

Assessment of the Market for **COMPRESSED AIR EFFICIENCY SERVICES**



Office of Industrial Technologies



Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

OVERVIEW

The *Assessment of the Market for Compressed Air Efficiency Services*, hereafter referred to as the *Compressed Air Market Assessment*, was commissioned by the U.S. Department of Energy with technical support provided by the Compressed Air Challenge® (CAC). The CAC is a voluntary collaboration of manufacturers, distributors and their associations; industrial users; facility operating personnel and their associations; consultants; state research and development agencies; energy efficiency organizations; and utilities. 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 objective of this report is to provide a comprehensive and balanced view of the market for engineering and consulting services to improve the energy efficiency of plant compressed air systems. These services include plant assessments or audits to identify opportunities to improve compressed air system operations, preventive maintenance services, such as leak detection and repair that are aimed at reducing energy use, and redesign of controls and other system components to reduce energy use. The report is intended for use by the CAC and other industrial energy efficiency program operators in developing strategies to encourage the growth of the compressed air system efficiency industry and enhance the quality of the services it offers. Compressed air system vendors and designers may also find it useful in charting their own approach to providing energy efficiency services.



COMPRESSED AIR SYSTEM ENERGY USE AND THE BENEFITS OF INCREASED EFFICIENCY

Compressed Air System Electric Use

Compressed air systems account for 10% of all electricity and roughly 16% of all motor system energy use in U.S. manufacturing industries.¹ Seventy percent of all manufacturing facilities in the United States have some form of compressed air system. Most of these systems provide compressed air to drive a variety of equipment within a given plant, including machine tools, painting booths, materials separation, and materials handling.

Benefits of Compressed Air System Efficiency

Recent experience in a variety of “system optimization programs,” as well as the experience of consultants in the field, suggests that over 50% of industrial plant air systems harbor opportunities for large energy savings with relatively low project costs. Compressed air system measures identified in energy audits of small- to medium-sized industrial facilities by the Industrial Assessment Centers had average projected

¹ Unless otherwise noted, information in this section is taken from XENERGY, Inc. (1998) *United States Industrial Electric Motor Systems Market Opportunities Assessment*. Washington, D.C.: U.S. Department of Energy, Office of Industrial Technologies, and Oak Ridge National Laboratory. The study is hereafter referred to as the *Motor Market Assessment*.

savings of 15% of compressed air system usage with simple paybacks in less than 2 years. Many case studies conducted for system optimization programs have identified savings in the range of 30 to 60% of initial system usage. The *United States Industrial Electric Motor Systems Market Opportunities Assessment (Motor Market Assessment)* estimated that compressed air system energy use in the typical manufacturing facility could be reduced by 17% through measures with simple paybacks of 3 years or less. In addition to energy benefits, optimization of compressed air systems frequently results in corresponding improvements in system reliability, product quality, and overall productivity.

Seventy percent of all manufacturing facilities in the United States have some form of compressed air system.

OVERVIEW OF THE PROJECT AND REPORT

This market assessment was designed and carried out in consultation with the Ad Hoc Evaluation Committee of the Compressed Air Challenge®. The Committee reviewed the research plan, the assessment interviewing approaches, draft questionnaires, and drafts of the various sections of this report.

Objectives

The project was designed to answer a number of key questions concerning the demand and supply sides of the market for compressed air efficiency services. Among the key research questions to be addressed on the **demand side** of the market were the following:

- What extent are customers in key end-use sectors aware of compressed air usage, costs, and savings opportunities?
- What practices do these customers follow to monitor, maintain, and enhance the efficiency of compressed air systems?
- What, if any, services do these customers purchase to maintain or enhance the efficiency of compressed air systems?
- What barriers do customers experience in purchasing such services?

The key research questions on the **supply side** of the market were as follows:

- What efficiency services do compressed air distributors, installers, and consultants currently offer?
- What is the current volume of sales for these services (number of customers, number of projects, dollar volumes)? How has volume changed over the past few years? What are vendors' expectations regarding growth?
- What role do these services play in the overall business strategy of manufacturers, distributors, and consultants?
- What barriers do these businesses face in developing and selling compressed air system efficiency services?

Research Activities

The report is based on a combination of primary and secondary research, including:

- An assessment of 91 compressed air equipment distributors. We concentrated our efforts to characterize the supply side on distributors, since these companies have established commercial and service relationships with end users, and are in the best position to serve as a channel for delivering system efficiency services.
- An assessment of 222 industrial end users who have compressed air systems.
- Interviews with 5 veteran compressed air efficiency consultants, designed to capture their perceptions of the current state and recent changes in both the demand and supply side of the market for compressed air system efficiency services.
- Reanalysis of data on compressed air use and maintenance practices collected in 1997 as part of the field inventory for the *Motor Market Assessment*.
- Review of regional studies of the market for compressed air system efficiency services.²

KEY FINDINGS

Demand-Side Findings

- **Customer awareness of and concern for compressed air efficiency is low.** Only 9% of customers interviewed for the program identified controlling energy costs as the primary objective in compressed air system maintenance and management. Only 17% mentioned efficiency at all as a system management objective. This low level of interest and knowledge was echoed in findings from the regional studies and interviews with compressed air system efficiency consultants.
- **Maintenance of consistent, reliable compressed air supply is the principal objective of system management.** Seventy-one percent of customers reported that ensuring adequate air supply is their primary objective in system management. According to consultants interviewed for this project, concern about operating consistency provides an effective route to selling efficiency-oriented services.
- **A large portion of customers report serious problems in compressed air system operation and maintenance.** Thirty-five percent of those interviewed reported that they had experienced unscheduled shutdowns of their compressed air systems during the previous 12 months. For 60% of these establishments, or 21% of all establishments, the shutdown had lasted 2 days or more.
Two-thirds of the customers reported experiencing potentially serious operating problems in their compressed air systems. Excess moisture and inadequate air pressure were the most frequently reported problems.
- **A significant portion of customers report having service contracts for their compressed air systems, but few of these contracts**

...energy use in the typical manufacturing facility could be reduced by 17% through measures with simple paybacks of 3 years or less.

² Including Aspen Systems Corporation, *The Compressed Air Systems Market Assessment for New England*, Compressed Air Baseline Study Group, April 2000; and Customer Opinion Research, *Compressed Air Market Transformation: Quantitative Baseline Research*, prepared for Pacific Gas & Electric, 1999.

address system efficiency. Thirty percent of customers reported that they had service contracts for their compressed air systems. However, only one-third of these (or 10% of all participants) reported that efficiency-oriented services such as leak detection, energy-use monitoring, or assessment of control strategies were included in the service contract. There was no difference in the incidence of unscheduled system shutdowns or operating problems between customers with service contracts and those without such contracts.

- **Thirty-five percent of customers interviewed reported that they conducted leak prevention programs.**
- **Reported implementation of compressed air efficiency measures is very low.** The 1998 *Motor Market Assessment* found that 57% of manufacturing plants had taken *no* action to improve compressed air system efficiency—including repairing leaks—over the 2 years prior to the survey. A 1999 survey of 270 large industrial users served by Pacific Gas & Electric (PG&E) obtained a similar finding.³
- **Seventy-five percent of operators of the systems installed had had no formal training in compressed air system efficiency.**
- **Seventeen percent of customers reported that they had undertaken a compressed air system audit over the past 7 years.⁴** Most of the audits had been conducted in the past 6 years; and 6 were underway at the time of the interview. While most of the audits included estimates of energy use and identified potential energy-saving measures, fewer than half included estimated savings and costs for recommended measures. Two-thirds of the customers who conducted system audits reported that they had implemented at least one of the recommended measures.
- **One-third of the customers reported that vendors selling “services specifically designed to reduce energy costs in... compressed air systems” had approached them.** The nature of these services varied widely. The most frequently mentioned were preventive maintenance for compressors, assessment of control strategies, and identification of energy-saving measures. No one service was mentioned by more than 46% of those interviewed. This result reflects the formative state of the market for compressed air system efficiency services. Vendors have not defined the nature of such services consistently.

Only 3% of customers reported that they had purchased compressed air efficiency services in response to these sales approaches. The most frequent objections to these services were high cost and the customers' view that they could undertake such activities with in-house staff.

Seventy-five percent of operators of the systems installed had had no formal training in compressed air system efficiency.

Supply-Side Findings

- **A large portion of distributors report that they offer compressed air efficiency services.** Over three-quarters offer system-efficiency measures, while over one-half offer end-use analyses and leak services.

³ Customer Opinion Research, *Compressed Air Market Transformation: Quantitative Baseline Research*, prepared for Pacific Gas & Electric, 1999.

⁴ Compressed air system audit was defined in the questionnaire as “a study of how to make your compressed air system as a whole more energy efficient.” Field experience of CAC Committee members suggests that audit methods are not uniform and are seldom comprehensive.

- **However, efficiency services are a very minor portion of distributor revenues.** An estimated 4% of total revenues are derived from compressed air efficiency services.
- **Over one-half of vendors feel that the demand for efficiency services has increased over the last year.**
- **Most distributors that offer efficiency-related services have entered the market within the past 10 years; one-third have entered in the past 4 years.**
- **Most distributors interviewed consider efficiency services essential to their competitive positions.** Sixty-seven percent of distributors rate efficiency services as being important to their competitive position. Their major motivation to enter the market is customer retention. With the number of firms that offer efficiency services increasing, vendors believed that they needed to reply in kind to maintain satisfaction among their equipment purchasers. Access to additional revenue streams from consulting was not mentioned at all as a motivating factor.
- **Most distributors identified customers' lack of understanding of the benefits of compressed air efficiency measures as the major barrier to their increased sale.** These findings mirror the experience of compressed air efficiency consultants. Forty-five percent of the vendors identified customer perceptions that compressed air efficiency services were already being provided by in-house staff as an objection to sales efforts. This finding, combined with the reported low incidence of specific measure implementation, further reinforces the consultants' observation that customers are largely in the dark about the nature of compressed air system efficiency measures and maintenance practices.

Most distributors identified customers' lack of understanding of the benefits of compressed air efficiency measures as the major barrier to their increased sale.

This finding is consistent with the distribution of the national list by number of employees. The relatively large size of the companies should be kept in mind when interpreting other evaluation results.

Total Compressed Air System Horsepower. Table 2-4 displays the distribution by SIC and another measure of size, self-reported compressor horsepower. Again, most interviewed establishments fall into the medium range here as well.

Hours of System Operation. The findings from both this study and the PG&E survey indicate that compressed air systems generally have very heavy hours of operation. Table 2-5 shows self-reported hours of operation from customers to the *Compressed Air Market Assessment* and the PG&E survey. **Sixty-three percent of the customers to this assessment reported that they run their compressed air systems more than 80 hours per week,** as did 45% of the respondents to the PG&E survey. Nearly a quarter of those interviewed during this assessment reported that their compressed air systems run continually, as did 17% of the PG&E respondents. This high level of use suggests the importance of the compressed air systems in supporting overall manufacturing operations, as well as the importance of high-quality system management and maintenance in realizing energy savings.

Incidence of Compressed Air Systems. In an effort to learn more about the presence or absence of compressed air systems in different industries, the assessment research firm recorded the number of establishments that were screened out because they did not use compressed air systems in their facilities. This screening question was posed to the contact from the subscription list or, if that person no longer worked at the facility, the plant manager, plant engineer, or maintenance manager. We are therefore confident that the customer could accurately answer whether the facility had a compressed air system. Table 2-6 displays the results of this screening. Given the small size in each industry, the results cannot be extrapolated to the population. However, the results closely resemble those of the *Motor Market Assessment*, which found that 18% of all manufacturing plants have no compressed air systems.

Sixty-three percent of the customers to this assessment reported that they run their compressed air systems more than 80 hours per week....

Compressed Air System Management

Position of Person with Responsibility for Compressed Air System Management. Maintenance Managers are responsible for the management of compressed air systems in nearly two-thirds of the establishments assessed (See Table 2-7). Plant engineers and plant managers are responsible in most of the remaining establishments. This suggests that compressed air system management is considered more as a maintenance function and is not generally tied to decision-making on capital improvements.

Objectives of Compressed Air System Management. Table 2-8 shows customers' responses to open-ended questions regarding their objectives in managing compressed air systems. Control of energy costs ranks very low among the objectives for managing compressed air systems. Without prompting, just 9% of customers mentioned energy efficiency as their primary system management objective; only 22% mentioned efficiency at all as a system management objective.

One of the consultants interviewed expressed the opinion that the level of system maintenance efforts was declining due to trends in outsourcing and assignment of maintenance personnel to production positions occasioned by historically high levels of production.

Leak Prevention Programs. Identification and repair of leaks in the air distribution system and end-use tools can often reduce system energy use by 10 to 15%. The value of leak prevention seems intuitively obvious, given the exposed nature of air lines and the audible hiss of leaks. However, only 35% of those interviewed during this assessment regularly conducted leak prevention programs in their facilities. There was no consistent pattern of association between the implementation of leak prevention programs and either SIC or size of the establishment. The primary activities included in these leak prevention routines are checking for leaks near compressors/dryers and repairing leaks (See Table 2-12). For almost 90% of the customers with leak prevention programs, in-house staff performs these routines.

System Monitoring and Management. The assessment contained a number of questions concerning customers' efforts to monitor compressed air system performance. They were asked if they had made a variety of operating measurements over the past 2 years. Table 2-13 displays the different quantities that were measured by those interviewed. One-quarter of them had made no measurements at all. Measuring pressure levels was cited most often, by almost two-thirds of the customers. Forty percent of them mentioned making operating measurements related to energy use: demand on compressor motors, energy use by compressor motors, leak loads, and load profiles (defined as periodic demand measurements over the course of one or more days). The high proportion of customers who report measuring pressure levels is consistent with the high proportion of customers who are concerned with reliability of air supply.

In-house staff carried out the above measurements for almost three-quarters of the establishments that performed such measures.

The percentage of customers who have made capital improvements to their compressed air systems to reduce energy consumption is very low.

TABLE 2-12: Leak Prevention Activities

Leak Prevention Activity	Percent Included in Leak Prevention Programs
Check for leaks around compressors and air dryers	77%
Repair leaks	67%
Check joints for leaks	49%
Check regulators and tools for leaks	45%
Tag leaks	41%
Check for open bleed valves	39%
Check bypass valves	37%
Number of customers	75

Of those interviewed who purchased energy efficiency services, almost one-half did so because they believed they would save a substantial amount of energy. Other reasons cited include improved production control, improved production efficiency, the reputation of the vendor, and a lack of staff time. Among the reasons for *not* purchasing efficiency services, the most frequently mentioned were that it was too costly or because it could be performed by in-house staff (See Table 2-18).

Of those customers who were not approached to purchase energy efficiency services, 58% reported that they would be interested in such services. Among customers who were not interested in these services, the most common reason for their lack of interest was their ability to perform the services in-house (32%) or the small size of their systems (39%).

Training. Slightly over one-quarter of all customers reported that someone in their staff had been trained in compressed air system efficiency. In roughly half of these instances, their compressed air equipment vendor had sponsored the training. Only 6% of all customers were aware of the Compressed Air Challenge® program. **The key finding from this series of questions reveals that operators of 75% of the systems had had no formal training.**

Compressed Air System Efficiency Studies. Almost 20% of all customers reported undertaking energy-efficiency studies of their compressed air systems over the past 7 years.³ For those establishments that did undertake efficiency studies, most used a specialized compressed air system consultant (37%) or an equipment vendor (24%) to perform the study (See Table 2-19).

There is no uniform set of procedures or protocols for conducting compressed air system efficiency study. There are a number of computerized study programs currently available which call for extensive measurements of compressor power and operating parameters under various load conditions. Other protocols are somewhat less rigorous. Many consultants have developed their own procedures that they modify to meet the particular requirements of the site. Table 2-20 lists the activities included in these system studies. While most contained the full complement of technical assessments, it is interesting to note that fewer than half of the studies estimated cost and energy savings for the recommended measures. This information is often necessary to motivate customers to implement recommendations.

Twenty-five of the 38 establishments (66%) that undertook an efficiency study reported that they implemented measures recommended in those studies. Twelve of these companies reported implementing two or more measures. A variety of efficiency measures were implemented due to the efficiency study (See Table 2-21). Among those 13 customers who had not implemented any measures, 7 reported that their study was not yet complete. A number of these customers reported that they intended to implement the recommended measures.

Fifty-eight percent of customers who were not approached to purchase energy efficiency services reported that they would be interested in purchasing such services.

Twenty-five of the 38 establishments (66%) that undertook an efficiency study reported that they implemented measures recommended in those studies.

³ The relevant question read: "Have you undertaken or contracted for a study of how to make your compressed air system as a whole more energy efficient?"

For additional information, please contact:

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