Market Research Report

Compressed Air Efficiency

prepared by

Pacific Energy Associates, Inc.
Research Into Action

*report #*00-058

August 2000

NORTHWEST ENERGY EFFICIENCY ALLIANCE
www.nwalliance.org

522 SW Fifth Avenue, Suite 410
Portland, Oregon 97204
telephone: 503.827.8416 • 800.411.0834
fax: 503.827.8437

MARKET RESEARCH REPORT: COMPRESSED AIR EFFICIENCY

Prepared For:

The Northwest Energy Efficiency Alliance

Prepared By:

Pacific Energy Associates, Inc.
Fred Gordon
Will Miller

Research Into Action, Inc.
Jane Peters, Ph.D.
Mark Cherniack

August 2000

Table of Contents

Executive Summary I

Research Design I

Research Findings II

Nature of Opportunities III

Size of Market IV

Service Delivery IV

Customer Perspective VI

Market Barriers VIII

Recommendations IX

Overall Strategy IX

Key Elements X

I. Introduction 1

II. Study Objectives 3

III. Research Design 5

A. Literature Review 5

B. Expert Interviews 5

C. Market Actor Interviews 6

D. Analysis 7

IV. Research Findings 9

A. Nature of Opportunities 9

B. Size of the Compressed Air Services Efficiency Market and Distribution by SIC and System Size 12

1. Secondary Sources of Data on Savings Potential and Cost 12

2. Size of the Market 14

C. Delivery Structure 17

1. Manufacturers 18

2. Distributors 20

3. Consultants 22

4. Energy Service Companies and Energy Service Providers 23

5. Compressed Gas Companies 25

Table of Contents

IV. Research Findings ..... Cont.

D. Overall Volume of Baseline Services Delivery 25

E. Customer Management Of Compressed Air 28

V. Market Structure, Market Barriers, Opportunities, and Options for the Alliance 33

A. Market Structure 33

B. Barriers 35

C. Opportunities 38

1. *Compressed Air Challenge* 38
2. Market Momentum 40
3. Developments in the Energy Services Industry 41
4. Developments in Industrial Management 41
5. *AIRMaster* 41

D. Recommendations 42

1. Overall Strategy 42
2. Education 45
3. Develop Demonstration/Case Studies to Fuel *Compressed Air Challenge* 47
4. Accelerating Development of Integrated Services for Medium-Sized Systems 50
5. Education and Quality Control for Small Systems 52

APPENDICES

Appendix A: Technical Experts Interviewed for this Report

Appendix B: Expert Interview Discussion Guide

Appendix C: Equipment Vendors, Engineering Consultants, and Energy Service Companies Interviewed

Appendix D: Distributor Interview Guide

Appendix E: Consultant Interview Guide

Executive Summary

The Northwest Energy Efficiency Alliance (the Alliance) contracted with Pacific Energy Associates, Inc. (PEA) and Research Into Action, Inc. (RIA), two independent consulting firms, to conduct a study of the market for compressed air efficiency services in the Northwest. This study was completed in July 1998. The Alliance asked PEA/RIA to explore the current level and character of services in the compressed air efficiency market, and to assess whether opportunities exist to increase the level of service offerings.

To meet these needs, PEA/RIA conducted a literature review and a series of interviews. The intent was to assess the level of market activity in compressed air system retrofit, and describe market barriers, opportunities, and potential solutions. PEA/RIA also explored methods of gathering quantitative data on the compressed air market.

Research Design

The literature review included 15 documents, and covered compressed air opportunities, potential savings, program experiences, current initiatives, and market characteristics, focusing on the Northwest but also including leading studies from other regions.

To provide in-depth knowledge of technical opportunities and market structure, and to help define questions and terminology for interviewing market actors. A national compressed air efficiency expert was included in the research team. Then, an initial picture of the market status was drawn through structured, open-ended interviews with 12 additional regional and national experts.

To provide detailed information about baseline activity levels, vendor and customer awareness, and the potential for changes in the market, further interviews were conducted with market actors. These included: 1) Northwest firms who might offer compressed air efficiency services, including consultants, engineering firms, energy services companies, and energy services providers; 2) major compressed air equipment sales organizations in the Northwest; and 3) a few national firms which might be increasing Northwest activity. The intent of these *market actor* interviews was to assess the scale and focus of compressed air efficiency activity, and

to get the respondents' ideas of the size of the market, potential segments, barriers, opportunities, etc. In all, we contacted 26 market actors, 23 of which provided data. Respondents included 9 consulting engineers, 4 Energy Service Companies/Energy Service Providers (ESCos/ESPs), 9 compressed air equipment distributors, and one manufacturer's representative.

The data proved quite useful for understanding market dynamics, but not sufficient for precise quantification of market size or savings potential, due to the modest interview sample and the imprecise, sometimes limited, and overlapping nature of the responses. For strategic planning purposes, *approximations* of some quantitative market parameters are included in this report. We believe that these are worth considering in that they provide ballpark estimates of the size of the overall market, potential savings, the proportion of the load from systems of various sizes, etc. We further believe that, while these estimates could be incrementally improved, precise data on compressor loads is possible only through an extensive customer survey, and that more precise data on baseline efficiencies are obtainable only through extensive site audits.

Key Research Findings

- There are significant opportunities to save energy in the compressed air marketplace.
- Most customers and contractors are not currently acting to optimize the efficiency of compressed air systems.
- Many contractors are considering becoming more active in compressed air system efficiency, but will not move forward until they see changes in customer interest.
- Most customers spend little time thinking about compressed air system efficiency, and have limited faith in their existing contractors to address the issue.
- A combination of recruitment, training, and demonstration could lead to significant market transformation among large systems (over about 500 HP). In this case, market transformation means

sustainable, increased levels of system retrofit activity independent of any subsidy.

- However, large systems constitute only about half of the horsepower of compressed air systems in the region. The potential for market transformation among smaller systems is less certain and will take larger efforts.

Nature of Opportunities

The largest source of potential Compressed Air efficiency opportunities is in improvements to existing systems. These opportunities differ significantly from site to site, based on system characteristics. While some opportunities are simple and inexpensive to identify (e.g., reduce pressure), many require a significant investment in monitoring to identify the benefits and the appropriate strategy. Technical opportunities include: 1) improved system operations and maintenance; 2) compressor improvements; 3) better compressor unit control; 4) improved cooling and dehumidification systems; 5) controls for sequencing compressors; 6) leak reduction; 7) design and mechanical improvements to distribution piping and system configuration; 8) improved end-use devices (e.g., nozzles); and 9) improved end-use applications of compressed air.

The most prominent national compressed air efficiency consultants focus first on finding some easy, quick savings items to capture the customers' interest. However, once the customer's attention is captured, they first work to match the needs of end users efficiently with end-use equipment**,** then to improve distribution, then optimize the controls, and then (only after these elements are considered) look at compressor improvements. This approach often permits downsizing of compressors, or even removing compressors from active operation. By contrast, many consultants and utility programs get most of their savings from compressors and controls. This may reflect differences in local savings opportunities, but may also indicate that many people in the industry have neither the opportunity nor the experience in taking a comprehensive approach.

Potential Energy Savings

A study of national data on savings, applied to Northwest loads, indicates that the Northwest technical potential for energy savings from compressed air system improvements probably exceeds 150 average MegaWatts (AMW), and may be significantly larger. Over half of the potential savings are in the forest products industries: pulp and paper products and wood products. The rest occurs among several industries. Respondents to our interviews confirmed this pattern. A large fraction of the savings are very inexpensive, with savings covering the costs in one year or less. If purchase of a new compressor can be avoided, costs can be negative.

Savings can constitute 30% to 50% of compressed air load and, for some industries, as much as 10% to 20% of plant electric load. While savings of over 10% were found in audits of many forest products industry plants, these audits were probably in smaller plants than are typical in the Northwest. One yet-unpublished national study provides smaller estimates of savings.

Utilizing data from contractors, engineering consultants, and experts, PEA/RIA made an effort to estimate the number of compressors of different sizes in the market, and their concentration by industry. Development of these estimates involved extensive judgement. Systems under 500 HP constitute 47% of total HP using one method of estimation, and 71% of HP using another. Systems under 200 HP constitute 35% and 17% of HP in the two estimates. While these estimates may somewhat overstate the importance of smaller systems (because smaller systems may have fewer load hours), it is clear that a significant fraction of the total compressed air load, and conservation potential, lies outside the very large systems.

Service Delivery

Compressed air services can come from a number of alternative routes. The services industry consists of:

- About five ***manufacturers***. These firms have not traditionally focused on efficiency as a profit center. Some have viewed efficiency as in conflict with their goals of selling compressors.

While their perceptions are beginning to change, their efficiency actions have been limited.

- A few dozen ***distributors*** of equipment and services in the Northwest, with perhaps ten of these dominating sales. Some provide customer O&M services, and most provide efficient compressors on request, but their focus on efficiency is limited. Many may have limited capabilities for looking beyond the compressor, at efficiency opportunities in the broader system.

- About a dozen ***consultants*** who perform energy audits, meter systems, and/or help design new systems. Other consultants do occasional new system or troubleshooting work. Few of these individuals work on compressed air efficiency full-time, and many are not closely affiliated with organizations that deliver services to customers. Many of the analysis or O&M firms do not provide extensive metering services. Some are affiliated with, and promote, specific products that tend to narrow the focus of recommendations and are not always appropriate. There are only a few firms that can provide advice, and package and manage a comprehensive analysis and installation project. Thus, packaging is often exclusively in the hands of end-users, many of whom do not have the time or interest to take on this task. End-users tend to rely on distributors for information more than consultants, but do not always trust that information.

- A handful of ***Energy Service Companies (ESCos) and Energy Services Providers (ESPs)*** who market turnkey or performance-guaranteed compressed air services. For most ESCos and ESPs, these services are offered as part of broader energy services offerings. Only one company appears to be actively pursuing compressed air efficiency in the Northwest, dealing primarily with large systems. Other companies have proposed compressed air services, but either are not selling much of anything or are selling something else.

- A few ***Compressed Gas companies***, who sell a variety of industrial gasses, including compressed air. These companies deal primarily with large manufacturers with diverse industrial gas needs. The one firm we learned the most about is just becoming aware of

compressed air energy efficiency, and has no existing capability in this area.

Our interviews indicate that there is a small volume of compressed air services being offered in the Northwest today (relative to the magnitude of low-cost opportunity), and there are no concrete plans to expand the level of services. While several parties are poised to expand their offerings, they are waiting for evidence of increased customer demand.

PEA/RIA developed estimates of the general magnitude of service offerings in the Northwest *(as shown in Table ES-1)*. These estimates involved significant judgement and should be considered to be useful at assessing the *magnitude* of activity, but not the precise level.

Table ES-1: Estimated Volume of Compressed Air Services

SERVICE	PROVIDER	VOLUME (PROJECTS/YEAR)
System Efficiency Surveys	Engineers, ESCos	20
System Load Monitoring	Engineers, ESCos	7
Compressor Controls/ Sequencing	Engineers, ESCos, some Distributors	9
Compressor Auxiliary Enhancements**	Mostly Distributors	59*
System O&M	Engineers	9***
Piping Design	Engineers, Distributors	14*
Process Tool Assessment	Engineers	6

* *It is unclear whether many of these projects involve efficiency improvements*

** *E.g., refrigeration, outside air.*

*** *In addition to distributor services.*

We asked whether respondents were hoping to expand business in specific areas. There was moderate interest in expansion of a number of services, including surveys, monitoring, O&M, and compressor and auxiliary

enhancements. In some cases, it was unclear whether the planned O&M and hardware enhancements had an efficiency focus or were focused on other customer objectives.

We also discussed various types of marketing services that might help in "packaging" efficiency for customers in a way that makes it easier to implement. Distributors were most interested in ***system design***, *and* ***management of system installation*** because they now dominate that work**.** ***Guaranteed system performance*** was emphasized by some, but not all ESCos and ESPs. It is important to note that those who had more experience with guarantees were, on average, more equivocal. ***Unit Pricing*** (i.e., selling cubic air by the CFM to a plant) was not familiar to most respondents. We heard of six plants in the region where this is used, three of which were contracted to one service firm. Those most familiar said that opportunities were limited largely to new plants by the need of the service firm to own a self-contained space in or near the plant.

Service Provider Perceptions of End-Users

The information we gathered on end-user practices is second-hand because our interviews were with people in the compressed air services business, not the end-users. Nevertheless, the picture they painted was fairly consistent.

Generally speaking, plant personnel try to keep systems working, with pressure up to levels that meet user demands, but compressed air O&M is largely neglected and system efficiency is rarely considered. Many plants have no on-site personnel (contract or staff) who understand maintenance fundamentals. Distributor personnel are called when there is a crisis. A few of the more efficiency-minded customers occasionally perform checks for system leaks, but few customers survey for inappropriate end-use. Fewer maintain a regular program of leak-detection and repair. Among those firms who check for leaks, it is common for identified leaks to go unrepaired. Some larger facilities have undergone efforts to improve compressed air system efficiency, either independently or through utility programs. However, those efforts are rarely comprehensive. New system design is often haphazard, with little consideration of efficiency.

Most customers do not have separate electric meters for compressed air and do not know what the electric costs of compressed air are. As a

consequence, most purchase decisions are based on speed and first cost. The customers do not know how to secure reliable and comprehensive assistance, due to their limited attention to compressed air issues and the fragmented services delivery industry. Many customers hesitate to pay for compressed air studies, yet mistrust recommendations provided for free by vendors.

There is more knowledge, capability, and attention to compressed air efficiency in *some* large facilities, but even among those with several hundred horsepower of compressed air load, the plant-to-plant variation in focus on compressed air is dramatic.

The limited scale of dollar savings from compressed air energy efficiency can inhibit interest, even if paybacks are attractive. For example, a sawmill might see a one-year payback on a $15,000 investment, but is more worried about where their timber supply will come from next year. As a consequence, when industrial firms pursue compressed air enhancements, it is usually for non-energy reasons. The most common reason is to avoid buying a new compressor or to enhance system reliability. There are other cost savings related to reduced overhead, improved reliability and performance, etc.

Market Barriers

The pattern of barriers appears to differ by size class. The following very approximate size breaks are used to clarify the trends by size.

- For 0-100 HP systems, options are limited because the savings can rarely support the cost of a detailed technical study. However, there are still opportunities for efficient compressors, some controls, and in-house O&M improvements. For these options, awareness, knowledge, confidence, and custom (e.g., traditional sales focus of distributors) present significant barriers, but ones that might be influenced by carefully-targeted information from a credible source.

- 100-500 HP systems, from economic and technical perspectives, could benefit from a wide array of technical opportunities. However, there are significant awareness, knowledge, confidence and custom (i.e., traditional practice and market structure) barriers.

Additionally, many customers in this size range may not have the time and knowledge to organize and manage services from separate contractors who offer audits and installation, and are more likely to allocate scare capital to other needs. The limited number of systems experts and energy service companies offering turnkey services is another significant hindrance.

- In general, the range of technical and project management services currently available is much greater for larger systems (e.g., over 500 HP). While current activity is limited, contractors of many types are eager to provide a package of technical, financing, installation, and guarantee services to large customers. Large customers have the magnitude of potential savings to better afford and attract the few system efficiency experts. While the scale of financial benefits is larger than for smaller plants, it may not be larger in proportion to other expenses and opportunities at the plant. So, even large compressed air opportunities often receive a low priority for internal attention and funding.

Recommendations

The following recommendations present a synthesis of our market research finding and our broader knowledge of the market. PEA/RIA does not recommend who should carry our these recommendations. Various recommendations could be addressed by the Alliance, utilities, government entities, or industry alliances.

Overall Strategy

- Focus primarily on efficiency improvements to existing compressed air systems.
- There are many types of compressed air service firms who might profit from efficiency. It is premature to preclude any as potential partners for Alliance projects.
- For existing systems, the Alliance should focus on two types of efficiency opportunities:
    - System retrofit or upgrade

- System operation and maintenance

- Separate strategies should be developed for different sizes of systems.

Key Elements

- It is crucial to provide education, awareness building, and confidence building for efficient approaches, technologies, and service delivery systems. A credible training and (preferably) certification program, such as that planned by the Compressed Air Challenge (CAC),[1] with appropriate follow-through to re-enforce the lessons, may largely serve these ends. The CAC has established a management center to maintain the curriculum and a contractor to organize and hold the classes across the country. It is not necessary to replicate this structure in the Northwest. Through its continued participation in the governance of CAC, the Alliance needs to help assure that the quality and credibility of the training are unimpeachable. Additionally, the Alliance needs to assure that key decision-makers are recruited to attend, and that there is sufficient participation for Northwest training so that CAC's efforts in the region can expand. This might best be achieved through a series of targeted recruiting efforts aimed at key individuals (compressed air operators and facility engineers). Recruiting aids might include scholarships, or, for far-flung plants, subsidized air fare.

- A very important compliment to the training effort would be case studies to give facility engineers in key industrial "peer groups" (specific plant types and geographic areas) the knowledge and tools to proceed. The case studies should: 1) involve firms who are customary "concept leaders" in the industry; 2) incorporate information on energy, and especially non-energy benefits; and 3) include practical information to help firms with similar plants proceed. The Alliance may also need to encourage facility engineers and plant managers to communicate more with their peers about compressed air efficiency. In our study, we did not study the

[1] CAC is a national collaborative effort to transform efficiency of compressed air use. Participants include manufacturers, distributors, consultants, government, utilities, end-users, and regional planning groups (including the Alliance).

industry peer groups extensively, and do not know if they are tightly enough knit to act as an efficient vehicle for transmitting innovation.

The above two activities could result in significant transformation of the large customer market and are important for the medium-sized market (e.g., 100-500 HP systems). However, many customers with medium-sized systems need ways of procuring analysis, installation, and management with few players, steps, and risks. While ESCos and ESPs may be ready to work with large customers to address the need for integrated services, more help may be needed to build the service infrastructure to package projects for medium-sized customers. Options for utilities to encourage the development of such packaging include:

- Alliance or utility subsidies for delivery of integrated services (e.g., metering with O&M, or audit/install/guarantee) in a small number of medium-sized plants, to build alliances and experience;
- Alliance or utility help in project administration and oversight; or
- Alliance or utility guarantees and quality control for installations. This would simplify the number of services which contractors would need to provide, thereby making entry into the medium-size market of turnkey contractors, or metering-and-O&M firms more feasible.

For small systems (e.g., <100 HP), targeted educational efforts may have the most impact. These could include mailed information on efficient equipment and a 1-800 line to support customers when they are choosing compressors to match specific circumstances. Significant market transformation in the small system market may be a difficult goal to achieve