Residential Retrofits:
Directions in Market Transformation

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ABSTRACT

America's existing housing stock offers tremendous opportunities for energy savings. However, capturing this savings potential within the established structure of the home improvement market has proven to be quite a challenge. Homeowners face a daunting array of decisions and competing priorities when investing in home improvements. The sheer diversity of specialized contractors and trades offering home improvement services can overwhelm homeowners seeking to improve the aesthetics, comfort, value, and performance of their homes.

Building on a strong base of research documenting the key problems afflicting existing homes and the most promising solutions, program implementers have launched innovative programs to promote energy efficiency improvements in existing homes. Key to these efforts is attracting and educating forward-thinking contractors seeking new business models that improve sales closure rates, increase the average job size, and enhance the services they offer to their customers.

This report briefly describes some current and recent residential retrofit programs; discusses the successes, challenges, and lessons learned to date; presents promising new tools, resources, and program strategies; and identifies areas for further research and inquiry. The research is designed to support efforts by program designers, implenters, and other decision makers to develop or improve residential retrofit program offerings.

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INTRODUCTION

America's existing housing stock offers tremendous opportunities for energy savings. This has long been recognized by policy makers, energy experts, program implementers, and advocates in the energy efficiency community. A small but growing number of professional contractors in the home improvement industry are also realizing the business opportunity of efficiency upgrades. However, capturing the energy savings potential in existing homes has proven to be quite a challenge. Homeowners face a daunting array of decisions and competing priorities when investing in home improvements. The diverse number of specialized contractors and trades offering home improvement services can also be overwhelming to homeowners seeking to improve the aesthetics, comfort, value, and performance of their homes.

Over the years, numerous efforts to promote or achieve energy savings in the existing homes market have emerged. State and local governments have pursued policy approaches to capture energy savings in the retrofit market, including a range of financing programs, energy conservation ordinances, home energy ratings, and energy mortgages.[1] In many ways, these efforts laid the groundwork for programmatic efforts that have been undertaken more recently at the national, state, and local level. Building on a strong base of research documenting the key problems afflicting existing homes and the most promising solutions, program implementers have launched innovative programs to promote energy efficiency improvements in existing homes. Some programs have focused on particular building systems or components (e.g., duct systems, air sealing, and HVAC installations) while others have taken on a "whole-house" approach, attempting to systematically address the biggest problems as identified by house-by-house analyses.

The objective of this report is to provide program designers, implenters, and other decision makers with the information needed to support efforts to develop or improve residential retrofit program offerings. To this end, the report provides a brief overview of the retrofit market, key players, and energy savings potential; chronicles the experience of current program efforts; discusses the successes, challenges, and lessons learned to date; presents some promising new directions for addressing obstacles and seizing opportunities to capturing the energy savings potential in existing homes; and identifies areas needing additional research and inquiry.

OVERVIEW OF THE RETROFIT MARKET

Market Size

More than 100 million existing American homes—including almost 70 million owner-occupied units—create an important source of economic activity and an attractive opportunity for improved energy and environmental performance. In recent years, annual homeowner spending on home improvements has grown, reaching $104 billion in 1999.

[1] ACEEE covered these policy options in detail in an earlier report (Suozzo, Wang, and Thorne 1997). These options will not be discussed further in this report.

Projects to add, improve, or otherwise alter interior spaces accounted for 36% of expenditures; replacements or upgrades of major home equipment and systems accounted for 44% of expenditures; and the remaining 20% of spending went toward other projects including routine maintenance and repairs, outdoor projects, and disaster repairs (JCHS 2001). Current demographic trends toward more single-person households and an overall aging in the population are likely to further increase the share of home improvement spending devoted to replacements and upgrades rather than additions or major alterations.

Spending on existing homes is anticipated to match or even surpass new construction by 2010. The geographic pattern of home improvement spending is also expected to shift. Given the typical age of housing stock undergoing improvement (25 to 30 years), much of the housing stock in the Northeast and Midwest that was constructed in the 1950s and earlier has been remodeled and had at least one round of major equipment replacement. A greater number of housing units constructed in the 1970s can be found in the South and West, and as a result, overall remodeling and retrofit activity in these regions are expected to increase as homes reach the typical age for greater spending on improvements. According to the JCHS (2001), metropolitan regions in the South and West (including Houston, Miami, Phoenix, and Tampa) are expected to see an uptick in the number of home improvement projects through the remainder of the decade.

Market Structure and Players

Achieving market transformation within existing homes requires some understanding of the structure of the industry as a business, and as a set of skilled trades working in it. In general, contractors who work on existing houses can be classified as either general contractors or specialty contractors. The general contractor will handle all aspects of a remodeling or home improvement project, but usually employs specialty subcontractors to handle specific tasks such as insulation, window replacement, HVAC installation, and so on. The specialty contractor rarely deals in more than one of these core trades. A recent study in California found little overlap in residential contracting specialties, with the most common dual licensing being a general contracting license along with a specialty license (Bordner et al. 2000). It is common for contractors to inhabit their own niche of the residential market and to target consumers only with the specialty service they can provide. This practice presents a significant barrier to whole-house approaches to home improvement.

An estimated 172,000 remodeling firms (i.e., those with a majority of their income from home improvements and repairs) operate in the United States. In addition, there are 200,000 self-employed contractors serving as general contractors or specialty contractors on remodeling projects. Table 1 shows the breakdown of general contractors and specialty trade contractors.

These numbers demonstrate the variety of contractors involved in selling home improvement services to homeowners. Many of these specialists perform work that has an impact on home energy performance or are in a position to work with other specialty contractors to identify and promote efficiency and home performance upgrades to consumers. Efficiency programs have traditionally worked most closely with those trade specialists most directly involved in

installation or repair of "energy" measures such as HVAC equipment, insulation, windows, etc.

Table 1: U.S. Contractors by Trade

Business	Number
General contractor	119,800
Specialty contractors (total)	250,400
Heating, AC, and plumbing	53,600
Painting and paper hanging	47,800
Electrical work	20,800
Masonry, stone, tile, plaster	16,200
Carpentry and floor work	56,000
Roofing, siding, sheet metal	31,600
Concrete work	3,200
Miscellaneous	21,200

Source: JCHS 2001

Weatherization contractors also possess the varied skill-set to perform whole-house retrofits. Many have experience using diagnostic equipment such as blower doors and duct blasters, and skills in air sealing, insulation, and equipment replacement. However, many weatherization contractors limit their business to work for municipal and nonprofit agencies servicing low-income weatherization clients. The weatherization community represents an organized and trained body of knowledgeable contractors who could learn skills to augment their business with private sector energy efficiency retrofits. As noted below, retrofit programs in the Pacific Northwest, Missouri, Wisconsin, and elsewhere are increasingly recruiting weatherization contractors to participate in their programs.

Contractor trade associations represent another active player in the residential retrofit market. In addition to serving as an outlet for training and networking among their members, many associations support professional development activities such as certification programs. Leading certification programs include the North American Technician Excellence (NATE) program for HVAC technicians and the Building Performance Institute (BPI) certifications for auditors, shell specialists, and heating specialists.

Energy Savings Potential

Estimated energy savings from residential retrofits vary depending on the extent of the retrofit and the number of systems repaired, upgraded, or replaced. Table 2 provides estimated savings from several common retrofit measures as well as a selection of typical combined retrofit measures recommended by many home energy performance experts.

Market Barriers

A number of substantial barriers have limited growth of high-quality energy efficiency services in the residential retrofit market. In this report we discuss key barriers on both the demand and supply side of the equation.

Table 2: Savings from Common Retrofit Measures

Measure	Annual Savings	Estimated U.S. Savings Potential
Air sealing (including insulation and window replacements)	20%	0.5 quads
Duct repair and sealing	15%	0.3 quads
HVAC equipment upgrade	20%	0.5 quads
Improved HVAC installation practices	15%	0.4 quads
Lighting and appliance upgrades	10%	0.1 quads

Note: Savings from individual retrofit measures are not additive.
Sources: EIA 2001; Neme, Proctor, and Nadel 1999; ACEEE estimates

Consumer (Demand-Side) Barriers

- Cost plays a major role in limiting consumer demand for many efficiency upgrades. Whether it is the higher incremental cost for a higher-efficiency system and comprehensive installation, the cost associated with duct repair and sealing, or investment in a full home assessment with implementation of recommended measures, cost considerations often prevent consumers from pursuing retrofits. Even when a relatively short payback can be demonstrated, first cost often remains a barrier to customer investment.

- The limited consumer understanding of the benefits that can result from various home retrofit projects also poses a barrier. Many homeowners do not realize how retrofits can improve their comfort, increase the safety of their home, enhance their home's value, and significantly lower utility bills. Furthermore, efficiency improvements are largely intangible. Homeowners may not be able to see the results of their investment right away and can not show them off to their neighbors.

- Consumers may also have a hard time identifying what work needs to be done to improve their homes' performance, much less which contractors to hire to perform these services. Widespread mistrust of contractors only makes the situation worse.

- The timing of home improvements can pose a barrier. Equipment replacement often takes place in an emergency situation when existing equipment fails. This can be a hard time to convince homeowners to consider energy efficiency or more extensive home improvements. Larger remodeling projects are typically undertaken when a home reaches a certain age or in the first few years after turnover. Each of these points presents an opportunity, but most homes do not fall into these categories so efforts to educate homeowners on the benefits of retrofits and why it makes sense to take action at other times can help.

Contractor (Supply-Side) Barriers

- Many contractors cite the lack of consumer demand as a major barrier to implementation of residential retrofit measures. Contractors often lack the marketing and sales skills or do

not have the appropriate information to successfully sell efficiency improvements or more comprehensive services to their customers.

- The risk involved in investing time and resources in learning new skills and purchasing new equipment presents a barrier to greater contractor involvement, especially when the customer demand is not clear. In some parts of the country, contractors have bad memories of previous utility programs targeting home diagnostics and retrofits—when the programs ended and incentives dried up, they were left with unused equipment representing a substantial investment of money and training. Contractors will need greater assurance of a persistent market for these services before they are ready to get back into the business.

- Contractors are also reluctant to identify problems beyond their expertise or that may cut into their core business. By offering more extensive diagnostic services, contractors may worry that their time is wasted generating business for other tradesmen or that selling efficiency may reduce the bottom line on jobs because customers can then downsize their new heating or cooling systems.

RESIDENTIAL RETROFIT PROGRAMS: APPROACHES TO DATE

Attempts to "crack the nut" presented by the home retrofit market have incorporated a broad range of program approaches, with varying results. This section summarizes these approaches.

System-Specific Programs

In this context, we use "systems" to refer to the set of components that work together to meet a particular functional need in a house. The "envelope" as a system includes the roof, ceilings, exterior walls and windows, and foundation, all of which work together to keep the outside and inside environments as separate as the occupants desire: keeping rain out and interior temperatures moderate, while letting light in. The plumbing system includes everything required for potable water supply, use, and disposal. The HVAC system is not just the furnace (or boiler) and air conditioner or heat pump, but also the duct or pipe system that distributes heating and cooling services.

Early efforts to improve the efficiency of existing homes, in particular, sought to address the most common problems contributing to home energy waste and to work through specific, established contractor trades. For example, a growing body of research in the early and mid-1990s pointed to the significant energy loss associated with improperly installed and poorly maintained HVAC systems.[2] Several programs were designed to educate homeowners about these problems and work with HVAC contractors to encourage improved installation. In general, system-specific efforts have targeted the following equipment and services:

[2] Neme, Proctor, and Nadel (1999) summarized dozens of studies documenting air conditioner and heat pump installation problems and the energy savings from improved practices. Thorne (1998) provided a similar summary for gas-fired heating equipment.

- HVAC installation and maintenance
- Air sealing
- Duct repair and sealing
- Insulation
- Window replacements
- Lighting and appliances (typically during remodeling or new additions)

Common program elements include contractor training and certification programs, diagnostic tools, guidelines or specifications for best practices, customer education and marketing, and financial incentives. Some leading efforts are summarized below.

New Jersey Residential HVAC Program

New Jersey's three largest investor-owned electric utilities administer CoolAdvantage, a joint HVAC program targeting the replacement market for central air conditioning systems and heat pumps. The program offers rebates for installation of high-efficiency systems. In order to qualify for the rebate, contractors are required to submit documentation of measurements and calculations related to equipment sizing (ACCA Manual J), airflow, and refrigerant charge. Technicians are provided with technical training on the skills needed to meet these program requirements, while contractor sales staff may attend training sessions on methods for selling energy efficiency. To further enhance contractor skills, the utilities encourage participating contractors to obtain technician certification through the North American Technician Excellence certification program. Finally, recognizing the importance of customer demand in developing a sustainable market, the utilities have developed a customer education and promotion campaign highlighting the benefits of energy efficiency and the elements of a good, efficient installation.

In 2001 alone, more than rebates were given for 16,000 high-efficiency systems in New Jersey. In 2002, installation rebates grew to 18,000. Nearly 2,000 technicians received training in proper refrigerant charge, airflow, and Manual J sizing calculations through late 2001. The growing pool of qualified technicians has improved the approval rate of rebate applications and there is evidence that the rate of equipment oversizing has been reduced substantially (Foster et al. 2002). In 2002, another 1,000 technicians received training largely focused on preparation for the NATE certification test. The utilities were able to redirect their training efforts in 2002 as a number of major equipment manufacturers and distributors began to offer the same training on proper installation techniques that the utilities had been offering (Neme 2003).

From the outset, the program has been targeted at the larger HVAC contractors operating in New Jersey. These contractors represent an easier audience because there are a smaller number of large firms, and these companies tend to be more technically sophisticated and business savvy. Also, given the higher percentage of the market served by this smaller subset of firms, they represent the "biggest bang for the buck" in terms of program spending. Furthermore, the larger contractors are more involved in trade associations and trade groups that serve as important partners in disseminating program information and materials. All of these factors have been credited in contributing to the success of the program (Neme 2003).

Despite the program's progress to date among larger contractors, there has been little attention directed to smaller contractors and, as a result, little change in installation practices among this segment of the contracting market. Smaller contractors typically are very hard to reach, less likely to participate in training, and more likely to be driven by low-bid practices tailored to the most price-conscious segments of the market. However, these firms are an important part of the market, accounting for more than half of all statewide sales of central air conditioners and heat pumps. At this time, no specific strategy for addressing smaller contractors has been developed, although there is some hope that the improved practices adopted by larger contractors and more widespread training offered by manufacturers and distributors will diffuse to smaller firms. Beyond this, next steps are unlikely to have a specific focus on small contractors. Instead, the strategy will focus on efforts to improve the field efficiency of equipment in conjunction with manufacturers and distributors, build consumer demand for improved equipment installations, and promote adoption of state licensing standards for contractors as a means for driving smaller contractors to improve their installation practices (Neme 2003).

Performance Tested Comfort Systems

The Performance Tested Comfort Systems (PTCS) program, launched by the Northwest Energy Efficiency Alliance (NW Alliance), provides an interesting example of a multi-faceted approach to promoting duct and equipment diagnostics and services. Originally started as a pilot in September 1997, the program expanded into a full-fledged initiative in 2000 under the auspices of a nonprofit organization, Climate Crafters, with financial support from the NW Alliance. To address limited contractor capacity in duct and equipment diagnostics and services, PTCS offers classroom and field training and certification in two categories: (1) residential air systems diagnostics and (2) heat pump and air conditioning diagnostics. Climate Crafters targets its PTCS-certification at HVAC and weatherization contractors.

To date, over 150 residential air distribution technicians and 45 heat pump technicians have been certified through PTCS. All work completed in any home by a PTCS-certified contractor is verified or inspected for quality assurance by Climate Crafters or a PTCS-certified utility inspector. Homeowners receive a certificate documenting compliance with appropriate performance standards; the certificate can then be used to claim rebates and incentives from participating utilities. The program has tested and certified ducts in more than 2,400 homes to date, but a number of obstacles have limited overall program impact and its future prospects. For example, the program has struggled to attract contractors to the training and certification process because of the time and costs involved. According to many contractors surveyed in a recent evaluation, the process is too expensive and too time-consuming, given the limited customer demand for the services (Smith and Stober 2003. Many contractors do not see the business opportunity; those that do see an opportunity typically participate only as a means to qualify for utility rebates. The limited investment in consumer education and marketing has done little to increase awareness or demand for the services offered through the PTCS program (Sanders 2003).

The program is currently in transition as Climate Crafters works to become self-sustaining without further support from the NW Alliance. As part of this transition, Climate Crafters continues to perform training and certification and is also working under contract to local utilities to perform duct sealing services, primarily in mobile homes.

Sacramento Municipal Utility District

The Sacramento Municipal Utility District (SMUD) launched a residential duct improvement program in June 1999. The program utilizes the Aeroseal sealant technology, injecting the proprietary aerosols into the ductwork to seal them. The Aeroseal product has several benefits for program operators relative to traditional duct sealing methods:

- The process takes less time to complete than conventional duct sealing.
- Savings can be verified with the requisite pre- and post-sealing diagnostics, ensuring SMUD and the customer of savings and providing contractors an additional sales tool.
- Field studies have demonstrated greater energy savings with Aeroseal than conventional sealing methods and shown that the aerosol-based product can seal very small leaks and leaks in inaccessible locations that are otherwise missed.

Through the program, SMUD offered an initial group of four contractors a 50% discount on the franchise fee and a guarantee of a minimum level of program activity for the first six months of the program. Customers are offered a low-cost duct diagnostic service (SMUD pays $50 of the $75 cost) and a rebate on the cost of the duct sealing service if warranted in their homes. The initial program rebate of $400 was reduced to $200 after the first 11 months of the program once contractors became more comfortable using and selling the service.

SMUD developed a strong marketing and promotion strategy to introduce the program to customers and generate initial leads for participating contractors. Local news reports also helped to generate leads. The initial class of four contractors was expanded to seven when three additional contractors expressed an interest and paid the full franchise fee. As of June 2003, five contractors continue to participate in the program. From July 1999 through April 2000, contractors performed duct diagnostics in 1,323 homes and sealing jobs in 593 (Kallett et al. 2000). In 2001, the program grew, completing a total of 1,738 diagnostic tests and 600 duct sealing jobs (SMUD 2002). In addition to duct sealing, participating contractors were able to identify and sell additional services to customers. Typical add-on services include duct cleaning, HVAC system replacements, HVAC services, new thermostats, and new duct systems.

Follow-up interviews with customers demonstrated high levels of customer satisfaction with the duct sealing diagnostic report and sealing service. Contractors also expressed satisfaction with the program and have reported increased use of duct sealing in their business. Participating contractors have been successful in conducting enough sealing projects to begin recovering their investment in the sealing equipment. SMUD reduced its investment in promotion and marketing of the program, encouraging contractors to generate a higher proportion of their own leads. Program operators attribute early program success to customer education and marketing, and the reliance on an effective technology with verifiable results.

Furthermore, SMUD's credibility with local customers and the use of rebates has helped address customers' barriers (Kallett 2003).

After the program's early success, the level of activity began to decline. In 2002, diagnostics performed in 1,137 homes resulted in 236 sealing jobs. In response, SMUD met with the three most active program contractors to discuss ways to revitalize interest in the program. As a result, the program rebate was increased to $300 as of January 2003, eligibility for the utility's Loan Program was extended to Aeroseal customers, and targeted marketing was conducted, including direct mail. In addition, Aeroseal has recruited two additional contractors to participate in the program. Additional time is needed to determine the effectiveness of these measures, but the closure rate in 2003 appears to be improving: as of June, a total of 372 diagnostics had yielded 107 sealing jobs for the year (Kallett 2003).

ENERGY STAR® Programs

The ENERGY STAR program—sponsored by the U.S. Environmental Protection Agency (EPA) and Department of Energy (DOE)—has developed specifications for envelope improvements, duct performance, and heating and cooling equipment. The ENERGY STAR Home Sealing specification includes requirements for air infiltration levels (maximum and minimum), minimum insulation levels, and window performance by region; the ENERGY STAR Duct Sealing specification establishes performance criteria and guidance for contractors to use when sealing ducts. These specifications are intended to set a standard for performance that consumers can ask for and contractors can sell as the recognized and endorsed level of energy-efficient practice. ENERGY STAR has developed promotional materials for consumers and contractors to help consumers understand what to ask for when purchasing new heating and cooling equipment and to help contractors sell more efficient systems. Many rebate programs for heating and cooling equipment are tied to the ENERGY STAR specifications for central air conditioners, heat pumps, furnaces and boilers, and room air conditioners. The Home Sealing and Duct Sealing specifications have found more limited use as information resources.

Other Activities

The Consortium for Energy Efficiency (CEE) has developed the Residential HVAC Quality Installation Specification (QI Spec), an in-depth specification providing a comprehensive definition of an energy-efficient residential HVAC installation (Foster et al. 2002). The QI Spec gives guidance on proper airflow, system sizing, and refrigerant charge along with information on duct design and maintenance for homes with central air conditioners, heat pumps, and gas furnaces. The QI Spec, finalized in August 2000, is being used in technician and installer training, equipment rebate programs, local building codes, and technician certification tests administered by the Building Performance Institute and North American Technician Excellence. For the most part, the QI spec serves as a resource. For example, it has served as a guide in the development of training curricula and test questions for local certification efforts, and it is increasingly requested as a guide by builders and other contractors (Foster 2003). One of the positive attributes of the QI spec is that it is accessible

free-of-charge via the CEE website to anyone who is interested. Unfortunately, this has limited CEE's ability to track who has downloaded the spec and how it is being used.

Much less program activity has targeted air sealing. Most activity has taken the form of blower door-guided air sealing programs run as part of utility low-income programs or weatherization assistance programs, especially in colder climates with a prevalence of electric heat (e.g., Long Island). Vermont Gas also offers a low-income program for air sealing. These programs are not tied to the ENERGY STAR Home Sealing specification. At this time, no stand-alone market transformation programs targeting air sealing have been found.

Whole-House Retrofit Programs

Knowledge of building science and understanding of the complex interactions among building systems and components has grown substantially in the past decade. Leading building science professionals have developed new methods for diagnosing home performance problems and implementing solutions to these problems. In turn, this has led to growing interest in promoting residential retrofits that can capture the compounded savings from addressing whole houses instead of specific systems. Many whole-house retrofit programs incorporate components of the system-specific programs discussed above. The leading whole-house programs are briefly described in this section.

Austin Energy

The Total Home Efficiency Program operated by Austin Energy is one of the oldest continuously operating whole-house programs in the country. Founded in 1982 as the Whole House Rebate and Loan Program, the initiative works with trained contractors and sub-contractors to perform a home energy analysis, develop a proposal for recommended improvements (including eligible Austin Energy incentives), and carry out the desired upgrades approved by the homeowner. The home energy analysis includes inspection of the HVAC system, ducts, attic insulation, and envelope leakage. Over the past ten years, the program has evolved to place greater emphasis on duct sealing relative to air infiltration and to incorporate the new diagnostic tools and equipment that have been become available. Blower door, duct blaster, and combustion safety tests are now required during the analysis and once improvements are complete. Austin Energy inspects all jobs once they are completed.

Eighty HVAC and specialty contractors participate in the program and are eligible for monthly training at discounted rates, equipment financing, sales incentives for job completion, and co-op advertising. Austin Energy relies heavily on marketing to promote the full range of benefits to consumers—lower energy bills, greater comfort, and improved indoor air quality. In addition, the utility invests in advertising and promotion through bill inserts, direct mail, billboards, movie theaters, sporting events, and newspapers. Customers are also eligible to receive incentives (up to $1,500) and a range of payment options (including low-cost, unsecured loans) to help offset the costs associated with recommended efficiency measures. As a result, the program averages 1,500 to 1,700 completed jobs a year.

The program manager credits the utility's cooperative relationships with participating contractors, their outreach to customers, and the use of aggressive incentives for the program's ongoing success (Gustafson 2003). Additional factors contributing to program success include a diverse contractor base that HVAC contractors can subcontract to perform insulation, air sealing, and other services, and also the well-educated and environmentally aware customer base in Austin.

Over the twenty years since the program's inception, a number of changes have been implemented to address various challenges and barriers that have arisen. For example, a constant challenge to the program has been overcoming the higher first cost associated with a total home efficiency upgrade relative to a simple air conditioning system change-out. In response, Austin Energy has developed customer outreach materials that educate homeowners on the higher return on investment, attractive paybacks, and improved comfort associated with whole-house retrofits. Rebates have also been adjusted to cover a greater portion of the incremental cost. Another challenge to the program has been maintaining contractors' participation during the summer months and other times when they are very busy. Many HVAC contractors found it hard to justify taking the time to up-sell jobs for participation in the Total Home Efficiency Program (particularly when much of this work would be carried out by subcontractors anyway) when they had so much work already performing equipment replacements. To encourage ongoing participation during even the busiest months, Austin Energy introduced a sales incentive payable to HVAC contractors for selling a comprehensive retrofit. This solution proved very attractive to the HVAC contractors, who could pocket incentives for their time selling the program and bring in subcontractors to perform the additional work. In fact, the program is currently considering increasing contractor sales incentives in lieu of any increase to already aggressive customer incentives (Gustafson 2003).

California's Residential Contractor Program

California's statewide Residential Contractor Program (RCP) was designed to serve both single- and multi-family housing with the objective of promoting a self-sustaining contractor market for energy efficiency services. Under the program, customers received vouchers redeemable for any of a specified list of improvements including HVAC, windows, insulation, and lighting upgrades. In order to accept the vouchers, contractors were required to have training in best practices and conduct specified performance and safety tests. In essence, the program's goal was to encourage contractors to market and perform more extensive efficiency retrofits. In addition, the program encouraged customers to consider the interactions of various home systems when seeking to improve the efficiency, comfort, and safety of their homes.

In practice, the RCP fell short of its goals for several reasons. Limited requirements for diagnostic testing and in the set of improvements eligible for financial incentives were not effective in generating comprehensive retrofit jobs. Since participating contractors were not required to perform multiple measures, most completed jobs consisted of only one to three measures, with window replacements representing the most common measure installed (more than 16,000 rebated window replacements in the 2000 program year alone) (SCE 2002).

Other common measures included HVAC system tune-up, duct testing and sealing, and attic insulation.

The program suffered from other shortcomings. Although RCP was statewide, there was no consistent training of contractors on the whole-house approach or business development issues across the participating service territories. Furthermore, the financial commitment to develop the infrastructure for whole-house contracting was lacking; little funding was available to offset the cost of diagnostic equipment or increase marketing of whole-house concepts to consumers and contractors (Riedel 2003). As a result, contractors were not given the tools or assistance they needed to successfully market and perform the efficiency retrofits that the program was seeking.

The RCP was discontinued after the 2001 program year because of the high program costs relative to its benefits (Knight 2003). More recently, the California PUC approved $1.6 million for a pilot program in conjunction with the California Building Performance Contractors Association. Through the program, the association is working with contractors in San Jose and Fresno to develop and implement a Home Performance with ENERGY STAR program to promote whole-house retrofits. The PUC funding will cover training, infrastructure development, and marketing of the program to consumers. The program has begun to actively train contractors and offer mentoring in all aspects of the whole-house performance business. Participating contractors are providing extensive job data to the program administrators; verification of initial jobs and customer satisfaction is underway. So far, participants are reporting improved closure rates (Reidel 2003).

ENERGY STAR

In addition to its system-specific approaches, the EPA has developed the Home Performance with ENERGY STAR program as a branded service for marketing whole-house improvements. The program centers on a marketing message emphasizing comfort and durability, health and safety, and professional problem-solving along with energy efficiency. To carry the Home Performance with ENERGY STAR brand, programs must: use a whole-house approach; emphasize improved home performance through an initial home evaluation, diagnostic testing, and "best practice" installation; and require quality assurance through an inspection protocol or a recognized certification/accreditation program for contractors.[3] Featured measures include energy-efficient lighting, insulation, windows, HVAC equipment, duct sealing, and air sealing. Participating contractors may perform all of the services themselves or work with allied contractors to complete the job. The variety of programs that has signed on to Home Performance with ENERGY STAR represents a range of approaches in size, investment, and services. A few of the programs are discussed below.[4]

[3] The Building Performance Institute is the national certification organization for Home Performance with ENERGY STAR.

[4] In addition to the programs discussed here, the following Home Performance with ENERGY STAR programs have recently been launched: a National Grid, NStar, and Berkshire Gas program in Massachusetts; a National Grid program in Rhode Island; and the California Building Performance Contractors Association in Fresno and San Jose, as discussed briefly above.

New York State Energy Research and Development Authority. The first pilot Home Performance with ENERGY STAR program was initiated by the New York State Energy Research and Development Authority (NYSERDA) in the spring of 2001. Key elements of the program include:

- aggressive marketing campaign with a staged rollout in select markets
- interest rate buy-downs of up to 5% on unsecured loans
- simplified loan applications processed onsite by the contractor
- required diagnostics and whole-house assessment
- contractor training assistance
- use of BPI certification and accreditation for quality assurance
- financial assistance for contractor equipment purchases

In response to challenges and limitations identified after the program launch, a number of changes were made. Additional consumer financing options were added to the program, including direct incentives for homeowners that self-finance improvements outside of the program's loan fund. Training and additional development of contractor skills in heating, shell, cooling, and mobile home improvement measures were added. To encourage greater communication among the trades, NYSERDA introduced a contractor referral incentive.

By early 2003, the New York Home Performance with ENERGY STAR program had yielded impressive results. In its first two years, the program had generated over 18,000 consumer calls and completed approximately 2,000 home assessments. A total of 1,340 homes have received more than $10 million worth of energy-related upgrades, with an average job of $6,500 (NYSERDA 2003). Contractors report that the overall closure rate of more than 60% far exceeds their closure rates prior to participation in the program. Strong contractor participation has helped the program—over 100 accredited contractors and 250 certified technicians are eligible to offer services (Rogers 2003). Estimated energy savings in New York total over 700,000 kWh from electric measures and 43 billion Btus in gas and oil savings as well as peak demand reductions of 82 kW (NYSERDA 2003).

Assessments of the NY program attributed the program's success to date to the following elements: a strong marketing component designed to create consumer demand; investment of the time and resources necessary to build a competent contractor base through training, certification, and technical assistance; efforts to significantly reduce the startup cost and risk of market entry for interested contractors with incentives for training, equipment, and certification; development of a "one-stop-shopping" approach for consumers including assessment, implementation, and contractor-originated consumer financing (Fisk 2003). The success of the program led NYSERDA to introduce the Assisted Home Performance with ENERGY STAR program in 2002. The program provides low-income households with a 50% subsidy toward the services offered through the Home Performance with ENERGY STAR program.

As of 2003, NYSERDA scaled back its marketing campaign by reducing the amount of paid media advertising promoting the program. Next steps for the program include expansion into the New York City metropolitan area (this will require training and certification development

customized for the New York City housing stock, particularly low-rise row housing), integration of advanced metering, stronger integration of ENERGY STAR lighting and appliances, enhanced financing programs, and entrance into the remodeling market (Fisk 2003). Addition of the New York City market is expected to result in tremendous overall program growth.

Wisconsin Focus on Energy. Through the Wisconsin Focus on Energy initiative, the Wisconsin Energy Conservation Corporation (WECC) administers the state's residential retrofit program. Wisconsin launched one of the initial Home Performance with ENERGY STAR pilots in October 2001. The program has two core components: a whole-house retrofit program and the Efficient Heating and Cooling Initiative.

Under the whole-house program, a customer pays an upfront fee of $100 to $200 to a participating contractor for an assessment of his/her home's performance. The assessment covers the overall age and condition of the home as well as evaluations of insulation, air leakage, mechanical equipment, moisture, combustion safety, and carbon monoxide levels. The contractor also conducts an interview with the customer. Participating contractors are required to attend training conducted by WECC. If the customer decides to follow up with implementation of measures recommended in the home assessment, WECC refunds $75 of the assessment cost and the customer is also eligible for other targeted incentives that average about $500 per house. Once work on the home is completed, an inspection is performed to ensure that the work meets the program's standards. Unlike the New York program, WECC is spending very little money on initial program marketing. Instead, the program is encouraging participating contractors to promote the service and the program incentives themselves. Over the first year of the program, 77 contractors attended training and 35 took action to perform assessments and implement measures in a total of 158 Wisconsin homes (Carroll 2002). The average home performance job totaled over $1,900 for an average annual customer savings of $335 on electricity and natural gas (EDU 2003).

The Efficient Heating and Cooling Initiative operates more like one of the system-specific programs outlined in the previous section. Since earlier efficiency programs in Wisconsin resulted in very high saturations of high-efficiency furnaces (90 AFUE and higher) in the state, this initiative has expanded its focus to include installation of high AFUE furnaces (greater than 90), high-efficiency furnace fans, and high-efficiency central air conditioners, all installed in accordance with established quality installation practices similar to the CEE QI specification. Contractors are trained and tested in the appropriate quality installation guidelines and WECC supports certification efforts for HVAC contractors in Wisconsin. The program also incorporates customer education on the many benefits of high-efficiency equipment and proper installation, as well as how to identify and buy a quality job. In addition, the program offers customer incentives in the form of "Cash Back Rewards" of $150 to $200 for qualifying equipment installed by a participating contractor. The program is marketed to contractors through HVAC suppliers, distributors, and trade organizations and WECC has found that participating contractors are happy to do their own marketing to customers without WECC's support. As of the fall of 2002, more than 600 contractors had signed on to the program and of these, approximately 475 were active participants (Carroll

2002). By mid-2003, **more** than 9,000 homes have been serviced through the program with new equipment installations (EDU 2003).

Since the launch of the Wisconsin Home Performance with ENERGY STAR program, WECC has actively encouraged contractors to market and promote the program directly to customers. This not only keeps program costs low, it pushes the contractors to develop a sustainable business model that they can continue to build after the financial support for the program is lifted. This has proven to be one of the more difficult aspects of the program. Many contractors in Wisconsin are skeptical of the market for home performance contracting, particularly in the absence of financial incentives for customers, based on their experience with earlier DSM programs. Once utility funding was discontinued, customer interest dried up and many contractors were left with expensive blower doors and other diagnostic equipment without any means to recoup their investment. WECC is working to address this barrier by demonstrating to contractors ways to build a viable home performance business and also providing the training and initial push needed to increase consumer demand in the state. For example, WECC is exploring a remodeling pilot to encourage whole-house contractors to develop relationships with remodelers (such as window replacement firms) as a way to reduce their marketing costs and get a foot in the door of the strong home improvement market in the state. WECC is also evaluating its quality control mechanism and investigating ways to get trained contractors more active in marketing and participating in the program.

Metropolitan Energy Center, Kansas City. A different approach to Home Performance with ENERGY STAR is being pursued in Kansas City. In the absence of state or utility program sponsorship, the Metropolitan Energy Center (MEC) is working to develop a program that can operate with a very limited budget and little administrative oversight. Through the program, MEC has partnered with the BPI to train and certify contractors in the greater Kansas City area. MEC markets the program to local homeowners, utilities, and other interested parties. The goal of the program is to develop a successful, self-sustaining model for home performance contracting. Once established, local certified contractors can sell their services directly to consumers. Local utilities will be able to refer interested homeowners to certified contractors without going to the time and expense of developing their own residential retrofit program. To date, six BPI-certified contractors are listed on the MEC website (MEC 2003). Quality assurance for the program is being provided through BPI's local affiliate, the Kansas Building Science Institute. Mechanisms to provide mentoring and sales training to contractors interested in incorporating whole-house practices into their business models are currently being explored.

Lessons Learned from Current Efforts

The examples above illustrate the range of program opportunities for successful energy savings initiatives in existing homes. At the same time, the extent of the challenge becomes increasingly clear. To begin with, efforts to capture the potential energy savings in existing homes—whether through packaging of individual system-specific approaches or through integrated whole-house efforts—require recruiting members of the highly fragmented and specialized residential contracting trades. Furthermore, greater consumer awareness and

demand for whole-house improvements will be required, especially if program implementers expect contractors to invest in training, credentialing, new equipment, etc. Key lessons from experiences to date are summarized here.

- Initial efforts to build an infrastructure for *quality* residential retrofit services must target contractors. Training, certification, and licensing requirements are all important and effective tools in ensuring a cadre of contractors with the necessary skills and experience to perform the high-quality work required to capture energy savings, improve home performance, and build customer confidence.

- Consumer education is also a requirement for building lasting demand and transforming the market. Before they will demand comprehensive home energy improvements, consumers must understand how these services will benefit them through greater comfort, improved home safety, and lower energy bills.

- Efforts to reduce the risk to contractors interested in offering home performance services can be very important in encouraging them to take the first steps into the business. Strategies that have been used successfully include: offering financing or other assistance with the purchase of necessary tools and equipment; providing strong marketing leads; and giving compensation for the time it takes to establish relationships with other contractors and make the necessary referrals.

- Consumer rebates can be a helpful tool to attract homeowners' attention, but they cannot be the centerpiece of a program or its main element. Without adequate consumer education and attention to building a strong contractor base, rebates cannot spur a sustainable demand for effective home energy retrofits or create the infrastructure to provide these services.

- Important factors in generating consumer interest and confidence in the expected results of a retrofit project include: a clear energy analysis based on a thorough assessment of the home and the energy usage patterns; recommended measures based on the analysis; trained contractors that not only know how to perform quality work, but also how to sell quality to consumers; and clear information on recommended options, subcontractors, and financing to help consumers through the decision-making process.

- With creativity and flexibility, program implementers can develop successful home retrofit strategies to fit different program budget levels, resource constraints, and market conditions.

- While there has been progress, some persistent challenges remain. Engaging smaller contractors continues to be difficult for many program operators. Convincing contractors to pursue their own broader marketing efforts has been a problem; however, this is an important step in market transformation and is vital to programs operating with very small budgets.

- Contractors need help incorporating new practices into their business models. With the value-added services inherent in the whole-house approach, contractors will almost always charge more for some services. The key is communicating the additional benefits to consumers and competing on the comprehensive and quality work rather than on a low-bid basis.

PROMISING NEW DIRECTIONS

Where comfort and efficiency are concerned, houses are systems; however, the existing structure of the residential contracting market is not geared toward addressing the whole house to provide the owner comprehensive services to maximize comfort and efficiency. In many ways, large-scale implementation of whole-house retrofits will require a significant evolution of both the market and the range of skills and services offered by contractors. "Whole-house contracting" (or "home-performance contracting") is a relatively new specialty requiring contractors to develop the diagnostic skills to effectively analyze home performance, identify and perform the necessary retrofits, and/or work with the appropriate specialists to complete a package of retrofits.

This section presents some new directions that hold promise for more wide-scale adoption of improved retrofit practices by helping existing contractors expand their businesses, improve their sales closure rates, and support new profit centers. In general, we identify two approaches. First, contractor-centered approaches target opportunities for specific contractors to expand into new trade specialties. Second, housing type-centered approaches seek to simplify the problem by focusing on specific types of housing that are important in particular regions and offer good energy efficiency opportunities.

Contractor-Centered Approaches

As noted in the discussion above, several residential efficiency programs are taking steps to develop contractor capacity and build the infrastructure for whole-house retrofits. While programs work to build the market for whole-house retrofits, it is important to realize that many contractors will be interested in maintaining a focus on their specific line of work or take a more cautious approach to diversification in their business with a more staggered investment in additional training and equipment. Particularly in the near term as whole-house approaches continue to catch on and in regions where program resources are not available to offset contractor costs and support customer education and marketing efforts, it may be necessary to help contractors build their business more gradually.

One way to engage these contractors is to begin with efforts designed to improve the services they offer within their existing area of expertise and then to introduce them to additional services that make the most sense or present the most natural avenues for growth. For example, an HVAC contractor would focus first on improving his skills to ensure proper installation and maintenance of HVAC systems, and possibly become NATE or BPI certified. Then, the contractor could expand into duct diagnostics and sealing. These services are complementary and are often required to meet individual homeowner needs. Similarly, an insulation contractor could incorporate envelope diagnostics and air sealing into her business.

An important component of infrastructure development is providing contractors with the tools to analyze home performance and efficiency opportunities and also the skills to communicate these opportunities to homeowners and secure the job. As discussed earlier, a clear assessment of the system or home's performance and a specific proposal of options for addressing problems and improving comfort and efficiency can build customer confidence and increase sales. New tools and approaches have been developed to help contractors with this.

ACEEE has proposed the "Residential Sales Advisor" as one such approach.[5] Initially, this approach was developed to target opportunities during HVAC installation. Recognizing that better installation practices for HVAC, such as those outlined in the CEE QI Specification, are necessary but often not sufficient to capture the full energy savings potential and maximize occupant comfort, this approach focuses on augmenting the skills of the contractor sales staff. By providing the sales advisor with the tools to identify the needs of the homeowner and the skills to sell a broader offering of services, the firm can perform a more profitable job that improves the overall HVAC system rather than simply replacing the equipment boxes. Useful tools could include a balanced set of hardware and software for simplified equipment sizing (for example, a palm computer-camera to get photos of the exterior walls to simplify the work of Manual J calculations) and methods for diagnosing distribution problems. In addition, the sales advisor would be trained to look for issues that lead to profitable referrals such as poor insulation or air infiltration issues. The same concept can be carried from the HVAC contractor to the insulation contractor.

An alternative is a set of software tools designed to help home performance contractors benchmark a home's energy bills, record test results and homeowner input, and model overall home energy use. The TREAT tool (Targeted Residential Energy Analysis Tools) has been developed by Performance Systems Development, Inc. and Taitem Engineering as a method for evaluating home energy performance, identifying improvements, putting together packages of retrofit options, and producing reports for presentation to the customer (PSD 2003). The program's designers hope that the tool will reduce contractor sales costs while improving their closure rates and increasing the profitability of each job. The tool is currently being used by contractors working with New Hampshire utilities, NYSERDA's Assisted Home Performance with ENERGY STAR program, and the California BPCA's Home Performance with ENERGY STAR pilots in San Jose and Fresno (Thomas 2003). In addition, the tool is available for contractors participating in NYSERDA's full Home Performance with ENERGY STAR program. These efforts should provide useful feedback on the tools' effectiveness and usefulness to contractors.

Housing-Type Centered Approach

A second approach to increasing the implementation of whole-house retrofits focuses on the key opportunities in specific housing types. Research into common building performance problems has documented specific issues shared by particular housing types. For example, older frostbelt homes typically suffer from drafts, condensation, and high heating bills as a

[5] For a full description of the Residential Sales Advisor concept, see the ACEEE proposal: "Prospectus for Program Development: The Sales Engineer: Key to Residential HVAC Efficiency," February 2003.

result of leaky envelopes, old windows, and poor distribution systems. In the high-growth suburbs of the sunbelt, predominately slab-on-grade houses with HVAC distribution through the attic, the leaky ducts combined with undersized returns lead to inefficiency and pressure imbalances that drive infiltration and a host of comfort problems. In general, if contractors know the housing type, they know the good energy efficiency opportunities to look for and program designers can work with the local trades to identify the best set of methods and measures to best serve customers. Many of the tools discussed earlier, such as the ENERGY STAR Home Sealing and Duct specifications and the CEE QI Specification, could be tailored for the housing types and regions identified.

Developing appropriate diagnostic methods for these houses and training salespeople in them is much simpler than doing the same for all housing types. Furthermore, a number of different specialists—remodelers, insulation contractors, and HVAC firms—can be cross-trained to perform diagnostics and identify the common problems. A base of tools designed to identify common problems in a specific type of house and the skills to address those problems could serve as an easier way to get contractors interested in expanding their business. Experience with these jobs could build their skills and confidence to broaden their marketing to a wider customer base with other housing types. Alternatively, contractors can use the information from their diagnostics for profitable cross-referrals, and this may be much easier than inventing a new class of building efficiency and performance specialist to be unleashed on the existing market.

Additional research and compilation of findings from ongoing research efforts will be needed to put together an effective set of efficiency "packages" targeting specific housing types. A key topic of inquiry would lead to better characterization of housing types. In order to identify promising targets, program designers need more detailed information about the prevalence of specific housing types and their regional distribution.[6] Recent research has led to abundant information on the most common problems for particular types of houses and climates. Similarly, data on the market for home repairs and remodeling and the demographic, economic, and regional trends impacting homeowner investment is available (JCHS 2001, 2003). Further detailed research into specific housing markets, compilation of data, and analysis of findings will be necessary to identify the most attractive targets for initial pilot-scale program activity.

CONCLUSIONS AND RECOMMENDATIONS

The potential for significant, cost-effective energy savings in existing homes is unquestionable. The opportunity to save energy and money while improving comfort makes home retrofits attractive to consumers—if they are aware of their options. This review of current efficiency programs targeting existing home performance—either on a system-specific or whole-house basis—demonstrates a number of strategies for successfully addressing this market opportunity. Program implementers must incorporate steps to build

[6] The Partnership for Advanced Technology in Housing (PATH), a public-private partnership managed by the U.S. Department of Housing, has also identified this type of characterization and categorization as a top priority in its Technology Roadmap for improving the efficiency of existing housing (HUD 2002). The roadmap identifies the main areas for PATH-funded research and development.

the capacity of contractors to offer quality retrofits services in their area and to educate consumers about the myriad benefits they stand to realize from their investment.

Building an infrastructure of qualified contractors requires contractor investment of the time and resources to develop the necessary skills to offer improved services, expand the range of services they provide, and learn how to effectively sell a higher level of service to their customers. Effective contractor recruitment strategies work to reduce the perceived risk of entry into the new business and demonstrate the strength of the new approach as a lasting, sustainable, and profitable business model. Financing or incentives to offset the cost for new equipment and tools, low-cost training, support for contractor certification efforts, and resources for marketing and consumer education have played a role in successful efforts to date. In addition, some programs are offering contractor referral incentives to encourage contractors to take the time to identify and recommend improvement measures that they may not have the time or relevant skills to perform themselves. Efficiency programs could also help to identify qualified firms and develop contractor networks as a way to encourage cross-referrals and greater communication among the trades in their service area.

The experience of other contractors that have established successful home performance businesses can also be very persuasive. Case studies and testimonials from these contractors speak volumes to others in the field and carry a credibility that it is difficult for an efficiency program implementer or utility staffer to match.[7] These professionals can demonstrate the range of skills they use in their business: technical skills to identify problems and appropriate fixes; marketing skills to sell comfort, energy efficiency, and the financial returns; and management skills to effectively conduct their business and supervise and develop junior staff.

Creating customer awareness and demand requires education, marketing, and as simple a transaction as possible. Many consumers are not sure what can be done to improve their home's performance—which problems can be addressed and which are just part of the home's "character." Successful home performance contractors have found that the use of diagnostics and tools that help explain to the homeowner how their home is performing and how they can improve the comfort and efficiency of their home yields a higher closing rate, larger jobs, and an increase in referrals. This approach offers more valuable information to the consumer, better meets his/her needs, and builds trust in the contractor. Efficiency programs can provide education and marketing that lays the groundwork and encourages homeowners to investigate the opportunities within the home with a contractor. These materials should highlight all of the benefits of a systematic and comprehensive approach to upgrading a home. For example, in addition to the comfort and energy savings benefits, customers should be informed of financing opportunities, the solid rate of return associated with many home improvements, and the potential for increasing the market value of their home.

Strong market research can help programs target their marketing efforts and messages to get the biggest bang for the buck. Successful efforts have identified key target segments by

[7] A number of leading contractors have published articles about their business models and regularly appear at industry conferences and trade shows to share insight into their success.

location or specific customer characteristics (e.g., high energy use) and directed specialized marketing materials to these consumers. For even greater success, these marketing efforts can be backed up by a program of rebates or easy-to-access financing and coordinated referrals that make the transaction as simple as possible for the consumer. Ideally the customer only has to work with one contractor to get an assessment of his/her home and list of recommended improvements, select the set of measures to implement, and obtain approval for financing or rebates to be paid once the job is completed and verified.

In addition to the successful strategies that are beginning to make a difference in select markets around the country, a number of promising new directions have been identified. Better diagnostic and sales tools can enable contractors to better meet customer needs while increasing the scope and profitability of their businesses. Further development of these concepts and field testing of new tools should provide useful feedback on the value of these approaches in the near term. Recognizing that the opportunities in the home retrofit market are large but heterogeneous, better characterization of the opportunities available in different climate regions, in homes of a particular construction and vintage, and in specific comfort conditioning systems may allow contractors to use a more prescriptive set of improvements as a starting point. Additional research and analysis will be useful for identifying the best opportunities and appropriate measures as well as a few particularly attractive markets to test the concept.

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