

# **Do ENERGY STAR® Homes Programs Make a Difference? Comparison of Baseline Studies in Two States—One with and One without a Residential New Construction Program**

*Dorothy Conant, Independent Consultant, Hudson, MA  
Leslie Badger, Vermont Energy Investment Corporation, Burlington, VT  
Richard Faesy, Vermont Energy Investment Corporation, Burlington, VT  
Thomas Mauldin, Nexus Market Research, Inc., Cambridge, MA*

## **ABSTRACT**

Residential new construction baseline studies are conducted to establish a starting point for new programs and are then updated periodically to identify market changes in building practices and to use as a baseline for calculating program savings. Understanding current market baseline practices is critical for both designing new programs and updating existing programs to adequately address current market conditions. Having good information on current market practices enables programs to identify and target construction practices and product and equipment choices offering the greatest potential for providing cost-effective energy savings.

This paper will take advantage of the rare opportunity to compare the findings of two recently completed residential new construction baseline studies conducted in two states—one with a long standing ENERGY STAR Homes program (Vermont) and one planning to develop a residential new construction program (Maine). Both studies were completed in 2008. Each study audited roughly 80 non-ENERGY STAR-qualified homes. In addition, 30 ENERGY STAR Homes in Vermont were audited. Both studies collected detailed information on building shell characteristics; HVAC and water heating equipment; lighting, including the use of compact fluorescent bulbs; appliances; and included blower door and duct blaster testing. In addition, both studies interviewed builders.

## **Introduction**

Do ENERGY STAR Home programs make a difference? In Vermont, some characteristics of ENERGY STAR-qualified homes are clearly more energy efficient than in non-ENERGY STAR homes. Beyond that, there are a number of questions without such obvious answers. Do changes in building practices and choice of building products adopted by ENERGY STAR builders spill over to non-participating builders? Are non-qualified homes in Vermont, with a mature program, more energy efficient than homes in Maine, with no existing program? What building practices appear to be improving regardless of whether or not there is a residential new construction program in place and what building practices appear unlikely to become more energy efficient without program involvement and encouragement? Are homes in a state with a residential new construction program more likely to meet local building code requirements than homes in a state without a program? Do non-participating builders in a state with an ENERGY STAR Homes program feel they need to offer the same energy-efficient options ENERGY STAR builders are offering to be competitive, especially in today's stressed new housing market? Do builders say their clients are asking for energy-efficient homes and/or energy-efficient equipment and building products? Does today's market present a golden opportunity for recruiting additional builders into new construction programs? These are some of the questions this paper will address.

This paper compares the results of residential new construction baseline studies conducted in Maine and Vermont to determine differences in residential new construction practices between the two states. The

Maine study (VEIC, ERS & GDS 2008) was conducted to establish a baseline for a new residential construction program. The Vermont study (NMR, RLW & Conant 2008) was conducted to identify changes in building practices and equipment since the previous baseline study, conducted in 2002 (WHE&C 2003). In Maine, certified Energy Raters inspected 78 homes that had been built and occupied since January 1, 2005; homes were inspected in the fall of 2007 and early winter of 2008. A cluster sample approach was used to determine representative communities from which to recruit participating homeowners. In Vermont, trained auditors inspected 106 homes completed in 2005 or later; 11% were completed in 2005, 63% in 2006, 23% in 2007 and 3% in 2008. Audits were conducted from January through April 2008. Both the 2002 and 2008 Vermont baseline studies used a nested sampling approach, under which homeowners were asked to participate in an on-site audit after completing a telephone survey.

Both the Maine and Vermont studies included interviewing builders. In Maine, interviews were conducted with eight builders and eight architects; interviewees were selected through a number of means including personal referrals, suggestions from home builder associations and word of mouth. The Vermont study interviewed 25 builders; most interviewed builders (19 out of 25) were recruited from the pool of builders who built homes that were inspected as part of the baseline study; additional builders were recruited from home builder association member lists and internet searches.

## Background

The Vermont ENERGY STAR Homes Program (VESH) has been in place for several years. As of May 2009, Efficiency Vermont's (EVT) website lists more than 300 builders who have built at least one ENERGY STAR-qualified housing unit since mid May 1997 and have collectively built more than 6,000 ENERGY STAR-qualified housing units in Vermont.<sup>1</sup> The Environmental Protection Agency (EPA) reports that 27% of 1,482 single-family homes built in Vermont in 2007 were ENERGY STAR-qualified.<sup>2</sup> Even though Maine does not have a state ENERGY STAR Homes program, EPA reports that, as of the end of 2008, a total of 718 ENERGY STAR-qualified housing units have been built in Maine and that 3% of 5,053<sup>3</sup> single-family homes permitted in Maine in 2007 were ENERGY STAR qualified.<sup>4</sup>

The EPA website<sup>5</sup> also lists builders who have signed partnership agreements—builders must sign a partnership agreement to use the ENERGY STAR logo. As of June 2009, there are 50 builders (including modular home companies) serving Vermont and 81 builders (including modular home companies) serving Maine listed as ENERGY STAR partners. (The VESH Program has not encouraged builders to sign partnership agreements unless they want to use the ENERGY STAR logo in their marketing.) It appears that as the housing market slumped and builders needed to compete and market their businesses more aggressively, more builders signed partnership agreements; the majority of listed builders for both Maine (90%) and Vermont (72%) did not become partners until after 2006. Increasing interest in green building is likely another reason builders are signing ENERGY STAR agreements. Many green building programs either require ENERGY STAR certification or give points toward meeting program requirements for achieving ENERGY STAR certification.

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<sup>1</sup> <http://www.encyvermont.com/stella/filelib/VESH%20Builders%20List.pdf>

<sup>2</sup> <http://www.energystar.gov/index.cfm?fuseaction=qhmi.showHomesMarketIndex>

<sup>3</sup> <http://www.census.gov/const/C40/Table2/tb2u2007.txt>

<sup>4</sup> <http://www.energystar.gov/index.cfm?fuseaction=qhmi.showHomesMarketIndex>

<sup>5</sup> [http://www.energystar.gov/index.cfm?fuseaction=new\\_homes\\_partners.showHomesResults&partner\\_type\\_id=SHB&s\\_code=VT&letter=ALL&current\\_sort\\_column=NAME&current\\_sort\\_order=ASC&layout=print&startnum=1&resultsperpage=50](http://www.energystar.gov/index.cfm?fuseaction=new_homes_partners.showHomesResults&partner_type_id=SHB&s_code=VT&letter=ALL&current_sort_column=NAME&current_sort_order=ASC&layout=print&startnum=1&resultsperpage=50)

## Builders

Builders in both Maine and Vermont say that most buyers are interested in energy efficiency and that they encourage buyers to make energy-efficient choices. Interviewed Vermont builders report homebuyers are showing increased interest in energy efficiency, but do not tend to specifically request ENERGY STAR-labeled materials or equipment. Builders of high-end custom homes in both Maine and Vermont say that the type of clients they work with expect high efficiency homes. Over half of the Vermont builders interviewed who build custom homes say that more than half of their clients ask about solar and/or green building options. These builders also say that only a small percentage of their clients actually install solar options and that most clients interested in green products do not know what specific products to request—they think more in terms of the concept of green than specific products.

Builders in both states agree that the biggest obstacle to getting customers to choose energy-efficient options is cost—buyers start out wanting the highest-efficiency options, but they are the first things to be cut out of the budget. Interviewed Maine builders indicate there is a considerable demand for energy-efficient heating options, but that homebuyers typically reject additional insulation or an upgraded window in lieu of keeping cosmetic features. Interviewed Maine architects report the same type of demand for energy-efficient features as builders and say they hear the same reasons for rejecting those features when clients learn their cost. A majority of the architects say they go a step further by presenting the client with the financial benefits of upgrading to higher efficiency equipment and measures. They explain that granite counter tops, hardwood floors and tile can easily be upgraded down the road, but it is much more difficult and disruptive after the home is completed to change windows or add additional insulation.

### Builder Energy-Efficiency Marketing and Training

In both states, builders who say they market energy efficiency tend to rely on one-on-one marketing to clients. Over two-thirds of builders interviewed in Vermont say they and/or their employees have had energy-related training and/or support; the most frequently mentioned type of training is EVT based training—EVT administers the VESH Program. Several interviewed Maine builders and architects say that they believe having more information and training would increase their ability to sell energy efficiency to homebuyers.

## Homeowners

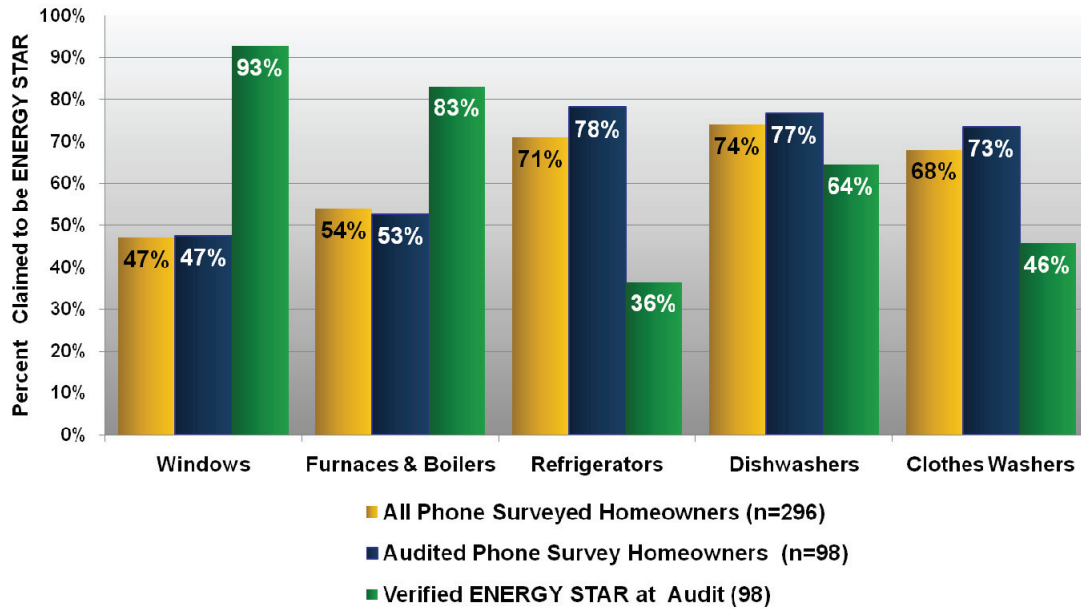
Home buyers may show interest in getting an energy-efficient home and builders may market energy efficiency to buyers, but homeowners are not a reliable source of information about the ENERGY STAR status of components in their homes. The Vermont study included a phone survey of 296 homeowners. Homeowners were asked to describe the efficiency of several components of their homes as ENERGY STAR qualified, energy efficient but *not* ENERGY STAR labeled, of average efficiency, or not energy efficient.<sup>6</sup> Owners of 98 of the 106 home audited in Vermont participated in the phone survey. Figure 1 shows the percentages of all 296 surveyed homeowners and the 98 whose homes were audited saying that the windows, furnaces/boilers, and appliances in their homes are ENERGY STAR qualified, and the percentages of audited homes where auditors verified that these components are ENERGY STAR qualified.

As shown, the percentages of all surveyed homeowners and those whose homes were inspected saying specific components in their home are ENERGY STAR qualified are very similar. However, on-site audit

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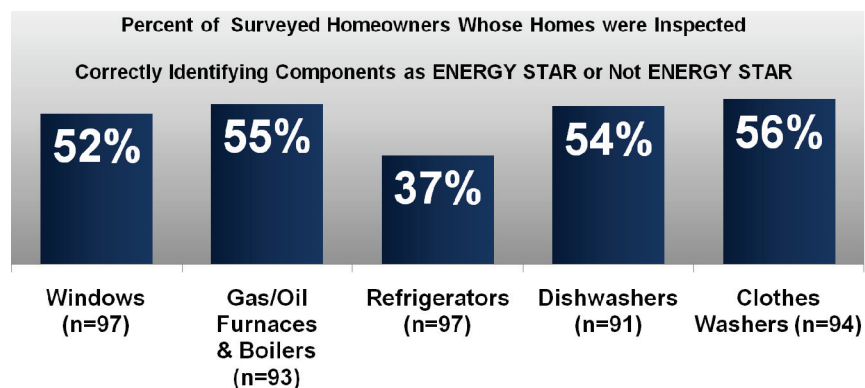
<sup>6</sup> There is no ENERGY STAR qualification of insulation levels, and although specific insulation products are ENERGY STAR labeled, generic types of insulation are not. However, surveyed homeowners were given the option of indentifying the level and type of insulation in their homes as ENERGY STAR.

findings show much higher percentages of ENERGY STAR-qualified windows and furnaces/boilers, much lower percentages of ENERGY STAR-qualified refrigerators and clothes washers, and a somewhat lower percentage of ENERGY STAR-qualified dishwashers.



**Figure 1.** Perceived vs. Actual ENERGY STAR Penetrations in Vermont (NMR, RLW & Conant 2009 16)

Comparing how individual Vermont homeowners described the energy efficiency of various components in their home to what auditors found during the on-site audit, many homeowners described ENERGY STAR-qualified components as not ENERGY STAR qualified or described non-ENERGY STAR-qualified components as ENERGY STAR qualified. Figure 2 shows the percentages of owners correctly identifying the ENERGY STAR status of the windows, gas and oil heating systems, and appliances in their homes. Overall, homeowners were correct just over half of the time—only slightly better than would happen by chance.



**Figure 2:** Vermont Homeowners Correctly Identifying ENERGY STAR Components (NMR, RLW & Conant 2009 17)

## **Building Shell and Equipment Comparison**

Table 1 shows the average building characteristics of audited homes, presenting information on all Maine homes, all Vermont homes, Vermont non-ENERGY STAR homes and Vermont ENERGY STAR homes. Vermont homes have more energy-efficient characteristics than Maine homes and, in Vermont, ENERGY STAR homes have more energy-efficient characteristics than non-ENERGY STAR homes.

### **Vermont and Maine Homes Compared**

Looking at all (ENERGY STAR and non-ENERGY STAR combined) audited homes in Vermont and Maine, audited homes in Vermont compared to audited homes in Maine:

- Are less likely to have 2x4 framing and more likely to use SIPs or ICFs
- Have higher R-value wall and ceiling insulation
- Are more than four times as likely to have insulated foundation walls
- Have more energy-efficient windows
- Have lower air infiltration
- Are much less likely to have oil-fired heating systems
- Have higher AFUE boilers and furnaces
- Are less likely to have inefficient tankless coil water heating
- Have more than double the percentage of lighting sockets fitted with CFLs

### **Vermont ENERGY STAR and Non-ENERGY STAR homes Compared**

Differences between audited ENERGY STAR and non-ENERGY STAR homes in Vermont show that EVT has been successful in helping participating builders build more energy-efficient homes. Compared to non-ENERGY STAR homes, Vermont ENERGY STAR homes:

- Have higher average levels of wall and ceiling insulation
- Are more likely to use something other than fiberglass batt insulation
- Are more likely to have foundation walls insulated to prescriptive code compliance requirements
- Have lower U-value (more energy efficient) windows
- Have lower air infiltration
- Have higher AFUE heating systems

### **Vermont and Maine Non-ENERGY STAR Homes Compared**

Comparing the characteristics of the audited non-ENERGY STAR homes in Vermont and Maine provides insight on whether or not the changes in building practices and choice of building products adopted by ENERGY STAR builders spill over to non-participating builders. Vermont non-ENERGY STAR homes, compared to non-ENERGY STAR Maine homes:

- Are less likely to have 2x4 framing and more likely to use SIPs or ICFs
- Have higher average R-value wall and ceiling insulation
- Are more than four times as likely to have insulated foundation walls
- Have more energy-efficient windows
- Have only slightly lower air infiltration measured in air changes per hour

- Have more energy-efficient heating systems
- Are less likely to have inefficient tankless coil water heating
- Have double the percentage of lighting sockets fitted with CFLs

**Table 1.** Characteristics of Audited Maine and Vermont Homes (NMR 2008; VEIC 2008)

Home Characteristic/Feature <sup>7</sup>	Maine (n=78)	Vermont (all homes) (n=106)	Vermont Non- ENERGY STAR (n=76)	Vermont ENERGY STAR (n=30)
Above Grade Conditioned Floor Area—Average Sq. Ft.	2,057	1,901	1,978	1,708
<b>Wall Framing—Conditioned/Ambient Walls</b>				
2x4 Wall Framing	9%	3%	4%	0%
2x6 Wall Framing	87%	83%	86%	83%
Other (ICFs, SIPs, 2x8, log)	4%	14%	11%	17%
<b>Insulation Levels</b>				
Average Above Grade Wall Insulation	R-18	R-21	R-20	R-25
Average Flat Ceiling Insulation	R-31	R-39	R-36	R-44
Average Sloped Ceiling Insulation	R-31	R-34	32	40
Foundation Walls—Percent of Homes No Insulation	66%	17%	16%	14%
Slab on Grade—Insulation Under or on Perimeter	57%	57%	41%	88%
<b>Windows</b>				
Average Window U-value	0.37	0.34	0.35	0.33
Average Glazing Percentage of Wall Area	15%	13%	13%	14%
<b>Envelope Leakage</b>				
Average Air Leakage (Blower Door CFM50)	2,037	1,598	1,702	1,212
Average Air Changes per Hour at 50 Pascal (ACH50)	5.4	5.1	5.3	4.2
<b>Heating System Fuel and Efficiency</b>				
Natural Gas	4%	10%	7%	33%
Propane	15%	49%	48%	47%
Oil	75%	39%	45%	13%
Other	5%	2%	0%	7%
Average Boiler AFUE	85.3	87.4	86.9	88.9
Average Furnace AFUE	87.7	88.9	88.9	91.9
<b>Water Heating Type and Energy Factor</b>				
Stand Alone Tank	13%	16%	15%	23%
Instantaneous and Combined Units <sup>8</sup>	7%	4%	5%	3%
Integrated (indirect-fired) Storage Tank	63%	74%	74%	73%
Tankless Coil	17%	5%	7%	0%
Average Propane/Nat. Gas-fired Indirect Tank (EF)	0.83	0.82	0.81	0.83
Average Oil-fired Indirect Tank (EF)	0.78	0.79	0.79	0.8
<b>Lighting</b>				
Average Percent of Sockets that are CFLs	10%	25%	22%	32%
Average Number of Sockets per Home	70	56	59	53
Average Number of CFL Bulbs per Home	7	14	13	17

<sup>7</sup> Not all homes have all characteristics/features.

<sup>8</sup> Combined units feature a powerful water heater that provides space heating as a supplemental end-use.



Clearly, non-ENERGY STAR homes in Vermont have more energy-efficient characteristics than Maine homes, suggesting that changes in building practices and building products adopted by ENERGY STAR builders have spilled over to non-participating Vermont builders. Supporting this finding, over half of the ENERGY STAR builders interviewed in Vermont say that they think the VESH Program is having an effect on builders outside the program. They say clients typically talk to multiple builders, so, to be competitive, non-ENERGY STAR builders need to know what ENERGY STAR builders are saying and doing. They also say that customers are asking questions and some are requesting ENERGY STAR homes—builders need to be able to answer their clients' questions and meet their needs. In addition, ENERGY STAR materials, equipment, and building supplies are widely available and marketed, more builders and subcontractors are offering high-efficiency insulation options, and energy awareness is rising.

## **Performance Comparison**

In addition to a building component level comparative analysis, we wanted to better understand how Vermont and Maine homes compare on a performance level. To do this we ran two analyses—the first comparing Vermont non-ENERGY STAR homes to Maine homes, the second comparing all Vermont homes to Maine homes.

### **Methodology**

For the first analysis, Vermont non-ENERGY STAR Homes compared to Maine homes, we created an average composite REM/Rate model of the sample homes for each state and obtained a HERS Index for each. The Vermont model includes data only from non-ENERGY STAR Homes in the sample. There were some differences in how the models were created due to data constraints. The Maine baseline study conducted HERS ratings for each home in the sample while the Vermont baseline study did not. Therefore, the format of the raw data from which we were able to obtain the average REM/Rate inputs varied slightly. Whenever possible, we followed the same methodology to calculate average composite values for each state model. In cases where this was not possible due to data constraints, assumptions were made based on the best data available. We do not feel that these assumptions affected the resulting HERS ratings to any significant degree.

For Vermont and Maine, we analyzed all of the collected data for each home in the same way to generate REM/Rate inputs for an average composite home. Weighted averages were used to provide inputs representative of homes with and without each feature. For example, to determine the average slope ceiling area, we took the average area of all slope ceilings and multiplied it by the percentage of homes with a slope ceiling. Details of a given component (e.g. framing, insulation levels etc.) within the slope ceiling were a straight average of values from homes in the sample with that component. Ultimately, the composite model does not represent an actual home. Rather, the model provides average values for geometry and efficiency levels of all homes in each sample.

### **Analysis**

#### **Vermont and Maine Non-ENERGY STAR Homes Compared**

Table 2 shows the resulting HERS Indices of the Vermont non-ENERGY STAR and Maine composite homes. The HERS scale represents a 1% increase in energy efficiency for every 1 point decrease in HERS Index. The average Vermont home scored 13 points lower than the average Maine home. Therefore, on average, we can assume that Vermont non-ENERGY STAR homes are 13% more energy efficient than Maine homes.

**Table 2.** Vermont Non-ENERGY STAR and Maine Composite Home HERS Indices

	Vermont	Maine	% Difference in Energy Efficiency
<b>HERS Index</b>	72	85 <sup>9</sup>	13%

In order to better understand the 13 point HERS Index difference between the Vermont non-ENERGY STAR and Maine composite homes we generated a list of components that we suspected might have a large impact on the rating. What we found was that one component, foundation wall insulation, did indeed have quite a large impact on the HERS rating. In general, most of the differences resulted in a one or two point difference. However, when all of these differences are combined, the result is a much more comparable composite home rating. Table 3 on the next page lists each component, with the corresponding Vermont and Maine composite model values. For each component, we applied the Maine value to Vermont’s model and noted the HERS Index point change.

It should be noted that there may be slight differences in the values listed here and those reported in the Vermont and Maine Residential New Construction Baseline Studies. This is because the calculation of component values may have varied slightly depending on the final reporting requirements. For example, the Vermont baseline study reports foundation wall R-values by above and below grade; in this analysis we were looking at combined average R-values by location (e.g. conditioned to ambient). Additionally, the Vermont baseline study reports 13% glazing to wall area. This percentage includes the area of foundation walls when the basement is conditioned. The 12% listed below is for above grade walls only. For Maine, the baseline study reported an average conditioned area of 2,057 square feet, which represented above grade floors only; the Vermont baseline study reported an average conditioned area of 2,576, which represented all intentionally heated area including heated basements. The square footages of conditioned area listed below for both Maine and Vermont are above grade conditioned area.<sup>10</sup>

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<sup>9</sup> The Maine Residential New Construction Technical Baseline Study, May 15, 2008, reported a HERS Index of 86 for the Maine composite home. The difference in Index is due to a REM/Rate version update. The indices reported above are from REM/Rate v12.61.

<sup>10</sup> There is no consistency across residential new construction baseline studies, programs or building codes in how conditioned floor area or conditioned basements are defined. Different definitions for conditioned area include: above grade conditioned floor area; intentionally heated floor area, above or below grade; finished floor area etc. The inconsistency in definitions of conditioned floor area is an issue that needs to be addressed not only in field studies, but also in program implementation and in codes.



**Table 3.** Maine and Vermont HERS Index Comparison

Vermont vs. Maine Baseline Values	Vermont	Maine	HERS Index Points	Notes
<b>Above Grade Conditioned Floor Area—Sq. Ft.</b>	1,978	2,507		
<b>Foundation Wall Insulation</b>			7	
<b>Conditioned/Ambient</b>	R-11	R-4		
<b>Unconditioned/Ambient</b>	R-9	R-2		
<b>Slab Insulation</b>			n/a or 0	
<b>Perimeter Under</b>	R-7.6	R-1.6 R-2.0		
<b>Above Grade Wall Insulation</b>			1	
<b>Conditioned/Ambient</b>	R-20	R-18		While nominal R-values are similar, VT has a higher proportion of continuous insulation.
<b>Windows</b>			2	
<b>Percent of floor area</b>	11%	12%		Increased VT glazing to 15% of wall area (equally distributed N,S,E,W)
<b>Percent of above grade wall area</b>	12%	15%		
<b>Ceiling Insulation</b>			1	
<b>Flat ceiling</b>	R-36	R-31		While nominal R values are similar, VT has a higher proportion of continuous insulation.
<b>Slope ceiling</b>	R-32	R-31		
<b>Duct Leakage to Outside (CFM25)</b>	243	269	1	
<b>Infiltration (CFM50)</b>	1,702	2,037	2	
<b>Percent CFL Fixtures</b>	22%	15%	1	

When looking at the total point difference of all selected components in the table above, the combined HERS point difference is 15. Adding these 15 points to the Vermont composite home HERS Index of 72 results in an Index of 87. In other words, if Vermont homes were built to Maine standards in these seven selected areas, we would see much more comparable HERS Indices.

Foundation wall insulation had the greatest impact on the HERS Index. Insulation levels were significantly higher in Vermont than Maine. However slab insulation levels, which were also higher in Vermont, produced no change in the HERS Index. In the cases of above grade wall and ceiling insulation levels, nominal R-values were similar in each state. However, we found that Vermont had, on average, a higher proportion of continuous insulation over cavity insulation. Applying both the nominal insulation R-value as well as the continuous to cavity proportions of the Maine composite home to Vermont increased the Index (worse performance) by 1 point for each component.

**All Vermont and Maine Homes Compared**

The average HERS Index across all Vermont homes, ENERGY STAR and non-ENERGY STAR, is 69. To derive this value we calculated the average HERS Index of the 30 VESH homes in the baseline study sample. The average HERS Index of Vermont ENERGY STAR Homes is 60. In 2007, EPA reported a 27% single-family market penetration of ENERGY STAR Homes for Vermont. Taking a weighted average of

the HERS Indices for ENERGY STAR and non-ENERGY STAR Homes, HERS 72, equates to a HERS 69 across all Vermont single-family homes as noted in Table 4 below.

**Table 4. Vermont ENERGY STAR and Non-ENERGY STAR Home HERS Indices**

Home Type	HERS Index	Market Penetration <sup>11</sup>
ENERGY STAR	60	27%
Non-ENERGY STAR	72	73%
All Vermont Homes	69	100%

This represents a 16% difference in energy efficiency from the average Maine home, which rated 85 HERS Index. In other words, the average Vermont home is 16% more energy efficient than the average Maine home. To validate the average HERS Index of 60 for such a small sample size we also looked at the average HERS Index across a sample of 312 VESH homes completed in 2008. The average Index for these homes was 61. Therefore, we feel that HERS 60 is an appropriate average rating to use for this comparison.

## Meeting Code

Maine and Vermont have different residential building code standards and different compliance requirements. In Maine, the code is “voluntary” (i.e. town can opt to adopt, but few have and there is little-to-no enforcement). In Vermont, the code is supposed to be builder-reported, but there is limited compliance (mostly as part of VESH program participants) and virtually no enforcement. Although the Vermont study did not collect all the data needed for a full compliance analysis, the collected data were sufficient to estimate compliance. Analyses of code compliance in both states show audited Vermont homes are much more likely than Maine homes to meet state building code standards. This finding does not prove that homes in a state with an active ENERGY STAR Homes program are more likely to meet building code requirements, but certainly suggests it is factor in achieving improved compliance rates.

Maine homes were tested for code compliance using the REM/Rate code compliance analysis tool. Of the homes audited in Maine, 83% do not pass the “IECC 2003 Consumption Compliance” analysis and 95% do not pass the alternative compliance path, the “IECC 2003 Overall U<sub>o</sub> Compliance” analysis. Individual Maine homes have a mix of efficient and inefficient energy features. The average audited Maine home included mechanical equipment (heating, cooling, and hot water) that exceeded minimum federal code requirements, but insulation levels generally fell short of code requirements.

In Vermont, an estimated 72% of the audited homes do meet Vermont Residential Building Energy Standards (RBES). RBES is based on the 2000 International Energy Conservation Code (IECC) with state specific amendments. RBES offers four compliance methods: Fast-Track and Trade-Off prescriptive methods, VT*check* Software and Home Energy Ratings (HERS). All 30 of the Vermont ENERGY STAR homes audited meet RBES requirements using the HERS compliance path—meeting code is a requirement of the VESH Program. Of the 76 non-ENERGY STAR Vermont homes audited, 61% meet RBES requirements using VT*check* software; 15 of these homes also meet RBES requirements using the Trade-Off method.

<sup>11</sup> <http://www.energystar.gov/index.cfm?fuseaction=qhmi.showHomesMarketIndex>

## Conclusions

Do ENERGY STAR Home Programs make a difference? Yes, we believe they do. Changes in building practices and choice of building products adopted by ENERGY STAR builders spill over to non-participating builders. Builders of ENERGY STAR homes are more likely to use high-efficiency non-traditional building products such as SIPs, ICFs and non-fiberglass batt insulation. In a state with an aggressive ENERGY STAR Homes Program, the demand for these non-traditional building products increases the availability and marketing of these products to all builders. Furthermore, from a market perspective, as the penetration of ENERGY STAR-qualified single-family homes increases—now over 25% in Vermont—non-participating builders need to offer comparable energy-efficient options to remain competitive, especially in a depressed housing market.

Are non-qualified homes in Vermont, with a mature program, more energy efficient than homes in Maine, with no existing program? Clearly, they are. Both prescriptive and performance comparative analyses show the average Vermont home is more efficient than the average Maine home. Comparing the performance of all audited Vermont and Maine homes, the average Vermont home is 16% more energy efficient than the average Maine home. Furthermore, supporting the finding that practices adopted by ENERGY STAR builders spill over to non-participating builders, the average non-ENERGY STAR Vermont home is 13% more energy efficient than the average Maine home.

Are homes in a state with a residential new construction program more likely to meet local building code requirements than homes in a state without a program? Although not definitive because Vermont and Maine building code requirements are different and the analyses of code compliance differed between the two studies, the code compliance analyses suggest having a program in place is very likely a factor in achieving improved compliance rates.

What building practices appear to be improving regardless of whether or not there is a residential new construction program in place? Although the average boiler AFUE is higher in Vermont than in Maine, the average in both states exceeds the minimum AFUE 85 requirement for ENERGY STAR qualification. Average water heating energy factors are virtually the same in Vermont and Maine, and the majority of homes in both states have efficient integrated tank water heating—74% in Vermont and 63% in Maine. These findings suggest that installing high-efficiency boilers and water heating is becoming pretty much standard practice for all builders, not just ENERGY STAR builders.

Are homebuyers asking for energy-efficient homes and building products? Builders interviewed in both Vermont and Maine say homebuyers start out wanting high-efficiency options, but cost is a major obstacle and high-efficiency options are some of the first to be cut.

Do non-participating builders in a state with an ENERGY STAR Homes program feel they need to offer the same energy-efficient options ENERGY STAR builders are offering to be competitive, especially in today's stressed new housing market? Interviewed Vermont builders say yes. They say clients typically talk to multiple builders, so, to be competitive, non-ENERGY STAR builders need to know what ENERGY STAR builders are saying and doing and offer the same options.

Does today's market present a golden opportunity for recruiting additional builders into new construction programs? The recent cycles of high energy prices and the increased competition for jobs in a depressed housing market will likely prompt builders who need to incorporate more energy-efficient practices and equipment to remain competitive to seek some type of energy-related training. The obvious choice for these builders is to participate in a residential new construction program where they will likely not only get the training they seek, but on-site support in implementing more energy-efficient practices.

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