# FINAL REPORT: PHASE 1 EVALUATION OF THE EFFICIENCY VERMONT RESIDENTIAL NEW CONSTRUCTION PROGRAM

Prepared for

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October 14, 2003

# E

# EXECUTIVE SUMMARY

## E.1 OVERVIEW

This is the Final Report of the Phase 1 Evaluation of Efficiency Vermont's (EVT's) Residential New Construction Program (RNC). The overall goal of the RNC is to increase the energy efficiency of new homes built in Vermont, primarily by providing technical assistance, marketing support and financial incentives for adoption of efficient construction practices to builders and remodelers. This evaluation develops a comprehensive description of the residential new construction market in Vermont and assesses the accomplishments of the program from its inception in March 2000 through November 2002.

### *E.1.1 Program Description and Operations through May 2002*

**Program Objectives.** The objectives of Efficiency Vermont's Residential New Construction program as stated in the original program plan are to:

- Increase market recognition of superior construction promoted by the pre-existing Vermont Star Home program;
- Increase awareness and compliance with the Vermont Residential Building Efficiency Standard;
- Increase penetration of cost-effective electric and fossil-fuel energy efficiency measures;
- Improve occupant comfort, health and safety;
- Institutionalize Home Energy Ratings, and
- Increase the use of mortgage benefits for energy-efficient homes.

**Program Development.** A consortium of Vermont electric utilities jointly operated a predecessor program known as Vermont Star Homes for more than two years prior to the start up of Efficiency Vermont. The program was operated by a contractor – Vermont*wise* Energy Services of Rochester. Efficiency Vermont (EVT) contracted with Vermont*wise* Energy Services to deliver the EVT residential new construction program, and retained most of its key features. The Vermont Gas Systems ("VGS") offered their own residential new construction program known as HomeBase, as did the Washington Electric Cooperative and the Burlington Electric Department.

The Vermont Star Program began operating under contract to EVT in March 2000. In 2001, EVT and VGS worked together to develop a unified program to be delivered statewide. The consolidated program – Vermont Energy Star Homes ("VESH") –features revised qualifying specifications and rebate structures, as well as additional services to participating builders. From

an operational standpoint, the major difference between Vermont Energy Star Homes and earlier versions of the EVT program is that the basic offer to builders and homeowners has been simplified, as has the incentive structure. The VESH program went into effect January 1, 2002, with a six-month transition period during which previously enrolled participants could choose to complete construction under Vermont Star, HomeBase, or VESH standards.

**Program Services, Incentives, and Operations.** The program offers the following services and incentives.

- ***Eligible projects.*** The program offers incentives for new construction or substantial renovation projects in single-family homes and multi-family residential buildings of three stories or less.
- ***Qualifying standards and incentive levels.*** To qualify for the Vermont Energy Star Home designation, a house must achieve a Home Energy Rating score of 86 points, or 5 Star, which is equivalent to the U. S. Environmental Protection Agency's ENERGY STAR home rating. Generally, homes must contain high levels of insulation, efficient heating and hot water equipment, and high-quality air sealing measures to meet this rating. Homes that score 86 or above in the Home Energy Rating will use approximately 20 percent less energy for heating, cooling, and hot water than those that meet the minimum requirements of Vermont's Residential Building Energy Standard (RBES). In addition to the 86 point home energy rating, VESH-qualifying homes must have least four energy-efficient lighting fixtures in high use areas, hard-ducted returns above the first floor deck for forced hot air systems, power-vented or sealed combustion equipment, and efficient mechanical ventilation systems.

  The owners or builders of Vermont Energy Star qualifying homes receive a home energy rating at no cost as part of the program, a $500 value. In addition, they may also receive rebates up to approximately $1,300 in most of the state or up to $1,800 in VGS territory for installation of efficient lighting fixtures and appliances. Additional services for Vermont Energy Star Homes participants may include plan review, technical training, and marketing support for qualifying homes.

**Program Accomplishments through December 2001.** In its first 10 months of operation (through December 2000), the program issued 323 rebates for home energy ratings: 106 of them for homes qualifying for Vermont Star designation; 217 for Vermont Advantage participation, a lower level defined in pre-existing programs. An additional 192 customers received rebates for the installation of specific measures without energy ratings. Customers who received home energy ratings through the program also received rebates for the installation of qualified energy efficiency equipment. The typical package of measures for such projects included an average of nine compact fluorescent lighting fixtures and a mechanical ventilation system.

In 2001, the program accomplished the following.

- ***Builder participation.*** 85 builders submitted preliminary applications for project qualification to the program in 2001, including 40 who had not participated in the previous year.
- ***Volume of participation.*** 699 units in single- and multi-family construction projects applied for program assistance; 623 units received rebates for the installation of energy efficient measures/and or qualification under the home rating component of the program. These "completed units" represent 22.6 percent of all new housing units built in Vermont in 2001.
- ***Vermont Star designation.*** 196 of the completed construction projects received Vermont Star Designation. representing 8.3 percent of the single-family units built in 2001.
- ***Other Measures.*** 429 of the participating homes that installed energy efficiency measures under the program either did not apply for or were not eligible to receive Vermont Star designation.

Preliminary review of program records from 2002 show strong growth in the volume of program activity. The total number of units completing the program grew to 816, an increase of 31 percent over the previous year. The number of single-family homes completing the home rating tracks (Vermont Star homes enrolled in 2001 and Vermont Energy Star Homes) increased 46 percent from the previous year to a total of 287.

## E.2 OVERVIEW OF THE PHASE 1 EVALUATION

### *E.2.1 Phase 1 Evaluation Objectives*

**Program Impact Assessment.** The key Phase 1 research questions in regard to program impact are as follows.

1. ***Baseline.*** To what extent are the construction practices required by the programs used by participant builders and by nonparticipant builders? To what extent did participant builders use those practices prior to program enrollment?
2. ***Changes in construction practice***. How have construction practices changed since the implementation of the program? How do construction practices differ between homes that have gone through the program and those that have not?
3. ***Attribution of adoption of efficient building practices to program influence.*** To what extent do participant builders attribute changes in construction practices to information and experience gained through the program? To what extent do nonparticipants attribute changes in construction practices to program influences? (Untracked savings)

**Market Characterization.** The key research questions in regard to market characterization are as follows.

1. ***Size and segmentation of the new construction market.*** How large is the residential new construction market? What are its characteristics in terms of distribution by region, price, type of home (primary residence v. vacation), mode of construction (custom v. production v. owner-built v. manufactured housing) and features such as heating fuel? How large is the population of builders and how is it segmented by location, firm size, and specialty?
2. ***Baseline construction practices.*** What is the level of energy efficiency in current construction practice? What is the level of compliance with the technical and administrative provisions of the Residential Energy Building Standards ("RBES")?
3. ***Role of other market actors in promoting energy-efficient construction.*** To what extent and through what mechanisms do the following sets of market actors affect builders' decisions regarding energy efficient construction: HVAC and other trades contractors, home energy rating services, industry associations, lenders?

**Process Evaluation.** The key research questions in regard to process evaluation are as follows.

1. What are Vermont Star Home participants' key motives for enrolling; why do nonparticipants stay away?
2. What program elements do builders and homebuyers find most useful?
3. What incentives or information could convince builders to implement the Vermont Star standards on a larger percentage of homes?

**Recommendations for program improvement.** Based on review of the analyses described above and experience in evaluating and operating other residential new construction programs, XENERGY developed a set of recommendations designed to improve the performance and/or cost-effectiveness of the RNC.

### *E.2.2 Methods and Activities*

Table E-1 summarizes the research activities and analysis activities undertaken to support the evaluation.

**Table E-1**
**Summary of RNC Evaluation Primary Research and Analysis Activities**

| TASK/*Objective* | Description/Sample Approach & Size |
|---|---|
| **SUPPLY-SIDE ANALYSIS** | |
| ***Builder Survey*** | Probe current practices in regard to energy efficient construction and marketing, code compliance, program effects, perceptions of program, customer demand, value of energy efficiency. Also split of work between new construction and renovation, geographic scope of activity.<br>Random sample of 54 builders with quotas for 2 geographic zones, allocated by location of firms in the zones, with probability of selection proportional to size as measured by # of employees reported to Dun & Bradstreet |
| ***Remodeler Survey*** | Probe the same topics as builder survey. Also, explore opportunities and interest in potential retrofit energy efficiency measures and programs.<br>Random sample of 35 remodeling contractors, with quota for kitchen remodelers. Sampling procedure similar to builder survey |
| ***In-depth Interviews with Other Market Actors*** | In-depth interviews with HVAC contractors, real estate agents, and lenders to probe influence on energy-related construction decisions; adoption of energy efficient practices, perception of builder practices, demand.<br>30 interviews in all, with samples systematically selected to provide representation for key subgroups and all geographic regions. |
| **DEMAND-SIDE ANALYSIS** | |
| ***Analysis of Property Tax Records*** | Analyzed "Grand Lists" of land parcel property tax status submitted by 230 of Vermont's 260 towns to identify addresses on which new residential construction was likely to have occurred. Used other municipal sources for remaining towns to develop similar lists. |
| ***Telephone Survey of Recent Homebuyers*** | Closed-ended survey to probe customer experience with builders, knowledge of programs, codes and energy efficiency measures. Contact was also used to recruit participants for on-site surveys.<br>Statewide random sample of 200. Sample frame developed from analysis of "Grand Lists" prepared by cities and towns for use in statewide property tax assessment and collection. |
| ***On-site Customer Survey*** | Assess "as built" adoption of efficient construction practices and products. Probe customer awareness and perception of value of energy efficient construction; experience with builder promotion of energy efficiency, awareness of program.<br>Statewide random sample of 159 |
| **PROGRAM OPERATIONS** | |
| ***Staff and Contractor Interviews*** | In-depth interviews with key program staff and delivery contractors. These interviews were used to gather details on administrative and marketing processes, history of program development and changes in design, perceptions of market response to the program, corroboration of findings from other sources, and response to preliminary recommendations. |
| ***Analysis of Program Records*** | Analysis of program data bases to assess patterns of participation by builders and consumers over time and by region. |

## E.3 OVERVIEW OF THE VERMONT HOUSING MARKET

Assessment of the effectiveness of the RNC requires an understanding of the structure and operation of the market for new housing in Vermont. The key features of this market are as follows.

### *E.3.1 Market Size and Structure*

#### *The Demand Side*

**Market Size.** Based on analysis and assessment of four different sources of estimates for the number of new homes built in Vermont, we estimate that between 2,600 and 2,800 housing units were built annually between 1999 and 2001, and that the number increased slightly each year.

**Distribution by Type.** About 85 percent of the units built each year are single-family homes. Roughly 10 percent are in multifamily buildings of 5 or more units. The remaining 5 percent are in 2 – 4 family homes.

**Owner-built v. Builder/Developer-built homes.** Roughly 20 percent of all single-family homes are built by the owner acting as general contractor.

**Manufactured Housing.** Manufactured housing – mobile homes and site-assembled units – account for 17 percent of all new single-family homes built in Vermont.

**Custom versus "spec" built.** Only 6 percent of homes occupied by respondents to the telephone survey were "spec built", that is: completed entirely prior to purchase. Sixty-two percent were custom built to the plans developed exclusively for the owner; 15 percent were built according to stock plans customized to the owner's needs; the remainder were manufactured housing.

**Geographic Distribution.** Table E-2 shows the distribution of new construction activity in 1999 by housing market area. These areas were defined in consultation with individuals familiar with the Vermont housing market and represent regions with varying economic characteristics and networks of builders and related organizations.[1] Note that the Vermont Star program did not begin statewide operations until March 2000.

**Table E-2**
**Regional Distribution New Housing Units (1999) and Vermont Star Homes (2000)**

| Housing Market Area | % of all Housing Units | Percent of Enrolled Homes[2] |
|---|---|---|
| Northeast | 14% | 2% |
| Northwest | 48% | 83% |
| Southeast | 21% | 9% |
| Southwest | 17% | 6% |

### *The Supply Side*

**Market size.** The supply side of the Vermont housing market is characterized by a huge population of establishments, each building relatively few units.

- ***Number of establishments.*** The number of establishments that claim single-family home construction as their primary line of business is very large in comparison to the number of homes built. Specifically, there are 560 such establishments versus 2,200 to 2,500 single-family homes built per year. There are an additional 70 establishments with other primary lines of business (primarily remodeling) that claim to be involved in residential new construction.
- ***Size distribution of establishments.*** These establishments are generally very small. Seventy-six percent of all builders employ fewer than 5 persons. Thirty-one percent are one-person operations.
- ***Geographic distribution.*** The geographic distribution of the listed builders by market area mirrors almost exactly the regional distribution of new home construction. This finding may imply that home building is very much a local activity in Vermont.

**Average number of homes built and market share of size segments.** Table E-3 shows the estimated total number of units built by all Vermont builders by size category, along with the

[1] The counties in the four market areas are as follows: Northwest: Chittenden, Franklin, Lamoille, Grand Isle, Washington. Northeast: Essex, Orleans, Caledonia. Southeast: Windham, Windsor, Orange. Southwest: Bennington, Rutland, Addison.

[2] To enroll in the program, either the builder or the owner must sign an agreement and return it with plans and forms describing energy features of the project.

percentage of total units accounted for by establishments in the size category, and the average number of units built. Small builders (those with 4 or fewer employees) accounted for the largest share of total units built (50 percent), although each establishment completed, on average, only 2.3 houses per year. Medium sized firms (5 to 24 employees) accounted for 40 percent of total construction, and the 12 largest firms in the state accounted for an estimated 229 units, or 9 percent of total units constructed. Clearly, residential new construction activity in Vermont is highly fragmented, especially when one takes into account the 15 – 20 percent of homes that are owner-built.

**Table E-3**
**Volume of Construction and Market Share by Size Segment: 2001**
**Builder Sample: n = 54, Population Weighted**

| | Small | Medium | Large | All Builders |
|---|---|---|---|---|
| N = | 544 | 125 | 12 | 693 |
| Estimated Total Units Built | 1,301 | 1,076 | 229 | 2,606 |
| Share of Total Units | 50% | 41% | 9% | 100% |
| Average units built/establishment | 2.3 | 8.6 | 19.1 | 3.8 |

**Sources of Revenue/Involvement in Remodeling.** Even among builders that list their primary business activity with Dun & Bradstreet as residential new construction, remodeling accounts for a substantial portion of revenues. Twenty-eight percent of all sample builders do commercial new construction, 70 percent are involved in residential remodeling, and 32 percent pursue commercial remodeling. The percentage of establishments involved in activities other than residential construction is highest among larger firms. Similarly, larger firms derive a greater portion of their total revenues (47 percent) from activities other than residential new construction. On average residential remodeling provided 17 percent of total revenues for the sample builders. Moreover, many firms who report residential new construction as their primary business activity to Dun & Bradstreet actually derive more than half of their revenue from remodeling.

**Sales Prices.** The sample builders were asked to estimate the average price of the custom and production homes they built in Vermont and sold in 2001. The mean of these estimates for custom-built units was approximately $475,152, while the mean price reported for production homes was $279,258. The median reported "typical" sales price for custom homes was $500,000. The corresponding figure for production homes was $212,000.

### *RBES and the Absence of Code Enforcement*

In 1996, Vermont adopted an energy code (Residential Building Energy Standard or RBES) based on the 1995 Model Energy Code (CABO/MEC). A Task Force representing the full

range of interested parties, after extensive study and consideration, recommended a number of additions and modifications to CABO/MEC including:

- Extension of coverage to building types not included in CABO/MEC;
- Prescriptive standards for water heaters;
- Requirements for vent dampers on exhaust fans;
- Measures to reduce air leakage associated with fireplaces; and
- A variety of thermal and glazing requirements over and above those in CABO/MEC.

Vermont has no statewide fire and life safety standards that apply to single-family new construction. Thus, Vermont municipalities have never provided building code inspection services for single-family homes, and the initial code development Task Force found that it would be infeasible to require municipalities to enforce the RBES. Code compliance is self-certified by the builder. Prior to occupancy, the builder is to provide the owner with a certificate of compliance. Further, the builder is to file copies of the certificate with the municipality and with the Vermont Department of Public Service.

For all intents and purposes, the home rating procedures embedded in the RNC constitute the only third-party code compliance verification mechanism available to builders and owners. As of the October 2000 report of the code update advisory committee – roughly two years after the code compliance rules took effect -- only 250 certificates of RBES compliance were on file with the DPS. In that time period, 4,000 to 5,000 housing units had been built in Vermont.[3]

## E.4 SUMMARY OF PROGRAM ACTIVITY

Tables E-4 and E-5 summarize information about the volume of program enrollments and completions through the period of transition to EVT management and the first two full years of operation. Proper interpretation of these data is complicated by the fact that responsibility for new construction services to market-rate multi-family developments was transferred to another program in April 2001. Moreover, under current program operations multi-family projects are not "enrolled" using the same process as single-family projects, and therefore are not captured in the enrollment line after 2001. Table E-5 breaks out program completions by project type defined by the categories new construction v. remodeling and single-family v. multifamily. These tables show the following trends.

- ***Units completed.*** The level of overall program completions remained consistent between 1999 and 2001, varying between 617 in 2000, the year of management transition, to 650 in 1999. However, in 2002, the total number of units completed increased to 816, a

[3] Richmond Energy Associates. (2000). *Draft Report of the Vermont Residential Building Energy Standards Update Advisory Committee.*

difference of 31 percent from the previous year. Over this period, the best available estimates of residential construction activity suggest that the number of units built each year increased slightly: from 2,600 to 2,747.

- ***Units completing the home rating track.*** The number of completed single-family units passing through the Vermont Star or Vermont Energy Star components has increased steadily since EVT assumed management responsibility for the program. In 2000, the number of qualifying units totaled 93. This figure more than doubled in 2001 to 196, and increased by an additional 46 percent to 287 in 2002. This is equal to roughly 13 percent of the new housing units built in Vermont that year.

**Table E-4**
**Trend in Project Completions**

| | Pre-EVT | | EVT Management | | |
|---|---|---|---|---|---|
| **Year** | **1999** | **Jan – Feb 2000** | **Mar – Dec 2000** | **2001*** | **2002** |
| **UNITS ENROLLMENTS** | | | | | |
| Advantage | n/a | n/a | 599 | 270 | n/a |
| Vermont Star Homes | n/a | n/a | 287 | 380 | n/a |
| Vermont Energy Star Homes | n/a | n/a | n/a | 49 | 701 |
| **Total Enrolled** | **978** | **233** | **886** | **699** | **701** |
| **UNITS COMPLETED** | | | | | |
| Advantage | 540 | 182 | 323 | 429 | 205 |
| Vermont Star Homes | 110 | 19 | 93 | 196 | 148 |
| Vermont Energy Star Homes | | | | | 139 |
| Multifamily Units | | | 294** | 320** | 324 |
| **Total Completed** | **650** | **201** | **416** | **625** | **816** |

* Management of market rate multi-family projects moved to another program in April, 2001.

** Included in Advantage and Vermont Star Homes rows above.

Table E-5 shows the distribution of projects completed under EVT management by type: single v. multi-family and new construction v. renovations and additions. The table shows that, through 2001, the number of units completed through the program was split roughly evenly between single- and multifamily projects. Renovation projects made up about 10 percent of the project flow.

**Table E-5**
**Distribution of EVT Unit Completions by Project Type**

| | | Units Completed | | |
|---|---|---|---|---|
| | | 2000 (Mar – Dec) | 2001 | 2002 |
| Single Family | Rehab | 17 | 33 | 492 |
| Single Family | NC | 281 | 270 | |
| Multifamily | Rehab | 47 | 31 | n/a |
| Multifamily | NC | 247 | 289 | 324 |
| | | 592 | 623 | 816 |

## E.5 BASELINE CONSTRUCTION PRACTICES AND PROGRAM EFFECTS

### *E.5.1 Changes in Baseline Construction Practices: 1995 and 2002*

Table E-6 compares key results of on-site surveys of newly constructed Vermont homes conducted in 1995 and 2002. The table shows that the energy efficiency of new homes in Vermont improved in many respects over that period. Nearly 60 percent of the homes inspected in 2002 met the RBES requirements for total thermal transmittance (UA), versus an estimated 35 to 40 percent in 1995. Other construction elements that improved substantially included the level of insulation in walls, the level of insulation in basement walls, the presence of mechanical ventilation, and measured air infiltration. Moreover, the saturation of high efficiency central heating plants increased, and very inefficient tankless water heating systems were virtually eliminated.

### *E.5.2 Association of Efficient Construction Features and Equipment with RNC Participation*

Comparison of the energy efficiency characteristics of homes that participated in the RNC or predecessor programs and those that did not was complicated in a few cases by the absence of definitive documentation of program participation. However, using owner self-reports to define participation status, the following emerged as clear differences between homes that went through the program and those that did not.

- ***RBES Compliance.*** As discussed above, 59 percent of homes in the sample met RBES requirements for general thermal transmittance. All qualifying Vermont Star or Vermont Energy Star homes would meet this standard.
- ***Glazing Materials.*** Fifty-three percent of participants' homes had gas-filled low-e windows, versus 20 percent for nonparticipants.

**Table E-6**
**Comparison of 1995 and 2002 On-site Home Inspection Results**

| Compliance Feature | 1995 n = 151* | 2002 n = 158* | Comments |
|---|---|---|---|
| Percent of homes meeting UA Requirements | 35 – 40% | 59% | 1995 compliance estimate based on homes with prescriptive requirements |
| Attic insulation meets or exceeds code requirements | 61% | 68% | |
| Wall insulation meets or exceeds code requirements | 57% | 90% | |
| Basement wall insulation meets or exceed code requirements | 48% | 62% | |
| % glazing area with 2-pane, Low-e | 70% | 80% | Window/wall ratio higher for 2002 homes |
| Mean Air Infiltration | ~.45 ACH | .31 ACH | |
| Mechanical ventilation installed per proposed code update | 6% | 32% | |
| Mean AFUE of Central Heating Systems | n/a | 0.850 | General improvement observed. In 1995, 20 percent of boilers did not meet code requirement: AFUE 80. |
| Mean Heating system Oversizing Factor | >100 % | 92% | In 1995, 71 percent of heating systems were more than 100% oversized. |
| Percent with tankless coil water heating | 32% | 3% | |

* The sample for the 1995 study was developed from lists provided by Green Mountain Power, Central Vermont Public Service and Citizens Utilities. The sample selection process did not cover the full state, and documentation for development of the sample is incomplete. The sample for 2002 survey was developed through a random process using a statewide list of new homes developed through analysis of municipal records.

- ***Mechanical ventilation.*** Seventy percent of participants' homes had mechanical ventilation systems that complied with the DPS's proposed RBES update versus 15 percent of nonparticipants.
- ***Compact Fluorescent Lighting.*** Eighty percent of participants homes had compact fluorescent lighting fixtures installed, with an average of 5.52 fixtures per home. Only 31 percent of nonparticipants had CF fixtures installed, with an average of 1.16 fixtures per home.

## E.6 PROGRAM INFLUENCE ON BUILDER PRACTICE

**Influence on construction practices.** In addition to the evidence of program influence provided by the on-site survey, the twelve sample builders who participated in the program reported that the program had significant influence on their adoption of various efficiency measures and on their use of those measures in other homes they built. This finding was particularly strong in regard to low-e glazing, compact fluorescent fixtures, high efficiency heating equipment, insulation above code requirements, and the use of a third party home energy rating service.

**Marketing and Selling Vermont Star Homes.**

- ***Effects of program requirements on construction costs.*** Nine of the 12 participating builders interviewed indicated that installing features required to meet Vermont Energy Star specification resulted in added construction costs compared to homes without those features. The median estimate for added construction costs was $4,000, and the estimates ranged from $1,000 to $20,000. One of the participating builders reported that he incurred no added costs to meet program requirements; one was unsure of the amount of the added costs; and the third was unsure whether compliance with program requirements had added costs to the project.
- ***Effects of program qualification on salability.*** Eight of the 12 builders interviewed reported that they were able to sell qualified homes more easily than other, similar homes built during the same period.
- ***Effects of program qualification on sales prices.*** Seven of the 12 builders interviewed reported that they were able to obtain a higher selling price for homes qualified by the program. Most builders were unable to indicate the average increase in selling price for qualified homes, stating that the price increase generally depends on the general desirability of the home (size, location, etc) before considering efficient construction or features. Among those who were able to indicate a price increase, estimates ranged from $4,000 to $20,000 and averaged $7,815.

## E.7 PROCESS EVALUATION AND RECOMMENDATIONS

### *E.7.1 Overview*

The findings presented in the previous sections suggest the following conclusions about the operations and impact of the Efficiency Vermont Residential New Construction program.

- ***Single-family homes that go through the program clearly exhibit higher levels of energy efficiency than those that do not.***
- ***The program has done a good job of serving multifamily developments.*** In 2000, the program completed projects in 84 percent of the estimated number of multifamily units

(in structures with 2 or more units) built in Vermont. The corresponding figure in 2001 was 73 percent.

- ***While the number of total single-family units receiving program qualification increased in the current year (2002), it is still relatively low in comparison to the total volume of new home construction.*** In 2000, the program completed projects accounting for approximately13 percent of the estimated number of new single-family homes built in Vermont. The corresponding figure for 2001 was 12 percent. In 2001, 196 homes met program specifications. In 2002, 287 homes met Vermont Star or Vermont Energy Star specification – an increase of 46 percent in the number of units over the previous year. Assuming the total volume of single-family home construction remained stable between 2001 and 2002 (at roughly 2,350 units), the share qualified by the program rose from roughly 8 percent to 12 percent.
- ***Program participation remains concentrated in the Northwest region.*** Despite diligent efforts on the part of Vermont*wise* to identify and track housing starts, most of the construction activity in areas outside the Northwest appears to be falling through the cracks. In 2001, market areas other than the Northwest accounted for 19 percent of the program's enrollments, even though they hosted more than one-half of single-family new home construction. Over the life of the program, the Northwest region has accounted for over 85 percent of the program's project completions.[4]

**Key area for program improvement: increase volume.** Given the above findings, it is clear that the key to increasing the effectiveness of the RNC program is to increase the number of single-family homes that go through the qualification process. EVT and Vermont*wise* have already taken a number of important steps towards that objective. The two most important were to simplify the structure of the program and to establish the cooperative working arrangement with VGS. Both make the program(s) easier for builders and owners to identify, understand, and enroll in. The elimination of the requirement for participants to pay the home energy rating fee up front also appears to have removed a disincentive to participation. However, more efforts will be required if the RNC is to have a significant impact on the overall energy efficiency level of new homes built in Vermont.

EVT and Vermont*wise* will need to find ways to overcome the challenges posed by the fragmentation of the new construction market and the continued high demand for new homes in order to increase program volume.

[4] Factors contributing to the concentration of program activity in the Northwest may include synergism of earlier EVT and Vermont Gas System efforts, concentration of year-round housing construction in the region, and the long, uninterrupted period in which residential new construction programs have been offered in the region.

### *E.7.2 Specific Findings and Recommendations*

#### *Findings: Marketing and Communications*

**General Recognition.** Only 3 of the 54 builders interviewed for this evaluation reported that they had not heard of the Vermont Star Homes Program. In addition, 8 of the 24 individuals representing firms listed as builders in D&B but transferred to the remodeler sample reported that they had not heard of Vermont Star Homes. All of these individuals represented firms with 1 or 2 employees.[5]

**Understanding of the program.** Understanding of program objectives and requirements varied greatly among the sample builders and remodelers. Generally, we found a fair amount of confusion about program benefits and requirements. Some of this confusion may be due to the changes in program name and features in recent years.

**Builder perceptions of marketing efforts.** Builders generally felt that Efficiency Vermont needed to do more to publicize the program and to keep builders abreast of changes in program requirements. At the end of the builder survey, all respondents were asked to identify steps that Efficiency Vermont could take to promote energy efficiency in new construction and renovation. Twenty-six of the respondents, including all of the twelve builders who had participated in the program offered one suggestion each. The most frequent suggestion regarding program improvement was to increase outreach and education to builders (8 of 26 suggestions offered). Four other respondents volunteered that the program should do more to promote itself in response to other open-ended questions.

**Suggested channels for program information.** Four of the builders interviewed were aware of the annual conference and other seminars that Efficiency Vermont offered and believed that they were very valuable. In addition, builders and remodelers identified the following potential channels for distribution of information: media advertising, zoning boards and town clerks' offices, remodeling trade shows, and direct mail.

**Perceptions of costs of compliance.** Vermont*wise* and EVT staff found builders' estimates of the cost of required construction features to be extraordinarily high. Program managers and staff estimated that the costs of compliance in most homes would be no more than $1,000 to $2,000 and mentioned that some measures, such as direct vent boilers with no flues, might actually cost less than their less efficient counterparts. Clearly, this is one area in which more builder education is needed.

**Manufactured Homes.** According to the on-site survey and telephone surveys, manufactured homes account for a substantial portion – 17 percent or more -- of new home construction. Here we are referring to homes that are assembled on-site using factory-produced components, not to mobile homes. Construction standards for "double-wides" and other types of mobile homes are established and administered by the U. S. Department of Housing and Urban Development. They are not eligible to participate in the program. Only two of the homes in the on-site sample

[5] One possible explanation for this finding is that Vermont Energy Star Homes does not provide services for projects that involve remodeling only.

fit the HUD definition of mobile home. Moreover, the on-site survey found that manufactured homes were less likely to be energy efficient than other kinds of housing. According to Dun & Bradstreet, there are only 6 establishments in Vermont that list erection of prefabricated housing as their main business activity. Builder lists compiled by EVT suggest that there are a relatively small number of additional businesses in Vermont that erect manufactured housing as one of their services.

### *Recommendations: Marketing and Communications*

EVT and Vermont*wise* have already undertaken a number of marketing and communication activities to increase recognition and use of the program among targeted market segments and regions. These efforts have included the following:

- On a regular basis, EVT sends targeted direct mail of program materials to builders outside the Northwest region with follow-up phone calls to identify builders with projects in the early stages of development.
- EVT has hired a part-time RNC business development specialist to market the program, with emphasis on regions that have been underrepresented to date.
- EVT has distributed program materials through municipal officials in towns outside the Northwest, including mailings of posters and materials to Town Clerks.
- EVT has approached some of the larger builders of manufactured homes concerning their interest in training and participation in the program.

XENERGY recommends reserving some incentive funds for the RNC business development specialist to stimulate participation builders in areas outside the Northwest, or for special incentives to first-time participants.

### *Findings: Project Tracking Processes*

**Attrition of enrolled projects.** According to annual program activity statistics, the number of projects enrolled in the program is considerably greater than the number of project completions, particularly in the home rating track. One way to increase program volume would be to increase the percentage of enrolled projects that make it through the qualifying process. Unfortunately, the annual statistics provide little information on which to develop a strategy to accomplish that objective. Construction projects often span two or more program years, and some planned projects are never completed. It is impossible to tell from the annual figures what percentage of projects drop out for various possible reasons.

**Identification of completed projects.** In the course of completing the on-site survey, the evaluation contractor experienced difficulties in gaining definitive information on the program participation status of some of the sample homes. This was particularly the case for Vermont Advantage participants, but there were some instances in which it was not possible to verify whether a home had received a home energy rating. Part of the problem stemmed from

difficulties in matching addresses assigned to properties through the 911 location system to property identifiers stored in the program database.

**Program share among participating builders.** Perhaps the most efficient way to increase program volume would be to ensure that builders who have learned how to use the program send all of their projects through it. The participating builders interviewed for this evaluation reported that they had sought program qualification for roughly 60 percent of the homes they completed in 2001. This finding raises the question of why they did not seek to meet program qualifications for all of the units they completed. According to EVT staff, the most frequent reasons why participating builders do not qualify all homes they build include customer refusal to adopt required features and architectural designs that preclude compliance, especially in higher-end homes.

### *Recommendations*

**Intervene to limit program attrition.** To initiate the development of processes to increase the conversion of enrolled projects, we recommend that the evaluation contractor be given a task early in the next phase of work to analyze Vermont*wise*'s lead tracking data base and to conduct a survey of a small sample of "drop outs" to ascertain the disposition of the project and reasons for not following through with the program.

**Ensure identification of completed projects.** There should be some way of updating project records upon completion to capture permanent address information. Another approach might be to post some kind of permanent marker in the home to signify that it has been qualified by the program.

**Increase program share among participating builders.** According to Vermont*wise* staff, the program regularly contacts builders who have participated in the past to develop leads for future projects. Program staff could use this occasion to gather information on the extent of their activities outside the program and to probe reasons why they chose not to seek program qualification for some of their homes. Alternatively, the evaluation contractor could undertake a more in-depth survey of participating builders to gain detailed information on their response to the program and to test potential strategies for increasing the share of units for which program qualification is sought.

**Exploit more fully the capabilities of the FastTrack™ program tracking system database to identify opportunities to improve business processes.** Efficiency Vermont has purchased a FastTrack™, a full-featured program tracking database system, to support and document program operations. A thorough assessment of Efficiency Vermont's implementation and maintenance of this system was not included in the scope of this evaluation. However, based on the response of Vermont*wise* and Efficiency Vermont to various requests for tracking system data, we formed the impression that neither organization is taking full advantage of the system's capability to support analysis of program operations. We recommend that the Department of Public Service include a thorough review of tracking system and its use in program management as part of the next evaluation cycle. This review would include assessment of input data completeness and quality, "end-to-end" testing of a sample of cases to identify and strengthen

data quality assurance procedures, analysis of the data to explore some of the issues identified above, and design of standard reports for program managers and DPS.

# 1 INTRODUCTION

## 1.1 OVERVIEW

This is the Final Report of the Phase 1 Evaluation of Efficiency Vermont's (EVT's) Residential New Construction Program (RNC). The overall goal of the RNC is to increase the energy efficiency of new homes built in Vermont, primarily by providing technical assistance, marketing support and financial incentives for adoption of efficient construction practices to builders and remodelers. This evaluation assesses the accomplishments of the program from its inception in March 2000 through November 2002.

### *1.1.1 Program Description and Operations through May 2002*

**Program Objectives.** The objectives of Efficiency Vermont's Residential New Construction program, as stated in the original program plan are to:

- Increase market recognition of superior construction promoted by the pre-existing Vermont Star Home program;
- Increase awareness and compliance with the Vermont Residential Building Efficiency Standard;
- Increase penetration of cost-effective electric and fossil-fuel measures;
- Improve occupant comfort, health and safety;
- Institutionalize Home Energy Ratings, and
- Increase the use of mortgage benefits for energy-efficient homes.

**Program Development.** A consortium of Vermont electric utilities jointly operated a predecessor program known as Vermont Star Homes for more than two years prior to the start up-of Efficiency Vermont. The program was operated by a contractor – Vermont*wise* Energy Services of Rutland. Efficiency Vermont (EVT) contracted with Vermont*wise* Energy Services to deliver the EVT residential new construction program, and retained most of its key features. The Vermont Gas utilities offered their own residential new construction program known as HomeBase, as did a number of smaller municipal utilities, notably the Washington Electric Cooperative. The Vermont Gas System program continued operation under its own name and administration after the inception of the EVT RNC.

The Vermont Star Program began operating under contract to EVT in March 2000. In 2001, EVT and Vermont Gas Systems (VGS) worked together to develop a unified program to be delivered statewide. The new program went into effect January 1, 2002, with a six-month

transition period during which builders had the option to participate in the existing Vermont Star and HomeBase programs, or in the new program.

The new program – Vermont Energy Star Homes –features revised qualifying standards and rebate structures, as well as additional services to participating builders. From an operational standpoint, the major difference between Vermont Energy Star Homes and earlier versions of the EVT program is that the basic offer to builders and homeowners has been simplified, as has the incentive structure.

**Program Services, Incentives, and Operations.** The program offers the following services and incentives.

- ***Eligible projects.*** The program offers incentives for new construction or substantial renovation projects in single-family homes and multi-family residential buildings of three stories or less.
- ***Qualifying standards and incentive levels.*** To qualify for the Vermont Energy Star Home designation, a house must achieve a Home Energy Rating score of 86 points, or 5 Star, which is equivalent to the U. S. Environmental Protection Agency's ENERGY STAR home rating. Generally, homes must contain high levels of insulation, efficient heating and hot water equipment, and high-quality air sealing measures to meet this rating. Homes that score 86 or above in the Home Energy Rating will use approximately 20 percent less energy for heating, cooling, and hot water than those that meet the minimum requirements of Vermont's Residential Building Energy Standard (RBES). In addition to the 86 point home energy rating, VESH-qualifying homes must have least four energy-efficient lighting fixtures in high use areas, hard-ducted returns above the first floor deck for forced hot air systems, power-vented or sealed combustion equipment, and efficient mechanical ventilation systems.

  The owners or builders of Vermont Energy Star qualifying homes receive a home energy rating at no cost as part of the program, a $500 value. In addition, they may also receive rebates up to approximately $1,300 in most of the state or up to $1,800 in VGS territory for installation of efficient lighting fixtures and appliances. Additional services for Vermont Energy Star Homes participants may include plan review, technical training, and marketing support for qualifying homes.

**Program Accomplishments through December 2001.** In its first 10 months of operation (through December 2000), the program issued 323 rebates for home ratings: 106 of them for homes qualifying for Vermont Star designation; the remainder for the Vermont Advantage designation. An additional 192 customers had received rebates for specific measures.

In 2001, the program accomplished the following.

- ***Builder participation.*** 85 builders participated in the program in 2001, including 40 who had not participated in the previous year.

- ***Volume of participation.*** 699 construction projects applied for program assistance; 622 were completed.
- ***Vermont Star designation.*** 193 of the completed construction projects received Vermont Star Designation.
- ***Other Measures.*** 429 of the participating homes that installed energy efficiency measures under the program either did not apply for or were not eligible to receive Vermont Star designation.

## 1.2 OVERVIEW OF THE PHASE 1 EVALUATION

XENERGY, the Vermont Department of Public Service (DPS), and a group of stakeholders developed the scope of the Phase 1 RNC Evaluation through an iterative process through which both the evaluation objectives and methods were refined. This process produced a number of interim documents including:

- ***Preliminary Market Characterization (September 2001).*** This document compiled information from in-depth interviews with local market participants, program staff, and program contractors, as well previous research results to develop a preliminary portrait of the size and structure of Vermont's residential lighting and appliance markets. The documents also summarized existing findings regarding the share of efficient equipment in those markets and the barriers to its further acceptance.
- ***Final Evaluation Plan (January 2002).*** Based on extensive discussions with representatives of DPS and EVT concerning the *Preliminary Market Characterization* and various draft research plans, XENERGY developed a final evaluation plan that provided the objectives and methods for the analysis reported here.
- ***Preliminary Report (May 2002).*** To fulfill legislative reporting requirements, XENERGY developed a short report of evaluation results as of early 2002. This document received extensive review from DPS and the stakeholders, and XENERGY took comments received at that point into account in completing the research and preparing the Final Report

### *1.2.1 Phase 1 Evaluation Objectives*

**Program Impact Assessment.** The key Phase 1 research questions in regard to program impact are as follows.

1. ***Baseline.*** To what extent are the construction practices required by the programs used by participant builders, by nonparticipant builders? To what extent did participant builders use those practices prior to program enrollment?

2. ***Changes in construction practice***. How have construction practices changed since the implementation of the program? How do construction practices differ between homes that have gone through the program and those that have not?
3. ***Attribution of adoption of efficient building practices to program influence.*** To what extent do participant builders attribute changes in construction practices to information and experience gained through the program? To what extent do nonparticipants attribute changes in construction practices to program influences? (Untracked savings)

**Market Characterization.** The key research questions in regard to market characterization are as follows.

1. ***Size and segmentation of the new construction market.*** How large is the residential new construction market? What are its characteristics in terms of distribution by region, price, type of home (primary residence v. vacation), mode of construction (custom v. production v. owner-built v. manufactured housing) and features such as heating fuel?
2. ***Role of other market actors in promoting energy-efficient construction.*** To what extent and through what mechanisms do the following sets of market actors affect builders' decisions regarding energy efficient construction: HVAC and other trades contractors, home energy rating services, industry associations, lenders?

**Process Evaluation.** The key research questions in regard to process evaluation are as follows.

1. What are Vermont Star Home participants' key motives for enrolling; why do nonparticipants stay away?
2. What program elements do builders and homebuyers find most useful?
3. What incentives or information could convince builders to implement the Vermont Star standards on a larger percentage of homes?

**Recommendations for program improvement.** Based on review of the analyses described above and experience in evaluating and operating other residential efficient equipment programs, XENERGY developed a set of recommendations designed to improve the performance and/or cost-effectiveness of the RNC. XENERGY presented these recommendations to DPS, EVT, and the program contractors to gather their perceptions regarding the practicality and likely effectiveness of the proposed actions. The recommendations presented here represent reflect XENERGY's independent judgment concerning prudent next steps in program development.

### *1.2.2 Methods and Activities*

This section provides an overview of the full range of research and analysis activities undertaken for this evaluation. Detailed descriptions of various activities, including statistical principles, response rates, and limitations on interpretation are presented in subsequent sections where results are presented. Appendices A and B present additional methodological details.

In general, the methodological approach developed by XENERGY in consultation with DPS and other stakeholders involved the development of multiple observations on key indicators of program performance. Ideally, baseline characterization would consist of a set of replicable observations of key market characteristics, such as incidence of various construction features in new homes, customer awareness and knowledge of energy efficient construction practices, and builder perceptions of the market value of energy-efficient approaches. Information on a limited range of these topics was available from various sources, including an on-site study of Vermont homes conducted in 1995. Therefore, we needed to make best efforts to synthesize a reasonable picture of baseline conditions out of available information and research conducted specifically for this evaluation. This primary research included collection of data from builders on their recent and current construction practices, a survey of customers who had purchased new homes in 1999 and 2000, and an on-site survey of 159 newly constructed homes.

Similarly, an ideal characterization of market effects would include multiple observations on key variables such as market share of efficient products at different times subsequent to program inception, and market actor perceptions of program effects. However resource limitations precluded this kind of comprehensive "triangulation" in most cases. DPS and other stakeholders – with input from XENERGY – made decisions as to the allocation of resources for primary data collection with eye to greatest value for program evaluation and improvement at this juncture.

Table 1-2 summarizes the primary research and analysis activities undertaken for the RNC evaluation and presents some details regarding sample size and selection. Table 1-3 shows the key evaluation questions to which the results of the various research and analysis activities were applied.

**Table 1-1**
**Summary of RNC Evaluation Primary Research and Analysis Activities**

| TASK/*Objective* | Description/Sample Approach & Size |
|---|---|
| SUPPLY-SIDE ANALYSIS | |
| ***Builder Survey*** | Probe current practices in regard to energy efficient construction and marketing, code compliance, program effects, perceptions of program, customer demand, value of energy efficiency. Also split of work between new construction and renovation, geographic scope of activity.<br>Random sample of 54 builders with quotas for 2 geographic zones, allocated by location of firms in the zones, with probability of selection proportional to size as measured by # of employees reported to Dun & Bradstreet |
| ***Remodeler Survey*** | Probe the same topics as builder survey. Also, explore opportunities and interest in potential retrofit energy efficiency measures and programs.<br>Random sample of 35 remodeling contractors, with quota for kitchen remodelers. Sampling procedure similar to builder survey |
| ***In-depth Interviews with Other Market Actors*** | In-depth interviews with HVAC contractors, real estate agents, and lenders to probe influence on energy-related construction decisions; adoption of energy efficient practices, perception of builder practices, demand.<br>30 interviews in all, with samples systematically selected to provide representation for key subgroups and all geographic regions. |
| DEMAND-SIDE ANALYSIS | |
| ***Analysis of Property Tax Records*** | Analyzed "Grand Lists" of land parcel property tax status submitted by 230 of Vermont's 260 towns to identify addresses on which new residential construction was likely to have occurred. Used other municipal sources for remaining towns to develop similar lists. |
| ***Telephone Survey of Recent Homebuyers*** | Closed-ended survey to probe customer experience with builders, knowledge of programs, codes and energy efficiency measures. Contact was also used to recruit participants for on-site surveys.<br>Random sample of 200 with geographic quotas. Sample frame developed from analysis of "Grand Lists" prepared by cities and towns for use in statewide property tax assessment and collection. |
| ***On-site Customer Survey*** | Assess "as built" adoption of efficient construction practices and products. Probe customer awareness and perception of value of energy efficient construction; experience with builder promotion of energy efficiency, awareness of program.<br>Random sample of 159 with geographic quotas |
| PROGRAM OPERATIONS | |
| ***Staff and Contractor Interviews*** | In-depth interviews with key program staff and delivery contractors. These interviews were used to gather details on administrative and marketing processes, history of program development and changes in design, perceptions of market response to the program, corroboration of findings from other sources, and response to preliminary recommendations. |
| ***Analysis of Program Records*** | Analysis of program data bases to assess patterns of participation by builders and consumers over time and by region. |

**Table 1-2**
**Application of Research and Analysis Results**

| | | | In-Depth Interviews | | Surveys with Probability Samples | | | |
|---|---|---|---|---|---|---|---|---|
| **EVALUATION COMPONENT**/Research Topic or Question | **Tax Records Analysis** | **Program Records Analysis** | **Prog. Staff/ Contr.** | **Realtors/ Lenders/ Trades** | **Builders** | **Remod-elers** | **Telephone Customer Survey** | **On-Site Home Surveys** |
| **BASELINE CHARACTERIZATION** | | | | | | | | |
| Number and distribution of new homes by size, type, region, other attributes | X | | | | X | | X | X |
| Efficiency characteristics of new homes | | | | | X | X | X | X |
| Builder/remodeler construction and sales practices | | | X | X | X | X | X | X |
| Builder/remodeler assessment of the cost and commercial value of efficient construction practices | | | X | | | X | | |
| Customer interest in and knowledge of efficient construction practices and equipment | | | | | X | X | X | X |
| Realtor and lender promotion of energy-efficient new homes | | | X | X | | | X | |
| **ASSESSMENT OF PROGRAM EFFECTS** | | | | | | | | |
| Changes in penetration of efficient construction practices and equipment in new homes | | | X | | X | X | | X |
| Changes in builder/remodeler construction and marketing practices | | | | | X | X | X | |
| Changes in builder assessment of the cost and commercial value of efficient construction practices | | | X | | X | X | | |
| Changes in realtor and lender promotion of efficient homes | | | X | X | | | X | |
| Changes in customer interest in and knowledge or efficient construction practices and equipment | | | | | X | X | X | X |

**Table 1-2 (Continued)**
**Application of Research and Analysis Results**

| | | | In-Depth Interviews | | Surveys with Probability Samples | | | |
|---|---|---|---|---|---|---|---|---|
| **EVALUATION COMPONENT**/Research Topic or Question | **Tax Records Analysis** | **Program Records Analysis** | **Prog. Staff/ Contr.** | **Realtors/ Lenders/ Trades** | **Builders** | **Remod-elers** | **Telephone Customer Survey** | **On-Site Home Surveys** |
| **PROCESS EVALUATION** | | | | | | | | |
| Effectiveness of program marketing | | X | X | | X | X | X | |
| Effectiveness in identifying principals in housing starts | | X | X | | | | X | |
| Comprehensiveness of opportunities captured in participating homes | | | | | X | | | X |
| Appropriateness of program record-keeping and tracking systems | | X | X | | | | | |
| Appropriateness of incentive levels; specifications for qualifying practices and equipment, inspection and rating procedures | | | X | | X | X | X | |
| Effectiveness in increasing awareness of and compliance with the Vermont RBES | | | X | | X | X | X | X |

## 1.3 GUIDE TO THE REMAINDER OF THE REPORT

The remainder of this report is organized in the following sections.

- ***Section 2: Program Description.*** This section presents the chronology of program development, including activities and accomplishments of predecessor programs. It then provides a detailed description of current operations and an analysis of patterns of program participation by homebuyers and builders.
- ***Section 3: Market Size and Structure.*** This section summarizes information on the size and structure of the residential new construction market. On the demand side, we focus on developing estimates of the number of new units built each year, and their distribution by regional location, type (single-family versus multifamily), prevalence of manufactured homes, and prevalence of owner-built homes. On the supply side we characterize the population of establishments that build housing in Vermont: number, distribution by size and specialty, sources of revenue, and extent of construction activity.
- ***Section 4: Analysis of New Construction Practice.*** This section summarizes the findings of on-site surveys of new single-family homes undertaken in 1995 and in 2002. The findings from these studies are used to assess changes in construction practices over that time period, as well as differences between homes that went through the program and those that did not.
- ***Section 5: Builder Practices and Program Response.*** This section presents the results of the builder and remodeler surveys in regard to self-reports of construction practices, comparison of reported to observed practices, awareness of efficiency programs and RBES, and assessment of their effects on housing construction and marketing practices.
- ***Section 6: Homebuyer Practices and Program Response.*** This section summarizes the results of the homebuyer telephone survey, focusing on homebuyer awareness and knowledge of energy-efficient construction practices; extent of decision making over energy-related home features and equipment, and awareness of energy efficiency programs.
- ***Section 7: Other Market Actors.*** This section presents results of the realtor, lender, and HVAC contractor interviews.
- ***Section 8: Process Evaluation and Recommendations.*** This section summarizes information on customer and builder perceptions of the program and the specific ways in which customers and builders used the program to overcome barriers to broader acceptance of the targeted products. These sections conclude with recommendations to improved project operation.

We provide the following documentation of research methods in appendices.

- ***Appendix A: Questionnaires and Interview Guides.*** Final versions of all questionnaires and in-depth interview guides used in the evaluation.
- ***Appendix B: On-site Inspection Form and Customer Questionnaire.*** Inspection form and customer questionnaire used for the on-site inspections.

# 2 RNC PROGRAM DESCRIPTION

## 2.1 PROGRAM DEVELOPMENT

### *2.1.1 Predecessor Programs*

**Overview.** Vermont utilities began to operate programs to encourage energy-efficient construction of new homes in 1992. For the five utilities that became sponsors of the Vermont Star Homes program in 1997, Table 2-1 displays the number of homes that completed predecessor programs prior to the launch of Vermont Star Homes. Vermont Gas System and Washington Electric Coop continued to operate their own programs after the launch of Vermont Star Homes. As discussed in Section 1, Vermont Gas System agreed to merge its program operations with Efficiency Vermont in 2001.

**Table 2-1**
**Summary of Vermont Utility Residential New Construction Program Activity**
**Number of Homes Completing Programs by Year and Company**

| | Eventual Vermont Star Homes Sponsors | | | | | Independent Programs | | |
|---|---|---|---|---|---|---|---|---|
| YEAR | Burlington Elec. Dept | Citizens Utiliites | Central Vermont | Green Mtn Power | Vermont Elect Coop | VT Gas System | Washington Elect Coop | Total |
| 1992 | | | 92 | 241 | | | | 333 |
| 1993 | | 100 | 214 | 275 | | 50 | 7 | 646 |
| 1994 | 88 | 78 | 193 | 256 | | 246 | 31 | 892 |
| 1995 | | 88 | 129 | | 0 | 104 | 46 | 367 |
| 1996 | 22 | 22 | 241 | | 19 | 80 | 20 | 404** |
| 1997 | 82 | | 222 | 13 | 16 | 107 | 31 | 471** |
| 1998 | | | | | | 172 | n/a | 172 |
| 1999 | | | | | | 249 | n/a | 249 |
| Grand Total | 192 | 288 | 1,091 | 785 | 35 | 1,008 | 135* | 3,534 |

* Participation figures for Washington Electric Coop program for 1998 and 1999 not available.

** Participant totals may include some double counting among BED, GMP, and VGS customers.

Although program activity varied substantially from year to year, the total number of homes passing through the predecessor programs was fairly high, at least as a percentage of the flow of new construction. If we assume an average of 2,300 single-family homes built per year (see discussion of market size in Section 3.2), the 3,534 homes that completed new construction programs from 1992 through 1999 constitute roughly 15 - 20 percent of the number built. As discussed below, Vermont Star Homes completed 1,018 homes during the period 1997 – 1999, some of which may also appear in the totals shown in Table 2-1. Thus, on average, about 20

percent of all new single family homes built in Vermont were passing through some kind of residential new construction program prior to the advent of Efficiency Vermont.

**Development of the Vermont Star Homes Program.** The major Vermont utilities began contracting with Vermont*wise* Energy Services for the implementation of a residential new construction program in May 1997. The purpose of the program was to encourage and assist homeowners, builders, developers, and other parties select and install cost-effective electric and non-electric energy-efficient equipment and adopt energy-efficient design and construction practices in new construction and major rehabilitation projects.

***Qualifying efficiency packages and incentives*.** The initial program design provided for two tiers of qualifying measures and practices, each with its own associated set of incentives and verification requirements.

- **Vermont Star Homes.** To qualify for the Vermont Star Home designation, a house had to achieve a Home Energy Rating of 86. As a point of reference, the U. S. Environmental Protection Agency's 5-star ENERGY STAR home rating, which was developed after the inception of Vermont Star Homes, also requires a Home Energy Rating of 86. Generally, homes had to contain high levels of insulation, efficient heating and hot water equipment, and high-quality air sealing measures to meet this rating. (Homes that score 86 or above in the Home Energy Rating will use approximately 20 percent less energy for heating, cooling, and hot water than those that meet the minimum requirements of Vermont's Residential Building Energy Standard.) In addition, at least 10 lighting fixtures or 30 percent (whichever was lower) in Vermont Star homes had to be energy efficient. Rebates were provided for these fixtures. Finally, these homes had to have efficient mechanical ventilation systems installed.

  Builders or owners of Vermont Star Homes needed to pay for the Home Energy Rating, but received a rebate of $350 to be applied to its cost. They could also receive additional rebates up to approximately $700 for installation of efficient lighting fixtures, appliances, and ventilation systems. Additional services available to participants included plan review, technical training programs and marketing support for qualifying homes.

- **Vermont Advantage Homes.** Customers and builders who elected not to build up to the Vermont Star standard could still receive incentives for incorporating energy efficient features into their homes that meet RBES requirements through the Vermont Advantage option. Under this benefit package, home energy ratings were encouraged but not required. If the builder or homeowner elected to purchase a home energy rating, the program reimbursed $100 of its cost. The builder or homeowner was also eligible for rebates for the installation of efficient lighting fixtures, refrigerators, and mechanical ventilation systems. Rebates for the purchase of efficient clothes washers were available through the statewide efficient appliance program.

***Lead development and project enrollment.*** Under its contract with the participating utilities, Vermont*wise* was responsible for identifying residential construction projects in the planning

phase and for enrolling builders and owners in the program. Leads were obtained from a number of sources, including new service requests to the participating utilities, Act 250 applications, and interested builders. Vermont*wise* then approached the builder or property owner to solicit their participation. (See "Current Operations" below for more detail on the project enrollment process.) If the principals were interested, they enrolled in the program by signing an agreement and returning it with plans and forms describing energy features of the project.

***Project oversight and incentive delivery.*** Energy Rated Homes of Vermont (ERH/VT), a contractor to the sponsoring utilities, provided plan review and technical assistance services to the builder during the course of construction. Once the construction was complete, ERH/VT conducted the final inspection and forwarded the results to Vermont*wise*. Vermont*wise* reviewed the inspection form and computed the incentives for which the builder or owner was eligible. The incentives were paid directly by the customer's utility company. Given the exigencies of the construction process, there was some attrition of projects between the enrollment and completion phases. In some cases, planned projects were not completed or significantly delayed. In others, the builder or owner elected not to go through with the required measures.

***Level of Program Activity.*** Table 2-2 shows the number of projects enrolled and completed per year from the inception of Vermont Star Homes through the March of 2000. At that point the program was brought under EVT management.

**Table 2-2**
**Summary of Vermont Star Homes Activity Prior to EVT Transition**

| Year | 1997* | 1998 | 1999 | 2000** | Total |
|---|---|---|---|---|---|
| **Total Leads Identified** | **1353** | **1687** | **2028** | **376** | **5444** |
| *Advantage Enrolled* | *333* | *515* | *678* | *122* | *1648* |
| *VT Star Homes Enrolled* | *108* | *125* | *300* | *111* | *644* |
| **Total Enrolled** | **441** | **640** | **978** | **233** | **2292** |
| *Advantage Completed* | *58* | *270* | *540* | *182* | *1050* |
| *VT Star Homes Completed* | *1* | *39* | *110* | *19* | *169* |
| **Total Completed** | **59** | **309** | **650** | **201** | **1219** |

* Program began May 15, 1997, and provided service to the following electric utility service territories: BED, CUC, CVPS, GMP, & VEC

** Through March 15, 2000.

Table 2-2 shows that, over the roughly three years of pre-EVT operation, only 24 percent of the projects that enrolled in the Vermont Star Homes program tier completed that track, versus 64 percent for the Vermont Advantage track. Moreover, Vermont Star Homes project completions accounted for only 14 percent of total program completions. These results do not necessarily

indicate that the objectives of the program were not met. All of the Vermont Star Homes were electric utilities, and the Vermont Advantage tier captured many of the electric savings opportunities available in new homes through incentives for efficient lighting, appliances, and ventilation equipment. However, the results summarized in Table 2-2 suggest that the Vermont Star Homes program, prior to consolidation of the tiered incentive system, may have had limited impact on the broader range of new home construction practices related to heating systems and thermal integrity.

### *2.1.2 Transition to EVT Management*

Transition of the residential lighting programs to EVT management was accomplished with little disruption to the basic organizational structure of the Vermont Star Home effort. EVT contracted with Vermont*wise* to continue implementation of the program, and ERH/VT retained its role in plan review, technical assistance, and inspection.

Upon assuming overall responsibility for the program, EVT instituted a number of changes, including the increasing the number of efficient fixtures to be installed and developing an incentive package for ENERGY STAR appliances. In 2001, EVT and Vermont Gas Systems (VGS) worked together to develop a unified program to be delivered statewide, except in the Washington Electric Cooperative territory. The new program went into effect January 1, 2002, with a six month transition period during which prior enrollees had the option to participate in the existing Vermont Star and HomeBase programs, or in the new program.

The new program – Vermont Energy Star Homes –features a substantially simplified incentive structure. There is only one tier of qualifications: projects must be built to the national ENERGY STAR Standard to receive any kind of rebate. The home energy rating fee is paid for by the program, without obligating the customer or builder to front the money. According to program contractors, the upfront payment requirement had deterred participation in the past. Additional incentives up to $1,300 are available for the installation of energy-efficient lighting equipment and appliances. The maximum incentive available from VGS is $1,800.

## 2.2 CURRENT PROGRAM OPERATIONS

**Organization and Staffing.** Program management is overseen by EVT's Residential Program Manager, who devotes 20 – 30 percent of her time to the program. A number of other EVT program staff spend relatively small portions of their time on the program as well.

***Vermont*wise *Energy Services*** is the lead contractor for the program, with two full-time management staff and one part-time administrative person to handle data entry and mailing. Vermont*wise* is primarily responsible for managing the lead development and enrollment, and provides some project assistance functions. It is also responsible for reviewing ratings and inspection forms, computation of rebate amounts, program activity tracking and reporting.

***Vermont Gas Systems*** is responsible for enrolling and managing projects that originate through requests for gas service. The company assigns two individuals to these functions. One gas marketing specialist spends roughly half his time enrolling builders and consumers and monitoring the progress of enrolled projects. A second field staff spends about one-third of his time on final inspections. These individuals receive administrative support from VGS's marketing department.

While VGS has taken on a limited range of tasks in the joint program, they have sought to maintain a fairly high profile to their customers and within the program administrative structure. VGS program staff interviewed for the evaluation mentioned that they want to keep the company's identity, especially when dealing with builders. They believe their relationships to builders are particularly close due to interactions involved in getting gas service into new homes. VGS staff also reported that they make it a point to mention to builders and customers that VGS "co-funds" the program. VGS also does some independent print advertising and mailings for the program. Finally, VGS maintains its own separate database to track program leads, relying primarily on requests for gas service to initiate a case.

***Energy Rated Homes of Vermont*** is part of Vermont Energy Investment Corporation, the organization responsible for the management of EVT, and provides plan review, technical assistance to builders, and home energy ratings to the program.

**Program Marketing.** Since the inception of the Vermont Star Homes program, the sponsoring utilities and, later, EVT have pursued a wide range of strategies to market the program to builders. These practices include mounting an annual conference on energy efficiency and building, placement of articles in trade and popular publications, appearance at home shows, presentation at builders and trade association meetings, and sponsorship of the builders association golf tournament.

**Lead Development and Tracking.** As discussed above, leads are developed through a variety of sources, including requests for electric and gas service, Act 250 postings, outreach events, and builders already active in the program. Once a principal in a new construction project is identified, Vermont*wise* mails the potential program participant an application packet. There are separate packets for consumers, builders, and first-time builders. Once the initial packet is sent, Vermont*wise* uses the following contact sequence to secure project enrollment:

- Three phone calls over a period of thirty days.
- If contact is not made or approval is not received, a second packet is sent out.
- If Vermont*wise* receives no response to the second mailing, the customer is called two more times over a period of thirty days.
- If there is still no response, another mailing and round of calls is made before giving up.

**The Enrollment Process.** Vermont*wise* sends a package to identified leads that includes an Enrollment Agreement outlining the participant's responsibilities and an Energy Features Form

for information on the construction project. The participant returns the Agreement and Form, and project plans to Vermont*wise* (or in some cases VGS staff). Staff review the materials for completeness, enroll the project in the tracking system, forward plans and/or energy features form to ERH/VT, and contact the participant to confirm enrollment or request additional information. ERH/VT then reviews the plan and provides technical assistance.

**Project Management, Inspection, and Closeout.** When ERH/VT receives the project package, staff contact the participant, review the plan, and develop an initial energy rating. ERH/VT provides technical assistance to ensure that the home as will achieve the needed energy rating level and that the home meets ventilation and lighting criteria. ERH/VT (with some assistance from Vermont*wise)* monitors the construction process through follow-up calls to the participant. Once the project is complete ERH/VT conducts the final inspection. ERH/VT mails the completed inspection forms to Vermont*wise* for review. Vermont*wise* notifies the participant if changes need to be made for program qualification. Once the project qualifies, Vermont*wise* notifies the participant, computes the rebate amount, and notifies EVT and VGS of completion.

## 2.3 SUMMARY OF PROGRAM ACTIVITY

This section summarizes the results of program operations during the first two years, focusing on the distribution of participating builders and completed units by region, and the degree to which program activity was concentrated among the most active builders. We begin by characterizing housing market regions within Vermont that were identified to us by program personnel and other market actors. We will use those regions throughout this report to assess geographic distribution of program activity and market conditions. We then move on to characterize patterns of builder and homebuyer participation in the program over its first 22 months of operation.

### *2.3.1 Trend in Program Activity*

Table 2-3 shows the volume of project completions through the period of transition to EVT management and the first year of operation. The level of overall program completions remained consistent, varying between 617 in 2000, the year of management transition, to 650 in 1999. However, the share of projects accounted for by qualified Vermont Star Homes increased sharply from 17 – 18 percent in 1999 and 2000 to 31 percent in 2001. In 2002, the number of qualified projects continued to increase – from 196 in 2001 to 263 in 2002. This is an increase of 32 percent from the previous year. Homes completing the inspection process accounted for roughly 9 percent of all single-family homes constructed in Vermont in 2001; 13 percent in 2002.

**Table 2-3**
**Trend in Project Completions**

| | Pre-EVT | | EVT Management | | |
|---|---|---|---|---|---|
| **Year** | **1999** | **Jan – Feb 2000** | **Mar – Dec 2000** | **2001** | **2002** |
| **Total Enrolled** | **978** | **233** | **1,241** | **669** | **734** |
| *Advantage Completed* | *540* | *182* | *323* | *429* | *202** |
| *VT Star Homes Completed* | *110* | *19* | *93* | *196* | *147* |
| *VT Energy Star Homes Completed* | | | | | *116* |
| **Total Completed** | **650** | **201** | **416** | **625** | **465** |

* Figures do not contain multifamily projects with have been transferred to management by the REEP program.

### *2.3.2 Program Activity by Type of Project*

Table 2-4 shows the distribution of projects completed under EVT management by type: single v. multi-family and new construction v. renovations and additions. In 2002, management of large multi-family projects was placed under a different program and the count of total units completed was not available at the time of this writing. Table 2-4 shows that, through 2001, the number of units completed through the program was split roughly evenly between single- and multifamily projects. Renovation projects made up less than 10 percent of the project flow through 2001 and virtually stopped in 2002.

**Table 2-4**
**Distribution of EVT Unit Completions by Project Type**

| | | Units Completed | | |
|---|---|---|---|---|
| | | **2000 (Mar – Dec)** | **2001** | **2002** |
| Single Family | Rehab | 17 | 33 | 3 |
| Single Family | NC | 281 | 270 | 462 |
| Multifamily | Rehab | 47 | 31 | n/a |
| Multifamily | NC | 247 | 289 | n/a |
| | | 592 | 623 | 465 |

### 2.3.3 Housing Market Areas in Vermont

Housing market observers and actors interviewed for this evaluation identified a number of distinct regional housing markets within the state. These markets are characterized by differences in economic drivers and conditions, pricing, construction approach, and the population of builders. The following paragraphs identify the regional markets and compile some of the comments we received from market observers regarding the differences between them. Table 2-5 shows the distribution of all new single-family homes built in 1999 (per compilation of Form 411 data) among the four housing market areas, as well as the distribution of homes that made applications to the program in 2000 and 2001.

- ***Northwestern Vermont.*** (Chittenden, Franklin, Lamoille, Grand Isle, and Washington Counties) Northwestern Vermont – especially the Burlington area -- is home to the highest levels of economic and housing growth in the state. In 2000, this area of the state accounted for 48 percent of new housing units built and 83 percent of the homes enrolled in Vermont Star Homes. This is the home region for both EVT and Vermont Gas Systems.
- ***Southwestern and South Central Vermont***. (Bennington, Rutland, and Addison Counties) This region of the state contains many of its major ski areas. The Manchester and Rutland areas have experienced an increase in resort development and construction of large custom and vacation homes. Builders in Rutland County have participated relatively heavily in the Vermont Star Homes program, although participation in the region overall has not kept pace with building. It accounts for 17 percent of 1999 new construction versus 6 percent of program participation through May 2001.

**Table 2-5**
**Distribution New Housing Units and Vermont Star Homes (2000)**
**By Regional Housing Market Area**

| Housing Market Area | % of all Housing Units* | Percent of Enrolled Homes |
|---|---|---|
| Northeast | 14% | 2% |
| Northwest | 48% | 83% |
| Southeast | 21% | 9% |
| Southwest/South Central | 17% | 6% |

* Based on distribution of new housing units estimated from Forms 411, 1999.

- ***Northeastern Vermont***. (Essex, Orleans, and Caledonia County) Known locally as "the Kingdom", this is the least economically developed area of the state. It is primarily rural and characterized by a high percentage of low-income households. One market observer noted that a significant portion of new homes in the region are likely to be built by non-professional owners, that a relatively low percentage of the region's builders are licensed, and that many are trained through informal apprenticeships that may reinforce traditional building techniques.

- ***Southeastern Vermont.*** (Windham, Windsor, and Orange Counties) This is also rather economically depressed, similar to the northeastern portion of the state. As noted above, the South also has no active homebuilders association, fewer code workshops and seminars.

### *2.3.4 Patterns of Builder Participation*

**Establishment Type.** Table 2-6 summarizes information on the program activity accounted for by different types of establishments and individuals. Over the two years covered, homebuilders have accounted for roughly 40 percent of the program participants and half of the projects completed. Developers account for roughly 10 percent of participants and 40 percent of projects completed. The "other category" contains primarily individual owner/builders. Over the time period covered by the records, only one in five of these individuals who enrolled a project in the program went on to complete it. The "close rate" for builders was one-third; for developers roughly one-half.

Over the first two years of the program, 85 builders (as opposed to other kinds of establishments) participated in the program. This amounts to 15 percent of the 560 establishments identified as having single-family residential construction as their primary line of business. (See Section 3.2 for a discussion of SIC definitions and counts from the Dun & Bradstreet iMarket database.)

**Table 2-6**
**Program Activity by Type of Establishment**

| | | Percent of Projects | | |
|---|---|---|---|---|
| | **Estab. w/ Proj. Completed** | **Projects Enrolled** | **Applications Submitted** | **Projects Completed** |
| ***2000 Totals*** | ***30*** | ***266*** | ***145*** | ***102*** |
| Builders | 43% | 61% | 59% | 52% |
| Developers | 20% | 26% | 30% | 37% |
| Architects | 0% | 0% | 0% | 0% |
| Modular Builder | 3% | 1% | 1% | 1% |
| Tech Ed | 7% | 0% | 1% | 2% |
| Other | 27% | 13% | 10% | 8% |
| *Total* | *100%* | *100%* | *100%* | *100%* |
| ***2001 Totals*** | ***55*** | ***414*** | ***243*** | ***196*** |
| Builders | 38% | 46% | 44% | 48% |
| Developers | 20% | 28% | 40% | 40% |
| Architects | 0% | 0% | 0% | 0% |
| Modular Builder | 2% | 3% | 0% | 1% |
| Tech Ed | 4% | 0% | 1% | 1% |
| Other | 36% | 23% | 15% | 10% |
| *Total* | *100%* | *100%* | *100%* | *100%* |

**Geographic patterns of builder enrollment.** To assess the comprehensiveness of the program in reaching builders in different market areas, we tabulated the location of construction establishments participating in the program. The Northwest accounted for the highest portion of enrollments, with 57 percent of the participating establishments. The Northeast had the lowest portion of enrollments, with 10 percent. The number of establishments enrolled to participate in the doubled in 2001 to 195. This increase was consistent in all areas of the state. Between 2001 and 2002, the number of establishments enrolled in the program increased by 66 or 33 percent. Again, the growth was spread fairly evenly across the four market areas. See Table 2-7 for details.

**Table 2-7**
**Regional Distribution of Enrolled Establishments**

| Program Year | 2000 | | 2001 | | 2002 | |
|---|---|---|---|---|---|---|
| **Market Area** | **Number** | **% of Total** | **Number** | **% of Total** | **Number** | **% of Total** |
| Northeast | 6 | 6% | 13 | 7% | 15 | 6% |
| Northwest | 54 | 57% | 109 | 56% | 150 | 58% |
| Southeast | 20 | 21% | 40 | 21% | 58 | 22% |
| Southwest | 15 | 16% | 32 | 16% | 37 | 14% |
| Total | 95 | 100% | 194 | 100% | 260 | 100% |

**Completion of program-qualifying homes.** To assess the level of builder activity within the program, we compared the number of builders enrolled by region with the number who completed Vermont Star Homes certified projects in 2000 and 2001. Table 2-8 shows the results of this comparison. The number of builders completing Vermont Star Homes completed projects doubled between 2000 and 2001, then leveled off. The portion of enrolled builders who completed certified projects was fairly consistent across regions, with the exception of the Northeast. There, the small number of registered builders leads to wide swings in any indicator of participation built on percentages.

**Table 2-8**
**Number of Builders Completing Vermont Star Homes Certified Projects by Region**

| Market Area | # of Builders | % of Registered | # of Builders | % of Registered | # of Builders | % of Registered |
|---|---|---|---|---|---|---|
| Northeast | 4 | 67% | 1 | 8% | 2 | 3% |
| Northwest | 16 | 30% | 34 | 31% | 30 | 44% |
| Southeast | 4 | 20% | 14 | 35% | 12 | 18% |
| Southwest | 4 | 27% | 8 | 25% | 10 | 15% |
| Total Vermont | 28 | 29% | 57 | 29% | 54 | 79% |

**Concentration of program activity among most active builders.** Table 2-9 shows the percentage of projects enrolled, applied for, and certified by the builders most active in the program, ranked by number of projects certified.

**Table 2-9**
**Project Enrollments, Applications, and Completions**
**by Most Active Builders**

| | Number of Projects | | |
|---|---|---|---|
| | **Enrolled** | **Applications** | **Completions** |
| ***2000 Registered builders = 95*** | | | |
| **Total Projects** | 255 | 136 | 93 |
| *Percent Accounted for by:* | | | |
| Top 5 builders | 17% | 30% | 34% |
| Top 10 builders | 18% | 36% | 41% |
| Top 15 builders | 19% | 38% | 44% |
| ***2001 Registered builders = 194*** | | | |
| **Total Projects** | 387 | 243 | 196 |
| *Percent Accounted for by:* | | | |
| Top 5 builders | 23% | 45% | 56% |
| Top 10 builders | 26% | 67% | 76% |
| Top 15 builders | 29% | 70% | 80% |
| ***2002 Registered builders = 70*** | | | |
| **Total Projects** | 734 | 278 | 263 |
| *Percent Accounted for by:* | | | |
| Top 5 Builders | 8% | 21% | 22% |
| Top 10 Builders | 24% | 28% | 30% |
| Top 15 Builders | 18% | 32% | 34% |

While Vermont*wise* promptly responded to information requests, XENERGY did not have access to the full program database. Thus, the analysis must be restricted to the concentration of builders by projects completed, which is the order in which we requested the data. The concentration of applications and projects completed among the participants increased significantly between 2000 and 2001. In 2002, the concentration of applications and completions among the top builders was somewhat lower than it was in 2000. In the case of project completions, the result reflects a peculiarity of timing. Three large projects accounting for 75 units reached completion in 2001. However, the developers of those projects did not have any other units in the pipeline at the close of the year. Those developers also submitted applications in 2001, leading to an apparent increase in the concentration of applications.

Moreover, inspection of the data shows that 8 builders submitted applications for 10 or more units in 2001, versus only 2 builders in 2000.

### *2.3.5 Patterns of Project Development*

**Distribution by market area.** Table 2-10 shows the number of projects enrolled, applications submitted, and completed homes certified by year and market area. As discussed above, all aspects of project development activity were heavily concentrated in the Northwest market area.

**Table 2-10**
**Regional Distribution of Program Activity**

| | Projects Enrolled | Applications Submitted | Projects Certified |
|---|---|---|---|
| ***2000*** | | | |
| Northeast | 2 | 4 | 4 |
| Northwest | 224 | 116 | 78 |
| Southeast | 19 | 9 | 7 |
| Southwest | 10 | 7 | 4 |
| *Total* | *255* | *136* | *93* |
| ***2001*** | | | |
| Northeast | 10 | 6 | 1 |
| Northwest | 313 | 205 | 170 |
| Southeast | 38 | 21 | 17 |
| Southwest | 26 | 11 | 8 |
| *Total* | *387* | *243* | *196* |

**Patterns of measure installation.** Table 2-11 shows the number of different types of measures rebated to participating projects that went through the Vermont Star Homes certification process and those that did not. The following observations can be made from Table 2-11.

***Energy Ratings.*** During the first 22 months of program operation, far more homes received energy ratings in the non-certified track than in the certified track – 457 v. 293. Enrollees who failed to certify their homes generally opted not to achieve all criteria due to objections to compact fluorescent fixtures, fireplace glass doors, or other program requirements. Also many builders used the partial rating rebate to assist with state energy code compliance. As a program design issue, the point is moot since all participants must now receive an energy rating, and the cost of the energy rating is paid up front by the program.

***Lighting.*** The clearest difference between the tracks, in terms of measures rebated, occurs in lighting. In both years, the average number of fixtures (interior and exterior) rebated per participant in the Vermont Star Homes track was 9.3 or above. The corresponding number for customers in the non-certified track was 4.6 in 2000 and 2.8 in 2001.

***Mechanical Ventilation.*** The results in Table 2-11 suggest that virtually all participants in both tracks installed and received rebates for installation of efficient mechanical ventilation systems. The onsite survey found that only 15 percent of homes that did not go through the program had a mechanical ventilation system.

**Table 2-11**
**Measures Rebated by Year and Program Track**

| | 2000 | | | | 2001 | | | |
|---|---|---|---|---|---|---|---|---|
| | Certified Homes | | Non-certified Homes | | Certified Homes | | Non-certified Homes | |
| NUMBER OF UNITS REBATED | Total | Per Home | Total | Per Home | Total | Per Home | Total | Per Home |
| ***Number of Homes*** | ***93*** | | ***323*** | | ***196*** | | ***429*** | |
| Total | 1,306 | 14.0 | 2,479 | 7.7 | 2,586 | 13.2 | 2,135 | 5.0 |
| Direct installed Lighting | 44 | 0.5 | 315 | 1.0 | 62 | 0.3 | 260 | 0.6 |
| Exterior lighting | 46 | 0.5 | 14 | 0.0 | 65 | 0.3 | 49 | 0.1 |
| Interior lighting | 853 | 9.2 | 1,485 | 4.6 | 1,763 | 9.0 | 1,138 | 2.7 |
| High Intensity Discharge Lights | 1 | 0.0 | 3 | 0.0 | | 0.0 | 2 | 0.0 |
| *Total Lighting* | *944* | *10.15* | *1,817* | *5.63* | *1,890* | *9.64* | *1,449* | *3.38* |
| Efficient Refrigerator | 35 | 0.4 | 67 | 0.2 | 10 | 0.1 | 64 | 0.1 |
| Energy Rating | 101 | 1.1 | 222 | 0.7 | 192 | 1.0 | 235 | 0.5 |
| Energy Star Package | | 0.0 | | 0.0 | 71 | 0.4 | | 0.0 |
| ENERGYSTAR Refrigerator | | 0.0 | | 0.0 | 3 | 0.0 | 14 | 0.0 |
| Mechanical Ventilation | 103 | 1.1 | 313 | 1.0 | 191 | 1.0 | 302 | 0.7 |
| Motion Sensor | 22 | 0.2 | 60 | 0.2 | 38 | 0.2 | 71 | 0.2 |
| Vt Star Bonus | 101 | 1.1 | | 0.0 | 191 | 1.0 | | 0.0 |

# 3 MARKET SIZE AND STRUCTURE

This section uses a variety of sources to estimate the size and describe the segmentation of the residential new construction market in Vermont. On the demand side, we compile information regarding the number, location, construction approach (production v. custom) and energy characteristics of homes built in Vermont. We also estimate the extent of major renovation activity. On the supply side, we characterize the population of builders and remodelers and develop information on segmentation by firm size and range of activities.

## 3.1 DEMAND SIDE: SIZE AND SEGMENTATION

### *3.1.1 Estimate of number of homes completed in recent years*

**Sources of Information.** With a few exceptions, Vermont municipalities do not conduct health and safety inspections of single-family homes; nor do they issue occupancy permits. Thus, estimates of the number of new homes built need to be developed from statistical systems that do not directly track construction activity. The most comprehensive source of information on property dispositions and type are the "Grand Lists" that each town compiles to support the assessment and collection of the statewide property tax. The Grand Lists contain information on each land parcel in the town, including address, use category, improved/unimproved status, assessed value, and identifying information for the property owners. By identifying changes in use designation and assessed value for individual parcels from one year to the next, it is possible to compile a list of properties on which new home construction *is likely* to have occurred. Most Vermont towns now provide their Grand Lists directly to the Vermont Department of Property Tax Valuation in electronic format.

Each municipality is also required to file a Form 411 each year with the Vermont Department of Property Tax Valuation. The form lists the total number of buildings in various use categories. Comparing the number of buildings in each category from one year to the next provides a rough estimate of the number of single-family homes, vacation homes and condos built in the town each year.

For this evaluation, XENERGY found or developed four estimates of the number of new single-family homes built in Vermont during a recent one-year period. Unfortunately the sources yield different results, and we find no compelling reason related to methods or data quality for choosing one over the other. The four estimates are as follows.

- ***Vermont Department of Property Tax Valuation Form 411 Analysis.*** Using the Form 411 data, the Department of Property Tax Valuation estimated that 2,327 single family homes and 538 condo units had been built in 1999. Table 3-1 shows the result of this analysis by county.

**Table 3-1**
**Distribution of New Housing Units by County and Type: 1999**

| County | Total New Homes | Attached Homes | SF Homes | Percent of All New Homes |
|---|---|---|---|---|
| Addison | 217 | 0 | 217 | 8% |
| Bennington | 103 | 0 | 103 | 4% |
| Caledonia | 100 | 0 | 100 | 3% |
| Chittenden | 683 | 182 | 501 | 24% |
| Essex | 44 | 0 | 44 | 2% |
| Franklin | 193 | 11 | 182 | 7% |
| Grand Isle | 105 | 0 | 105 | 4% |
| Lamoille | 229 | 133 | 112 | 8% |
| Orange | 127 | 0 | 127 | 4% |
| Orleans | 267 | 143 | 124 | 9% |
| Rutland | 146 | 0 | 146 | 5% |
| Washington | 152 | 37 | 115 | 5% |
| Windham | 238 | 0 | 228 | 8% |
| Windsor | 255 | 32 | 223 | 9% |
| | | | | |
| **Totals** | 2,859 | 538 | 2,327 | 100% |

- ***U. S. Census Survey of Construction.*** The U. S. Bureau of the Census estimates the number of housing starts at the state level. In places that are not covered by municipal permitting systems, such as Vermont, housing starts are identified by Census workers who drive sampled areas to identify new housing units under construction. Once a construction site is so identified, the Census workers execute a follow-up process to find the owner and administer a short survey covering the characteristics and value of the unit. The sample for this Non Permit Area Survey consists of seventy geographic areas nationwide. Based on the description of the sampling method published by the Census[1], it appears that there are 4 to 6 sample areas in Vermont. It is not clear how many towns are included in those areas. Table 3-2 shows the Census estimates of the number of new homes constructed for the years 1999 through 2001. The results match the estimate from the 1999 Form 411s fairly closely. The Census process produced an estimate of 2,187 single-family homes versus 2,327 from the Form 411 comparison, a difference of 6 percent.

[1] www.census.gov/const/www/newresconst.html

**Table 3-2**
**U. S. Bureau of the Census Estimates of Vermont Housing Starts**

| Year | One-Family | Two-Family | 3-4 Family | 5+ Units | Total |
|---|---|---|---|---|---|
| 1999 | 2,187 | 60 | 30 | 323 | 2,600 |
| 2000 | 2,212 | 68 | 39 | 187 | 2,506 |
| 2001 | 2,349 | 82 | 49 | 267 | 2,747 |

- ***Processing and verification of Grand List data[2].*** To develop the telephone sample frame, West Hill Energy & Computing and XENERGY worked directly with the Grand Lists from 230 of Vermont's 260 towns, as well as with other kinds of lists provided by some of the remaining towns. Preparation of the list proceeded in the following steps.

  - *Identification of likely projects.* The sample frame was developed by making a parcel by parcel comparison of the 2000 and 2001 Grand Lists for 230 of the 252 towns in the state. Properties that changed status from vacant to residential, or which experienced a large change in value between the two years were brought into the sample frame. This process could also have captured major renovation or non-commercial building projects, as well as single- and two-family new construction. Fourteen towns were excluded from the sample because the grand lists were not readily accessible and the level of new construction was low. For twenty-seven towns, the list of new homes was obtained directly from the town clerk. This process produced a list of 3,108 properties that were likely to be single and two-family homes constructed in 2001.
  - *Screening calls to verify new construction status.* XENERGY was able to develop valid phone numbers for 1,320 of the properties in the original sample frame. In the course of conducting the customer telephone survey and recruitment for the on-site survey, XENERGY or its subcontractors placed calls to all but 275 of the homes with valid phone numbers.

    Table 3-3 shows the disposition of the 394 calls where contact was made with a resident of the sample property and its status as a new home ascertained. Fifty-five percent of the properties for which a status was ascertained were determined to be single or two-family homes built in 2000 or 2001. Applying this ratio to the number of properties identified as possible new one- or two-family homes results in an estimate of 1,711 single family homes built in 2001.

    Of the units that did not meet the sample criteria, almost all (170 cases) were reportedly built in1999 or earlier. Of the 80 cases for which year of construction was

[2] Thanks to West Hill Energy & Computing for their support and collaboration on the analysis of Vermont tax records.

reported by the respondent, about one half were before 1995. Respondents reported that some of the properties were over 40 years old.

**Table 3-3**
**Disposition of Completed Survey Screening Calls**

| | | Completed Calls | |
|---|---|---|---|
| **Sample Status** | **Detailed Disposition** | **Number** | **Percent** |
| Not Qual'd | NOT A RESIDENTIAL PROPERTY | 4 | 1.0% |
| Not Qual'd | YEAR BUILT REPORTED BEFORE 1999 | 80 | 20.3% |
| Not Qual'd | NOT SURE OF YEAR, BUT SURE NOT BUILT IN 2000 OR 2001 | 90 | 22.8% |
| Not Qual'd | NOT A SINGLE OR TWO-FAMILY HOUSE | 3 | 0.8% |
| Qualified | CALLBACK TO COMPLETE - HAS STARTED SURVEY | 10 | 2.5% |
| Qualified | ON-SITE RECRUIT WITHOUT COMPLETING PHONE SURVEY | 2 | 0.5% |
| Qualified | COMPLETE | 200 | 50.8% |
| Qualified | BREAK-OFF | 4 | 1.0% |
| Qualified | HOME PREVIOUSLY OCCUPIED BEFORE CURRENT OWNER | 1 | 0.3% |
| | | 394 | 100.0% |

Clearly, there is some lag in picking up changes of status in the property assessment process. Towns are supposed to refresh their Grand Lists at least once every three years. However, since municipal revenues depend capturing increases in property values, the towns have a strong incentive to refresh the lists more often. Owners, of course, have an incentive to delay recognition of large increases in the value of their property.

We can assume that some part of the sample attrition caused by capture in the frame of houses built in previous years will be offset by new homes whose presence was missed in the development of the Grand Lists. Experience with making verification calls to owners of homes identified directly by the Town Clerks yielded a much higher ratio of targeted homes than those made to properties identified by analysis of the Grand Lists: 83 percent v. 55 percent for the sample frame as a whole. This difference provides some insight into the comprehensiveness and reliability of the Grand List analysis.

***Analysis of Builder Survey Data.*** The builder survey asked respondents for the number of housing units they had completed in 2001. Applying the population weights to the responses yielded a total of 2,606 units, with a 90 percent confidence interval of +/- 9 percent. This is quite close to the estimate generated through the Census Survey of Construction. Moreover, the distribution of units built by structure type (1-family, 2-family, and so on) is very close to that developed by the Census.

**Estimate used for further analysis.** The annual totals of single-family homes and units in multi-family buildings are, of course, key statistics in the evaluation of the RNC program. They provide the basis on which to assess the reach of program activities. The data available to us do not support a point estimate of these figures. For the purposes of this report, we adopt the Census Bureau estimate as the "mid-level" number, with a 10 percent margin of error on either side for the low and high estimates. Our rationale for this approach is as follows.

- While the Census figures have the disadvantage of being based on a small sample, the data collection itself is based on in-field observations verified through interviews with the occupants. Moreover, the estimates were compiled using consistent methods from 1999 onward and cover multi- as well as single-family structures. Finally, the Census estimates lie between the total generated by comparing Form 411s and the total generated through XENERGY's analysis and verification of Grand List data.
- The estimate for 2001 single-family home construction of 1,711 units developed through analysis of the results of screening calls to Grand Listees is certainly too low given that all evidence suggests that the Grand List process misses a substantial number of units built in a given year, while the screening process eliminated all listed units built in previous years.
- The totals generated by comparing one year's Form 411s to the previous years are likely to be too high. Analysis of the construction dates of the homes eliminated from the 2001 sample suggests that there are many more "old" homes captured in a given year's changes than there are new homes missed.

Table 3-4 shows the estimated construction totals that are used throughout the report to assess program performance.

**Table 3-4**
**Estimates of New Housing Completions: Number of Units**

| | Single-Family | | | Multi-Family (2-4 unit + >5 units) | | |
|---|---|---|---|---|---|---|
| **Year** | **Low** | **Mid-level** | **High** | **Low** | **Mid-level** | **High** |
| 1999 | 1,968 | 2,187 | 2,406 | 372 | 413 | 454 |
| 2000 | 1,991 | 2,212 | 2,433 | 265 | 294 | 323 |
| 2001 | 2,114 | 2,349 | 2,584 | 358 | 398 | 438 |
| *3-year Average* | *2,024* | *2,249* | *2,474* | *332* | *368* | *405* |

### 3.1.2 Geographic Distribution of New Home Construction

For information on the geographic distribution of new housing construction, see Section 2.3.2 on the characteristics of Vermont's regional housing market areas and Table 3-1 for patterns of housing construction by county.

### 3.1.3 Distribution of New Homes by Type of Construction

Purchasers of new homes may have more or less input into the design and energy characteristics of a home, depending on the nature of their involvement in the process. Table 3-5 summarizes the results of the homebuyer telephone survey in regard to the circumstances under which sample homeowners built or acquired their houses. The general results of this line of questioning suggest that owners and purchasers of new homes in Vermont are much more involved in construction decisions than their counterparts in other states. For example, twenty-two percent of the respondents reported that they themselves built the houses they were living in. Sixty-two percent of the respondents reported that they had purchased custom homes, i.e.: homes built according to plans developed exclusively for them by their builders or architects. By way of contrast, the corresponding figure in New Jersey was 16 percent in 1999. Spec homes – that is homes completed entirely prior to customer purchase – constituted only 6 percent of the houses purchased by the respondents.

The on-site survey also contained questions and inspection guidelines on this issue. The findings from the on-site sample closely paralleled those of the telephone survey. Seventeen percent of the homes in the on-site sample were determined to be manufactured housing (versus 16 percent in the telephone sample), and 23 percent of the owners in the on-site sample reported having built their own homes (versus 22 percent in the telephone sample).

**Table 3-5**
**Circumstances of Construction**
**Results of the Homeowner Telephone Survey (n=200)**

| Circumstances under which house was built & purchased | % |
|---|---|
| House built by contractor – not the occupant | 78% |
| Respondent was builder/occupant | 22% |
| Custom home: built to plans developed specifically for the owner | 62% |
| Manufactured Home: assembled on site from pre-fab modules | 16% |
| Semi-custom Home: built to existing plan modified to owner's needs | 15% |
| Spec Home: completed entirely prior to purchase | 6% |
| Other | 1% |

## 3.2 SUPPLY SIDE MARKET SIZE AND SEGMENTATION

The process of building and selling new homes involves many groups of market actors: builders, trades contractors, materials suppliers, real estate agents, appraisers, and lenders. However, residential new construction market assessments and program evaluations show consistently that the builder is responsible for most of the decisions that affect the energy efficiency of a home. Builders also have the most at stake in such decisions in terms of their effects on costs, profits, reputation, and ability to market current and future construction projects. Thus, most of the efforts of the RNC focus on providing builders with incentives to adopt energy efficient construction practices, such as rebates for home energy rating fees and specified products, training (to reduce the information costs of learning new techniques), and marketing support. Likewise, the Phase 1 evaluation efforts focused heavily on characterizing Vermont's home builder market, current construction and marketing practices, and program effects on those practices.

This section compiles and analyzes information on the characteristics of establishments engaged in building new homes in Vermont. We focus on their distribution by size, region, range of activities (new construction, remodeling, etc.), market areas served and involvement in other construction specialties. This material is presented as background for the analysis in Section 5 of builder practices in regard to energy efficiency and participation in the RNC program.

### *3.2.1 Data Sources*

Our discussion of the business characteristics of construction establishments in Vermont is based primarily on the following two sources.

**Analysis of Dun & Bradstreet iMarket Database information.** To develop a preliminary profile of the population of Vermont builders, XENERGY analyzed establishment data from Dun & Bradstreet contained in the iMarket database. In this and a number of other recent studies, we have found that builder lists developed from Dun & Bradstreet are generally accurate in two key respects. First, virtually all of the firms or individuals contacted report that they had built single and/or multifamily homes in the past two years. Second, their classification by number of employees tended to be accurate. We used this relatively accessible source as a place to start assembling a basic portrait of Vermont's construction industry.

**Builder and Remodeler Survey.** As part of this evaluation, XENERGY conducted surveys of 54 establishments that listed single-family home construction as their primary SIC and 34 establishments that listed single-family remodeling as their primary SIC. The surveys were designed to yield information on a number of key issues, including business characteristics of the targeted establishments, current construction and marketing practices in regard to energy efficiency, and knowledge of and response to the RNC programs. The following paragraphs summarize key methodological aspects of the survey.

- ***Sample Design.*** XENERGY employed a stratified sampling approach. The state was divided into the four market areas discussed above. Within these market areas, establishments were divided into three size categories based on the number of persons they employed per Dun & Bradstreet. The size categories were as follows: Small - 1 to 4 employees; Medium – 5 – 24 employees; Large 25+ employees. The number of persons employed was used as a proxy for the number of new homes built. The targeted number of completions were allocated to the twelve regional/size strata according to the proportion of all employees in all establishments in the sample frame accounted for by each stratum.
- ***Sample Selection.*** Establishments were selected from the D&B list with probability proportional to size, as measured by the number of employees. Similar procedures were used to develop the remodeler sample. At the request of DPS and other stakeholders, XENERGY targeted a number of the remodeler interviews to kitchen remodeling companies.
- ***Contact procedures and incentives.*** To enhance response XENERGY sent an advance letter to all sampled builders describing the purpose of the survey and the qualifications for an eligible survey respondent. To further enhance the probability of reaching our sample quotas, we offered each respondent $50 check as an incentive for participation in the interview.
- ***Interviews completed.*** Ultimately, we were able to complete interviews with 54 single-family home builders in the size categories specified by the sample design. Table 3-6 shows the allocation of completed surveys among the sample strata defined by region and employment.

**Table 3-6**
**Completed Builder and Remodeler Surveys**

| Region | Size | | | Total Builders | Remodelers |
|---|---|---|---|---|---|
| | Small | Medium | Large | | |
| Northwest | 17 | 6 | 5 | 28 | 15 |
| Northeast | 1 | 2 | 0 | 3 | 2 |
| Southwest | 7 | 3 | 1 | 11 | 7 |
| Southeast | 6 | 5 | 1 | 12 | 6 |
| Kitchen Remodelers | | | | | 4 |
| Total | 31 | 16 | 7 | 54 | 34 |

- ***Weighting and Analysis Procedures.*** Most of the items in the survey were analyzed using a ratio estimation procedure that yields an estimate of "market share" for practices of interest in terms of the portion of units built as opposed to the percentage of builders adopting the practice. Similarly, average values, such as insulation levels, are computed to reflect the population of houses reportedly built by the respondents. Thus, in reporting

results, we generally use the formulation "builders representing xx percent of the market or xx percent of all units built." This approach supports direct comparison of the results of the builder survey with those of the customer survey and on-site surveys, where each respondent corresponds to a single housing unit.

- ***Weighting and computation of values.*** Builder survey responses were weighted to reflect the number of homes constructed by the sample builder as well as the population weight of the size stratum from which the firm was drawn. Where the questionnaire sought responses in the form of a number or percentage – say, the portion of homes built with energy efficient features, the survey responses were calculated using the combined ratio estimator $\hat{R}_c$:

$$\hat{R}_c = \frac{\sum_h \frac{N_h}{n_h} \sum_i B_{h_i} x_i}{\sum_h \frac{N_h}{n_h} \sum_i x_i},$$

where

i = sample builder,

$N_h$ = number of builders in the population in sample stratum *h*,

$n_h$ = number of builders in the sample in stratum *h*,

$B_{h_i}$ = builder i's response (expressed as a number or percentage), and

$x_i$ = number of new homes builder i built in 2001.

If the question elicited a categorical response (e.g., yes/no), a $B_{h_i}$ was created for each possible response. For the selected response, $B_{h_i} = 1$. For the response/s not selected, $B_{h_i} = 0$.

The ratio estimation approach supports the estimate

- ***Precision of estimates.*** The use of the combined ratio estimator supported the estimate of a standard deviation and standard error for each variable. The standard error for each estimate is shown in Appendix B in a table located directly below the results table on each page. We used the standard errors to calculate appropriate measures of precision for various kinds of results. For estimates of totals and ratios (such as average percentage of homes built to Vermont Star standards), and proportions (such as the percentage of builders who had adopted a given practice), we generally used 90 percent confidence intervals.
- ***Alternative estimation methods.*** For some variables, we found it was more appropriate to use the weighted mean or proportion of the stratified random sample,

rather than the ratio estimator. This was the case, for example, in estimating the average number of homes built individual builders and, from those averages, the total for the population. Tables are clearly labeled as to the computation process used.

### *3.2.2 Home Builders: Market Size and Segmentation*

**The Population of Builders.** . Table 3-6 shows the distribution of establishments that list single-family construction as their "primary SIC" or main line of business.

**Table 3-7**
**Distribution of Residential Construction Establishments**
**by Number of Employees and Market Area**

| | Number of Employees | | | | | | |
|---|---|---|---|---|---|---|---|
| **Market Area** | **1** | **2 to 4** | **5 to 9** | **10 to 24** | **25 – 99** | **Total** | **% of Total** |
| Northeast | 20 | 28 | 6 | 7 | 0 | 61 | *11%* |
| Northwest | 76 | 106 | 37 | 14 | 5 | 238 | *43%* |
| Southeast | 36 | 64 | 24 | 6 | 1 | 131 | *23%* |
| Southwest | 43 | 55 | 19 | 10 | 3 | 130 | *23%* |
| Total | 175 | 253 | 86 | 37 | 9 | 560 | *100%* |
| *% of Total* | *31%* | *45%* | *15%* | *7%* | *2%* | *100%* | |

Key findings from the analysis of the Dun & Bradstreet data are as follows.

- ***Number of establishments.*** The number of establishments that claim single-family home construction as their primary line of business is very large in comparison to the number of homes built. Specifically, there are 560 such establishments versus 2,000 to 2,500 single-family homes built per year. By way of contrast, there are 1,670 builders listed in New Jersey with an annual construction total of 30,000 units.
- ***Size distribution of establishments.*** These establishments are generally very small. Seventy-six percent of all builders employ fewer than 5 persons. Thirty-one percent are one-person operations.
- ***Geographic distribution.*** The geographic distribution of the listed builders by market area mirrors almost exactly the regional distribution of new home construction. This finding may imply that home building is very much a local activity in Vermont.
- ***Single-family home building as secondary activity.*** The Dun & Bradstreet data collection form allows establishments to identify up to three business areas in which they are active, in addition to their primary SICs. Table 3-7 shows the total number of all businesses naming at least one residential construction specialty among their three areas of business, by market area. The bottom row shows the number of establishments that name the construction specialty at the head of the column as their primary SIC. Over 900 Vermont establishments report being involved in some aspect of residential construction. 630 establishments claim to be involved in new construction of single-family homes. These findings are consistent with the results of the builder and remodeler surveys described below.

**Table 3-8**
**Vermont Establishments by Residential Construction Specialty And Market Area**

| Market Area | Single Family New Const | Single Family Remodeling | Pre-fab Home Erection | Multifamily Construction | Total |
|---|---|---|---|---|---|
| Northeast | 60 | 12 | 1 | 7 | 80 |
| Northwest | 273 | 92 | 1 | 62 | 428 |
| Southeast | 151 | 33 | 2 | 27 | 213 |
| Southwest | 140 | 29 | 2 | 24 | 195 |
| Total | 624 | 166 | 6 | 120 | 916 |
| *Total w/ Primary SIC* | *554** | *92* | *6* | *78* | |

* Does not include prefabricated home erection, here tabulated separately.

### *3.2.3 Detailed Builder Characteristics*

**Sources of Revenue/Involvement in Remodeling.** Even among builders that list their primary business activity with Dun & Bradstreet as residential new construction, remodeling accounts for a substantial portion of revenues. Table 3-9 displays information from the builder survey on the portion of sample firms involved in various kinds of construction activities, and the average percentage of total revenue derived from those activities. Twenty-eight percent of all sample builders do commercial new construction, 70 percent are involved in residential remodeling, and 32 percent pursue commercial remodeling. The percentage of establishments involved in activities other than residential construction is highest among larger firms. Similarly, larger firms derive a greater portion of their total revenues (47 percent) from activities other than residential new construction.

On average residential remodeling provided 17 percent of total revenues for the sample builders, with a range of 16 percent for small firms up to 30 percent for larger firms. This distribution makes sense in that larger firms will likely need to pursue a broad range of projects to keep their employees fully occupied.

**Table 3-9**
**Involvement in and Revenue From Various Construction Activities**
**Builder Sample: n = 54, Population Weighted**

| | Size Category | | | |
|---|---|---|---|---|
| | **Small** | **Medium** | **Large** | **All Builders** |
| ***Percent of Establishments*** | | | | |
| General Contracting: Residential NC | 100% | 100% | 100% | 100% |
| General Contracting: Commercial NC | 25% | 35% | 60% | 28% |
| Residential Remodeling | 68% | 76% | 88% | 70% |
| Commercial Remodeling | 33% | 27% | 48% | 32% |
| Other | 4% | 0% | 0% | 3% |
| ***Percent of Total Revenues*** | | | | |
| General Contracting: Residential NC | 77% | 70% | 53% | 75% |
| General Contracting: Commercial NC | 2% | 4% | 8% | 3% |
| Residential Remodeling | 16% | 22% | 30% | 17% |
| Commercial Remodeling | 3% | 3% | 8% | 3% |
| Other | 2% | 0% | 0% | 2% |

Table 3-9 does not, in fact, convey the full scope of "builder" involvement in remodeling or the porous nature of the boundary between the two activities. XENERGY contacted over 200 firms from the list of companies claiming residential new construction as their primary SIC. We completed 78 interviews with these firms, however 24 reported that they derived more than one-half of their revenues from residential remodeling, and were thus shifted to the remodeling sample. On average, the firms in the remodeling sample reported that they derived 16 percent of their total 2001 revenues from new home construction. See Section 3.2.5 for details

**Extent of construction activity in Vermont.** Builders representing approximately 69 percent of the volume of new homes built in 2001 indicated that Vermont is the only state in which they provide their services. Of those who build in other states, respondents indicated that 80.6 percent of their company's total revenues came from the state of Vermont. Among all survey respondents, approximately 92 percent of 2001 revenues were generated in Vermont. See Table 3-10 for details.

Small and medium-sized firms generated a somewhat larger percentage of their revenues from projects located outside Vermont, perhaps reflecting the relatively low overhead expenses involved in moving a small operation to where the work is.

**Table 3-10**
**Geographic Distribution of Work Among Builders, by State**
**(Weighted by Volume of New Homes Built)**

| Location | Percent of Total Mkt |
|---|---|
| Build only in VT | 69% |
| Build in Other States * | 31% |
| NH | 45% |
| NY | 55% |
| MA | 30% |
| CT | 14% |

Respondents allowed to indicate more than one "other" state.

### *3.2.4 Characteristics of Homes Built*

**Average number of homes built and market share of size segments.** Table 3-11 shows the estimated total number of units built by all Vermont builders by size category, along with the percentage of total units accounted for by establishments in the size category, and the average number of units built. Small builders (those with 4 or fewer employees) accounted for the largest share of total units built (50 percent), although each establishment completed, on average, only 2.3 houses per year. Medium sized firms accounted for 40 percent of total construction, and the 12 largest firms in the state accounted for an estimated 229 units, or 9 percent of total units constructed. Clearly, residential new construction activity in Vermont is highly fragmented, especially when one takes into account the 15 – 20 percent of homes that are owner-built.

**Table 3-11**
**Volume of Construction and Market Share by Size Segment: 2001**
**Builder Sample: n = 54, Population Weighted**

| | Small | Medium | Large | All Builders |
|---|---|---|---|---|
| N =* | 544 | 125 | 12 | 693 |
| Estimated Total Units Built | 1,301 | 1,076 | 229 | 2,606 |
| Share of Total Units | 50% | 41% | 9% | 100% |
| Average units built/establishment | 2.3 | 8.6 | 19.1 | 3.8 |

* The difference between the Ns in this table and in earlier tables used to describe the population of builders is due to the fact that an earlier version of the iMarket database was used to develop the sample plan.

**Home Characteristics.** Each survey respondent was asked to indicate the percentage of housing units they built in 2001 that fell into several categories. These responses were averaged to yield the information displayed in Table 3-12 about the characteristics of new construction in 2001. Note that multi-family homes account for a far greater proportion of homes built by large builders than by small builders, and that large builders account for a greater proportion of

vacation homes, custom homes, and homes built through affordable housing programs than builders in the other size categories.

**Table 3-12**
**Mean Percentage of New Housing Units with Particular Characteristics by Size of Builder: (Weighted by Volume of New Homes Built)**

| Characteristic | Builder Size | | | All Builders |
|---|---|---|---|---|
| | Small | Medium | Large | |
| Single Family Homes | 91% | 91% | 18% | 83% |
| Two Family Homes | 9% | 9% | < 1% | 8% |
| Multiple Family Homes | < 1% | < 1% | 82% | 9% |
| Built for Year-Round Occupancy | 96% | 86% | 70% | 89% |
| Custom-Built Homes | 85% | 51% | 100% | 69% |
| Built Through Affordable Housing Programs | < 1% | < 1% | 23% | 3% |

**Sales Prices.** The sample builders were asked to estimate the average price of the custom and production homes they built in Vermont and sold in 2001. The mean of these estimates for custom-built units was approximately $475,152 while the mean price reported for production homes was $279,258. The median and modal values for home prices were similar.

**Number and Extent of Remodeling Projects.** Sample builders representing approximately 58 percent of 2001 new home construction in Vermont also completed at least one remodeling, rehabilitation, or renovation project that year. Table 3-13 shows the mean number of projects completed by builders within each size segment by project type. Large builders account for the greatest proportion of overall remodeling projects.

**Table 3-13**
**Mean Number of Remodeling Projects by Builder Size and Project Type**

| Extent of Remodeling Project | Mean Number Remodeling Projects by Builder Size | | | Overall Mean Number of Projects |
|---|---|---|---|---|
| | Small | Medium | Large | |
| Additions involving construction of new exterior walls or roof | 5 | 3 | 37 | 7 |
| Build-out or "gut" rehabilitations of existing spaces | 32 | 2 | 36 | 5 |
| Less intensive remodeling of one or more rooms | 1 | 5 | 10 | 3 |

**Equipment Added or Replaced During Remodeling.** Builders were asked to indicate the proportion of their 2001 remodeling projects that included particular features. Responses to these questions indicate the following:

- 68 percent of these projects involved adding or replacing heating or cooling equipment;
- 77 percent involved adding or replacing windows; and
- 87 percent involved adding or replacing hard-wired lighting fixtures.

**Reported compliance with RBES in remodeling.** Of the builders who completed additions and/or gut rehabilitations, 100 percent indicated that they install insulation to RBES levels in these types of remodeling projects. Given the findings of the on-site surveys of new and existing homes conducted for this evaluation, it seems reasonable to expect that actual RBES compliance levels are lower than reported.

### *3.2.5 Detailed Remodeler Characteristics*

**Sources of Revenue/Involvement in New Construction.** On average, firms classified as remodelers derived 16 percent of their total 2001 revenues from residential new construction. This percentage was particularly high among the 4 establishments identified as kitchen specialists. The large remodelers in the sample reported that they generate 75 percent of their revenues from commercial projects. See Table 3-14.

**Table 3-14**
**Percentage of 2001 Revenue from Various Construction Activities**
**Remodeler Sample: n = 35**

| | Small | Medium | Large | Kitchen | All |
|---|---|---|---|---|---|
| General Contracting: Residential NC | 13% | 16% | 0% | 31% | 16% |
| General Contracting: Commercial NC | 2% | 1% | 0% | 0% | 2% |
| Residential Remodeling | 78% | 76% | 25% | 49% | 72% |
| Commercial Remodeling | 5% | 7% | 75% | 20% | 9% |
| Total * | 98% | 100% | 100% | 100% | 99% |

* May not add to 100 percent due to rounding.

**Extent of services in Vermont.** Among the sample remodelers, firms representing 93 percent of the remodeling projects in the state reported that they did all of their work in Vermont. Surprisingly, the percentage of small firms reporting work outside Vermont was considerably higher than that for medium and larger firms: 31 percent v. 11 percent and 1 percent, respectively.

**Types of projects.** Table 3-15 shows the average number of projects carried out by contractors in the size groups, and the percentage of those projects that entailed various features that could have an energy efficiency content. Among the sample remodelers, the kitchen specialists reported carrying out by far the greatest number of projects, an average of 270 per firm. The average number of projects per firm for all sample remodelers was 42.

**Table 3-15**
**Number and Type of Remodeling Projects, Average by Size Group**
**Remodeler Sample: n = 35, Population Weighted***

| | Small | Medium | Large | Kitchen | Total |
|---|---|---|---|---|---|
| **n =** | 22 | 8 | 1 | 4 | 35 |
| **Average number of projects: 2001** | 6 | 29 | 5 | 270 | 42 |
| ***Percent of projects in which*** | | | | | |
| Walls are breached | 42% | 4% | 40% | 29% | 26% |
| HVAC equipment installed | 43% | 22% | 60% | 40% | 38% |
| New windows are installed | 68% | 51% | 100% | 88% | 67% |
| New light fixtures are installed | 71% | 93% | 100% | 98% | 80% |
| Washing machine/Dryer Installed | 21% | 15% | 0% | 26% | 19% |
| New Kitchen Appliances installed | 43% | 26% | 100% | 60% | 42% |
| Contractor selects appliances | 17% | 55% | 50% | 83% | 34% |

* The kitchen remodelers were not drawn from the same sample frame as the other remodelers. The results for this group are not weighted.

A look at the percentage of projects with various kinds of features suggests that many, if not most of the projects that Vermont remodelers undertake have the potential to affect the energy efficiency of the property. On average, 26 percent of the reported projects involved breaching walls, which could provide an opportunity for increasing insulation or air sealing. Similarly, two-thirds of the reported projects involved installation of new windows, 80 percent involved installation of new light fixtures, and nearly 40 percent involved installation of heating and ventilation equipment. Kitchen remodelers reported that customers install new appliances in 60 percent of their projects, and that they select the appliance models in 83 percent of these cases.

## 3.3 THE VERMONT RESIDENTIAL BUILDING EFFICIENCY STANDARDS

The Vermont Residential Energy Code (Residential Energy Building Standard or RBES) constitutes a key element of the market framework in Vermont. We therefore present information on the code and compliance issues here, as opposed to in the section describing the market. Description of the technical provisions of the code is contained in Sections 4 and 5**,** in the context of analyzing baseline and current construction practices.

**Overview of the RBES.** The Vermont Legislature passed legislation in 1996 (Act 20) creating the RBES. The law also required and provided procedures for revisions every three years and prescribed a method of compliance. The initial code was developed by a Task Force appointed by the governor in 1995. The Task Force used the Model Energy Code of 1995 (CABO/MEC) as a point of departure. Based on a variety of data on recent building practices, the Task Force recommended a number of additions and modifications to CABO/MEC including:

- Extension of coverage to building types not included in CABO/MEC;
- Prescriptive standards for water heaters;
- Requirements for vent dampers on exhaust fans;
- Measures to reduce air leakage associated with fireplaces; and
- A variety of thermal and glazing requirements over and above those in CABO/MEC.

After a multi-year consensus-based process, an Advisory Committee representing all affected stakeholder groups proposed a number of changes to the current code. The most significant is a requirement for mechanical ventilation. The DPS anticipates a revised code will be effective on January 1, 2004.

**Compliance methods.** There are four paths to assess compliance with the RBES. The first is a performance-based home energy rating score using the VTCheck software. The second is a professional home energy rating. The third is a prescriptive approach with a range of qualifying specifications for building components. The fourth "Professional Services Method" involves system analysis and has been rarely used.

**Documentation and enforcement procedures.** Vermont has no statewide fire and life safety standards that apply to single-family new construction. Thus, the vast majority of Vermont municipalities have never provided building code inspection services for single-family homes, and the initial code development Task Force found that it would be infeasible to require municipalities to enforce the RBES. Code compliance is self-certified by the builder. Prior to occupancy, the builder is to provide the owner with a certificate of compliance. Further, the builder is to file copies of the certificate with the municipality and with the Vermont Department of Public Service.

The code development Task Force wrote in its 1995 report that it expected a number of developments to encourage builders to follow the code compliance procedures. These included the standardization of home energy rating procedures then underway, the broadening availability to customers of home energy ratings, and the interest of mortgage lenders and secondary mortgage market actors in certification of energy efficiency for homes they financed. These

market forces were to be supplemented by outreach and training activities sponsored jointly by trade associations, the DPS, utilities, and home energy rating organizations.[3]

As of the October 2000 report of the code update advisory committee – roughly two years after the code compliance rules took effect -- only 250 certificates of RBES compliance were on file with the DPS. In that time period, 4,000 to 5,000 housing units had been built in Vermont.[4]

| Feature | Standard | Option | Gen. not Offered | Doesn't Apply |
|---|---|---|---|---|
| a. Attic insulation above R – 38 | 51% | 37% | 9% | 3% |
| b. Wall insulation above R-19 | 40% | 49% | 11% | 0% |
| c. Basement insulation above R-10 | 46% | 37% | 9% | 9% |
| d. Floor insulation greater than R-10 | 34% | 46% | 11% | 9% |
| e. Low-e windows | 86% | 11% | 0% | 3% |
| f. Argon-filled windows. | 57% | 34% | 6% | 3% |
| g. Reduced air infiltration as measured using blower door equipment. | 6% | 29% | 49% | 17% |
| h. Energy Star high-efficiency heating and cooling equipment | 46% | 29% | 11% | 14% |
| i. Duct sealing and leakage testing | 6% | 26% | 54% | 14% |
| j. Energy Star high-efficiency appliances | 23% | 49% | 20% | 9% |
| k. Energy Star hard-wired compact fluorescent lighting fixtures | 20% | 57% | 14% | 9% |

[3] State of Vermont, Department of Public Service. (1995). *Report of the Governor's Task Force on Energy Efficiency Standards for New Residential Construction.*

[4] Richmond Energy Associates. (2000). *Draft Report of the Vermont Residential Building Energy Standards Update Advisory Committee.*

# 4 ANALYSIS OF NEW CONSTRUCTION PRACTICE

This section analyzes recent changes in single-family home construction practices based on the results of two on-site surveys of large samples of newly-built homes in Vermont. The first survey was commissioned in 1995 by a group of Vermont utilities and studied homes built in 1993 and 1994. The second was conducted in 2002 as part of the RNC program evaluation effort. The latter included inspections of a statewide random sample of 159 homes built between 1999 and 2001. Fifty of the homes in the 2002 survey had participated in the Vermont Star Homes program. The analysis presented in this section focuses on the following three questions:

- How have single-family home construction practices changed since the mid-1990s in regard to features that affect energy efficiency?
- To what extent do homes that went through the Vermont Star Homes Program differ from those built in the same period without going through the program?
- To what extent does the current cohort of homes comply with the Residential Building Efficiency Standards (RBES)? How has the extent of code compliance changed since the early 1990s?

## 4.1 METHODS

The following paragraphs summarize the sampling and data collection methods used for the two surveys.

### *4.1.1 The 1995 Survey*

Prior to the current evaluation, the most recent comprehensive study of residential construction practices in Vermont was begun in 1995.[1] Data collection for the study was initially sponsored by three utilities: Central Vermont Public Service, Citizens' Utility, and Green Mountain Power. The population for the study was intended to be homes built in the service territories of the three utilities during the period 1993 – 1994. These utilities serve approximately 75 percent Vermont's residential electric customers. Data collection involved on-site inventories of 151 new homes conducted by experienced technicians. The data collection protocol included home energy ratings and blower door tests to estimate air leakage.

For various reasons, the data collected from this effort were not analyzed until 1998. At that point information on sample development and recruitment had been lost. However, it appeared upon review that the selection of at least a portion of the sample deviated from standard random

[1] West Hill Energy and Computing. (1999). *Report on the 1995 Residential New Construction Baseline Data.* Montpelier, Vermont Department of Public Service.

procedures. In particular, it seemed that all of the Citizens' Utility customers in the sample (20) were drawn from participants in the then-current Residential New Construction program. Various post-hoc analyses of distributions of sample home characteristics such as size and number of bedrooms against population distributions for the towns from which the samples were drawn were inconclusive as to the representativeness of the sample. In any case, participants in the current RNC programs were significantly overrepresented in both the CU and Central Vermont areas. Given this problem with the sample, the time lapse between data collection and analysis, and attendant interpretation problems, the results of the study should be viewed as an indication of general tendencies, not as a detailed baseline profile of Vermont's new housing stock in 1993 – 1994.

### *4.1.2 The 2002 Survey*

The 2002 survey was carried out as part of the EVT RNC program evaluation. XENERGY designed the sample approach and developed the sample frame from Grand Lists and other materials provided by Vermont municipalities. West Hill Energy and Computing and XENERGY worked together to develop the on-site data collection protocol. West Hill managed the data collection effort using a group of trained auditors in the field. West Hill was also responsible for data compilation, cleaning, and analysis, as well as preparation of the final report of the survey. The results presented in this section are drawn from the draft version of that final report.

#### *Sample Design and Implementation*

The general strategy for the sample design was to develop a sample frame of all single and two-family homes built in 2001 and to select a simple random sample of 160. Sample development proceeded in the following steps.

**Development of the Sample Frame.** The sample frame was developed by comparing the 2000 and 2001 Grand Lists for each town in the state. Properties that changed status from vacant to residential, or which experienced a large change in value between the two years were brought into the sample frame. West Hill obtained Grand Lists for most of the 252 towns in Vermont from the Department of Property Valuation. Fourteen towns were excluded from the sample because the grand lists were not readily accessible and the level of new construction was low. For twenty-seven towns, the list of new homes was obtained directly from the town clerk. This process produced a list of 2,413 properties that were likely to be single and two-family homes constructed in 2001. This list became the sample frame for the customer telephone sample.

**Attachment of respondent identifying information.** The completed lists contained the names of the owner and co-owner of the property, the mailing address and the site location. The Grand Lists did not contain telephone numbers, and in many cases did not contain traceable customer names. XENERGY used a commercial telematching service to generate telephone numbers for the properties on the list. This process yielded numbers for 35 percent of the properties, considerably below the typical "hit rate" of 50 to 60 percent. This high level of attrition was attributable to a number of factors: lags in the assignment of mailing addresses to previously

unimproved property; lags in recording of telephone numbers; and delays in revision of owners' names upon transfer.

**Screening for sample eligibility.** Due to uncertainty concerning the accuracy of information in the Grand Lists and other municipal records, the telephone sample contained initial screening questions to verify the respondent's eligibility for the survey. To be included in the survey, the respondent and home needed to meet the following criteria:

- The customer needed to be first owner of the home.
- The home needed to have been completed in 2000 or 2001.
- The building needed to be used as a home.
- The home needed to be a one- or two-family structure.

About 25 percent of the homes with phone numbers were screened out, almost all because they had been completed prior to 2000.

**Recruitment through the telephone survey.** First, potential participants were asked to respond to the telephone survey, and then solicited for the on site survey after completion of the phone questionnaire. The telephone survey was conducted in early February 2002. Respondents were offered an incentive of $50 to participate in the survey. Seventy-six of the 158 respondents who ultimately participated in the on-site survey were identified in this manner.

**Supplemental recruitment.** To reach the survey quota, additional participants were solicited from the remainder of the sample frame. An additional 156 willing respondents were identified through supplemental recruitment. West Hill and its auditors were able to schedule and complete 158 surveys.

### *Data Collection*

West Hill and its auditors conducted the site visits between February and August 2002. The field work was conducted by seven subcontractors, covering different sections of the state. Visits were performed by prior appointment only. Most visits occurred during normal working hours, but some were also performed during evenings and on Saturdays to achieve a sufficient participation sample size for the study's requirements and to avoid possible bias related to restricting the study to homeowners who are available during regular business hours.

Building components were checked through visual inspection and measurement. Several procedures were used to collect the data for each home: attics were accessed (if possible) and thoroughly inspected; walls were visually inspected; windows were checked for the presence of low emissivity (low-e) coatings; equipment nameplate data were recorded; blower doors were operated to identify building air exchange rates (Minneapolis Blower Door); and ducts were visually inspected. Homeowners were questioned about house components that could not be ascertained through visual inspection, as well as heating fuel usage, and use of ventilation systems and other general house information. If available, the auditors also used plans and the RBES certificate to ascertain the required information. Table 4-1 displays the information collected on site, by category.

**Table 4-1**
**Summary of Data Collected for Each House**

| Data Category | Types of Data Collected |
|---|---|
| General Information | • Owner name, address<br>• Completion/occupancy dates<br>• Builder information<br>• Act 250<br>• Private/public water and sewage<br>• Use of whole house ventilation system |
| General Building Description | • Home type<br>• Volume and floor area<br>• Number of floors and bedrooms<br>• Basement type<br>• Orientation and footprint |
| Energy Code Compliance Information | • Familiarity with RBES code<br>• RBES certificate displayed |
| VT*check* Compliance Information | • Areas/perimeters for multiple sections of ceilings, walls, basements, and floor and multiple doors, windows, and skylights<br>• Insulation R-values for all components and sections<br>• Heating and cooling equipment type and efficiencies<br>• Calculated and required UA |
| Detailed Building Characteristics | • Details on each building envelope component<br>• Areas/perimeters, orientation, location<br>• Insulation R-values<br>• Framing spacing<br>• Window and skylight areas, orientation, frame type, glazing type, U-value<br>• Door characteristics<br>• Heating/cooling system type, heating fuel, capacity, efficiency, make, controls, zones, thermostat type, venting<br>• Fans and ventilation |
| Water Heater Characteristics | • Fuel type, efficiency, size |
| Air Infiltration/Ventilation Characteristics | • Blower door measured air infiltration rate |
| Detailed Appliance and Lighting Characteristics | • Refrigerators, room air conditioners, dishwashers, clothes washers<br>• Manufacturer, vintage<br>• Fuel type for clothes dryers and cooking stoves<br>• Number of ceiling fans<br>• Lighting fixture type and location, lamp type, control type |

### *4.1.3 Analysis of 2002 Data*

The analysis is based on site surveys of 158 homes for thermal shell characteristics and lighting, and 159 homes for appliances. Of these 159 homes, 139 received complete site visits and the auditors collected partial data on the remaining 20, and retrieved the thermal shell characteristics from Vermont Star Homes data files.[2] The data entered into the VTCheck analysis were built up from the detailed data collected on site for each building component and piece of equipment.

**Code Compliance Analysis.** There are three verification methods for RBES code compliance, i.e., the VTCheck software, meeting the Home Energy Rating standard and the prescriptive approach. For most homes in the study, compliance was determined by the VTCheck methodology. Compliance for the twenty homes that went through the Vermont Star Homes program and received energy ratings was assessed by the Home Energy Rating standard. Homes that failed to meet compliance by either of these methods also failed the prescriptive path.

West Hill determined basic code compliance by running a simulation of VTCheck software for each building based on the observed building characteristics collected on site. Using the VTCheck methodology, West Hill calculated the maximum thermal transmittance (UA) allowed by the code and the UA calculated for the building as built ("Your Home" UA). The compliance software adjusted the allowable UA based on the efficiency of the heating equipment, with more efficient heating systems allowing higher building UAs. If the calculated UA was equal to or less than the maximum allowable value, West Hill recorded in the database that the building complied with the code. These data, in combination with the energy rating results obtained from the Vermont Star Homes participants, supported analysis of the proportion of houses that met the code and the distribution of the house UAs relative to the required level.

**Blower door analysis.** A blower door test was conducted as part of the site visit whenever possible. A single point pressurization and depressurization test was performed at 50Pa to determine CFM50. The average of these two values was used to determine the leakage area. This data point was then used to calculate the average natural air changes during the months of September through May. The methodology used is described in the 2001 ASHRAE fundamentals as the LBL model. It adjusts for building height, temperature difference and wind speed. An average temperature difference of 30° F and an average wind speed of 5 mph were used in the calculation. There are a total of 156 data points in the sample. Of these, 137 were collected on site using the methodology discussed above.

The blower door tests on the remaining19 homes were done by Energy Rated Homes of Vermont in conjunction with ratings for the Vermont Star Homes program. For these homes, the natural air changes per hour were obtained from the program data and were based on a single

[2] In one case, the home did not actually receive the energy rating and the auditor could not reschedule. Consequently, only partial information covering lighting and appliances is available for this home. In another home, the lighting had not been installed at the time of the site visit.

depressurization test. The calculations were done using the methodology used by the program field staff.

**Data Verification.** All major data points were checked for valid entries and cross-referenced with other related data points. The data entry for thirty-two (20%) randomly selected surveys was checked against the hard copy, showing an error rate of less than 1%. A few basic data points were checked against the telephone survey responses to look for patterns of errors in data collection, but this process did not reveal any systematic problems.

## 4.2 BASIC CHARACTERISTICS OF THE SAMPLED HOMES

**Regional Distribution.** The final sample contained home in thirteen of the Vermont's fourteen counties. Table 4-2 shows the distribution of the on-site sample, telephone sample, and new homes built (1999) by market area. The Northwest was somewhat overrepresented in both the telephone and on-site samples.

**Table 4-2**
**Regional Distribution of Survey Samples**

| Regions | On Site Survey | | Telephone Survey | Estimated New Homes 1999[3] |
|---|---|---|---|---|
| | n | % | % | |
| Northwest | 103 | 65% | 61% | 48% |
| Northeast | 9 | 6% | 8% | 14% |
| Southwest/South Central | 22 | 15% | 18% | 17% |
| Southeast | 24 | 14% | 14% | 21% |
| **Total** | **158** | | **200** | **2,859** |

**Home Size and Heated Area.** On average, the homes in the 2002 survey had 3.1 occupants and 3.2 bedrooms per home. The median home size was 2,510 square feet of heated area (excluding garage space) with a 95 percent confidence interval of 2,284 to 2,545 square feet. The average home size in the 1995 baseline study (2,380) is within this confidence interval. The difference in the means may be partially due to variations in measuring and defining heated space. In the current study, conditioned space included heated basement area that may not be finished, as opposed to the 1995 study in which the area measurements included only finished "living" area.

Comparison of the 1995 and 2002 surveys shows a trend toward heating and using basement areas. In the 1995 study, 36 percent of the homes had heated basements, and only 18 percent had finished basements. About half of the homes in the 2002 survey had heated basements, and

[3] The estimated number of new homes built in 1999 is from an analysis of the 411 forms collected by the Department of Property Valuation from the towns in Vermont.

auditors reported that a large majority of these basements had at least some finished area. See Table 4-3 shows the distribution of the two samples by size. The mean and median sizes of the Vermont Star Homes were virtually the same as that for the 2002 sample as a whole. However, the Vermont Star Homes were more closely clustered in the middle of the size distribution (2000 – 2,999 square feet) than the rest of the sample. This result may suggest that the program was relatively less attractive to builders and owners of small inexpensive homes and large custom homes. This conclusion is consistent with the observations of program managers and contractors.

**Table 4-3**
**Distribution of House Sizes**

| | 1995 Study | 2002 Study | |
|---|---|---|---|
| | "Living " Finished Area | Heated Area Full Sample | Heated Area VT Star Only |
| **House Size Category** | | | |
| less than 1,000 | 4% | 0% | 0% |
| 1,000 to 1,499 | 12% | 8% | 9% |
| 1,500 to 1,999 | 29% | 25% | 15% |
| 2,000 to 2,499 | 21% | 25% | 26% |
| 2,500 to 2,999 | 11% | 19% | 30% |
| 3,000 to 3,499 | 10% | 9% | 9% |
| 3,500 to 3,999 | 6% | 8% | 9% |
| 4,000 to 4,499 | 4% | 3% | 0% |
| 4,500 to 4,999 | 2% | 2% | 0% |
| greater than 5000 | 2% | 2% | 2% |
| | | | |
| Mean | 2,380 | 2,510 | 2,527 |
| Median | 2,130 | 2,390 | 2,460 |

**Construction Type.** Ninety percent of the 2002 sample homes fell into four categories: cape, colonial, contemporary and ranch. The most common construction type was wood framed, 16" on center (116 homes or 73%). The remainder consisted of wood framed 24" on center (25 homes or 16%), stress skins (8 homes or 5%), log (7 homes) and other (2 homes). The distribution of the 1995 sample among construction types was roughly the same.

**Program Participation.** Forty-seven of the 158 sample homeowners reported that their homes had been through the Vermont Star Homes program, with 27 (18 percent of total respondents) claiming that the home received a home energy rating. However, further investigation suggests that information provided by the on site respondents may overstate the number of energy ratings and program participation. Of the 27 customer-reported ratings, 6 could not be verified by

Vermont Star Homes. Two of these six were participants in the Vermont Star Homes program but did not receive ratings. Three of the six were identified as VGS participants but could not be verified by VGS.

Direct conversations with two participants and two builders indicates that some builders are claiming that homes have been rated when, in fact, these specific homes did not receive energy ratings. In one case, the builder has a history of participating in the program and constructing homes to the program standard, but another builder has not chosen to participate in the program to date. It is equally possible that some homeowners are not aware that their homes were served through the program.

## 4.3 CHANGES IN CONSTRUCTION PRACTICES: THERMAL FEATURES AND RBES COMPLIANCE

In this section we analyze the changes in construction practices between 1995 and 2002, focusing on features that affect the thermal load of the home. These features include insulation levels, glazing area and materials, and air leakage. The section ends with a detailed analysis of the RBES compliance of the 2002 sample homes and a comparison to the 1995 results.

### *4.3.1 Insulation Levels*

**Attic and Wall Insulation.** Attic and wall insulation generally met or exceeded prescriptive code levels for the majority of homes. These results are similar to the 1995 baseline study, indicating that attic and wall insulation practices have not changed significantly since the RBES code was instituted. See Table 4-4 for details.

**Table 4-4**
**Attic and Wall Insulation: Results of the 2002 and 1995 Surveys**

| | Attic Area | | | |
|---|---|---|---|---|
| | **Flats** | **Slopes** | **Kneewalls** | **Walls** |
| ***Minimum RBES Requirement***[4] | R-38 | R-30 | R-19 | R-19 |
| **2002 Results** | | | | |
| Number of Homes with Feature | 141 | 113 | 34 | 158 |
| R-value Below Code | 28% | 36% | 21% | 10% |
| R-value Meets or Exceeds Code | 68% | 64% | 79% | 90% |
| | | | | |
| Minimum | 15 | 19 | 0 | 8 |
| Maximum | 83 | 60 | 32 | 40 |
| Median | 38 | 30 | 19 | 19 |
| Mean | 40 | 32 | 19 | 20 |
| Average Area (sq. ft.)[5] | 1,115 | 775 | 297 | 1,931 |
| **1995 Results** | | | | |
| R-value Meets or Exceeds Code | 62% | 65% | 89% | 94% |
| Mean | 33 | 29 | 19 | 19 |

As can be seen from the table above, there is room for improvement in attic insulation. Thirty-six percent of the slopes in the sample homes were underinsulated in comparison to the minimum prescriptive code requirement. However, homes generally did not have multiple deficiencies in the thermal shell, i.e., these substandard conditions were sporadic and not found grouped in particular homes or types of homes. For example, a slope area in one home may have been underinsulated, but the attic flats and wall insulation levels were consistent with the RBES code or better. Also, a large majority of homes that failed to meet the RBES code had R-values close to the standard. Walls were insulated to R-19 or better in 90 percent of the homes.

**Basement Insulation.** Comparison to the 1995 study suggests that basement insulation is becoming much more common. Over 60 percent of the homes in the current study had foundation wall insulation meeting the RBES minimum prescriptive level of R-10, as compared to 48 percent in the 1995 study. However, even with these improved construction practices, basement walls were found without any insulation in about 25 percent of the homes, the slab edge of a walkout basement was almost always left without insulation and a number of homes had incomplete foundation insulation not reflected in the nominal R-values, i.e., a number of the

[4] The prescriptive code path allows for numerous ways to meet the code. These value represent the minimum and the builder may be required to increase the of other house components to meet the standard.

[5] Areas of the house components were not available for the 19 Vermont Star Homes participants for whom program data was substituted for direct data collection. The average area excludes these participants.

homes that meet the nominal R-value requirement of the RBES code still have deficiencies in the basement insulation. Unlike attics and walls, most of the homes failing the RBES prescriptive standard had little or no insulation. See Table 4-5 for details.

**Table 4-5**
**Basement Insulation**
**Results of the 2002 and 1995 Surveys**

| Area | Walls | Floors | Floors over Uncond. Space | Slab |
|---|---|---|---|---|
| **Minimum Code Requirement** | **R-10** | **R-38** | **R-30** | **R-10** |
| **2002 Results** | | | | |
| Number of Homes with Feature | 146 | 26 | 45 | 63 |
| R-value Below Code | 38% | 73% | 67% | 63% |
| R-value Meets or Exceeds Code | 62% | 23% | 33% | 37% |
| | | | | |
| Minimum R-value | 0 | 8 | 0 | 0 |
| Maximum R-value | 29 | 43 | 45 | 11 |
| Median R-value | 10 | 30 | 28 | 0 |
| Mean R-value | 8 | 30 | 25 | 4 |
| Average Area (sq. ft.) | 1036 | 134 | 629 | N/A |
| **1995 Results** | | | | |
| R-value Meets or Exceeds Code | 48% | n/a | 24 | n/a |
| Mean | 7.0 | 30 | | |

### *Windows and Doors*

**Glazing Materials.** Use of high-efficiency glazing materials had reached significant levels in 1995, and the results of the 2002 survey suggest that market share for these materials has continued to increase. Double pane windows with Low-E glass was the most common choice for glazing among survey respondents who did not participate in the Vermont Star Homes or utilities programs, with about 80 percent of these homes having low-E glazing on 75 percent or more of their window area (107 of 135). The remainder of these surveyed homes (about 20%) had double pane without Low E or argon.

Among the 139 homes that received full site visits, about 80 percent of all glazing area contained Low-E glass and 58 percent contained Low-E glass with argon gas fill. The U–values for 19 program participants where shell features were recorded from program records indicate that all of these homes had double pane windows with low-E glass and about half also installed windows with argon gas.[6]

[6] The data from the Vermont Star Home program consisted of one U-value for windows for the house.

While windows with low-E and argon gas are a common occurrence, there were very few instances of higher efficiency windows such as triple pane with low E. Six door units and one window unit contained triple pane glass, for a total glazing area of 83 sq ft. Single pane windows were rare. Only one home contained single pane windows with low E storms.

The 1995 study indicated that about 70% of the homes had windows with low E and less than 40% had low-E and argon. These results show that windows with low-E and argon have become common building practices, and that the market has been moving toward more efficient windows.

**Glazing area.** Although window efficiency has been improving, comparison of the 1995 and 2002 surveys indicates that the window-to-wall ratio in new homes has increased substantially. In general, homes have a greater ratio of glazing to wall area than found in the 1995 study, as shown in Table 4-6 below. The 1995 study showed that almost a quarter of the homes had less than .10 glazing in comparison to the wall area, and only 15 percent of the homes had more than a .15 glazing ratio. In the current study, this trend is reversed, with only 10 percent of the homes having a glazing to wall area ratio of less than .10 and 35 percent of the homes having more than .15 glazing. To comply with RBES, a house with a glazing ratio of .17 or higher needs to increase the efficiency of other building components substantially.

**Table 4-6**
**Glazing Area**
**Results of the 2002 and 1995 Surveys**

| Window to Wall Area Ratio | 2002 Survey | 1995 Survey |
|---|---|---|
| N = | 139* | 151 |
| Less than 10% | 10% | 23% |
| 10 to 12% | 29% | 32% |
| 13 to 15% | 26% | 30% |
| 16 to 20% | 19% | 9% |
| More than 20% | 16% | 6% |
| | | |
| Minimum | 6% | n/a |
| Maximum | 27% | n/a |
| Mean | 14% | n/a |
| Median | 13% | n/a |

* Data not available for 19 homes for which program records were used in data collection.

This trend toward higher glazing ratio is particularly prevalent in larger houses. The mean house size of homes with a glazing-to-wall ratio of less than .17 is 2380 square feet (99 homes), as compared to an average size of 2750 square feet for homes with .17 or more (40 homes). This difference between the house sizes of the two groups is significant at the 95% confidence level.

### *Compliance with RBES Total Thermal Transmittance Requirements*

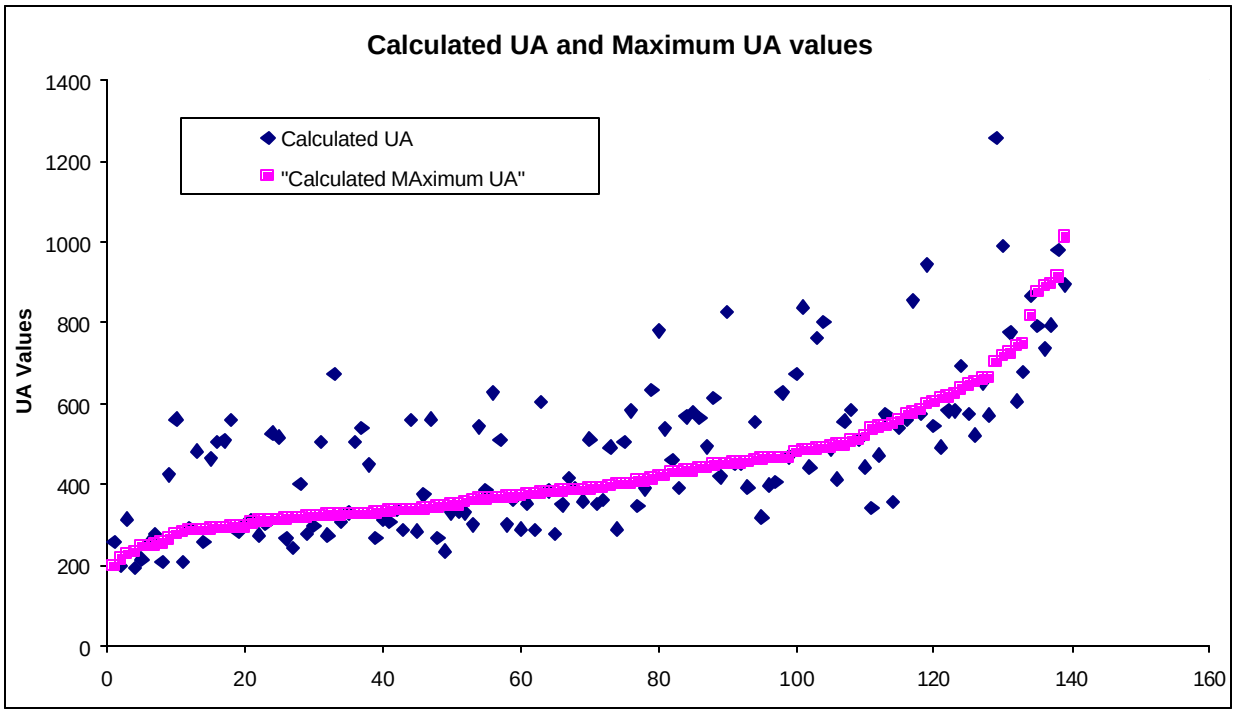
Of the 158 homes in the 2002 sample, 94 (59 percent) met the thermal transmittance standards of the Vermont Residential Building Efficiency Standard (RBES). Compliance was determined for 139 of the sample homes using the VTCheck methodology of U values multiplied by the areas of building components to obtain a total UA value for all building components. Seventy-seven of these homes were determined to meet the standard. Another 19 homes had received energy ratings through the Vermont Star program that demonstrated their compliance with RBES. The UA value for many homes are clustered around the RBES compliance criteria, with almost one third (51 homes) within 10% on either side of the RBES code.

The percentage of homes passing RBES shows an improvement over the 1995 baseline study, in which 35 to 40 percent of the homes were estimated to pass the RBES code. As in 1995, lack of foundation insulation, both basements and slabs, was a leading reason for noncompliance. A total of 53 homes lacked foundation insulation on at least some portion of their foundation and in 45 homes the area involved exceeded 20 feet of perimeter. Another major factor contributing to noncompliance was a high percentage of glazing and doors to wall area. About 40% of the homes that failed to meet the compliance criteria had window-to-wall proportions of 17% or

greater. A less common reason for noncompliance was sporadic missing or inadequate insulation in other envelope areas.

Figure 4-1 is a scatter plot of the UA values as compared to the code-required maximum UA values, calculated for the 139 homes where complete data was collected. The broad line shows the minimum code compliance, and the dots represent the actual homes; dots above the line are homes that do not meet the standard, while dots below or on the line comply with the standard. Larger homes appear toward the right of the chart, and smaller ones toward the left.

**Figure 4-1**
**Calculated UAs versus Maximum Allowable UAs**




Homes built under Vermont's Act 250 passed the RBES standard at a nominally higher rate that the survey respondents as a whole, with 32 out of 48 homes (66%) meeting the code. This rate of code compliance, however, is not statistically different from the sample as a whole. In contrast, manufactured homes passed at a rate that was substantially lower than site built homes (41% as compared to 61%). This difference is statistically significant at the 95% confidence level. Homes built by owner-builders are notable for their presence on both ends of the spectrum. Many of these homes were at the top of the efficiency ladder, and others were among the least efficient. Of the five homes that exceeded the code requirements by the greatest percentage (by VTCheck standards), three were built by owner builders, and two of the bottom five homes failing the code requirements by the largest margin were constructed by their owners.

### *Compliance with Other RBES Requirements*

The RBES code includes requirements beyond the thermal shell standard, for example a standard for recessed lighting. This study was not designed to provide a comprehensive assessment of compliance with these additional requirements, due to time limitations and the other critical objectives of the site visits. However, the information collected through the site visits does provide some insight into compliance with these items, as list below in Table 4-7.

**Table 4-7**
**Compliance with Other RBES Requirements**

| RBES Requirements | Description | Compliance Issues |
|---|---|---|
| Air Leakage | Seal joints , access holes, connections; standards for recessed lights | Houses generally very tight; only 28% over .31 air changes per hour; compliance with recessed light standard unknown |
| Vapor Retarders | Installed in all non-vented framing components | Attics generally vented; vapor barriers common in walls |
| Duct Insulation | Ducts in unconditioned space insulated to R-5 | Ducts predominantly installed within thermal barrier; 1 home with uninsulated, unsealed ducts in unconditioned space |
| Duct Sealing | Ducts in unconditioned space must be sealed with mastic | See above |
| HVAC System Efficiency & Balancing | Minimum AFUE of .78 for furnaces, .80 for boilers; must have means for balancing | All homes met minimum AFUE requirement; no information on balancing is available. |
| Temperature Controls | Each HVAC zone must have a thermostat | All homes met this requirement |
| HVAC Piping Insulation | HVAC pipes insulated in unconditioned space | HVAC pipes predominantly installed within thermal barrier; 3 homes with uninsulated pipes in unconditioned space |
| Swimming Pools | Timer on pump, heater on/off switch and cover for heated pools | Only two homes with pools; compliance unknown |
| DHW | Meet minimum federal standard from 1992, minimum R-value of R-14; heat traps or pipe insulation for stand alone tanks. | All homes met federal standards; three homes had external tank wrap. |
| Fireplaces | Fireplaces must have one of the following: tight-fitted doors or chimney damper, or chimney cap damper. | 50% of homes had fireplaces; about half of homes with fireplaces have tight doors, about two-thirds have designated air |
| Exhaust Fans | Dampers required for bath, kitchen and dryer fans. | Compliance unknown |
| Certification | Certificate displayed in home, sent to state and town clerk | Low certification rate (18% displayed in home) |

### *Ventilation and Infiltration*

**Ventilation.** Of the 157 homes in the survey with complete ventilation data, 11 homes contained HRV's and 40 had exhaust fans on a timer control. This result indicates that 32 percent of the homes had a whole house ventilation system, which represents a substantial increase from the 6 percent homes in the 1995 baseline study. This trend seems to be largely driven by the efficiency programs, i.e., Vermont Star Homes Program, Vermont Gas's HomeBase Program, Washington Electric Coop's and Burlington Electric Department's residential new construction programs. Seventy percent of the homes that were constructed with the assistance of one of these efficiency programs have a whole house ventilation system, as compared to 15 percent of the nonparticipating homes.

Comparing the homeowners' perceptions with the survey results showed that the 34 homeowners did accurately identify their homes as having a whole house ventilation system. In contrast, in 17 homes with ventilation systems, the homeowner apparently was unaware of it. Eleven of these homes were built by program participants.

**Measured Infiltration/Blower Door Test Results.** The 1995 survey found that infiltration (measured in air changes per hour - ACH) was generally low in the sample of new homes tested. Sixty-four percent of the 1995 sample registered below 0.40 ACH (the level needed to meet ASHRAE 119 standards in Northern Vermont). Another 22 percent of the sample registered met the standard for Southern Vermont at 0.57 ACH or below. The results of the 2002 survey suggest that the newer cohort was slightly more air-tight. Sixty-six percent of the 2002 sample homes registered fewer than 0.31 natural air changes per hour, with an additional 22 percent below 0.50 ACH. The mean ACH for the 156 homes measured was 0.27. There were a very limited number of homes with infiltration problems.

Although the homes are tight, they generally meet the ASHRAE Standard 62 guidelines for air flow at the current occupancy levels.[7] Only 6% of the homes failed to meet the standard and did not have a whole house ventilation system. In addition to the effectiveness of the efficiency programs in encouraging the installation of ventilation equipment, this result may also be an unintended consequence of the trend toward large homes.

[7] Standard 62 requires 15 cfm per person. Consequently, the level of occupancy of the house has an impact on the air flow requirements.

## 4.4 SPACE AND WATER HEATING EQUIPMENT

### *4.4.1 Space Heating*

**Primary heating fuel and secondary systems.** Table 4-8 shows the distribution of homes in the 1995 and 2002 samples by primary heating fuel. The table is provided for reference in interpreting subsequent reporting of system efficiency findings. The apparent changes in the distribution of new homes by heating fuel (shift from oil to gas) likely reflect the mechanics of sample development rather than underlying shifts in the population.

**Table 4-8**
**Distribution of Homes by Primary Heating Fuel**
**Results of the 2002 and 1995 Surveys**

| Primary Heating Fuel | % of Homes: 1995 Sample | % of Homes: 2002 Sample |
|---|---|---|
| Oil/Kerosene | 60% | 45% |
| Natural Gas | 6% | 19% |
| Propane | 29% | 29% |
| Wood | - | 6% |
| Electric/Other/Combination | 5% | 1% |
| Wood/Other | | |

Forty-five percent of the homes in the 2002 sample had a secondary heating system, with wood stoves the most common (in 32 homes), followed by propane or natural gas stoves (16 homes), space heaters (6 homes) including two homes with electric space heaters, and fossil fuel central systems used as secondary systems in seven homes.

**Central heating equipment efficiency.** Comparison of the 1995 and 2002 surveys shows some improvement in the efficiency of central heating units. Twenty percent of the boilers found installed in the 1995 study did not meet RBES standards (.80 AFUE). In the interim, federal minimum energy efficiency standards were increased to .80 AFUE for boilers. In the current sample, all boilers installed met those standards, and 50 percent met the current ENERGY STAR specification of .85 percent. Furnace efficiency had an unusual distribution, with almost half in the two bottom bins and the rest above 91 percent. As was the case with boilers, the very bottom of the 1995 distribution was eliminated through the promulgation of new federal efficiency standards that raised the minimum allowable rating to .78 AFUE. The current ENERGY Star specification for furnaces is .90 AFUE. The central heating equipment efficiency distributions found in the 2002 sample suggest that HVAC contractors and builders may be using the ENERGY STAR label to support marketing of efficient models. See Table 4-9 for details.

**Table 4-9**
**Distribution of Central Heating Plant Efficiency: 2002 Sample**

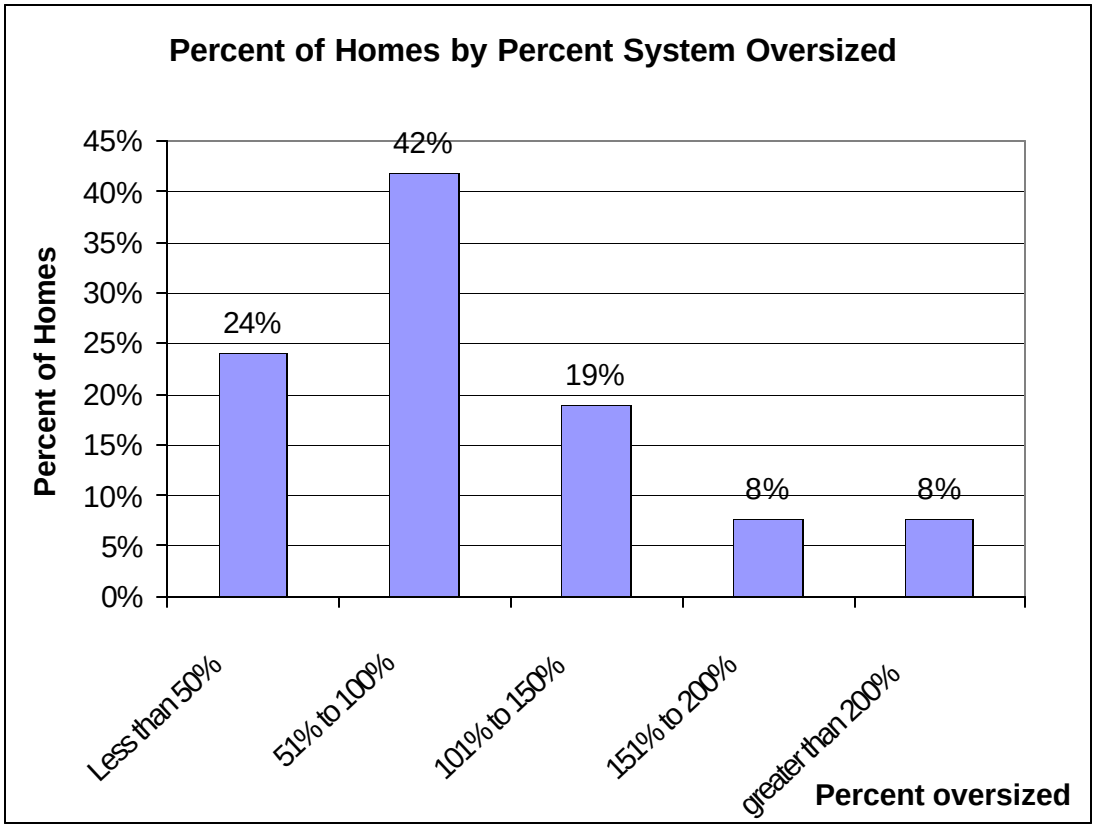
| | Boilers | | Furnaces | | Manu. Hsg. Furnaces | |
|---|---|---|---|---|---|---|
| | # | % | # | % | # | % |
| **n =** | 120 | | 20 | | 24 | |
| **Efficiency Ranges** | | | | | | |
| < 0.780 | 0 | 0% | 0 | 0% | 0 | 0% |
| 0.780 to < 0.800 | 0 | 0% | 5 | 25% | 5 | 21% |
| 0.800 to < 0.830 | 24 | 20% | 3 | 15% | 19 | 79% |
| 0.830 to < 0.870 | 78 | 65% | 0 | 0% | 0 | 0% |
| 0.870 to < 0.910 | 18 | 15% | 0 | 0% | 0 | 0% |
| >= 0.910 | 0 | 0% | 12 | 60% | 0 | 0% |
| | | | | | | |
| Federal Minimum Std. | 0.80 | | 0.78 | | 0.78 | |
| ENERGY STAR Spec. | 0.85 | | 0.90 | | 0.90 | |
| Minimum | 0.802 | | 0.780 | | 0.780 | |
| Maximum | 0.890 | | 0.930 | | 0.862 | |
| Median | 0.850 | | 0.910 | | 0.821 | |
| Mean | 0.848 | | 0.865 | | 0.821 | |

**Heating System Sizing.** Excessive oversizing of the heating system reduces its seasonal efficiency. The 1995 study found that sample heating systems were consistently oversized in relation to design heating load. More than 71 percent of the sample homes had sizing factors (ratio of heating system capacity to design load) greater than 2.0; 29 percent had sizing factors greater than 3.0. The recommended sizing factor is 1.25.

Analysis of the 2002 on-site survey results found that the practice of oversizing heating systems remains very common in Vermont new construction, although the extent of oversizing appears to have decreased somewhat. West Hill compared the sizing of the heating system output to the design load requirement for 117 homes in the sample. If domestic hot water was also provided by the system, i.e., integrated or tankless coil, the DHW load was added to the design load. Systems were considered correctly sized (oversizing percent is 0) if they were at or near 125 percent of the design load. Only 7 of the 117 or 6 percent were correctly sized.[8] Figure 4-2 breaks out the homes into bins depending on the output capacity of the heating equipment as a percentage of the calculated maximum load.

[8] Defined as (System Output – (Design load * 1.25))/(Design load * 1.25)

**Figure 4-2**
**Sizing of Heating Systems v. Estimated Design Load**




The median oversizing factor was 81 percent. In other words, the median system had 90 percent more capacity than the design heating load, after allowing for a 25 percent safety margin. This is an improvement over the results of the 1995 study, which found that over 71 percent of the sample homes had similarly oversized heating systems.

Natural gas equipment tended to be somewhat less oversized than other sample systems: mean oversizing of 69 percent v. roughly 100 percent for the remainder of the sample. This result may be attributed both to the VGS New Construction Program and the availability of lower capacity equipment for gas.

Many of the same issues mentioned in the 1995 study contribute to the oversizing of boilers and furnaces. Equipment is not made for homes with very small design loads. Gas and LP Boilers start at outputs of 30,000 while oil boilers have minimum outputs of 56,000 BTU's. There are a few natural gas and propane furnaces available with outputs below 30,000 BTU.[9] This lack of smaller heating equipment and the tendency of contractors to oversize the equipment are two factors contributing to the equipment choices.

[9] GAMA directory April 2001.

**Heat distribution systems and controls.** Eighty-three percent of the 2002 sample 154 homes with complete system information had hydronic heat distribution systems, with 67 percent of those homes selecting baseboard, 21 percent radiant and the remainder a combination of the two. Fourteen percent of the homes had furnaces with forced hot air distribution. These results are consistent with the 1995 baseline survey. Only one home with a furnace had unsealed ducts outside of the conditioned space. Four homes had uninsulated air distribution systems outside of the conditioned space.

The presence of equipment needed to establish zoned heating control was slightly higher in the 2002 sample than in the 1995 cohort. Eighty percent of the homes in the 2002 sample[10] had multiple heating zones, ranging from two to eight zones. Forty-three percent had at least one setback thermostat. By comparison, only sixty-six percent of the homes in the 1995 sample had controls for multiple zones (zone valves or circulating pumps); 26 percent had at least one set-back thermostat installed.

### *4.4.2 Water Heating*

**Water heating fuel.** Forty percent of the 2002 sample homes used oil to fire domestic water heating equipment, followed by propane with 32 percent, natural gas with 17 percent, electric (8 percent) and the remainder split among wood, kerosene and solar (one home). The penetration of electric tanks closely matches the 1995 baseline study.

Integrated, indirect fired tanks dominated (76 percent of the sample homes), with stand alone tanks accounting for 20 percent , tankless coils at 3 percent and on-demand systems at 1 percent. This distribution represents a remarkable improvement from the 1995 study, in which almost 30 percent of the sample homes had low-efficiency tankless coils. Electric water heaters occur much more frequently in manufactured housing than in the general sample. Seven of the twelve homes with electric DHW were found in manufactured homes, and these seven homes represent almost 40 percent of the eighteen manufactured homes included in the survey.

Table 4-10 shows the distribution of homes for which DHW information was available by water system heating type and Energy Factor. The median Energy Factor for the most common configuration -- indirect-fired fossil fuel units -- remained more or less the same between the two studies. The median Energy Factor increased somewhat for fossil and electric stand-alone models. The greatest increase in efficiency was realized, however, by the general abandonment of tankless coils.

[10] These numbers do not include the efficiency program participants where only partial data was collected since this information was not available from the program database.

**Table 4-10**
**Distribution of Homes by DHW Type and Efficiency**
**Results of the 2002 and 1995 Surveys**

| | 1995 Sample, n = 151 | | 2002 Sample, n = 137* | |
|---|---|---|---|---|
| | Percent of Sample Homes | Median Energy Factor | Percent of Sample Homes | Median Energy Factor |
| Tankless Coil | 32% | 0.50 | 3% | n/a |
| Indirect fired: Fossil Fuel | 46% | 0.78 | 83% | 0.77 |
| Indirect fired: Fossil w/ External Insulation | 4% | 0.83 | n/a | n/a |
| Stand Alone: Electric | 8% | 0.82 | 6% | 0.88 |
| Stand Alone: Fossil Fuel | 11% | 0.52 | 11% | 0.60 |

* Inspections could not determine the efficiency of 21 systems.

## 4.5 LIGHTING AND APPLIANCES

### *4.5.1 Lighting*

**Number of hardwired fixtures per home.** About 34 hardwired light fixtures were installed per home, showing an increase over the 25 fixtures per home from the 1995 baseline. The greater number of fixtures could be related to the increase in house size from the earlier study to the current one. Vermont Star Home and utility program participants had a slightly higher number of total fixtures (36) than nonparticipants (33).

Among all sample homes, about 8 percent of the fixtures contained compact fluorescent lamps and 6 percent contained other kinds of fluorescent lamps. This result shows a small improvement over the 1995 baseline study, which found that 5 percent of the fixtures installed were compact fluorescent and 4 percent were linear or circular fluorescents.

The Vermont Star Homes and utility programs were clearly a driver in promoting the installation of fixtures with compact fluorescent lamps. Among program participants, the penetration of fixtures with compact fluorescent was 16 percent, whereas the corresponding figure for nonparticipating homes was only 4 percent. The penetration of other non-incandescent lighting was approximately the same between the two groups.

Slightly under half of the homes in the survey installed one or more fixtures with compact fluorescent lamps, as compared to about one-third of the survey respondents of the 1995 study. Program participants were much more likely to install at least one CFL fixture (80 percent as compared to 31 percent) and tended to install more CFL fixtures per home than the survey respondents as a whole. See Table 4-11 for details.

**Table 4-11**
**Installation of Compact Fluorescent Fixtures: 2002 Sample**

| | All Respondents | | Program Participants | | Nonparticipants | |
|---|---|---|---|---|---|---|
| No of CFL Fixtures | # of Homes | % | # of Homes | % | # of Homes | % |
| 0 | 84 | 53% | 10 | 20% | 74 | 69% |
| 1to 3 | 37 | 23% | 15 | 30% | 22 | 20% |
| 4 to 6 | 14 | 9% | 6 | 12% | 8 | 7% |
| 7to 9 | 10 | 6% | 9 | 18% | 1 | 1% |
| 10 to15 | 9 | 6% | 8 | 16% | 1 | 1% |
| More than16 | 4 | 3% | 2 | 4% | 2 | 2% |
| n | 158 | | 50 | | 108 | |
| | | | | | | |
| Mean | 2.77 | | 5.52 | | 1.16 | |
| Min | 0 | | 0 | | 0 | |
| Max | 36 | | 36 | | 33 | |

Overall survey results indicate that CFL fixtures were located fairly equally in likely high use and low use locations.[11] Program participants, however, showed a greater tendency to place CFL fixtures in high use and mid-use locations, whereas nonparticipants were more likely to place CFL fixtures in mid- and low use locations.

By way of contrast, the on-site survey of existing homes conducted in support of the Efficient Products Program evaluation found that 15 percent of the sample households had compact fluorescent fixtures installed, with an average of 0.45 bulbs installed per household. Thus, CF fixtures are being installed in new construction to a much greater extent than in the general population, even among households that did not participate in RNC programs.

### *4.5.2 ENERGY STAR Appliances*

The saturation of ENERGY STAR appliances in new homes was high, with 47 percent of clothes washers, 36 percent of dishwashers and 27 percent of refrigerators verified as meeting the Energy Star criteria. Estimates of the general ENERGY STAR market share for these appliances, developed for the EPP evaluation were as follows: clothes washers – 28 percent; dishwashers – 41 percent; refrigerators – 20 percent.

[11] The program defines kitchens, living rooms and family rooms as high use locations; halls and bathrooms as mid-use locations (for which rebates are paid); and garage interiors, unfinished basements, and closets as low-use locations..

Dishwashers and refrigerators were most commonly purchased for the new home. Freezers were the most likely to be moved from the previous home, and many of these freezers were quite advanced in years, some over 30 years old. Moved refrigerators also tended to be older models, having a median age of 10 years.

## 4.6 MANUFACTURED AND OWNER-BUILT HOUSING

About 23 percent of the sample (37 homes) were owner built, which is consistent with the results of the telephone survey (22 percent). Twenty-seven homes were manufactured homes, either double wides or modular homes. In a number of respects, the efficiency levels of manufactured homes were lower than site built homes. Only about 40 percent of the manufactured homes in the survey passed the RBES compliance as measured by the VTCheck software, as opposed to over 60 percent of site built homes. Although the overall incidence of electric water heaters was low, most of these units were installed in modular and owner-built homes. The high saturation of electric stand alone tanks in manufactured homes is likely to be related to the higher percentage of homes with furnaces. Another item of note is that the manufactured homes generally had heating systems with lower efficiencies. See Table 4-12 for details.

**Table 4-12**
**Comparison of Selected Features: Manufactured v. Owner-Built and Builder Homes**

| | n | # with Elec. DHW | % with Elec. DW | # with Furnaces | % with Furnaces | Average Furnace AFUE |
|---|---|---|---|---|---|---|
| Manufactured Homes | 26 | 7 | 27% | 9 | 35% | 0.821 |
| Owner-Built | 36 | 3 | 8% | 2 | 6% | 0.854 |
| Builder & Spec Homes | 96 | 2 | 2% | 12 | 12% | 0.856 |
| All Homes | 158 | 12 | 8% | 23 | 15% | 0.850 |

## 4.7 COMPARISON OF VERMONT ON-SITE RESULTS WITH MASSACHUSETTS CODE COMPLIANCE STUDY

In this section we compare the results of the Vermont on-site surveys to a study conducted in Massachusetts. In 1998, Massachusetts adopted a building code based, as is the RBES, on the CABO Model Energy Code. Moreover, Massachusetts towns are required to issue permits and inspect new construction for code compliance. The Massachusetts Bureau of Building Regulation and Standards commissioned a study of energy code compliance based on inspection of a random statewide sample of 186 new homes. Data collection for the study took place in late 2000, roughly 18 months after the code went into effect. XENERGY managed this project, and West Hill adopted many of the data collection and analytical approaches used in the Massachusetts study to the Vermont effort. Table 4-13 summarizes the results of both studies on key code compliance issues.

**Table 4-13**
**Comparison of Massachusetts Code Compliance Study**
**And Vermont On-site Study Results**

| Compliance Feature | Vermont | Mass. | Comments |
|---|---|---|---|
| Percent of homes meeting UA Requirements | 59% | 46% | In both states, most homes that exceeded allowable UAs were within 10% of the allowable value. |
| Mean Window/Wall Area Ratio | 14% | 14% | |
| % glazing area with 2-pane, Low-e | 80% | 76% | |
| Mean Air Infiltration | <.30 ACH | .34 ACH | |
| Mean AFUE of Heating Systems | 0.850 | 0.850 | 31% of the MA homes had natural gas furnaces v. 19% for Vermont. Gas furnaces on the market can obtain higher AFUEs than gas or oil boilers. |
| Mean Heating System Oversizing Factor | 81% | 92% | |
| Duct systems adequately sealed | see note | 19% | Only one home observed with ducts outside conditioned space. |
| HVAC pipes insulated | see note | 68% | In Vermont, HVAC circulation pipes predominantly installed in conditioned space. 3 houses with uninsulated pipes in unconditioned space. |
| Each heating zone with thermostat or similar controls | 100% | 89% | |

The comparison of the two studies shows that new homes in Vermont generally perform better on energy criteria than those in Massachusetts, despite the absence of code enforcement in Vermont. The difference in the percentage of homes meeting the UA requirement is particularly striking. In making this comparison, one should keep in mind that the Massachusetts code had only been in place for 18 months when data were collected for the BBRS study and that many towns were still putting code enforcement procedures in place at that time.

# 5 BUILDER PRACTICES & PROGRAM RESPONSE

This section characterizes builders' current construction and marketing practices in regard to energy efficiency in new homes, their recognition and understanding of the Vermont Energy Star Homes program and its predecessors, and the program effects that builders perceive. Data to support this analysis comes primarily from the builder (n = 54) and remodeler (n = 35) surveys. Where useful and appropriate, we compare the results of the builder survey to those of the on-site and customer telephone surveys, as well as to the results of interviews with other market actors and program staff.

## 5.1 ENERGY EFFICIENCY IN MARKETING AND CONSTRUCTION PRACTICES

**Energy efficiency in the home sales and planning process.** Sample builders were asked whether they discussed energy efficiency with buyers in the course of planning or selling a new home. They were also asked to name the benefits of energy efficiency that they identified to customers. Builders representing approximately 92 percent of the 2001 new construction volume in Vermont indicated that they discuss energy efficiency considerations in some or most cases when developing plans for custom-built homes.[1] Builders accounting for nearly 90 percent of new construction volume indicated that they discuss reduced energy costs with homebuyers, and more than 20 percent mentioned the additional benefits of greater comfort, lower maintenance costs, and environmental benefits. Builders representing approximately 10 percent of new home volume mention higher resale value and longer component life as benefits as well. See Table 5-1 for details.

**Table 5-1**
**Frequency of Discussing Energy-Efficiency When Developing Plans for New Homes**
**(Weighted by Volume of New Homes Built)**

| | Builder Size | | | |
|---|---|---|---|---|
| Frequency | Small | Medium | Large | Overall |
| In All or Most Cases | 81% | 76% | 100% | 82% |
| In Some Cases | 7% | 21% | < 1% | 10% |
| In Relatively Few Cases | 9% | 3% | < 1% | 6% |
| In No Case | 3% | < 1% | < 1% | 2% |
| Total | 100% | 100% | 100% | 100% |

[1] The builder survey results were analyzed using a ratio technique that allows us to express survey results in terms of the percentage of total new housing units that the sample builders completed in 2001. This approach supports straightforward comparison of the results between the builder survey on the one hand, and the home owner and on-site surveys, which used a list of homes built as the sample frame. For a discussion of the statistical techniques used to process the builder survey data, see pp 3-7 to 3-10.

**Energy Efficiency Offerings.** The sample builders were read a list of energy-related home features and asked to indicate whether each one was standard, optional or generally not offered for the homes they build. Table 5-2 displays their responses to these items, as well as the percentage of surveyed homes in which energy-efficient features were found.

**Table 5-2**
**Frequency of Energy Efficiency Offerings (Weighted by Volume of New Homes Built) v. Observed Prevalence in New Homes**

| Feature | Standard | Option | Not Offered | Observed On-site |
|---|---|---|---|---|
| ***Shell Features*** | | | | |
| Low-e windows | 94% | 6% | - | 80% |
| Argon-filled windows | 76% | 21% | 3% | 53% |
| Basement insulation above R-10 | 72% | 27% | 1% | 62%[1] |
| Wall insulation above R-19 | 56% | 41% | 3% | 90%[1] |
| Attic insulation above R-38 | 55% | 38% | 7% | 68%[1] |
| Floor insulation greater than R-30 | 31% | 38% | 31% | 33%[1] |
| Reduced air infiltration measured using blower door equipment | 21% | 31% | 48% | n/a, but homes are very tight |
| Home orientation to take advantage of solar gain | 51% | 22% | 27% | n/a |
| ***Heating Equipment*** | | | | |
| Advanced controls (i.e., fan timers, programmable thermostats) | 51% | 28% | 21% | 43%[2] |
| Duct sealing and leakage testing | 47% | 15% | 37% | Almost all had sealed ducts |
| ENERGY STAR high-efficiency hvac equipment | 65% | 20% | 15% | Boilers: 50%<br>Furnaces: 60% |
| ***Lighting and Appliances*** | | | | |
| ENERGY STAR high-efficiency appliances | 31% | 26% | 43% | CW 47%<br>DW 36%<br>REF 27% |
| ENERGY STAR hard-wired compact fluorescent lighting fixtures | 20% | 57% | 24% | % all 47%<br>% part 70%<br>%non-part 30% |

[1] Percent of homes that meet or exceed RBES standard.

[2] Percent of homes with at least one set-back thermostat.

Previous studies of this kind have found that builders tend to overreport the prevalence of energy-efficient features in the homes they construct. However, the results of the builder and on-

site surveys summarized in Table 5-2 are consistent on many points, and there are no wild discrepancies between observed and reported practice. Some points of divergence between reported and observed practices are as follows.

- ***Windows.*** A higher percentage of builders reported installation of low-E and argon-filled windows as standard than is consistent with the findings of the on-site survey. The differences, however, are small. Only in the case of the argon fill is the difference large enough to suggest a disconnect between builder perceptions of their own practice and what they actually do.
- ***Insulation.*** Levels of insulation observed on site were consistent with the builders' reported practices.
- ***Efficient heating equipment.*** This finding is remarkable for the level of agreement between builder-reported practices and the findings from the on-site. Given the relatively low percentage of homes in the sample that went through the home rating and Vermont Star Homes certification process, these findings are surprising, and bear a closer look in the second round of the evaluation.
- ***Compact Fluorescent Lighting Fixtures.*** The main reason builders gave for not including a given feature as standard was that customers didn't request the feature in question. For hard-wired compact fluorescent lighting fixtures, the primary reasons were customers' negative responses to color and quality of the light as well as the delay in the bulbs' reaching their full brightness when switched on. Builders also indicated that many customers select their own lighting fixtures; the same is true of appliances and, to a lesser extent, heating and cooling equipment.
- ***Duct leakage and blower door testing.*** Builders representing roughly one-half of construction volume report that they do not offer duct leakage or blower door testing. For ducts, this probably reflects the low incidence of forced hot air distribution systems in the population of new homes. The absence of blower door testing does not seem to have affected the performance of new homes in terms of infiltration.

**Customer Objections to Efficient Equipment.** Builders representing approximately one-third of the 2001 new construction volume indicated that their customers raise no objections to efficient equipment ( Table 5-3). Objections raised include the feeling that the initial cost of efficient equipment is too high or that the payback period is too long. Builders representing approximately one-fourth of Vermont's new construction volume in 2001 indicated that customers' objections relate to compact fluorescent lighting, specifically that customers dislike the color or quality of light.

**Table 5-3**
**Builder Observations of Customer Objections to Efficient Equipment by Size ***
**(Weighted by Volume of New Homes Built)**

| Feature | Builder Size | | | Overall |
|---|---|---|---|---|
| | Small | Medium | Large | |
| Initial Cost Too High | 37% | 48% | 4% | 36% |
| CFLs –Customers Color or Quality of Light | 21% | 41% | 14% | 26% |
| Payback Period Too Long | 3% | 6% | 79% | 14% |
| Other Reason | 3% | 11% | 69% | 15% |
| No Objections | 37% | 36% | 3% | 32% |

* Builders allowed to indicate more than one customer "objection"; total may be greater than 100 percent.

## 5.2 AWARENESS OF ENERGY STANDARDS AND RATINGS

**Residential Building Energy Standards (RBES)**. Approximately 85 percent of new homes built in Vermont in 2001 were built by builders who indicated that they were aware of the RBES. However, of the builders who reported they were aware of the RBES, those who reported posting certificates of compliance (as required by the RBES) represented only 37 percent of new construction volume in the state. Auditors found RBES certificates posted in only 18 percent of the homes inspected in the on-site survey.

Builders were asked to identify, without prompting, home features that were required by the RBES. Table 5-4 shows the percentage of new construction volume represented by builders who were able to name particular features necessary for compliance, by feature and size of business. Builders representing more than three-quarters of new homes built in 2001 were familiar with attic and wall insulation levels required to meet RBES standards. However, beyond insulation, the percentage of builders who were able to name required efficiency features dropped off quickly.

This relatively low level of awareness of provisions of the RBES is consistent with compliance findings reported in Section 4. Analysis of the thermal properties of the sample homes found that only 59 percent met RBES requirements for overall thermal transmittance.

**Table 5-4**
**Unaided Recall of Features Necessary for RBES Compliance, by Feature and Size**
**(Weighted by Volume of New Homes Built)**

| Feature | Builder Size | | | Overall |
|---|---|---|---|---|
| | Small | Medium | Large | |
| Attic insulation at least R – 38 | 73% | 82% | 12% | 77% |
| Wall insulation at least R-19 | 72% | 83% | 24% | 77% |
| Argon-filled windows | 28% | 72% | < 1% | 53% |
| Basement insulation at least R-10 | 63% | 32% | 24% | 44% |
| Low-e windows | 57% | 31% | < 1% | 40% |
| Floor insulation at least R-30 | 45% | 29% | < 1% | 35% |
| High efficiency heating and cooling equipment | 36% | 25% | < 1% | 28% |
| Reduced air infiltration | 43% | 13% | < 1% | 24% |

**Home Energy Ratings.** Builders representing more than 75 percent of homes built in Vermont during 2001 indicated that they do not purchase home energy ratings from third party agencies for any of the homes they build. The most frequently cited reason for this was that builders were unaware of the service. Builders representing approximately 77 percent of new construction volume indicated that they do not recommend that their customers obtain home energy ratings for the same reasons.

## 5.3 AWARENESS OF AND PARTICIPATION IN ENERGY EFFICIENCY PROGRAMS

### *5.3.1 Reported Program Awareness and Participation*

Builders were by far more aware of the Vermont Star Homes Program than either the HomeBase Residential New Construction Program or the Washington Electric Coop Residential New Construction Program; builders representing approximately 95 percent of the state's new construction in 2001 indicated awareness of the program (Table 5-5). Of these, builders representing about a quarter of the state's new construction reported that they had built homes that had received rebates or certification from one of the RNC programs in 2001.

**Table 5-5**
**Builder Recognition of and Participation in Energy Efficiency Programs**
**by Program and Builder Size**
**(Weighted by Volume of New Homes Built)**

| Program | Aware | | | | Participated (Of Those Aware) | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | Medium | Large | Overall | Small | Medium | Large | Overall |
| Vermont Star Homes Program | 88% | 100% | 100% | 95% | 14% | 19% | 76% | 24% |
| HomeBase Residential New Construction Program | 6% | 74% | < 1% | 35% | < 1% | 19% | - | 18% |
| Washington Electric Coop Residential New Construction Program | 53% | 55% | < 1% | 48% | 20% | 6% | - | 13% |

Table 5-6 presents the same data as Table 5-5 broken out by region rather than size. Awareness of the Vermont Star Homes program was high in all regions except the Northeast. However, it should be noted that we were able to complete interviews with only three builders in the Northeast. .

**Table 5-6**
**Builder Recognition of and Participation in Energy Efficiency Programs**
**by Program and Builder Size**
**(Weighted by Volume of New Homes Built)**

| Program | Aware | | | | | Participated (Of Those Aware) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | NW | NE | SW | SE | Overall | NW | NE | SW | SE | Overall |
| Vermont Star Homes Program | 98% | 11% | 90% | 100% | 95% | 23% | < 1% | 14% | 39% | 24% |
| HomeBase Residential New Construction Program | 39% | < 1 | 37% | 19% | 35% | 23% | - | < 1% | < 1% | 18% |
| Washington Electric Coop Residential New Construction Program | 55% | 89% | 10% | 46% | 48% | 5% | 100% | < 1% | 27% | 13% |

### *5.3.2 Vermont Star Homes Program: Participant Response*

Twelve of the sample builders reported that they had participated in the Vermont Star Homes program in 2001: i. e. completed homes that received either a rebate or certification through the program. The following paragraphs summarize findings from the builder survey about the basic characteristics of these enterprises, their motivations for participation, and their experiences with the programs.

**Volume of construction and share through the program.** The 12 sample builders who reported participating in the Vermont Star Homes Program completed a total of 155 homes in 2001. They reported receiving program certification for 88 of these homes, or 57 percent of the total number of homes they built.

**Influences on Participation.** The twelve builders who identified themselves as 2001 participants in Vermont Star Homes were asked to identify the sources through which they had heard of the program and the one that had the most influence on them. Most of the respondents identified only one source of information. Table 5-7 shows the source respondents identified as being most important in their decision to find out more about the program.

**Table 5-7**
**Most Influential Sources of Information on the Vermont Star Homes Program**

| Source of Information | Number of Builders |
|---|---|
| Vermont Star Home program staff | 1 |
| Efficiency Vermont program staff | 1 |
| Efficiency Vermont direct mail, other materials | 1 |
| Utility | 1 |
| Home Builders Associations | 4 |
| Other trade or professional organizations | 1 |
| Potential homebuyers | 1 |
| Other | 2 |
| Total | 12 |

**Reasons for Participation.** Three of the participating builders reported that the main reason they used the program was that they were requested to by the principals. In one case, the owner was a major developer (Smuggler's Notch). In the other two cases, the owners were individuals. Two of the builders reported that their main reason for participating was to get the rebates. The other seven builders each had a different reason for participating. Two others mentioned the marketing support they received from the program. The remaining five builders each had a different reason for participating, ranging from a desire to learn more about energy-efficient building techniques to wanting to maintain good relations with the local utility.

**Knowledge of Required Features.** The participant portion of the builder survey contained a question sequence in which respondents were asked to name, unaided, the construction features and equipment required for certification as a Vermont Star home. For each feature they mentioned, we then went on to ask the following sequence:

- Had the respondent been aware of the energy efficient feature prior to participating in the program?
- Since participating in the program, had the respondent included the feature in all or most of the houses he or she had completed?
- On a scale of 1 to 5, where 5 was very important, how important had the respondent's experience with the Vermont Star Homes program been in the decision to include the feature in houses they built outside the program?

Table 5-8 shows the results of this sequence for ten key technical requirements of Vermont Star Homes. The sample program participants mentioned high efficiency heating and cooling equipment most frequently of all required program features (9 of 12). Of those that mentioned high efficiency HVAC, 8 claimed to have been aware of the measure prior to participating. Nine reported that they installed high efficiency heating equipment most or all of the units they built in 2001, regardless of their status in regard to the program. Of those 8, 7 reported that they installed high efficiency in *all* units they built in 2001. Finally, six of the builders who mentioned high efficiency HVAC as a program requirement rated the importance of the program in influencing their decision to use efficient equipment as 4 or 5 on a five-point scale. All of the sample participants were able to name at least one construction feature required by the program; 9 could name four or more valid features.

**Table 5-8**
**Participant Builder Awareness and Adoption of Program Features**

| | Number of Participants: n=12 | | | | |
|---|---|---|---|---|---|
| **VT Star Program Requirementt** | **Unprompted Awareness** | **Aware Prior to Program** | **Installed in All or Most: 2001** | **Installed in All Units: 2001** | **Program Import-ant to Use** |
| High Eff. HVAC | 9 | 8 | 9 | 7 | 6 |
| Low-e Windows | 7 | 7 | 7 | 5 | 4 |
| RBES Compliance | 6 | 6 | 6 | 6 | 2 |
| Air Sealing | 6 | 4 | 6 | 5 | 4 |
| Duct Sealing | 6 | 5 | 6 | 3 | 4 |
| Insulation Above Code | 6 | 6 | 6 | 4 | 5 |
| HERS | 5 | 3 | 5 | 4 | 5 |
| CF Lighting | 5 | 3 | 5 | 4 | 4 |
| EN STAR Appliances | 4 | 3 | 4 | 2 | 3 |
| Mech. Ventilation | 3 | 3 | 3 | 3 | 2 |

The results summarized in Table 5-8 suggest that many participating builders believe that the program had an effect on important efficiency aspects of their construction practice. The majority of participating builders who used program-required construction features in other projects attributed a high level of importance to their experience in the program to their decision to adopt the practice. The one exception was RBES compliance, which most builders should know they needed to do anyway.

**Marketing and Selling Vermont Star Homes.**

- ***Effects of program requirements on construction costs.*** Nine of the participating builders interviewed indicated that installing features required to gain certification from the program resulted in added construction costs compared to homes without those features. These added construction costs averaged $6,766 (median = $4,000) and ranged from $1,000 to $20,000. Builders indicated that it was difficult to estimate added construction costs because these costs depend largely on general home characteristics, particularly size; for example larger homes would generally incur higher additional construction costs to include features necessary for certification than would a smaller home.
- ***Effects of program certification on salability.*** Eight of the 12 builders interviewed reported that they were able to sell certified homes more easily than uncertified homes built during the same period.
- ***Effects of program certification on sales prices.*** Seven of the 12 builders interviewed reported that they were able to obtain a higher selling price for homes certified through the program. Most builders were unable to indicate the average increase in selling price for certified homes, stating that the price increase generally depends on the general desirability of the home (size, location, etc) before considering efficient construction or features. The three estimates of incremental home prices that respondents offered ranged from $4,000 to $20,000.

### *5.3.3 Vermont Star Homes Program: Nonparticipant Response*

**Familiarity with Program.** Thirty-eight of the builders who indicated that they'd heard of the Vermont Star Homes program answered a series of questions about the construction and equipment features required for the program. Of these, builders representing approximately 17 percent of new construction volume outside the program were unable to list any features required for homes to be certified through the program. Among builders who were able to name at least one required feature, low-e windows were mentioned by those representing nearly half of the non-program new construction volume.

**Table 5-9**
**Unaided Recall of Features Required for Vermont Star Homes Program**
**Among Non-Participating Builders by Builder Size: n = 42**
**(Weighted by Non-participant Volume of New Homes Built)**

| Feature | Builder Size | | | Overall |
|---|---|---|---|---|
| | Small | Medium | Large | |
| Low-E Windows | 67% | 34% | < 1% | 49% |
| Insulation At or Above Code Levels | 60% | 28% | < 1% | 42% |
| Air Sealing | 66% | 15% | < 1% | 40% |
| Duct Insulation and Sealing | 51% | 25% | < 1% | 37% |
| High Efficiency Lighting Fixtures | 56% | 5% | < 1% | 30% |
| High Efficiency HVAC | 45% | 10% | < 1% | 27% |
| Energy Star Appliances | 41% | 1% | < 1% | 21% |
| RBES Requirements | 13% | 19% | < 1% | 16% |
| Home Energy Rating (HERS Ratings) | 7% | 4% | < 1% | 5% |
| No Understanding of Required Features | 27% | 4% | 100% | 17% |

**Familiarity with Services and Marketing Support.** Non-participating builders representing approximately 74 percent of new construction volume outside the program indicated that they were familiar with the services and marketing support offered by the Vermont Star Homes Program, and builders representing the remaining 26 percent indicated that they were at least somewhat familiar. Builders representing approximately 13 percent of the 2001 new construction volume were unable to name any of these services, but the remaining were able to recall at least one, including Energy Star certification, financial incentives, and marketing assistance.

**Value of Services.** Builders who indicated that they were aware of the Vermont Star Homes Program but did not participate in the program were read a list of services offered to builders by the Program. These services included the following:

- Review of building plans to identify energy saving opportunities;
- Training and assistance in energy efficient construction techniques and energy code compliance;
- Home energy ratings by certified raters;
- Rebates for home ratings and inclusion of energy efficient equipment and features; and
- Marketing assistance.

Builders were then asked to indicate whether or not they felt the services would be useful in marketing the homes they built. Builders representing approximately 36 percent of the 2001 new construction volume indicated that they felt such services would be useful, and those representing 56 percent of the new construction volume indicated that marketing assistance would be among the most useful services offered.

Builders who represented approximately 20 percent of the state's non-program new construction volume thought the program would *not* be useful because they were not responsible for marketing the homes they build (Table 5-10). Builders representing approximately 14 percent of non-program new construction volume stated that builders' reputations are more important than any program incentives or that they already build efficient homes.

**Table 5-10**
**Reasons That the Services and Support Offered by the Vermont Star Homes Program Would Not Be Useful Among Non-Participating Builders by Size: n = 42**
**(Weighted by Volume of New Homes Built)**

| Feature | Builder Size | | | Overall |
|---|---|---|---|---|
| | Small | Medium | Large | |
| Other Entities (i.e., Architects) Market Our Homes | 40% | 10% | < 1% | 18% |
| Builder's Reputation is More Important | 20% | 13% | < 1% | 14% |
| Already Built Energy Efficient Homes | 20% | 8% | 100% | 14% |
| Participation is a Hassle | 5% | 15% | < 1% | 12% |
| Customers are Wealthy and Not Interested in Savings | 5% | 5% | < 1% | 5% |

**Reasons for Nonparticipation.** Builders representing approximately 28 percent of the state's non-program new construction volume indicated that their primary reason for non-participation was that they had no trouble selling their homes without the Program's assistance. Other reasons mentioned include the following:

- The belief that customers have no interest in energy efficiency;
- The impression that they would be unable to recover costs necessitated by participating in the Program;
- No time to learn about the Program; and
- General dislike of the Program.

### *5.3.4 Energy Efficiency as a Business Proposition*

Builders who were aware of at least one energy efficiency program were asked to rate the importance of marketing and delivering energy efficient homes to the overall success of their

business. Table 5-11 shows their responses. Builders representing 30 percent of the 2001 new home volume in Vermont gave a rating of 5 ("Very Important") and builders representing an additional 40 percent gave a rating of 4.

**Table 5-11**
**Importance of Energy Efficient Homes to Builders' Business Success by Size**
**(Weighted by Volume of New Homes Built)**

| Importance | Builder Size | | | Overall |
|---|---|---|---|---|
| | Small | Medium | Large | |
| 1 – Not at All Important | 32% | 18% | < 1% | 24% |
| 2 | 3% | < 1% | < 1% | 1% |
| 3 – Neutral | 8% | 1% | < 1% | 5% |
| 4 | 12% | 65% | 100% | 40% |
| 5 – Very Important | 46% | 15% | < 1% | 30% |

# 6 HOMEBUYER PRACTICES & PROGRAM RESPONSE

## 6.1 INTRODUCTION

According the results of the homebuyer survey detailed in this section, over three-quarters of the single-family homes were either custom-built for (or in some cases by) their owners or built from standard plans with features heavily customized with the buyer's input. This finding suggests that homebuyers in Vermont exercise a great deal of influence over the energy efficiency elements of their houses. However, buyers are generally "in the market" for a relatively short period of time, especially compared to builders and developers. From a programmatic standpoint, they are therefore difficult to reach. Thus, homebuyers' perceptions and attitudes constitute an important set of market conditions that builders must take into account when deciding whether, how, and how hard to sell energy efficiency.

Most of the information presented in this section is taken from a telephone survey of recent homebuyers conducted for this evaluation in February 2002. In some cases, West Hill was able to make comparisons of customer responses to results of inspections of their homes carried out as part of the on-site survey. At the end of this section, we discuss those comparisons to assess the extent to which customer perceptions agree with observed conditions in their homes.

## 6.2 CUSTOMER SURVEY OBJECTIVES & METHODS

**Objectives.** The general objectives of the Vermont RNC Homeowner survey were to examine:

- customer awareness of/participation in Efficiency Vermont's new construction programs;
- customer awareness of/receipt of home energy efficiency ratings;
- customer awareness of/compliance with building codes (RBES—the residential building energy standard);
- customer familiarity with the ENERGY STAR® label;
- the promotion of energy-efficient home features by builders or other contacts;
- perceived benefits and drawbacks of energy-efficient home features;
- the decision-making process and influences regarding selection and installation of home appliances, permanent lighting fixtures, windows, heating and air conditioning systems, and insulation:
    - the input/role of builders or other contacts on purchase and installation decisions;
    - product features considered by homeowners;

- reasons of installing/not installing energy-efficient home features and appliances.

**Questionnaire**. XENERGY worked closely with the DPS and stakeholders to develop the questionnaire for this survey.

**Methodology**. The Vermont homeowner research plan consisted of a Computer Assisted Telephone Interviewing (CATI) survey administered to 200 randomly selected new homeowners throughout Vermont. The survey was fielded between February 13th and February 25th, 2002. See Section 4.1.2 for a description of the sample development and selection process for this survey.

## 6.3 SAMPLE CHARACTERISTICS

**Geographic distribution.** The survey sample includes respondents from all fourteen counties in Vermont. The regional distribution is displayed in Table 6-1 below. This distribution is comparable to new homes to the distribution of new homes in the state, with somewhat greater representation of the Northwest.

**Table 6-1**
**Sample Distribution by Region (n=200)**

| | N | % | New Homes Built 2000 - 2001 Per Form 411's |
|---|---|---|---|
| Northwest | 122 | 61% | 48% |
| Northeast | 16 | 8% | 14% |
| Southwest | 35 | 18% | 17% |
| Southeast | 27 | 14% | 21% |

**Buyers & Owner/Builders**. For certain analyses, the survey sample was divided into two segments: *buyers* and *builders*. Because many respondents built their own homes, certain questions pertaining to buyers' interactions with their builders (or realtors or salespeople) were not applicable.

*Builders*: Twenty-two percent of respondents (n=45) say that they built their home themselves. A majority of these owner/builders (64 percent) built just one home in the year prior to the survey, and therefore are not representative construction firms.

*Buyers*: Of the 78 percent of respondents (n=155) who did not build their own home, the majority selected the builder or designer of their home. As shown in Table 6-2, the most important reasons why buyers selected their builders are:

- the recommendations of friends or family (28 percent);
- they liked other homes that the builder built (25 percent);

- price (18 percent);
- the builder's reputation for energy-efficient, environmentally sound construction (12 percent), [or because builder offered energy-efficient options (2 percent)];
- Other top reasons include the builder's reputation, the quality of the construction, and being acquainted with the builder.

Buyers generally learned of a builder's reputation for energy-efficient construction or offerings through word-of-mouth (friends, other contractors, or the builder himself) or through marketing materials and brochures.

**Table 6-2**
**Reasons for Selecting Builder (n=121)**

| | All Reasons [a] | Primary Reason | Other Reasons [a] |
|---|---|---|---|
| Recommendations of friends/relatives | 28% | 21% | 7% |
| Seen/liked other homes they had built | 25% | 15% | 10% |
| Price/ bid was lower than others | 18% | 11% | 7% |
| Reputation for energy-efficient construction | 12% | 7% | 6% |
| Reputation of builder | 9% | 6% | 3% |
| I knew the builder/family | 9% | 7% | 2% |
| Quality of the construction/home | 8% | 7% | 2% |
| Only one I could use | 5% | 5% | 0% |
| Liked "standard features" | 4% | 2% | 2% |
| Timing met my needs | 4% | 2% | 2% |
| Offered energy-efficient options | 2% | 1% | 1% |
| Location of home | 2% | 0% | 2% |
| Not Sure | 12% | 12% | 0% |
| Other | 6% | 3% | 2% |

[a] Multiple response question.

Among buyers who did not choose their builder, the primary reason for their home selection was location, followed by price and size of the home. Among the six respondents who cited energy efficiency as a factor in their selection, two could not say how they knew their home was energy-efficient, two said they knew from home energy rating results, and one knew from a RBES compliance certificate.

**Characteristics of Sample Homes.** Key sample statistics are as follows:

- 37% of the homes represented were built in 2001, 50% in 2000, and 13% in 1999;
- 99% of the homes are single-family, detached;
- 98% of the homes are primary residences;
- The homes averaged 2,175 square feet, with 6.6 rooms and 3.1 occupants.
- Most homes were "custom" built (see Table 6-3).

**Table 6-3**
**Type of Home (n=200)**

| **Category:** Definition read to respondent | % |
|---|---|
| Custom home: "built according to plans developed exclusively for you" | 62% |
| Semi-custom Home: "built according to an existing plan modified for your needs" | 15% |
| Spec Home: "completed entirely prior to your purchase" | 6% |
| Manufactured Home: Verbatim from responses | 16% |
| Other | 1% |

## 6.4 GENERAL PROMOTION AND PERCEPTIONS OF ENERGY EFFICIENCY

### *6.4.1 Perceptions of Builder Promotion of Energy Efficiency*

Thirty percent of sample buyers reported that they received estimates of the annual energy consumption or costs associated with their home. These estimates were often provided by the builder or sales representative, however some respondents received estimates from appliance salespeople or researched the information for themselves. Other sources include "*the plumber*," "*Vermont Gas*," "*the electric company*," "*Vermont Energy*," "*Vermont Five Star,*" and *"a consultant from the Vermont Department of something."* None of the builders of production homes interviewed for this study reported that they provided energy use estimates for purchasers. Among custom builders, roughly one-half reported that they provided energy use estimates to customers in all or most cases. Given the predominance of custom building in Vermont, the observations of customers and self-reported builder practices are fairly consistent.

Approximately half of buyers reported that they had discussed the benefits associated with an energy-efficient home with their builder or with someone else—such as their realtor, *"the local power company," "the appliance company sales rep," "rep from Energy Efficiency Vermont," and "the architect."* Builders representing 82 percent of all completed housing units reported that they discussed the benefits of energy efficiency with their customers in all or most cases. These findings indicate that there is a difference in perception between buyers and builders in terms of the effort that builders put into informing their customers about the general benefits of energy efficiency options.

More than one-third of buyers (39 percent) had discussions regarding specific construction techniques or equipment selection to reduce energy costs. These discussions had a strong positive impact, in that they made most of the buyers want to install more energy-efficient equipment. When we asked buyers *why* they wanted to install more energy-efficient equipment as a consequence of the discussions, many said they wanted to save money, while others offered a range of reasons, including a desire to save energy and to have an energy-efficient home. Some remarks include:

*"It made me aware of all of the savings over the longevity of the house."*
*"The contractor said that since we have a lot of windows it would be best to get a lot of energy-efficient windows."*
*"We wanted to have the best energy efficiency possible."*
*"Cost, but also we are environmentally conscious."*
*"We wanted a house that was the most energy-efficient available that matched the house we wanted and our life style."*

Among buyers who reported discussing energy efficiency benefits with their builders, by far the single most common benefit discussed was reduced energy costs. Reduced costs were mentioned by 64 percent of respondents who answered this question. Eleven percent reported that builders had mentioned improved comfort as a benefit of energy efficient construction practices. See Table 6-4 for a complete tabulation of responses to this question.

**Table 6-4**
**Benefits of an Energy-efficient Home Identified by Builders (n=75)**

| Benefits discussed with Buyers | % |
|---|---|
| Reduced energy costs | 64% |
| Improved comfort | 11% |
| Improved indoor air quality | 8% |
| Better for environment | 7% |
| Insulation | 5% |
| Five Star program | 4% |
| Increased resale value | 4% |
| Better equipment performance | 3% |
| Low wattage light bulbs | 3% |
| Code compliance | 1% |
| Eligibility for rebates | 1% |
| Energy-efficient labels | 1% |
| Reduced maintenance requirements | 1% |
| Other | 1% |

Among buyers who discussed benefits; Multiple response question.

### *6.4.2 Homebuyer Perceptions of Benefits and Disadvantages of Energy-Efficient Home Construction*

Sample homebuyers were asked to identify both the benefits and disadvantages they perceived in energy-efficient construction practices. Seventy-six percent (both buyers & builders) associated

reduced energy costs with energy-efficient home features. In addition, more than one in five respondents (22%) link energy-efficient homes to conservation of resources, and therefore as being better for the environment. Eight percent of customers mentioned better comfort. The next most frequently mentioned benefit was higher resale value (3 percent of customers).

As shown in Table 6-5, one in four respondents identified drawbacks associated with energy-efficient home features. Some of these drawbacks included: costly up-front investment, dislike of specific features, and poor air circulation.

*"Houses that are too tight and do not breathe."*

*"The doors are sometimes hard to open and close."*

*"It takes too much time to look for energy-efficient features."*[1]

**Table 6-5**
**Overall Drawbacks that Owners Associate with Energy-efficient Homes (n=200)**

| | % |
|---|---|
| None | 65% |
| Costly up-front investment | 12% |
| Dislike specific features (i.e. compact fluorescents) | 5% |
| Poor air circulation / ventilation | 3% |
| Other | 6% |
| Don't know | 11% |

Multiple response question.

## 6.5 ENERGY EFFICIENCY RATINGS, BUILDING CODES, AND PROGRAMS

### *6.5.1 Awareness of Building Codes, Energy Ratings, and EE Programs*

The Homebuyer questionnaire contained a number of items probing respondents' awareness of different kinds of organizations, programs, and services related to energy efficiency in new homes. Their responses reflect both the effectiveness of the programs in reaching consumers as well as the efforts of the respondents to inform themselves about efficiency-related programs and issues.

#### *Energy Efficiency Programs and Organizations*

**Vermont Star Homes.** A majority of the sample homeowners were unaware of the Vermont Star Home program.

[1] Coded as "Other" but could also be interpreted as "Costly up-front investment".

- Four out of ten new homeowners (39 percent) had heard of the "Vermont Star" or the "Vermont Star Home" program;
- Twenty-one percent of buyers reported that their builder had spoken to them about building their home to the Vermont Star Home standard;
- Thirty-one percent of owner/builders reported that they had considered building their home to the Standard.

Eleven percent of respondents (n=21) indicated that they have a Vermont Star Home; one has a Vermont Advantage home. Forty-three percent of those with a Vermont Star Home (9 of the 21) indicated that they (or their builder) received rebates from the Efficiency Vermont program for having a Vermont Star Home; 24 percent were not sure if they received rebates.

**Efficiency Vermont**. Approximately one in five new homeowners (19 percent) reported that they had heard of "Efficiency Vermont." A larger proportion, however, appeared to be aware of some of the program's features. Approximately one-third (35 percent) of owners said that they were aware that "through the Efficiency Vermont program, builders and owners are eligible for a number of financial incentives in the form of rebates if they conduct a Home Energy Rating, install key features, or receive a Vermont Star Home or Vermont Advantage Home designation."

**The HomeBase Program.** Six percent of new homeowners (n=12) had heard of Vermont Gas Systems' HomeBase program; 2 of these 12 respondents received rebates from the program.

### *Residential Building Energy Standard (RBES)*

The majority of new homeowners (71 percent) said they are unaware of any building codes in Vermont related to energy efficiency. However, when directly asked about the RBES, one-third of respondents said that they had heard of "Vermont's Residential Energy Code, also known as the Residential Building Energy Standard." (Table 6-6). Although only one-third of new homeowners reported that they are aware of the code, fully one-half of them went on to say that their new home complies with the standard; the remainder are not sure whether or not their home is in compliance. Furthermore, only half of those who indicate their home complies with the RBES say that they have a certificate of compliance.

Although respondents who built their own homes are much more aware of the code than are those who did not build, there is not a significant difference between the two groups with respect to compliance with the RBES. The percentage of respondents to the telephone survey who claim to have a certificate of RBES compliance is quite close to that of the percentage of homes in the on-site survey that had certificates posted (25 v. 18 percent)

**Table 6-6**
**Residential Building Energy Standard**

| | Overall (n=200) | Buyers (n=155) | Builders (n=45) |
|---|---|---|---|
| % Aware of any residential building codes in Vermont related to energy efficiency | 29% | 24% | 44% |
| % Aware of the RBES | 32% | 27% | 47% |
| % say new home complies with RBES | 50% | 51% | 47% |
| % not sure if new home complies with RBES | 44% | 43% | 47% |
| % have certificate of compliance | 25% | 28% | 16% |

### *Other Programs and Services*

**The Energy Star® Label.** Overall, nearly 80% of respondents say they are familiar with the ENERGY STAR label, however, only about half—or 54% of all respondents—were able to describe it (usually by the star, the word "energy," or the appropriate colors). As shown in Table 6-7 below, the label primarily connotes energy savings, reduced bills, certification, and quality.

Respondents to this survey may be more likely to say they are familiar with the ENERGY STAR label because of the sample population (new homeowners vs. general population) and possibly due to the effect of participating in the survey.[2]

**Table 6-7**
**What The ENERGY STAR Label Means (n=109)[a]**

| | % |
|---|---|
| Uses less energy | 54% |
| Lower utility bills | 27% |
| Product is tested; meets standards | 20% |
| High quality | 10% |
| Government endorsement | 3% |
| Less pollution | 2% |
| Other | 6% |

[a] Asked only of those who described label; multiple response question.

[2] The survey is about energy efficiency, and energy efficiency is discussed in survey items prior to the questions about the ENERGY STAR label .

**Home Energy Ratings.** Seventy-eight percent of respondents reported that they had heard of "Home Energy Efficiency Ratings" or "Home Energy Ratings." Overall, 24 percent of respondents (both buyers and builders) say their new home had received a Home Energy Rating; nearly one in four buyers are unsure. Forty percent of those who had a Home Energy Rating—or 10 percent of respondents overall— say they received a rebate from Efficiency Vermont for having their home rated. Among respondents to the on-site survey, West Hill was able to verify that 12 percent had received home energy ratings, and figures from ERH/VT are consistent with this lower figure. Thus, customer responses to questions about home energy ratings likely reflect some confusion over the nature of the service.

## 6.6 EFFICIENT CONSTRUCTION FEATURES: SELECTION AND INFLUENCES

The homeowner survey contained detailed sequences of questions concerning the parties who influenced homeowners in their selection of energy-related construction features and equipment, the factors that they took into consideration in their selections, and the outcomes of those selections. In the following sections we summarize the results from those items and compare them, where appropriate, to the corresponding results from the on-site and builder surveys.

### *6.6.1 Insulation*

**Homebuyer involvement in decisions.** About half of sample homebuyers reported that they were involved in deciding what level and types of insulation would be installed in their home: 29 percent made the decision with their builder, and 20 percent reportedly decided on their own. (Table 6-8)

**Table 6-8**
**Decision-Maker: Insulation [a] (n=155)**

| Who decided what level and types of insulation would be installed in home? | N | % |
|---|---|---|
| Owner decided [b] | 31 | 20% |
| Received / gave input into decision [c] | 45 | 29% |
| Owner not involved in decision [d] | 78 | 50% |
| Don't know | 1 | 1% |
| Total | 155 | 100% |

[a] asked of buyers only; [b] or with spouse; [c] 44/45 of decisions made with the builder; [d] 77/78 decisions were made by the builder.

**Builder influence on decisions.** Respondents were asked whether or not they discussed insulation for various parts of their home: ceiling/attic, wall, floor, basement, slab edge, and caulking/weather-stripping. We also asked whether or not they discussed the type of insulation or if they discussed increasing insulation above the builder's minimum standard. Results are shown in Table 6-9.

The majority of buyers discussed insulation for their ceiling or attic and for walls. In most of case, the type of insulation discussed. A substantial portion of buyers also discussed insulation for other areas as well: basement (55 percent), floor (45 percent), slab edge (43 percent), and caulking and weather stripping (53 percent).

Fifty-five percent of buyers discussed increasing the level of insulation in their ceiling or attic; at least 25% of buyers discussed increasing insulation in each of the other areas as well.

**Table 6-9**
**Discussions Regarding Insulation[a] (n=77)**

| | Ceiling/ Attic | Wall | Floor | Basement | Slab Edge | Caulking/ weather-stripping |
|---|---|---|---|---|---|---|
| % of buyers who had discussions about their home insulation[b] | 77% | 69% | 45% | 55% | 43% | 53% |
| % discussed type of Insulation | 60% | 55% | 36% | 45% | 32% | 35% |
| % discussed increasing insulation above builder's minimum standards | 55% | 39% | 25% | 34% | 27% | 27% |

[a] excludes owners who were not involved in decision; [b] in the vast majority of cases, the discussion was with the builder

**Selection of insulation levels exceeding code.** Table 6-10 displays the percentage of respondents who chose to increase their level of insulation above the builder's minimum standards. This table provides figures for a) all owners who had input in the decision and b) for just those buyers who discussed increasing their insulation with their builder.

The majority of buyers who discussed increasing insulation with their builder say that they *did* increase their level of insulation. This is true for all six parts of the home discussed. Among homeowners who did not expressly report discussing insulation levels with their builder the portion who added insulation above required levels was considerably less. The portion of respondents who reported adding insulation above required levels was roughly equal to percentage of homes in the on-site sample with increased levels of insulation observed.

**Table 6-10**
**Percent Chose to Increase Insulation above Minimum Standards**

| | Ceiling/ Attic | Wall | Floor | Basement | Slab Edge | Caulking/ weather-stripping |
|---|---|---|---|---|---|---|
| | Among those who had input in decision about insulation [a] | | | | | |
| % of owners who increased insulation above minimum standards | 56% | 39% | 21% | 35% | 28% | 28% |
| # observations | 122 | 122 | 122 | 122 | 122 | 122 |
| | Among those who discussed insulation with builder [b] | | | | | |
| % of owners who increased insulation above minimum standards–among those who discussed it with the builder | 86% | 83% | 74% | 81% | 67% | 81% |
| # observations | 42 | 30 | 19 | 26 | 21 | 21 |

[a] among builders (n=45) and buyers who had input in decision (n=77); [b] among buyers who discussed increasing insulation

### *6.6.2 Windows*

**Homebuyer involvement in decisions.** Sixty percent of homebuyers were involved in choosing their windows: 37 percent of buyers decided on their own which kinds of windows to install and 23 percent decided jointly with their with builder (Table 6-11). Where builders were involved in the decision, buyers reported that the builder recommended energy-efficient windows in 90 percent of the cases.

**Table 6-11**
**Decision-Maker: What types of Windows would be Installed [a] (n=155)**

| Who decided what type of windows would be installed in home? | N | % |
|---|---|---|
| Owner decided [b] | 57 | 37% |
| Received / gave input into decision [c] | 36 | 23% |
| Owner not involved in decision [d] | 60 | 39% |
| Not Sure | 2 | 1% |
| Total | 155 | 100% |

[a] asked of buyers only; [b] and/or spouse; [c] decision made with builder; [d] builder decided.

**Equipment selected.** We asked all respondents about the features of their windows. As shown in Table 6-12, 87 percent of new homeowners reported that they have energy-efficient windows installed in their homes; 95 percent of respondents indicated that their windows have at least one of five specific energy-efficient features: double pane, triple pane, gas fill, low-e coating, or heat-mirror.

- "Double-panes" is the most common of the five features; four out of five homeowners say they have double-pane windows;
- Slightly more than half of respondents say they have gas fill between the panes (52 percent) or "low-e" coating (59 percent);
- Triple panes and "heat-mirror" are least common.

These owner reports correspond almost exactly with the results of on-site inventory of windows. Eighty percent of homes in the on-site sample had double-pane windows with low-E coating. Fifty-three percent had windows with argon gas fill.

As is likely true among other home features, the data indicate some respondent confusion or lack of knowledge regarding what constitutes "energy-efficient" windows:

- 12% (n=22) of those who indicate they have *at least one* of the five energy-efficient window features say that they do not have any energy-efficient windows, or that they are not sure;
- 3% (n=6) of those who say they have energy-efficient windows do *not* indicate that they have any of five energy-efficient window features.

**Table 6-12**
**Installation of Energy Efficient Windows (n=200)**

| | Have EE Windows? | Triple Panes | Double Panes | Gas Fill | Low-e coating | Heat-mirror |
|---|---|---|---|---|---|---|
| Yes | 87% | 15% | 80% | 52% | 59% | 5% |
| No | 4% | 71% | 12% | 21% | 16% | 60% |
| Not Sure | 9% | 14% | 8% | 27% | 25% | 35% |

Respondents made a strong connection between energy-efficient windows and home comfort. Thirty-one percent mentioned increased comfort as a reason for purchasing efficient windows. The same percentage mentioned energy savings as a reason to purchase efficient windows.

### *6.6.3 Heating and Cooling Equipment*

**Homeowner Involvement in Heating Equipment Selection.** Three-quarters (75 percent) of homebuyers reported being involved in selecting their \heating system: 58 percent of respondents decided on their own and 17 percent decided jointly with their with builder or heating system contractor (Table 6-13).

**Table 6-13**
**Decision-maker: Type of Heating System**

| Who decided what type of heating system would be installed in home? | N | % |
|---|---|---|
| Owner decided [a] | 115 | 58% |
| Received / gave input into decision | 34 | 17% |
| Owner not involved in decision [b] | 48 | 24% |
| Not Sure | 3 | 1% |
| Total | 200 | 100% |

[a] or with spouse; [b] 46/48 decisions were made by builder.

Among those who received input from others (i.e., builders, heating system contractors or plumbers), 59 percent say that it was recommended to them that they install an energy-efficient heating system. More than one-third (38 percent) of buyers say that their builder or contractor reviewed with them the methods used to select the size of the heating system installed.

**Equipment Selected.** Overall, 54 percent of new homeowners say they have energy-efficient heating systems installed in their homes. Again, this result corresponds almost exactly to the percentage of homes in the on-site sample that had ENERGY STAR-qualified furnaces or boilers installed (53 percent).

**Reasons for Equipment Selection.** Respondents gave several reasons for why they installed energy-efficient heating system systems. By far the most common reasons were to save money and energy. Only two percent mentioned builder or HVAC contractor recommendations as a reason for installing efficient equipment.

Twenty-two customers provided reasons for not choosing energy efficient equipment. Four mentioned price as the main reason for not installing energy-efficient equipment. Three claimed not to be aware of the option. Unfortunately we can't estimate the level of awareness of efficient heating equipment among the sample as a whole, because the question was not specifically asked. Obviously, those who say they installed an efficient system are aware, however, we don't know if all respondents who did not install an efficient system were aware of them.

**Central Air Conditioning.** Six percent of new homeowners (12 of 200) have central air-conditioning. In most cases, the builder decided what type of air-conditioning system would be installed; in one case an air-conditioning system contractor decided In nine of these twelve cases, homeowners had no input in the decision.

Five of the twelve homeowners with central air-conditioning (42 percent) reported that they have an energy-efficient system, while half (n=6) are unsure if their system is energy-efficient. Of the five reportedly efficient systems, one was selected by an HVAC contractor, three were selected by a builder, and one was selected by the owner.

## 6.7 LIGHTING

**Homeowner involvement in fixtures selection.** Four of five homeowners (79 percent) reported that they personally selected (at least some) permanent lighting fixtures for their new home. Among those who selecting fixtures, the average number purchased was 18; 24% chose more than 20 fixtures. By way of comparison, the average number of permanent fixtures installed in homes inventoried for the on-site sample was 34.

**Table 6-14**
**Number of Fixtures Selected[a] (n=157)**

| | # Fixtures Selected | # *Energy-Efficient* Fixtures Selected | % of Selected Fixtures that are Energy-Efficient |
|---|---|---|---|
| Mean | 18 | 6 | 35% |
| Median | 15 | 2 | 26% |
| Minimum | 1 | 0 | 0% |
| Maximum | 55 | 50 | 100% |
| # Fixtures | | | |
| none | | 32% | |
| 1-5 | 11% | 17% | |
| 6-10 | 20% | 8% | |
| 11-15 | 18% | 9% | |
| 16-20 | 16% | 5% | |
| 21-30 | 16% | 3% | |
| >30 | 8% | 2% | |
| Not sure | 11% | 24% | |

[a] Among those who personally selected permanent lighting fixtures

Table 6-14 shows the number of fixtures and efficient fixtures selected by respondents who reported selecting at least one new fixture for their new homes. It also shows the distribution of these respondents by the number of fixtures selected and the number efficient fixtures reportedly selected. Among those who selected fixtures, nearly two thirds (68 percent) reported that at least some were energy-efficient. In other words, 54 percent of all respondents reported that they had selected at least one energy-efficient fixture for their home. This result is close to the 47 percent of households in the on-site survey in which compact fluorescent fixtures were observed.

According to the respondents, an average of six fixtures per home about 35 percent of all the permanent fixtures that they selected were energy efficient. This figure appears to be high. If it were true, and if telephone survey respondents had the same number of permanent fixtures installed as the on-site respondents, then roughly 18 percent of all fixtures installed in the homes of these customers would be energy efficient. Only 8 percent of the fixtures in the on-site sample used compact fluorescent technology. Another six percent used other types of fluorescent technology.

As shown in Table 6-15, homeowners typically purchased their lighting fixtures at a home center such as Home Depot (60 percent) or at a lighting specialty store (40 percent). Other sources for fixtures include electrical supply houses (22 percent) and catalogs or samples provided by the builder (12 percent).

**Table 6-15**
**Sources for Selection of Permanent Lighting Fixtures (n=157)**

| Sources used for selection of fixtures | % |
|---|---|
| Home center (e.g. Home Depot) | 60% |
| Lighting specialty store | 40% |
| Electrical supply house | 22% |
| Catalogs or samples provided by the builder | 12% |
| Efficiency Vermont, ENERGY STAR® lighting catalog | 4% |
| Other | 3% |
| Don't know | 2% |

Multiple response question.

Among the 38 buyers who did not select their own fixtures, 24 percent (n=9) provided their builder with suggestions or advice concerning the lighting fixtures to be installed in their home; 21 percent (n=8) requested that energy-efficient fixtures be used.

Homeowners who selected or requested efficient fixtures became aware of them through a variety of means. More than one in four (28 percent) saw them at a retailer, while 11 percent became aware through their builder or contractor, or from mailings and magazines—including ENERGY STAR or Efficiency Vermont catalogs.

## 6.8 APPLIANCES

**Homeowner involvement in appliance selection.** Eighty-three percent of the sample homebuyers reported purchasing new refrigerators upon moving into their new homes. The corresponding figure for dishwashers was 90 percent and 68 percent for clothes washers. For each of the appliances for which data were gathered, the homebuyers made the model selection in 90 percent of the purchases, either exclusively or in consultation with an appliance sales person. The builder had input into very few of these decision. See Table 6-16.

Input in appliance selection reportedly came from several sources, although most frequently, input was provided from appliance salespersons. Providers of input recommended purchasing an ENERGY STAR or energy-efficient appliance approximately half of the time. About one-third of respondents considered energy efficiency when selecting their appliances.

**Table 6-16**
**Appliance Selection Decision Makers**

| Decision-Maker | Refrigerator | Dishwasher | Clothes Washer |
|---|---|---|---|
| Homeowner decided on their own | 61% | 58% | 54% |
| Homeowner gave or received input / (joint decision) | 17% | 15% | 9% |
| Homeowner not involved in decision | 5% | 7% | 3% |
| Did not buy a new appliance | 17% | 10% | 32% |
| Does not have appliance | 0% | 11% | 2% |
| # Observations | 200 | 200 | 200 |
| **Providers of Input into Decision** [a] | | | |
| Salesperson | 66% | 76% | 67% |
| Builder | 14% | 10% | 11% |
| Friend/relative | 9% | 3% | 11% |
| Consumer Reports | 9% | 7% | 6% |
| Someone else | 3% | 3% | 6% |
| % of input providers who recommended an EE appliance | 51% | 52% | 56% |
| # Observations | 35 | 29 | 18 |

[a] Among homeowners who gave input to provider or received input from provider;

**Appliance Selection.** Approximately half of new homeowners say they installed ENERGY STAR or energy-efficient appliances. It is important to note that a substantial portion of respondents do not know whether or not their appliances are energy-efficient. The actual shares of ENERGY STAR appliances observed during the on-site inspections were as follows: 47 percent of clothes washers, 36 percent of dishwashers and 27 percent of refrigerators. The results of the two surveys are compared in Table 6-17.

Comparison of responses to these items among customers who participated in both the telephone and on-site survey found that many customers who had ENERGY STAR appliances were not aware of that fact, and that many who reported having ENERGY STAR or "energy-efficient" appliances actually did not. Customer confusion on this point has been found in many studies of appliance programs.

**Table 6-17**
**Share of ENERGY STAR Appliances Installed**
**Telephone Survey v. On-site Survey Results**

| Appliance Type | Telephone Survey, n = 200 | On-Site Survey: n = 159 |
|---|---|---|
| Refrigerator | 57% | 27% |
| Clothes Washer | 50% | 47% |
| Dishwasher | 48% | 36% |

Homeowners cite a range of reasons why they installed energy-efficient appliances. The most frequently mentioned reasons are because they are less expensive to run and/or because they save energy. Other reasons include price, the amount of water used, the style of the appliance, its features, or the size. New homebuyers and owners mentioned rebates only infrequently as a reason for purchasing energy-efficient appliances. See Table 6-18 for more detail.

We note that analysis undertaken for the Efficient Products Program showed that the availability of rebates did have a strong net effect on the market share of ENERGY Star washing machines. Availability of rebates may have less of an impact on new homebuyers' decisions since the incremental costs of ENERGY STAR models are negligible in the context of the expenses of building a new home.

**Table 6-18**
**Appliance Summary (B)**

| % of New Homes with Energy-Efficient Appliances [a] | Refrigerator | Dishwasher | Clothes Washer |
|---|---|---|---|
| Appliance is energy–efficient | 57% | 48% | 50% |
| Appliance is not energy–efficient | 19% | 18% | 19% |
| Respondent is Not sure | 24% | 34% | 30% |
| # Observations | 200 | 178 | 195 |
| **Top Reasons for Installing Energy-Efficient Appliance** [b] | | | |
| Energy efficient / saves energy | 33% | 29% | 28% |
| Save money / less expensive to run | 38% | 20% | 24% |
| Price | 9% | 9% | 5% |
| Water Usage | - | 5% | 16% |
| # Observations | 113 | | 98 |
| **Reasons for Not Installing Energy-Efficient Appliance** [c] | | | |
| Did not have a choice / appliance came with home | 16% | 22% | 5% |
| Cost / price | 16% | - | 18% |
| Wanted / needed specific size or features | 18% | - | - |
| Not available / not offered / didn't see any | 10% | - | 5% |
| Already had appliance | 8% | - | 29% |
| Other reasons | 16% | 44% | 23% |
| Not sure | 21% | 34% | 29% |
| # Observations | 38 | 32 | 38 |

[a] Among those who have appliance; [b] Among those who installed EE appliance; Multiple response question; not all responses shown;
[c] Among those who did not install an EE appliance; Multiple response question; not all responses shown.

# 7 OTHER MARKET ACTORS

As part of this evaluation, XENERGY conducted interviews with small samples of supply side market actors who are in position to influence homebuyer and builder decisions in regard to the energy efficiency features of new homes. These groups are as follows.

- **Lenders.** Lenders can influence homebuyer decisions in regard to energy efficiency by offering "preferred mortgage products" to finance the purchase of homes with energy-efficient features. These products, often known as Energy Efficient Mortgages, typically allow the buyer and lender to take into account energy savings in calculating the maximum amount the buyer can borrow. This obviates trade-offs between energy efficiency and other features the buyer would like to have in the home. XENERGY completed in-depth interviews with six lenders.
- **Realtors.** Realtors could influence buyer behavior by educating buyers to the value of energy efficiency and promoting builders or developers who emphasize energy-efficiency. XENERGY completed in-depth interviews with 12 realtors.
- **HVAC Contractors.** Builders typically rely on HVAC contractors to specify and size central heating and cooling equipment. Thus, HVAC contractors typically exercise a fair amount of influence on these key energy-related home features. XENERGY interviewed 12 HVAC contractors in depth, focusing on their perceptions of the factors that influence the efficiency of systems installed in new residential new construction.

## 7.1 LENDERS

### *7.1.1 Survey Respondents*

Primary market lenders may include mortgage companies, savings and loans, commercial banks, credit unions, and state and local housing finance agencies. Respondents to this survey included loan officers at some of the largest banks in Vermont, one of the largest credit unions in Vermont, one of the nation's largest non-bank-affiliated retail mortgage originators, and a savings and loan. Each of these lending institutions made hundreds of loans in 2001 for new or existing homes, and collectively they serve borrowers throughout Vermont.

### *7.1.2 Types of Preferred Energy-Efficiency Products*

Two of the six lenders now offer or and three used to offer an energy mortgage product. There are two general classifications of mortgages with an energy provision: an Energy Efficient Mortgage (EEM) and an Energy Improvement Mortgage (EIM). There is confusion between these two terms and lenders and other involved parties appeared to use them interchangeably.

- An EEM is a loan product primarily geared for the purchase of ***new*** homes that meet or exceed certain energy efficiency requirements. The EEM may include preferred

mortgage rates or terms, though is often defined as featuring expanded (higher) qualifying ratios of income and down payment to principal.

- An EIM is a loan product primarily geared for the purchase of existing homes. The borrower is allowed to roll the cost of energy improvements into the overall mortgage amount.

The most common energy mortgage mentioned was Vermont Housing Finance Agency's (VHFA) YESS (Yearly Energy Savings System) program. This product had been serviced through Energy Rated Homes of Vermont (ERH-VT). However, the program was discontinued in the Spring of 2002.

Under the YESS program, a borrower had to finance a minimum of $2,500 in home energy improvements. The money for the improvements went into escrow and the work was completed after closing. ERH-VT evaluated the existing home, and designed and facilitated the home energy improvement project for the borrower.

As an example of the confusion around these types of programs, two lenders incorrectly describe having offered the YESS program as an EEM loan with expanded ratios for new homebuyers. Moreover, some lenders appeared to be unaware that the YESS program had been discontinued.

### *7.1.3 Experience with Energy Efficiency Mortgage Products*

**Freddie Mac EEM.** At the time of the interview, one lender reported offering an EEM loan product from Freddie Mac that allows for higher ratios. The respondent estimated that over 50 percent of new construction would qualify for the program, though they do not make many loans with this product (about 2 percent). It was not clear from the interview why this percentage was so low. In addition, they have also offered the YESS EIM loan.

**YESS EIM.** One lender described two experiences with the YESS EIM program. One borrower received a YESS EIM loan, liked the outcome, and was happy to get the home energy improvements. For another borrower who needed the loan, the process grew too "time-consuming," the borrower became "discouraged," and ultimately did not wait to follow through with the program. This lender stated that while it normally takes four to six weeks to close, the YESS loan took eight to twelve weeks. The lender added that, in all fairness, *part* of the reason the processing took longer is because they do so few of the YESS loans that they are not used to doing it.

**Energy Rating Loan.** Another lender described what he initially considered to be an EEM product—the Energy Rating Loan which they offered through a partnership with a Vermont energy company (Citizens Utilities). This program targeted new homes and featured a reduced down payment requirement. They began offering this product more than five years ago, however, it received virtually no utilization because borrowers were "in a lower income area

with lower-end housing." The lender added that the Energy Rating Loan is not really a "product," but rather, more an education program. The primary goal was to get customer to realize energy savings. They currently do not advertise the program and no one has used it in years.

Some lenders added that their energy mortgage programs failed to meet expectations in terms of volume of use and public recognition; others criticized the energy mortgages for their complexity: time consuming and laden with paperwork and regulations. One company that considered offering energy efficient mortgages concluded that the paperwork requirements were too cumbersome and that the overall effort involved in delivering the product precluded them from offering it:

> "That program has too many specifics to think about—there's, like, seventy-five pages of regulations. No way. It's not worth it to the lender or borrower….homeowners want to get their mortgages and get into their homes, not wait around for all this paperwork."

**Other Special Mortgage Products.** To assess whether lender practices or views in regard to energy efficient mortgage products were extensions of general attitudes towards special mortgage products we asked respondents to describe other special products that they had available. The respondents offered relatively few such programs overall. All six offered one or two products for low-income buyers, backed by Vermont or U. S. government agencies. Two lenders offered programs for first-time buyers, and one offered a program backed by the Veterans Administration. Thus, it appears that the lenders do not shy away from special-purpose mortgage programs because they are more work than conventional operations.

### *7.1.4 Awareness of Energy Star and Utility Programs*

One lender had not heard of any of the five residential new construction programs: Vermont Energy Star Homes, Vermont Star Homes, Vermont Gas System's HomeBase program, Washington Electric Coop's New Home program, and the US EPA ENERGY STAR® Program.

Five of the six lenders had heard of the VT Energy Star Homes program, three had some knowledge of the program goals. Two lenders were able to cite features a home must have to receive qualification, including a high home energy rating, high levels of insulation, energy-efficient windows, and set-back thermostats.

Several lenders had were confused when we asked about VT Star Homes, as they did not distinguish it as different from the VT Energy Star Home program; only one lender had heard of VGS' HomeBase program and WEC's New Home program. Four respondents thought that VHFA sponsored the programs, while another lender named the VT DPS.

Four of the six lenders we spoke with were unaware of the RBES. Two lenders—one in northeastern Vermont and the other in Lamoille—were familiar with the code and also knew of the VT Department of Public Service regulations concerning certification of compliance for new

homes. Both of these lenders check for evidence of certification. The lender in Lamoille states that evidence of RBES compliance is required for their loan applications for new homes.

We asked lenders if they had undertaken any promotions or other joint activities with any of the energy efficiency programs for new construction within the past two years. Only one respondent (based in Lamoille county) had done so. She stated that her organization was involved in a rating audit program with Energy Rated Homes of Vermont (ERH-VT). She added, however, that it was infrequently used, noting the additional cost ($400) and "duplication" with respect to RBES certification.

The particular lender referenced above had more knowledge of new construction programs and the RBES than did the other respondents. Moreover, she believes very strongly in the importance of energy efficient construction for buyers, builders, and lenders, as well as for safety reasons and for the environment. Since 1992, her organization has had a special construction loan program to help residential and small business to meet energy efficiency requirements. As part of the program they gave out the energy code booklets for new construction loans.

In addition, this lender stated that many people in her area use wood for heating, and feels that people do not see the importance of using an alternative to wood. She added that insurers are getting more and more particular out of safety concerns, and that they cannot sell mortgages for homes heated by wood on the secondary market.

### *7.1.5 Barriers to Using Energy Efficient Mortgages.*

**Automated Underwriting Limitations .** Three of the lenders we interviewed made reference to limitations in their ability to offer special energy mortgage products (e.g., expanded qualifying ratios, income "credit" for estimated energy savings) because of automated underwriting.

Underwriting is the process of verifying data and analyzing a borrower's credit history and other factors in determining the amount of a loan. Two of the most commonly used automated systems are run by Federal Home Loan Mortgage Corporation (Freddie Mac) and Federal National Mortgage Association (Fannie Mae). Freddie Mac calls its system "Loan Prospector," while Fannie Mae uses "Desktop Underwriter." In addition, many major lenders have developed their own automated underwriting systems.[1]

Automated underwriting generally takes into account a borrower's credit history and financial situation in its evaluation of a mortgage loan application. In addition, it may consider other elements not related to credit, such as a borrower's employment status, the length and type of loan, or the type of home being purchased (condo, town house, single home).

[1] http://www.csmonitor.com/durable/2000/07/03/p16s2.htm

Automated underwriting systems necessarily thwart efforts by lenders to offer mortgage products benefiting existing or pending energy efficient construction if there is no provision whereby estimated energy savings can be factored into the loan equation:

- When asked whether their company ever considered offering energy efficient mortgages, one lender simply responded that they use Fannie Mae's automated desktop underwriting system, Desktop Underwriter, which has no program to incorporate provisions for energy efficiency.
- A lender at another institution says it no longer offers energy efficient mortgages because they have automated underwriting.

**Viability on the Secondary Mortgage Market.** At various points in their interviews, three of the lenders spoke about the importance of being able to sell mortgages on the secondary market, linking it to the promotion and utilization of energy efficient mortgage programs as well as to the importance of energy efficient new construction and home improvements.

Lenders brought up the secondary mortgage market while discussing what would be useful and/or necessary in considering whether or not to offer preferential mortgage products for energy efficient homes:

- A loan officer at one of the largest banks in Vermont stated "Get the secondary market on board." Furthermore, she adds "They look at energy efficiency, but don't offer incentives."
- A loan officer at a large credit union said they would need to know whether or not a loan could be sold on the secondary market.
- A lender with borrowers concentrated in Lamoille County stressed the importance of homes being energy efficient and "up-to-code" because of the (in)ability to sell a home's mortgage on the secondary market. For example, this lender is concerned that they cannot sell mortgages for homes heated by wood on the secondary market (because of fire risks and growing concerns among insurers). This is one reason why her institution works with builders to promote energy efficient construction: it enables them to make loans that can later be sold—a factor clearly deemed important. Moreover, they are conscious and supportive of the obvious advantages energy efficient construction holds for both homeowners and for the environment.

**Useful Information to Evaluate and Overcome Objections to Energy Efficient Mortgage Products.** We asked lenders to indicate what kinds of information they would find useful in considering whether or not to offer preferential mortgage products for energy efficient homes, for example, data on levels of fuel cost savings associated with energy efficiency and on the default rates and volume of lending for similar products.

Five of the lenders stated that data on fuel cost savings would be useful, and three of them reported that information on default rates and volume of lending for similar products would be useful as well.

One lender would want to see program details, for example, whether the rates are fixed or variable, and whether or not it can be sold on the secondary market or if it must they keep in their portfolio.

One lender at a retail mortgage company feels that it is not so much a matter of information, but rather, having an efficient, straightforward program: “We need a quick and simple program.” Specifically, he would like the programs to "get rid of all the regulations, requirements, and red tape," and make participation effortless.

## 7.2 REALTORS

### *7.2.1 Survey Objectives and Methods*

**Objectives**. The primary objectives of the survey were to:

- gauge realtors’ awareness of new construction programs;
- understand the effects of program qualification on the sale of a home;
- characterize homebuyers’ awareness of the programs and energy efficiency from the realtors’ perspective;
- examine realtor sales practices as they relate to energy efficiency; and
- solicit comments and suggestions regarding the promotion of energy efficiency in the residential construction market.

**Sample.** Vermont real estate agents who had personally sold at least three newly-constructed homes in 2001 were eligible for participation in the survey. We utilized several sources to construct a sample frame, which included Dun & Bradstreet’s iMarket Database, various websites directories (e.g., www.allrealestaterealtors.com), as well as referrals from developers.

We attempted to include realtors from all regions of the state. However, this was difficult to accomplish. Outside of the northwest region of Vermont (and in particular Chittenden county), clusters and/or developments of new construction are few and far between. Because of this lack of new construction, it was difficult to find *individual* realtors who had sold more than two new homes in 2001.

Moreover, many of the dozens of real estate offices with whom we spoke said that their *entire office* did not sell three new homes—let alone one agent. They were likely to indicate that their business was primarily resale—due to the lack of new construction in their area. Several realtors

noted that new construction is not necessary sold through a realtor's office. Prospective homebuyers might purchase *land* through a realtor, but then they would hire a builder on their own.

### *7.2.2 Sample Characteristics*

- Most respondents' offices provide services to communities in the northwest region of Vermont (Table 7-1).[2]
- Collectively, the twelve realtors we interviewed had sold 135 newly constructed homes in 2001. Four of the realtors sold more than ten new homes.

**Table 7-1**
**Counties Served Through Realtors' Offices**

| Counties | # of offices (out of 12) | % of offices |
|---|---|---|
| Chittenden | 7 | 58% |
| Franklin | 4 | 33% |
| Lamoille | 4 | 33% |
| Addison | 3 | 25% |
| Bennington | 2 | 17% |
| Washington | 2 | 17% |
| Windham | 1 | 8% |
| Grand Isle | 1 | 8% |

Totals exceed 100% because some offices serve multiple counties.

Table 7-2 displays respondents' establishments features. Respondents work for independent companies and at branch offices of some of the largest real estate firms in Vermont. Three realtors (those who sold the most homes) sold exclusively for developers.

**Table 7-2**
**Establishment Characteristics of Respondents' Offices**

| # agents in office | # homes Sold in 2001 | # New homes Sold in 2001 |
|---|---|---|
| 45 | 1000s | ~100-150 |
| 15 | 400 | 25 |
| 4 | 110 | 25 |

[2] In our attempt to gain more representation outside of Chittenden county, one realtor in Montpelier who had sold two new homes was included in the sample.

| | | |
|---|---|---|
| 2 | 105 | ~15-20 |
| 1 | 80 | 80 |
| 7 | 78 | 9 |
| 6 | 75 | ~15-20 |
| 5 | 75 | 10 |
| 12 | 35 | 4 |
| 2 | 35 | 35 |
| 1 | 17 | 17 |
| 1 | 6 | 2 |

### *7.2.3 Awareness and Knowledge of New Construction Programs*

**Vermont Energy Star Homes**. All participating realtors had heard of Vermont Energy Star Homes. There was a wide range in how much they know about the goals and objectives of the program. For example, some realtors mention that the goal is to promote awareness and build market desirability for new construction to produce more energy efficient homes. Some say that program objectives include verifying that homes meet requirements and are up to code. Others say the programs are there to help consumers save money, and offer buyers and/or builders rebates and incentives. Three realtors did not know anything about the programs goals. Table 7-3 summarizes the sample realtors' responses to an open-ended question concerning specific requirements for Vermont Energy Star Home designation.

**Table 7-3**
**Realtor Perceptions of Vermont Energy Star Home Requirements**

| # Mentions | Requirement (unprompted) |
|---|---|
| 2 | ***Can't name any*** |
| 8 | Certain quality of insulation/ meet required levels |
| 4 | Efficient lighting features |
| 4 | Pass air infiltration/Blower door test |
| 4 | EE windows |
| 2 | (High) home energy rating |
| 2 | Efficient/Energy Star Appliances |
| 2 | Efficient/Energy Energy Star Heating and Cooling equipment |
| 1 | Mechanical Ventilation |
| 3 | Other |

**Vermont Star Homes**. Six of the respondents said "no" when asked if they had heard of Vermont Star Homes. There was some confusion among the other six realtors—who seemed to have some recognition of the name, but none of who could not describe the goals or objectives of the program; they did not distinguish "Vermont Star Homes" as being different from "Vermont Energy Star Homes."

**Vermont Gas System's (VGS) HomeBase.** Three realtors (each of whom sell homes for specific developers in and around Chittenden County) have heard of VGS' HomeBase program. Program knowledge by each of these three realtors is as follows:

- [VGS] offers incentives to put energy-efficient items in the home; provides payments; installs "gas updates";
- "Provides rebates for certain furnaces or heating systems";
- The realtor indicates that their [new construction] programs "start through VGS…who orders the blower door test through Vermont Star Homes."

One additional realtor (based in Franklin County) was aware that VGS has a program, but was unfamiliar with the name "HomeBase."

**Washington Electric Coop New Home Program.** One realtor—based in Montpelier—had heard of WEC's program, however, he did not know anything about the program's objectives.

**US EPA ENERGY STAR Program.** Three of the twelve realtors have heard of the US EPA ENERGY STAR Program. Two of the three respondents did not know anything about the program's goals—they had just heard or read about it. The third respondent feels that the objective of the program is to "give consumers a benchmark to evaluate efficiency" of (typically) home appliances.

**Knowledge of Certification Requirements.** Ten of the twelve realtors could name at least one feature a home must have for certification. Insulation (quality, level, and/or location) was the most common feature named (cited by n=8 realtors). Other common features (mentioned by four realtors each) include energy efficient lighting, windows, and the air infiltration/blower door test.

**Understanding of consumer benefits of energy efficiency.** The interviewed realtors displayed a fairly broad understanding of the consumer benefits of energy-efficient construction practices. They viewed lower energy costs as the most important benefit of energy efficiency for buyers of new homes. Most realtors mention other benefits as well:

- Improved comfort (warmer home/ cooler home/ no draft)
- Confidence to the buyer that the home is of a *"good standard"*
- There is *"more regard for safety issues; less risk of fire*"
- It's less wasteful (because it uses less energy)
- "*As a rule, it's a better built home*"

### *7.2.4 Effects of Program Qualification on the Sale of a Home*

Nine realtors sold homes that had been qualified through one of the programs.

**Effect on Selling Price**. Realtors disagreed about the effects of program qualification on the selling prices of the homes they sold. Four of the nine realtors who sold qualified homes say that qualification had no effect on price (compared to homes with similar features in their area). Of the five realtors who say the price of qualified homes was higher, two specify that it was only slightly higher. One realtor pointed out that buyers generally pay more for newer homes—regardless of qualification:

**Effect on Customer Appeal.** The sample realtors believed program qualification has had a positive effect on the customer appeal of the homes, although the effect is mild. On the plus side, none of the realtors associated any negative effects attributed to program qualification. It is generally thought of as just another positive thing to say about a home, and anything a realtor can say that is positive about a home is "helpful" in making a sale. Some describe the effect on home appeal in more qualified terms, for example, program qualification does not have much effect among buyers who are not interested, are not educated about it, or just don't care.

One realtor who sells five star homes expresses it this way:

> *"Some people are very interested. Others are glad…but it wouldn't make or break the deal."*

**Effect on Time Spent on the Market.** The majority of realtors say that program qualification did not affect the amount of time the homes spent on the market. One realtor reasoned that this was the case "*since most of the homes are rated*," while another said there was no effect because "*there is so much action in the market*."

### *7.2.5 Perceptions of Homebuyer Interest in Energy Efficiency*

According to the twelve realtors, on average, roughly one-third of prospective homebuyers mention energy efficiency when discussing the features they are looking for in a home. However, the experiences of the individual realtors varies widely:

- Five realtors say that *50% or more* of prospective buyers mention energy efficiency;
- Four say that *5% or less* mention efficiency;
- The remainder (n=3) fall between *15% and 40%*.

Very small proportions of homebuyers ask whether a particular home they are interested in has been qualified by one of the residential construction programs. Even fewer ask whether a particular home has been certified as complying with Vermont's Residential Building Energy Standards (RBES):

- Half of the realtors say that *fewer than 1%* of homebuyers ask if a home has been qualified by EVT or another program

- The majority of realtors say that *<=1%* of homebuyers ask if a home complies with RBES.

A realtor who sells exclusively for one developer says that few buyers ask about qualification and RBES certification because "*it's in all their materials*." Another realtor with a large agency in Chittenden County says "0%" of buyers ask about RBES because, as he describes, it's "*secret*."

Realtors say purchasers of new production homes rarely select upgrade packages that contain energy efficiency related items for the reason that those features are generally basic components of new homes:

> *"Usually new construction comes with "four star plus," so it's in the base, and not an upgrade."*
>
> *"In new homes…it's the norm. Energy rated is part of the base. Upgrades are for frills, such as floors."*

### *7.2.6 Sales Practices and Energy Efficiency*

In general, most of the realtors report taking the initiative to tell prospective homebuyers about a home's energy efficiency features—though in many cases, they do so only if a home is new, or is in fact, "energy efficient."

**Program Qualification as a Selling Point.** Roughly half of the realtors (7 of 12) said they typically use qualification for the Vermont Star or Vermont Gas Home Base program as a selling point in ads for homes; this includes the three realtors who sell for developers of rated homes. Another realtor says his company uses the generic language of homes being "energy efficient."

**RBES certification as a selling point.** Most of the realtors (8 of 12) we spoke with typically do not check to see whether a certificate of compliance with RBES is posted in a new home. None of the realtors personally check to see if a certificate is filed with their local government and with the VT Department of Public Service. The two realtors who sold for developers reported that they do not check government filings because they (their companies) file the certificates themselves. They say the certificate is generally not posted in the new home at the time of the closing, but that they would bring it to the closing or mail it to the homeowner a couple of weeks later.

### *7.2.7 Effect of RBES on the Energy Efficiency of New Homes*

Most of the realtors (8 of 12) feel that the RBES has had an effect on the energy efficiency of homes built since its implementation in 1998. Two respondents describe the effect in very general terms—that it has had a "positive" impact and that public awareness has increased. With

the exception of furnaces, the six realtors who mentioned specific changes they have seen in energy efficient features each cite something different:

- Studded and insulated basement perimeter walls
- Fresh air exchange
- Insulated basement foundations and higher efficiency furnaces.
- Changes in furnaces
- Lighting and appliance packages
- Overall types of products—mostly toilets and showers. (*"The builders I work with have always used better windows*").

One realtor at a large agency in Chittenden County feels that the code has no effect because "*many builders do not even know about it*." A realtor in Bennington County says the code has no effect because there is "*such a lack of new homes*." And as a realtor in Windham County puts it, the code has not had an effect because "*homes are built to a standard which is generally in line with what's being recommended*." His general impression is that people in Vermont are not "*big on government*," and see it as one more piece of paper to file.

### *7.2.8 Usefulness of Information Received From Efficiency Vermont*

Six of the twelve realtors said they have received information from Efficiency Vermont or other programs regarding their new construction programs; two realtors were not sure whether or not they had received anything.

The six realtors were then asked to describe the materials and to rate the information on how useful is was in understanding how to use program certification to market or sell a new home. On a ten-point scale (where *10=very useful*), the average of the six ratings is *6.3*.

Table 7-4 below details the realtors' impressions of the materials. Two realtors feel that the information they received was "useful," and added that in general, any information that can be passed along to the buyer is helpful. One realtor said that although the brochures she has received contain "good information," they would be more helpful to buyers if they were less wordy and had more charts and bullets. Another realtor thought the material was not particularly persuasive in its purpose: "*(the material is) not real convincing that it is necessary or important*."

**Table 7-4**
**Information Regarding Home Construction Programs**

| Description of Materials | Rating | Reason for Particular Rating |
|---|---|---|
| A couple page memo a long time ago | 9 | It's useful. The more information they can provide people the better it is for buyers and realtors. |
| Four-color handout sheets; received updates on program requirements. | 8 | Useful as promotional materials. The information was easy to understand. “Anything you can put into the hands of the buyer is useful." |
| Materials about fans & insulation requirements (received because works with a developer) | 7 | N/A |
| Brochures | 6 | It has good information, but "they are wordy." It would be more helpful to the buyer if there were more charts, bullets, and if it was less verbose. |

## 7.3 HVAC CONTRACTORS

### *7.3.1 Survey Objectives and Methods*

The primary objectives of this survey were to:

- Assess HVAC contractors’ role and influence on the selection and sizing of equipment installed in new homes;
- Gather HVAC contractors’ views on the factors that affect builder and owner decisions regarding selection of HVAC equipment;
- Assess HVAC contractors’ awareness and understanding of the RNC program; and,
- Gather HVAC contractors’ views on the extent to which the RNC program could be used to help them promote the use of efficient equipment in new construction.

The sample was selected at random from the iMarket Database. We targeted completions for 7 small HVAC contractors (4 or fewer employees) and 5 larger contractors. XENERGY staff conducted the interviews.

### *7.3.2 Respondent Characteristics*

Table 7-5 summarizes the business characteristics of the respondents to the HVAC contractor survey. The smaller companies generally consist of one proprietor/sales technician with one to three assistants. The larger companies do commercial as well as residential work.

**Table 7-5**
**Characteristics of Sample HVAC Contractors**

| | Small 1 – 4 emps. | Large > 4 emps | All |
|---|---|---|---|
| n = | 7 | 5 | 12 |
| Average # of Vermont heating or cooling equipment installations: 2001 | 16 | 89 | 46 |
| Number of ***new*** Vermont homes in which heating or cooling equipment was installed in 2001 | 12 | 30 | 20 |
| Average number of employees at location | 3 | 33 | 13 |
| Average number of technicians/installers at location | 2 | 21 | 9 |
| Number that work outside local metropolitan area | 3 | 3 | 6 |

### *7.3.3 Perceived Influence on Equipment Selection and Sizing*

The sample HVAC contractors reported that they exercised a great deal of influence on the efficiency specification and sizing of the equipment they installed in residential new construction. As can be seen in Table 7-6, the respondents reported that they specified system capacity (sizing) in virtually all new construction installations. On average, the respondents reported that they specified or recommended the efficiency rating of over 80 percent of the systems they installed in residential new construction. The majority believed that they exercised "a lot" of influence on these decisions.

**Table 7-6**
**HVAC Contractor Perceptions of Influence on Residential HVAC Equipment Selection**

| | Small 1 – 4 emps. | Large > 4 emps | All |
|---|---|---|---|
| n= | 7 | 5 | 12 |
| Percent of new construction projects: specify capacity (size) | 85% | 100% | 96% |
| Percent of new construction projects: specify or recommend efficiency | 90% | 77% | 81% |
| Number who believe they exercise "a lot" of influence on specification | 3 | 4 | 7 |
| Number who believe they exercise "some" influence on selection | 4 | 1 | 5 |

Most of the 12 respondents volunteered that they tried to "sell the general contractor up" to efficient equipment. In so doing, they mentioned (unprompted) a wide range of advantages for efficient equipment, including reduced operating costs, better quality and durability, and quieter operation. While the respondents mentioned that many general contractors were aware of high efficiency, they reported that builders seldom took the initiative to request it. On average, the respondents reported receiving specific requests for efficient heating and cooling equipment in

only 12 percent of new construction projects undertaken during the previous year. Generally, the respondents reported that customers showed more interest in purchasing efficient equipment than builders and general contractors.

### 7.3.4 Awareness and Installation of ENERGY STAR-qualifying Equipment

Three of the seven small contractors and four of the five larger contractors reported that they were aware of the ENERGY STAR specifications for all residential heating and cooling equipment covered by the labeling program: gas and oil furnaces, oil and gas boilers, central air conditioners, air source heat pumps, and programmable thermostats. Additionally, one of the smaller contractors claimed to be aware of the specifications for some of the ENERGY STAR equipment.

After reviewing ENERGY STAR specifications, the interviewer asked the sample contractors to estimate what percentage of different kinds of equipment they installed in 2001 met those specifications. Table 7-7 summarizes the results of this series of questions.

**Table 7-7**
**Average Percent of ENERGY STAR-qualified Equipment Installed: 2001**
**New Construction and Existing Homes**

| Equipment Category | Small Contractors | | Large Contractors | | All | | On-Site |
|---|---|---|---|---|---|---|---|
| | New | Existing | New | Existing | New | Existing | Results |
| 1. Gas/oil furnaces | 50% | 53% | 65% | 93% | 61% | 81% | 60%* |
| 2. Gas/oil boilers | 39% | 24% | 87% | 92% | 73% | 72% | ~70%** |
| 3. Central air conditioners | 41% | 26% | 37% | 70% | 38% | 58% | n/a |
| 4. Air source heat pumps | - | - | 100% | 100% | 100% | 100% | n/a |
| 5. Programmable t-stats | 29% | 28% | 60% | 35% | 51% | 33% | 43% |

* This figure does not manufactured housing units. Including those sample units, the ENERGY STAR share is 27%.

** Data were grouped exactly to reflect the ENERGY STAR specifications.

Based on Table 7-6, the following observations can be made.

- Contractor reports of the share of qualifying units they install in new construction matches quite closely to observed saturations in the on-site sample, at least if we consider only site-built housing.
- Large contractors install a higher share of qualifying equipment than small contractors. This difference is especially pronounced in the case of boilers, which account for most central heating units in the state.

### *7.3.5 Sizing and Installation Methods*

Many recent studies have demonstrated that application of "best practices" in equipment sizing and installation contributes considerably more to reduced operating costs than upgrading of equipment components' intrinsic efficiency. Under standard practices, the greatest portion of heating and cooling energy loss occur due to improper configuration, installation, and insulation of air and hydronic circulation system. Applying best practices in duct installation and sealing can reduce heating and cooling system energy use from 10 to 20 percent compared to practices most often observed in the field. Correcting improper charging levels can significantly improve the efficiency of central air conditioning systems. However, these systems are rare in Vermont and operate relatively few hours per year. Correcting oversizing from levels observed in the field can also increase efficiency up to 5 percent. Table 7-8 displays information concerning the number of sample contractors who have adopted various specification and installation practices that have been shown to affect heating and cooling system efficiency.

**Table 7-8**
**Adoption of Installation Methods to Ensure Efficient Operation**

| | Small 1 – 4 emps. | Large > 4 emps | All |
|---|---|---|---|
| n= | 7 | 5 | 12 |
| ***Sizing Methods Used**** | | | |
| Rules of Thumb | 2 | 0 | 2 |
| Manual J | 1 | 2 | 3 |
| Computer Program | 1 | 3 | 4 |
| Third party: distributor or manufacturers representative | 5 | 1 | 6 |
| ***Duct Installation**** | | | |
| Insulation of all ducts in unconditioned spaces | 2 | 4 | 6 |
| Use of special duct mastic for sealing | 1 | 3 | 4 |
| Placement of ducts in conditioned spaces, whenever possible | 0 | 1 | 1 |
| ***Check for proper refrigerant charging**** | | | |
| Weigh refrigerant | 0 | 2 | 2 |
| Superheat or subcooling methods | 0 | 5 | 5 |
| Check refrigerant temperature against manufacturer specifications | 3 | 5 | 8 |
| Don't know | 4 | 0 | 4 |
| ***Procedures to ensure proper air flow over interior coils**** | | | |
| Manometer | 2 | 2 | 4 |
| Magnahelic guage | 1 | 3 | 4 |
| Measure temperature drop | 0 | 3 | 4 |
| None/Don't know | 5 | 2 | 6 |

* Multiple responses accepted for each category of practices.

The survey results summarized in Table 7-8 suggest that adoption of best practices in system specification and installation have achieved moderate levels among the sample contractors. No more than half of the respondents report consistent use of any of the practices on which information was sought. For example, six of the twelve reported that they regularly insulate all heating ducts and pipes in uninsulated spaces. Only one reported consistent placement of ducts in conditioned spaces. All but two of the contractors reported using industry-accepted methods for system sizing.

### *7.3.6 Awareness and Assessment of Vermont Energy Star Homes Program*

**Awareness.** Seven of the twelve builders reported that they were aware of the Vermont Energy Star Program. However only one claimed to be even somewhat familiar with the operation and provisions of the program.

**Assessment.** After describing the program in some detail, the interviewer asked the respondents whether they believed the program would help them convince builders to install high efficiency HVAC equipment in residential new construction. Nine of the twelve, including all the small contractors, believed that it would. Among the reasons volunteered for this assessment were the following.

*"Gives the homeowner some incentives to ask for higher efficiency systems and educates homeowners and builders."*

*"More expensive equipment, means more profits usually."*

*"If you're an approved builder, it will probably get you more business and help sell the product.*

*"Helps cut the cost of big houses."*

Among the contractors who were skeptical about the program's potential effect, selected reasons for holding that opinion were as follows.

*"Unsure that people in general know enough about it. If more knew about the program, then yes it would be effective."*

*"Unqualified wholesalers end up doing the design of many systems and they just sell what they have on their shelves. They don't make an effort to properly size equipment for house's needs-because they're not really qualified to do that analysis and they want to sell specific brands in inventory."*

*"No pain. Only 1 plumbing inspector in the whole state. No enforcement of anything in VT. Contractors won't do anything without enforcement of codes."*

*"High efficiency vs. low shouldn't make any difference on installation."*

# 8 PROCESS EVALUATION AND RECOMMENDATIONS

## 8.1 SUMMARY

The findings presented in the previous sections suggest the following conclusions about the operations and impact of the Efficiency Vermont Residential New Construction program.

- ***Single-family homes that go through the program clearly exhibit higher levels of energy efficiency than those that do not.*** Although comparison of participating and nonparticipating homes in the on-site sample is complicated by uncertainty over the participation status of some of the sample structures, the results indicate that adoption of high-efficiency lighting fixtures, efficient mechanical ventilation systems, and windows with argon fill is higher among participants than it is among nonparticipants. Moreover, all program-certified homes meet RBES requirements for total thermal transmittance is higher versus the population average of 59 percent. Thus, we can conclude that participation in the program is associated with the adoption of more energy efficiency construction features than would have occurred in the absence of the program. This evaluation did not explicitly assess the causal relationship between program participation and adoption of more efficient construction practices. Such an analysis would have required more in-depth interviews with participating owners and builders. This issue will be explored in the second phase of the evaluation.
- ***The program has done an excellent job of serving multifamily developments.*** In 2000, the program completed projects in 84 percent of the estimated number of multifamily units (in structures with 2 or more units) built in Vermont. The corresponding figure in 2001 was 73 percent.
- ***While the number of total single-family units increased in the current year (2002), it is still relatively low in comparison to the total volume of new home construction.*** In 2000, the program completed projects in 13 percent of the estimated number of new single-family homes built in Vermont. The corresponding figure for 2001 was 12 percent. The number of single family projects completed in 2002 increased from 303 to 464 (53 percent) over the previous year. However, 205 of the 2002 completions were accounted for by Vermont Advantage projects enrolled in 2001 or earlier. Perhaps a better measure of the increase in program activity is provided by the change in the number of homes certified. In 2001, 196 homes received Vermont Star designation. In 2002, 287 homes received Vermont Star or Vermont Energy Star certification – an increase of 46 percent over the previous year.

Despite this growth, the percentage of new single-family homes completed under the program has changed relatively little over the five years of program operation and stood at 12.8 percent in 2002.

- ***Program participation remains concentrated in the Northwest region.*** Despite diligent efforts on the part of Vermont*wise* to identify and track housing starts, most of the construction activity in areas outside the Northwest appears to be falling through the cracks. In 2001, market areas other than the Northwest accounted for 19 percent of the program's enrollments, even though they hosted more than one-half of single-family new home construction. Over the life of the program, the Northwest region has accounted for over 85 percent of the program's project completions. This result may be attributable to a number of factors, including the location of program sponsors in the region, concentration of large-scale home building, and the long, continuous operation of the program and its predecessors in the region.

**Key area for program improvement: increase volume.** Given the above findings, it is clear that the key to increasing the effectiveness of the RNC program is to increase the number of single-family homes that go through the certification process. EVT and Vermont*wise* have already taken a number of important steps towards that objective. The two most important were to simplify the structure of the program and to establish the cooperative working arrangement with VGS. Both make the program(s) easier for builders and owners to identify, understand, and enroll in. The elimination of the requirement for participants to pay the home energy rating fee up front also appears to have removed a disincentive to participation. However, more efforts will be required if the RNC is to have a discernible impact on the overall energy efficiency level of new homes built in Vermont.

**Challenges.** EVT and Vermont*wise* will face considerable challenges in attempting to increase the flow of projects. The most important of these are as follows.

- ***Fragmentation of the Vermont housing market – supply side***. The results of the telephone and on-site surveys suggest that roughly 20 percent of new single-family homes in Vermont are built by owners who act as their own general contractors. It is possible that some of these individuals are in the homebuilding business, but it is likely that many will be in the construction market only once. The results of the builder survey indicate that half of the professionally-constructed homes are built by small firms (4 or fewer employees) who complete an average of 2.3 units per year.
- ***Hot Vermont Housing Market.*** Despite some downturn in Vermont's economy, all builders, developers, realtors, and lenders we spoke with reported that new homes were still very much in demand. All of these observers reported that virtually all units were presold prior to construction, and this observation is consistent with the findings of the customer survey. In these conditions, the business logic of spending time and money to participate in a voluntary program is not clear.

- ***Perception of high baseline efficiency.*** Most builders and realtors we interviewed for this project believe that new homes in Vermont are generally energy efficient, and the results of the on-site survey suggest that they are, to a large extent, right. This perception mitigates the "product differentiation" motive for participating in the program, and indeed, only one of the twelve participating builders interviewed reported this as a motive for participation.

Our recommendations in regard to increasing program volume focus on two areas:

- Increasing marketing and communication of program benefits to builders and remodelers, and,
- Increasing Vermont*wise's* ability to identify, track, and expedite construction practices.

Our recommendations in regard to the latter are provisional at this point. Although Vermon*wise* responded promptly and thoroughly to our requests for program data, further development of recommendations in regard to systems will require that XENERGY obtain a copy of the program database itself. Vermont*wise* is currently completing a thorough overhaul of its data systems and was unable to provide a copy of the database in the timeframe required. We describe the specific analyses we propose to conduct early in the second phase of the evaluation as part of our recommendations in regard to systems.

## 8.2 SPECIFIC FINDINGS AND RECOMMENDATIONS

### *8.2.1 Marketing and Communication*

#### *Findings*

**General Recognition.** Only 3 of the 54 builders interviewed for this evaluation reported that they had not heard of the Vermont Star Homes Program. In addition, 8 of the 24 individuals representing firms listed as builders in D&B but transferred to the remodeler sample reported that they had not heard of Vermont Star Homes. All of these individuals represented firms with 1 or 2 employees.

**Understanding of the program.** Understanding of program objectives and requirements varied greatly among the sample builders and remodelers. All of the participating builders were able to name at least one construction feature required for program certification, and most could name more than four. Among the nonparticipating builders, 83 percent could name at least one required feature, although no more than one-half the respondents named any one of the qualifying features. In the view of DPS and EVT, the program has remained fairly uniform in recent years.

However, many small builders appear to have only occasional contact with the program and may perceive things differently. As one participating builder mentioned,

> *"Paperwork keeps changing -- seems like every time we get used to it, it changes - maybe try to standardize it and stick with it."*

**Builder perceptions of marketing efforts.** Builders generally felt that Efficiency Vermont needed to do more to publicize the program and to keep builders abreast of changes in program requirements. Comments on this issue from builders who claimed to have participated in the program included the following.

> *Vermont Energy Star homes should advertise and have books or brochures with guidelines readily available -- if we have to find them, some may not bother to do it. I would welcome their literature but I haven't seen it in all my 25 years in business.*

> *[They] need to make builders more aware of features & benefits of the program PRIOR to construction -- that is the standards they are looking for.*

At the end of the builder survey, all respondents were asked to identify steps that Efficiency Vermont could take to promote energy efficiency in new construction and renovation. The most frequent response was to increase outreach and education to builders (8 of 26 suggestions offered). The suggestions next most frequently mentioned were to implement a code enforcement program (five mentions), and, more realistically, to increase efforts to educate customers (four mentions).

**Suggested channels for program information.** Four of the builders interviewed were aware of the annual conference and other seminars that Vermont*wise* offered and believed that they were very valuable. In addition, builders and remodelers identified the following potential channels for distribution of information: media advertising, zoning boards and town clerks' offices, home shows, and direct mail.

**Perceptions of costs of compliance.** We asked the 12 builders who claimed to have participated in the program to estimate the incremental costs of installing the features required for certification. We received 9 answers, ranging from $1,000 to $20,000 with an average of $6,800. Vermont*wise* and EVT staff found this number to be extraordinarily high. They estimated that the costs of compliance in most homes would be $1,000 -- $2,000 and mentioned that some measures, such as direct vent boilers, might actually cost less than their less efficient counterparts. Clearly, this is one area in which some education is needed.

**Manufactured Homes.** According to the on-site survey and telephone surveys, manufactured homes account for a substantial portion – 17 percent or more -- of new home construction. Moreover, the on-site survey found that manufactured homes were less likely to be energy efficient than other kinds of housing. They were less likely to comply with RBES standards for thermal transmittance, and had a higher incidence of lower efficiency space and water heating

equipment. According to Dun & Bradstreet, there are only 6 establishments in Vermont that list erection of prefabricated housing as their main business activity.

#### *Recommendations*

Because unit energy savings from the RNC program are relatively modest, we acknowledge that large investments in increased program marketing are unlikely to be justified. We therefore recommend that EVT and Vermont*wise* undertake selected pilot efforts to increase builder participation, particularly in areas outside the Northwest region. These pilot efforts could include:

- Targeted direct mail of program materials to builders outside the Northwest with follow-up phone calls to identify builders with projects in the early stages of development.
- Distribution of program materials through municipal officials in towns outside the Northwest that have recently experienced some new construction activity according to Form 411 records.
- Offer a small bounty to community organizations in areas outside the Northwest for referrals that result in program enrollments.
- Target manufactured home builders for intensive recruitment and training. Initiate a planning process involving manufactured home erectors to identify an appropriate package of measures and incentives.
- Increase incentives for participation, particularly in areas outside the Northwest region.

### *8.2.2 Improvement of Project Tracking Processes*

#### *Findings*

**Attrition of enrolled projects.** According to annual program activity statistics, the number of projects enrolled in the program is considerably greater than the number of project completions, particularly in the certification track. One way to increase program volume would be to increase the percentage of enrolled projects that make it through the certification process. Unfortunately, the annual statistics provide little information on which to develop a strategy to accomplish that objective. Construction projects often span two or more program years, and some planned projects are never completed. It is impossible to tell from the annual figures what percentage of projects drop out for various possible reasons: abandonment, postponement, loss of builder or owner commitment to follow through.

**Identification of completed projects.** In the course of completing the on-site survey, the contractor experienced difficulties in gaining definitive information on the program participation status of some of the sample homes. This was particularly the case for Vermont Advantage participants, but there were some instances in which it was not possible to verify whether a home had received a home energy rating. Part of the problem stemmed from difficulties in matching

addresses assigned to properties through the 911 system to property identifiers stored in the program database.

**Program share among participating builders.** Perhaps the most efficient way to increase program volume would be to ensure that builders who have learned how to use the program send all of their projects through it. The participating builders interviewed for this evaluation reported that they had sought program certification for roughly 60 percent of the homes they completed in 2001. As discussed in Section 2, builders sometimes elect not to pursue program participation on custom homes where owner or architect preferences preclude qualification.

### *Recommendations*

**Intervention to limit program attrition.** According to Vermont*wise* staff, a project is enrolled once the principal agrees (verbally) to submit an application for program participation. Once the application is sent out, there is some follow-up with the principal based on a tickler system. It would be useful to ascertain and analyze the disposition of these tickler calls to find out the following:

- Percentage of enrolled projects that submit an application.
- The distribution of projects by elapsed time between enrollment and submission of an application.
- The reasons for "drop outs" between enrollment and submission of the application.

If, for example, a large percentage of drop-outs occur because the building project itself is never completed, then it may be worthwhile to add some screening questions to the enrollment protocol to qualify leads. If a large portion are dropping out due to failure to complete the application, then some intervention to assist the builder or owner in filling out the application may be justified, especially in the case of first-time participants or owner builders.

To initiate the development of processes to increase the conversion of enrolled projects, we recommend that the evaluation contractor be given a task early in the next phase of work to analyze Vermont*wise*'s lead tracking data base and to conduct a survey of a small sample of "drop outs" to ascertain the disposition of the project and reasons for not following through with the program.

**Ensuring identification of completed projects.** There should be some way of updating project records upon completion to capture permanent address information. Another approach might be to post some kind of permanent marker in the home to signify that it has been certified by the program.

**Increasing program share among participating builders.** According to Vermont*wise* staff, the program regularly contacts builders who have participated in the past to develop leads for

future projects. Program staff could use this occasion to gather information on the extent of their activities outside the program and to probe reasons why they chose not to seek certification for some of their homes. Alternatively, the evaluation contractor could undertake a more in-depth survey of participating builders to gain detailed information on their response to the program and to test potential strategies for increasing the share of units for which certification is sought. One by-product of this effort could be the design of a builder contact system for subsequent use by program staff and contractors.

**Exploit more fully the capabilities of the FastTrack™ program tracking system database to identify opportunities to improve business processes.** Efficiency Vermont has purchased a FastTrack™, a full-featured program tracking database system, to support and document program operations. A thorough assessment of Efficiency Vermont's implementation and maintenance of this system was not included in the scope of this evaluation. However, based on the response of Vermont*wise* and Efficiency Vermont to various requests for tracking system data, we formed the impression that neither organization is taking full advantage of the system's capability to support analysis of program operations. We recommend that the Department of Public Service include a thorough review of tracking system and its use in program management as part of the next evaluation cycle. This review would include assessment of input data completeness and quality, "end-to-end" testing of a sample of cases to identify and strengthen data quality assurance procedures, analysis of the data to explore some of the issues identified above, and design of standard reports for program managers and DPS.