Mid-market transformation programs: programs to promote best practices in system specification and installation

Mitchell Rosenberg
KEMA-XENERGY Inc.
P. O. Box 9035, 6800 ET Arnhem, The Netherlands
m.rosenberg@kema.nl

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Abstract

This paper summarizes the experience of programs designed to promote the adoption of best practices in equipment specification and installation among distributors and installation contractors in the residential central air conditioning and industrial compressed air equipment markets. For each of those markets, the paper identifies the current understanding of best practices, characterizes energy savings available from their adoption, assesses the nature of barriers to their adoption, and describes the operations and accomplishments of programs designed to address those barriers.

Introduction

Field studies of homes, commercial buildings, and industrial facilities have identified significant energy efficiency opportunities in end-use systems consisting of many components: for example residential air conditioning, commercial heating, ventilation, and air conditioning (HVAC), and industrial pump, compressed air, and fan systems. Technical studies of these systems all arrive at the same, by now, commonplace conclusion: the largest portion of energy savings available comes from the application of best practices to system specification (in relation to load), installation, and maintenance. Selection of components with high intrinsic efficiency can help, but their contribution to capturing potential savings is relatively minor in comparison.

This technical dimension of systems-oriented energy efficiency opportunities has been understood, at least in general terms, for some time. However, the systematic development of programs to capture these opportunities has only begun in the past few years. Distributors, dealers, and installation contractors in these markets – especially those serving small and medium-sized C&I customers – had not participated in the first generation of U. S. demand-side management programs. These programs had focused primarily on providing rebates for installation of fairly standard kinds of products, such as energy-efficient lighting. Improvements to HVAC and industrial process systems had generally been accomplished through customized technical assistance and project financing programs, which served primarily larger customers.

At first glance, it appears obvious that equipment distributors and installation contractors constitute the best channel for delivering programs to improve the efficiency of HVAC and industrial systems. They have direct contact with customers, and are thus aware of customer needs and interests. For larger kinds of systems, they are generally aware of at least some technical details of size, design, and operation. Most owners of HVAC and industrial systems have service contracts with their vendors for emergency and/or preventive maintenance. Thus, installation contractors, and in some case distributors, can serve as a direct link to the end-user market and to the installed inventory of targeted end-use equipment. However, for a variety of reasons, it had proven difficult, if not impossible, to draw these “mid-market” actors who stood between equipment manufacturers on the one hand, and customers on the other, into active participation in energy efficiency programs.

Table 1. Summary of Programs Reviewed in this Paper.

Program Sponsor	Program Name	Geographic Scope	Objectives and Features
RESIDENTIAL AIR CONDITIONING PROGRAMS			
Consortium for Energy Efficiency	QI: Quality Installation Initiative	National U. S.	• Develop an agreed-upon specification for selection and proper installation of energy efficiency residential air conditioners. • Advocate for incorporation of QI specification into rebate programs and technical training curricula.
U. S. Environmental Protection Agency	ENERGY STAR Residential Heating and Cooling	National U. S.	• Develop and field a national communications campaign to promote energy efficient cooling equipment. • Develop labeling specifications and program for efficient equipment. • Develop tools, training programs, and materials to assist contractors in selling ENERGY-STAR labeled models.
Joint Program of New Jersey Utilities	ENERGY STAR Residential HVAC Program	New Jersey	• Provide rebates for installation of ENERGY STAR models that meet technical requirements for efficient installations. • Contractor training and marketing support. • Consumer education.
Reliant Energy	A/C Distributor Program	Texas	• Provide financial incentives to distributors for sale of specified quotas of ENERGY STAR-qualified equipment.
COMPRESSED AIR SYSTEM EFFICIENCY PROGRAMS			
U. S. Department of Energy	Compressed Air Challenge	National U. S.	• Provide training to end-users and vendors in identifying compressed air efficiency opportunities and compressed air system management.
New York State Energy Research and Development Authority	Compressed Air System Efficiency Program	New York	• Develop compressed air system assessment techniques and tools that can be used by compressed air system vendors. • Demonstrate application of tools through development of pilot projects. • Provide technical and marketing support to vendors using the plant assessment tools.
Northwest Energy Efficiency Alliance	SAV-AIR Initiative	Pacific NW region	• Invest in company that developed an instrumented system to assess and monitor compressed air system performance. • Support piloting and marketing of the system and related services.

This paper reviews the experience of programs designed to capture energy efficiency opportunities in residential air conditioning industrial compressed air systems through promotion of "best practices" in specification, installation, and maintenance. These programs have been carried out since 2000 in the United States. Some have addressed national markets; others have concentrated on specific regions or states. Table 1 summarizes the programs reviewed. We begin by identifying the principal barriers that businesses in the mid-markets face in promoting and delivering energy-efficient products and services and the general program design strategies that have been identified to address those barriers. Then, for each of the markets addressed, we describe the nature and magnitude of the technical opportunities for energy savings through proper specification, installation, and maintenance; the particularities of market structure and barriers to their adoption; the design of two or more programs currently underway to address those barriers; and the results of those programs to date. We conclude with a section on lessons that can be derived from program experience so far accumulated.

Barriers to energy efficiency in contractor-installed systems and implications for program design

BARRIERS

Over the past five years, national and regional energy efficiency program operators have sponsored studies of the HVAC and industrial process markets in preparation for the development of programs to capture energy savings in those end-uses.[1] These studies all found that distributors and installation contractors faced significant barriers to the adoption and promotion of identified best practices in system specification and installation. Moreover, the barriers in the various markets were quite similar. The most important were as follows.

- **Markets characterized by extreme price competition.** HVAC and industrial equipment vendors operate in a business environment characterized by rigorous cost pressures. New systems are always competitively bid on

1. See for example XENERGY Inc. 2000. *National Compressed Air System Efficiency Services Market Assessment.* Washington D. C.: U. S. Department of Energy. and Chris Neme et al. 1999. *Energy Savings Potential from Addressing Residential Air Conditioner and Heat Pump Installation Problems.* Washington D. C.: American Council for an Energy Efficient Economy.

specifications developed by the owner or engineers hired by the owner. Replacement of major components is frequently competitively bid. Under these circumstances, it is difficult to communicate the value of efficient equipment to customers or to win business on the basis of lower life-cycle cost.

The effects of operating in a highly price-competitive market on vendors' interest in promoting energy-efficient products and practices extend well beyond the formal constraints of the competitive bidding process. In vendors' experience, the key to profitability is to squeeze as many costs and risks out of the operation as possible. They are reluctant to undertake initiatives that will increase sales costs, such as learning and applying new diagnostic and specification skills in the sales process. Also, contractors are reluctant to increase the risk of call-backs from customers dissatisfied with the performance of new and more efficient components or control technologies.

- **Perceived lack of customer interest in energy efficiency.** Market research surveys of air conditioning and compressed air installers consistently found that respondents believed that customers were neither interested in the energy efficiency of their systems nor willing to pay for services that would reduce energy costs. Rather, they believed that customers were much more concerned with system reliability and low costs for equipment and basic maintenance services. Combined with the effect of price competition on marketing efforts described above, this view of customer priorities dampened dealer and installer interest in promoting energy efficiency.

IMPLICATIONS FOR PROGRAM DESIGN

Based on the view of the markets that emerged from the research summarized above, program sponsors developed approaches that featured a fairly uniform set of elements. These were as follows.

- **Market assessment.** As a first step in program development, sponsors often commissioned an assessment of the local market in which the program would operate. The key objectives of the assessment were to identify key individuals and organizations whose assistance will be needed in program elaboration and marketing, characterize in detail motivations and barriers that local market actors face in promoting energy-efficient practices, and establish baseline estimates of the prevalence of advanced practice for use in subsequent program evaluation.
- **Specification of best practices.** One of the first tasks that a "best practices" program must accomplish is to define what the best practices are. Most programs approached this task by convening a technical committee or steering group composed of consulting engineers, academic researchers, program administrators, manufacturers, and distributors or contractors who have been identified as industry leaders. The committee was then charged with defining, usually in fairly broad terms, the elements of best practices that the program will promote.
- **Development of technical tools.** Once best practices are identified it is necessary to develop mechanisms to facilitate their application to specific facilities and systems. In most cases, this is accomplished through the development of tools to structure the collection of site-specific data on the configuration of the system, its loads, and patterns of operation. These data are then used to populate calculations of system energy use, to assess the applicability of typical energy efficiency measures, and to estimate energy savings available from those measures.
- **Development of sales tools.** Identifying energy efficiency measures and estimating associated savings is only part of the project development process. Equally important is convincing the facility operator, management officers, and owners to undertake the project. Best practices programs have developed a wide range of tools to accelerate and reduce the cost of selling efficiency projects. These include automated report generators, case studies, and other sales materials featuring third-party endorsements of the best practices approach.
- **Pilot program operation and assessment.** Once tools and procedures are developed, the next step is to pilot their application in the field. Generally, this is accomplished by recruiting a small number of vendors who are known to be interested in energy efficiency services and who have the resources necessary for participation.
- **Marketing support.** The rigorous price competition that characterizes target markets for best practices programs suggests that, under current conditions, customers place relatively little value on energy efficiency compared to initial systems costs and reliability. Moreover, customers are often unaware of the availability of energy-efficient products and services. Program operators have undertaken a number of tactics to strengthen customer understanding of and demand for efficiency services. These include development and sponsorship of end-user oriented training seminars in system efficiency basics, development and maintenance of web sites dedicated to the topic of system efficiency, establishment of links to other energy efficiency programs that can provide subsidization for related technical services or capital improvements, appearances at trade shows and industry conventions, and development and distribution of print materials.

Organizations that are contemplating the development of best practices programs should be aware that the sequence of steps described above takes a minimum of one year and can easily take two or three. Of course, the development of programs in "real life" has not always followed this sequence. Some sponsors have, in fact, attempted to move directly from program concept to broad-based launch. However, as discussed below, these sponsors have found it necessary to fill in the omitted steps due to disappointing response from vendors and customers.

Programs to promote efficient residential air conditioning installations

THE RESIDENTIAL HVAC EFFICIENCY RESOURCE: SAVINGS FROM PROPER EQUIPMENT SELECTION AND INSTALLATION

Energy savings in residential central air conditioning can be achieved through two basic strategies: installation of energy efficient units and application of best practices in installation. Installation of an ENERGY STAR-qualified central air conditioner (SEER 12) versus a model meeting federal standards (SEER 10) can result in energy savings of 10-18 percent of annual system usage, depending on climate, house configuration, and patterns of occupancy. Application of best practices in installation can reduce energy use by as much as 27 percent, based on analyses of field observations of 70 recent installations of new systems in New Jersey.[2] The key elements of best practices in installation include:

- **Proper sizing.** Field studies of samples of recent air conditioner installations in the field find that units are generally oversized by a factor of 50 to 100 percent in comparison to estimated cooling load, plus a "safety factor" of 25 percent. Oversizing leads to inefficiencies and accelerated system wear due to rapid cycling.
- **Reduction of outside air leakage.** The New Jersey study discussed above found that 34 percent of supply air flow was accounted for by leakage to the outdoors. This waste of energy can be drastically reduced through proper duct configuration and sealing.
- **Proper refrigerant charging.** Field studies find that, on average, two-thirds of residential central air conditioners are improperly charged – mostly undercharged. Both conditions can cause loss of cooling capacity and shortened equipment life.
- **Proper air flow adjustment over cooling coils.** Most manufacturers specify maintenance of 400 cfm air flow over cooling coils for proper operation. At flow rates below 350, the unit's efficiency is compromised. The New Jersey study found that one-half of the observed units had air flows lower than 325 cfm.

BARRIERS TO ADOPTION OF BEST PRACTICES IN RESIDENTIAL AIR CONDITIONER INSTALLATION

Although central air conditioners represent a large expense and greatly affect the utility of a home, owners only buy them once or twice during their tenure in a given house. Therefore, the level of customer knowledge concerning efficient equipment is low and their knowledge of efficient installation practices virtually nil. The New Jersey market study also found that customers generally restrict their search to one contractor, rarely obtain proposals for alternative models, and rarely seek information about air conditioning equipment from sources other than the contractor. Given this pattern of customer behaviour, it is not surprising that contractors put relatively little effort into customer education about efficient alternatives or into "selling up" to efficient models.

For their part, contractors report being deterred from actively selling efficient equipment because they perceive relatively little savings or value to the customer. This problem is compounded by the common use of field technicians and installers, who generally have little background in efficiency or sizing, to sell replacement equipment during the busy summer season.

INITIATIVES TO ADDRESS THE MIDDLE MARKET

Over the past two years, government agencies, regional and utility-based energy efficiency program operators, manufacturers, trade associations, and technical standards organizations have cooperated in a voluntary and largely informal effort to develop the elements of a comprehensive mid-market strategy to increase the efficiency of residential air conditioning installations. The following initiatives, addressing the elements of mid-market market transformation strategy are currently underway.

Development of installation standards: the quality installation initiative

The Consortium for Energy Efficiency, a non-profit organization that focuses on coordinating national energy efficiency efforts sponsored the development of a Residential HVAC Quality Installation Specification (QI Spec). The document 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 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. Utility and government energy efficiency program operators funded its development through a collaborative effort. A committee of specialists representing manufacturers, government agencies, and industry associations oversaw technical work. The QI is currently being used in training and rebate programs, building codes, and technician certification tests.

Consumer education and labeling: the ENERGY STAR Cool Change Program

The U. S. Environmental Agency's ENERGY STAR Program offers customer education and contractor training to support increased demand and delivery of best installation practices. ENERGY STAR promotes QI through its web site and the NATE certification program (described below). Promotion of the systems approach also occurred through a national HVAC advertising and public relations campaign entitled "Make a Cool Change to ENERGY STAR," which ran from April to August 2002. Many residential air conditioning manufacturers and dealers supported the campaign through co-advertising. For contractors, the promotion offers information, tools and training to enhance sales of ENERGY STAR-labelled cooling equipment. Cool Change provides support materials, including a consumer education guide that can be customized to manufacturers' and contractors'

2. XENERGY Inc. 2001. *New Jersey Residential HVAC Baseline Study.* New Jersey HVAC Working Group.

sales efforts. Of course, ENERGY STAR labels products that meet efficiency standards. Finally, ENERGY STAR program has also run a contractor training program for a number of years, which has concentrated on teaching contractors how to "sell up" to high efficiency equipment. Training curricula and tools developed for this program have been used in state and regional programs, as described below.

Utility Programs: broad application of technical and sales tools with customer incentives

A number of utilities have developed programs that make use of the Q1 specification and the sales and customer education resources developed by ENERGY STAR to support efforts to induce changes in installation practices among contractors in their local markets. Here we describe the joint efforts of the three large investor-owned utilities in New Jersey; there are similar programs in other states. The utilities had each run rebate programs to promote the installation of efficient central air conditioners in existing homes since the late 1990s. Beginning in 2000, they developed a joint program with the following features.

- **Rebates tied to documentation of proper sizing and installation.** In order to receive incentives for installation of efficient equipment in replacement situations, the participating contractors must submit forms documenting the following: minimum equipment efficiency; industry standard load calculations; measurements and calculations regarding refrigerant and airflow levels.
- **Technical training for HVAC contractors and technicians.** The program's training component includes courses on sizing methods and software, proper charge and airflow, and duct design. These courses are administered by the local trade organization, and they 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 sell efficiency to their consumers. EPA's ENERGY STAR sales training curriculum is used.
- **Consumer 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.
- **Promotion of contractors with certified technicians.** The utilities are supporting the North American Technician Excellence (NATE) certification program. Through their work with the local trade organization they are encouraging contractors to have their technicians certified.

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 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. That is roughly 7-9 times larger than the national market share. 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 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.

There are still many issues to be addressed before the program achieves its goals. These include the lack of participation among smaller contractors – who represent roughly one-half the market – and continued observed problems in installations. The development of the New Jersey programs clearly shows the positive impact of technical and marketing support from national initiatives on the effectiveness of local programs.

The success of the New Jersey program also stands in contrast to the early experience of a statewide residential air conditioning program in Texas.[3] That program was initially designed to provide incentives to distributors who undertook to sell specified volumes of ENERGY STAR-qualified units via contractors. In its first year, the program fell far short of its goals because contractors, who have direct contact with the customers, had not been trained or provided with any commercial rationale for selling the more expensive efficient equipment. In subsequent years contractor training and marketing support components have been added to the program, and it has been substantially more successful.

Programs to promote compressed air system efficiency

THE COMPRESSED AIR EFFICIENCY RESOURCE

Verified patterns of compressed air system use suggest that industrial compressed air systems present an attractive target for "resource acquisition" demand-reduction and energy efficiency programs. To summarize:

- **Industrial compressed air systems consume huge amounts of electricity.** Air compressors use 16 of all electricity used to power motor driven processes in US industries.[4]
- **Most industrial compressed air systems are enormously inefficient.** Well-engineered efficiency improvements

3. Garland, Glenn et al. 2002. "Pickup Trucks and Broken Hearts: Analysis fo a Texas Upstream A/C Incentive Program," in *Proceedings of the ACEEE 2002 Summer Study on Energy Efficiency in Buildings.* Washington D. C.: American Council for an Energy-Efficient Economy.
4. XENERGY Inc. 1998. *United States Industrial Electric Motor System Market Opportunities Assessment.* Washington D. C.: U. S. Department of Energy.

yield verified savings in the range of 15 to 30 percent of system energy consumption. Some case studies have documented savings of more than 50 percent.[5]

- **Compressed air system efficiency improvements are highly cost-effective.** Many verified projects and studies have identified significant energy and demand reduction projects with paybacks less than one year. Most projects yield savings sufficient to amortize investments in two years or less.
- **The range of efficiency improvements is broad and must be carefully tailored to the configuration of the existing system, as well as the production requirements of the facility.** Few compressed air system efficiency strategies involve simple substitution of an efficient component for a standard model. Rather, the strategies involve a number of related capital, maintenance, and operating changes. There are certain measures that are applicable to the majority of systems: leak detection and repair, substitution of timer-activated moisture drains with level-activated drains. However, these measures achieve the greatest savings when implemented in concert with adjustments to controls, air storage, supply horsepower, and end-use tools that closely match delivered air supply to the requirements of production activities. Identification and assessment of the appropriate suite of measures for a given system requires a sophisticated grasp of the interaction between the system and its loads, and among the various components of the system.

MOTIVATIONS AND BARRIERS TO ADOPTION OF BEST PRACTICES IN COMPRESSED AIR SYSTEM MANAGEMENT

Motivations. The motivations for customers to engage in compressed air system improvement activities are clear. The financial returns to energy efficiency measures in compressed air systems are among the best available from any end-use technology. Moreover, the non-energy benefits of these improvements are extremely valuable. The most important of these is increased system availability. Other commonly reported non-energy benefits include restoration of adequate pressures to all parts of the system, reduced maintenance costs, and increased product quality control.

For compressed air system vendors, the motivations for offering efficiency services included primarily customer retention in markets that were declining in overall size due to the decrease in manufacturing activity in the U. S. economy as a whole. Other benefits included equipment sales to implement recommended measures and increased revenues from service activities.

Barriers. The survey of plant managers mentioned above found that only one-third engaged consistently in even the most rudimentary compressed air system management practices. Only 9 percent listed energy efficiency as an objective of their compressed air system maintenance and management routines.

On the supplier side of the market, market assessment findings mirrored the low level of customer knowledge and interest. While most compressed air equipment vendors reported that they offered efficiency services, further probing determined that they offered only one or two isolated services, such as leak detection, not the comprehensive approach required to effect significant improvements in system operation and energy efficiency. Moreover, they reported deriving, on average, only 4 percent of annual revenues from activities related to system energy efficiency; and only 18 percent from all activities other than equipment sales and service. When asked to explain why they had not entered the efficiency services market, vendors most frequently mentioned perceived scepticism or lack of interest on the part of customers (75 percent).

COMPRESSED AIR SYSTEM EFFICIENCY PROGRAMS: APPROACHES AND RESULTS

Background

One of the key objectives for programs to stimulate the adoption of best practices compressed air system management was to educate customers and vendors to the nature and magnitude of the benefits of best practices. The second was to consolidate and organize the working knowledge that successful compressed air consultants had accumulated and to somehow make it available to others interested in developing the capability to deliver efficiency services.

In this section, we describe the operations and results of three programs designed to increase the flow of energy efficiency services through compressed air system vendors to end-use customers.

The Compressed Air Challenge

Overview. The mission of the CAC is to develop and provide resources that educate industry on the opportunities to increase net profits through compressed air system optimization. The program is funded primarily by the U.S. Department of Energy and is administered by the Lawrence Berkeley National Laboratory. To date, the primary activity of the CAC has been to develop, promote, and present training programs in compressed air system efficiency targeted to equipment vendors and end users.

CAC currently offers two levels of training: *Fundamentals of Compressed Air Systems* and *Advance Management of Compressed Air Systems*. CAC recruits local sponsors to market the training sessions to end-users and compressed air system vendors and to provide local logistical support. Attendees are charged a registration fee. The *Fundamentals* session is a one-day workshop designed to serve as an introduction to compressed air system operation and management. The *Advanced* workshop is designed to provide facility engineers, maintenance supervisors, equipment distributors and other key personnel with the most up-to-date, in-depth technical information on how to troubleshoot and implement improvements to industrial compressed air systems.

A technical committee consisting of experienced efficiency consultants, academic engineers, and regional program operators developed the training courses. These individuals

5. Mitchell Rosenberg, 2001 "Demand Reductions through Compressed Air System Efficiency," *Proceedings of the 2001 International Energy Program Evaluation Conference.*

also account for a large portion of the training instructors. The *Fundamentals* course was first offered in February 1999; the *Advanced* course in May 2000. As of May 2001, 3 029 individuals had attended the CAC "Fundamentals of Compressed Air Training" and 925 individuals had attended "Advanced Management of Compressed Air Systems." These individuals represented 1 400 – 1 500 separate business establishments.

Program Effects. The Department of Energy commissioned an independent evaluation of the effects of the training program on seminar attendees.[6] The evaluation was based on telephone interviews with 200 attendees: 100 representatives of end-user organizations and 100 with representatives of compressed air system equipment vendors.

The key findings from the evaluation in regard to end-users were as follows:

- A very high portion of end-users reported using materials from the training directly in making efficiency improvements to their compressed air systems. Seventy-six percent of the sample end-user representatives reported that they had made significant capital or operating improvements to their compressed air system since attending the CAC training. Two-thirds of these end-users reported that they had used materials and knowledge gained from the training to guide the improvements they made.
- End users who implemented compressed air system efficiency measures achieved high levels of energy savings. Using a conservative approach to the savings analysis, evaluators estimated that attendees who implemented compressed air system efficiency measures after completing the training saved, on average 7.5 percent of pre-project system energy.
- End users who implemented compressed air system efficiency measures experienced significant non-energy benefits. Seventy-six percent of end users who implemented system efficiency measures reported experiencing benefits such as: reduced downtime, reduced moisture and contamination in the system air, more consistent pressure in system, restored delivery of adequate pressure to all system components.

The key findings in regard to vendors were as follows.

- Since participating in the training, 52 percent of vendors reported that their companies had begun to offer new efficiency services.
- The majority (85 percent) of vendor participants claimed that they have used training workshop materials or information when they evaluate customer compressed air systems.

New York State Energy Research and Development Authority: Compressed Air System Efficiency Program

Program description and accomplishments. The New York State Energy Research and Development Authority (NYSERDA) initiated the compressed air system efficiency program specifically to stimulate delivery of compressed air efficiency services through compressed air equipment vendors. NYSERDA engaged a team that contained two well-respected compressed air system consultants who had been active in the state and who were well known to the major distributors in the market. Participation of these individuals proved to be a key factor in recruiting vendors and customers to the pilot effort. The pilot portion of the program took approximately two years to complete. It consisted of the following components.

- **Vendor Recruitment.** The project team recruited 13 of the 19 major distributors in the state to participate in the program and received signed Memoranda of Understanding from these vendors. Ultimately, seven went on to identify customers interested in receiving a plant assessment and to deliver those assessments. Personal appeals from the expert consultants to their contacts among distributors greatly accelerated the recruitment process.
- **Field Process and Tool Development.** The main objective of this task was to develop a compressed air system assessment process and accompanying materials that vendors would be able to use with little technical support after going through the process of pilot project development. This *Compressed Air System Assessment Toolkit* was consisted of the following: data collection forms, load calculation and energy savings estimation instructions, a report template, case studies and other marketing materials, and accompanying instructions.
- **Customer Workshops and Site Recruitment.** To generate customer interest in the compressed air system assessment offer, the program team co-sponsored a set of compressed air system training workshops with the national *Compressed Air Challenge.* The rationale for including this element in the program was to provide an independent source of information to customers on the technology and value of compressed air system efficiency, and thereby increase the perceived value and legitimacy of the services offered in conjunction with the NYSERDA program.
- **Plant Assessment and Project Development.** The project team worked with seven vendors to complete thirteen plant assessments in a wide variety of industrial facilities. Of the thirteen plants, eight went on to implement the full complement of recommended projects, without further subsidization from other programs. The estimated energy savings for these projects total 6 629 MWH per year or $455 800 at current electric rates. The estimated design and installation costs for the projects are $425 350, which yields a payback period of less than one year.

Unresolved issues and steps toward the second phase. NYSERDA found the results of the pilot phase sufficiently encouraging to approve a second phase. However, a number of key operating issues remained unresolved. The most important was to develop a strategy that would encourage and support a larger portion of the participating vendors to com-

6. XENERGY Inc. forthcoming. *Evaluation of the Compressed Air Challenge Training Program.* Washington D.C.: U. S. Department of Energy.

plete site assessments and customer reports on their own. The first step in addressing this issue was to increase the user friendliness of the data collection forms and report template. The second phase of the program is now getting underway. NYSERDA is implementing an approach to working with the vendors designed to "meet them where they are" in terms of their level of technical capability and commercial interest. To do this, the Authority is offering three levels of technical assistance in completing site assessments and reports, each with a corresponding level of financial incentive.

THE SAV-AIR INITIATIVE

Program design. The *SAVE-AIR Market Transformation Initiative,* supported by The Northwest Energy Efficiency Alliance (the Alliance) represents an attempt to increase customer uptake of efficiency services by using automated remote data collection to reduce costs. This approach relies on a single technology/consulting company to develop, market, and deliver the service, and has generally not worked with vendors to sell or deliver the service.

The project approach is unusual in that the Alliance has provided equity capital to the company, along with two other outside investors. This investment provided funding for development of hardware and software and construction and operation of an "alpha" site on which equipment, software, and communication routines could be tested. The private company SAV-AIR, LLC was formed in 1997, and was selected by the Alliance in December 1998 as one of its initiatives. SAV-AIR's first contract with the Alliance began in December 1998, and continued through December 2000,with ongoing commitments by SAV-AIR for demonstration of their approach through December 2001. The second contract began in May 2001 and ended in May 2003.

SAV-AIR's business plan envisioned three phases of service to each customer. These are:

- **Performance Evaluation.** The current status of the compressed air system is determined through detailed metering and analysis. Recommendations are made for system optimization.
- **System Optimisation.** System monitoring data are analysed to estimate baseline usage, identify appropriate capital and operating improvements, and estimate savings associated with recommended measures.
- **Ongoing Services.** This phase includes customer staff training in interpreting monitoring data, ongoing remote monitoring, troubleshooting, and consultation to support continued system optimisation.

Program Accomplishments. As of June 2002, nine "beta" systems had been installed and six of these had reached the phase of system optimisation. Eleven additional projects were in the performance evaluation phase, and six additional projects had reached the system optimisation phase. There were no projects in which ongoing services were being provided. After four-and-a-half years of development, the company was breaking even on a current basis, but none of the investors had seen returns.

The Alliance had commissioned three independent evaluation reports on the SAV-AIR initiative conducted at regular intervals. The most recent evaluation[7] (March 2002) included interviews with four of the customers whose projects had completed the system optimisation phase. Findings at each of the four sites indicated excellent client satisfaction, with energy savings at predicted levels or higher. Monitored usage data indicated savings of 31 to 56 percent of baseline system energy use, with average cost savings of over $60 000 and a payback period of 2.3 years. According to the customers, the value of non-energy benefits equalled or exceeded the energy savings.

Challenges in the next phase. The SAV-AIR initiative has clearly demonstrated the value of the highly instrumented, remotely monitored approach to delivering compressed air system optimisation expertise. However, the basic design of the delivery process raises a number of problems for market acceptance. The first is the expense to the customer. While the SAV-AIR permanent instrumentation delivers value, it is far more expensive than the short-term monitoring that is typically used to develop compressed air system baseline usage estimates and supporting data for energy savings estimates. To date, this high first cost has been sustained through project subsidies available from regional utilities. However, those subsidies are not available in most of the country and may not be available in the long term. The second, perhaps more decisive, drawback is the length of the project development cycle. Energy savings and other benefits are realized only once system optimisation steps are taken. Installation, debugging, and calibration long-term monitoring equipment typically took one to two months, and additional time was needed for analysis and preparation of optimisation project plans. In the course of this process, customer interest in proceeding with optimisation was sometimes lost. In the two years of operation since emerging from the beta pilot phase, the company has sold only ten assessments, which have led to six project completions.

Lessons learned

The programs described above, and others like them addressed to the commercial HVAC market and industrial motor systems market, provide a rich and very real base of experience from which to draw insights in designing best practices programs for the mid-market. Program operators have identified the following points as critical to success in mid-market programs.

Programs must work *in* the market, not *on* the market. Virtually all of the programs that have enjoyed any measures of early success were developed with significant and fairly lengthy involvement of key firms, trade and professional organizations, and opinion leaders in the targeted markets. This involvement is time consuming and can be costly, but it provides a number of key resources for program success.

7. Pacific Energy Associates, 2002. *The SAV-AIR Initiative: Third Market Progress Evaluation Report.* Portland, OR: Northwest Energy Efficiency Alliance.

These include:

- Useful, "authentic" information on what the motivations and barriers are for mid-market actors to cooperate and participate in the program.
- Access to the informal network of industry contacts for use in recruiting participating vendors and end-use customers.
- The legitimacy of industry opinion leaders and trade organizations in endorsing best practices as both a technical and business strategy.
- Forum for building consensus around the technical elements of best practices and practicable methods for their implementation in the field.
- Sources of information for developing a defensible characterization of baseline conditions and practices for use in program evaluation.

Engagement of the market actors with direct access to customers is necessary for success. The experience of the Texas residential air conditioning program and the SAV-AIR initiative strongly suggests that program designs or strategies that do not explicitly recruit and train firms that have direct, frequent customer contact will experience very slow uptake. Moreover, the experience of the New Jersey residential air conditioning program shows that the effects efforts to train installation contractors can result in improved quality of installation in the fairly short term.

Even with program activities to develop tools and reduce costs of marketing delivering efficiency services, many firms will not find the effort of participation worth the potential return. As in any market transformation program, the early efforts of the program will attract the energy efficiency *avant-garde* of local vendors. This is a perfectly acceptable result. Moreover, it is important to work closely with early joiners to gather as much information as possible about their experiences so that the program can be made attractive to less motivated vendors.

Long-term commitment. As the program narratives presented above indicate, development and revision of the multi-faceted efforts required to address the middle market takes a long time. Moreover, as discussed in the introduction to this paper, the business perspectives of distributors and installation contractors is very long term. Therefore, sponsors need to signal their intent to provide continuing support for program development, and to remain open to suggestions from leaders in the targeted markets. The successful programs reviewed above have undergone frequent changes and "fine tuning" in response to evaluation and feedback from supply-side participants.

Need for support on demand as well as the supply side. Mid-market businesses simply do not have the resources needed to educate customers to the nature and benefits of efficient equipment and best practices in installation. Moreover, as discussed above, mid-market actors identify lack of customer awareness of and interest in energy efficiency opportunities as one of the main barriers to their development of efficiency service capabilities. Unfortunately, the programs discussed above, and particularly their customer education elements, have not been in operation long enough to assess their results. In the case of residential HVAC, customers are "in the market" so infrequently that it seems unlikely that customer education measures will have much effect. The prospects may be better for industrial systems and commercial HVAC, which require a fairly high level of ongoing attention from facility operators.

Demonstrate the business model. In the long term, mid-market programs succeed to the extent that best practices are widely adopted without the need for ongoing support from program sponsors. The practical implications of this success criterion are that 1) at least some vendors and distributors will need to find ways to retain customers and make money delivering services informed by best practices and 2) given the highly competitive nature of the targeted industries, trade and professional organizations will likely need to keep up the work of advocating for the adoption of best practices. This is challenge to be addressed in later stages of program operation, but early efforts to collect success stories on both the project and enterprise level will be needed to make the case to the majority of vendors, who continue to sit on the sidelines and watch their competitors' efforts to develop energy efficiency services.