOW FOR APPROPRIATE EQUIPMENT TYPE]. Is this correct?

1. YES **[GO TO ME3.]**
2. NO **[GO TO ME2b.]**
- 96 REFUSED **[GO TO ME3.]**
- 97 DON'T KNOW **[GO TO ME3.]**

[FURNACE:] Your house is heated by forced hot air through registers in the floor, walls or ceiling.

[BOILER:] Your house is heated by hot water circulated through baseboard radiators or through radiant floors or ceiling heat.

[ELECTRIC RESISTANCE:] Your house is heated with electric baseboard radiators.

[GEOTHERMAL HEAT PUMP AND AIR-SOURCE HEAT PUMP: NO ADDITIONAL DESCRIPTION NEEDED.]

ME2b. What is your primary heating system? Is it a **[READ LIST, RECORD ONE RESPONSE]**

1. Furnace (forced-hot air), meaning your house is heated by forced hot air through registers in the floor, walls or ceiling,
2. Boiler (baseboard, forced-hot water), meaning your house is heated by hot water circulated through baseboards,
3. Boiler (radiant floors), meaning your house is heated by hot water circulated through radiant floors,
4. Electric resistance, meaning your house is heated with electric baseboards,
5. Geothermal heat pump,
6. Air-source heat pump, (mini-split)
7. Wood Stove,
8. Wood pellet stove,
9. Or Something else? (specify: _____)

-96 REFUSED

-97. DON'T KNOW

ME3. Does your home have supplemental heat? **[READ IF NECESSARY: Is your home equipped with an additional heating system, such as a woodstove, electric space-heaters, wood fireplace, or gas fireplace?]**

1. YES
2. NO **[GO TO ME6a]**
- 96 REFUSED **[GO TO ME6a]**
- 97 DON'T KNOW **[GO TO ME6a]**

ME4. What type of supplemental heat? **[READ LIST, RECORD ALL THAT APPLY]**

1. Woodstove
2. Wood pellet stove
3. Wood Fireplace
4. Gas Fireplace **[IF NECESSARY:]** Is your fireplace heated with natural gas?
5. Propane fireplace
6. Electric baseboard or electric plug-in heater, or
7. Kerosene space heater
8. OTHER, Please describe type and fuel: _____

-96 REFUSED

-97 DON'T KNOW

Homeowner Survey Instrument

ME5. Was the supplemental heat in place when the home was purchased?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

ME6a. Since moving into the home, have you or anyone in your household made any changes to your heating system?

- 1. YES
- 2. NO [GO TO ME7a]
- 96 REFUSED [GO TO ME7a]
- 97 DON'T KNOW [GO TO ME7a]

ME6b. Please describe the changes to your heating system. Did you... **[READ LIST, RECORD ALL THAT APPLY]**

- 1. Install a new furnace
- 2. Install a new boiler
- 3. Extend the distribution system to unheated areas, or
- 4. Add a supplemental heat source?
- 5. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

ME7a. Is your home equipped with programmable thermostats?

- 1. YES
- 2. NO [GO TO ME8.]
- 96 REFUSED [GO TO ME8.]
- 97 DON'T KNOW [GO TO ME8.]

ME7b. Were the programmable thermostats in place when your home was purchased or did you or another member of your household purchase and install them after moving into your home?

- 1. IN PLACE AT TIME OF PURCHASE
- 2. INSTALLED BY HOMEOWNER
- 96 REFUSED
- 97 DON'T KNOW

[ASK ME7c IF AW5=1 AND ME7B=2.]

ME7c. How important was your experience with living in a New York ENERGY STAR[®] home in your decision to install programmable thermostats? Would you say... **[READ LIST]**

5. Very important
4. Somewhat important
3. Neither important nor unimportant
2. Somewhat unimportant
1. Not at all important
- 96 REFUSED
- 97 DON'T KNOW

ME8. How do you control your primary heating system? Do you? **[READ LIST, RECORD ONE RESPONSE]**

1. Set the thermostat at one temperature and leave it
2. Manually adjust temperature as needed
3. Setback the temperature using programmable thermostats, or
4. Manually turn down the thermostat at night or when home is unoccupied
5. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

ME10. What type of cooling system do you have in your home? By cooling systems I mean, air conditioners and fans. Do you have? **[READ LIST; SELECT ALL THAT APPLY]**

1. Central air conditioning with ducts
2. Room or wall air conditioners
3. Whole-house fan
4. Room ceiling fans
5. Stand-alone fans, or
6. Nothing
7. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

[ASK IF ME10=1]

ME10a. Is your central air conditioning system ENERGY STAR?

1. YES
2. NO
- 96 REFUSED
- 97 DON'T KNOW

Homeowner Survey Instrument

[ASK IF ME10=1]

ME11. Which of the following best describes how your household controls the central air conditioning system? Do you? **[READ LIST, RECORD ONE RESPONSE]**

1. Set the thermostat at one temperature and leave it
 2. Manually turn down the thermostat when cooling is needed **[IF NECESSARY:]** Do you keep the thermostat at a higher temperature and only turn it down when you want to cool the home?
 3. Setback the temperature using programmable thermostats
 4. Manually adjust the thermostat to a higher temperature when home is unoccupied or no cooling is needed **[IF NECESSARY:]** Do you keep the thermostat at a lower setting and only turn it up when you do not need to cool the home?
 5. OTHER (specify: _____)
- 96 REFUSED
-97 DON'T KNOW

[ASK ME12 SERIES IF ME10=2]

ME12a. How many room or wall air conditioners are in your home? **[ALLOW ONLY NUMERIC RESPONSES]**

-
- 96 REFUSED
-97 DON'T KNOW

[ASK ME12b IF (AW1=1 OR AW2=1, AND ME10=2).]

ME12b. How many of your room or wall air conditioners are ENERGY STAR? **[ALLOW ONLY NUMERIC RESPONSES]**

-
- 96 REFUSED
-97 DON'T KNOW

[ASK IF ANY RESPONSES TO ME10<4]

ME13. Since you moved into your home, have you or another member of your household purchased any new cooling equipment? By cooling equipment, I mean central air conditioning, room air conditioners or whole house fan. I do not mean floor or ceiling fans. **[READ LIST; SELECT ALL THAT APPLY]**

- 1 Yes, central air conditioning
 - 2 Yes, room air conditioning
 - 3 Yes, whole-house fan **[GO TO NEXT SECTION]**
 - 4 NO **[GO TO NEXT SECTION]**
- 96 REFUSED **[GO TO NEXT SECTION]**
-97 DON'T KNOW **[GO TO NEXT SECTION]**

[IF ME13 = 2 AND ME12B > 0 AND (AW1=1 OR AW2=1), ASK ME14.]

ME14. How many of the new room or wall air conditioners are ENERGY STAR? [ALLOW ONLY NUMERIC RESPONSES]

-
- 96 REFUSED
 - 97 DON'T KNOW

[IF (AW1=1 OR AW2=1) AND AW5=1 AND ((ME13=1 AND ME10=1) OR (ME14 > 0)), ASK ME15.]

ME15. How important was your experience with living in a New York ENERGY STAR[®] homes in your decision to purchase an ENERGY STAR air conditioner? Would you say... [READ LIST]

- 5. Very important
- 4. Somewhat important
- 3. Neither important nor unimportant
- 2. Somewhat unimportant
- 1. Not at all important
- 94 THE PURCHASED AIR CONDITIONER WAS NOT ENERGY STAR
- 96 REFUSED
- 97 DON'T KNOW

VENTILATION SYSTEM

VS1. A mandatory requirement of the New York ENERGY STAR Homes program is that every home built with assistance from the program is equipped with an automated ventilation system to provide for good indoor-air quality. The system may consist of an exhaust fan with an automated timer switch or it may be a more advanced system sometimes called a heat recovery ventilation system (HRV) or an energy recovery system (ERV) [NOTE TO INTERVIEWER: SOME HOMEOWNERS MAY REFER TO THIS AS AN "AIR-TO-AIR HEAT EXCHANGER"]. Can you tell me if this system is still in place and working?

- 1. YES
- 2. NO [GO TO VS3.]
- 96 REFUSED [GO TO NEXT SECTION.]
- 97 DON'T KNOW [GO TO NEXT SECTION.]

Homeowner Survey Instrument

VS2. Does your ventilation system run on an automatic timer, is it controlled manually, or does it run continuously? **[READ LIST, RECORD ONE RESPONSE]**

1. AUTOMATIC TIMER **[GO TO VS4]**
2. CONTROLLED MANUALLY. **[GO TO VS4]**
3. RUNS CONTINUOUSLY. **[GO TO VS4]**
4. OTHER (Specify) **[GO TO VS4]**
- 96 REFUSED **[GO TO VS4]**
- 97 DON'T KNOW **[GO TO VS4]**

VS3. Why are you no longer using the ventilation system?

[GO TO NEXT SECTION]

- 96 REFUSED **[GO TO NEXT SECTION]**
- 97 DON'T KNOW **[GO TO NEXT SECTION]**

VS4. Were the ventilation controls modified since you moved into your home? Controls may include timers or delay switches.

1. Yes, we turned off the timer and now control the fan manually.
2. Yes, we modified the timer so the fan would run for a shorter period of time.
3. Yes, we modified the timer so the fan would run for a longer period of time.
4. No changes were made.
5. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

WATER HEATING

DHW1. What is your primary water heating fuel? Is it heated by **[READ LIST, RECORD ONE RESPONSE]**

1. Fuel Oil
2. Natural Gas (not Propane)
3. Propane (bottled LP gas)
4. Electric
5. Wood
6. Solar/Electric
7. Solar/Gas, or
8. Solar/Propane?
9. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

DHW2. What type of water heater do you have? Is it a ...? **[READ LIST, RECORD ONE RESPONSE] [IF RESPONDENT HAS A FURNACE (ME2b =1, OR (ME2a=YES AND RESPONDENT HAS FURNACE AS HEATING SYSTEM IN THE SAMPLE), DO NOT READ/ALLOW RESPONDENT TO CHOOSE OPTION 2 OR 3]**

1. Stand alone tank which is a completely separate water heating tank, not connected to the boiler or furnace
 2. Indirect-fired tank where the boiler that is used to heat the home also heats the water for domestic use and is stored in a tank,
 3. Tankless coil which is attached to or inside the boiler and the water is heated by the boiler
 4. On-demand (also referred to as instantaneous) which is a water heater that heats the water when someone turns on any of the hot water faucets. There is no storage tank.
 5. OTHER (specify: _____)
- 96 REFUSED
-97 DON'T KNOW

DHW3a. Since you moved into your home, have you made any changes to your water heater?

- 1 YES
 - 2 NO **[GO TO NEXT SECTION]**
- 96 REFUSED **[GO TO NEXT SECTION]**
-97 DON'T KNOW **[GO TO NEXT SECTION]**

DHW3b. Please describe the changes to your water heating system.

1. INSTALLED NEW WATER HEATER
 2. ADDED ANOTHER WATER HEATING DEVICE
 3. OTHER (specify: _____)
- 96 REFUSED
-97 DON'T KNOW

HOME MODIFICATIONS

HM1a. Have you made renovations to your home since you moved in? **[IF NECESSARY:]** Did you add any heated space to your home such as finished a room over a garage or in the basement, or do other major remodeling projects?

1. YES
 2. NO **[GO TO HM2a]**
- 96 REFUSED **[GO TO HM2a]**
-97 DON'T KNOW **[GO TO HM2a]**

Homeowner Survey Instrument

HM1b. What changes have you made? Have you. . .[**READ LIST, RECORD AS MANY AS APPLY**]

1. Finished the basement,
 2. Added heated space
 3. Remodeled heated space
 4. Finished space in garage, or
 5. Something else? (specify: _____)
- 96 REFUSED
-97 DON'T KNOW

HM2a. Have you added any insulation since you purchased the home?

1. YES
 2. NO [**GO TO NEXT SECTION**]
- 96 REFUSED [**GO TO NEXT SECTION**]
-97 DON'T KNOW [**GO TO NEXT SECTION**]

HM2b. Did you add insulation to the attic?

1. YES
 2. NO [**GO TO HM2d**]
- 96 REFUSED [**GO TO HM2d**]
-97 DON'T KNOW [**GO TO HM2d**]

HM2bx. What kind of insulation did you add? Was it . . .[**ACCEPT MULTIPLE RESPONSES**]

1. Fiberglass batts or blankets,
 2. Loose-fill or blown-in cellulose,
 3. Foam board insulation, or
 4. Spray foam insulation?
- 96 REFUSED
-97 DON'T KNOW

HM2c. Can you describe what was done?

1. YES, Please describe: _____
 2. NO
- 96 REFUSED
-97 DON'T KNOW

HM2d. Did you add insulation to the foundation or basement walls?

1. YES
 2. NO [**GO TO INSTRUCTIONS BEFORE HM2F**]
- 96 REFUSED [**GO TO INSTRUCTIONS BEFORE HM2F**]
-97 DON'T KNOW [**GO TO INSTRUCTIONS BEFORE HM2F**]

HM2dx. What kind of insulation did you add? Was it . . . [ACCEPT MULTIPLE RESPONSES]

1. Fiberglass batts or blankets
2. Loose-fill or blown-in cellulose
3. Foam board insulation, or
4. Spray foam insulation?
- 96 REFUSED
- 97 DON'T KNOW]

HM2e. Can you describe what was done?

1. YES, Please describe: _____
2. NO
- 96 REFUSED
- 97 DON'T KNOW

[ASK HM2f IF AW5=1 AND HM2a =1.]

HM2f. How important was your experience with living in a New York ENERGY STAR[®] home in your decision to add insulation to your home? Would you say... [READ LIST, RECORD ONE RESPONSE]

5. Very important
4. Somewhat important
3. Neither important nor unimportant
2. Somewhat unimportant
1. Not at all important
- 96 REFUSED
- 97 DON'T KNOW

APPLIANCES AND LIGHTING

AL1a. How many refrigerators are in your home? [ALLOW ONLY NUMERIC RESPONSES]

- _____
- 96 REFUSED
 - 97 DON'T KNOW

Homeowner Survey Instrument

AL1b. Was your primary refrigerator...? **[READ LIST, RECORD ONE RESPONSE]**

1. Provided with the new home
2. A new refrigerator purchased separately by you or another member of your household
3. Or a previously-owned refrigerator that was moved to your current home.
4. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

AL1c. Is your primary refrigerator an ENERGY STAR model?

1. YES
2. NO
- 96 REFUSED
- 97 DON'T KNOW

[ASK AL1d IF (AW1=1 OR AW2=1) AND AW5=1 AND AL1b=2 AND AL1c=1]

AL1d. How important was your experience with living in a New York ENERGY STAR® home in your decision to purchase an ENERGY STAR refrigerator? Would you say... **[READ LIST, RECORD ONE RESPONSE]**

5. Very important
4. Somewhat important
3. Neither important nor unimportant
2. Somewhat unimportant
1. Not at all important
- 96 REFUSED
- 97 DON'T KNOW

AL2a. Is your home equipped with a built-in dishwasher?

1. YES
2. NO **[GO TO AL3a]**
- 96 REFUSED **[GO TO AL3a]**
- 97 DON'T KNOW **[GO TO AL3a]**

AL2b. Was your dishwasher...? **[READ LIST, RECORD ONE RESPONSE]**

1. Provided with the home
2. A new dishwasher purchased separately by you or another member of your household
3. Or a previously-owned dishwasher that was moved to your current home.
4. OTHER (specify: _____)
- 96 REFUSED
- 97 DON'T KNOW

AL2c. Is your dishwasher an ENERGY STAR model?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

[ASK AL2d IF (AW1=1 OR AW2=1) AND AW5=1 AND AL2b=2 AND AL2c=1]

AL2d. How important was your experience with living in a New York ENERGY STAR[®] home in your decision to purchase an ENERGY STAR dishwasher? Would you say... **[READ LIST, RECORD ONE RESPONSE]**

- 5. Very important
- 4. Somewhat important
- 3. Neither important nor unimportant
- 2. Somewhat unimportant
- 1. Not at all important
- 96 REFUSED
- 97 DON'T KNOW

AL3a. Is your home equipped with a clothes washer?

- 1. YES
- 2. NO **[GO TO AL4a]**
- 96 REFUSED **[GO TO AL4a]**
- 97 DON'T KNOW **[GO TO AL4a]**

AL3b. Was your clothes washer...? **[READ LIST, RECORD ONE RESPONSE]**

- 1. Provided with the new home
- 2. A new clothes washer purchased separately by you or another member of your household
- 3. Or a previously-owned clothes washer that was moved to your current home.
- 96 REFUSED
- 97 DON'T KNOW

AL3c. Is your clothes washer an ENERGY STAR model?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

Homeowner Survey Instrument

[ASK AL3d IF (AW1=1 OR AW2=1) AND AW5=1 AND AL3b=2 AND AL3c=1]

AL3d. How important was your experience with living in a New York ENERGY STAR[®] homes in your decision to purchase an ENERGY STAR clothes washer? Would you say... **[READ LIST, RECORD ONE RESPONSE]**

- 5. Very important
- 4. Somewhat important
- 3. Neither important nor unimportant
- 2. Somewhat unimportant
- 1. Not at all important
- 96 REFUSED
- 97 DON'T KNOW

AL4a. Do you have a clothes dryer?

- 1. YES
- 2. NO **[GO TO AL5]**
- 96 REFUSED **[GO TO AL5]**
- 97 DON'T KNOW **[GO TO AL5]**

AL4b. Is your dryer electric or gas operated?

- 1. ELECTRIC
- 2. GAS
- 96 REFUSED
- 97 DON'T KNOW

AL5. Do you use a dehumidifier?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

AL6. Does your home use a sump pump in the basement to remove water to prevent the basement from flooding?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

AL7. What type of fuel do you use for cooking? **[READ LIST, RECORD ONE RESPONSE]**

1. Natural Gas
 2. Electric
 3. Propane
 4. OTHER (specify: _____)
 5. ELECTRIC OVEN WITH GAS STOVETOPS
- 96 REFUSED
-97 DON'T KNOW

AL8. Approximately how many hardwired light fixtures are in your home? I am not referring to plug-in lamps. **[THIS SHOULD INCLUDE LIGHT FIXTURES IN BASEMENTS AND GARAGES]**
[ALLOW ONLY NUMERIC RESPONSES]

- _____
- 996 REFUSED
-997 DON'T KNOW

AL8a. Is your home equipped with compact fluorescent light fixtures? These fixtures require special pin-based bulbs. I am only asking about hardwired fixtures that take CFL pin-based bulbs, not **[EMPHASIZE "NOT"]** plug-in lamps or fixtures that take standard screw in bulbs.

1. YES
 2. NO **[GO TO AL9a]**
- 96 REFUSED **[GO TO AL9a]**
-97 DON'T KNOW **[GO TO AL9a]**

AL8b. Approximately how many of the fixtures in your home have pin-based CFL bulbs? **[THIS SHOULD INCLUDE LIGHT FIXTURES IN BASEMENTS AND GARAGES]** **[ALLOW ONLY NUMERIC RESPONSES]**

- _____
- 996 REFUSED **[GO TO AL9a]**
-997 DON'T KNOW **[GO TO AL9a]**

AL8c. When you moved into your home, approximately how many of the fixtures in your home had pin-based CFL bulbs? **[ALLOW ONLY NUMERIC RESPONSES]**

- _____
- 996 REFUSED
-997 DON'T KNOW

Homeowner Survey Instrument

[IF AL8c > AL8b AND AL8c WAS ANSWERED, ASK AL8d AND THEN TO GO AL9a.]

AL8d. Why are you no longer using some of the CFL pin-based fixtures? **[READ LIST, RECORD AS MANY AS APPLY]**

1. [IF AL8b-AL8c=1] It broke. [OTHERWISE:] They broke.
 2. Pin-based bulb replacements are too hard to get.
 3. Removed during remodeling.
 4. OTHER (SPECIFY: _____)
- 96 REFUSED
-97 DON'T KNOW

[ASK AL8e IF AW5=1 AND AL8c < AL8b AND AL8c WAS ANSWERED]

AL8e. How important was your experience with living in a New York ENERGY STAR[®] home in your decision to install additional CFL pin-based fixtures? Would you say... **[READ LIST, RECORD ONE RESPONSE]**

5. Very important
 4. Somewhat important
 3. Neither important nor unimportant
 2. Somewhat unimportant
 1. Not at all important
- 96 REFUSED
-97 DON'T KNOW

AL9a. Approximately how many of the hardwired light fixtures in your home have screw-in bulbs (either CFL or Incandescent)? **[ALLOW ONLY NUMERIC RESPONSES]**

- _____
- 996 REFUSED **[GO TO NEXT SECTION]**
-997 DON'T KNOW **[GO TO NEXT SECTION]**

AL9b. **[ASK IF AL9a >0]** Approximately how many of those fixtures are currently equipped with screw-in CFL bulbs? **[AS OPPOSED TO INCANDESCENT. ALLOW ONLY NUMERIC RESPONSES]**

- _____
- 996 REFUSED
-997 DON'T KNOW

AL9c. **[ASK IF AL9b >0]** Approximately how many of those fixtures were equipped with screw-in CFL bulbs when you moved into your home? **[ALLOW ONLY NUMERIC RESPONSES]**

- _____
- 996 REFUSED
-997 DON'T KNOW

[ASK AL9d IF AW5=1 AND AL9c < AL9b AND AL9c WAS ANSWERED]

AL9d. How important was your experience with living in a New York ENERGY STAR® home in your decision to add screw-in CFLs in your home? Would you say... **[READ LIST, RECORD ONE RESPONSE]**

- 5. Very important
- 4. Somewhat important
- 3. Neither important nor unimportant
- 2. Somewhat unimportant
- 1. Not at all important
- 96 REFUSED
- 97 DON'T KNOW

POOLS / SPAS / DRIVEWAY MELT SYSTEMS

PS1a. Is your home equipped with a swimming pool?

- 1. YES
- 2. NO **[GO TO PS2]**
- 96 REFUSED **[GO TO PS2]**
- 97 DON'T KNOW **[GO TO PS2]**

PS1b. Is your pool heated?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

PS2. Does your home have an outdoor spa/whirlpool tub?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

PS3. Is your home equipped with a driveway melt system?

- 1. YES
- 2. NO
- 96 REFUSED
- 97 DON'T KNOW

CHANGES IN OCCUPANCY AND ENERGY USE PATTERNS

CH1a. How many rooms are there in your home? Please do not include basements unless there are finished rooms in the basement, pantries, bathrooms or hallways. **[ALLOW ONLY NUMERIC RESPONSES]**

-96 REFUSED

-97 DON'T KNOW

CH1b. How many rooms do you heat? **[ALLOW ONLY NUMERIC RESPONSES]**

-96 REFUSED

-97 DON'T KNOW

CH1c. How many rooms do you cool? **[ALLOW ONLY NUMERIC RESPONSES]**

-96 REFUSED

-97 DON'T KNOW

CH2. How many bedrooms are in your home? **[ALLOW ONLY NUMERIC RESPONSES]**

-96 REFUSED

-97 DON'T KNOW

CH3a. How many people, including yourself, are currently living in your home? Do not include anyone who is just visiting or who may be away at college or deployed in the military. Include all members of your household, whether or not they are related to you. **[ALLOW ONLY NUMERIC RESPONSES]**

-96 REFUSED

-97 DON'T KNOW

CH3b. When you first moved into your home, how many people including yourself were living there? **[ALLOW ONLY NUMERIC RESPONSES]**

-96 REFUSED

-97 DON'T KNOW

CH4a. Approximately how many weeks a year are all occupants away from the home on vacation or for other reasons during the winter months? **[IF NECESSARY:]** Winter months are defined as November through March. **[READ LIST, RECORD ONE RESPONSE]**

1. 1-2 weeks
2. 3-4 weeks
3. 4-6 weeks
4. More than 6 weeks
5. Not at all, house is always occupied
- 96 REFUSED
- 97 DON'T KNOW

CH4b. Approximately how many weeks a year are all occupants away from the home on vacation or for other reasons during the summer months? **[IF NECESSARY:]** Summer months are defined as June through August. **[READ LIST, RECORD ONE RESPONSE]**

1. 1-2 weeks
2. 3-4 weeks
3. 4-6 weeks
4. More than 6 weeks
5. Not at all, house is always occupied
- 96 REFUSED
- 97 DON'T KNOW

CH4c. Since moving into your home, has there been any change in the number of weeks when no one is at home?

1. YES
2. NO
- 96 REFUSED
- 97 DON'T KNOW

CH4d. **[ASK IF CH4c =1]** Are you spending more or less time at home now than when you moved in?

1. MORE
2. LESS
- 96 REFUSED
- 97 DON'T KNOW

Homeowner Survey Instrument

CH5. Since you moved into your home, have there been any other changes that have affected your energy use? **[READ LIST, RECORD ONE RESPONSE]**

1. Yes, use more energy now
2. Yes, use less energy now
3. No change, energy use is the same
- 96 REFUSED
- 97 DON'T KNOW

DEMOGRAPHICS

Finally, I have a few general questions for statistical purposes. This information will be combined across all respondents and will not be shared with anyone outside of the evaluation team in any way that identifies you or your household.

D1. What is the highest level of education completed by the head of the household?

1. High school graduate or less
2. Some college (including Associate's degree)
3. Bachelor's degree
4. Graduate study or degree
- 96 REFUSED
- 97 DON'T KNOW

D2. Please stop me when I read the range that contains the total combined income of all members of your household over the past 12 months.

1. Less than \$15,000
2. \$15,000 - \$24,999
3. \$25,000 - \$34,999
4. \$35,000 - \$49,999
5. \$50,000 - \$74,999
6. \$75,000 - \$99,999
7. \$100,000 or more
- 96 REFUSED
- 97 DON'T KNOW

D3. Respondent's gender **[RECORD, BUT DO NOT ASK]**

1. Male
2. Female

Those are all of the questions that I have for you today. Thank you for participating in the telephone survey portion of this important study. You will be mailed a \$25 incentive check. What is the best address to send the check, and what is the correct spelling of the person's name that I should make the check out to?

- I1. Name:
- I2. Address1:
- I3. Address2:
- I4. City
- I5. State
- I6. Zip

IN-HOME ASSESSMENT

You will be mailed the \$25 incentive check shortly. As you may recall, you may **[EMPHASIZE "MAY"]** be selected to participate in an in-house assessment and someone from GDS Associates may be contacting you soon to inquire about scheduling an in-home energy assessment of your home.

[IF RESPONDENT INQUIRES ABOUT AN IN-HOME ASSESSMENT OR THE \$100 PORTION OF THE INCENTIVE, CONFIRM:] once the in-home assessment portion of this evaluation is completed another \$100 incentive will be provided]

[FOR ALL RESPONDENTS]

Thank you for your participation in our survey. If you have any questions regarding any portion of this study you may call Carley Murray, New York State Energy Research and Development Authority (NYSERDA) at 518.862.1090 ext 3277.

PARTICIPATING BUILDER SURVEY INSTRUMENT

NYSERDA ENERGY STAR[®] Homes Program (NYESH)
Impact Evaluation 2010/2011
Participating Builders Survey
Final Field Version

Hello my name is _____ and I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. Our records indicate that your company participated in the NYSERDA ENERGY STAR[®] Homes Program, completing program homes in 2007 or 2008.

We're researching a small sample of projects that received incentives from the New York ENERGY STAR[®] Homes Program (NYESH) and would like to talk with you about your participation in the Program. **[READ IF NECESSARY:** Because we are only talking to a few people, your participation in this evaluation is important to us. The information you provide will be used to improve NYSERDA's programs and will be kept confidential to the extent permitted by law. We sent you a letter recently telling you that we would be calling and explaining the research we are doing.]

SCREENER FOR CONTACT

SCR-1. This survey will take about 15 minutes to complete. Are you the best person to speak to about the firm's participation in the New York ENERGY STAR Homes program and the energy- related building practices of your firm?

[IF YES GO TO SCR-3]

[IF NO] Can you provide me with a contact name and phone number for someone who may be able to complete this survey?

NEW CONTACT: Or refer to another contact within the firm? **[LIST NAME AND PHONE # IN SPACE BELOW]**

Name: _____ Phone: _____
(____)_____ext._____

[CONTACT THIS PERSON, REPEAT INITIAL INTRODUCTION AND CONTINUE WITH THE FOLLOWING QUESTION]

SCR-2 Mr./Ms. [NAME] referred me to you to discuss issues related to the firm's participation in the New York ENERGY STAR Homes Program and the decision to build homes to the program specifications **[DESCRIBE BRIEFLY AS THIS IS ANOTHER PERSON]**. This survey will take about 15 minutes to complete. Can we discuss the firm's New York ENERGY STAR Homes Program participation now, or can we schedule a time when I can call you back?

- a. CAN DISCUSS NOW **[PROCEED TO SCR-3]**
- b. CALL BACK ON: _____ AT TIME: _____
- c. **[IF THIS PERSON IS NOT THE MOST QUALIFIED PERSON, LOOP BACK TO SCR-1]**

Participating Builder Survey Instrument

SCR-3. Our records indicate that your firm has participated in the New York ENERGY STAR Homes Program within the last 4 years. Is this correct?

1. YES [**GO TO FR1**]
2. NO [**THANK AND TERMINATE**]
96. REFUSED [**THANK AND TERMINATE**]
97. DON'T KNOW [**ASK SCR-4**]

SCR-4. Is there someone else at the firm who may be familiar about the company's participation in the New York ENERGY STAR Homes Program?

1. YES [**OBTAIN CONTACT INFORMATION AND LOOP BACK TO SCR-2**]
2. NO [**THANK AND TERMINATE**]
96. REFUSED [**THANK AND TERMINATE**]
97. DON'T KNOW [**THANK AND TERMINATE**]

FR. FREE-RIDERSHIP

As you know, specifications for NYSERDA's New York ENERGY STAR Home Program are based on a Home Energy Ratings system (also known as a HERS score). In 2007 and 2008, NYSERDA's New York ENERGY STAR Home Program required a HERS score of 86 or better for a home to qualify for incentives and receive the New York ENERGY STAR certification. When the HERS rating system was modified in 2009, the program specifications were changed to a HERS score of 84 or higher.

Please be aware that the EPA's National ENERGY STAR Home Labeling program recognizes a different energy rating system where a home must have an index of 80 or lower to qualify (lower is better). The program specifications referenced in this survey relate only to NYSERDA's New York ENERGY STAR Home Program.

FR1. From 2007, the year before the recession to 2010, approximately how many total homes has your company built in New York State, not [**EMPHASIZE NOT**] including Long Island? This number should include both New York ENERGY STAR and non-New York ENERGY STAR homes.

_____ NUMBER OF HOMES [**ALLOW ONLY NUMERIC RESPONSES**]

[**ASK FR1b IF FR1 = 0**][**IF THE BUILDER ONLY DOES RENOVATIONS OR REHABS THEY MIGHT ANSWER THIS QUESTION AS ZERO. IF FR1 > 0, GO TO FR2**]

FR1b. Why is it that?

1. DOING ONLY RENOVATION OR REHAB WORK [**SKIP TO SP2**]
95. OTHER [**THANK AND TERMINATE**]
96. REFUSED[**THANK AND TERMINATE**]
97. DON'T KNOW[**THANK AND TERMINATE**]

FR2. How many of these were spec-built, and how many were custom-built?

[IF NECESSARY] ‘Custom’ means the buyer had their own land and hired a contractor to build on it or bought land from you and then you built a home for them. ‘Spec’ means the home was either completed or under construction before the buyer became involved.

_____ SPEC-BUILT

_____ CUSTOM-BUILT

[IF SPEC-BUILT + CUSTOM-BUILT DOES NOT EQUAL FR1 THEN CORRECT AS FOLLOWS: I have [FR1] total homes built and [SPEC-BUILT + CUSTOM-BUILT] homes built for the two types. Which number do I need to correct? **(PROGRAMMER: DO NOT ALLOW SPEC + CUSTOM BUILT TO DIFFER FROM FR1)]**

For the next four questions, I’ll be asking you about four categories of ALL of the homes that you’ve built in the last four years **[READ IF NECESSARY, Not just Energy Star Homes]**. I’ll be asking about homes that received builder incentives through the program, homes that were rated and could have received incentives through the program, homes that were built to program specifications but were not rated, and homes that did not meet program specifications. For your reference, the answers to these four questions should add up to 100%.

FR3a. Thinking about all the homes your company built in New York State in the last four years, (not **[EMPHASIZE NOT]** including Long Island), what percent received builder incentives through the New York ENERGY STAR Homes Program?

Were submitted to the program and received incentive: _____ %

996. REFUSED

997. DON'T KNOW

FR3b. What percentage of the homes your company built in the last four years (2007-2010) in New York State (not including Long Island) received an official rating, met or exceeded the New York ENERGY STAR program specifications, yet did not **[EMPHASIZE NOT]** receive a builder incentive?

Met or exceeded program specifications, rated, not submitted: _____ %

996. REFUSED

997. DON'T KNOW

FR3c. What percentage of the homes your company built in the last four years (2007-2010) in New York State (not including Long Island) met or exceeded the program specifications, but did not receive an official rating?

Met or exceeded program specifications, not rated: _____ %

996. REFUSED

997. DON'T KNOW

Participating Builder Survey Instrument

FR3d. What percent of homes that your company built in New York within the last four years (2007-2010) in New York State (not including Long Island) did not meet New York ENERGY STAR Homes program specifications?

Did not meet program specifications: _____ %

996. REFUSED

997. DON'T KNOW

[SUM OF RESPONSES FOR FR3a THROUGH FR3d SHOULD TOTAL 100%]

[READ BACK THE PERCENTS FOR CONFIRMATION. PROGRAMMER: ALLOW INTERVIEWER TO PROCEED ONLY IF FR3a THROUGH FR3d =100%]

[IF [FR3a] = 0, SKIP TO SP1]

FR4. You said that **[FR3a]** % of the homes that you built in the last four years (2007-2010) were rated and received an HERS score of greater than 86 or 84, met the program requirements, and therefore received an incentive from the New York ENERGY STAR Homes program. If the New York ENERGY STAR Homes Program had not existed, what percentage of these homes do you estimate would have met or exceeded the New York ENERGY STAR Homes requirements? Could you please provide a range and also your best estimate?

[IF NEEDED FOR CLARIFICATION:] For example, the percentage of homes might range from 20% to 40% with a best overall estimate of 30%.

Lower bound _____ % Upper bound _____ % Best estimate _____ %

996. REFUSED

997. DON'T KNOW

FR5. What percentage of the New York ENERGY STAR Homes that your company constructed during the last four years in New York State (not **[EMPHASIZE NOT]** including Long Island) incorporated the following measures? **[LIST MAJOR MEASURES OR MEASURE CATEGORIES] [REFER TO TABLE BELOW]** What percentage used...?

FR6. **[READ FOR EACH MEASURE IN WHICH FR 5>0]** Of the New York ENERGY STAR Homes you mentioned that incorporated [Measure], what percentage of these homes do you estimate would have incorporated this energy efficiency measure if the New York ENERGY STAR Homes Program had not existed?

MEASURE	FR5 % NYESH THAT <u>USE</u> <u>MEASURE</u> 0%=None 100%=All homes 996 = REFUSED 997 = DON'T KNOW	FR6 % OF THESE HOMES THAT WOULD HAVE USED <u>MEASURE</u>
High performance insulation system (e.g., spray foam insulation, dense-packed cellulose insulation) and air sealing (i.e., caulking at certain framing locations, foam around indoors and doors, etc)	FR5_a	FR6_a
ENERGY STAR® windows or doors	FR5_b	FR6_b
ENERGY STAR® Refrigerator	FR5_c	FR6_c
ENERGY STAR® Clothes washer	FR5_d	FR6_d
ENERGY STAR® Dishwasher	FR5_e	FR6_e
ENERGY STAR® or high-efficiency Furnace or Boiler	FR5_f	FR6_f
ENERGY STAR® Central Air Conditioner	FR5_g	FR6_g
ENERGY STAR® Lighting (CFLs or fixtures)	FR5_h	FR6_h
High Efficiency water heater	FR5_i	FR6_i
Duct-sealing	FR5_j	FR6_j

SP. SPILLOVER

[ASK SP1 IF FR3b + FR3c > 0%]

[READ IF SP1 IS ASKED] Please keep in mind that NYSERDA's New York ENERGY STAR Home Program required a HERS score of 86 or better in 2007 and 2008. However, the program specifications were changed to a HERS score of 84 or higher for homes completed in 2009 or later.

SP1. Earlier, you said that **[FR3b + FR3c]** % of your homes were built to meet or exceed New York ENERGY STAR Homes specifications but did not receive an incentive through the program. Why did you decide not to submit these homes to the program for incentive?

-96. REFUSED

-97. DON'T KNOW

[ASK SP2 IF FR3b + FR3c + FR3d > 0%]

SP2. Now I'd like you to think about the residential new construction or complete gut rehab projects your company has worked on in the last four years that are not **[EMPHASIZE NOT]** part of the New York ENERGY STAR Homes Program. **[IF NECESSARY:** By complete gut rehab we are referring to those homes that were completely gutted such that the only thing remaining of the original building was the framing.] What percent of your residential new construction and gut rehab projects incorporated each of the following measures?

MEASURE	<p align="center">SP2. % (NONPROGRAM HOMES)</p> <p align="center">0%=None 100%=All homes 996 = REFUSED 997 = DON'T KNOW</p>	<p align="center">SP3. IMPORTANCE OF <u>THE</u> <u>PROGRAM</u></p>
High performance insulation system (READ IF NECESSARY: spray foam insulation, dense-packed cellulose insulation) and air sealing (READ IF NECESSARY: caulking at certain framing locations, foam around indoors and doors, etc)	SP2_a	SP3_a
ENERGY STAR® Windows or doors	SP2_b	SP3_b
ENERGY STAR® Refrigerator	SP2_c	SP3_c
ENERGY STAR® Clothes washer	SP2_d	SP3_d
ENERGY STAR® Dishwasher	SP2_e	SP3_e
ENERGY STAR® or high efficiency Furnace or Boiler	SP2_f	SP3_f
ENERGY STAR® Central Air Conditioner	SP2_g	SP3_g
ENERGY STAR® Lighting (CFLs or fixtures)	SP2_h	SP3_h
High Efficiency water heater	SP2_i	SP3_i
Duct Sealing	SP2_j	SP3_j

[ASK SP3 FOR EACH MEASURE IN WHICH SP2 > 0%]

SP3. On a scale of 0 to 4, where 0 ‘means not at all important’ and 4 means ‘very important’, how important was the New York ENERGY STAR Homes Program in your decision to use **[SP2 MEASURE WHERE SP2>0%]** in homes you construct that are not part of the New York ENERGY STAR Homes Program?

- 0. NOT AT ALL IMPORTANT
- 1. SOMEWHAT UNIMPORTANT
- 2. NEITHER IMPORTANT NOR UNIMPORTANT
- 3. SOMEWHAT IMPORTANT
- 4. VERY IMPORTANT
- 96. REFUSED
- 97. DON'T KNOW

[IF FR1 = 0, SKIP TO Z1]

[ASK SP7 IF FR3b +FR3c > 0%]

SP7. On a scale of 0 to 4, where 0 ‘means not at all important’ and 4 means ‘very important’, how important was the New York ENERGY STAR Homes Program in your decision to construct homes that meet or exceed the program specifications in non-program homes?

- 0. NOT AT ALL IMPORTANT
- 1. SOMEWHAT UNIMPORTANT
- 2. NEITHER IMPORTANT NOR UNIMPORTANT
- 3. SOMEWHAT IMPORTANT
- 4. VERY IMPORTANT
- 96. REFUSED
- 97. DON'T KNOW

Z. FIRMOGRAPHICS

Finally, I have a few general questions about your business.

Z1. Approximately what percentage of your new home construction projects in New York State are located in...?

[READ ALL, THEN RECORD. PROGRAMMER: DISPLAY ALL 3 OPTIONS ON SCREEN AND ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]]

_____ % New York City vicinity, including Westchester County but excluding Long Island

_____ % Long Island

_____ % Upstate New York

[SUM OF RESPONSES TO Z1 SHOULD TOTAL 100%]

Z2. Considering New York State (not including Long Island), what percentage of your residential Projects over the last four years fall into the following categories? **[READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%] [IF NECESSARY: By complete gut rehab we are referring to those homes that were completely gutted such that the only thing remaining of the original building was the framing.]**

_____ % New Homes

_____ % Complete gut rehabs

_____ % Significant renovations or remodels

_____ % Additions

_____ % Other types of jobs

[SUM OF RESPONSES TO Z2 SHOULD TOTAL 100%]

_____ -96 REFUSED

_____ -97 DON'T KNOW

Z3. Of the new homes that your company worked on in the last four years in New York State (not including Long Island), approximately what percentage fell into the following categories **[EMPHASIZE FOUR YEARS]? [READ ALL OPTIONS AND THE DESCRIPTIONS, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

_____ % For developers (The developer and builder are completely separate entities; the developer hires the builder as a contractor to construct the building to the specifications provided by the developer.)

_____ % Design-Bid-Build with Homeowners (Design and construction are a collaborative process between the homeowner and builder.

_____ % Built on speculation (Homes either completed or under construction before the buyer becomes involved.)

_____ % Another type (specify: _____)

[SUM OF RESPONSES TO Z3 SHOULD TOTAL 100%]

_____ -96 REFUSED

_____ -97 DON'T KNOW

Participating Builder Survey Instrument

Z3b. Of the new homes that your company worked on in the last 12 months in New York State (not including Long Island), approximately what percentage fell into the following categories? **[EMPHASIZE 12 MONTHS] [READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

- _____ % For developers
- _____ % Design- Build with Homeowners
- _____ % Built on speculation
- _____ % Another type (specify: _____)

94. NO HOMES WORKED ON IN PAST 12 MONTHS

-96. REFUSED

-97. DON'T KNOW

Z3c. Of the new homes that your company will build in the NEXT 12 months in New York State (not including Long Island), approximately what percentage do you think will fall into the following categories? **[EMPHASIZE NEXT 12 MONTHS] [READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

- _____ % For developers
- _____ % Design- Build with Homeowners
- _____ % Built on speculation
- _____ % Another type (specify: _____)

94. NO NEW HOME PLANS FOR NEXT 12 MONTHS

-96. REFUSED

-97. DON'T KNOW

Z4. What percentage of the new home construction projects you work on within New York State, not including Long Island, are...? **[READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

- _____ % Single family detached homes
- _____ % Single family attached homes (town homes, row houses)
- _____ % Apartment buildings with 5 or more units
- _____ -96 REFUSED
- _____ -97 DON'T KNOW

Those are all the questions I had. Thank you very much for your time!

NON-PARTICIPATING AND FORMERLY PARTICIPATING BUILDER SURVEY INSTRUMENT

**NYSERDA ENERGY STAR[®] Homes Program (NYESH)
Impact Evaluation 2010/2011
Non-Participating and Former Participating Builder Survey**

Final Version 10/7/11

Hello my name is _____ and I'm calling on behalf of the New York State Energy Research and Development Authority or NYSERDA. Our firm is under contract with NYSERDA to conduct interviews with residential builders as part of a broad program evaluation effort.

[FOR FORMER BUILDER SAMPLE READ: Our records indicate that you previously participated in the New York ENERGY STAR[®] Homes Program.]

We're researching a small carefully designed sample of residential builders and would like to talk to you about building practices, energy using equipment, programs, and other topics. This survey will take about 10 minutes. The information you provide will be used to improve NYSERDA's programs and will be kept confidential to the extent permitted by law. A letter was sent to you telling you that we would be calling and explaining the research we are doing.

SCREENER FOR CONTACT

[ASK SCR1 FOR NON-PARTICIPATING BUILDER SAMPLE ONLY; FORMER PARTICIPATING BUILDERS SHOULD GO TO SCR2]

SCR1. Did your firm build at least five new 1-4 family homes in New York State, not **[EMPHASIZE NOT]** including Long Island, over the last four years.

- 1. YES
- 2. NO **[THANK AND TERMINATE]**
- 96 REFUSED **[THANK AND TERMINATE]**
- 97 DON'T KNOW **[THANK AND TERMINATE]**

SCR1x. Our records indicate that you did NOT participate in NYSERDA's NEW YORK ENERGY STAR[®] Homes Program in 2007 or 2008. Is this correct?

- 1. YES
- 2. NO **[THANK AND TERMINATE]**
- 96 REFUSED
- 97 DON'T KNOW

Non-Participating and Formerly Participating Builder Survey Instrument

SCR2. Are you an appropriate person to discuss your company's energy related building practices in any of these residential new construction projects?

- 1. YES [GO TO NEXT SECTION]
- 2. NO [CONTINUE]
- 96. REFUSED [CONTINUE]
- 97. DON'T KNOW [CONTINUE]

SCR3. Can you provide me with a contact name and phone number for a person who can speak about the firm's energy-related building practices?

- 1. Yes [LIST NAME AND PHONE # IN SPACE BELOW]

Name: _____ Phone:

(____) _____ ext. _____

- 2. NO [TERMINATE]
- 97. REFUSED [TERMINATE]

[CONTACT THIS PERSON, REPEAT INITIAL INTRODUCTION AND CONTINUE WITH THE FOLLOWING QUESTION]

SCR4. Mr./Ms. [NAME] referred me to you to discuss issues related your organization's energy-related building practices. This survey will take about 10 minutes to complete. Can we discuss these decisions now, or can we schedule a time when I can call you back?

- 1. CAN DISCUSS NOW [PROCEED TO SECTION AW: PROJECT SPECIFIC REVIEW]
- 2. CALL BACK ON: _____ AT TIME: _____
- 3. I AM NOT THE CORRECT PERSON FOR THIS INTERVIEW. [CONTINUE]
- 96. REFUSED [TERMINATE]
- 97. DON'T KNOW [TERMINATE]

SCR5. Can you provide me with a contact name and phone number for a person who can speak about energy-efficiency design and equipment issues at your firm?

- 1. Yes [LIST NAME AND PHONE # IN SPACE BELOW]

Name: _____ Phone:

(____) _____ ext. _____

- 2. NO [TERMINATE]
- 97. REFUSED [TERMINATE]

[CONTACT THIS PERSON, REPEAT INITIAL INTRODUCTION AND CONTINUE WITH THE FOLLOWING QUESTION]

AW. PREVIOUS PARTICIPATION AND PROGRAM AWARENESS

[ASK AW1 OF FORMERLY-PARTICIPATING BUILDERS SAMPLE. FOR NON-PARTICIPATING BUILDERS SAMPLE, SKIP TO AW2]

AW1. Our records show that you were active in the New York State ENERGY STAR Homes Program in [RATING YEAR] but have not participated in the Program since then. To confirm, have you participated in the Program in 2007 or later?

1. YES [**THANK AND TERMINATE - SEE LANGUAGE BELOW**]
2. NO [**GO TO SP1a**]
94. HAVE NEVER PARTICIPATED IN THE PROGRAM [**GO TO AW2**]
96. REFUSED [**THANK AND TERMINATE**]
97. DON'T KNOW [**GO TO AW2**]

[IF TERMINATING: This particular survey concerns projects that you completed that did not receive incentives from the New York State ENERGY STAR Homes Program. You may be called later for other surveys being conducted with participants in the New York ENERGY STAR Program. Thank you for your time. **[TERMINATE]**]

AW2. Have you heard of the New York ENERGY STAR Homes Program?

1. YES
2. NO
96. REFUSED
97. DON'T KNOW

AW2x. How familiar are you with the standards required for a new home to be an ENERGY STAR Home? [**READ LIST. ALLOW 1 RESPONSE**]

0. Not at all familiar
1. Slightly familiar
2. Somewhat familiar
3. Extremely familiar
96. REFUSED
97. DON'T KNOW

AW3. How familiar are you with the use of the Home Energy Rating System, or HERS? Would you say you are... [**READ LIST. ALLOW 1 RESPONSE**]

0. Not at all familiar [**GO TO NEXT SECTION**]
1. Slightly familiar
2. Somewhat familiar
3. Extremely familiar
96. REFUSED [**GO TO NEXT SECTION**]
97. DON'T KNOW [**GO TO NEXT SECTION**]

Non-Participating and Formerly Participating Builder Survey Instrument

AW4. Have you ever used a HERS rater to assess the energy efficiency of a home that your company has constructed?

- 1. YES
- 2. NO
- 96. REFUSED
- 97. DON'T KNOW

SP. SPILLOVER AND BASELINE

[READ TO ALL] The next series of questions relates to new homes built by your firm over the last four years, that is from 2007 (a year before the recession) through 2010.

SP1a. Over the past four years, approximately how many total homes has your company built in New York State, not including Long Island? **[FOR FORMER PARTICIPANTS OR IF AW2=1 ADD: This includes both ENERGY STAR and non-ENERGY STAR homes.]**

_____ Number of homes **[ALLOW ONLY NUMERIC RESPONSES]**

- 96. REFUSED **[THANK AND TERMINATE]**
- 97. DON'T KNOW **[THANK AND TERMINATE]**

[ASK SP1b IF SP1a = 0]

SP1b. Why is that?

- 1. DOING ONLY RENOVATION WORK
- 95. OTHER (Specify) **[THANK AND TERMINATE]**
- 96. REFUSED **[THANK AND TERMINATE]**
- 97. DON'T KNOW **[THANK AND TERMINATE]**

[IF SP1b =1, SKIP TO SP8]

SP2. How many of these were spec-built, and how many were custom-built? Please make sure your answer adds up to the [ANSWER IN SP1a] total home(s) built in the past 4 years.

[IF NECESSARY: Custom means the buyer had their own land and hired a contractor to build on it or bought land from you and then you built a home for them. Spec means the home was either completed or under construction before the buyer became involved.]

_____ Spec-built

_____ Custom-built

[IF SPEC-BUILT + CUSTOM-BUILT DOES NOT EQUAL SP1A THEN CORRECT AS FOLLOWS]

I have [SP1a] total homes built and [SPEC-BUILT + CUSTOM-BUILT] homes built for the two types. Which number do I need to correct? **[PROGRAMMER: DO NOT ALLOW SPEC + CUSTOM BUILT TO DIFFER FROM SP1a.]**

[READ ONLY IF AW3 = 2 OR 3, OR IF AW1 = 2] I have a few questions about homes you build that may meet our criteria for high efficiency new homes which are the specifications of NYSERDA's New York ENERGY STAR Home Program. The program specifications are based on a Home Energy Ratings system (also known as a HERS score). In 2007 and 2008, program specifications required a HERS score of 86 or higher for a home to qualify for incentives and receive the New York ENERGY STAR certification. When the HERS rating system was modified in 2009, the program specifications were changed to a HERS score of 84 or higher.

Please be aware that the EPA's National ENERGY STAR Home Labeling program recognizes a different energy rating system where a home must have an index of 80 or lower to qualify (lower is better). The program specifications referenced in this survey relate only to NYSERDA's New York ENERGY STAR Homes Program.

[ASK SP3A THROUGH SP3C ONLY IF (AW2X =2 OR 3), OR IF AW1=2; OTHERWISE GO TO SP8]

[IF AW1 DOES NOT = 2 AND AW4 DOES NOT =1, AUTOFILL SP3a AS "0" AND PROCEED TO SP3b]

SP3a. What percent of all the homes that your company built in the last four years in New York State, not including Long Island, met program standards, were Certified, but were not submitted for an incentive through the New York ENERGY STAR Homes program? **[INTERVIEWER NOTE: 'Certified' means that the home received an official rating and met program standards (a HERS rating of 86 or higher for homes completed in 2007 and 2008, and a HERS rating of 84 or higher for homes completed in 2009 and 2010)]**

- 1. [RECORD PERCENT]
- 96. Refused
- 97. Don't Know

SP3b. What percent of all the homes that your company built in the last 4 years in New York State, not including Long Island, met New York ENERGY STAR Homes program standards, but were not Certified?

- 1. [RECORD PERCENT]
- 96. Refused
- 97. Don't Know

SP3c. And what percent of all the homes that your company built in the last 4 years in New York State, not including Long Island, did not meet New York ENERGY STAR Homes program standards?

- 1. [RECORD PERCENT]
- 96. Refused
- 97. Don't Know

[VERIFY THAT SUM OF RESPONSES FOR SP3a THROUGH SP3c TOTAL 100%]

[READ BACK THE PERCENTS FOR CONFIRMATION]

[ASK SP4 IF SP3a + SP3b > 0%, OTHERWISE, GO TO SP8]

SP4. How has the percentage of homes your company has built to Certification standards changed in the last four years? Would you say it has... **[READ LIST. ALLOW 1 RESPONSE]**

- 5 Increased significantly
- 4 Increased somewhat
- 3 Stayed the same
- 2 Decreased somewhat
- 1 Decreased significantly
- 96 REFUSED
- 97 DON'T KNOW

[IF (SP4 = 5 OR 4) ASK SP5; OTHERWISE GO TO SP8]

SP5. On a scale of 0 to 4, where 4 means 'Very Important' and 0 means 'Not at all Important', how important were the energy efficiency programs in New York in helping to bring about this increase?

- 0. NOT AT ALL IMPORTANT
- 1.
- 2.
- 3.
- 4. VERY IMPORTANT
- 96 REFUSED
- 97 DON'T KNOW

[THERE IS NO SP6 OR SP7]

SP8. **[ASK TO ALL]** Now I'd like you to think about how often you incorporate the following design features and equipment into the homes that your company has worked on in the past four years. What percent of your projects incorporated the following measures? **[READ LIST OF MEASURES]**

SP9. **[READ FOR EACH MEASURE IN WHICH SP8>0]** Of the homes you mentioned that incorporated [Measure], what percentage of these homes would have incorporated this measure if energy efficiency programs had not existed in New York?

MEASURE	SP8. % FOR PAST 4 YEARS	SP9. % OF HOMES THAT WOULD HAVE USED MEASURE IF NO PROGRAM
	0%=None 100%=All homes 96 = REFUSED 97 = DON'T KNOW	
High performance insulation system (READ IF NECESSARY: spray foam insulation, dense-packed cellulose insulation) and air sealing (READ IF NECESSARY: caulking at certain framing locations, foam around indoors and doors, etc)	SP8a	SP9a
ENERGY STAR® Windows or doors	SP8b	SP9b
ENERGY STAR® Refrigerator	SP8c	SP9c
ENERGY STAR® Clothes washer	SP8d	SP9d
ENERGY STAR® Dishwasher	SP8e	SP9e
ENERGY STAR® Furnace or Boiler	SP8f	SP9f
ENERGY STAR® Central Air Conditioner	SP8g	SP9g
ENERGY STAR® Lighting (CFLs or fixtures)	SP8h	SP9h
High Efficiency water heater	SP8i	SP9i

EQ. AVAILABILITY OF EQUIPMENT AND HERS RATERS

EQ1. On a scale from 0 to 4, where 0 means 'Not at all available' and 4 means 'Very easily Available', how would you rate the availability today of high efficiency equipment? **[IF NECESSARY]**: the high efficiency equipment we just discussed.

- 0. NOT AT ALL AVAILABLE
- 1.
- 2.
- 3.
- 4. VERY EASILY AVAILABLE
- 96 REFUSED
- 97 DON'T KNOW

EQ2. Now please tell me how you think the availability of the following measures has changed in the last four years? Would you say **[INSERT ITEM – ROTATE LIST]** has increased significantly, increased somewhat, stayed the same, decreased significantly, or decreased somewhat?

- a. High efficiency insulation and air tightness (*such as air sealing or duct sealing*)
- b. ENERGY STAR windows or doors
- c. ENERGY STAR Refrigerator
- d. ENERGY STAR clothes washer
- e. ENERGY STAR Dishwasher
- f. ENERGY STAR Furnace or Boiler
- g. ENERGY STAR Central Air Conditioner
- h. ENERGY STAR Lighting (CFLs or fixtures)
- i. High Efficiency water heater

- 5 INCREASED SIGNIFICANTLY
- 4 INCREASED SOMEWHAT
- 3 STAYED THE SAME
- 2 DECREASED SOMEWHAT
- 1 DECREASED SIGNIFICANTLY
- 96 REFUSED
- 97 DON'T KNOW

[IF AW3 = 0 GO TO NEXT SECTION]

EQ3. On a scale from 0 to 4, where 0 means 'Not at all available' and 4 means 'Very easily available', how would you rate the availability today of HERS raters?

- 0. NOT AT ALL AVAILABLE
- 1.
- 2.
- 3.
- 4. VERY EASILY AVAILABLE
- 96 DON'T KNOW
- 97 REFUSED

EQ4. Would you say the availability of HERS raters in the last few years has...? **[READ LIST. ALLOW 1 RESPONSE]**

- 5 Increased significantly
- 4 Increased somewhat
- 3 Stayed the same
- 2 Decreased somewhat
- 1 Decreased significantly
- 96 REFUSED
- 97 DON'T KNOW

EQ5. On a scale of 0 to 4, 0 'means not at all important' and 4 means 'very important', how important was the New York ENERGY STAR Homes Program on the availability of HERS rating in New York?

- 0. NOT AT ALL IMPORTANT
- 1. SOMEWHAT UNIMPORTANT
- 2. NEITHER IMPORTANT NOR UNIMPORTANT
- 3. SOMEWHAT IMPORTANT
- 4. VERY IMPORTANT
- 96. REFUSED
- 97. DON'T KNOW

Z. FIRMOGRAPHICS

Finally, I have a few general questions about your business.

Z1. Approximately what percentage of your new home construction projects within New York State over the last four years were in...?

[READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. PROGRAMMER: DISPLAY ALL 3 OPTIONS ON SCREEN AND ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]

_____ % New York City vicinity, including Westchester County but excluding Long Island

_____ % Long Island

_____ % Upstate New York

96. REFUSED

97. DON'T KNOW

Z2. Considering New York State (not including Long Island), what percentage of your residential Projects over the last four years fall into the following categories? **[READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%] [IF NECESSARY: By complete gut rehab we are referring to those homes that were completely gutted such that the only thing remaining of the original building was the framing.]**

_____ % New Homes

_____ % Complete gut rehabs

_____ % Significant renovations or remodels

_____ % Additions

_____ % Other types of jobs

96. REFUSED

97. DON'T KNOW

Z3. Of the new homes that your company worked on in the last four years in New York State (not including Long Island), approximately what percentage fell into the following categories **[EMPHASIZE FOUR YEARS]? [READ ALL OPTIONS AND THE DESCRIPTIONS, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

_____ % For developers (The developer and builder are completely separate entities; the developer hires the builder as a contractor to construct the building to the specifications provided by the developer.)

_____ % Design-Bid-Build with Homeowners (Design and construction are a collaborative process between the homeowner and builder.

_____ % Built on speculation (Homes either completed or under construction before the buyer becomes involved.)

_____ % Another type (specify: _____)

96. REFUSED

97. DON'T KNOW

Z3b. Of the new homes that your company worked on in the last 12 months in New York State (not including Long Island), approximately what percentage fell into the following categories? **[EMPHASIZE 12 MONTHS] [READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

_____ % For developers

_____ % Design- Build with Homeowners

_____ % Built on speculation

_____ % Another type (specify: _____)

94. NO NEW HOMES BUILT IN THE LAST 12 MONTHS

96. REFUSED

97. DON'T KNOW

Non-Participating and Formerly Participating Builder Survey Instrument

Z3c. Of the new homes that your company will build in the NEXT 12 months in New York State (not including Long Island), approximately what percentage do you think will fall into the following categories? **[EMPHASIZE NEXT 12 MONTHS] [READ ALL, THEN RECORD] [VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

_____ % For developers

_____ % Design- Build with Homeowners

_____ % Built on speculation

_____ % Another type (specify: _____)

94. NO NEW HOMES PLANNED IN THE NEXT 12 MONTHS

96. REFUSED

97. DON'T KNOW

Z4. What percentage of the new home construction jobs you worked on in New York State over the last four years, not including Long Island, are...?**[VERIFY THAT SUM OF RESPONSES TOTAL 100%. ALLOW INTERVIEWER TO PROCEED ONLY IF TOTAL = 100%]**

_____ % Single family detached homes

_____ % Single family attached homes (town homes, row houses)

_____ % Apartment buildings with 5 or more units

96. DON'T KNOW

97. REFUSED

[INTERVIEWER: CONFIRM CORRECT SPELLING OF RESPONDENT'S NAME]

Those are all the questions I had. Thank you very much for your time.

ON-SITE INSPECTION CHECKLIST



ENERGY STAR VERSION 2 INSPECTION CHECKLIST

Date: November 16, 2011 Rating No.:
 Building Name: Rating Org.: HERS Rater
 Owner's Name: Phone No.:
 Property: One Main Street Rater's Name:
 Address: Anytown, NY xxxxx Rater's No.:
 Builder's Name: Energy Star Builder
 Weather Site: Rochester, NY Rating Type: Based On Plans
 File Name: Sample.blg Rating Date: 2/15/07

Building Information:

Conditioned Area (sq ft): 3823
 Conditioned Volume (cubic ft): 29704
 Insulated Shell Area (sq ft): 6550

Building Option Checklist:

Bonus room over garage
 Walk-out basement
 Conditioned basement

*This REM model includes the above checked features. If the building being inspected includes features not checked above, please complete and attach supplemental inspection forms.

Inspections

Date	Inspection/Phase	Inspector
	Insulation/Air Sealing	
	Blower Door #1	
	Blower Door #2/Final	
	Other	

ENERGY STAR Appliances

Type	Manufacturer	Model #	Rebate
Refrigerator			
Dishwasher			
C. Washer			
GFX			
Central A/C			
Other			

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ENERGY STAR VERSION 2 INSPECTION CHECKLIST

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ENERGY STAR CFL Fixtures*

Quantity	Wattage	Int/Ext

*Fixtures located in closets do not qualify for rebates.

This project as submitted, currently has a NY HERS score of 87.4 and a HERS Index of 63 with the below listed specifications.

The items below will be inspected for certification as an ENERGY STAR Home. Any deviation from these specifications should be brought to the attention of your ENERGY STAR representative, as soon as possible to assure that the project will still comply with ENERGY STAR standards.

Energy
Star
Use

Ceilings:

[] 1. Attic: R-38 Attic (1140 s.f.)
R-27.0 continuous insulation, R-11.0 cavity insulation.
Name: Flat Insulation Grade: I II III Face / Inset

Comments/Location _____

[] 2. Attic: R38,FG2,X-24 (252 s.f.)
R-0.0 continuous insulation, R-38.0 cavity insulation.
Name: Slope Insulation Grade: I II III Face / Inset

Comments/Location _____

Above-Grade Walls:

[] 1. Wall: R13,FG2,4-16 (608 s.f.), Between conditioned space and ambient
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: North Wall Insulation Grade: I II III Face / Inset

Comments/Location _____

[] 2. Wall: R13,FG2,4-16 (608 s.f.), Between conditioned space and ambient
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: South Wall Insulation Grade: I II III Face / Inset

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Comments/Location _____

- [] 3. Wall: R13,FG2,4-16 (544 s.f.), Between conditioned space and ambient
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: East Wall Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 4. Wall: R13,FG2,4-16 (544 s.f.), Between conditioned space and ambient
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: West Wall Insulation Grade: I II III Face / Inset

Comments/Location _____

Windows and Skylights:

Window-to-Wall Area Ratio: 0.14

- [] 1. Window: U:0.37, SHGC:0.35 (116 s.f., North), U-Value: 0.370, SHGC: 0.350
For windows without labeled U-factors, describe features:
Name: North Orientation: North

Comments/Location _____

- [] 2. Window: U:0.37, SHGC:0.35 (164 s.f., South), U-Value: 0.370, SHGC: 0.350
For windows without labeled U-factors, describe features:
Name: South Orientation: South

Comments/Location _____

- [] 3. Window: U:0.37, SHGC:0.35 (42 s.f., East), U-Value: 0.370, SHGC: 0.350
For windows without labeled U-factors, describe features:
Name: East Orientation: East

Comments/Location _____

Doors:

- [] 1. Door: R7 steel insul (21 s.f.), R-Value 7.0

Comments/Location _____

Frame Floors:

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ENERGY STAR VERSION 2 INSPECTION CHECKLIST

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- [] 1. Floor: R30,FG1,X-16 (76 s.f.), Between conditioned space and ambient conditions
R-0.0 continuous insulation, R-30.0 cavity insulation.
Name: South Insulation Grade: I II III Face / Inset

Comments/Location _____

Foundation Walls:

- [] 1. Wall: R11,G1, Draped Batt (240 s.f.), Between conditioned space and ambient/ground
R-11.0 interior continuous insulation, R-0.0 interior cavity insulation, R-0.0 exterior insulation.
Name: North Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 2. Wall: R11,G1, Draped Batt (304 s.f.), Between conditioned space and ambient/ground
R-11.0 interior continuous insulation, R-0.0 interior cavity insulation, R-0.0 exterior insulation.
Name: South Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 3. Wall: R11,G1, Draped Batt (304 s.f.), Between conditioned space and ambient/ground
R-11.0 interior continuous insulation, R-0.0 interior cavity insulation, R-0.0 exterior insulation.
Name: East Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 4. Wall: R11,G1, Draped Batt (304 s.f.), Between conditioned space and ambient/ground
R-11.0 interior continuous insulation, R-0.0 interior cavity insulation, R-0.0 exterior insulation.
Name: West Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 5. Wall: R11,G1, Draped Batt (64 s.f.), Between conditioned space and garage/ground
R-11.0 interior continuous insulation, R-0.0 interior cavity insulation, R-0.0 exterior insulation.
Name: GH Wall Insulation Grade: I II III Face / Inset

Comments/Location _____

Slab Floors:

- [] 1. Slab: Uninsulated (1274 s.f.)
R-0.0 perimeter insulation, R-0.0 under slab insulation.
Name: Heated bsmt Insulation Grade: I II III Face / Inset

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ENERGY STAR VERSION 2 INSPECTION CHECKLIST

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Comments/Location _____

Rim and Band Joists:

- [] 1. Joist: Bsmt Blocker (144 s.f.), Between conditioned space and ambient
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: Bsmt Blocker Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 2. Joist: Blocker (128 s.f.), Between conditioned space and ambient
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: Blocker Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 3. Joist: GH B Blocker (8 s.f.), Between conditioned space and garage
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: GH B Blocker Insulation Grade: I II III Face / Inset

Comments/Location _____

- [] 4. Joist: GH Blockers (8 s.f.), Between conditioned space and garage
R-0.0 continuous insulation, R-13.0 cavity insulation.
Name: GH Blockers Insulation Grade: I II III Face / Inset

Comments/Location _____

Mechanical Equipment:

- [] 1. Heating: Fuel-fired air distribution, Natural gas, 82.8 AFUE.
Make and Model Number: _____

- [] 2. Water Heating: Conventional, Natural gas, 0.82 EF, 40.0 Gal.
Make and Model Number: _____

- [] Programmable Thermostat

Mechanical Ventilation System:

- [] Mechanical ventilation system rated for, and capable of, providing continuous ventilation.
System shall include automatic firing controls.

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ENERGY STAR VERSION 2 INSPECTION CHECKLIST

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System type: Exhaust Only, 100 cfm, 4.0 hrs/day, 25.0 watts.

System description(make): _____

Air Leakage Control:

[] House is air-sealed so as to achieve 1240.00 CFM50 or less. (Max CFM50 is: 1240)

Blower Door Results: _____ CFM50

Total Duct Leakage to Outdoors: 123.00 CFM

Measured Duct Leakage: 123.00 CFM25 (Measured duct leakage must be equal or less)

Measured Duct Leakage: _____ CFM25

Duct Insulation:

[] Ducts in conditioned space must be insulated to R-0.0.

[] Ducts in conditioned space must be insulated to R-0.0.

NOTES TO FIELD (ENERGY STAR Use Only)

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DEVELOPMENT OF THE BASELINE HOME

For comparing the energy modeling that was done through the program, calibrated to billing data and adjusted based on the results of the telephone survey the Impact Evaluation Team developed an appropriate baseline. Although, HERS ratings use the International Energy Conservation Code of 2004 (IECC 2004) as the reference home in the development for the HERS index, NYSERDA converts this to a traditional HERS score described in previous sections of this report. The methodology used by NYSERDA to estimate savings utilizes the difference between the HERS scores of the homes modeled in the program and a baseline HERS score of 81.3 which has been determined to be slightly better than the Council of American Building Officials (CABO), Model Energy Code of 1993 (MEC93).

Thermostats

The evaluation baseline home contains a non-programmable thermostat. So when comparing a modeled ENERGY STAR Home with a programmable thermostat against the baseline (UDRH) home a savings credit is applied to the ENERGY STAR Home based upon a five degree set-back for 8 hours of heating in the winter months and 6 hours of cooling in the summer periods.

Active Solar

The baseline home defined here does not include any active solar components used for domestic hot water or space heating. This is consistent with all sources reviewed. If a home in the program does have these components they will realize savings based upon the difference in usage from the primary water system.

Foundation Walls

If the modeled home has a basement defined as unconditioned then the baseline assumption is un-insulated concrete foundation walls. Foundation walls in a conditioned basement are assumed to be insulated to R13. While the assumption is that a conditioned basement would need to be insulated to comply with building code which dictates either R10 continuous insulation or R13 cavity insulation, an insulated foundation is, for economic reasons, likely insulated with fiberglass batts. This is supported by the research performed for the study conducted by Conservation Services Group (CSG)¹. Other baseline studies for northeastern states showed similar results. The 2005 Massachusetts baseline study showed that homes with conditioned basements and had insulated foundations were insulated to an average R-value of R-12.2 and consisted of fiberglass batt insulation and all homes with foundations whether conditioned or unconditioned basements had an average of R-15². The previous Massachusetts baseline study yielded a baseline foundation insulation level of R12. However, the earlier study did not differential between homes with conditioned basements and unconditioned basements³.

¹ Reference Design Guide for Highly Efficient Residential Construction", VEIC/CSG, July 2007

² "Massachusetts ENERGY STAR Homes: 2005 Baseline Study, Part I: Inspection Data Analysis Final Report", Nexus Market Research, Inc. May 8, 2006

³ "ENERGY STAR® Homes Program – Market Assessment and Baseline Study for Massachusetts and Rhode Island, Final Report, Prepared for The Joint Management Committee, Delta Technologies Group, LLC, Marietta, GA September 1999

Slab Floors

Baseline insulation levels for concrete slabs are specific to their location either on-grade or below grade and whether or not they are heated slabs (e.g. radiant). The UDRH included insulation R-values for slab edges and under slab. The following table displays the baseline assumptions used in the UDRH.

Table F-1. Baseline Slab Insulation Values

Slab Location / Type	Slab Edge Insulation	Under Slab Insulation
On Grade / Not Radiant	R10	R0
On Grade / Radiant	R15	R0
Below Grade / Not Radiant	R0	R0
Below Grade / Radiant	R0	R0

Slab insulation is only addressed in the UDRH for those slabs that are part of the conditioned area of the home. For example, homes that either have a conditioned basement or slab on-grade.

Other baseline studies were reviewed for baseline conditions of slabs and expressed lower baseline r-values for slab insulation. However, the studies that were reviewed showed frequencies for homes with conditioned space over a slab that were too low to establish reliable results.

Framed Floor

Framed floors were identified as being over ambient conditions or over an unconditioned basement or garage. A common example of a floor over ambient conditions is in the case of a split-level ranch where a second level floor extends beyond the exterior wall of the lower level over ambient conditions. The floor assembly defined in the UDRH file includes the nominal cavity R-value and the insulation grade in accordance with RESNETs insulation installation quality grading system. Under the RESNET inspection protocol for insulation quality an insulated assembly is assigned a grade of either Grade I, Grade II or Grade III as briefly described below⁴:

- Grade I - Insulation that is installed according to manufacturers' instructions and/or industry standards. A Grade I installation requires that the insulation material is uniform and fills each cavity side-to-side and top-to-bottom, without gaps or voids around obstructions (such as wall bracing or blocking), and is installed to fit tightly around wiring, plumbing and other infrastructure in the cavity. Exceptions are made for flat ceilings, floors over basements and rim joists where they can be considered Grade I or II and not be closed on all six-sides.
- Grade II describes cavity insulation installed with moderate to frequent installation defects: gaps around wiring, electrical outlets, plumbing and other intrusions; rounded edges or "shoulders"; or incomplete fill amounting to less than 10% of the area with 30% compression. To attain a rating of Grade II insulation shall be enclosed on all six sides and shall be in substantial contact with the sheathing material on at least one side (either interior or exterior) of the cavity. Exceptions are made for flat ceilings, floors over basements and rim joists where they can be considered Grade I or II and not be closed on all six-sides.
- Grade III describes an installation with substantial gaps and voids, with missing insulation amounting to greater than 2% of the area, but less than 5% of the surface area. Anything greater than 5% missing insulation is measured and modeled as a separate assembly of un-insulated surfaces.

⁴ 2006 Mortgage Industry National Home Energy Rating Systems Standards, Residential Energy Services Network (RESNET) and National Association of State Energy Officials, 2006

The following table shows the assumptions used in the baseline home.

Table F-2. Baseline Insulation for Framed Floors

Location	Nominal Insulation Value ⁵
Over Ambient	R30
Over Garage	R30
Over Unconditioned Basement or Crawlspace	R30

Above Grade Walls

The above grade walls (including those separating conditioned areas and attics, garages, unconditioned stairwells) were reviewed from various sources and compared what was being used in other states. Because the sample included homes from two different climate zones; Climate Zone 5 and Climate Zone 6 (U.S Dept of Energy) the impact evaluation team identified two different UDRH files; one to be used for homes in Climate Zone 5 and one for those in Climate Zone 6. This is the only building component that identifies different values dependent upon climate zone. Otherwise, the two UDRH files are the same.

The following table illustrates the various baseline insulation levels used in other northeastern states as well as the baseline values used for this impact evaluation of the NYESH program.

Table F-3. Baseline Characteristics for Above Grade Walls (separating conditioned space from ambient conditions)

Climate Zone	Framing	Nominal Cavity Insulation Value				
		NY		MA	ME	NH
		NYESH Impact Evaluation Baseline	2007 Reference Design Guide ⁶	Baseline Study 2005 ⁷	Baseline Study 2008 ⁸	Program Baseline 2008 ⁹
CZ 5	2x4 16 o.c.	R13, Grade II	R13, Grade III	R13, Grade II ¹⁰	n/a	n/a
CZ 6	2x6 16 o.c.	R19, Grade II	R19, Grade III	R19, Grade I	R19, Grade II ¹¹	R19, Grade III

⁵ “Energy Conservation Construction Code of New York State”, International Code Council, Inc/New York State Department of State, August 2007

⁶ “Reference Design Guide for Highly Efficient Residential Construction”, VEIC/CSG, July 2007

⁷ “Massachusetts ENERGY STAR Homes: 2005 Baseline Study, Part I: Inspection Data Analysis Final Report”, Nexus Market Research, Inc. May 8, 2006

⁸ Maine Residential New Construction Technical Baseline Study, VEIC et al, Final Report, 2008

⁹ Although there was no source documentation provided by managers of the New Hampshire program the baseline efficiency of shell components were valued in terms of wall assembly U-values which equate to the values shown in the tables.

¹⁰ The 2005 Massachusetts baseline study references recorded wall R-value for a 2x4 with 16” o.c. stud-spacing to be R12.5 which is equivalent to R13 installed at a Grade II quality (not including framing factor).

¹¹ The Maine baseline study reported an average R-value for above grade walls to be R17.5 which is equivalent to an R19 installed at Grade II quality.

RESNET Insulation Grading Protocol

The 2007 Reference Design Guide for Highly Efficient Residential Construction recorded wall characteristics from climate zones 5 and 6 as R13 and R19 (nominal cavity R-value), respectively. This same study also characterizes the wall insulation installation quality to be Grade III. Based upon research in other states of baseline conditions and responses to the non-participant builder survey where builders self-reported 76% of their homes receiving high performance insulation systems. Appendix G contains graphic illustrations of the Grades I, II, and III for wall-cavity insulation grading and is used by HERS raters when performing insulation inspections as per RESNET inspection protocol.

Ceilings

Baseline ceiling insulation is not unique from what is experienced in other northeastern states. The baseline flat ceiling assumption is R35 representing flat ceilings that are typically insulated with a blown-in loose-fill insulation product such as cellulose or blown-in fiberglass. Insulation levels and installation grades for flat and vaulted ceilings are identified by the 2007 Reference Design Guide as R35 Grade II and R29 Grade II, respectively. As mentioned, this is fairly consistent with what is found in neighboring states. However, the other studies shows slightly lower values as shown in the table below and although codes vary from Climate Zone 5 to Climate Zone 6 the average values remain fairly steady across both climate zones. When blown-in, loose-fill insulation is installed during new construction coverage over joists is typical as was the case with the Massachusetts baseline study.

Table F-4. Baseline Characteristics for Ceilings

Ceiling Type	NY		MA	ME	NH
	NYESH Impact Evaluation Baseline	2007 Reference Design Guide ¹²	Baseline Study 2005	Baseline Study 2008	Program Baseline 2008
Flat	R35, Grade II	R35, Grade II	R31.5, Grade II (R34.3 where joists are covered)	R31, Grade II	R30, Grade II
Vaulted	R30, Grade II	R30, Grade II	R31, Grade II	R31, Grade II	R30, Grade II

Door

Typical insulation values for doors ranged from R2.5 to R4.0 from the various sources reviewed. The impact evaluation team used the values recorded in the 2007 Reference Design Guide as the baseline for this evaluation (R-4).

Windows

The Impact Evaluation Team used a baseline U-value for windows of U 0.35 and a solar heat gain coefficient (SHGC) of 0.40 for use in this impact evaluation. This is fairly consistent with the findings of other baseline studies of that time. The Maine and Massachusetts studies each found that the typical U-value of the windows in each of the two studies were 0.36 and 0.37 respectively and the respective SHGC's were 0.353 and 0.45. While the 2007 Reference Design Guide noted that the typical window U-value was 0.47 and the SHGC was 0.40, the results of the Non-Participant Builder Survey showed that ENERGY STAR-labeled windows were installed in new homes 96% of the time in both Climate Zone 5 and Climate Zone 6. Threshold requirements for a window to achieve an ENERGY STAR certification at that time was for the U-value to be 0.35 or lower and in these two climate zones there was no limit on

¹² "Reference Design Guide for Highly Efficient Residential Construction", VEIC/CSG, July 2007

SHGC. Therefore, for the purposes of this impact evaluation the Impact team used the minimum U-Value for ENERGY STAR certification (U-0.35) and the SHGC as documented in the 2007 Reference Design Guide.

For baseline skylight values, the team used those required to comply with the NY statewide energy code¹³. These values are 0.60 and 0.31 for U-value and Solar Heat Gain (SHGC) Coefficient respectively.

Air Infiltration

Building air leakage rates as recorded from the various sources reviewed for this evaluation were recoded in differing units of measure. For example, the Maine baseline study recorded an average blower door result of 2,037 cubic feet per minute at -50 pascals of test pressure (CFM₅₀). This unit of measure does tell us how much air volume is being drawn in from the buildings shell while being held at the test pressure of -50 pascals. However, this unit of measure is not useful if trying to relate one home to another or to determine if this is a “leaky” or “tight” home because this determination is relative to the size and volume of the home being testing. For this reason, air changes per hour, which takes into account the volume of the home is a more reliable unit of measure upon which to base a program standard.

Some reports stated air infiltration in terms of natural air changes per hour (ACH_{nat}). While this may provide a more consistent measure of air-infiltration from one home to another when the same coefficients are applied to blower door results recorded in CFM₅₀. The calculation of natural air changes (ACH_{nat}) from CFM₅₀ includes a certain degree of subjectivity on the part of the rater or analyst when applying the appropriate N-factor to the equation. The N-factor is chosen from a look-up matrix where the analyst chooses the appropriate climate zone¹⁴, number of stories and level of shielding that protects the building (e.g. well-shielded, normal or exposed). The following equation displays the conversion from CFM₅₀ to ACH_{nat}:

$$ACH_{nat} = \frac{CFM_{50} \times 60}{\text{Building Volume (c. f.)}} \times N$$

A more consistent unit for assessing air infiltration for the comparison to other buildings or other levels of air infiltration is air changes per hour at -50 pascals (ACH₅₀) calculated as follows:

$$ACH_{50} = \frac{CFM_{50} \times 60}{\text{Building Volume (c. f.)}}$$

The following table shows the various air infiltration rates found upon review of other studies and their conversion to ACH₅₀.

¹³ “Energy Conservation Construction Code of New York State”, International Code Council, Inc/New York State Department of State, August 2007

¹⁴ This table was developed by the Lawrence-Berkeley National Laboratory and refined by George Tsongas and uses zone identifications that are different than used by the U.S. Dept. of Energy, EPA and RESNET.

Table F-5. Baseline Air Infiltration Rates

	NY		MA	ME	NH
	NYESH Impact Evaluation Baseline	2007 Reference Design Guide ¹⁵	Baseline Study 2005	Baseline Study 2008 ¹⁶	Program Baseline 2008
As Reported		0.50 ACH _{nat}	6.36 ACH ₅₀	2,037 CFM ₅₀	6.72 ACH ₅₀
ACH ₅₀	6.65	6.65 ¹⁷	6.36	5.35	6.72

For this study the Impact Evaluation Team used a baseline air infiltration rate of 6.65 ACH₅₀.

Equipment Location

The baseline assumption for the location of heating and water heating equipment is the same as the compared home. The 2007 Reference Design Guide noted that the typical location of mechanical equipment was in unconditioned spaces. The Massachusetts baseline study showed that over 75% of the space heating equipment was located in unconditioned spaces (e.g. basements and/or attics).

Heating System

For the purposes of this study the baseline home used for the basis of savings estimation included the following assumptions for system type, fuel type, efficiency and size of the space heating equipment.

Table F-6. Space Heating Equipment Baseline Characteristics

Equipment Type	Fuel Type	Efficiency	Source:
Furnace	Natural Gas	90% AFUE	Non-Part. Builder Survey
Boiler	Natural Gas	82% AFUE	Non-Part. Builder Survey
Air Source Heat Pump	Electricity	8.5 HSPF	NYS ECCC, 2007

The Non-participant builders interviewed by APPRISE noted that ENERGY STAR rated space heating equipment is installed in 92% of the cases. Based upon this response and similar results in other baseline studies the impact team decided that the values shown in Table 3-9 are the most appropriate baseline values.

The following table highlights the findings of the review of other baseline studies and assumptions.

¹⁵ “Reference Design Guide for Highly Efficient Residential Construction”, VEIC/CSG, July 2007

¹⁶ Average volume of homes in the Maine study is 22,826 cubic feet.

¹⁷ Conversion to ACH₅₀ was done using an LBL N-factor of 13.3.

Table F-7. Space Heating Equipment Efficiencies from Other Baseline Studies

Equipment Type	NY		MA	ME	NH
	NYESH Impact Evaluation Baseline	2007 Reference Design Guide ¹⁸	Baseline Study 2005	Baseline Study 2008	Program Baseline 2008
Furnace (NG or LP)	90% AFUE	78% AFUE	90.1% AFUE	88.9% AFUE	89.2% AFUE
Boiler (NG or LP)	82% AFUE	n/a	83.9% AFUE	90% AFUE	85.6% AFUE
Air Source Heat Pump	8.5 HSPF	n/a	n/a	n/a	n/a

RESNET Insulation Grading Standards For Above Wall Insulation Quality Grading¹⁹

Grade I: Insulation generally installed according to manufacturers’ instructions and/or industry standards. Grade I installation requires that the insulation material uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging), and is split, installed, and/or fitted tightly around wiring and other services in the cavity. During inspection (typically before drywall is installed), if the exterior sheathing is visible from the building interior through gaps in the cavity insulation material, it is not considered a “Grade I” installation.

To attain a rating of "Grade I", wall insulation shall be enclosed on all six sides, and shall be in substantial contact with the sheathing material on at least one side (interior or exterior) of the cavity.

For exterior applications of rigid insulation, insulation shall be in firm contact with the structural sheathing materials, and tightly fitted at joints to be considered a “Grade I” installation.

For faced batt insulation, Grade I can be designated for side-stapled tabs, provided the tabs are stapled neatly (no buckling), and provided the batt is only compressed at the edges of each cavity, to the depth of the tab itself, and provided it meets the other requirements of Grade I.

For sprayed or blown-in products, density shall be sufficient that the fill material springs back when compressed slightly with a hand or finger, and provided it meets the other requirements of Grade I.

Occasional very small **gaps** are acceptable for “Grade I”.

Compression or incomplete fill amounting to 2% or less, if the empty spaces are less than 30% of the intended fill thickness, are acceptable for “Grade I”.

¹⁸ “Reference Design Guide for Highly Efficient Residential Construction”, VEIC/CSG, July 2007

¹⁹ 2006 Mortgage Industry National Home Energy Rating Systems Standards Residential Energy Services Network (RESNET) and National Association of State Energy Officials

Figure 1: Maximum Compression Allowable for Grade I

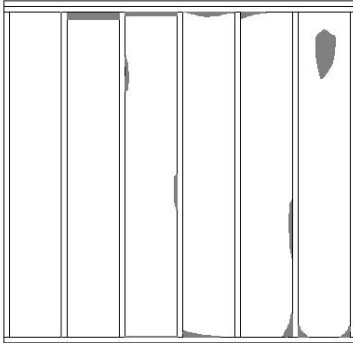
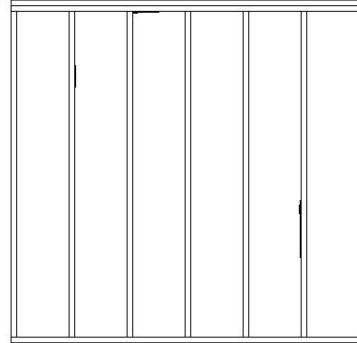


Figure 2: Maximum Gaps for Grade I



Grade II shall be used to describe an installation with moderate to frequent installation defects: gaps around wiring, electrical outlets, plumbing and other intrusions; rounded edges or “shoulders”; or incomplete fill amounting to less than 10% of the area with 70% or more of the intended thickness (i.e., 30% compressed); or gaps and spaces running clear through the insulation amounting to no more than 2% of the total surface area covered by the insulation. To attain a rating of "Grade II", wall insulation shall be enclosed on all six sides, and shall be in substantial contact with the sheathing material on at least one side (interior or exterior) of the cavity.

The following illustrations represent the boundary conditions between Grade II and Grade III, that is, the installation shall be at least this good to be labeled as “Grade II”:

No more than 2% of surface area of insulation missing is acceptable for “Grade II”

No more than 10% of surface area of insulation compressed or incomplete fill, by up to 30% (70% or more of intended thickness) is acceptable for “Grade II”.

Figure 4: Maximum Allowable Compression for Grade II

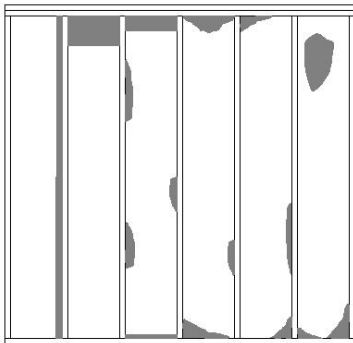
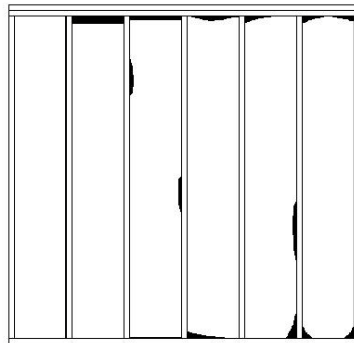


Figure 3: Maximum Allowable Gaps for Grade II



Grade III is an installation with substantial gaps and voids, with missing insulation amounting to greater than 2% of the area, but less than 5% of the surface area is intended to occupy. More than 5% missing insulation shall be measured and modeled as separate building wall components and treated as un-insulated surfaces.

This designation shall include wall insulation that is not in substantial contact with the sheathing on at least one side of the cavity, or wall insulation in a wall that is open (unsheathed) on one side and exposed to the exterior, ambient conditions or a vented attic or crawlspace. The presence of an air-impermeable barrier such as house wrap will be considered to enclose the building cavities.

The following illustration represents the boundary conditions between Grade III and the situation whereby one must measure the un-insulated areas; that is, the installation shall be at least this good to be labeled as “Grade III”:

Figure 5: Maximum Allowable Gaps for Grade III

