Residential HVAC Quality Installation: New Partnership Opportunities and Approaches

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ABSTRACT

Traditionally, residential HVAC programs designed to achieve "Quality Installation" (QI) have used specification-, incentive-, education/training-, and certification-based approaches to influence specific market stakeholders, mainly installers. This paper focuses on these program approaches and suggests expanded program components designed to influence other market players, including salespeople, consumers, and manufacturers. It includes information on a national installation specification, a national consumer-education campaign, two statewide program approaches, and an industry certification effort.

CEE's QI Specification and its Role in the Market

The Consortium for Energy Efficiency's Residential HVAC Quality Installation Specification (QI Spec) was finalized in August 2000. The QI Spec compiles existing research on best practices for technicians and installers into a manageable size and format for technicians and installers to use in the field. It contains information on system sizing, refrigerant charge, and proper airflow for residential central air conditioners, heat pumps, and gas furnaces. It also includes information on duct system design and maintenance.

Its development was funded through a collaborative effort by Pacific Gas & Electric, Sacramento Municipal Utility District, and the New York State Energy Research and Development Authority. The effort grew out of initial work conducted by the Quality Installation Roundtable Subcommittee. This informal working group, formed by CEE in 1998, initially explored concerns about, and potential approaches to, HVAC installation. Research conducted by this group confirmed that there are a number of formidable barriers to improving installation practices, but the lack of a clear, industry-accepted definition of a "quality, energy-efficient installation" was the most significant.

CEE contracted with R. J. Karg Associates and Saturn Resource Management to develop the specification. The draft specification was reviewed by members of the Quality Installation Roundtable Subcommittee, as well as manufacturers, contractors, and technicians, who were involved in the peer review process of the document. These included representatives from the Air Conditioning and Refrigeration Institute (ARI), Carrier, Goodman, Honeywell, Lennox, Refrigeration Service Engineers Society (RSES), Rheem, the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), Trane, and York.

The resulting document, the first of its kind, acts as an industry-accepted definition of the practices and techniques constituting an energy-efficient installation. The document is

available for download on CEE's web site (www.cee1.org/resid/rs-ac/hvac.php3) and since the first posting in August 2000, has been downloaded an average of 40-70 times per week (Newman 2002).

Use of the Specification

CEE believes that the Quality Installation Specification plays a significant role in the market. Due to limitations in the way the QI Spec is distributed (largely over the Internet), CEE has been unable to compile a comprehensive list of programs currently using the specification.[1] A few examples are provided here to demonstrate how the QI Spec has been used in training and rebate programs, building codes, and technician certification tests. Each of these uses is discussed below.

Since its finalization in August 2000, the specification has been used to train technicians and installers in the techniques and practices that constitute a quality installation. In a partnership with Commonwealth Edison, the Illinois Community Energy Cooperative used the specification in an incentive program that replaced 725 HVAC units in the Chicago metropolitan area in 2001. They provided a half-day training session on proper equipment sizing and other quality installation issues, and included the specification in their contract with participating contractors. Through the training, 98 percent of the incentivized units were reduced in capacity. The average reduction in size was a half ton. The size reduction, combined with higher SEER equipment (average 12.5 SEER), resulted in mean savings of more than 1.5 kW per unit in this peak load reduction program (Puckett et al. 2002).

Cities and states in different parts of the country have pursued adoption of the specification into building codes. The City of Philadelphia is currently pursuing adoption of the spec as a part of its general building and energy specifications. If the specification is adopted, it will be required for use in city- and federally-funded residential houses built for low- and moderate-income residents (Wagner 2002).

The QI Spec has also been used as a guide to making enhancements in national certification programs. Exam questions based on information in the specification have been incorporated into certification tests administered by the Building Performance Institute and North American Technician Excellence (see below).

Addressing Key Market Actors

The QI Spec targets technicians and installers of HVAC equipment and offers an important vehicle for training these market actors. In addition to this audience, however, there are other key market actors who should be included in program design. One of these actors is the salesperson, who is often responsible for specifying the type and size of HVAC equipment later installed and serviced.

A New Jersey study revealed that 50 percent of contractors in that state have staffs of five employees or less. In this situation, the person specifying and selling the unit is often the person installing it. However, anecdotal information from that state indicates that small contracting firms (five employees or less) have been the least interested in participating in

[1] CEE hopes to remedy this shortcoming in the future by requiring contact information to be entered into our web site before the document can be downloaded.

efficiency or certification programs in the past (Neme 2001). This evidence indicates a need to educate sales staff on proper sizing and other installation issues.

Because over-sizing can result in efficiency losses of 2-10 percent, the salesperson should be targeted in any comprehensive QI program (Neme, Proctor & Nadel 1999). Suggested approaches for working with salespeople include ENERGY STAR® (or other) sales training and a national certification that encompasses sales functions as well as installations.

Other efforts to educate the salesperson about sizing and quality installation issues are being undertaken by a variety of organizations. The Air Conditioning Contractors of America (ACCA) currently offers sales training, and has expressed interest to ENERGY STAR about increasing the focus on efficiency within that course. In addition, ENERGY STAR is working with several manufacturers to develop a sales training template based on the information presented in the QI Spec (South 2001).

The customer is another important actor to include in program design. Lack of customer awareness and the increased cost to the consumer are two major barriers to industry adoption of QI (Karg & Krigger 2000). Approaches to educate consumers that are currently being used by efficiency programs include participating in campaigns such as Cool Change (discussed below), as well as utilizing direct mail, bill inserts, co-op advertising with contractors who practice QI, and video education pieces for consumers to watch while contractors evaluate equipment and installation needs of the household.

The following portions of this paper will demonstrate successful program approaches that include the market actors discussed above. By using these approaches, utilities (and other program administrators) can include quality installation in their residential HVAC programs, thus providing additional energy savings, monetary savings, and comfort to their customers.

ENERGY STAR Systems Approach

The ENERGY STAR Program aims to transform the residential HVAC market by educating consumers and contractors about the systems approach to heating and cooling equipment. This approach incorporates a variety of ENERGY STAR-labeled products: heating and cooling equipment, programmable thermostats, ceiling fans, and an ENERGY STAR specification for sealing existing ducts. ENERGY STAR also promotes QI through the CEE Residential HVAC QI Spec and the NATE certification program (described below).

Cool Change: A Promotional Campaign

ENERGY STAR is undertaking a campaign to educate consumers about the benefits of quality installation and the systems approach while providing tools and marketing materials to increase contractor knowledge and interest in this area. The systems approach is promoted through the ENERGY STAR web site, www.energystar.gov, and through manufacturer, retail, and efficiency program partners. Promotion of the systems approach will also occur through a national HVAC campaign entitled "Make a Cool Change to ENERGY STAR," which is taking place from April to August 2002.

The Cool Change promotion, which involves manufacturers, retailers, and utilities[2], encompasses a number of products from central and room air conditioning to programmable thermostats and dehumidifiers. Early manufacturer and retailer participants include Lennox, GE Motors and Controls, Trane, Sears, and Home Depot.

For contractors, the promotion offers information, tools and training to enhance sales of ENERGY STAR-labeled cooling equipment. It encourages homeowners to look at their cooling equipment as a system – how the components work together and can be properly installed and maintained for highest efficiency.

Cool Change provides support materials, including a consumer education guide that can be customized to manufacturers' and contractors' sales efforts. The guide is a comprehensive information source for energy-efficient home cooling, and includes information on equipment, a checklist for identifying home cooling needs, and recommendations about working with contractors.

In addition, a Cool Change web site (www.energystar.gov/coolchange) has been developed, offering user-friendly information on home cooling for consumers and contractors. The web site includes savings calculators, an ENERGY STAR tutorial for contractors, product information, and an animated house model that allows users to click on relevant equipment for more information. Moreover, the web site will feature special promotions on cooling equipment from participating retailers and manufacturers as well as efficiency program rebates.

Cool Change also offers sales training and materials that can be tailored to contractor and manufacturer needs. The promotion will include several templates with messaging that can easily be customized to contractor and manufacturer sales efforts, including advertisements, fact sheets, product clings, and posters. The campaign will be promoted through news releases to regional and national media, including radio, TV and newspapers.

Following this promotion, information will be made permanently available through the heating/cooling and home improvement sections of the ENERGY STAR web site. Evaluation of the promotion will provide direction on the systems approach in future years. Continuing efforts to work with retailers, manufacturers and utilities will be made to support the systems approach both regionally and nationally. Future ENERGY STAR promotions will likely highlight systems information to consumers and contractors, which can be used by local, statewide, and regional programs to enhance their marketing efforts.

The ENERGY STAR Cool Change campaign demonstrates the importance of raising consumer awareness in a successful QI program. While primarily a consumer-oriented campaign, its sales training component targets sales staff of contractors, while ENERGY STAR's ongoing support of NATE certification focuses on the technician and installer.

Tying QI to Equipment Incentives in New Jersey

Working with the Northeast Energy Efficiency Partnerships (NEEP), the three large investor-owned utilities in New Jersey got together in late 1997 to begin exploring new approaches to promoting efficient residential central air conditioning systems. Initial discussions led to three key decisions: 1) join forces and launch a single, common, statewide

[2] The ENERGY STAR HVAC residential central air conditioning specification is now being updated to SEER 13 for most equipment, but this change will not be effective until Fall 2002. Therefore, the Cool Change Campaign will promote SEER 12 equipment.

program; 2) address efficiency holistically, covering not only equipment efficiency, but also proper sizing and installation; and 3) comprehensively address a variety of market barriers with the goal of long-term market transformation.

With this framework in place, the utilities explored a variety of program design options for meeting their goals. Representatives from the HVAC contractor community were involved in the discussions. Ultimately, the utilities decided upon a multi-pronged strategy:

- **Rebates tied to documentation of proper equipment sizing and installation**. The minimum equipment efficiency for rebates is SEER 13, EER 11. The HVAC contractor must submit an ACCA Manual J load calculation and fill out a form showing measurements and calculations regarding refrigerant and airflow levels. The central air conditioner must be sized within 15 percent or one-half ton of the design load. Refrigerant levels and airflow over the indoor coil must be within ranges specified by the equipment manufacturers. Rebate levels are substantial ($370 for SEER 13, EER 11; $550 for SEER 14, EER 12). The utilities felt this was necessary to overcome great initial resistance from HVAC contractors to QI requirements. As participation grows and contractors become more comfortable with new ways of doing business, future rebate levels may be reduced.
- **Technical training for HVAC contractors/technicians**. This includes courses on Manual J (including software programs), proper charge and airflow, and Manual D (for duct design) – all coordinated and administered for the utilities by the Eastern Heating and Cooling Council (EHCC). These courses have proven essential as initial rebate applications demonstrated that many HVAC contractors' staffs did not have the skills necessary to meet program requirements.
- **Sales training**. HVAC contractors' sales staffs are encouraged to attend classes on how to better "sell" efficiency to their consumers. EPA's ENERGY STAR sales training curriculum is used.
- **Contractor outreach**. The utilities (largely through EHCC) are making regular sales calls on HVAC contractors and distributors, encouraging them to promote the program to consumers as well as answering questions and dispelling myths. Emphasis is placed on the largest contractors (the top 6 percent are estimated to account for 42 percent of all sales [Xenergy 2001]). This effort recognizes the critically important influence contractors have on consumers and the suspicion with which some contractors view the utilities and their efforts to influence contractor practices.
- **Consumer marketing and education**. The utilities have developed, and are distributing, educational brochures and videos. These materials explain the key elements of equipment operating efficiency, as well as "what to look for and what to expect from an HVAC contractor." HVAC contractors promoting quality installations are encouraged to distribute these materials. Consumers are also encouraged to request them directly from utilities through a variety of marketing channels, including Yellow Pages ads, bill inserts, direct mail and other media placements. The goal of this effort is to create market demand for efficiency.
- **Promotion of HVAC contractors with certified technicians**. The utilities are supporting the North American Technician Excellence (NATE) certification program. Through their work with the Eastern Heating and Cooling Council, they are encouraging contractors to have their technicians certified.

This multi-pronged strategy has been phased in over time. Some key elements, such as documentation of proper sizing and HVAC technician training, were introduced in parts of New Jersey in 1998. Other elements, such as promotion of contractor certification and some marketing features, did not begin until the second half of 2001.

Early returns from the program have been very promising. The utilities expected participation to decline immediately following the adoption of more rigorous program requirements – particularly those related to proper sizing and installation. While participation did decline initially, it has rebounded quickly, to the point where the number of rebates in 2001 (nearly 16,000 units) was the highest it had been in years. This is estimated to correspond to a market share in excess of 30 percent for equipment rated SEER 13 or greater.[3] That is roughly 7-9 times larger than the national market share (ARI 1999). Interestingly, three-quarters of the 2001 rebates were for equipment rated SEER 14 or higher. This has led to an estimated SEER 14 market share of more than 20 percent – roughly 20 times the national average (ARI 1999).

The program has also made important progress in improving equipment sizing and installation practices. By the end of 2001, nearly 2,000 HVAC technicians had received training through the program in proper charging and airflow; an additional 500 had received training in Manual J load calculations. Some of the effects of this training are already noticeable in the market. Among these are significant reductions in the percentage of rebate applications that were rejected either for being completed improperly or for failing site inspections designed to ensure that equipment was sized and installed properly.

Recent market research provides more concrete evidence of market changes, particularly regarding equipment sizing. Site inspections of 70 randomly selected homes (in which air conditioners had recently been installed) suggests that the average central air conditioner in New Jersey was over-sized relative to the Manual J design load by only 0.37 tons (Xenergy 2001). Although there is no pre-program baseline estimate of over-sizing in existing New Jersey homes – against which that figure can be compared – it is substantially lower than the national average of about 1.0 ton (Neme et al. 1999). It is also much lower than the average over-sizing of 1.58 tons that was found in new single-family homes constructed in New Jersey in 1995 (VEIC/PEG 1997).

Interviews with a stratified sample of 30 HVAC contractors in the state provided additional evidence of changes in sizing practices. Virtually all of the large and medium-sized contractors (which account for nearly half of all central air conditioner sales in New Jersey) now claim to use Manual J to size equipment. Importantly, most of those contractors indicated that they changed their sizing techniques due to participation in the New Jersey utilities' DSM program (Xenergy 2001). While it may be appropriate to view contractor claims with some skepticism, the combination of their claims and relatively low levels of measured over-sizing do suggest that the program is having a significant impact.

There are also some signs of progress in other elements of quality installations. For example, program inspectors have reported a marked change in attitude among a number of contractors. These contractors, openly antagonistic and technically incapable of meeting utilities' installation requirements in the past, have completely changed their practices. In

[3] Market research conducted by the utilities suggested that the market share for equipment rated SEER 13 or higher was 28 percent for units sold between 1998 and 2000 (Xenergy 2001). The volume of rebates in 2001 was 22 percent higher than the annual average for the period 1998 through 2000. If market share has increased at the same rate as rebate volumes, it will have increased to approximately 34 percent.

some of these cases, contractors indicated they are using proper techniques in all their installations, whether they qualify for a utility rebate (e.g. SEER 13, EER 11 or higher) or not. While training classes have played an important part in these changes, the treatment of inspections as an educational opportunity rather than just a "policing" function appears to have been equally important. This anecdotal evidence is reinforced by some market research data. For example, all large contractors are now reporting that they exclusively use one of the three acceptable methods for refrigerant charging: weighing the refrigerant, the superheat method and/or the sub-cooling method. Most medium-sized contractors also use these methods (Xenergy 2001).

Despite these successes, there is still clearly a need for continued efforts to improve installation practices. For example, most small contractors – which still account for a little more than half of all sales in the state – do not use Manual J to help size equipment. Also, most small contractors do not use any of the proper methods for determining the correct amount of refrigerant for a system. Finally, and probably most important, most installations still suffer from significant problems associated with the duct system. Indeed, more than half of all systems recently tested had less than the recommended minimum airflow over the coil (350 cfm/ton[4]); one-third had airflow rates of less than 300 cfm/ton. In addition, average duct leakage to the outdoors was estimated to be 329 cfm (measured at a pressure of 25 pascals), or 34 percent of the supply airflow. Moreover, there was evidence of deliberate attempts to seal ducts in only 8 percent of the duct systems inspected (Xenergy 2001).[5]

In short, the New Jersey program appears to have made significant – perhaps unprecedented – progress in improving the efficiency of new central air conditioning systems (both equipment efficiency and installation practices). However, there is still much work to be done; this was fully expected, given the depth of the technical problems and market barriers the program faces. As a result, the utilities have committed to a long-term presence in this market.[6] They are also planning enhancements to the program – including the creation of a new duct sealing component – to better address the efficiency opportunities in the market.

The New Jersey program addresses all of the market actors necessary for a comprehensive program for QI. The technicians and installers are addressed through technical training and certification, the salesperson is educated through training using the ENERGY STAR curriculum, and customers are educated through a marketing campaign. In addition, a substantial rebate exists to draw both contractors and consumers into the program.

Wisconsin's Quality Installation Program

The Efficient Heating & Cooling Initiative is an element of the Home Performance with ENERGY STAR program offered through the Wisconsin Focus on Energy (WFOE) Initiative. The Wisconsin Focus on Energy Initiative is the state public benefits effort in Wisconsin administered by the Department of Administration. The Efficient Heating &

[4] The industry standard is 400 cfm/ton, although 50 cfm/ton above or below that standard is considered acceptable. Hence, 350 is the minimum in the acceptable range of 350-450.

[5] The average duct leakage to the outdoors in the homes in which some duct sealing had been attempted was less than half of the average for the entire population.

[6] In response to regulatory requirements, the utilities have filed program plans and budgets through 2004. This program has the largest estimated three-year (2002-2004) budget of all the residential programs the electric utilities have proposed.

Cooling Initiative was developed by the Wisconsin Energy Conservation Corporation (WECC), which also oversees the program implementation. WECC is the residential administrator for the WFOE Initiative.

Initiative Goals and Objectives

The basic goal of the Efficient Heating & Cooling Initiative is to increase the market share of 1) high-efficiency residential HVAC equipment and 2) quality installation and maintenance services in Wisconsin. As a result of overlapping programs in the early- to mid-1980s, about 80 percent of furnace replacements in Wisconsin have an AFUE rating of greater than 90[7]. For this reason, the Initiative focuses on promoting 90-plus AFUE furnaces with efficient motors (ECMs)[8] and high-efficiency central air conditioners (Pigg & Nevius 2000).[9] To help ensure that customers actually receive the benefits of buying high-efficiency equipment, the Initiative also educates HVAC contractors and customers about the importance of QI.

From a design perspective, the Efficient Heating & Cooling Initiative has three important objectives. The first is reducing the growth in peak demand that has contributed to a need for additional generation and transmission facilities within Wisconsin. The second objective is capturing "lost opportunities" to ensure the quality installation of high-efficiency residential HVAC equipment at time of replacement. And the third is preparing the market through education and other means to create: 1) demand for efficient equipment and QI; 2) changes in industry procedures; and 3) promotional efforts/stocking practices to support increased requests for high-efficiency equipment and QI.

Key Initiative Elements

These objectives will be achieved through three key elements. The first is to promote energy-efficient HVAC equipment and QI on the basis of customer value through increased efficiency (e.g. increased comfort, lower bills etc.) as well as through the availability of incentives, known as “Cash Back Rewards” (typically $150-200 per unit). A Cash Back Reward is provided to help overcome the high first-cost barrier (as well as other barriers) of high-efficiency HVAC equipment.

A second element of the Initiative is to provide consumers with accurate and useful information about the value of high-efficiency equipment that is installed and maintained in a quality manner, as well as helping them to identify what QI is and may cost.

The third element is to expand the opportunity for HVAC providers to improve the service offered to consumers. This is done by providing opportunities for contractor training

[7] A 90-plus AFUE furnace is a furnace that has an annual fuel utilization efficiency (AFUE) of 90% or more. The AFUE is a laboratory-derived measure of the system's efficiency considering certain types of losses incurred for start-up and cool-down, and other real-world operating losses. To qualify for ENERGY STAR, an oil or gas furnace must have an AFUE of 90% or higher.

[8] In addition to offering higher efficiencies than standard A/C motors, Electronically Commutated Motors (ECMs) are valuable to improving system efficiency due to their variable speed capability, which allows more effective and efficient matching of supply to load requirements. This capability allows improved air flow across a range of static duct pressures typically found in residences and higher efficiencies at full or partial loads.

[9] High-efficiency central air conditioners are defined as SEER 12 units. Additional incentives are offered for SEER 13 or above efficiency levels.

and testing, establishing appropriate standards for QI, and providing HVAC contractors the opportunity for greater visibility through a voluntary certification program based on training and testing (written tests such as NATE and field exams).

Initiative Implementation

WECC has chosen to implement this effort through HVAC suppliers, distributors and trade organizations, rather than directly with HVAC contractors. There are several reasons for this decision: 1) sustained market change is only viable if all key actors in the HVAC industry see a reason to change; 2) HVAC suppliers/distributors have a strong profitability interest in increasing the market share of high-efficiency equipment; and 3) HVAC suppliers/distributors have an established and ongoing relationship with their contractors that makes them a better salesperson for the program than "folks from the state." HVAC suppliers/distributors also provide a more practical and cost-effective way to disseminate information and training opportunities.

All of the HVAC suppliers/distributors/trade organizations in Wisconsin, or serving Wisconsin, have agreed to participate in the Initiative. WECC has used a "train the trainer" approach and has taught the suppliers' instructors about the program, who in turn (with WECC assistance as needed) train their contractors. As of March 2002, approximately 16 suppliers, representing 2000 HVAC firms, are participating in the effort. The current program participation requirements are described below.

The first requirement pertains to the availability of Cash Back Rewards. A customer reward is only available for eligible equipment after the contractor has gone through a Consumer Checklist with a customer, explaining the benefits of high-efficiency equipment and QI. The checklist also provides information about how and why to select high-efficiency equipment, as well as information about other public benefits program availability.

The second participation requirement mandates that the HVAC firm must have its technicians and salespeople attend at least eight hours of training on topics such as quality installation similar to those set forth in CEE's QI Spec. In addition, marketing guidelines exist that require advertisement pre-approval by WECC. The emphasis of the advertisements must be on the value of high-efficiency equipment rather than the presence of a Cash Back Reward.[10]

For the first year of the Initiative, QI requirements will be voluntary and additional incentives (beyond those for high-efficiency equipment) will be provided for a quality installation. However, the HVAC industry has been informed that after a reasonable time for training and testing, customer rewards may be limited to contractors who can pass appropriate QI tests. In addition, efforts are underway with the Wisconsin Technical College System to better integrate HVAC QI and "whole-house" curriculums into core and elective HVAC courses. These improved training opportunities, together with the development of voluntary certification opportunities such as NATE, will allow the HVAC Initiative participation requirements to be raised in the future.

[10] The majority of the marketing funds for the Initiative are being supplied by the HVAC suppliers or contractors.

Evaluation and Initiative Success

The Efficient Heating & Cooling Initiative will not be an easy or quick success. It was developed to address the various actors in the HVAC industry who have significant barriers to their participation in increasing the market share of high-efficiency equipment. The Initiative's success will be based on cooperatively working with the HVAC industry and creating a more appropriate perception by both industry and consumers of the value in high-efficiency equipment and quality installation. The program will be evaluated through actual savings (kWh, KW, and therms), market indicators (such as increases in inventory and contractor-sponsored promotions), and increased consumer demand.

The Wisconsin program, while not yet validated by results, includes the significant market actors necessary for a comprehensive and successful program. The focus of the program is on technicians and installers, who are addressed through training and certification. The salesperson is included in the program through a requirement for 8 hours of sales training. And while the consumer is not a primary focus of the program, an education and marketing campaign, as well as a cash incentive, serve to address this market actor.

Technician Certification and its Role in QI

Properly trained and certified technicians are an important component of residential HVAC QI. North American Technician Excellence (NATE), a certification program for HVAC technicians, has worked extensively with the efficiency community, and is now supported by the entire industry. NATE was created in 1997 as the result of an industry-wide effort to create an independent, voluntary technician certification program providing more efficient installation, service, and operation of HVAC equipment. The new, unified NATE test is the result of input from industry associations, including ACCA, RSES, and the Plumbing-Heating-Cooling Contractors (PHCC).

Among NATE's supporters are HVAC manufacturers, trade associations, utilities, wholesalers, educators, technicians, and contractors. Allies include ACCA, ARI; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE); Building Performance Institute (BPI); Electric Power Research Institute (EPRI); Gas Appliance Manufacturers Association (GAMA); RSES; U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA).

The NATE test has been designed with four unique factors that add value to NATE certification. These include focus, job relevancy, inclusiveness, and independence. The certification exams are not static, but changing and evolving to reflect current industry knowledge and best practices. Test questions are reviewed and maintenance is regularly performed at Technical Committee meetings.

Only technicians who install or service HVAC equipment can be NATE-certified. Certification is valid for a five-year period and to remain qualified, the technician must re-certify at regular five-year intervals throughout his or her career. Technicians can be certified in either *installation* or *service* of HVAC equipment. In addition to core tests for installation or service, there are currently five specialties in which a technician can become certified: air-conditioning, air-to-air heat pumps, air distribution, gas heating, and oil heating. To date, 10,500 technicians nationwide hold NATE certification.

In 2001, NATE worked with CEE to improve the quality and volume of specific efficiency-related test questions on the certification exams. CEE sponsored an expert to participate in the Technical Committee meetings and be responsible for test question revision and new question approval. As a result, 35 test questions – specific to airflow, charge, and proper sizing – were added to the test question bank. These questions are now drawn at random to appear on the certification exams.

In the future, NATE will continue to focus on improving its certification exams and increasing the role that efficiency plays in them. NATE has begun discussions with the DOE regarding the development of a specific energy-efficiency specialty test. This specialty certification would be available for use by efficiency programs nationally, and would offer a way to market and distinguish contractors with technicians capable of performing QI.

Certification programs such as NATE are an effective way to address technicians and installers in QI. In order to be successful, though, even certification programs must include other market actors. Consumer education is needed to drive demand for certified technicians. NATE has recently introduced the Consumer-Contractor-Connection, a searchable web database for consumers to locate contractors who have NATE-certified technicians.[11] To address the salesperson, NATE is considering adding more questions to its certifications that are targeted to this market actor, including an emphasis on system sizing and specification.

Conclusions and Recommended Next Steps

Although they have been supported by the nationwide initiatives of CEE and ENERGY STAR, to date QI programs have existed in geographically isolated parts of the country. The programs presented above demonstrate that addressing QI by focusing on each important market actor has been successful on a statewide scale. CEE asserts that, with national coverage, the programs could be even more successful and could lead to transformation of the residential HVAC installation market.

If any program argues for a multi-element approach, it is residential HVAC installation. Because of the many market actors involved, there is a greater opportunity for failure than for other products or services typically promoted by efficiency programs. For example, under one scenario, if the salesperson over-sizes a system and then a technician installs the equipment efficiently, significant savings are lost. A second scenario could include a consumer who demands QI and seeks out a qualified salesperson but who can find no technicians to perform it. Unlike other programs, a simple financial incentive is not adequate to address the potential barriers to QI. CEE proposes a comprehensive program approach that includes each of the following critical elements, drawn from the programs highlighted above:

- Consumer education through marketing
- Technician training on QI
- Technician certification through a nationally recognized organization
- Salesperson training on proper sizing and selling “up” to high-efficiency equipment and installation

[11] The web database is available at http://www.natex.org/natex/consumer.asp.

- Use of resources from national initiatives such as CEE and ENERGY STAR
- Targeted incentives where appropriate

CEE suggests an ongoing forum for practitioners to participate in discussions on how best to include QI in residential HVAC programs. By pursuing quality installation of residential HVAC equipment, efficiency programs can deliver energy savings, increased comfort, and improved equipment performance to their customers, all while working within a nationwide effort to transform the installation market.

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