Improving Residential HVAC Installation Practices by Transforming National Markets

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ABSTRACT

This paper provides background on HVAC installations and opportunities for stakeholders in the residential HVAC sector to transform market conditions. The authors identify four market conditions that should exist if quality installations (QI) are to become more prevalent. To achieve these market conditions, the authors make recommendations about specific market transformation approaches that need to be implemented by key stakeholders to move the market, en masse, to a quality installation focus.

Introduction

Over the past decade building scientists have concluded that equipment installation, including the duct system, significantly influences the performance of the HVAC system.[1] For example, a high-efficiency air conditioner with duct leakage may waste significantly more energy than a properly installed lower-efficiency unit. Further, an improper installation may result in discomfort and could lead to poor indoor air quality and structural degradation. Figure 1 presents four key components of a quality installation, as well as key benefits.

QI will minimize these problems and lead to numerous stakeholder benefits. Unfortunately, while equipment efficiency has dramatically increased over the past two decades, there is little evidence that residential installation practices have improved. While many HVAC contractors purport to perform QI, actual practices usually aim for a code-compliant installation. Some installations are substandard, and result in poor performance and risks to health and safety. This is despite the efforts of several stakeholders, including programs, to promote the installation of high efficiency equipment using equipment rebate strategies.[2]

Improved residential HVAC installation practices would benefit equipment manufacturers and distributors (reduced warranty exposures)[3], HVAC contractors (reduced call backs), utilities and other efficiency program administrators (energy and peak demand savings), and most importantly, consumers (improved comfort, health, safety, reliability, and efficiency).

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[1] Installation decisions that affect system performance are commonly broken into four categories: equipment sizing/selection, duct system design/installation, air flow over the indoor coil, and refrigerant system/charge. For more information on these aspects of a quality installation goto www.acca.org and http://www.cee1.org/resid/rs-ac/hvac.php3. For details on the prevalence and energy savings potential of addressing each component see Neme et al, 1999.

[2] Numerous efficiency program studies have documented that installation problems persist even with increased efforts to promote a higher efficiency product through rebates. This suggests that while effective in moving the box, equipment rebates are not necessarily effective in changing installation practices.

[3] In the first quarter of 2003 alone according to a warrantyweek.com report HVAC/R vendors spent some $560 million or 1.9% of total product revenue on warranties.

All participants in the value chain such as manufacturers, distributors, trainers, certification authorities, federal entities, and nonprofit organizations play a potentially important role in promoting QI. The importance of in-field HVAC system performance to these stakeholder groups has resulted in a number of simultaneous but varied efforts to improve installation practices. These efforts, often driven by the strengths of the sponsoring institutions, are varied in approach, reach, applicability and ultimately success. Limited coordination among stakeholders has occurred, however the diversity of this market and the state of the industry requires a unified, well-coordinated national effort among stakeholders to bring meaningful change.

Key Stakeholders

Stakeholders in the residential HVAC marketplace can be placed into four generalized categories: 1) direct market participants (e.g. manufacturers, distributors, contractors, architects, engineers and consumers), 2) market influencers such as supporting industry organizations (i.e., trade associations and professional societies) and efficiency program administrators (including utilities, state energy offices, regional and national nonprofit entities), 3) governmental entities (EPA and DOE in particular), and 4) others interested in building sciences and policy (environmental, research, and advocacy organizations). Key stakeholder groups are discussed in additional detail below.

Direct Market Participants

The group of stakeholders that most affect HVAC installation practices is the direct market players that manufacture, distribute, install, service, maintain, and sell the equipment. The most common sales channel for residential HVAC equipment is:

Manufacturer Þ Distributor Þ Contractor Þ Consumer

Each of the downstream market participants depends on their upstream supplier, and for a consumer to receive a QI all of these actors in the value chain must take the necessary steps. The manufacturer must produce a reliable, high-efficiency product as well as provide the necessary information for installers to optimize the equipment for peak performance. Ideally, the manufacturer provides product training, technical support, and takes other actions to aid the installer. Distributors must make the decision to stock quality, high-efficiency equipment and parts, and often need to act as a conduit between the contractor and the manufacturer in providing product technical support. Contractors must make the decision to establish long-term relationships with customers by providing QI (and ensure their sales people, installers, and service technicians are capable of doing so). They must take the time to listen to customer needs, sell the consumer the proper equipment, explain the benefits of QI and then follow through, even when demand is high. Lastly, the consumer needs to demand QI and hold the contractor accountable for delivering it. At a minimum, the consumer needs to know what questions to ask.

Supporting Industry Organizations

In addition to the direct market participants, numerous organizations exist to support the HVAC industry. These include nonprofit trade organizations that represent and support

manufacturers, contractors, and technicians; testing and certification organizations; training and education groups; and the numerous businesses that manufacturer and sell the tools and technologies used by technicians to properly install, diagnose, and maintain equipment. Many of these organizations take steps to promote QI and are integral to any national effort. Trade organizations are also logical points for industry-to-industry discussions and coordinating efforts.

Efficiency Program Administrators

While not directly involved in the sale or installation of equipment, efficiency program administrators affect the market for these goods. Electric utilities provide the energy necessary to operate air conditioners and heat pumps and could theoretically be included in the supply side of the market. In addition to utilities, efficiency program administrators include state energy offices, state research and development authorities, state regulatory commissions, and nonprofits. These organizations are often viewed by consumers as experts in energy related issues, and at times serve as a credible third party resource regarding the purchase of equipment and services. Program administrators also have many useful resources to promote QI such as relationships with local HVAC contractors, consumer outreach efforts, and public or system benefits funds.

Efficiency programs are as diverse as the types of organizations offering them. Most employ some type of financial incentive to promote energy-efficient products and services. Rebates have become less prevalent due to their high costs and because the goals of some efficiency programs have shifted to changing consumer attitudes and purchasing habits in the long run. Yet rebates and special financing are still very common for high-efficiency HVAC equipment and likely serve a function in overcoming some market barriers such as reducing risk for contractors and overcoming first-cost issues for consumers.

Because the residential central air conditioner and heat pump standard is set to increase on January 23, 2006 the energy savings potential of promoting high-SEER equipment will decrease and many programs will be compelled to demonstrate savings through other strategies. Promoting QI is a logical direction for programs to move. Some efficiency programs already work to improve the efficiency of the entire HVAC system by promoting QI. A variety of approaches have been used, including training, consumer education, incentives for NATE technicians, and in-field verifications. The New York State Energy Research and Development Authority (NYSERDA) has adopted a "whole-house" approach that promotes QI through home performance incentives. Whole-house programs also exist in a growing number of other states.

Federal Government

In addition to playing a regulatory role in the HVAC industry, government agencies are also heavily involved in voluntary energy efficiency programs. The Environmental Protection Agency (EPA) oversees the ENERGY STAR HVAC program, which maintains a specification for high-efficiency air conditioners and heat pumps. In addition to offering a powerful nationally-recognized brand for high-efficiency HVAC equipment, EPA has also promoted QI through: duct sealing guidelines; consumer education and marketing campaigns; QI sessions at partner meetings; facilitating an installation best practices working group; and providing funding to nonprofit groups to conduct pertinent research and facilitate meetings that address QI.

Figure 1: Benefits and Necessary Elements of QI

Element	Discussion
Sizing/Selection:	The air conditioning or heat pump equipment must be sized per the methodology described in ACCA's Residential Load Calculation (Manual J®). Manual J considers a multitude of factors such as building size, type, orientation, construction materials, fenestration, air leakage in the house envelope, solar orientation, and placement/level of insulation just to name a few. Common rules of thumb are pointedly not part of the procedure and inflating estimates is also strongly dissuaded. Since rigorous load calculations are seldom performed, systems are commonly oversized, resulting in higher energy consumption (due to cycling), poor humidity control and thermal conditioning, higher humidity, and higher first costs and on-going expenses for the consumer.
Duct System	A properly installed HVAC unit includes a well-designed duct system (i.e., per ACCA's Manual D® Residential Duct Systems). The duct design and installation make a large difference in both the cost and the effectiveness of the system. Most important are the size & location of ducts (conditioned or unconditioned spaces), degree of duct tightness, and level of duct insulation. Ducts are very important to indoor air quality, as they can be pollutant pathways to distribute airborne contaminants throughout the entire home if not properly sealed and protected from contamination. A high-quality duct system is sealed, sized properly, located within conditioned space when possible and insulated properly when not.
Air Flow over the Indoor Coil	Air conditioners and heat pumps have a recommended air flow range that is intended to balance dehumidification with sensible heat transfer (comfort cooling). However the airflow recommended by manufacturers is not always achieved due to incorrectly setting or failure to adjust fan speeds, and/or ducts that are poorly designed or improperly installed. Too much airflow may increase duct leakage and lead to inadequate dehumidification or it can cause condensed moisture to be blown back into the supply air stream causing upstream indoor air quality problems.
Refrigerant Charge	While air conditioners and heat pumps are shipped pre-charged from the factory, technicians must remove or add refrigerant to optimize system performance. The appropriate amount of refrigerant in a split-system air conditioner or heat pump depends on the length and diameter of the lines connecting the indoor evaporator coil to the outdoor condenser coil. Field studies have found that more than half the systems are incorrectly charged (Neme, et al 1999), which leads to efficiency losses, insufficient cooling, and premature equipment failure. To properly adjust refrigerant charge, the superheat method on non-TXV or sub-cooling methods on TXV systems are the most commonly recommended methods to check and adjust the charge.

Benefits of a Quality Installation

- Energy savings (reducing pollution and operating costs)
- Peak demand savings (increase grid reliability & reduce system expansion needs)
- Better building ventilation
- Enhanced occupant comfort and indoor air quality with improved health and safety
- Equipment and distribution system downsizing (first cost to consumer, energy savings)
- Reduce the manufacturer's and contractor's liability exposure and potentially lead to lower insurance costs
- Reduced noise and vibration
- Increase equipment life, reduced equipment maintenance costs
- Increased durability of the related building systems
- Highly satisfied customers

Successful Promotion of QI Requires Stakeholder Coordination and Buy-In

Despite decades of intervention by various stakeholder groups, several factors have prevented any single group from gaining enough momentum to improve installation practices; among the most critical are the complexity of the industry, the perceived financial risk to contractors of providing QI, and the pressure on technicians to turn jobs around quickly because of a shortage of technicians. The authors believe that numerous organizations have roles to play, especially those with the resources to overcome the hurdles discussed in the next section.

The entities participating in a product's distribution chain (e.g. manufacturers, distributors, and retailers.), trade allies who are responsible for specifying and installing targeted products (e.g. contractors, engineers, builders), organizations responsible for implementing an efficiency program (e.g. utility companies, state offices, and special coordinating organizations), brokers/facilitators with knowledge and breadth of contacts (e.g. government agencies and trade associations), and other interested parties (e.g. research organizations and advocacy groups) all have a vested interest in QI. The authors believe that market transformation efforts should be designed to actively involve all of these stakeholders, but before taking action, stakeholders must agree on the market conditions that must exist for QI to be more prevalent, and which groups are best equipped to promote QI to ensure consistent messaging and calls to action.

Current Market Conditions: Why QI Isn't the Norm

Poor installation practices in the residential HVAC marketplace are the result of multiple factors. Six of the most significant market barriers to QI are summarized below. Figure 1 describes additional market conditions leading to poor installation practices.

Most Consumers Don't Understand the Benefits of a Quality Installation

Perhaps the single most important market factor leading to improper HVAC installations is lack of consumer demand for QI. This is directly related to a lack of knowledge regarding their HVAC systems. Most homeowners don't know when their HVAC system is incorrectly installed, and rarely link a poor installation to uncomfortable humidity, uneven temperatures, mold or moisture problems, high utility bills, or poor indoor air quality. This lack of knowledge causes consumers to depend on the advice of the contractor and to often base their purchase decision solely on price—not on the value of QI.

There Isn't an Easily-recognizable Brand or Image for Quality Installation

Given the complexity of HVAC installations, consumers need a simple way to identify QI. North American Technician Excellence (NATE)[4] has potential to become a brand of quality;

[4]North American Technician Excellence (NATE), has emerged as a leading technician certification organization and receives broad industry and efficiency program support. NATE was created in 1997 as the result of an industry-wide effort to create an independent, voluntary, technician certification program. Test questions are developed with input from many industry associations, including ACCA, RSES, and PHCC. NATE is now working with these industry groups as well as the efficiency community to develop an energy efficiency specialty test that will allow technicians to demonstrate expertise in the design and installation of high-efficiency HVAC systems.

however, consumers tend to hire a contractor, not a technician. Further, even technicians who have the expertise to become NATE-certified may not choose to provide QI. Field studies would be needed to demonstrate that NATE technicians are indeed providing QI.

ENERGY STAR also has great branding potential given its high levels of awareness for quality and efficiency; however, EPA has stated that they will not support an ENERGY STAR Contractors program. Efforts are underway to explore other ways the ENERGY STAR brand can be leveraged to promote QI. In order to develop a brand for QI, definitions for quality contractors and QI that are agreed upon by all stakeholders are necessary.

Most Equipment Replacements are Unexpected, Unplanned Purchases

Of the approximately 6 million unitary shipments reported by ARI in 2003, roughly 55-65% are replacements. Many of these installations are the result of equipment failures during peak periods (winter for furnaces and summer for air conditioners). During these times, contractors often experience a demand for services that cannot be met by their normal staffing. This issue is compounded by a labor shortage of qualified technicians. Additionally, consumers tend only to demand the level of comfort and efficiency delivered by their previous system. Given that consumers simply want the heating or cooling to be restored, and contractors feel pressure to replace the equipment quickly, technicians have an incentive to focus more on the turn-around-time of jobs than on quality (Lawrence and Jenkins 2000). Only to exacerbate this situation, few consumers plan for such emergencies resulting in a household financial crisis and prioritization of up-front costs above life-cycle costs. Financing might be effective in overcoming this barrier, yet consumers continue to choose HVAC equipment based on price rather than value.

A Shortage and High Turnover of Technicians and an Excess of Quasi-contractors Exist

One of the most commonly listed job postings today is for HVAC technicians. Just to meet today's demand for HVAC installation and maintenance services requires 20,000 new entry-level technicians entering the field each year (ARI 2003). This shortage of technicians and high volume of work further influences a contractor's willingness to allow low-quality installations. Important steps such as performing a load calculation[5] or sealing ducts are often omitted if they result in time savings. The excess demand that can't be met by quality contractors favors the poorly trained, unlicensed or otherwise unqualified individuals installing HVAC systems.

To make matters worse, the best technicians often desire to be independent businesspeople. Great technicians are not always good businesspeople, and this creates additional competition for established contractors trying to sell on health, comfort, and safety, more than first cost. High turnover of technicians also reduces a contractor's willingness to provide or pay for training or certification.

Quality contractors often cite the challenge posed by untrained individuals who simply post signs on their vehicles advertising HVAC installation services. Even when contractors seek to adopt a more value-added business model that embraces QI, unlicensed contractors will cut

[5] Worth noting, is that technicians are not always responsible for performing the load calculation. For larger contractors, designated sales personnel decide equipment size and they are often commission based. Because larger systems cost more, installers have an additional incentive to oversize.

corners and offer prices and turn-around times impossible for a quality contractor to match. These "fly-by-night" contractors take advantage of uninformed consumers and the absence of an enforcement entity that provides quality control or even defines "what is a quality contractor." In addition these "fly-by-nights" often will provide valueless warranties, have no insurance and create poor perceptions of the industry in the consumers' eyes.

HVAC Contractors and Consumers Have Different Perceptions

Contractors perceive that a customer's replacement decision hinges on how quickly and inexpensively the new unit can be installed. This sense of urgency likely contributes to contractors' reluctance to market QI. Because they believe consumers expect the new equipment to be installed quickly, contractors seldom take the time to discuss the customer's concerns and promote the values inherent with high-efficiency equipment and QI, however a survey found contractors generally assume a greater urgency for replacements due to breakdowns than consumers do (Lawrence and Jenkins 2000). The survey also found that contractors promoting QI report customers are willing to opt for a QI if the salesperson takes the time to address their needs and explain the benefits of a QI as part of the relationship building process.

Figure 1 Additional Market Factors Discouraging Quality Installation

- Limited number of states with licensing requirements for mechanical contractors, and minimal enforcement by those who do. Licensing requirements are seldom based on a core-level of contractor competencies.
- HVAC industry is undervalued by consumers
- Higher up-front costs of a QI
- Varying and inconsistent definitions of QI
- No national accreditation organization for HVAC contractors
- Inexpensive energy costs in some regions limits the future value of saved energy costs

Recommended Market Conditions That Will Lead to QI

Many efforts are already underway to transform the market to promote the installation of high-efficiency equipment that will perform optimally in the field. While there have been successes, consumers are still more likely to have HVAC systems that have been installed improperly than systems that have been installed to optimize performance. This is likely because while some of the *necessary* market conditions for a QI now exist, those conditions are not currently *sufficient* to catalyze market transformation in the direction of QI. Key stakeholders have begun to identify both the *necessary* and *sufficient* market conditions that must exist for QI to become more common. We discuss below four of the most important market conditions that should exist for QI to become more common. While collectively these conditions may still be insufficient to transform the market, the authors wish to initiate dialogue and begin a nationwide effort to identify and, through existing infrastructure, implement sufficient market conditions.

1. Stakeholder Agreement on the Definitions of "QI" and "Quality Contractor"

While several sets of "good practices" for residential HVAC exist, there is still not universal agreement by stakeholders on which practices to promote and which characteristics a contractor must posses in order to be considered "quality." In order to enable coordinated marketing, education, training, technician certification and contractor accreditation programs,

agreement on what defines a QI is imperative. Messaging must then be correctly tailored for different audiences, and ideally these messages will be delivered in a unified fashion once the capability to consistently deliver QI is developed. While the definitions should ensure consumer benefit, consumers need not be involved in defining QI. At a minimum, manufacturers, contractors, certification organizations, efficiency program administrators, and the federal government must agree on this definition.

Before 2000, there was no document of "best practices" that technicians could reference. At that time CEE developed a QI specification that could be used nationally. The QI Spec compiles existing research on best practices for technicians and installers to use in the field. This document provided an important market condition for installation practices to improve, but has not yet been fully accepted by all stakeholders as the single reference for technician practices. Also, the CEE QI Spec's high-level of detail may not be appropriate for less technical audiences.

In 2003, ACCA published a new document to assist contractors in providing better indoor environments in an energy efficient manner (*Good HVAC Practices for Residential and Commercial Buildings: A Guide for Thermal, Moisture and Contaminant Control*). The guide helps HVAC contractors and designers identify and incorporate recognized industry practices into their business operations. With citations to relevant ACCA manuals, ASHRAE standards, and other technical sources that facilitate "good practices," the document provides a sound basis for contractors to have greater influence on the performance of the HVAC system, from the planning stage through installation, commissioning, and maintenance stages. Additionally, the guide introduces building diagnostics approaches to verify and document the multi-step processes needed for the new and replacement/retrofit markets.

2. QI Can be Verified and Measured in the Field

For stakeholders to successfully promote QI, it must be feasible to identify when QI has been performed. Ideally the existence of QI would be identified and measured through a system performance metric. At a minimum, a checklist of prescriptive requirements—based on the definition of QI accepted by all stakeholders—must be verifiable. Differentiating between a standard installation and QI will allow stakeholders promoting QI to ensure it was achieved and combat invalid claims by low-quality contractors. Documentation of the impact of QI in terms of health, comfort, safety, and energy savings by measuring system performance would also empower consumer-marketing campaigns and enable efficiency program administrators and the federal government to more-easily justify expenditures.

3. Supply-side Market Players are Able and Willing to Deliver QI

In order to transform the market so that QI increases, consumers must be able to obtain the necessary products and services specified by the agreed-upon set of good practices. This requires: 1) manufacturers producing equipment capable of performing optimally; 2) distributors stocking and promoting high-efficiency, high-quality equipment; 3) contractors choosing to promote this equipment and being committed to delivering QI; and 4) trained technicians and/or contractor sales staff willing and able to take all steps necessary (e.g. performing a Manual J and ensuring proper refrigerant charge) to deliver a QI.

To achieve this ability in the marketplace, an adequate supply of capable and readily identifiable technicians must be present, which requires recruitment, training, and certification.

QI must be considered cost-effective to consumers and profitable to contractors. The authors recognize that sufficient consumer demand will likely precede development of a mature and comprehensive infrastructure, but the desire of quality contractors to differentiate themselves in the marketplace will help drive development.

4. Consumers Value the Benefits of QI and Can Identify and Select QI in the Marketplace

The most effective way to encourage the supply side to deliver QI is by stimulating consumer demand. This requires education on the key concepts, marketing of the benefits, and a recognized, respected brand or image that can be promoted by stakeholders and easily identified by consumers. All stakeholders would offer a consistent message of the benefits associated with QI: health, comfort, safety, and lower utility bills because of energy savings. The benefits that matter most to consumers would be stressed. Anecdotal evidence suggests that consumers care more about health, comfort and safety than efficiency, but as energy prices increase, utilitiy bills will become a more important factor. Also, evidence in the form of field studies and laboratory investigations are necessary to measure and demonstrate the consumer benefits. Given consumers are not homogenous, stakeholders will likely need to target a base of consumers who are more apt to care about different benefits of QI.

Conclusion: A Call to Action

Achieving these market conditions requires significant stakeholder action. While much work remains, there are instances when all the necessary conditions exist and QI is delivered. Sometimes all it takes is a quality contractor—one that employs qualified technicians and works through a distributor that stocks quality products—doing the job right. However, because of the prevailing market conditions, this is uncommon as quality-focused contractors are outnumbered.

In other cases, a consumer demands one or more of the benefits that accompany QI, and he or she is able to identify a contractor that will be able to deliver these benefits. A quality-committed contractor's sales staff is able to explain how equipment size, refrigerant system, duct system, proper equipment startup and maintenance are all necessary if the customer is to receive those benefits—and, the customer is willing to pay for those services. The technician, who is properly trained and certified, correctly installs the HVAC system and is able to suggest other home improvements that would further improve the system's ability to deliver the desired benefits. In this scenario, the customer notices improved comfort and lower utility bills. Further affirmation that QI was delivered comes when a credible third party verifies the job. The customer then tells friends and neighbors about the positive experience, and the contractor uses this satisfied customer to recruit new customers. The authors believe that creating the aforementioned market conditions will increase this occurrence. Some of these market conditions are starting to be form:

- The ENERGY STAR brand, which is recognized by many consumers as a symbol of high-efficiency, is taking steps to promote QI and system performance.
- CEE's QI Specification and ACCA's *Good Practices*, both of which reference the ACCA Manuals and ASHRAE Standards, have much in common and some organizations point to them for the definition of QI; however, consensus among all stakeholders on the definition of QI still does not exist.

- Numerous training organizations are preparing technicians for testing and certification, although the quality and materials covered vary dramatically.
- NATE is the preeminent national HVAC technician testing and certification organization. Yet the number of NATE technicians is still relatively small and prevailing market conditions may discourage a qualified technician from performing QI.
- The Building Performance Institute offers "whole house" contractor accreditation in New York, but a national accreditation organization does not exist.
- Efficiency program administrators across the country are taking steps to promote QI; however the approaches vary and coordination with trade allies has been insufficient. Further, equipment incentives may contribute to a consumer focus on price and not value.

This paper presents ideas on why current market conditions do not lead to QI, and proposes the necessary and sufficient market conditions required for QI to become more widespread. Achieving these market conditions will require stakeholder coordination and an action plan that establishes strategies and sets goals for market change. Such strategies and goals must evolve as intermediate goals are accomplished and new information becomes available. The authors present the following actions stakeholders will likely need to take in order for the sufficient market conditions to exist. The timing of these actions is critical, and must be considered as stakeholders move to take coordinated action.

Create a Stakeholder Group Dedicated to Coordinating a Multi-Industry QI Campaign

For coordinated stakeholder action to occur a forum for interaction must exist and be facilitated by a neutral third party. This group could establish the consensus definition of QI, work to support supply-side players promoting QI, and ensure consistent messaging to consumers. Key to this group's success is agreeing on long-term goals, creating an atmosphere of mutual respect, acknowledging that stakeholders will act in their economic and political self-interests, and obtaining a commitment from participants to align their interests to a sufficient degree that coordinated action can be achieved. This would be a group representing the vested interests of all the various stakeholder organizations. This is likely to be a separate and autonomous body established with the sole interest of completing this mission.

Develop a Consumer Marketing Campaign that Focuses on Health, Comfort, and Safety

While energy savings are an important benefit of QI, anecdotal evidence suggests the other consumer benefits are more tangible (such as indoor air quality and comfort) and should be stressed. Contractors report that selling QI based on efficiency alone is difficult. Regardless of the benefits stressed in the marketing campaign, all the benefits that accompany QI, including energy and peak demand savings, will be realized. Part of this campaign should also work to change consumers' purchase decision so that it is based more on the total lifetime costs of the system, rather than the first cost. This will drive consumers to think of the initial expense as an investment and to demand the greatest value (in terms of comfort, health, safety, and energy efficiency). To the extent possible, the ENERGY STAR brand should be used to market these benefits. Prevailing evidence suggests the contractor is the main source of consumer information. Hence, providing tools to contractors to differentiate themselves and sell to consumers should

play an important role in the campaign. Efficiency programs have often established credibility with consumers and should also be very involved in marketing.

Establish Credible Third-party Measurement and Endorsement of QI

In-field measurements of home performance with and without QI will demonstrate the benefits, expose low-quality contractors, facilitate efficiency program evaluation, and provide necessary data for continuing to improve and update technician practices. Identification and labeling of QI by a credible party will simplify consumer efforts to obtain QI and enable stakeholder promotion of QI. Neutral third parties are also necessary to lend credibility to contractor claims that the added time and expense of QI are worthwhile. Not every installation must be evaluated, but a certain percentage must be checked to ensure workmanship is acceptable and meets the agreed upon requirements of QI. Efficiency program administrators, the federal government, and nonprofits are all potential candidates for carrying this out.[6]

Support NATE and Technician Training

NATE is a primary example of a highly credible, third party organization in the HVAC market.[7] Stakeholders can promote NATE by opening additional testing centers, providing preparatory education, and providing financial aid or other resources for training and testing.[8] In addition to the ongoing promotion of NATE certification, core competencies contained in the NATE exam should be worked into building codes and state licensing requirements. Efforts to work closely with NATE on completion of a specialty certification exam in energy efficiency should be of paramount importance. Stakeholders should be evaluating the value of promoting NATE as a household brand name for quality and efficiency (and ensure that it compliments ENERGY STAR). Quality assurance/quality control programs also must exist to verify NATE technician skills in the field. Development of sales staff certification to facilitate proper equipment selection by consumers is a logical next step for NATE.

Develop a Contractor Accreditation Program

Unfortunately, technician certification is likely not sufficient to increase the number of consumers obtaining QI. When purchasing a new HVAC system, consumers choose contractors, not technicians and therefore NATE has potential limitations as a national brand for QI. In many cases technicians will only pursue NATE certification if their employer (the contractor) supports

[6] A potentially suitable proxy for third-party measurement of QI is to develop and implement whole house energy assessments. Testing every home would enable consumers to evaluate houses based on their performance rating. If the value of a house depended on its efficiency, then consumers would be more likely to demand QI. Efforts to work with property assessors, appraisers and the real estate industry are one avenue to explore.

[7] It is important to note that NATE does not conduct any training. A certification body is to remain independent. NATE relies on the HVAC industry to properly train technicians.

[8] Anecdotal evidence suggests that training & certification has a direct correlation to actual in-field performance of installed equipment. Through the State Technologies Advancement Collaborative (STAC) NYSERDA, utilities in New Jersey, and NEEP (Northeast Energy Efficiency Partnership) have partnered to examine this issue. To the authors' knowledge, this will be the first attempt to document the impact of trained & certified installers vs. untrained and uncertified installers on installation quality & in-field system performance. Results are expected in Fall 2005.

it. Even technicians with the knowledge to perform QI may only do so if the contractor embraces quality over quantity. Tying contractor accreditation to NATE technician certification will likely reinforce and increase the value of NATE, including the possibility that NATE could become a national symbol for QI.

If comprehensive in nature, contractor accreditation could also address the fact that technicians often do not specify (in terms of size or efficiency) which equipment gets installed. The Federal Government could play a role in setting, or funding the creation of, guidelines for contractor accreditation. Once these guidelines are set, stakeholders that meet these guidelines could become accreditation organizations. DOE has previously offered to fund creation of a "National Accreditation and Certification Program for Installation and Acceptance of Photovoltaic Systems." The authors believe a similar effort for HVAC contractors would be beneficial.

In the absence of movement by the federal government, stakeholders should collectively establish the parameters that accrediting bodies need to operate under and authorize organizations to fulfill that mission. These accreditation organizations would be under the same umbrella with one set of rules. All certification and accreditation programs need to adhere to stringent, uniform protocols that are internationally accepted. ANSI has developed a program to accredit personnel certification bodies based on ISO-IEC 17024. NATE is currently seeking ANSI recognition.

Level the Contractor Marketplace

Stakeholders must take steps to provide quality contractors with support and credibility. Trade allies and other stakeholder groups should coordinate messaging with quality contractors and provide joint advertising when possible. Further, field studies to document the benefits of quality installation—and the costs of improper installations—would help level the marketplace.[9] Contractors, utilities, and efficiency programs have a significant field presence and could potentially help measure and report the benefits of QI through pre and post-installation tests and continuous diagnostics.

Incentives such as special public recognition, training and financial incentives, advertising cooperatives, membership in associations, accreditation, and job leads all should be provided by stakeholder groups to encourage participation. Consequences for poor-quality contractors must exist, must be significant, and must be enforced. These could include suspension of accreditation or membership in trade organizations, exclusion from joint sponsored promotional activities, higher insurance rates or loss of insurance, loss of HVAC license, loss of business license and even criminal prosecution for fraudulent actions.

Promote Quality Installation with Efficiency Programs

In 2006, the federal minimum standard will increase to 13 SEER, diminishing the energy savings potential of promoting high-SEER equipment. This should prove a significant driver for efficiency programs to focus more on QI. Ideally, efficiency programs will promote national programs that maximize reach and influence in addition to working with local contractors and training organizations. The authors believe programs should limit the use of equipment

[9] The STAC work to be conducted by NYSERDA, NJBPU and NEEP will begin to address this need, but additional research is likely necessary.

incentives as they conflict with efforts to end using a low-price approach to selling. When incentives for equipment are used they should only be for equipment installed by a quality contractor who demonstrates consistently that they deliver QI.

Gather Additional Market Information

In order to inform and update strategies to promote QI, stakeholders should:

- Perform market assessment of current and potential consumer drivers by demographic profile
- Perform a market assessment of purchasing patterns for specified demographics
- Develop communication/marketing strategy that contains messaging and influential strategies/media/tactics for promising demographics
- Conduct ongoing assessment of Impact vs. Desired objective of implemented strategies
- Monitor key trends and identify other market players promoting QI
- Document case studies of business models used by successful quality contractors

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