Benchmarking Current System-Wide Compressed Air Market Efficiency Practices in the Northeast United States And Programmatic Strategies to Improve Them

Jonathan B. Maxwell, Aspen Systems
Roland Clarke, NSTAR (formerly with Northeast Utilities)
Fred Gordon, Pacific Energy Associates
Edward McGlynn, NSTAR (formerly with Eastern Utilities)
Hale Powell, National Grid USA (formerly New England Electric System)

ABSTRACT

Six utility companies in Connecticut, Rhode Island, and Massachusetts conducted market assessment research during 1999 to: (1) Characterize the compressed air market; (2) Assess the remaining potential for compressed air system energy savings; (3) Benchmark current market practices; and (4) Suggest strategies for achieving energy savings and market transformation. A nearly identical project was completed in New Jersey in 2000.

In each project, researchers used secondary data to define market potential, then interviewed a near-census of suppliers in-person and size-stratified random samples of a combined total of 95 end-users by telephone to determine supply channels, market characteristics, barriers, decision processes, and to benchmark current practices and identify opportunities.

Savings potential was determined to be 30 percent of compressed air system energy use, which equates to $23,000 per year at each facility with at least 100 hp of non-backup air compressors in the subject region. Major barriers to market transformation include lack of awareness about costs and savings potential, perceived long payback times, and reluctance to interrupt continuous operations. Many solutions do not require major capital investments but instead are achieved through small investments and better ongoing maintenance. With the exception of better compressor part load control, most savings opportunities are outside of the compressor room in the form of leak reduction, pressure reduction, and eliminating unnecessary air use with equipment.

The findings suggest that utility companies should promote an approach to saving energy that considers the entire compressed air system—plant, distribution network, and air-using equipment. Training, utility Compressed Air Challenge (CAC) participation, funding of optimization services, sponsored case studies, promotion of optimization services at time of potential compressor replacement, continued equipment incentives, and subsidized ultrasonic and air flow measurement tool rentals will help transform the market.

Utility companies are implementing virtually all of the recommendations, and are collaborating through the CAC sponsorship to unify the message presented to suppliers and end-users.

Introduction

Compressed air is an expensive utility for industry. Pneumatic drills cost up to twenty times as much to operate as electric drills.[1] Even when operating as designed, compressed air systems have substantial losses. Many experts believe that air distribution system losses, inappropriate use of compressed air, and part load inefficiency are responsible for the majority of compressed air system waste that can be eliminated.[2]

These are challenging opportunities for external utility programs to address, but they represent considerable energy savings potential in an area traditionally underserved by utility programs. In spite of significant savings potential, facility managers have taken little action to eliminate waste.

Explanation of Utility Interest

Compressed air attracts attention from utility companies interested in helping their industrial customers save energy, because it appear to be an under-addressed conservation resource and therefore is likely to have substantial "low-hanging fruit." Also, compressed air equipment is used by all industry types. Aside from lighting and motors, compressed air is virtually the only industrial energy-using process that has this characteristic, and compressed air historically has drawn less attention than lights and motors. Because of this, seven New England and New Jersey utility companies decided to assess compressed air efficiency practices in their service territories.[3]

History of Intervention

Prior to 1998 utility involvement in industrial compressed air system improvements in New England focused on traditional incentive payments for the purchase of high efficiency compressors. Equipment incentives were neither standardized nor widely promoted, so compressed air system incentive activity was moderate. In some areas

---

[1] An example loss composition would be: 65% compression efficiency at full load x 60% of full load efficiency if throttle control operating at half capacity x 85% for regeneration air drying losses x 90% for oil separation/pumping/cooling x 90% distribution pressure reduction losses x 40% leak to load percentage x 50% tool turbine expansion efficiency = 5 percent efficiency. *Compressed Air Challenge: A Sourcebook for Energy* cites a 10% "wire-to-work" efficiency as typical.

[2] The United States Department of Energy's Industrial Assessment Centers maintain a database that tracks energy conservation opportunities recommended to small and medium industrial businesses. As of September 1, 1998 the database held data for 8,043 on-site audits and over 64,000 recommendations given over the preceding 22 years. More than 8,000 of the recommendations targeted compressed air. Less than 20 percent of compressed air recommendations required capital investments such as compressor purchases. The remaining recommendations were for low cost systemic upgrades and O&M-type measures such as ducting outside air to the compressor intake, heat recovery, water trap repair, and fixing leaks.

[3] The utility companies funded two separate studies. The first study was sponsored by New England Electric System (NEES, now National Grid USA), Northeast Utilities (now part of Con.Edison), Boston Edison (renamed NSTAR), Eastern Utilities (now part of National Grid), Commonwealth Electric (now part of NSTAR), and Fitchburg Gas & Electric. Public Service Electric & Gas funded the second study. Together the service territories include most of Rhode Island, Connecticut, Massachusetts, the majority of New Jersey's industrial customers, and part of New Hampshire.

incentives were not available at all. The most active company approved 36 compressed air-related custom applications in 1997. Several others approved none. Starting in 1998 two utility companies, Northeast Utilities and Massachusetts Electric, started paying incentives to customers that received compressed air system optimization services from approved vendors and consultants. These same two utility companies joined the Department of Energy's Compressed Air Challenge in 1998. Activity in New Jersey consisted of energy audits. GPU re-started funding for audits and measures in 2000. Other utilities in New Jersey had discontinued or not had program offerings.

Research Goals

Two market assessment studies were performed between November 1998 and November 2000 to help lay a foundation for individual and joint utility efforts to improve the efficiency of industrial compressed air systems in the Northeast. The first study was conducted in New England, the second in New Jersey. The goals of the two studies were essentially the same, to:

1. Characterize the compressed air market including end-user profiles, market supply channels, and barriers to efficiency;
2. Assess the remaining potential for compressed air system energy savings;
3. Benchmark current market practices; and
4. Suggest strategies for achieving energy savings and market transformation.

This paper shares the study results, describes the changes utility companies have made since the research concluded, and reviews initial customer response to new and continued outreach efforts.

Approach

Analysis Methodology

The researchers used an analytic framework to assess and provide benchmarks for measuring market transformation. The benchmarks track both the desired "end effects" and stages of progress that lead to their occurrence.

End effects are direct indicators of efficiency-related sales and system improvements. The studies used a combination of indicators to measure end effects. Counting the percentage of end-users that routinely find and fix air leaks is an example of measuring end effects.

Measuring intermediate indicators of progress helps project whether or not high efficiency services or products are likely to be sold in the near future in an immature market for energy efficiency services. For example, before a supplier sells system optimization services, they must understand the issues technologically, develop the service to sell, and market it. Before a customer implements a project either internally or by purchasing it from a supplier, the facility engineer needs to learn why it is worth doing, and must acquire management support to fund the project. These intermediate steps that mark progress are illustrated in Figure 1.

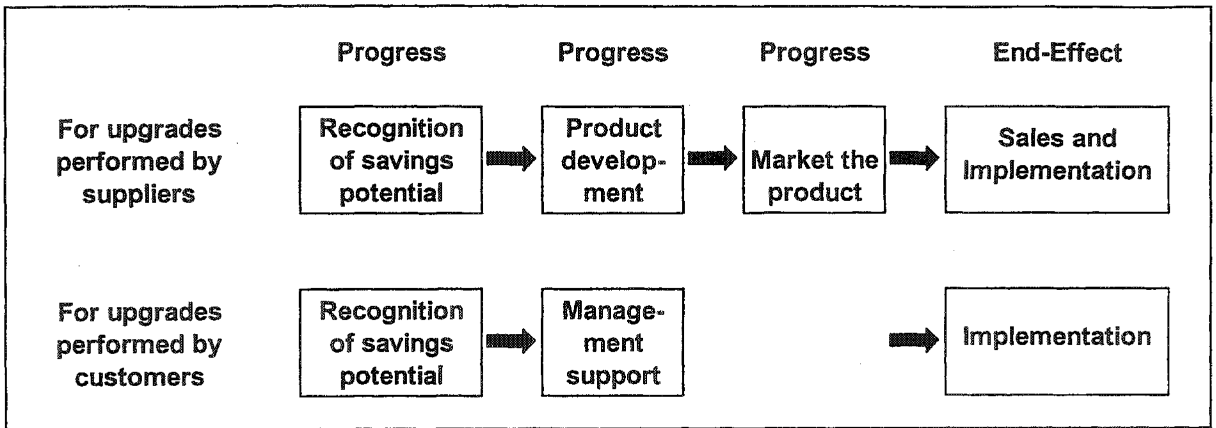

Figure 1. Stages of Progress Leading to Implementation

This framework is particularly compatible with compressed air system study, where no single factor defines energy efficient practice and when the market is in the early stages of market transformation. The market transformation barriers, benchmark "scores," findings, and recommendations were organized using the progress and end-effects frame.

Interviews and Interviewee Selection Methodology

For both studies researchers used a survey-based approach, interviewing both compressed air system suppliers and end-users. In the first study, researchers conducted a small number of initial interviews using open-ended questions for both customer and supplier surveys to help refine research questions, then converted the majority of non-numeric answers to discrete choice form for subsequent use. Since the second study built upon the first, there was no need to repeat the pretest development cycle. Senior researchers—two Professional Engineers and one Ph.D.—led all of the interviews. They talked with suppliers in person and with end-users via telephone.

Local compressed air service providers were identified through a combination of referrals, review of previous incentive applications, and Thomas Register and yellow pages review. The authors believe that the compressed air suppliers interviewed close the majority of sales in the region. Table 1 summarizes the suppliers interviewed from both studies, according to their primary business.

Table 1. Supplier Categories and Counts

Supplier Type	Number of Interviewees
Equipment vendors	21
Expert consultants	4
Compressed air equipment manufacturers	3
General engineering firms	2
Service provider/O&M contractors	1
Energy service companies	1
Total	32

There are 4,097 industrial customers served by the study group utility companies.[4] They were stratified into size categories according to expected compressed air plant size and subsequently re-categorized according to actual size. One hundred twenty-two customers were randomly selected and 55 were ultimately interviewed.[5] While plant kW and building type proved only a rough predictor of compressed air system size, error was nearly random. In both studies final counts of customers interviewed by size were within 10 percent of the goal counts.

Findings

The first step of analysis was to consider the structure of the compressed air systems market and key end-user characteristics regarding compressed air. Second, researchers analyzed survey data to identify barriers to transforming the market to one that embraced compressed air system optimization. Third, a baseline or benchmark scoring system was designed and applied, so that the state of the market could be re-assessed at a later date and compared with 1999/2000 in order to measure progress towards desired behavior.

Market Structure

Figure 2 illustrates the paths by which end-users procure compressed air goods and services. By far the strongest relationship is between the customer and the vendor. Also noteworthy is how many different paths ultimately lead to the independent compressed air consultants. This small community of specialists meets the region's compressed air needs through many channels. Their expertise is critical to the successful delivery of system-wide energy efficiency services. The consulting business already is subsidized by utility programs in New England but not in New Jersey.

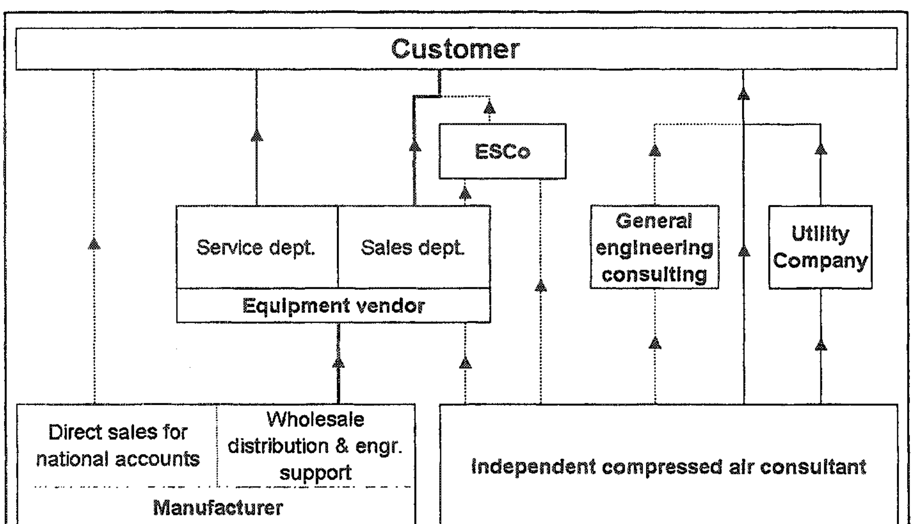

Figure 2. Compressed Air Market Structure

[4] For some utility companies customer data excluded those under 200 kW peak demand.
[5] Researchers used 140 percent over-sampling in New England, 200 percent in New Jersey.

A significant majority of customers have long-term relationships with a single compressed air equipment vendor; 56 percent have service contracts with them.[6] The market for independent consulting is limited even though there are many supply channels to this resource. Eighteen percent of customers have hired compressed air experts directly or through utility companies. A small market exists for energy service companies (only one of the 95 end-users had hired them for compressed air projects) and for general engineering firms in compressed air. Manufacturers provide direct sales to a small number of national accounts. Virtually all suppliers subcontract to expert consultants in certain circumstances.

In New Jersey there was a distinct division between progressive suppliers that promoted system-wide optimization services and those that concentrated on traditional plant repair and replacement services. New England's suppliers spanned the range more evenly.

To estimate average customer size and likely compressed air plant size and total population, end-users were first grouped by Standard Industrial Classification (SIC). Then researchers used utility billing information, SIC, and secondary data to estimate average loads.[7] Savings potential estimates were made based on a combination of secondary data and interview results.

On average, end-users use about 10 percent of their energy for compressed air. The percentage varies considerably. Part of the variance is explained by compressed air plant size. The "large" compressed air plant stratum customers had average hp/kW ratios between 0.20 and 0.25 hp/kW, compared to 0.07 to 0.08 for "small" customers. The size-weighted hp/kW ratio for each customer deviated from the sample average by an average of 42 percent.

Analysis of customer purchasing characteristics, internal decision-making and technical expertise as a function of customer size revealed more similarities than differences between size classes. The only notable exception is that large customers are more likely to have had a compressed air study completed. Furthermore, suppliers rarely concentrate on particular industry types. This leads to the conclusion that utility companies need not invest substantial effort in tailoring compressed air efficiency programs to particular market segments.

The estimated average annual compressed air electricity cost for all industrial customers is $23,000 per year. Customers with compressed air plants of at least 100 hp average $75,000 per year.[8] Surveys of compressed air experts and studies suggest that an average of 30 percent energy reduction is economically feasible to achieve.[9] For northeastern

---

[6] Stratification boundaries were different for the two studies. The New England study used 50, 150, and 300 hp as boundaries for customer size class, the New Jersey study used 100 and 300 hp. Customer response data was statistically weighted in each study and has been approximately re-weighted and combined for the purpose of reporting in this paper.

[7] A previously completed industrial saturation survey completed for NEES was key for the plant size estimates. See Regional Economic Research, "Compressed Air Profiles."

[8] Data on per customer costs are for PSE&G customers but is estimated to be similar in New England.

[9] Twelve experts surveyed in New England estimated an average of 28 percent savings potential. Eight experts in New Jersey estimated an average of 39 percent. These results correlate with findings in other studies around the country. See for example McKane, et al, *Compressed Air Challenge: Market Change from the Inside Out*. *Compressed Air Challenge: A Sourcebook for Energy* cites 20-50 percent. Easton Consultants, *Strategies to Promote Energy Efficient Motor Systems in North America's OEM Markets: Air Compressor Systems* cites 42-58 percent.

United States end-users with at least 100 horsepower (hp) of non-backup compressed air service, savings potential is estimated to average $23,000 per year per end-user.[10]

Barriers

Compressed air production averages ten percent of total electrical consumption, yet industrial end-users rank compressed air system management an average of only 13th on their list of priorities. End-users' biggest barriers to increasing the priority given to compressed air systems efficiency are listed in Table 2. Table 2 also presents suppliers' perceptions of their customers' barriers.

Table 2. End-User Barriers to Compressed Air System Upgrades

Biggest Barriers	New England	New Jersey
ACCORDING TO END-USERS (one choice allowed)	*(n=30)*	*(n=25)*
Payback times are too long	3	11
Lack of upper management support	6	2
Floor users don't realize how expensive compressed air is	3	5
Can't interrupt 24/7 operation	3	4
Inertia/"If it ain't broke don't fix it"	4	1
Not a big cost for my operation	3	1
Lack of time for engineer (downsizing)	4	0
Lack of training to identify problems or estimate savings	4	0
Capital not available	4	0
ACCORDING TO SUPPLIERS (multiple choices allowed)	*(n=21)*	*(n=11)*
Payback times are too long/customers don't have capital	13	9
Unaware of magnitude of savings	5	5
Don't trust supplier savings claims	8	2
Unaware of opportunities	3	2
Can't get executive approval	2	2
Don't care/stubborn/fear of unknown	0	3

Both customers and suppliers believe that customer payback times are too long. Based on the opinions of compressed air system experts around the country, this is a misguided concern, at least in part.[11] Much of the savings available from compressed air upgrades can be achieved without capital investment, or with investments that pay for themselves in less than two years. Presuming this is true, the real barrier is not actually long payback times but a lack of education about opportunities, their low cost, and their fast payback times. This barrier is prominent elsewhere on the list, and is an excellent target for utility market transformation activities. Compounding all of the barriers is the fact that staff responsible for compressed air plant operation typically are not accountable for utility bills.

[10] In the utility service territories studied, there are estimated to be 1,300 such end-users.

[11] See for example: Compressed Air Specialists, *The Compressed Air System Audit and Analysis Software: Case Studies*.

Benchmarking

Benchmark "scores," findings and recommendations were organized according to the stages of progress leading to implementation. Benchmark scores include a combination of tabulations from replicable "key" statistically weighted (if customer) parameters, tabulations of supporting data, and also subjective ratings of market conditions. Answers to selected individual questions are shown in Table 3.

Table 3. Responses to Market Transformation (MT) Survey Questions

Question or Parameter	N.E.	N.J.
MT End Effects: Frequency of system optimization sales transactions. Percent of end-users over the last two years that...		
Received a compressed air study in the last two years.	7%	12%
Bought part load or sequencing controls.	1%	N.A.
Bought receivers to improve part load performance that were not part of a compressor sale, response is projects per supplier, not percent of end-users.	N.A.	0.5
MT End Effects: Frequency of O&M efficiency-oriented activity. Percent of end-users that over the last two years...		
Routinely check for leaks.	58%	7%
Decreased pressure of air leaving the compressed air plant. *(higher % is better)*	16%	7%
Increased pressure of air leaving the compressed air plant. *(lower % is better)*	1%	5%
Installed engineered nozzles or eliminated compressed air end-uses	N.A.	23%
MT Progress Indicators: Supplier capabilities to deliver system optimization services. Percentage of suppliers that offer...		
Energy audits	93%	58%
Power metering, at least short term, not just spot metering	93%	58%
Air flow metering	57%	58%
Leak detection services/repair	11%/11%	58%/42%
Guaranteed savings	36%	8%
MT Progress Indicators: Awareness of savings potential		
Percentage of end-users that can estimate the compressed air portion of their electric bill[12]	49%	81%
Percentage of end-users that can estimate the electric bill cost	53%	61%
Avg. end-user estimate of percentage of waste outside the compressor room	75%	69%
MT Progress Indicators: Interest in compressed air training		
Percent of end-users that have had training in the last 2-3 years	30%	14%
Percent of end-users that would like to attend training	100%	87%
Percent of suppliers that have attended a CAC workshop in the last 2 yrs.	38%	58%
Percent of suppliers would pay for staff training	33% Yes 33% Maybe	8% Yes 25% Maybe
MT Progress Indicators: Product development/marketing of system-wide optimization services		
Percent of customers approached unsolicited about system-oriented services	13%	30%
Percent of suppliers that give sales staff higher commissions or other incentives for selling high efficiency equipment	10%	30%

[12] Cross-tabulation of data revealed that CAC-trained managers were twice as likely to be able to estimate both their bill size and portion of the bill for compressed air (75%) compared to others (38%).

All of the customer and supplier answers including answers to open-ended questions were reviewed against desired conditions of a transformed market that routinely offers system-wide energy optimization services. The final assessment included overall "indicators" for each of the two End Effects and the first Progress stage referenced in Figure 1 and Table 3 above.

Summary of Research Findings

Research led to the following conclusions regarding the potential for compressed air market transformation:

- CUSTOMER DEMAND: Creating increased customer and provider expertise alone is insufficient—Generating customer demand for comprehensive efficiency is crucial. Although customers are vaguely aware of the potential of comprehensive system savings, at present demand is very limited and customers are very skeptical about comprehensive project proposals from their vendors.
- SUPPLIER EXPERTISE AND MARKETING: Although most regional compressed air vendor owners or upper level staff have some familiarity with the comprehensive systems approach to efficiency, their field staff does not. Comprehensive approaches are typically not marketed to customers. Vendors cite the absence of demand for this lack of marketing effort.
- FINANCIAL DECISION-MAKERS: Customer engineers and technical staff cite lack of support by CFOs and financial staff as a key barrier to project implementation. Selling technical staff is insufficient. Promotional materials must address the concerns of CFOs and other financial decision-makers.
- CUSTOMER SEGMENTS: Regardless of size or industry segment, customers show similarity in internal decision-making processes and technical expertise. Tailoring programs or promotional activities for specific industries or size segments is unwarranted.
- NON-ENERGY BENEFITS: Given customer skepticism about energy savings, emphasis of non-savings benefits should be an important promotional element. Non-energy benefits cited include improved pressure regulation, creation of compressor backup capacity and deferral of planned compressor purchases.
- Compressed Air Challenge (CAC) TRAINING: Customers and vendors who have attended "Fundamentals" training give it high marks and could answer technical questions regarding their compressed air systems better than non-attendees.
- STANDARDIZED AUDITS: The development of standardized compressed air system audit protocols would help address customer skepticism of comprehensive project proposals. Regional utilities should develop an abbreviated and simplified protocol for small systems and a more extensive audit process for large systems. Utilities should consider making completion of these audits a prerequisite for financial rebates.
- UTILITY REBATES: While useful, rebates are not essential to generate and sustaining customer demand and vendor interest in comprehensive projects. Increased support of technical assistance, training and standardized audits is critical.

Recommendations

Prioritize efforts from the beginning to the end of the market development process as an investment in long-term market transformation. In regions such as New Jersey where the compressed air market has yet to mature in its basic understanding and implementation of compressed air optimization services, for example, concentrate on early progress improvements such as training and individual supplier support. More mature markets such as Massachusetts, Rhode Island, and Connecticut should intervene beyond the first stages.

1. Help end-users recognize savings potential – sponsor training. New England and New Jersey end-users are not sufficiently aware of compressed air system savings potential and cost effectiveness to take action. Buyers need to be educated to spawn demand. Training addresses the early stages of market transformation barriers. The CAC has been a good agent for training in New England. Research from other parts of the country supports the focus on training.[13] Training should include techniques to earn upper management support for compressed air system upgrades. It also should emphasize the link between system reliability, which users value highly, and efficiency. Customers welcome alternative media to in-person seminars to save time. Twenty customers expressed interest in training through videos compared to 19 interested in seminars. Videos are also more likely to attract smaller manufacturers who cannot take the time to attend off-site seminars. Topics of interest to end-users are predominantly technical:

Table 4. Ranking of Requested Training Topics

Training Topic	Number of End-Users Who Chose Topic
Optimizing compressed air system operation (general)	35
Air compressor controls	35
Finding and eliminating leaks	33
Basic operations and maintenance	29
Smart piping strategies	28
Types of air compressors and energy efficiency	23
Air compressor analysis software	9

2. Support suppliers with marketing – assist individual suppliers that support system-wide efficiency upgrades. In areas in the nascent stages of transformation such as New Jersey, it is most cost-effective to focus on helping the few capable and experienced vendors that already want to deliver system-wide efficiency services. Specific support that would be beneficial includes case studies with before-after power metering, training for customers led by these suppliers, training of these suppliers by experts from other parts of the country, and giving customers a list of suppliers qualified to perform system-wide upgrades.

[13] In Gordon et al, *Compressed Air System Services*, 13 of 21 suppliers interviewed recommended that customer education be pursued to increase the compressed air services market. No other intervention, including rebates. was recommended more than twice.

3. Support suppliers with product development – directly fund optimization services. The fastest way to encourage suppliers to develop comprehensive optimization service offerings is to develop an approved scope of work for such a project together and then pay for part of it. Smaller customers may require standardized contracts for funding of compressed air services.[14]

4. Support suppliers with product development – aggressively promote optimization at the time of prospective compressor replacement. It is difficult to persuade a facilities engineer to start a project on a system that appears to be in working order. However, when replacement or additional compressors are being considered, the prospect of a less expensive alternative is most attractive. The most aggressive approach to implement the recommendation would be to make compressor rebates contingent upon completion of a compressed air system study.

5. Support implementation – fund equipment incentives. Beyond high-efficiency compressor incentives, consider options that improve system part load efficiency such as funding for compressed air storage tanks, demand expanders/flow controllers, and variable speed drive part load control of twin-rotor screw air compressors. Keep programs simple. Anecdotal reporting by suppliers indicates that when program administrative costs exceed 30 percent of the incentive, their worth declines substantially.

6. Support supplier marketing – support standardization of compressor efficiency ratings publication. The Compressed Air and Gas Institute (CAGI) is succeeding in persuading manufacturers to test compressor performance according to standardized procedures. However, vendors are not conveying these data to customers. Utility companies should support CAGI's standardization efforts by requiring submission of standardized performance data sheets by sponsors before paying incentives. Encourage CAGI to devise standardized part load performance tests as well as full load tests, just as SEER and HSPF ratings are available for air conditioners and heat pumps.

7. Support supplier marketing – screening worksheet. Suppliers would welcome utility development of a two- or three-page screening worksheet. Distributed either during customer training seminars or given to suppliers to distribute, the worksheet would collect key customer data to help suppliers identify customers that are good candidates for optimization services. Similarly, a concise guide to identifying when compressed air systems might be operating sub-optimally and when more intensive study is cost-effective would be beneficial for general industrial energy auditors.

8. Support customer implementation – free loan of ultrasonic leak detector. With 24-hour per day, 7-day per week operations it can be difficult to find leaks simply by listening for them with the naked ear. Ultrasonic leak detectors eliminate this barrier, but many customers regard them as too expensive to buy for occasional use. At the same time they are unwilling to pay vendors to perform this labor-intensive service. Sixty-four percent of the

[14] This recommendation is taken from Barrer, *Compressed Air Efficiency Services in Medium-Sized Manufacturers*.

customers interviewed said that the free loan of leak detection equipment would be attractive to them.

Actions Taken and Results

Most of the identified strategies are being implemented by at least some of the participating utility companies. The New England utility companies together proposed a regional multi-utility Compressed Air Market Transformation Plan, which translated the study results into concrete intervention strategies.

The most aggressive action has been taken in the areas of training, Compressed Air Challenge support, and case study development. The study validated Northeast Utilities' prior support of system-wide optimization studies, which has been continued and expanded to other utility companies.

Training and the Compressed Air Challenge

NU, NSTAR and PSE&G have joined NEES (Now NGrid) as Compressed Air Challenge sponsors. Representatives of NU and NGrid have been active in the CAC, participating in CAC Level 2 training curriculum development. This new curriculum addresses issues not focused on in the Level 1 CAC training such as higher level training appropriate for service providers and customer decision-making—a significant market barrier identified in the research.

NU and NGrid hosted one "Level 1" (Beginner) training workshop in Connecticut during 1999; and two more workshops in Western Massachusetts during 2000. "Level 2" (Intermediate) training session was held in conjunction with the Compressor Distributor Association (CDA) during Oct 2000. Attendance was good. Whereas mostly suppliers attended the initial workshops, the majority of recent attendees have been end-users. NU is in the process of planning three Level 1 training workshops and two Level 2 workshops during 2001.

EUA and NGrid were active members of the CAC ad hoc marketing committee in 2000. NGrid continues to be active now that there is a permanent marketing committee.

Case Studies

NGrid completed and distributed 3 case studies of comprehensive compressed air projects during 2000, which will be used as marketing tools.

PSE&G completed one case study that was less successful. PSE&G recruited a customer from several candidates to perform a demonstration of compressed air system optimization. The customer implemented only one of seven recommended measures.[15] While

---

[15] The analysis identified a large air leak in underground tie line between two ends of the facility. This plus other leaks constituted about a third of peak use. The study also proposed several changes to the compressor system to improve efficiency, including improved pressure and flow control, a small pump for light-duty hours, replacement of some compressed air equipment with motor-driven equipment, and purchase of a new compressor to provide backup while reducing rental costs. Some of the measures had the potential to improve the reliability of production. All but one of the opportunities had paybacks of less than 18 months. The customer repaired the main leak but expressed no interest in pursuing the other measures, stating somewhat

the project probably resulted in significant energy and compressed air savings, it did not demonstrate compressed air system optimization, because the customer did not pursue the optimization measures.

Compressed Air Audits

To address the market barrier of the lack of common standards for system audits and assessments NGrid is working with PG&E, DOE, NYSERDA, and CAC to produce guidelines for three distinct levels of system assessments. The three levels, in increasing degrees of rigor, are intended for increasing levels of compressed air system size and complexity. These are not detailed audit protocols but guidelines or checklists of minimum standards for the assessments. NU is collaborating with on this project. The final form of these assessments will be reviewed by CAC technical staff in March and receive the CAC Board approval as CAC standard later this year.

NGrid expects to offer training on these assessment guidelines for equipment vendors and regional consultants by the summer of 2001. After training is offered, adherence to the guidelines is likely to be required for NGrid vendor program participation. Use by other New England and New Jersey utilities remains to be determined.

Ultrasonic Leak Detector Loan

Beyond the Northeast, Aspen has added an ultrasonic leak detector to an energy efficiency tool crib for the Wisconsin Department of Administration's Focus on Energy project. [16] Based on early activity it promises to be the most popular item in the crib.

References

Aspen Systems Corporation. 1999. *Compressed Air Systems Market Assessment and Baseline Study for New England.* Rockville, MD: Aspen Systems Corporation.

Aspen Systems Corporation, 2000. *Compressed Air Systems Market Assessment in the Public Service Electric and Gas Service Territory.* Rockville, MD: Aspen Systems Corporation.

Barrer, Peter J. 1999. *Compressed Air Efficiency Services in Medium Sized Manufacturers.* Prepared for the Massachusetts Electric Company. Unpublished.

Carroll, Hatch & Associates. 1993. *Industrial Compressed Air System Energy Efficiency Guidebook.* Portland, OR: Bonneville Power Administration.

Compressed Air Specialists. 1997. *The Compressed Air System Audit and Analysis Software: Analysis Methodology, Audit Manual for AIRMaster, Case Studies, How to Take a*

critically that there wasn't much of interest. It is not clear whether the customer made the adjustments to the system needed to maximize savings from the repaired air leak.

[16] Other devices include a multimeter and light level, current, temperature and humidity loggers. Pacific Gas & Electric's Tool Lending Library also includes an ultrasonic detector.

Self-Guided Tour of Your Compressed Air System, User Manual. Corvallis, OR: Oregon State University.

Easton Consultants. 1994. *Strategies to Promote Energy-Efficient Motor Systems in North America's OEM Markets, Air Compressor Systems.*

Gordon, Fred, Jane Peters, Jeff Harris, and Bill Scales. 1999. "Why Is the Treasure Still Buried? Breaching the Barriers to Compressed Air System Efficiency." In *Proceedings of the 1999 ACEEE Summer Study on Energy Efficiency in Industry*, June. Saratoga Springs, N.Y.: American Council for An Energy Efficient Economy.

Gordon, Fred, Jane Peters. 1997, *Compressed Air System Services*. Portland Oregon.

Maxwell, Jonathan B. 1992. *A Guidebook for Screw Air Compressor Controls: Operating Principles and Selection for Minimum Energy Use*. Portland, OR: Bonneville Power Administration.

McKane, Aimee T., Joseph P. Ghislain, Karen Meadows, "Compressed Air Challenge: Market Change from the Inside Out." In *1999 ACEEE Summer Study on Industry*, June. Saratoga Springs, N.Y.: American Council for An Energy Efficient Economy.

Regional Economic Research (1995). "Air Compressor Profiles." In *The NEES Companies C&I Data Development Project—Market Profiles Report*. Northborough, MA: New England Electric System Companies.