New Jersey's Clean Energy Program

Residential New Construction Program Impact Evaluation

FINAL

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1. Executive Summary

The New Jersey Clean Energy Program (NJ CEP) promotes energy efficiency and the use of clean, renewable sources of energy. The Residential Construction Program, known as the New Jersey ENERGY STAR Homes Program, furnishes technical assistance and financial incentives to builders who commit to construct new homes to the standards established by the ENERGY STAR Homes Program. The purpose of this report is to present the findings from the ENERGY STAR Homes Program Impact Evaluation.

1.1 Evaluation Goals

The purpose of the evaluation is to assess the performance of the New Jersey ENERGY STAR Homes Program in terms of energy and demand savings.

- **Program Accomplishments** – The study presents a retrospective assessment of program accomplishments from 2001 through 2006 based on the findings from the program impact evaluation research.
- **New Jersey Clean Energy Program Protocols** – The study makes recommendations for the savings calculation Protocols so that they can furnish accurate statements of energy and demand savings accomplishments.

This study is one of seven NJ CEP impact studies that are intended to give the Board of Public Utilities (BPU), the Office of Clean Energy (OCE), and the ratepayers' information on the performance of the NJ CEP.

1.2 Evaluation Design Approach

The design for this Impact Study focused resources on the research activities that furnished the greatest amount of information for program managers and the BPU. The approach included:

- **Database Analysis** – Development of statistics on ENERGY STAR Builders, Projects, and Homes using the program administration databases.
- **Sample Frames** – Development of Sample Frames for ENERGY STAR Homes and Nonparticipating Homes.

- **Matched Sample** – Selection of matching samples of ENERGY STAR and Nonparticipating builders, projects, and homes.
- **Mail Survey** – Administration of a mail survey to owners of ENERGY STAR and nonparticipating new homes.
- **Utility Usage Data** – Retrieval of electric and gas usage data for CY 2007 for survey respondents who signed authorization forms.
- **REM/Rate™ Data** – Retrieval of REM/Rate™ data (i.e., information on energy specifications and rating data) for ENERGY STAR Homes.
- **Analysis** – Multivariate analysis of available data to assess the performance of the homes constructed with ENERGY STAR Homes incentives, compared to other groups of homes, including: those constructed without incentives by ENERGY STAR Builders and those constructed by nonparticipating builders.

The evaluation focused on those market segments that account for most of the projected savings from the ENERGY STAR Homes Program.

- **Housing Unit Type** – The analysis focused on single family and townhouse units; those homes represent 95% of ENERGY STAR Homes.
- **Production Homes** – The analysis focused on Production Homes; those homes represent 93% of ENERGY STAR Homes.
- **Homes Certified in 2005 and 2006** – The analysis focused on homes certified in 2005 and 2006 to facilitate development of the comparison home sample. Half of all NJ ENERGY STAR Homes were certified in 2005 and 2006.

With the available data, the Impact Evaluation was able to address most of the targeted information goals for the study. However, due to resource limitations, the study was not able to develop information on freeridership and spillover.

1.3 Program Evaluation Findings

The data collected in the evaluation allow us to directly measure the electric and gas usage in ENERGY STAR Homes. In 2005, ENERGY STAR Homes were projected to use at least 30% less energy than the benchmark home built to the existing building code. In 2006, because of the implementation of new building codes and appliance efficiency standards, ENERGY STAR

Homes were projected to use at least 15% less energy than the benchmark home built to the existing building code. The REM/Rate™ projections for the ENERGY STAR homes in our sample estimated that the homes would use about 25% less gas and about 60% less electricity for air conditioning than the benchmark home.

Gross Realization Rates

The first purpose of the analysis was to assess how the ENERGY STAR Homes were performing compared the REM/Rate™ projections. For each group of homes, we compared the projected usage reduction for the home (Reference Home – ENERGY STAR Home) to the measured usage reduction (Reference Home – 2007 Measured Usage). The *Gross Realization Rate* is defined as the ratio of measured savings to projected savings. [Note: For electric usage impacts, we estimated the share of the electric bill that was attributable to air conditioning.]

Table 1-1 presents the findings. The mean *gross realization rates* for gas (therms) were close to 100%; age-restricted housing units were lower than 100% and nonage-restricted units were higher than 100%. The mean *gross realization rate* for electric air conditioning was almost 60%. For three of the housing unit groups, the rate was about 70%, but for the Townhome group, the *gross realization rate* was only 10%.

Table 1-1: Summary of ENERGY STAR Homes Gross Realization Rates[1]
By Housing Unit Type[2] and Fuel

Gross Realization Rate	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhomes	All ENERGY STAR Homes
Mean Therms	92%	74%	112%	132%	101%
Median Therm	101%	121%	130%	165%	129%
Mean kWh	71%	66%	75%	10%	57%
Median KWh	77%	78%	72%	0%	59%

[1] Gross realization rate = Measured savings / Predicted savings.

[2] We segmented the population of homes into four groups to allow us to better examine the way that the different types of homes performed. The four groups were: Age-Restricted Two Story, Age-Restricted One Story, Other Single Family, and Other Townhomes. Our sample sizes were larger for the Age-Restricted housing units because those households were more likely to respond to our mail survey.

Performance of the REM/Rate™ Model

The second purpose of the analysis was to assess the performance of the REM/Rate™ model in terms of modeling different types of housing units. With respect to gas usage, we found that the ratio of measured gas usage to projected gas usage varied from about 0.5 to 1.5. Using a regression analysis, we found a number of factors that appeared to be systematically related to variations in the ratio, including:

- Energy Behaviors – Households that report setting their thermostat above 70 degrees have higher usage and those that report using winter setback have lower usage. There is no way for the REM/Rate™ model to account for those household behaviors.
- Housing Unit Features – Those homes where it was reported that there was a multistory entryway, sunroom, or basement had statistically significant factors in the regression. It may be difficult for the REM/Rate™ model to account for such features.
- HERS Rating – For homes with higher HERS ratings, we found that measured usage was consistently less than projected usage. The implication of the finding is that higher HERS ratings are yielding better results than is projected.[3]

We did not find that a regression analysis helped us to assess factors that affected the ratio of measured air conditioning usage to projected air conditioning usage.

Net Program Impacts

The third purpose of our analysis was to compare usage for homes that received ENERGY STAR incentives to those that are not receiving incentives. For each housing unit type, we compared the survey data to ensure that the homes were similar. In general, our comparison homes matched our ENERGY STAR homes in terms of the most important household and

[3] For the rating system used by New Jersey in 2005 and 2006, a higher HERS score was given to housing units that were projected to have lower energy consumption.

housing unit characteristics. We then compared the 2007 measured usage of the ENERGY STAR homes to the usage for the Comparison Homes.

Table 1-2 shows the findings for the gas usage analysis. On average, the gross impact of the ENERGY STAR program was to reduce gas usage by about 18% compared to the Reference Home. However, the net impact of the program was to reduce gas usage by about 9% compared to the Comparison Homes. For age-restricted two-story homes, there was no apparent difference between the ENERGY STAR homes and the Comparison Homes.

Table 1-2: Summary of ENERGY STAR Homes Gross and Net Percentage Impacts on Gas Usage By Housing Unit Type

Gas Impacts	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhomes	All ENERGY STAR Homes
Gross Mean Therms	24%	17%	18%	41%	18%
Net Mean Therms	0%	10%	10%	11%	9%
Gross Median Therms	28%	23%	32%	47%	29%
Net Median Therms	3%	11%	15%	21%	11%

We also conducted a regression analysis to control for more factors. The findings from that analysis include:

- **Net Impact of ENERGY STAR** - ENERGY STAR Homes use less energy than homes that did not receive ENERGY STAR program incentives. Each HERS point appears to be associated with a 2.8% reduction in the energy usage per square foot.
- **Comparison Homes Energy Performance** - Comparison homes appear to be built to higher standards than the REM/Rate™ Reference Home. The average Comparison Home uses about 7% more per square foot than the average ENERGY STAR Home.
- **ENERGY STAR Builders** – The Comparison Homes built by ENERGY STAR builders did not perform better than those built by non-ENERGY STAR builders.

Table 1-3 shows the findings for the electric air conditioning usage analysis. On average, the gross impact of the ENERGY STAR program was to reduce usage by about 33% compared to the Reference Home (with the exception of the Townhomes). However, the net impact of the program was to reduce usage by about 10%.

Table 1-3: Summary of ENERGY STAR Homes Gross and Net Percentage Impacts on Gas Usage By Housing Unit Type

Gas Impacts	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhomes	All ENERGY STAR Homes
Gross Mean kWh	42%	39%	43%	5%	33%
Net Mean kWh	7%	-7%	33%	8%	10%
Gross Median kWh	46%	48%	47%	-12%	34%
Net Median kWh	4%	4%	35%	-7%	10%

The regression analysis for electric air conditioning usage found no difference between air conditioning electric usage for the ENERGY STAR Homes and the Comparison Homes.

1.4 Findings and Recommendations

The purpose of this evaluation is to assess the performance of the New Jersey ENERGY STAR Homes Program in terms of energy and demand savings, including a retrospective assessment of program accomplishments and recommendations for updates to the New Jersey Clean Energy Protocols. In general terms, this evaluation finds that ENERGY STAR Homes achieve the gas energy savings that are projected by the REM/Rate™ model and achieve about three-fourths of the air conditioning electric savings that are projected by the REM/Rate™ model. However, the net program impacts for the 2005 and 2006 ENERGY STAR Homes are considerably smaller than the gross program impacts. While ENERGY STAR Homes use considerably less gas and electricity than the REM/Rate™ Reference Homes, the differences between ENERGY STAR Homes and Comparison Homes that are built without ENERGY STAR incentives are considerably smaller than the differences projected by the REM/Rate™ model.

Based on the findings from the evaluation, we make the following recommendations with respect to the New Jersey ENERGY STAR Homes Program.

- **Program Accomplishments** – The evaluation demonstrates that the ENERGY STAR Homes are achieving the electric and gas usage savings established by the REM/Rate™ model. Until additional information is available on freerider and spillover effects, it is appropriate to leave the program accomplishments as stated in previous New Jersey Clean Energy Program Reports.

- **Protocol Revisions** – It appears that the new homes market in New Jersey has been transformed so that all new homes in the current ENERGY STAR Homes market segments are constructed to the minimum ENERGY STAR standards in place prior to the 2007 upgrades. From that perspective, homes being constructed with incentives from the ENERGY STAR Homes Program should be using the 2006 ENERGY STAR standards as the "Reference Home,"
- **Program Incentives** – ENERGY STAR Homes Program incentives should be focused on encouraging higher levels of savings in the existing market segments. Alternatively, it might be appropriate to allocate resources to market segments that have not yet been addressed by the ENERGY STAR Homes Program.
- **REM/Rate™ Revisions** – It may be appropriate to examine how well the REM/Rate™ model is performing with respect to certain housing unit features and to change the final ratings for home that include features that detract from a home's energy performance.

Table 1-4 presents the specific recommendations with respect to the New Jersey Clean Energy Program Protocols.

Table 1-4: ENERGY STAR Homes Protocol Findings and Recommendations

Issue	Findings	Recommendation
Validate Clean Energy Program Protocols for 2001-2006.	2005 and 2006 ENERGY STAR Homes achieved the Therm and kWh savings projected by the Protocols.	Confirm that the 2001-2006 Therm and kWh savings were achieved by the ENERGY STAR Homes Program.
	No new information was developed on demand impacts of the program.	Continue to use the 2001-2006 KW savings unless additional information is developed.
Assess whether freerider and spillover adjustments to the Clean Energy Program Protocols are appropriate.	Freerider and spillover research was not funded. The study found that nonparticipating homes are more efficient than the "reference home." This finding could indicate that ENERGY STAR homes are freeriders or that there is substantial spillover to the non-participants.	Continue to make the assumption that the net to gross ratio for the ENERGY STAR Homes Program is 1.0. Consider funding research on freeridership and spillover.
Propose Clean Energy Program Protocols for 2007 and later.	A matching sample of nonparticipating homes was as efficient as the homes that met the minimum ENERGY STAR Standard.	Make the reference home in the REM/Rate™ equal to the ENERGY STAR home. Since important program revisions were implemented in 2006, consider funding research on the performance of ENERGY STAR Homes built in 2007 and later.

2. Introduction

The New Jersey Clean Energy Program (NJ CEP) promotes energy efficiency and the use of clean, renewable sources of energy. The Residential Construction Program, known as the New Jersey ENERGY STAR Homes Program, furnishes technical assistance and financial incentives to builders who commit to construct new homes to the standards established by the ENERGY STAR Homes Program. In 2007, 6,180 new homes in New Jersey were built to ENERGY STAR standards under the New Jersey Clean Energy Program.

The purpose of this report is to present the findings from the ENERGY STAR Homes Program Impact Evaluation. The report provides background information on the program, describes the data collection and analysis methodology, and presents the findings with respect to energy impacts of the program. In addition, the report furnishes recommendations with respect to protocols for tracking the savings associated with the program.

2.1 Background

The New Jersey ENERGY STAR Homes Program was first implemented under individual utility DSM programs in the 1990s. The program has grown substantially under the NJ CEP, expanding from 746 homes in 1999 to 8,009 homes in 2005. For 2005, the program accounted for 42% of total tracked gas savings for the portfolio under evaluation, 1.4% of electric savings, and 23% of the electric demand savings. Even with recent declines in residential new construction, 5,509 ENERGY STAR Homes were built in 2006 and 6,180 ENERGY STAR Homes were built in 2007. The 6,180 ENERGY STAR Homes represented about 27% of the 23,140 Certificates of Occupancy issued in 2007.

The New Jersey ENERGY STAR Homes Program has been changed in several important ways since it became part of the NJ CEP portfolio in 2001.

- **Smart Growth Areas** – In 2003, the use of program incentives was restricted to areas designated for growth under the State Development and Redevelopment Plan.
- **MEC 95** – The adoption of MEC 95 building energy codes in July 2002 resulted in a change in the characterization of reference homes in the REM/Rate™. One set of

values was used for the period from January 2001 through March 2003. A second set of values was used from April 2003 to present.

- **Efficiency Standards** – In January 2006, the U.S Department of Energy issued new minimum efficiency standards for residential heat pumps and air conditioners, again resulting in changes the default values for reference homes.
- **IECC** – The adoption of the IECC building energy codes in 2006 further increased the standards for the reference homes.
- **Program Update** – In 2006, New Jersey participated in the nationwide update of the EPA ENERGY STAR Homes program and introduced a number of program enhancements. Most of those enhancements were implemented for homes constructed starting in 2007.

There are several other factors that are relevant to understanding the New Jersey ENERGY STAR Homes Program and measuring the program impacts.

- **Program Overlap** – In addition to the ENERGY STAR Homes Program, the NJ CEP portfolio also includes the *WarmAdvantage and CoolAdvantage* Programs that offer rebates for installation of high efficiency cooling systems and heating systems. The incentives are available to newly constructed homes in geographic areas designated for growth. We can expect that homes that do not participate in the ENERGY STAR Homes program, but that have received incentives for high efficiency furnaces and air conditioners will use more energy than ENERGY STAR Homes, but less energy than homes that do not participating in either program.
- **Builder Practices** – In New Jersey, ENERGY STAR builders that construct new homes outside areas designated for growth cannot receive NJ CEP incentives for either the ENERGY STAR Home or for the high efficiency HVAC equipment. However, the 2006 study by Summit Blue Consulting – *Energy Efficiency Market Assessment of New Jersey Clean Energy Programs: Book II – Residential Programs* – reported that many participating builders indicated that they are building all of their homes in New Jersey to ENERGY STAR standards, and that a number of builders are getting 100% of their New Jersey Homes ENERGY STAR certified.

This information about the NJ CEP programs, the ENERGY STAR Homes program, and the general new homes market in New Jersey was addressed in the program evaluation plan.

2.2 Evaluation Goals

The purpose of the evaluation is to assess the performance of the New Jersey ENERGY STAR Homes Program in terms of energy and demand savings.

- **New Jersey Clean Energy Program Protocols** – The study makes recommendations for the savings calculation Protocols so that they can furnish accurate statements of energy and demand savings accomplishments.
- **Program Accomplishments** – The study presents a retrospective assessment of program accomplishments from 2001 through 2006 based on the findings from the program impact evaluation research.

This study is one of seven NJ CEP program impact studies that are intended to give the Board of Public Utilities (BPU), the Office of Clean Energy (OCE), and the ratepayers' information on the performance of the NJ CEP.

2.3 Organization of Report

Three sections follow this introduction.

- Section II – Evaluation Design and Implementation
- Section III – Program Evaluation Findings
- Section IV – Findings and Recommendations

APPRISE prepared this report under contract to the New Jersey Board of Public Utilities. Program data for ENERGY STAR Homes was furnished by MaGrann Associates and JCP&L. PSE&G, Connectiv, and JCP&L furnished electric usage data for a sample of ENERGY STAR Homes and comparison homes. PSE&G, NJNG, SJG, and Elizabethtown Gas furnished gas usage data for a sample of ENERGY STAR Homes and comparison homes. MaGrann Associates and EAM furnish REM/Rate™ data for a sample of ENERGY STAR Homes. We appreciate the responsiveness of all of these organizations to our data requests. Please note that any errors or omissions in this report are the responsibility of APPRISE. The statements, findings, conclusions, and recommendations are solely those of the analysts from APPRISE and do not necessarily reflect the views of the NJ BPU, the Office of Clean Energy, the ENERGY STAR Homes Program Implementers, or the New Jersey electric and gas companies.

3. Evaluation Design and Implementation

This section of the report presents information on the design and implementation of the Impact Evaluation. The goals of the evaluation are to assess the performance of the New Jersey Energy Savings Protocols for the ENERGY STAR Homes Program; to verify the accomplishments of the program for the period 2001 through 2006 and to make recommendations that would increase the accuracy of the Protocols in the future. In this section, we describe how the evaluation made use of the information available from program implementation databases, owners of new homes, and gas and electric usage records to address the study goals.

3.1 ENERGY STAR Homes Population

The target population of ENERGY STAR Homes for the Impact Study is homes constructed with NJ CEP incentives during the period from January 2001 to December 2006. Table 3-1 shows the number of homes constructed and the estimated program impacts for those homes. The program grew consistently during the period from 2001 through 2005, both in terms of the number of homes and the percent of homes certified for occupancy in New Jersey. In 2006, the total number of homes declined, and the market share fell from about 26% in 2005 to 19% in 2006. In 2007, 6,180 homes were constructed, 27% of all new homes certified for occupancy in New Jersey.

Table 3-1: ENERGY STAR Homes Program Statistics – 2001 to 2006

	2001	2002	2003	2004	2005	2006
Homes	0	1,881	4,936	5,974	8,009	5,509
Market Share	N/A	6%	18%	21%	26%	19%
MWh Savings	119	3,262	4,773	4,551	6,132	5,181
MW Savings	0	3.4	11.2	14.9	18.9	3.3
Dtherm Savings	356	83,638	136,914	183,693	239.568	164,504

The estimated program impacts were specified by the Energy Saving Protocols. The estimated MWh savings and Dtherm Savings are a direct output from the REM/Rate™ modeling program for each home. The demand savings are estimated from the projected kWh savings using factors established from previous studies of homes in New Jersey. The year-to-year changes in the program impacts are, in part, a function of the number of homes constructed. However,

those changes also were affected by changes to the reference home parameters associated with the policy changes discussed in Section I. The most significant change was evident in 2006. The change in minimum efficiency standards for air conditioners and heat pumps significantly reduced the estimated electric kWh and demand impacts of the program for 2006.

Prior to 2007, each electric utility was responsible for reporting statistics for the ENERGY STAR Homes constructed in its service territory. There is no single database that can be used to describe the population of ENERGY STAR Homes. However, we can develop statistics from two sources. MaGrann Associates was responsible for data management for homes constructed in the service territories of PSE&G, Rockland Electric, and Connectiv. In addition, MaGrann was responsible for data management on a statewide basis for certain builders. JCP&L was responsible for data management in its service territory and on a statewide basis for certain builders.

Some key statistics that can be developed from the data tracked by MaGrann includes:

- **Builders** – 152 builders constructed one or more ENERGY STAR Homes. The average number of homes per builder was 42. The top 20 builders constructed 71% of all ENERGY STAR Homes tracked by MaGrann.
- **Projects Type** – 67% of homes were in single family projects, 26% of homes were in mixed developments, and 7% of homes were in multifamily developments.
- **Housing Unit Size** – The median housing unit size was 1,872 square feet and the average housing unit size was 1,964 square feet.

Some key statistics that can be developed from the data tracked by JCP&L includes:

- **Builders** – 128 builders constructed one or more ENERGY STAR Homes. The average number of homes per builder was 24. The top 20 builders constructed 89% of all ENERGY STAR Homes tracked by JCP&L.
- **Projects Type** – 84% of homes were in single family projects, 15% of homes were in mixed developments, and 1% of homes were in multifamily developments.
- **Housing Unit Size** – The median housing unit size was 2,532 square feet and the average housing unit size was 3,130 square feet.

These statistics indicate that most ENERGY STAR Homes built in New Jersey are single family or townhouse units constructed by production builders.

3.2 Evaluation Design Requirements

The goal of the evaluation is to measure the reduction in electric consumption, electric demand, and gas consumption that resulted from the implementation of the ENERGY STAR Homes program. For the 2001-2006 NJ CEP reports, the reported program impacts are the modeled impacts output from the REM/Rate™ software. The current program impact estimates do not make any freerider or market spillover adjustments.

Program Impact Measurement Issues

There are a number of reasons why the actual program impacts may differ from the model outputs.

- **Performance of ENERGY STAR Homes** – The energy consumption and energy demand for ENERGY STAR Homes may be different from the modeled estimates. Since the model cannot account for all conditions, there will be situations where the home uses less energy than projected and others where the home uses more energy than projected.
- **Performance of Reference Homes** – The modeled energy consumption of the reference home may be greater than or less than the energy consumption for the home that would have been built without the ENERGY STAR Homes Program. The use of a "reference home" suggests that all new homes would have been built according to the energy code in place at the time of construction. However, some builders may choose to construct homes that exceed those standards and consume less energy, while others may comply with the code requirements but have poor construction quality control that results in homes that consume more energy.
- **Market Spillover** – In addition to the direct impact on the homes constructed with program incentives, the ENERGY STAR Homes program also can have broader market impacts. Homes constructed by ENERGY STAR Builders that do not receive program incentives may use less energy as a result of company-wide improvement in home specifications or building practices. In addition, nonparticipating builders may feel a need to improve certain home specifications and/or building practices to compete with builders of ENERGY STAR Homes.

Accurate measurement of the impacts of the New Jersey ENERGY STAR Homes Program requires that we address these issues in our approach to the evaluation.

Measuring Direct Program Impacts on Electric and Gas Usage

To verify that the current Energy Savings Protocols are accurately estimating direct program impacts on electric and gas usage in participating homes, several measurements are needed.

- **Consumption of ENERGY STAR Homes** – The evaluation needs to measure the electric and gas consumption of ENERGY STAR Homes and compare consumption to REM/Rate™ model estimates.
- **Consumption of Reference Homes** – The evaluation needs to measure the electric and gas consumption of Reference Homes and compare consumption to REM/Rate™ model estimates.
- **Preprogram Builder Practices [Free Rider Estimate]** – The evaluation needs to assess the electric and gas consumption of homes the builder would have constructed if the program incentives were not available.

This is the set of information that is needed to furnish estimates of the direct impacts (gross and net) of the ENERGY STAR Homes Program on electric and gas usage.

Measuring Direct Program Impacts on Electric Demand

To verify that the current Energy Savings Protocols are accurately estimating direct program impacts on electric demand of participating homes, several measurements are needed.

- **Peak Demand of ENERGY STAR Homes** – The evaluation needs to measure the peak electric demand of ENERGY STAR Homes.
- **Peak Demand of Reference Homes** – The evaluation needs to measure the peak electric demand of Reference Homes.
- **Preprogram Builder Practices [Free Rider Estimate]** – The evaluation needs to assess the electric demand of homes the builder would have constructed if the program incentives were not available.

This is the set of information that is needed to furnish estimates of the direct impacts (gross and net) of the ENERGY STAR Homes Program on electric demand.

Measuring Program Spillover

There are two types of market spillover that might result from the implementation of the ENERGY STAR Homes Program in New Jersey.

- **Participating Builder Spillover** – Some ENERGY STAR Homes builders commit to construct all homes to program standards. Others make decisions on a project-by-project basis. In New Jersey, this can lead to two forms of market spillover.
    - **Non-Growth Areas** – In New Jersey, only those homes constructed in areas designated for growth can receive program incentives. To the extent that a builder commits to build all homes in the state to ENERGY STAR standards, the program impacts will exceed the direct impacts from homes built with program incentives.
    - **Builder Practices** – Those builders that do not construct nonparticipating homes to ENERGY STAR standards may find it more efficient to change basic building specifications or construction practices on a statewide basis in a way that partially meets ENERGY STAR standards.
- **Nonparticipating Builder Spillover** – In some market segments, nonparticipating builders may find that they need to upgrade their home specifications and/or building practices to complete effectively with ENERGY STAR builders.

This is the set of information that is needed to furnish estimates of the indirect impacts of the ENERGY STAR Homes Program on electric and gas usage, and electric demand.

3.3 Evaluation Design Approach

The evaluation design for this Impact Study focused available resources on research activities that would furnish the greatest amount of information for program managers and the BPU. The basic approach included:

- **Database Analysis** – Development of statistics on ENERGY STAR Builders, Projects, and Homes using the program administration databases.
- **Sample Selection** - ENERGY STAR Homes
    - Selection of a sample of ENERGY STAR Homes Builders.
    - Selection of a sample of ENERGY STAR Homes Projects
    - Selection of a sample of ENERGY STAR homes.
    - Retrieval of project characteristics data from the Hanley-Wood database.
- **Sample Selection** - Nonparticipating Homes
    - Selection of nonparticipating projects that matched selected ENERGY STAR projects in terms of housing unit characteristics and demographics on the Hanley-Wood database.
    - Retrieval of address information for homes constructed during the target analysis period.
    - Selection of a sample of nonparticipating homes.
- **Mail Survey** – Administration of a mail survey to owners of ENERGY STAR and nonparticipating new homes. Retrieval of authorization forms for release of utility electric and gas usage records.
- **Utility Usage Data** – Retrieval of electric and gas usage data for CY 2007 for survey respondents with signed authorization forms.
- **REM/Rate™ Data** – Retrieval of REM/Rate™ data for ENERGY STAR Homes with completed interviews.
- **Analysis** – Multivariate analysis of available data to assess the performance of the homes constructed with ENERGY STAR Homes incentives, compared to other groups of homes, including: those constructed without incentives by ENERGY STAR Builders and those constructed by nonparticipating builders.

As will be discussed below, there were certain resource, data, and information barriers that affected the design and implementation of the impact evaluation. These include:

- **Resource Limits** – The resources available for the Impact Evaluation were restricted to measurement of direct program impacts using survey and billing data.
    - Builder Interviews – Options for interviews with participating and/or nonparticipating builders were not funded. This affected the procedures used for measurement of freerider and market spillover effects.
    - On-Site Metering – Resources were not available to directly measure peak demand for a sample of homes.
- **Usage Data Confidentiality** – Since program participants for ENERGY STAR Homes are builders (not homeowners), the New Jersey electric and gas utilities required data release authorization forms for both participating and nonparticipating homeowners.

However, with the available data, the Impact Evaluation was able to address many of the targeted information goals for the study. The study design elements are discussed in the following.

Database Analysis

Using program databases made available from MaGrann Associates and JCP&L, we were able to extract basic information on ENERGY STAR Homes. Some key statistics that we developed includes:

- **Builders** – 280 builders constructed one or more ENERGY STAR Homes. The average number of homes per builder was 35. The top 20 builders constructed 63% of all ENERGY STAR Homes.
- **Projects** – 98% of homes were in multiunit developments. 93% of homes were in multiunit developments of 10 or more homes.
- **Projects Type** – 72% of homes were in single family projects, 23% of homes were in mixed development, and 5% of homes were in multifamily developments.
- **Housing Unit Size** – The median housing unit size was 2,035 square feet and the average housing unit size was 2,279 square feet.

The database analysis furnished information that was important to both the design and implementation of the Impact Evaluation.

- **Focus on Single Family Homes and Townhouses** – Based on the analysis of the program database, the decision was made to focus on Single Family Homes and Townhouses.
    - **Program Focus** – The NJ ENERGY STAR Homes Program is more focused on single family and townhouse units. 95% of the ENERGY STAR Homes were single family homes or townhomes.
    - **Measurement Issues** – For most multifamily projects, each individual unit has its own HVAC system. To effectively measure usage in the building would require a well-distributed sample of the homes in each building. With the requirement to obtain authorization forms for release of usage data, there was no way to effectively measure the energy performance of those units.
- **Focus on Production Homes** – Our analysis found that 93% of ENERGY STAR Homes were in projects with 10 or more units. Since we had a data source that could furnish a sample of projects that were comparable to the ENERGY STAR projects, we decided to focus on projects with 10 or more units.
- **Focus on Homes Certified in 2005 and 2006** – Our analysis found that about half of ENERGY STAR Homes were certified in 2005 and 2006, and that about three-fourths of Homes were certified in 2004-2006. Since we were able to locate a source of comparison homes for the 2005 and 2006 periods, were restricted our analysis to Home certified in 2005 and 2006. The findings for the 2006 homes are use to assess the accuracy of 2006 Protocol estimates. The findings for the 2005 homes are used to assess the accuracy of the 2004 and 2005 Protocol estimates. Adjustments to the findings for the 2005 homes are used to assess the accuracy of the 2002 and 2003 Protocol estimates.

The Impact Evaluation resources were focused on collection and analysis of data for the housing unit types that represented most ENERY STAR Homes and for homes certified during a period for which we could obtain valid comparison data.

Sample of ENERGY STAR Homes

The following procedures were used to select a sample of ENERGY STAR Homes from the program databases.

- **Builder Sample** – We selected a sample of 74 builders that was proportional to the number of ENERGY STAR Homes the builder constructed. The top 29 builders were selected with certainty. Of the remaining 325 builders, 45 were selected. The average measure-of-size interval for the non-certainty builders was 13 homes.
- **Project Sample** – We selected a sample of 103 projects that was proportional to the number homes certified in the project. The top 24 projects were selected with certainty. The average measure-of-size interval for the non-certainty projects was 9 homes.
- **Homes Sample** – We selected a sample of ENERGY STAR Homes from each project. For the certainty projects, we targeted a number of completed interviews that was proportional to the number of ENERGY STAR Homes in the project. For the non-certainty projects, we targeted 2 completed interviews.
- **Hanley-Wood Data** – We characterized each project in terms of key project, housing unit, and household information, including geography, average home value, average home size, housing unit type, main heating fuel, heating type, and age-restricted status. Those data were then used to select a purposive sample of comparison homes

The sample includes 74 builders, 103 projects, and 1,210 ENERGY STAR Homes.

Sample of Comparison Homes

The following procedures were used to select a purposive sample of Comparison Homes.

- **Project Sample** – Using the Hanley-Wood data, we selected a sample of 77 projects that matched the sample of ENERGY STAR Projects, but was not in the ENERGY STAR Program databases.
- **Address Retrieval** – By contacting local municipalities and using public records, we were able to identify addresses for homes that were constructed in 2005 and 2006 in the sampled projects.
- **Homes Sample** – We selected a sample of Comparison Homes from each project. For each project, we targeted the number of completed interviews that was targeted for the “matching” ENERGY STAR Homes Project.

- **Characterization** – We characterized each project with respect to whether it was constructed by an ENERGY STAR builder or a nonparticipating builder.

The sample includes 71 projects and 1,227 Comparison Homes.

Mail Survey

The following survey administration procedures were implemented.

- **Advance Letter** – APPRISE sent an advance letter explaining about the project and the survey. The mailing included a letter from the NJ BPU OCE encouraging survey participation.
- **First Mailing** – The first survey mailing included a cover letter, the survey, and a postage paid envelope to return the survey.
- **Postcard** – We sent a follow-up postcard to remind the respondent to return the survey approximately one week after mailing the survey.
- **Second Mailing** – The second survey mailing included a cover letter, a second copy of the survey, and a postage paid envelope.
- **Authorization Form Follow-Up** – If a respondent returned the survey without signing the Authorization Form, we sent the respondent a cover letter with the Authorization language and a postage paid envelope.

We obtained 352 completed ENERGY STAR Home surveys with authorization forms. The response rate was approximately 29%.

We obtained 344 completed Comparison Home surveys with authorization forms. The response rate was approximately 28%.

Electric and Gas Usage Data

We submitted requests to six electric and gas utilities for usage data for all ENERGY STAR Homes and Comparison Homes with completed surveys and authorization forms. Requests were sent to PSE&G, Elizabethtown Gas, NJNG, SJG, JCP&L, and Connectiv. The data request included the customer name, account number (where available), and the signed Authorization Form. We received data from all utilities. We received both the gas and electric

records for 549 of the 696 survey respondents. We received gas records for an additional 34 survey respondents. We received electric records for an additional 73 survey respondents.

REM/Rate™ Data

We submitted requests to MaGrann Associates and EAM for REM/Rate™ data for all ENERGY STAR Homes with completed surveys. The requested data included the *ENERGY STAR Home Verification Summary*, the *Energy Cost and Feature Report (HERS)*, and the *Fuel Summary (HERS)*. We received data from both contractors. We received the data for 259 of the 352 ENERGY STAR Homes survey respondents.

Summary of Data Collection Procedures

Table 3-2 presents information on the success of the data collection procedures. Starting with a sample of 1,210 ENERGY STAR Homes, we completed 352 interviews with Authorization Forms, a 29% response rate. We obtained all required data for 71% of the completed interviews. Starting with a sample of 1,227 Comparison Homes, we completed 344 interviews with Authorization Forms, a 28% response rate. We obtained all required data for 75% of the completed interviews. The most significant attrition problem was with the completion of the mail survey. Despite using appropriate response enhancement procedures, we were only able to achieve an average 29% response rate. The major barrier to survey response was completion of the Authorization Form. To some extent, concerns about non-response bias are reduced because both the ENERGY STAR Homes respondents and the Comparison Home respondents had similar response rates.

Table 3-2: Data Collection Statistics

	ENERGY STAR	Comparison
Builders	74	42
Projects	103	67
Sample of Homes	1,210	1,227
Surveys Completed	365	345
Authorization Forms	352	344
Utility Data		
Electric Data	325	297
Gas Data	304	279
REM/Rate Data	259	N/A
Homes with All Data	251	259
Percent of Homes will All Data	71%	75%

4. Program Evaluation Findings

The data collected in the evaluation allows us to directly measure the electric and gas usage in ENERGY STAR Homes, to compare the observed usage to the usage predicted by the REM/Rate™ models, and to compare the observed usage to comparison homes. In this section of the report we discuss the findings from those analyses.

4.1 ENERGY STAR Homes – Population Segments

The homes constructed using ENERGY STAR Homes program incentives may not be typical of newly constructed homes in New Jersey. Hanley-Wood has developed a database that covered about half of the new construction projects in New Jersey for 2006. Using that database, we were able to develop a comparison shown in Table 4-1 between all new homes in New Jersey and those constructed in projects using ENERGY STAR Homes program incentives. From that analysis, the most important difference is that almost half of the ENERGY STAR homes projects are coded as "age restricted" while only 31% of the overall population of housing units is coded that way. ENERGY STAR homes also are more likely to be single family homes (61% for ENERGY STAR vs. 46% for all homes) and are slightly larger (2,296 square feet for ENERGY STAR vs. 2,166 for all homes). We also found that the ENERGY STAR homes had slightly lower sales prices ($436,000 for ENERGY STAR vs. $482,000 for all homes).

Table 4-1: Characteristics of New Homes in New Jersey – 2006

Comparison of ENERGY STAR to All Homes

	ENERGY STAR (H-W Data for ENERGY STAR Project Sample)	All Homes (Hanley-Wood Data for all Projects in Database)
Number of Homes	2,652	11,530
Average Sales Price	$435,767	$481,591
Average Square Footage	2,296	2,166
Percent Age Restricted	50%	31%
Percent Single Family	61%	46%
Percent Gas Heat	100%	91%

Because the ENERGY STAR Homes are different from the average home in New Jersey, it is important for the evaluation to develop a comparison sample of homes that more closely "matches" the population of ENERGY STAR Homes. It also is true that, within the ENERGY

STAR Homes population, there are groups of homes that can be expected to perform quite differently because of their design and demographics. A one story home on a slab will have different energy properties than a two-story home with a basement. A townhouse with connecting walls also will be quite different.

To make it easier to assess the performance of the ENERGY STAR homes, we have segmented the population into four groups – Age-Restricted One-Story, Age-Restricted Two-Story, Other Single Family, and Other Townhomes. Among analysis sample of age-restricted homes, about 60% are one-story and 40% are two-story. Among our other homes, about 55% are single family and about 45% are townhomes. Table 4-2 furnishes some key statistics for the four population segments. Among the age-restricted homes, income is somewhat lower for the age-restricted one-story compared to the age-restricted two-story. The single family homes are much larger and more expensive than the other three groups. They have more household members and are much more likely to have a basement. The townhouses about the same size as the age-restricted homes, but are significantly more expensive and have larger household sizes.

Table 4-2: Basic Characteristics of ENERGY STAR Home Segments

	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhouse
Number	88	131	63	52
Mean Price (H-W)	$394,567	$401,100	$594,895	$584,580
Mean SF (H-W)	2,090	2,039	2,968	2,054
% Two-Story	100%	0%	90%	96%
% w/Basement	6%	8%	75%	35%
Household Members	2.1	1.9	3.2	2.6
Income GT $100,000	52%	25%	60%	52%

The survey with the occupants of the ENERGY STAR Homes asked them to characterize their homes in terms of some housing unit characteristics that might have a significant impact on energy usage. Table 4-3 furnishes some key statistics for the four population segments. The two-story age-restricted units are the most likely to have cathedral ceilings and sun rooms. These features are difficult to build in a way that maintains the energy integrity of the structure. The other single family homes are likely to have a multi-story entryway, a room over the garage, and a cathedral ceiling. The majority of homes of all types report that they have few or no

CFLs. However, they also report that over half of their major appliances (refrigerator, clothes washer, dishwasher, freezer, and dehumidifier) are ENERGY STAR labeled.

Table 4-3: Energy Characteristics of ENERGY STAR Home Segments

	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhouse
Number	88	131	63	52
Multistory Entryway	33%	9%	46%	15%
Room Over Garage	11%	21%	52%	65%
Wall 1/3 Glass	30%	22%	14%	29%
Cathedral Ceiling	83%	37%	57%	35%
Sun Room	43%	45%	29%	6%
Few or No CFLs	63%	63%	65%	52%
Mean # ENERGY STAR Appliances	2.8	2.9	2.7	2.6
Outdoor Lighting	63%	59%	62%	54%

The survey with the occupants of the ENERGY STAR Homes asked them to characterize their energy using behavior. Table 4-4 furnishes some key statistics for the four population segments. The energy using behaviors are similar for all groups. The median winter thermostat settings are 69 to 70 degrees. The occupants of age-restricted housing are somewhat more likely to setback their thermostats at night. The median summer thermostat settings are 72 to 73. The occupants of townhouses are less likely to be home at least 11 hours on a weekday.

Table 4-4: Energy Using Behaviors of ENERGY STAR Home Segments

	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhouse
Number	88	131	63	52
Mean # Electronic Devices	7.2	5.6	8.2	7.3
Median Winter Daytime Temperature	69.0	70.0	69.0	69.5
Median Winter Nighttime Temperature	66.5	66.0	68.0	68.5
Median Summer Daytime Temperature	72.0	72.0	73.0	72.0
Median Summer Away Temperature	77.0	76.0	78.0	76.5
At Home 11 Hours or More Weekdays	60%	61%	57%	38%

The survey with the occupants of the ENERGY STAR Homes asked them to report their satisfaction with the energy performance of their homes. Table 4-5 furnishes some key statistics for the four population segments. There are many similarities among the groups. A significant percentage of all groups (17% to 44%) that some rooms are too hot or too cold in the winter (winter discomfort), that some rooms are too hot or too cold in the summer, and that they have cold floors in the winter. Each of these reports might be indicators that they home is not performing as well as it should. Comparatively few of the occupants report that their homes have "condensation on the inside of windows" or "noticeable drafts." With the exception of townhouse occupants, about two-thirds of the occupants are aware that their homes are ENERGY STAR certified. Only about one-third of townhouse occupants are aware that their home is ENERGY STAR certified.

Table 4-5: Satisfaction of ENERGY STAR Home Segments

	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhouse
Number	88	131	63	52
Winter Discomfort (Always/Frequently)	34%	24%	25%	44%
Summer Discomfort (Always/Frequently)	22%	10%	21%	37%
Cold Floors (Always/Frequently)	24%	25%	17%	17%
Condensation (Always/Frequently)	3%	2%	3%	4%
Drafts (Always/Frequently)	8%	13%	8%	17%
Quiet (Very)	63%	61%	43%	52%
Well-Built (Very)	44%	44%	35%	42%
ENERGY STAR (Yes)	67%	69%	68%	38%

The analysis of the survey data illustrates that the most significant differences among the four groups are the feature of the housing units. The age restricted units are more likely to have cathedral ceilings and sunrooms. The occupants of age-restricted units are more likely to setback thermostats in the winter. The other units are more expensive, are more likely to have a basement, and are more likely to have a room over the garage. In addition, the single family homes are significantly larger than the other three groups. Of all groups, the townhouse occupants are least likely to be aware that their home was certified by the ENERGY STAR homes program.

4.2 Evaluation Findings – REM/Rate™ Projected vs. Actual Energy Consumption

As part of the ENERGY STAR Homes process, individual homes are modeled through the REM/Rate™ software to assess the expected usage of the homes compared to the reference home. For the interviewed homes, we obtained the REM/Rate™ files from MaGrann and EAM. Using these data, we can compare the projected energy usage for the homes to the measured energy usage available from utility billing data.

Table 4-6 furnishes information on gas usage for the Age-Restricted Two-Story Homes. The table shows the REM/Rate™ gas usage projections for the Reference Home, the REM/Rate™ gas usage projections for the ENERGY STAR Home, and the measured gas usage for 2007. The statistics we present include the mean value, the median value, and a trimmed mean.[4] For the age-restricted two story homes in the sample, the REM/Rate™ model predicts gas usage for ENERGY STAR homes to be about 25% lower than for the reference home. Our measured usage for those homes finds that it is about the same as the usage projected by REM/Rate™ for ENERGY STAR homes.

Table 4-6: Gas Consumption for Age-Restricted Two-Story Homes (N=75)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean Therms	1404	1056	75%	1076	77%	92%
Median Therms	1488	1102	74%	1079	73%	101%
Trimmed (N=75)	N/A	N/A	N/A	N/A	N/A	N/A

For this group, the gross realization rate is in the range of 90% to 100%. There are a number of reasons why the net realization rate may be different from this initial measurement. There were 9% fewer heating degree days in 2007 than the long term heating degree days. The number of household members in this group is significantly lower than what was assumed by

[4] The trimmed mean for gas consumption exclude units with less than 200 therms or more than 2,000 therms. This excludes about 5% of the cases. The trimmed mean for electric consumption excludes units with less than 2,000 kWh or more than 20,000 kWh. This excludes about 5% of the cases.

the REM/Rate™. However, the gross realization rate suggests that this group of ENERGY STAR homes is performing at about the projected level.

Table 4-7 furnishes information on estimated electric air conditioning usage for the Age-Restricted Two-Story Homes.[5] For the age-restricted two story homes in the sample, the REM/Rate™ model predicts usage for ENERGY STAR homes to be about 59% lower than for the reference home. Our measured usage for those homes finds that it is about 42% lower than the usage projected by REM/Rate™ for the reference home, but 40% higher than the usage projected by REM/Rate™ for the ENERGY STAR home.

Table 4-7: Air Conditioning Usage for Age-Restricted Two-Story Homes (N=70)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean kWh	2912	1196	41%	1683	58%	71%
Median kWh	2895	1172	40%	1552	54%	77%
Trimmed (N=69)	2914	1198	41%	1697	58%	71%

For this group, the gross realization rate is in the range of 71% to 77%. However, there are a number of reasons why the net realization rate may be different from this initial measurement. The most important difference between 2007 and the projection scenario is that there were 23% more cooling degree days in 2007 than long term cooling degree days.

Table 4-8 furnishes information on gas usage for the Age-Restricted One-Story Homes. For the age-restricted one-story homes in the sample, the REM/Rate™ model predicts gas usage for ENERGY STAR homes to be about 23% lower than for the reference home. Our measured usage for those homes finds that it is slightly higher than the gas usage projected by REM/Rate™ for ENERGY STAR homes. For this group, the gross realization rate is in the range of 74% to 121%.

[5] Electric usage for air condition was estimated using a shoulder season / summer season comparison procedure.

Table 4-8: Gas Consumption for Age-Restricted One-Story Homes (N=109)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean Therms	1039	817	77%	864	83%	74%
Median Therms	1083	877	81%	836	77%	121%
Trimmed (N=108)	1048	824	79%	851	81%	90%

Table 4-9 furnishes information on air conditioning electric usage for the Age-Restricted One-Story Homes. For the age-restricted one-story homes in the sample, the REM/Rate™ model predicts usage for ENERGY STAR homes to be about 59% lower than for the reference home. Our measured usage for those homes finds it is 39% lower than the usage projected by REM/Rate™ for the reference home and 47% higher than the usage projected by REM/Rate™ for the ENERGY STAR home. For this group, the gross realization rate is in the range of 66% to 78%.

Table 4-9: Air Conditioning Usage for Age-Restricted One-Story Homes (N-101)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean kWh	2377	984	41%	1448	61%	66%
Median kWh	2380	956	40%	1257	53%	78%
Trimmed (N=101)	N/A	N/A	N/A	N/A	N/A	N/A

Table 4-10 furnishes information on gas usage for the Other Single-Family Homes. For the other single-family homes in the sample, the REM/Rate™ model predicts usage for ENERGY STAR homes to be about 24% lower than for the reference home. Our measured usage for those homes finds that it is higher than the usage projected by REM/Rate™ for ENERGY STAR homes. However, the trimmed mean which drops only four cases, estimates a realization rate of 112%. Given the variability in the consumption for this group, we would recommend using the trimmed means for estimation of the gross realization rate.

Table 4-10: Gas Consumption for Other Single-Family Homes (N=58)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean Therms	1356	1033	76%	1133	85%	63%
Median Therms	1494	1146	76%	1033	69%	130%
Trimmed (N=54)	1395	1060	76%	1001	73%	112%

Table 4-11 furnishes information on air conditioning electric usage for the Other Single Family Homes. For the other single-family homes in the sample, the REM/Rate™ model predicts usage for ENERGY STAR homes to be about 59% lower than for the reference home. Our measured usage for those homes finds that it is about 44% lower than the usage projected by REM/Rate™ for the reference home and about than 37% higher than the usage projected by REM/Rate™ for the ENERGY STAR home. For this group, the gross realization rate is in the range of 72% to 75%.

Table 4-11: Electric Consumption for Other Single-Family Homes (N=44)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean kWh	3596	1460	41%	2014	56%	75%
Median kWh	3584	1271	35%	1902	53%	72%
Trimmed (N=43)	3553	1435	40%	1961	55%	75%

Table 4-12 furnishes information on gas usage for the Other Townhomes. For the other townhomes in the sample, the REM/Rate™ model predicts gas usage for ENERGY STAR homes to be about 23% lower than for the reference home. Our measured usage for those homes finds it is significantly lower than the gas usage projected by REM/Rate™ for ENERGY STAR homes. For this group, the gross realization rate is in the range of 132% to 165%.

Table 4-12: Gas Consumption for Other Townhomes (N=45)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean Therms	1113	767	69%	659	59%	132%
Median Therms	1136	798	70%	609	54%	165%
Trimmed (N=45)	N/A	N/A	N/A	N/A	N/A	N/A

Table 4-13 furnishes information on air conditioning electric usage for the Other Townhomes. For the other townhomes in the sample, the REM/Rate™ model predicts usage for ENERGY STAR homes to be about 52% lower than for the reference home. Our measured usage for those homes finds that it is about 5% lower than the usage projected by REM/Rate™ for the reference home and 97%% higher than the usage projected by REM/Rate™ for the ENERGY STAR home. For this group, the gross realization rate is in the range of 0% to 10%.

Table 4-13: Electric Consumption for Other Townhomes (N=35)

	REM/Rate™ Reference Home Projections	REM/Rate™ ENERGY STAR Projections	ENERGY STAR to Reference Ratio	2007 Measured Usage	Measured to Reference Ratio	Gross Realization Rate
Mean kWh	1776	854	48%	1687	95%	10%
Median kWh	1564	868	55%	1750	112%	N/A
Trimmed (N=35)	N/A	N/A	N/A	N/A	N/A	N/A

In this analysis, we have segmented the population into four groups and have found that the gross program realization rates have varied somewhat across the groups. Table 4-14 furnishes a summary of the realization rates for gas and electric air conditioning usage for the four housing unit types. The gas usage realization rate – defined as the average percent of expected savings realized in 2007 – ranged from 74% for age-restricted on-story homes to 132% for other townhomes. The electric air conditioning usage realization rate ranged from 10% to 75%.

Table 4-14: Summary of ENERGY STAR Homes Gross Realization Rates By Housing Unit Type

Gross Realization Rate	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhomes
Mean Therms	92%	74%	112%*	132%
Median Therm	101%	121%	130%	165%
Mean kWh	71%	66%	75%	10%
Median KWh	77%	78%	72%	0%

*Trimmed mean used

4.3 Evaluation Findings – Analysis of Projected vs. Actual Consumption Ratio

With respect to gas consumption, we found that the average gross realization rate approached 100% for all groups, and considerably exceeded 100% for the townhomes that were not age-restricted. However, while the average realization rate was close to 100%, the ratio of measured gas usage to the gas usage projected by REM/Rate™ varied considerably. To get a better understanding of how measured usage compares to projected usage, we computed a ratio of the two estimates for each home. Table 4-15 shows the range for the ratio of Measured Gas Usage to Projected Gas Usage. For the average home in each group (median) the ratio is less than or equal to 1.0; during 2007 the average home used less gas than was predicted by the REM/Rate™ model. Some homes used considerably more than was predicted and some used considerable less. As we will demonstrate later in this analysis, a considerable share of these differences can be explained by individual preferences with respect to thermostat settings and setbacks. However, a certain amount also relates to certain structure features in the homes that may not be effectively modeled by the software.

Table 4-15: Ration of Measured Gas Usage to REM/Rate™ Projected Usage (Trimmed Gas Usage)

Group	Number	Minimum Ratio	Lowest Quartile	Median	Highest Quartile	Maximum
AR Two-Story	75	0.44	0.83	1.00	1.15	1.71
AR One-Story	101	0.48	0.80	0.93	1.08	1.50
Other SF	49	0.55	0.66	0.81	1.00	1.49
Other Townhome	41	0.37	0.61	0.74	0.91	1.20

To try to get a better understanding of whether there was any systematic variation in the ratio, we ran a series of regressions with the ratio as the dependent variable. As independent variables, we included the factors outline in Table 4-2 to Table 4-5 above. We ran the regressions for all groups together and on each group separately.

The statistical model for the two groups of age restricted housing furnishes results that are informative for our analysis. In our test model, we hypothesized that a number of factors might be associated with variations in the ratio between actual gas usage and gas usage projected by the REM/Rate™ software. The variables we included in the test model included:

- **Housing Unit Variables**
  - Cold Area (Dummy Variable / IECC Region 5)
  - Square Feet ((Square Feet – 2000)/1000)
  - Two Story (Dummy Variable)
  - Presence of a Basement (Dummy Variable)
- **Housing Feature Variables**
  - Multistory Entryway (Dummy Variable)
  - Room Over Garage (Dummy Variable)
  - Wall 1/3 Glass (Dummy Variable)
  - Cathedral Ceiling (Dummy Variable)
  - Sun Room (Dummy Variable)
- **Housing Unit Performance Variables**
  - Rooms Too Hot or Cold in Winter (Dummy Variable)
  - Floors Cold in Winter (Dummy Variable)
  - Noticeable Drafts (Dummy Variable)
  - Condensation on Windows (Dummy Variable)
- **Household Behavior Variables**
  - Variance of Household Members from REM/Rate Assumption (#BR+1)
  - Winter Thermostat Setting (Setting – 70)

  - Thermostat Setback (Dummy Variable)
  - Person at Home 11 Hours or More Weekday (Dummy Variable)
- **ENERGY STAR Variables**
  - HERS Rating (HERS Rating – 85)
  - 2006 Certification Year (Dummy Variable)

The model performed relatively well. It had an adjusted R-square of 0.29. The variables with statistically significant parameters included:

- **Housing Unit Variables**
  - Cold Region (+0.098)
  - Square Feet (+0.042)
  - Presence of a Basement (Dummy Variable) (-0.22)
- **Housing Feature Variables**
  - Multistory Entryway (Dummy Variable) (+0.092)
  - Sun Room (Dummy Variable) (+0.070)
- **Housing Unit Performance Variables**
  - No variables had statistically significant parameters
- **Household Behavior Variables**
  - Winter Thermostat Setting (Setting – 70) (+0.033)
  - Thermostat Setback (Dummy Variable) (-0.088)
- **ENERGY STAR Variables**
  - HERS Rating (-0.046)
  - Constant = 1.117

Using these parameter values, we can make some inferences about the actual gas usage of ENERGY STAR homes compared to the projected usage. For an averaged sized housing unit (about 2000 square feet), with the average HERS value (about 87.5), with an average winter thermostat setting of 70 degrees that does not practice setback, the estimated ratio is 1.005,

indicating that measured usage is very close to projected usage. However, there are some conditions under with the ratio is estimated to be significantly different from 1.0.

- **Thermostat Setting and Setback** – For each degree that a household sets its thermostat above 70 degrees, the ratio is estimated to increase by 3.3 percent indicated that the unit would use 3.3 percent more gas. If the household practices setback, the ratio for the example housing unit is estimated to use about 9% less gas. These behavioral factors affect the ratio in ways that would be predicted by existing energy research models.
- **Entryway, Sunroom, and Basement** – If the housing unit has a multi-story entry way the ratio is estimated to 9.2% higher and if it has a sunroom, it is estimated to be about 7.0% higher. If the housing unit has a basement, the ratio is estimated to be 22.1% lower. These housing unit factors suggest that it may be difficult for the REM/Rate™ model to account for these housing structure variables.
- **Square Footage** – This parameter estimate that a home that is 2,500 square feet would have usage that is about 2.1% higher than projected, while a home that is 1,500 square feet would have usage that is about 2.1% lower.
- **HERS Rating** – This parameter estimates that the ratio is not consistent across HERS ratings. Using the example home, if it had a rating of 86 instead of 87.5, the regression estimates that the ratio of usage would be 1.09. And, if the ratio were 89 instead of 87.5 the ratio would be 93.7. One point on the HERS score is associated with 5 percentage points of usage. It appears from this regression analysis that the actual usage is not tracking the HERS scores for this group very well and that higher HERS ratings actually indicate lower usage than was projected.

Table 4-16 and Table 4-17 allow us to take a closer look at the Square Footage and HERS ratings factors. Table 4-16 shows the estimated ratio for housing units grouped by square footage. It appears that smaller homes (i.e., those less than 2,000 square feet) us less energy than is projected by REM/Rate™. Table 4-17 shows the ratio for housing units grouped by HERS rating. It appears that homes with a rating above 88 are performing significantly better than is being projected by REM/Rate™. It is important to note that these findings are for this very specific type of age-restricted housing that is constructed in New Jersey.

Table 4-16: Ratio of Measured Gas Usage to REM/Rate™ Projected Usage By Housing Unit Size (Age Restricted Homes / Trimmed Gas Usage)

	Less than 2000 SF	2000-<2500 SF	2500 SF or More	All Homes
Number of Homes	60	73	43	176
Mean Ratio	0.90	1.01	1.01	0.97

Table 4-17: Ratio of Measured Gas Usage to REM/Rate™ Projected Usage By HERS Rating (Age Restricted Homes / Trimmed Gas Usage)

	Less than 87	87-<88	88 or Higher	All Homes
Number of Homes	48	70	58	176
All Homes	0.98	1.02	0.90	0.97

We also prepared statistical models for Other Single Family Homes and Other Townhomes. We started with the same set of variables as for the Age Restricted Homes. However, our regression models found quite different results.

For Other Single Family homes, the model performed relatively well. It had an adjusted R-square of 0.32. Comparatively few variables had statistically significant values, indicating that variations in the Actual Usage to Projected Usage ratio were not related to housing unit construction variables. The variables with statistically significant parameters included:

- **Housing Unit Variables**
  - Square Feet (-0.107)
- **Housing Feature Variables**
  - No variables had statistically significant parameters
- **Housing Unit Performance Variables**
  - No variables had statistically significant parameters
- **Household Behavior Variables**
  - Winter Thermostat Setting (Setting – 70) (+0.016)

- **ENERGY STAR Variables**
    - HERS Rating (-0.129)
- **Constant = 1.325**

Using these parameter values, we can make some inferences about the actual gas usage of Single Family ENERGY STAR homes compared to the projected usage. For an averaged sized housing unit (about 2000 square feet), with the average HERS value (about 87.5), with an average winter thermostat setting of 70 degrees that does not practice setback, the estimated ratio is 1.0, indicating that measured usage is very close to projected usage. However, there are some conditions under with the ratio is estimated to be significantly different from 1.0.

- **Thermostat Setting** – For each degree that a household sets its thermostat above 70 degrees, the ratio is estimated to increase by 1.6 percent indicated that the unit would use 1.6 percent more gas.
- **Square Footage** – This parameter estimate that a home that is 2,500 square feet would have usage that is about 5.3% lower than projected, while a home that is 1,500 square feet would have usage that is about 5.3% higher.
- **HERS Rating** – This parameter estimates that the ratio is not consistent across HERS ratings. Using the example home, if it had a rating of 86 instead of 87.5, the regression estimates that the ratio of usage would be 1.19. And, if the ratio were 89 instead of 87.5 the ratio would be 0.80.

Table 4-18 and Table 4-19 allow us to take a closer look at the Square Footage and HERS ratings factors. Table 4-18 shows the estimated ratio for housing units grouped by square footage. It appears that larger homes (i.e., those more than 2,000 square feet) use less energy than is projected by REM/Rate™. Table 4-19 shows the ratio for housing units grouped by HERS rating. It appears that homes with a rating above 88 are performing significantly better than is being projected by REM/Rate™. It is important to note that these findings are for the specific type of single family housing that is constructed in New Jersey.

Table 4-18: Ratio of Measured Gas Usage to REM/Rate™ Projected Usage By Housing Unit Size (Single Family Homes / Trimmed Gas Usage)

	Less than 2000 SF	2000-<2500 SF	2500 SF or More	All Homes
Number of Homes	11	8	29	48
Mean Ratio	1.00	0.70	0.88	0.88

Table 4-19: Ratio of Measured Gas Usage to REM/Rate™ Projected Usage By HERS Rating (Single Family Homes / Trimmed Gas Usage)

	Less than 87	87-<88	88 or Higher	All Homes
Number of Homes	10	21	18	49
All Homes	1.00	0.91	0.74	0.87

For Other Townhomes, the model performed relatively well. It had an adjusted R-square of 0.33. Comparatively few variables had statistically significant values, indicating that variations in the Actual Usage to Projected Usage ratio were not related to housing unit construction variables. The variables with statistically significant parameters included:

- **Housing Unit Variables**
  - Cold Area (-0.200)
- **Housing Feature Variables**
  - No variables had statistically significant parameters
- **Housing Unit Performance Variables**
  - No variables had statistically significant parameters
- **Household Behavior Variables**
  - Winter Thermostat Setting (Setting – 70) (+0.030)
  - Winter Setback (-0.132)
- **ENERGY STAR Variables**
  - HERS Rating (+0.068)
- **Constant = 0.729**

Using these parameter values, we can make some inferences about the actual gas usage of Single Family ENERGY STAR homes compared to the projected usage. For an averaged sized housing unit (about 2000 square feet), with the average HERS value (about 87.5), with an average winter thermostat setting of 70 degrees that does not practice setback, the estimated ratio is 0.90, indicating that measured usage is about 10% less than projected usage. However, there are some conditions under with the ratio is estimated to be significantly different from that value.

- Thermostat Setting – For each degree that a household sets its thermostat above 70 degrees, the ratio is estimated to increase by 3.0 percent indicated that the unit would use 3.0 percent more gas. If the household practices winter setback, the home is estimated to use about 13% less gas.

- HERS Rating – This parameter estimates that the ratio is not consistent across HERS ratings. Using the example home, if it had a rating of 86 instead of 87.5, the regression estimates that the ratio of usage would be 0.729. And, if the ratio were 89 instead of 87.5 the ratio would be 1.0.

With respect to air conditioning electric consumption, we found that the gross realization rate was about 75% for most groups, but was very low for Townhomes. However, while the average realization rate was close to 75%, the ratio of measured air conditioning electric usage to the electric usage projected by REM/Rate™ varied considerably. To get a better understanding of how measured usage compares to projected usage, we computed a ratio of the two estimates for each home. Table 4-20 shows the range for the ratio of Measured Electric Usage to Projected Electric Usage. For the average home in each group (median) the ratio is less than or equal to 1.0; during 2007 the average home used less electric for air conditioning than was predicted by the REM/Rate™ model. Some homes used considerably more than was predicted and some used considerable less. As we will demonstrate later in this analysis, some of these differences can be explained by individual preferences with respect to thermostat settings and setbacks. However, a certain amount also relates to certain structure features in the homes that may not be effectively modeled by the software.

Table 4-20: Ratio of Measured Electric Usage to REM/Rate™ Projected Usage (Trimmed Electric Usage / Reference Home)

Group	Number	Minimum Ratio	Lowest Quartile	Median	Highest Quartile	Maximum
AR Two-Story	72	0.04	0.21	0.52	0.69	1.54
AR One-Story	109	0.06	0.34	0.57	0.81	1.79
Other SF	46	0.07	0.26	0.57	0.74	1.15
Other Townhome	35	0.16	0.71	0.96	1.18	2.63

To try to get a better understanding of whether there was any systematic variation in the ratio, we ran a series of regressions with the ratio as the dependent variable. As independent variables, we included the factors outline in Table 4-2 to Table 4-5 above. We ran the

regressions for all groups together and on each group separately. However, the air conditioning electric usage is a derived statistic (we estimate the share of electric consumption that is used for air conditioning by looking at difference in monthly energy consumption). For that reason, there is considerably more variation in the measured usage compared to the projected usage. The regression estimates did not furnish useful information on variations in the ratios.

4.4 Evaluation Findings – ENERGY STAR Homes vs. Comparison Homes

To develop a better understanding of how the ENERGY STAR Homes are performing compared to those that are not receiving program incentives, we identified a sample of comparison building projects that matched the sample ENERGY STAR projects.

Table 4-21 furnishes information on the characteristics of Age-Restricted Two-Story Homes. It compares our sample of ENERGY STAR homes to the sample of Comparison homes on a number of dimensions. We note the most important differences.

- **Housing Characteristics** – Comparison homes are more likely to have basements.
- **Housing Features** – ENERGY STAR Homes are more likely to have sun rooms.
- **Electric Usage** – The ENERGY STAR homes are less likely to report having CFLs, but are more likely to report having ENERGY STAR appliances.
- **Energy Behaviors** – There appear to be no significant differences in the energy using behaviors of the two groups of households.
- **Home Satisfaction** – ENERGY STAR homeowners are less likely to report the problem of having cold floors and are more likely to report the home is well built.

In general, it appears that these two groups of homes are comparable in most of the housing unit and household characteristics that would affect energy usage.

Table 4-21: 2007 Housing Unit Characteristics Comparison of ENERGY STAR to non-ENERGY STAR Age-Restricted Two-Story Homes

	ENERGY STAR Homes	Comparison Homes
Number	88	141
Housing Unit Characteristics		
Mean Square Footage (H-W)	2090	2040
Average Sales Price (H-W)	$355,000	$362,000
% with Basement	6%	21%
Housing Unit Features		
Multi-Story Entry	33%	34%
Cathedral Ceiling	83%	78%
Sun Room	43%	24%
Electric Usage		
Few or No CFLs	63%	55%
Outdoor Lighting (all night)	15%	13%
# ENERGY STAR Appliances	2.76	2.39
# Electronic Devices	7.2	6.2
Energy Behaviors		
Winter Temperature (median)	69	69
Winter Setback	65%	60%
Summer Temperature (median)	72	72
Summer Setback	36%	38%
Home Satisfaction		
Winter Discomfort	34%	35%
Summer Discomfort	22%	22%
Cold Floors	24%	34%
Drafts	11%	10%
Home Well-Built	44%	31%
ENERGY STAR	67%	13%

Table 4-22 furnishes information on REM/Rate™ projections for gas usage for the Reference Home, measured 2007 gas usage for ENERGY STAR Homes, and measured 2007 gas usage for comparison homes. The gross impact of the program is characterized as the percent reduction from the reference homes to the ENERGY STAR homes. The net impact of the

program is characterized as the difference between the ENERGY STAR homes and the Comparison Homes. The gross impact of ENERGY STAR appears to be about 24%, but there is very little difference between the usage by ENERGY STAR homes and Comparison homes.

Table 4-22: 2007 Gas Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Age-Restricted Two-Story Homes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes		76		122	
Mean Therms	1407	1075	24%	1075	0%
Median Therms	1492	1079	28%	1109	3%

Table 4-23 furnishes information on REM/Rate™ projections for air conditioning electric usage for the Reference Home, measured 2007 usage for ENERGY STAR Homes, and measured 2007 usage for comparison homes. The gross impact of ENERGY STAR on electric air conditioning usage is about 42%. However, the net impact is about 7%.

Table 4-23: 2007 Air Conditioning Electric Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Age-Restricted Two-Story Homes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes		74		121	
Mean kWh	2915	1687	42%	1809	7%
Median kWh	2895	1552	46%	1619	4%

Table 4-24 furnishes information on the characteristics of Age-Restricted One-Story Homes. It compares our sample of ENERGY STAR homes to the sample of Comparison homes on a number of dimensions. We note the most important differences.

- **Housing Unit Characteristics** – The ENERGY STAR Homes and Comparison Homes are similar on all dimensions.
- **Housing Unit Features** – The ENERGY Star Homes are more likely to have a sun room and less likely to have a multistory entryway.
- **Electric Usage** – The ENERGY STAR homes are more likely to report having ENERGY STAR appliances.
- **Energy Behaviors** – There appear to be no significant differences in the energy using behaviors of the two groups of households.
- **Home Satisfaction** – There appear to be no significant differences in the home satisfaction for the two groups of households.

In general, it appears that these two groups of homes are comparable in most of the housing unit and household characteristics that would affect energy usage.

Table 4-24: 2007 Housing Unit Characteristics
Comparison of ENERGY STAR to non-ENERGY STAR
Age-Restricted One-Story Homes

	ENERGY STAR Homes	Comparison Homes
Number	131	123
Housing Unit Characteristics		
Mean Square Footage (H-W)	2039	1978
Average Sales Price (H-W)	$358,000	$339,000
% with Basement	8%	11%
Housing Unit Features		
Multi-Story Entry	7%	6%
Cathedral Ceiling	37%	49%
Sun Room	45%	37%
Electric Usage		
Few or No CFLs	63%	62%
Outdoor Lighting (all night)	18%	16%
# ENERGY STAR Appliances	2.89	2.27
# Electronic Devices	5.6	5.2
Energy Behaviors		
Winter Temperature (median)	70	69
Winter Setback	66%	69%
Summer Temperature (median)	72	72
Summer Setback	34%	32%
Home Satisfaction		
Winter Discomfort	24%	27%
Summer Discomfort	10%	11%
Cold Floors	25%	28%
Drafts	9%	14%
Home Well-Built	44%	43%
ENERGY STAR	69%	17%

Table 4-25 furnishes information on REM/Rate™ projections for gas usage for the Reference Home, measured 2007 gas usage for ENERGY STAR Homes, and measured 2007 gas usage for comparison homes. The gross impact of ENERGY STAR appears to be about 17%. The net impact of ENERGY STAR for this group appears to about 10%.

Table 4-25: 2007 Gas Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Age-Restricted One-Story Homes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes	101			101	
Mean Therms	1039	864	17%	957	10%
Median Therms	1083	835	23%	934	11%

Table 4-26 furnishes information on REM/Rate™ projections for air conditioning electric usage for the Reference Home, measured 2007 usage for ENERGY STAR Homes, and measured 2007 usage for comparison homes. The gross impact of ENERGY STAR on electric air conditioning usage is about 39%. However, the ENERGY STAR homes in the sample use more electric for air conditioning than the Comparison Homes.

Table 4-26: 2007 Air Conditioning Electric Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Age-Restricted One-Story Homes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes	109			99	
Mean kWh	2389	1455	39%	1355	-7%
Median kWh	2398	1257	48%	1313	+4%

Table 4-27 furnishes information on the characteristics of Other Single Family Homes. It compares our sample of ENERGY STAR homes to the sample of Comparison homes on a number of dimensions. We note the most important differences.

- **Housing Characteristics** – Comparison Homes are more likely to have a basement.
- **Housing Features** – ENERGY Star Homes are less likely to have a multistory entryway.
- **Electric Usage** – The ENERGY STAR homes are more likely to report having few or no CFLs.
- **Energy Behaviors** – The households in ENERGY STAR Homes are more likely to practice summer setback and less likely to report winter setback than the households in Comparison Homes.
- **Home Satisfaction** – The households in ENERGY STAR Homes are less likely to report winter discomfort and cold floors, but are more likely to report Drafts than the households in Comparison Homes.

In general, it appears that these two groups of homes are comparable in most of the housing unit and household characteristics that would affect energy usage.

Table 4-27: 2007 Housing Unit Characteristics
Comparison of ENERGY STAR to non-ENERGY STAR
Other Single Family Homes

	ENERGY STAR Homes	Comparison Homes
Number	63	38
Housing Unit Characteristics		
Mean Square Footage (H-W)	2968	3036
Average Sales Price (H-W)	$514,000	$488,000
% with Basement	75%	95%
Housing Unit Features		
Multi-Story Entry	46%	58%
Cathedral Ceiling	57%	61%
Sun Room	29%	24%
Electric Usage		
Few or No CFLs	65%	58%
Outdoor Lighting (all night)	15%	13%
# ENERGY STAR Appliances	2.7	2.6
# Electronic Devices	8.2	8.6
Energy Behaviors		
Winter Temperature (median)	69	68
Winter Setback	59%	68%
Summer Temperature (median)	73	72
Summer Setback	44%	34%
Home Satisfaction		
Winter Discomfort	25%	34%
Summer Discomfort	21%	21%
Cold Floors	17%	29%
Drafts	27%	11%
Home Well-Built	35%	34%
ENERGY STAR	68%	10%

Table 4-28 furnishes information on REM/Rate™ projections for gas usage for the Reference Home, measured 2007 gas usage for ENERGY STAR Homes, and measured 2007 gas usage for comparison homes. The gross impact of ENERGY STAR appears to be about 18%. The net impact of ENERGY STAR for this group appears to about 10%.

Table 4-28: 2007 Gas Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Other Single-Family Homes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes		60		26	
Mean Therms	1380	1138	18%	1268	10%
Median Therms	1510	1033	32%	1187	15%

Table 4-29 furnishes information on REM/Rate™ projections for air conditioning electric usage for the Reference Home, measured 2007 usage for ENERGY STAR Homes, and measured 2007 usage for comparison homes. The gross impact of ENERGY STAR on electric air conditioning usage is about 37%. The net impact of ENERGY STAR on electric air conditioning usage is about 28%.

Table 4-29: 2007 Air Conditioning Electric Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Other Single-Family Homes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes		47		27	
Mean kWh	3623	2055	43%	3084	33%
Median kWh	3593	1909	47%	2924	35%

Table 4-30 furnishes information on the characteristics of Other Townhomes. It compares our sample of ENERGY STAR homes to the sample of Comparison homes on a number of dimensions. We note the most important differences.

- **Housing Unit Characteristics** – The Comparison Homes are less expensive and more likely to have a basement.
- **Housing Unit Features** – The ENERGY Star Homes are less likely to have a multistory entryway or a cathedral ceiling.
- **Electric Usage** – The ENERGY STAR homes are less likely to report having few or no CFLs and more likely to report having ENERGY STAR appliances.
- **Energy Behaviors** – There are no significant differences in energy behaviors.
- **Home Satisfaction** – The households in ENERGY STAR Homes are more likely to report winter discomfort and summer discomfort, but are more likely to report that their home is well builder than the households in Comparison Homes.

In general, it appears that these two groups of homes are comparable in most of the housing unit and household characteristics that would affect energy usage.

Table 4-30: 2007 Housing Unit Characteristics
Comparison of ENERGY STAR to non-ENERGY STAR
Other Townhomes

	ENERGY STAR Homes	Comparison Homes
Number	52	33
Housing Unit Characteristics		
Mean Square Footage (H-W)	2054	1970
Average Sales Price (H-W)	$499,000	$404,000
% with Basement	35%	70%
Housing Unit Features		
Multi-Story Entry	15%	21%
Cathedral Ceiling	35%	45%
Sun Room	6%	3%
Electric Usage		
Few or No CFLs	52%	67%
Outdoor Lighting (all night)	19%	15%
# ENERGY STAR Appliances	2.6	2.1
# Electronic Devices	7.3	7.0
Energy Behaviors		
Winter Temperature (median)	69	69
Winter Setback	62%	64%
Summer Temperature (median)	72	72
Summer Setback	38%	39%
Home Satisfaction		
Winter Discomfort	44%	24%
Summer Discomfort	37%	24%
Cold Floors	17%	18%
Drafts	17%	18%
Home Well-Built	42%	24%
ENERGY STAR	38%	9%

Table 4-31 furnishes information on REM/Rate™ projections for gas usage for the Reference Home, measured 2007 gas usage for ENERGY STAR Homes, and measured 2007 gas usage for comparison homes. The gross impact of ENERGY STAR appears to be about 41%. The net impact of ENERGY STAR for this group appears to about 11%.

Table 4-31: 2007 Gas Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Other Townhomes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes	45			23	
Mean Therms	1114	659	41%	738	11%
Median Therms	1136	609	47%	767	21%

Table 4-32 furnishes information on REM/Rate™ projections for air conditioning electric usage for the Reference Home, measured 2007 usage for ENERGY STAR Homes, and measured 2007 usage for comparison homes. The gross impact of ENERGY STAR on electric air conditioning usage is about 5%. The net impact of ENERGY STAR on electric air conditioning usage is about 8%.

Table 4-32: 2007 Electric Consumption
Comparison of ENERGY STAR to non-ENERGY STAR
Other Townhomes

	REM/Rate™ Reference Home Projections	Measured Usage for ENERGY STAR Homes	Gross Impact of ENERGY STAR Homes	Measured Usage for Comparison Homes	Net Impact of ENERGY STAR Homes
Number of Homes	35			27	
Mean kWh	1776	1687	5%	1824	8%
Median kWh	1564	1750	-12%	1643	-7%

In this analysis, we have segmented the population into four groups and have found that the gross and net program impacts have varied somewhat across the groups. Table 4-33 furnishes a summary of the estimated impacts for gas usage. The gross gas usage impacts are in the range of 20% for all groups except the other townhomes, for which the impacts are much higher than projected. The net gas usage impacts are in the range of 10% for all groups except the age-restricted two-story homes where the net gas usage impacts are estimated to be 0%.

Table 4-33: Summary of ENERGY STAR Homes Gross and Net Percentage Impacts on Gas Usage By Housing Unit Type

Gas Impacts	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhomes
Gross Mean Therms	24%	17%	18%	41%
Net Mean Therms	0%	10%	10%	11%
Gross Median Therms	28%	23%	32%	47%
Net Median Therms	3%	11%	15%	21%

Table 4-34 furnishes a summary of the estimated impacts for air conditioning electric usage. The gross impacts are in the range of 40% to 50% for all groups except the other townhomes, for which the impacts are much lower than projected. The net impacts are inconsistent across housing unit types, ranging from -7% to 33%.

Table 4-34: Summary of ENERGY STAR Homes Gross and Net Percentage Impacts on Electric Usage By Housing Unit Type

Gas Impacts	Age-Restricted Two-Story	Age-Restricted One-Story	Other Single Family	Other Townhomes
Gross Mean kWh	42%	39%	43%	5%
Net Mean kWh	7%	-7%	33%	8%
Gross Median kWh	46%	48%	47%	-12%
Net Median kWh	4%	4%	35%	-7%

4.5 Evaluation Findings – Multivariate Analysis of Net Program Impacts

We have developed estimates of the net and gross impacts of the New Jersey ENERGY STAR Homes Program by comparing mean and median gas and electric consumption for ENERGY STAR homes and a sample of Comparison Homes. Our analysis of the survey data demonstrated that the groups of homes were comparable with respect to housing unit and households characteristics that might affect energy consumption. However, our analysis of means and median values only controls for a limited number of factors.

To test our findings through a more comprehensive analysis, we developed regression models to examine the energy usage per square foot and include the ENERGY STAR HERS rating as an explicit variable in the analysis.

The variables we included in the gas usage model included:

- **Housing Unit Type Variables**
  - Other Single Family (Dummy Variable)
  - Other Townhouse (Dummy Variable)
- **Other Housing Unit Variables**
  - Cold Area (Dummy Variable / IECC Region 5)
  - Square Feet ((Square Feet – 2000)/1000)
  - Two Story (Dummy Variable)
  - Presence of a Basement (Dummy Variable)
- **Housing Feature Variables**
  - Multistory Entryway (Dummy Variable)
  - Room Over Garage (Dummy Variable)
  - Wall 1/3 Glass (Dummy Variable)
  - Cathedral Ceiling (Dummy Variable)
  - Sun Room (Dummy Variable)
- **Housing Unit Performance Variables**
  - Rooms Too Hot or Cold in Winter (Dummy Variable)
  - Floors Cold in Winter (Dummy Variable)
  - Noticeable Drafts (Dummy Variable)
  - Condensation on Windows (Dummy Variable)
- **Household Behavior Variables**
  - Number of Household Members
  - Winter Thermostat Setting (Setting – 70)

  - Thermostat Setback (Dummy Variable)
  - Person at Home 11 Hours or More Weekday (Dummy Variable)
- **ENERGY STAR Variables**
  - HERS Rating (HERS Rating – 85)
  - 2006 Certification Year (Dummy Variable)
  - ENERGY STAR Builder/Not Certified (Dummy Variable)

The model performed relatively well. It had an adjusted R-square of 0.35. The variables with statistically significant parameters (90% confidence) included:

- **Housing Unit Type Variables**
  - Other Single Family (Dummy Variable) (-0.061)
  - Other Townhouse (Dummy Variable) (-0.167)
- **Housing Unit Variables**
  - Cold Region (+0.051)
  - Square Feet (-0.079)
  - Two Story Home (Dummy Variable) (+0.072)
- **Housing Feature Variables**
  - Cathedral Ceiling (Dummy Variable) (+0.042)
  - Sun Room (Dummy Variable) (+0.035)
- **Housing Unit Performance Variables**
  - No variables had statistically significant parameters
- **Household Behavior Variables**
  - Number of Household Members (+0.023)
  - Winter Thermostat Setting (Setting – 70) (+0.011)
  - Thermostat Setback (Dummy Variable) (-0.034)
- **ENERGY STAR Variables**
  - HERS Rating (-0.016)

  - 2006 Certification Year (+0.028)
  - ENERGY STAR Builder (+0.038)
- **Constant = 0.567**

A number of findings can be developed from this regression analysis.

- **Net Impact of ENERGY STAR** - ENERGY STAR Homes use less than comparable homes in New Jersey that did not receive ENERGY STAR program incentives. Each HERS point appears to be associated with a 2.8% reduction in the energy usage per square foot. We note that this is less than the estimated 5% reduction projected by the REM/Rate™. However, it does seem to be clear that the HERS rating is measuring reductions in energy consumption.
- **Comparison Homes Energy Performance** - Comparison homes appear to be built to standards that are higher than the REM/Rate™ Reference Home. The difference in consumption per square foot between ENERGY STAR Homes and Comparison Homes is small; the estimated average consumption per square foot for a Comparison Home is 0.567 therms, compared to 0.527 for the average ENERGY STAR Home (about 7% lower consumption per square foot).
- **ENERGY STAR Builders** – The Comparison Homes built by ENERGY STAR builders did not appear to perform better than those built by non-ENERGY STAR builders. In fact, the model estimates that gas usage per square foot is about 0.038 therms higher for the ENERGY STAR builders.
- **2006 Certification Year** – Homes certified in 2006 appear to use more ENERGY than those certified in 2005, despite the higher standards in place for that time period.

This analysis supports and, in some cases, expands upon the findings from the analysis of mean and median consumption of gas usage for ENERGY STAR and Comparison Homes.

The variables we included in the electric air conditioning usage model included:

- **Housing Unit Type Variables**
  - Other Single Family (Dummy Variable)
  - Other Townhouse (Dummy Variable)

- **Other Housing Unit Variables**
    - Cold Area (Dummy Variable / IECC Region 5)
    - Square Feet ((Square Feet – 2000)/1000)
    - Two Story (Dummy Variable)
    - Presence of a Basement (Dummy Variable)
- **Housing Feature Variables**
    - Multistory Entryway (Dummy Variable)
    - Room Over Garage (Dummy Variable)
    - Wall 1/3 Glass (Dummy Variable)
    - Cathedral Ceiling (Dummy Variable)
    - Sun Room (Dummy Variable)
- **Housing Unit Performance Variables**
    - Rooms Too Hot or Cold in Summer (Dummy Variable)
    - Noticeable Drafts (Dummy Variable)
    - Condensation on Windows (Dummy Variable)
- **Household Behavior Variables**
    - Number of Household Members
    - Summer Thermostat Setting (75 - Setting)
    - Thermostat Setback (Dummy Variable)
    - Person at Home 11 Hours or More Weekday (Dummy Variable)
- **ENERGY STAR Variables**
    - HERS Rating (HERS Rating – 85)
    - 2006 Certification Year (Dummy Variable)
    - ENERGY STAR Builder/Not Certified (Dummy Variable)

The electric model did not perform as well as the gas usage model [Note: We expect that this is due, in part, to the fact that this is a derived estimate. It had an adjusted R-square of 0.17. The variables with statistically significant parameters (90% confidence) included:

- **Housing Unit Type Variables**
  - No variables had statistically significant parameters
- **Housing Unit Variables**
  - Square Feet (-0.229)
  - Two Story Home (Dummy Variable) (+0.113)
- **Housing Feature Variables**
  - Basement (Dummy Variable) (+0.237)
  - Cathedral Ceiling (Dummy Variable) (+0.091)
  - Sun Room (Dummy Variable) (+0.086)
- **Housing Unit Performance Variables**
  - No variables had statistically significant parameters
- **Household Behavior Variables**
  - Number of Household Members (+0.099)
  - Summer Thermostat Setting (75 - Setting) (+0.041)
- **ENERGY STAR Variables**
  - No variables had statistically significant parameters
- **Constant = 0.819**

The fundamental finding from this regression in that there does not appear to be a difference in air conditioning electric usage between the ENERGY STAR Homes and the Comparison Homes in our sample.

5. IV. Findings and Recommendations

The purpose of this evaluation is to assess the performance of the New Jersey ENERGY STAR Homes Program in terms of energy and demand savings, including a retrospective assessment of program accomplishments and recommendations for updates to the New Jersey Clean Energy Protocols. In general terms, this evaluation finds that ENERGY STAR Homes achieve the gas energy savings that are projected by the REM/Rate™ model and achieve about three-fourths of the air conditioning electric savings that are projected by the REM/Rate™ model. However, the net program impacts for the 2005 and 2006 ENERGY STAR Homes are considerably smaller than the gross program impacts. While ENERGY STAR Homes use considerably less gas and electricity than the REM/Rate™ Reference Homes, the differences between ENERGY STAR Homes and Comparison Homes that are built without ENERGY STAR incentives are considerably smaller. In this section of the report, we discuss the implications of these findings for the New Jersey Energy Saving Protocols and the ENERGY STAR Homes Program. In addition, we identify research and analysis that could supplement the findings from this study.

5.1 Interpreting the Results

The evaluation finds that ENERGY STAR Homes perform in the way that is predicted by the REM/Rate™ model. Our regression analysis finds that measured gas usage for 2007 for ENERGY STAR Homes is consistent with the REM/Rate™ projections. We also find that the estimated electric usage for air conditioning achieves about 70% of the expected usage reduction. [Note: For Other Townhomes, the gas usage reduction is greater than projected and the electric usage reduction is less than projected.]

However, the evaluation also finds that Comparison Homes use less energy is projected by REM/Rate™ model projects for the Reference Home. Only the ENERGY STAR Homes with higher HERS ratings appear to use less energy than the Comparison Homes. There are three possible interpretations of these findings.

- Free Riders – One interpretation of these findings is that New Jersey builders have consistently constructed homes that exceed Building Code standards during the entire period for which the ENERGY STAR Homes Program has been in place. Under this scenario, all program participants are freeriders and the program has not resulted in energy or electric demand savings.

- Spillover – Another interpretation of these findings is that New Jersey builders that construct homes in the market segments as the ENERGY STAR Homes builders have had to upgrade their construction practices to compete effectively with the ENERGY STAR builders. Under this scenario, the spillover to new homes market has resulted in far greater energy and electric demand savings than have been realized through the New Jersey Protocols.
- Combined Effect – A final interpretation of these findings is that a combination of factors has led to an increase in the performance of new homes in New Jersey

For attribution of energy and demand savings to the program, the interpretation of the results is important. If the findings imply that all program participants are freeriders, the program has accomplished much less than has been attributed to it. If the findings imply that the program has resulted in a substantial amount of spillover, the program has accomplished much more than has been attributed to it. The 2006 study by Summit Blue Consulting – *Energy Efficiency Market Assessment of New Jersey Clean Energy Programs: Book II – Residential Programs* – reported that many participating builders indicated that they are building all of their homes in New Jersey to ENERGY STAR standards, and that a number of builders are getting 100% of their New Jersey Homes ENERGY STAR certified. This gives some indication that the "spillover" interpretation of the results may be accurate. In the next part of this section of the Report, we offer some suggestions for how to gather supplemental information that might shed light on this issue.

From the perspective of program design, however, the results seem clear. For the market segments that are being currently covered by the ENERGY STAR Program, most homes are being built close to the minimum ENERGY STAR standards. From that perspective, it may be appropriate to focus NJ CEP resources on encouraging the construction of homes that exceed those standards.

5.2 Attribution Research – Next Steps

The approach used for this evaluation was able to measure the net impacts of the ENERGY STAR Program for a fixed point in time. We were able to get an ENERGY STAR and Comparison Sample for homes constructed in 2005 and 2006. Therefore, we are able to assess whether ENERGY STAR Homes that were constructed during that time period use less gas and electricity than Comparison Homes that were constructed during that same time period. Our research found that ENERGY STAR homes used about 7% less gas than Comparison

Homes. Moreover, we found that the Comparison Homes used about the same amount of gas as those homes that met the minimum qualifications for the ENERGY STAR Homes Program.

Option #1 – Retrospective Research

At the beginning of the ENERGY STAR Homes Program (2001), it is possible that many builders were constructing homes that did not meet the minimum ENERGY STAR Homes standards. We were not able to identify Comparison Homes that were constructed during that time period because the data source that we used was not available for that time period. If one or more of the gas utilities had the ability to identify new meters by the date of the meter set, it would be possible to examine the 2007 gas usage by vintage. If the average gas usage was consistent across vintages, it would be weak evidence that the ENERGY STAR Program is having no impact. If the average gas usage was declining across vintages, it would furnish weak evidence that the ENERGY STAR Program had a significant spillover effect.

Options #2 – Prospective Research

In 2007 the ENERGY STAR Homes Program was significantly upgraded. The research conducted in this evaluation could be repeated for homes constructed during 2007. If the research found that ENERGY STAR Homes constructed in 2007 used significantly less gas and electricity than Comparison Homes, it would furnish strong evidence that the program can, and probably did have an impact on gas and electric usage.

5.3 Recommendations

Based on the findings from the evaluation, we make the following recommendations with respect to the New Jersey ENERGY STAR Homes Program.

- Program Accomplishments – The evaluation demonstrates that the ENERGY STAR Homes are meeting the electric and gas usage projections established by the REM/Rate™ model. Until additional information is available on freerider and spillover effects, it is appropriate to leave the program accomplishments as stated in previous New Jersey Clean Energy Program Reports.
- Protocol Revisions – It appears that the new homes market in New Jersey has been transformed to the point that all new homes in the current ENERGY STAR Homes market segments are being constructed to the minimum ENERGY STAR standards

in place prior to the 2007 upgrades. From that perspective, homes being constructed with incentives from the ENERGY STAR Homes Program should be using the 2006 ENERGY STAR standards as the "Reference Home," rather than homes built according to New Jersey's Building Energy Code.

- Program Incentives – ENERGY STAR Homes Program incentives should be focused on encouraging higher levels of savings in the existing market segments. As an alternative, it might be appropriate to allocate resources to those market segments that have not yet been addressed by the ENERGY STAR Homes Program.
- REM/Rate™ Revisions – It may be appropriate to more carefully examine how well the REM/Rate™ model is performance with respect to certain housing unit features and to change the final ratings for home that include features that detract from the energy performance of a home.

In summary, nonparticipating homes in New Jersey are being built close to the minimum ENERGY STAR Homes standards that were in place in 2006. The program needs to move beyond that target to achieve additional program impacts.

Appendices: NJ New Homes Survey Questionnaire

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November 2007

Dear New Home Purchaser:

The New Jersey Clean Energy Program (NJCEP) promotes increased energy efficiency and the use of clean, renewable sources of energy. The results for New Jersey are a stronger economy, less pollution, and lower energy costs. NJCEP offers financial incentives, programs, and services for residential, commercial, and municipal customers.

The Office of Clean Energy at the New Jersey Board of Public Utilities has contracted with APPRISE, a leading New Jersey nonprofit research institute, to conduct research on newly constructed homes in New Jersey. By responding to this survey and signing the utility usage data Authorization Form on the last page, you will be helping us to learn more about homes that have been built in New Jersey in recent years. You can be confident that APPRISE will keep your individual information and usage history completely confidential.

Please take the time to complete this survey to help us make New Jersey a better and more energy-efficient place to live. If you want to contact the BPU about the survey, please contact Sharon Wolfe at (973) 648-7279. If you want to learn more about the New Jersey Clean Energy Program, please visit our web site, www.njcleanenergy.com.

Thank you in advance for your help.

Sincerely,

Michael Winka

Mike Winka, Director
New Jersey Office of Clean Energy

CHARACTERISTICS OF YOUR HOME

1. Do you OWN OR RENT this home?

- ☐ Own
- ☐ Rent

2. Does your home SHARE A WALL, CEILING OR FLOOR with another home? Check all that apply:

- ☐ Shares a wall
- ☐ Shares a ceiling or floor
- ☐ Doesn't share a wall, ceiling or floor with another home

3. How many STORIES does your home have (excluding the basement)?

- ☐ One
- ☐ Two or more

4. What year was your home BUILT? Your best estimate is fine. (YYYY)

☐☐☐☐

5. What month and year did you MOVE IN? (MM/ YYYY)

☐☐ ☐☐☐☐

6. How many SQUARE FEET of living space are there in your residence, not including garages, basements and unheated porches? Your best estimate is fine.

- ☐ Less than 1,000
- ☐ 1,000—1,499
- ☐ 1,500—1,999
- ☐ 2,000—2,499
- ☐ 2,500—3,000
- ☐ 3,001 or More

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4 or more

- ☐ Concrete slab
- ☐ Basement
- ☐ Crawl space
- ☐ None of these types

7. How many BEDROOMS does your home have?

- ☐ Multistory entryway
- ☐ Room over garage
- ☐ Wall that is one-third glass or more
- ☐ Cathedral ceiling
- ☐ Sun room
- ☐ None of these features

ENERGY USE IN THE HOME

10. What type of HEAT does your home use?

- ☐ Gas
- ☐ Electric
- ☐ Other, please specify: _____

11. Is your furnace or boiler HIGH EFFICIENCY?

- ☐ Yes
- ☐ No
- ☐ Don't know

12. Does your home have CENTRAL AIR CONDITIONING?

- ☐ Yes
- ☐ No

13. Is your air conditioner HIGH EFFICIENCY?

- ☐ Yes
- ☐ No
- ☐ Don't know
- ☐ Don't have central air conditioning

14. What type of WATER HEATING does your home use?

- ☐ Gas water heater
- ☐ Electric water heater
- ☐ Other type of water heater, please specify: _____

15. Does your home have a CENTRAL HUMIDIFIER?

- ☐ Yes
- ☐ No

16. How many REFRIGERATORS and FREEZERS do you have in your home?

	0	1	2	3 +
Refrigerators	☐	☐	☐	☐
Freezers (stand-alone)	☐	☐	☐	☐

17. How many LAMPS OR LIGHTING FIXTURES in your home use tube fluorescent or compact fluorescent bulbs?

☐ None ☐ Few ☐ Some ☐ Most ☐ All

18. Of the following APPLIANCES in your home, which of them are ENERGY STAR certified? Check all that apply:

- ☐ Refrigerator
- ☐ Clothes washer
- ☐ Dishwasher
- ☐ Freezer
- ☐ Dehumidifier
- ☐ None are ENERGY STAR

ENERGY USE IN YOUR HOME (continued)

19. How many of each of the following pieces of ELECTRONIC EQUIPMENT do you use in your home?

	Number of Items
Television	
Digital Video Recorder	
Music system (stereo, boom box)	
Computer (desktop, laptop)	
Video game console (Xbox, Playstation, Wii)	

20. Does your home have outdoor SECURITY LIGHTING?

- ☐ Yes, and it is used:
  - ☐ All night
  - ☐ With a timer
  - ☐ With a motion detector
- ☐ No

21. Does your home have outdoor ACCENT LIGHTING?

- ☐ Yes, and it is used:
  - ☐ All night
  - ☐ With a timer
- ☐ No

22. What OTHER LARGE ITEMS does your home have? And how are these items FUELED?

	None	Electric	Gas	Solar
Unheated pool	☐	☐	N/A	N/A
Heated pool	☐	☐	☐	☐
Hot tub	☐	☐	☐	☐
Jacuzzi bathtub	☐	☐	☐	☐

23. When you use your heating or cooling system, how WARM OR COOL do you keep your home (in degrees) . . .?

During the day when someone is at home?
During the day when no one is home?
At night when sleeping?

	Daytime At Home		Daytime No One Home		At Night When Sleeping	
	Temp	Don't Use	Temp	Don't Use	Temp	Don't Use
Winter		☐		☐		☐
Summer		☐		☐		☐

COMFORT IN YOUR HOME

24. How often do you experience the following PROBLEMS with keeping your home comfortable?

	Always	Frequently	Sometimes	Rarely	Never
Some rooms too hot/ cold in winter	☐	☐	☐	☐	☐
Some rooms too hot/ cold in summer	☐	☐	☐	☐	☐
Floors too cold in the winter	☐	☐	☐	☐	☐
Condensation on inside of windows	☐	☐	☐	☐	☐
Noticeable drafts	☐	☐	☐	☐	☐

25. How QUIET do you feel your home is?

☐ Very quiet ☐ Somewhat quiet ☐ Not at all quiet

26. How WELL-BUILT do you feel your home is?

☐ Very well-built ☐ Somewhat well-built ☐ Not at all well-built

27. Is your home certified as an ENERGY STAR home?

☐ Yes ☐ No ☐ Don't know

HOUSEHOLD CHARACTERISTICS

28. HOW MANY PEOPLE are in your household? And HOW OLD are they? Do not include people who are just visiting or children away at college.

	Under 13	13—18	19—64	65 or Older	TOTAL
Number of people					

29. On a typical weekday, about how many hours is at least one person AT HOME AND AWAKE?

☐ <6 ☐ 6-10 ☐ 11+

30. Which category best describes the TOTAL COMBINED INCOME in the last 12 months of all households members?

☐ Less than $50,000
☐ $50,000—$99,999
☐ $100,000—$149,999
☐ $150,000—$199,999
☐ $200,000 or More

ALMOST DONE! Just enter the information and sign below. Then, return this survey in the postage-paid envelope.

AUTHORIZATION FORM

Utility companies consider all customer usage information to be confidential.

I hereby give permission to the electric and natural gas company(ies) that deliver energy to me to provide information to APPRISE Incorporated for confidential use in connection with their survey for the New Jersey Board of Public Utilities, and further agree to hold harmless and/or release such companies from and against any claims, losses, demands, damages, or liability of any kind caused by or allegedly caused by such disclosure.

This authorization covers the total amount of electric and gas used by my household for the period January 1, 2006, to December 31, 2008. Companies are authorized to provide this information by monthly periods or by delivery date, whichever applies.

Which gas company do you use?

☐ Elizabethtown Gas
☐ New Jersey Natural Gas
☐ PSE&G
☐ South Jersey Gas
☐ Other, please specify: _____
☐ I do not use gas services

Name on Bill: _____

Account Number: _____

Which electric company do you use?

☐ Atlantic City Electric
☐ Jersey Central Power & Light
☐ Rockland Electric Company
☐ PSE&G
☐ Other, please specify: _____
☐ I do not use electric services

Name on Bill: _____

Account Number: _____

NOTE: If you cannot find your account number(s), just sign and date the form.

SIGNATURE_____

DATE_____

NEW JERSEY NEW HOMES SURVEY

Your participation is very important.

Please fill out this survey and authorization form. Answer the questions as best you can, making your best estimate, if necessary.

If you would like help in completing the survey, you can call Arlene Shipley toll-free at (888) 434-8008.

Please return the survey in the enclosed postage-paid envelope. Be sure to sign the Authorization Form and include your account number.

Please complete the survey for the following address: *Household Label*

THANK YOU VERY MUCH FOR YOUR PARTICIPATION!

Applied Public Policy Research
APPRISE
Institute for Study and Evaluation