

# **A Case Study in Triangulation: Assessing the Residential New Construction Market from Multiple Perspectives**

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## **ABSTRACT**

Many larger evaluation studies use multiple lines of inquiry to evaluate efficiency programs and market activities. In a recent evaluation of the residential new construction market in Vermont, this method of collecting information from numerous segments of the market was effectively employed to produce a final evaluation report in which the numerous pieces fit together to provide a more comprehensive picture of the market.

The evaluation objectives addressed in this paper are largely related to market assessment, i.e., characterizing the size and attributes of the market, investigating the roles of the market players and determining baseline construction practices and code compliance. This research was complicated by the lack of a state or local permitting system, the prevalence of custom building and the possible residual impacts of previous utility DSM programs. In this environment, the importance of drawing on various perspectives to assess the market was particularly acute.

This paper discusses the rationale for using multiple lines of inquiry, the specific methods used, and some of the major results of this evaluation. For three specific barriers identified through this research, we demonstrate how the various sources of information were integrated to inform our understanding of the market barriers and to plan strategies for program enhancements.

## **Introduction**

Characterizing the residential new construction (RNC) market can be a challenging task, particularly in Vermont where permitting is handled in more than 250 town offices, building inspectors are a rarity and a large part of the market is custom built, often by the future occupant. To address the complexities of this market, the Vermont Department of Public Service (VDPS) recently conducted an evaluation drawing information from multiple sources to develop a more comprehensive picture of the market. This strategy combined information currently available in the public sector and other sources with primary data recently collected from surveys of builders, homeowners and other market actors.

The result is a comprehensive study that yielded a firm set of baseline construction practices and valuable information regarding the decision making processes from both the builders' and homeowners' perspectives. Combining the results of the surveys gave us the ability to identify aspects of the market and market interactions that may be creating obstacles to reducing energy consumption. It also suggests direction for possible strategies to reduce these barriers. While this approach required more resources than simply choosing one type of survey, it produced a wealth of information that can be used for program design and modifications.

The focus of this paper is limited to the components of the evaluation that were associated with market assessment. The purpose of this assessment was to characterize the residential new construction market to inform and enhance the implementation of the statewide Vermont Energy Star Home Program. Through the selected evaluation activities, we solicited information from a wide range of market players

and integrated the information to identify the market barriers and develop specific recommendations for addressing them. In this paper, we will discuss three of the barriers, i.e., the fragmentation of the market, discrepancies between homeowners' and builders' perceptions and the trend toward larger houses with more glazing. For each barrier, we will explain how the components of the research were used to delineate the issue and to suggest possible approaches for program enhancements.

The remainder of the paper is divided into four sections; these are background, methods, results and conclusions.

## **Background**

During the mid-1990s, many of Vermont's twenty-two electric utilities and its one gas utility began operating DSM programs aimed at the residential new construction market. These programs generally offered rebates for efficient lighting and ventilation, and in some cases a free or discounted home energy rating. Given the low incidence of electric space heat (less than 1% in new homes) and central air conditioning (less than 10%), the programs fielded by the electric utilities were limited in potential savings, incentives and other resources. For the most part, penetration rates were in the range of 5% to 15% of the market. The Vermont Gas program, with its focus on reducing gas consumption, offered significant incentives for thermal shell and heating equipment upgrades. By the late 1990's, Vermont Gas was achieving penetration rates in excess of 50% in its service territory in the northwest section of Vermont.

In 1995, the three largest electric utilities in Vermont joined together to commission a baseline study of the residential new construction market. The utilities provided the sample frame to the contractor, who conducted about 200 on-site visits.<sup>1</sup> Based on preliminary findings from this study, Vermont adopted the Residential Building Energy Standards (RBES). This code was based on the national CABO/MEC standard with modifications for the Vermont climate and specific building conditions. There are three paths to code compliance, i.e., the VTCheck software (a variant of MECCheck), prescriptive requirements or the Home Energy Rating. By 1998 the code was required for all new residential homes. Although the Vermont legislature mandated certification of compliance with the RBES code, it did not establish an enforcement mechanism.

Toward the end of the decade, the larger electric utilities joined together to offer a single residential new construction program providing services throughout their territories. In 2000, most of the efficiency programs were consolidated as mandated by the Vermont state legislature. The new statewide programs are implemented by an independent entity under contract to the Vermont Public Service Board. This entity, Efficiency Vermont, offers a set of "core programs," including the Vermont Energy Star Homes Program. As specified by the legislature, the responsibilities for the evaluation of these statewide efficiency efforts were assigned to the VDPS.

Efficiency Vermont's Vermont Energy Star Homes Program is designed to promote higher efficiency in new homes through a combination of educational activities, plan review, energy ratings and rebates. A house can qualify for the Vermont Energy Star Home designation by achieving a Home Energy Rating score (HERS) of 86 points, or 5 Star, which is equivalent to the U. S. Environmental Protection Agency's ENERGY STAR<sup>®</sup> home rating, and installing specific electric efficiency measures. For qualifying homes, the fee for the home energy rating is waived and additional rebates up to \$1,300 are available (\$1,800 in Vermont Gas's territory). In 2002, the Vermont Gas program and Efficiency Vermont's programs were combined. Other services for builders of Vermont Energy Star Homes include technical training programs and marketing support for qualifying homes.

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<sup>1</sup> Vermont Energy Investment Corporation conducted the site visits, collected the data and performed a preliminary analysis. The results of this study were compiled into a report by West Hill Energy and Computing in 1999.

## Methods

The evaluation was designed to investigate the characteristics of the single-family, new construction market in terms of size, distribution, baseline construction practices, code compliance, and the saturation of efficient lights and appliances. A key objective of the evaluation was to investigate the interactions in the marketplace to identify potential areas for program enhancements. Some of the basic questions underlying the evaluation are sorted by category below.

- **Market Size and Characteristics:** How many houses are built each year? What are the size and characteristics of builders working in this market?
- **Market Players:** How are decisions relating to energy efficiency made? How much influence does the homebuyer exert on energy-related features? How do builders and homeowners interact with regard to efficiency-related decisions?
- **Baseline Construction Practices and Code Compliance:** Have homes changed since the 1995 baseline with respect to energy efficiency? How many homes comply with the RBES standard?

The evaluation assessed the number and general characteristics of new homes built each year, determined baseline construction practices and appliance and lighting efficiency, and investigated the relationships among the market players. The overall evaluation synthesized the results of six primary activities: analysis of statewide property tax data, characterization of the homebuilding market, in-depth interviews with realtors and lenders, telephone survey of homeowners, and an on-site survey of new homes. These activities spanned the calendar year of 2002. Other data sources were also used, such as Efficiency Vermont's program records, the 1995 study of baseline construction practices (West Hill Energy and Computing, 1999) and a recent code compliance study conducted in Massachusetts (Xenergy, 2001). Table 1 below shows the program objectives, evaluation objectives and activities.

**Table 1.** Overview of Program Objectives and Evaluation Activities

Program Objectives	Evaluation Objectives	Evaluation Activities
<ul style="list-style-type: none"> <li>• Increase recognition of superior building practices</li> <li>• Increase awareness &amp; compliance with RBES code</li> <li>• Increase penetration of electric and fossil fuel efficiency measures</li> <li>• Improve occupant comfort, health &amp; safety</li> <li>• Increase use of mortgage benefits for energy efficient homes</li> </ul>	<ul style="list-style-type: none"> <li>• Characterize market in terms of size, location, mode of construction, use of home, etc.</li> <li>• Assess role of market players in construction of energy efficient homes</li> <li>• Determine baseline construction practices and changes in the baseline since the 1995 study</li> <li>• Assess awareness and compliance with the RBES code</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis of statewide property tax data</li> <li>• Characterization of the homebuilding market</li> <li>• Telephone survey of builders</li> <li>• In-depth interviews with realtors and lenders</li> <li>• Telephone survey of homeowners</li> <li>• On-site survey of new homes</li> <li>• Review data from other sources, including program records</li> </ul>

The following paragraphs give a brief overview of each of the primary evaluation activities and a summary is provided in Table 2 near the end of this section.

## **Analysis of Statewide Property Tax Data**

The analysis of the property tax data was conducted for two main purposes, i.e., first, to determine the size and geographical distribution of new homes in the state, and second, to develop a list of new homes to be used as the sample frame for the homeowner telephone and on-site surveys.

We estimated the size of the new construction market by consolidating summary statistics provided by each town to the state. This process was hampered to some degree by the variations in the capabilities of each town to provide accurate information and a tendency among some town officials to redefine reporting categories more frequently than may be strictly necessary. This market analysis was conducted for 1999, 2000 and 2001 and provided the estimated number of new homes built for each town in the state. This process produced results that are comparable to the national census estimate of new homes and to the estimate developed from the builder survey.

A list of new homes 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. Fourteen towns were excluded from the sample because the grand lists were not readily accessible and the level of new construction was low. For the remaining towns, the list of new homes was directly obtained from the town office. The resulting list became the sample frame for the two homeowner surveys, i.e., the telephone and on-site surveys. While this list was valuable as a sample frame, it did not exclusively contain new homes. To ensure that most new homes were captured, the criteria for developing the sample frame encompassed other activities that resulted in a change in house valuation, such as remodeling. Consequently, this list was used solely for the purposes of generating leads for the homeowner surveys.

## **Characterization of the Homebuilding Market and Builder Survey**

To develop a preliminary profile of the population of Vermont builders, we analyzed establishment data from Dun & Bradstreet contained in the iMarket<sup>®</sup> database. We used this relatively accessible source as a place to start assembling a basic portrait of Vermont's construction industry.

As part of the evaluation, we also 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 Vermont Energy Star Home program. The sample plan for the builder survey incorporated a stratified sampling approach based on the size of the establishment and geographic distribution. The state was divided into four regions (northwest, northeast, southeast, southwest). Within these market areas, establishments were divided into three size categories based on the number of persons they employed per Dun & Bradstreet (small firms with 1 to 4 employees, medium with 5 to 24 and large with more than 25). The number of persons employed was used as a proxy for the number of new homes built.

## **Survey of Homeowners**

A telephone survey was designed to solicit opinions and home characteristics from homeowners. The Vermont homeowner research plan consisted of a Computer Assisted Telephone Interviewing survey administered to 200 randomly selected new homeowners throughout Vermont. The survey questions ranged from probing for knowledge of the Vermont RBES code and awareness of the Vermont Energy Star Home Program, to familiarity with the ENERGY STAR label and other efficient building practices, to the decision making process and working with their builders.

## Site Visits

An on-site survey was conducted to obtain direct and verifiable information about the efficiency characteristics of new homes. The sampling for the on-site survey was done in two phases: 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. Seventy-six of the 158 respondents who ultimately participated in the on-site survey were identified in this manner. To reach the survey quota, additional participants were solicited from the remainder of the sample frame. We scheduled and completed 158 surveys.

The on-site survey consisted of a visual inspection and measurement of all building components. Several procedures were used to collect the data for each home: insulation levels were checked if possible; 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. Homeowners were questioned about house components that could not be ascertained through visual inspection, as well as heating fuel usage, 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. Code compliance was verified by the VTCheck software methodology. The site visits did not include a HERS rating.

**Table 2.** Summary of Primary Research and Analysis Activities

<b>Task</b>	<b>Purpose</b>	<b>Sample Approach &amp; Size</b>
Analysis of Property Tax Records	Analyzed “Grand Lists” of land parcel property tax status to identify likely addresses for new residential construction	Electronic data was available for 230 of the 252 towns. Other municipal sources were used for the remaining towns.
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, geographic scope.	Random sample of 54 builders with quotas for 4 geographic zones, with probability of selection proportional to size as measured by # of employees reported to Dun & Bradstreet
Telephone Survey of Recent Homebuyers	Closed-ended survey to probe customer experience with builders, knowledge of programs, codes and energy efficiency measures.	Random sample of 200
On-site Customer Survey	Assess “as built” adoption of efficient construction practices and products. Probe fuel usage and homeowners’ familiarity with the RBES code.	Random sample of 158
In-depth Interviews with Other Market Actors	In-depth interviews with real estate agents, and lenders to probe influence on energy-related construction decisions and attitude toward energy-efficient mortgage products.	30 interviews in all, with samples systematically selected to provide representation for key subgroups and all geographic regions.

## **Interviews with Realtors and Lenders**

We completed in-depth interviews with six lenders and twelve realtors. In the interviews with lenders, we investigated their attitudes toward, and experiences with, Energy Efficient Mortgages. Respondents to this survey included loan officers at some of the largest banks and 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. The interviews with realtors were designed to assess the degree to which they currently discuss energy efficiency with the home buyer and promote builders or developers who emphasize energy efficiency.

## **Results**

Integrating the results of the various evaluation activities provided us with a greater understanding of this complex market and insights into issues related to program implementation. The evaluation results to be discussed in this paper can be summarized as follows:

- The residential new construction market is highly fragmented, indicating that no single approach is likely to achieve a high penetration in the market.
- There are significant discrepancies between builders' and homebuyers' perceptions of energy efficiency that could be creating barriers to improving building practices.
- Changes in energy efficiency and other house characteristics since the 1995 baseline study suggest that improvements in efficiency may be largely offset by the trend toward larger homes with more glazing.

These findings highlight some underserved segments of the market, gaps in the builders' perspective and larger implications of current trends in homebuilding.

In the remainder of this section, we discuss each of these three areas, with a description of how the specific components were integrated to develop the findings and identify the implications for program implementation.

### **Market Fragmentation**

In contrast to other states where large builders predominate and building on spec is a common practice, Vermont's market consists of many small players and complex interactions. The fragmentation of the market permeates all aspects of the market. Some of the key findings on this topic are given below with the source in parentheses.

- While the number of new homes built each year is somewhat over 2000, about 600 builders claim to be active in the new construction market and the vast majority has fewer than five employees. (Builder analysis)
- Many builders work both in the new construction and remodeling markets and the larger companies often work on multifamily and commercial buildings as well as single-family homes. (Builder analysis)
- A large majority (over three quarters) of the single-family homes in Vermont were either custom built or selected from stock plans by the homebuyer while only 5% were built on spec. (Homeowner survey)
- A significant portion of the new homes (20%) were built by the homeowner or with the homeowner acting as the general contractor, and a little less than 20% were manufactured homes. (Homeowner and on-site surveys)
- Lenders and realtors as a group did not express much interest in energy efficiency. Realtors discuss the efficiency of a home when the potential buyer asks about it or if the realtor sees it as a selling point of a particular home. Lenders were not enthusiastic about promoting the energy efficiency

mortgage products and did not see the efficiency of the homes as a part of their responsibility. (Interviews with lenders and realtors)

- In 2000 and 2001, the program completed projects accounting for somewhat less than 15% of the estimated number of new single-family homes built in Vermont. Over the life of the program, the northwest region has accounted for over 85 percent of the program's project completions, while slightly less than half of the total new homes in the state were located in this region. (Program records, analysis of property tax data)
- The efficiency levels of manufactured (mostly modular) homes were lower than site built homes. Only about 40% of the manufactured homes in the survey passed the RBES compliance as measured by the VTCheck software, as opposed to over 60% of site built homes. Although the overall incidence of electric water heaters was low, most of these units were installed in modular homes. Heating systems generally had lower efficiencies, and air infiltration rates were higher. (On-site survey)
- The components of the manufactured housing meet at least minimum code requirements when the units leave the factory, but the majority these homes do not meet the RBES standard following the installation process. Lack of basement insulation and low-efficiency heating equipment are two of the primary causes. Higher air infiltration rates also indicate that site installation practices may be less than optimum. (On-site survey)

On the supply side, many builders are small and tend to work in multiple markets. Most homes are custom built, indicating the homeowners are likely to have a significant level of input on a sizeable proportion of the total number of new homes. While some builder/owners may only construct one home in his or her lifetime, in aggregate the builder/owner segment of the market is significant at 20%. Less efficient, modular housing accounts for another significant segment of the market.

The northwest region is an exception in many respects. Almost half of the total new construction in the state is located in this section. Along with the greater incidence of new homes, there is a corresponding higher proportion of large builders. In addition, Vermont Gas has been diligent in promoting its program among the builders in its territory. Under these circumstances, it was not surprising to learn that Efficiency Vermont's program has been more effective in this region, with penetration rates over twice as high as found in other parts of the state.

While a primary program objective is to increase the penetration of efficient housing, program penetration has remained in the range of 15% of the eligible market over the last five years. These findings point to the importance of expanding the presence of the program outside the northwest region, and also suggest that outreach strategies proven to be successful in the northwest may not be effective in other sections of the state. Particularly outside the northwest, the market is highly diverse and can be reached most effectively via an equally diverse approach. Since the unit energy savings in the RNC market are relatively modest and would not necessarily support a large investment in marketing and education, we recommended that Efficiency Vermont undertake selected pilot efforts to increase builder participation, particularly in areas outside the northwestern region, possibly including activities such as the following:

- 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.

Other recommendations were focused on reducing attrition and increasing the program share of homes built by participating builders.

## Homebuyers' versus Builders' Perceptions of Efficiency

The combination of the homeowner and builder surveys allowed us to compare and contrast the perspectives of these two parties, leading to the identification of some discrepancies between builders' and homebuyers' perspectives. Some of the more critical findings from the homeowner and builder surveys are listed below.

- 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. (Homeowner survey)
- More than one-third of buyers (about 40%) 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. (Homeowner survey)
- The majority of buyers who discussed increasing insulation with their builder say that they *did* increase their level of insulation. (Homeowner survey)
- Among buyers who reported discussing energy efficiency benefits with their builders, by far the single most common benefit discussed was reduced energy costs. (Homeowner survey)
- 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. (Homeowner and on-site surveys)
- About two-thirds of homeowners reported that they did not associate any drawbacks with energy efficient homes. Of the 25% that identified disadvantages, these drawbacks included costly up-front investment, dislike of specific features, and poor air circulation. (Homeowner survey)
- Builders representing about two-thirds of the statewide construction volume indicated that their customers had objections to efficient equipment. Objections identified by the builders include concerns that the initial cost of efficient equipment is too high or that the payback period is too long. (Builder survey)
- About half of buyers reported that they had discussed the benefits associated with an energy-efficient home with their builder or with someone else, but builders representing about 80% of all completed housing units reported that they discussed the benefits of energy efficiency with their customers in all or most cases. (Homeowner and builder surveys)

The two major points emerging from the juxtaposition of these perspectives are the critical nature of the interaction between the builder and homeowner and the discrepancy in perceptions between the two parties regarding objections to energy-efficient equipment. On the first topic, these surveys suggest that homebuyers in Vermont exercise some degree of influence over the energy efficiency elements of their houses, but their choices are made from the options provided by the builders. Discussions between the builder and homeowner regarding high efficiency options appear to motivate the homeowner and improve the actual efficiency characteristics of the home. However, far fewer homeowners than builders recall these conversations, indicating that builders may not be initiating them as frequently as they think or homeowners may not be absorbing the information.

These findings also lead to the conclusion that builders tend to overstate their customers' objections to high efficiency products. While few homeowners expressed any objections to efficient equipment, the builders believe the upfront cost is a significant barrier to homeowners.

From the perspective of program implementation, this research provides direction for refining the education efforts targeted at builders. Builders may need to be reminded of the importance of emphasizing energy efficiency options with their clients. Efficiency Vermont may be able to facilitate these discussions by providing written materials for builders to share with clients or by other means. Armed with the findings of this evaluation, Efficiency Vermont may be able to, or at least attempt to, dispel the common assumption among builders that their clients are likely to reject any efficiency improvements that result in adding to the



cost of the home.

### Changes in Efficiency and Housing Characteristics

Even with the fragmented nature of the market and the discrepancies between builders’ and homeowners’ perceptions, the recent evaluation shows some impressive efficiency gains since the 1995 baseline study. Charting the improvements in building practices from the 1995 to the 2002 shows substantial gains in efficiency on many fronts. Table 3 below shows the differences in the specific home components for all sample respondents in each survey. Nearly 60% of the homes inspected in 2002 met the RBES requirements for total thermal transmittance (UA), versus an estimated 35 to 40 % in 1995. Other construction elements that improved substantially included 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 inefficient tankless water heating systems were virtually eliminated. HERS ratings were not conducted for the 2002 on-site survey, so it was not possible to compare the HERS ratings between the two samples.

Other findings suggest that these gains in efficiency may be largely offset by the trend toward larger houses with more glazing. As can be seen in Table 3, comparing the 1995 and 2002 studies shows an increase in mean house size from 2,380 to 2,510 square feet. While this difference is not statistically significant at the 95% level, it is likely to be an indicator that Vermont’s housing market is similar to the national market with regard to the trend toward larger homes.

**Table 3.** Comparison of 1995 and 2002 Home Inspection Results

<b>Compliance Feature</b>	<b>1995 n = 151</b>	<b>2002 n = 158</b>
Percent of homes meeting UA Requirements	35 – 40%	59%
Attic insulation meets or exceeds code requirements	61%	68%
Wall insulation meets or exceeds code requirements	94%	90%
Basement wall insulation meets or exceed code requirements	48%	62%
% glazing area with 2-pane, Low-e	70%	80%
% of homes with glazing-to-wall ratio > .15	15%	35%
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
Percent with tankless coil water heating	32%	3%
Mean House Size	2,380	2,510

House size was one characteristic in which we found a wide discrepancy between the on-site and telephone survey results. From the telephone survey of homeowners, we concluded that the mean house size was approximately 2,175 square feet, but the results of the on-site survey indicated that homes were much larger, with a mean 2,510 square feet. To investigate this discrepancy, we concentrated on the group of 76 homeowners who participated in both the telephone and on-site survey. For smaller homes (under 2,300 square feet), we found that the homeowner reports were reasonably accurate on average. However,

owners of larger houses (2,300 square feet and up) tended to underestimate the size of their homes, sometimes by a large margin. For this segment of the sample, the average underestimate was 640 square feet. We concluded that the estimate of house size from the on-site survey was more reliable.

Another trend appears to be the increase in window area in comparison to the total wall area. In the 1995 study, only 15% of homes had a glazing-to-wall ratio greater than .15. This percentage more than doubled to 35% in the recent study. The results of the 2002 on-site survey further indicate that larger homes tend to have a *higher* glazing-to-wall ratio than smaller homes. The RBES code requires greater efficiency in other building components for homes with a glazing-to-wall ratio greater than .15, and the high glazing-to-wall ratio was a significant reason for homes failing to comply with the RBES standard.

These results show the market moving toward greater efficiency, thus reducing energy usage, but also toward larger homes with more glazing, i.e., homes that can be expected to require more energy. These conflicting trends are not unique to Vermont, but cannot be easily address through codes, rebates, energy ratings or any of the other tools currently used to promote efficiency in Vermont.<sup>2</sup> The national trend toward larger homes has spawned a movement toward planning smaller homes that are more compact but still suit the homebuyers' needs. At this point, builder education may be the only politically palatable route to change in the market, and Efficiency Vermont has taken steps to engage Vermont builders in this discussion.

## Conclusions

The synergies created by conducting market research using existing sources of information combined with surveys of builders, homeowners and on-site verification have allowed us to construct a deeper and more complete picture of a complex market. Identifying the segments of the market and juxtaposing the builders' and homeowners' perspectives gave us a better idea of how efficiency decisions are made. The on-site survey provided the opportunity to compare the perceptions of the market players with the actual as-built homes. Comparing the results from the various sources of data also produced a more robust evaluation.

In combination, the characterization of the homebuilding market, the homeowners' survey and the on-site survey draw a picture of a highly fragmented market with many small players and subgroups of players. Evaluation results indicate that smaller builders, owner builders and manufactured housing combined account for over half of the new construction market and that regions outside the northwest part of the state are underserved by the Vermont Energy Star Home Program. For implementors working toward meeting the program objective of increasing the penetration of efficient housing, these findings clarify the gaps in current outreach strategies and direct attention to developing methods for attracting the attention of these harder-to-reach segments.

The high proportion of custom-built homes points to the importance of understanding the interactions between the builder and homeowner. Builders may tend to overstate the homeowners' objections to energy efficiency. However, the results also suggest that when the builder discusses energy efficient options with the homeowner, the response is frequently positive and the resulting house is likely to be more efficient. Consequently, encouraging and simplifying this exchange of the information between the builder and homeowner is likely to be an effective approach to increasing the penetration of efficiency measures.

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<sup>2</sup> This finding dovetailed nicely with Efficiency Vermont's decision to invite Susan Susanka, author of the Not So Big House, to be the keynote speaker at their 2002 builders' conference.

Comparing the results of the 2002 on-site survey to the 1995 baseline study illustrates two conflicting patterns, the first toward greater efficiency and the second toward larger homes with more glazing. In real terms, it is likely that the efficiency gains are not resulting in lower energy use, but counteracting the second trend raises complex issues. Efficiency Vermont has taken action to bring this topic to the forefront by featuring alternative strategies for designing smaller homes in its 2002 Builder Conference. Further activities of this type are probably the most feasible strategy at this point.

As with any evaluation, the results also generated new questions. Prior to this evaluation, some members of the team perceived the Vermont market to be geographically fragmented, that is the markets in the four regions were seen as having substantially different characteristics in terms of both the structure of the homebuilding firms and the resulting housing stock. While the evaluation was not designed to investigate these differences directly, the results seem to suggest that the differences are not nearly as marked as we expected.

Code compliance and enforcement also arose as a potential issue for further investigation. Despite the fragmentation of the market and the lack of enforcement of the RBES code, compliance rates are relatively high in comparison to other states. A recent study of code compliance in Massachusetts concluded that only 46% of the market was in compliance even with the enforcement carried out by town officials (Xenergy, 2001), in comparison to the 58% compliance rate in Vermont. This comparison raises some interesting questions about the effectiveness of code enforcement mechanisms and reasons for the relatively high compliance rates in Vermont. These issues may be addressed in the next round of evaluation.

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