Market Progress Evaluation Report

Sav-Air Market Transformation Initiative

prepared by

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SAV-AIR MARKET TRANSFORMATION INITIATIVE

MARKET PROGRESS EVALUATION REPORT #1

Final Report

Prepared For:

The Northwest Energy Efficiency Alliance

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Executive Summary

A. Introduction

Compressed air is often called the "fourth utility" in industrial facilities – after electricity, natural gas, and water. It is used for motive power for machinery, cooling, materials handling, and hand tools. It is a safe, flexible, and powerful resource.

Compressed air can also be a significant user of electricity, comprising from 10% to 35% of total electrical costs in many industrial sectors. A tool using compressed air takes as much as ten times the input energy as one using electricity (the remaining nine-tenths is waste heat). Yet compressed air costs are often "invisible," with no accounting or measurement in most plants. The priority for most firms in operating and maintaining their compressed air systems is to avoid breakdown, because breakdown could bring production to a halt. Most systems are not run for lower operating costs, for product quality, or even for best productivity. Most industrial compressed air systems operate at a fraction of their potential efficiency – and many owners do not know it. Thus, there are nearly always excellent opportunities for savings as well as other benefits from smarter compressed air system operation.

To summarize, the most important issues of industrial compressed air in regards to energy efficiency and management are:

1. Compressed air is a significant industrial end-use in the Northwest region and is an essential utility in these plants;

2. Compressed air is a fundamentally inefficient energy transformation process; and

3. Optimal operation of compressed air systems in industrial plants is seldom a priority and adequate management information is rare, resulting in even less efficiency and impact on production.

The *SAV-AIR Market Transformation Initiative* was undertaken by the Northwest Energy Efficiency Alliance (the Alliance) to change the way compressed air end-users and service providers view and manage this "fourth utility," and in doing so, achieve not only energy efficiency-related benefits, but also non-energy benefits such as increased system reliability.

Further, the Alliance and the SAV-AIR team want SAV-AIR to evolve into a self-sustaining business that will continue this work into the future. SAV-AIR, LLC was formed in 1997, and selected by the Alliance in December 1998, as one of its ventures. SAV-AIR's formal contract with the Alliance began in December 1998, and will continue through December 2000.

B. Evaluation of the SAV-AIR Initiative

Pacific Energy Associates, Inc. (PEA) was hired to assess the market transformation achievements of SAV-AIR, and to assist with "adaptive management" of the SAV-AIR venture. The latter means that the PEA team provides ongoing guidance on particular issues and materials to help SAV-AIR achieve its goals. This report comprises the first *Market Progress Evaluation Report* (MPER #1).

The specific objectives of the MPER #1 are:

- Describe SAV-AIR's approach and services.
- Review SAV-AIR's current status.
- Provide a comprehensive look at the compressed air market, including an estimation of the market potential for SAV-AIR services.
- Assess SAV-AIR's market effects to date.
- Assess the Alliance-sponsored *Compressed Air Challenge* (CAC) training program.
- Identify key issues and make recommendations to address them.

This report builds on market research previously conducted by PEA and Research Into Action, Inc. (RIA) through a new round of phone interviews with 12 experts[1] and 12 market actors.[2] PEA also performed in-depth

[1] Includes national experts who work with utilities and energy-related organizations (e.g., ACEEE), as well as consultants.

interviews with the SAV-AIR team and key Alliance staff for the project. As described in the methodology section of the report, some of the interviews with experts and market actors are re-contacts of those interviewed for the previous PEA/RIA study.

C. Overview of SAV-AIR's Approach and Services

The Alliance selected SAV-AIR as a market transformation venture because SAV-AIR's proposal stood out from others with its comprehensive, whole-system optimization approach, coupled with ongoing multi-point monitoring to manage system operations and efficiency over time. The proposal also demonstrated an understanding of what actions were required to change the market. Staff were impressed by the team members' combination of well-established business relationships with large industrial customers, strong sales skills, in-depth understanding of whole-system optimization, and hands-on technical skills.

SAV-AIR provides integrated compressed air management systems and engineering services. They have expertise and specialized technology to evaluate existing equipment, engineer upgrades, and provide monitoring and control of an entire compressed air system. The result is increased compressed air system reliability, decreased compressed air costs, and management information for verification and decision-making.

The SAV-AIR approach includes remote monitoring and control of compressed air systems involving sensors, computers and software. Although some off-the-shelf systems might have been marginally adequate for this approach, SAV-AIR desired to have a system that addressed the specific needs of compressed air systems and their expertise in managing and operating these systems. Thus, the SAV-AIR venture included extensive product development in terms of sensors, remote computers, networks, customized software, and databases. The advantages of this development are expected to be reduced implementation costs and a responsiveness to customer requirements that other systems could not achieve.

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[2] Defined as vendors, distributors, and consultants.

Based on the original *SAV-AIR Master Plan*, the SAV-AIR service approach is comprised of five delivery phases. (Note that this service plan is currently being revised and simplified.)

- *Phase I* – walk-through, temporary monitoring, and proposal
- *Phase II* – detailed audit and monitoring to determine baseline usage, savings potential, and system improvements
- *Phase III* – system improvements
- *Phase IV* – verification of savings
- *Phase V* – ongoing monitoring, reporting, and system optimization

In the body of this report, PEA points out that SAV-AIR is not the only firm promoting compressed air system optimization, and their approach is not the only approach. Other consultants are providing studies involving system observation, metering, analysis, and improvements. Some firms are also providing ongoing computer monitoring. There are also several initiatives providing training, marketing, or site studies (two examples being the *Compressed Air Challenge* and federally-supported Industrial Assessment Centers).

However, there do appear to be a number of important differences between SAV-AIR's proposed approach and their competitors'. At the same time, there is a critical caveat to our assessment: *SAV-AIR's services have yet to be fully proven in the field, both technically and in terms of business viability*. The following are some of the key features that PEA believes both distinguish SAV-AIR, and create potential sales and delivery challenges:

- SAV-AIR's comprehensive, continuous management approach should provide greater and longer-lasting energy savings.
- The SAV-AIR services may result in non-energy benefits such as improved product quality, increased production throughput, and other improvements on issues pivotal to plant managers and owners.
- SAV-AIR's services require marketing at higher and at multiple levels in a client's corporation. This is a barrier to making a sale.

However, is may eventually provide greater improvements in the industrial process.

- The financial support of the Alliance and other backers provides a unique window-of-opportunity to develop, refine, test, and conclusively demonstrate their service.

- SAV-AIR's approach and their software will streamline compressed air system modeling, data reporting, and optimization. This technology provides strong leveraging of the skills of the core SAV-AIR team, resulting in reduced service costs and allowing their compressed air expertise to be brought to bear on a much wider customer base.

- SAV-AIR is not a compressed air equipment or controls vendor, so their recommendations will be less biased.

- Since many industrial compressed air systems are under-maintained, implementation of SAV-AIR recommendations may increase O&M costs, but overall, reliability and productivity will benefit.

D. Assessment of SAV-AIR's Field Efforts and Market Effects to Date

This first MPER focuses on "early indicators" of market effects. These early indicators primarily concern SAV-AIR's internal progress in developing the "prototype" (or alpha) test site, delivering the first two phases of their services to pilot or "beta" sites, and customers' *expressed intent* to implement system changes and ongoing monitoring. This report also briefly assesses SAV-AIR's status regarding "progressive" indicators. These concern beta site implementation through *Phase V*, development of successful case studies, broader market effects as evidenced by changes in competitor activities, recognition by market actors of the credibility and technical merit of SAV-AIR's services, and successful evolution of SAV-AIR to a viable business.

Tables *ES-1* and *ES-2*, below, provide an overview of SAV-AIR's field activities to date and the status regarding both the early and progressive

indicators. The tables also describe any concerns the PEA team has about progress to date, and suggested strategies for moving forward.

Table ES - 1: Assessment of Early Indicators

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
ONE PROTOTYPE SITE OPERATIONAL BY THE SECOND QUARTER OF 1999	There was a prototype site physical demonstration to the Alliance in August 1999, and a prototype site plus basic (but not full) software demonstration in-house to SAV-AIR in September 1999.	Suggest a comprehensive demonstration of the complete control and monitoring system sometime during the 1st Quarter of 2000.
SIX INDUSTRIAL FACILITIES BETA SITES SELECTED BY THE THIRD QUARTER OF 1999	Four sites have been selected as of January 2000, and have received *Phase I* services. Two sites remain in negotiation.	The initial schedule may have been unrealistic. It may be more important to bring one site through to completion than to accelerate efforts at other sites. To the extent that both can be done in parallel, SAV-AIR should continue to push for agreement completions for the two sites in negotiation.
SUCCESSFUL IMPLEMENTATION OF SAV-AIR'S SERVICES UP THROUGH *PHASE II*	A *Phase II* installation of the SAV-AIR system is in progress at one of the current beta sites.	This is a critical-path item to financial success. SAV-AIR should continue with project implementation as quickly as possible. PEA will assess benefits and conduct customer interviews after SAV-AIR's system has been in place for several months.
		Continued
BETA SITE CUSTOMERS EXPRESS INTENT TO IMPLEMENT SAV-AIR'S RECOMMENDATIONS AND UNDERTAKE MONITORING	SAV-AIR indicates that customers plan to commit to the entire package of services. However, they are not contractually obligated to do so at this point.	PEA will conduct customer surveys over the next several months to assess the level of customer interest in SAV-AIR's recommendations and their monitoring services.
BETA SITE CUSTOMERS EXPRESS INTEREST IN REPLICATING SAV-AIR SERVICES IN OTHER CORPORATE FACILITIES	SAV-AIR selected the beta sites with replication potential in mind. Indications are that all six beta-site owners are strongly interested in replication.	PEA's customer surveys will also assess the level of customer interest in replication.

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
ABILITY OF SAV-AIR TO STREAMLINE THE SALES AND DELIVERY PROCESS AS THE INITIATIVE PROGRESSES	SAV-AIR developed new marketing materials in January 2000. First project implementation is currently underway, but sales are taking longer than anticipated. SAV-AIR is actively tracking sales and delivery costs and is acutely aware of the importance of streamlining.	The next months are critical. SAV-AIR should consider focusing on the most amenable prospects and continue to streamline sales and delivery.

Table ES - 2: Assessment of Progressive Indicators

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
DEMONSTRATION OF THE BENEFITS OF SAV-AIR SERVICES AT SIX BETA SITES THROUGHOUT THE PACIFIC NORTHWEST THROUGH CASE STUDIES AND OTHER MEANS	Four beta sites are under contract but not operational, so case studies have yet to be written. However, all four sites show good potential to serve as case studies for both energy and non-energy benefits.	SAV-AIR should continue to push towards completion of at least one beta site so they can demonstrate and document benefits. A recommended case study approach is included in *Appendix C*.
		Continued
THE COMPRESSED AIR INDUSTRY AND END-USERS RECOGNIZE SAV-AIR'S PRODUCTS AND SERVICES AS CREDIBLE, UNBIASED, AND TECHNICALLY ACCURATE	60% of the 24 experts and distributors interviewed for this report have heard of SAV-AIR. They believe the SAV-AIR approach has value, but withhold judgment about its cost-effectiveness.	PEA will periodically survey experts, distributors, and end-users to assess opinions of SAV-AIR's services.
NON-ALLIANCE SOURCES PROVIDE AT LEAST 50% IN MATCHING FUNDS FOR BOTH DEVELOPMENT AND IMPLEMENTATION OF THE *SAV-AIR MASTER PLAN*	Third parties, either utilities or ESCos, have committed some funding towards several of the beta sites.	SAV-AIR will continue to monitor budget and proposals. PEA will report on status in a later MPER when more information is available.

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
SUCCESSFUL LAUNCHING OF SAV-AIR AS A SELF-SUSTAINING BUSINESS	Commitment has continued from SAV-AIR's two major funders and the Alliance. SAV-AIR is in the process of creating a business plan, including a revenue analysis, and has enlisted the assistance of a business consultant.	SAV-AIR should continue to hone its business analysis, determine a pricing strategy, and track and streamline costs. PEA will review and provide feedback on the next iteration of the business analysis.

F. Assessment of the Market for Compressed Air Services

As part of this MPER, PEA described and analyzed the market for compressed air services. One of the key sources of secondary information was a study conducted for the Alliance in 1998 by Pacific Energy Associates, Inc. (PEA) and Research Into Action, Inc. (RIA).[3] This *Market Progress Evaluation Repor*t was built on the PEA/RIA study by conducting follow-up phone interviews with 12 national experts and 12 market actors. (Customer interviews will be conducted and reported on as part of *Market Progress Evaluation Report #2*.)

Below are the key findings from the market assessment.

Customer Attitudes, Activities, and Barriers to Practice Change

- Based on expert and market actor interviews, most customers and service providers do not currently optimize their compressed air systems, so there are significant savings opportunities.

[3] Pacific Energy Associates, Inc. and Research Into Action, Inc. *Research in the Market for Compressed Air Efficiency*. June 4, 1999.

- Most customers spend little time thinking about compressed air system efficiency and have limited faith in their existing service providers to address the issue. Major market barriers include lack of education, awareness, and accountability regarding compressed air costs, and the lack of demonstration of potential benefits of comprehensive services. Customers' ability to fund capital and services investments is also cited as a major barrier.

- Most experts and market actors interviewed believe customers could benefit from system optimization and long-term monitoring, but at the same time are doubtful customers would actually invest in these services.

Service Provider Activities

- Only the top national compressed air efficiency consultants approach systems in a truly comprehensive way. By contrast, many other service providers, including other consultants, vendors, and even utility programs target most of their services and achieve most of their savings from compressor equipment and controls.

- Many service providers say they are doing "system optimization," but at the same time do not offer the key service elements of true optimization. In general, compressed air services remain fragmented, while customers require services that are integrated.

- Regarding change in market activity over the last year for various services, responses were inconclusive. Distributors and consultants reported increases in their own level of activity. These estimates probably should be viewed as optimistic or high-end, since distributors' self interest would favor "looking busy." Nevertheless, based on all interviews conducted, including those with experts, there appears to be a general upward trend in customers' interest in overall system efficiency.

- Based on the interviews for this report, two firms appeared to offer an integrated approach. These two firms were the only ones to say

they offered all the services (including long-term monitoring) that make up a comprehensive approach. However, neither appeared to have software that came close to the sophistication of SAV-AIR.[4] This compares to one firm claiming to offer comprehensive services in the Northwest in PEA's prior study last year. Expert respondents also generally attested to a small increase in compressed air optimization activity.

- Many service providers are considering becoming more active in compressed air system efficiency, but indicate they will not move forward until they see definitive increases in customer interest.

Market Potential for Compressed Air Services

A combination of recruitment, training/education, and demonstration might lead to significant market transformation among large systems (larger than 500 HP). In this case, market transformation means sustainable, increased levels of system retrofit and monitoring 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.

Two studies we reviewed estimated about 90 average Megawatts (AMW) and 170 AMW of potential energy savings, respectively, and differed substantially in their estimates of savings by sector. Possible reasons for these differences are explored in the report.

G. Issues and Recommendations

Issues and recommendations in this section include, first, those for SAV-AIR followed by a number for the *Compressed Air Challenge*. These recommendations are in no particular order of importance.

[4] Honeywell's *Commercial Energy Management and Controls* system is probably the closest counterpart. However, Honeywell was not interviewed, so it is unclear whether they have a similar software tool for compressed air.

SAV-AIR Issues and Recommendations

Issue: Developing Financial Momentum

A critical question is whether SAV-AIR can build and maintain the financial momentum that will enable it to move from the start-up venture phase into a self-sustaining business. The team's business intuition, customer relationships, sales capabilities, and technical skills are very strong and have carried them with good success so far. More recently, the team has been developing a draft business analysis, actively exploring options for capturing revenues. They are using the beta sites to track costs and explore potential pricing strategies.

Recommendation:

We recommend that SAV-AIR continue with the more formalized business planning process it has begun. SAV-AIR's plan to enlist the services of a business-planning consultant is a good idea. The Alliance and the PEA evaluation team are also sources to draw on for business planning and technical assistance. SAV-AIR particularly needs to continue to analyze and streamline sales and delivery costs, and to formalize a pricing strategy. SAV-AIR might also consider incorporating a conservative estimate of non-energy benefits into their business analysis.[5]

Issue: Length of Sales Cycle and Delivery Process

This issue relates directly to the business analysis. The SAV-AIR team members are finding that the sales cycle is longer than they anticipated; despite well-established business relationships, it appears to take about six months from initial contact to a signed contract.

It appears that the original marketing plan was unrealistic, given the obtrusive involvement in customers' processes, the capital investment required, and the developmental state of the product. It is not clear that the

[5] Note that we are not suggesting quantifying non-energy benefits in customers' individual proposals.

length of the sales and delivery process can be substantially reduced, even as the services evolve and are streamlined. We suspect that the sales and delivery process may be inherently longer than they anticipated because of the nature of the services.

Recommendations:

- SAV-AIR should continue to closely track sales costs at the beta sites. They should analyze where both sales and delivery might be getting bogged down and where the process could be streamlined.

- SAV-AIR must quickly size up whether a customer is a good candidate for, and genuinely interested in, the type of long-term services they offer. They already appear to be doing this effectively for the beta sites.

- As the team is already discovering, services of this breadth must be sold strategically at multiple levels. Each sales effort must be explicitly tailored to the concerns of the party being targeted, and with an eye to the role and leverage of the person in the company.

- High quality, high profile case studies of both energy and non-energy benefits are a very valuable sales tool. SAV-AIR must continue to push aggressively towards beta site completion to be able to develop case studies.

Issue: Contractual Arrangements for Ongoing Monitoring

As noted earlier, one critical difference between SAV-AIR and other service providers is that their ongoing monitoring agreement and relationship with customers should ensure savings persistence. However, in the current sales and contractual arrangements, there is no formal "conversion" of a SAV-AIR installation to a SAV-AIR monitoring contract.

Recommendation:

SAV-AIR believes that customers should be continually reminded of the value of ongoing monitoring services, but they need to experience the value first in order to continue. SAV-AIR might consider that future *Phase II* contracts include provisions for low- or no-cost monitoring for some period. SAV-AIR might also consider selling customers ongoing monitoring and control as a package with their *Phase II* contracts. This monitoring could be used as a marketing tool to sell customers this service package.

Issue: Case Studies and Evaluation Reports

SAV-AIR clearly sees the value and importance of the case studies for their sales efforts, and for the Alliance's market-transformation goals. Given their project commitments, and that they are still in the early stages with many beta sites, they have not yet had the opportunity to develop and finalize the content or format of the case studies. However, in order to ensure that the case studies will be of greatest value, some data collection and planning needs to be done while the beta sites are being approached.

Recommendation:

To assist the SAV-AIR team with planning the case studies, PEA has provided recommendations regarding case study content, format, and audience in *Appendix C*. This provides for case studies appropriate for different levels within an organization.

Issue: Purpose of the Prototype Site

The Alliance staff we interviewed were under the impression that the prototype site will function as a fully-operational demonstration site where customers can observe and get hands-on experience with the SAV-AIR equipment and software. The SAV-AIR team did not indicate that it was their intention to use the prototype site in this way, although they did say they might consider doing off-site customer demonstrations using the remote host software.

Recommendation:

While the evaluation team does not consider this difference in perception to be of particular concern, the Alliance and SAV-AIR staff should clarify this so as to bring each party's expectations in line. One question to consider is if the prototype site is not used for full customer demonstrations, where might this be done?

Issue: Need for Greater Clarity on Beta Site Timelines and Goals

SAV-AIR had planned to recruit six beta sites by the third quarter of 1999. As of January 2000, four sites have been recruited and one of those has progressed to *Phase II*. The remaining two are in the negotiation phase. However, it is not clear what the Alliance's near-term expectations are in terms of how far in the delivery process SAV-AIR is expected to go, and by when. If the ultimate goal is to use the beta sites as case studies to demonstrate savings, at least one project will have to progress rapidly in the near future in order to develop the content for these studies.

Recommendation:

The Alliance and SAV-AIR should set some specific and realistic goals for the next six to twelve months. Our recommendation would be that the SAV-AIR team focus most intensely on moving the wood products site along (ideally through *Phase V*) so a case study can be developed. To the extent that SAV-AIR can continue to push at the same time for *Phase I* agreement completion for the two sites in negotiation, they should also do this. However, they may want to consider a cut-off date and identify alternate sites.

Compressed Air Challenge Issues and Recommendations

This discussion pertains to *Compressed Air Challenge* (CAC), a national effort to encourage compressed air system optimization through

promotion, training, certification,[6] and improved information on equipment efficiency. As part of PEA's interviews for the SAV-AIR evaluation, we asked questions focusing on the CAC training.

The *Compressed Air Challenge* is a voluntary collaboration of industrial users, manufacturers, distributors, operating personnel, consultants, efficiency organizations, and utilities. Together they have developed a nationwide effort consisting of training programs, materials, and instructors to increase awareness of the benefits of intelligent compressed air system management. CAC's *Level I* training – *Fundamentals of Compressed Air Systems* – has reached over 1,400 people nationwide, and over 100 in the Northwest.

Issue: Vendor Neutrality and Instructor Selection

Vendor neutrality is a clearly stated goal for the CAC program. However, some of the experts and vendors surveyed for this report repeatedly expressed concerns that the course is biased. Some perceive a vested interest on the part of the instructors, in that particular compressors are represented more often and as better than others. They felt that because the instructors are from one manufacturer, they appear to dominate the program, thus giving them an unfair sales advantage. One service provider had heard that, in order to be selected as an instructor, you had to be a co-sponsor.

The perceptions and opinions expressed on this issue must be considered carefully in light of the fact that they were voiced by experts (who are often consultants and service providers) and vendors (distributors of equipment). It is also important to be aware of the significant distrust in the industry. PEA will be revisiting these issues after the end-user surveys are completed. Since end-users are the primary target audience for the CAC, their opinions will carry the greatest weight. However, on a cautionary note, it is important not to discount the vendors' concerns around these issues just because they may be in direct competition with those sponsoring and instructing the class. Service providers are important

[6] Certification of analysts is a future goal.

players since they often bring the end-users to training through their recommendation. If vendors feel (whether by experience or rumor) that the classes are biased and instructors are unfairly chosen, they may influence their customers against attending the classes.

Recommendation:

Maintaining vendor neutrality is critical to the credibility and success of the CAC program. The instructor selection process should be reviewed to ensure vendor neutrality. CAC might consider using only instructors with no connections to a particular manufacturer or equipment distributor. Those with a high degree of technical knowledge do not always make the best trainers. If a vendor is selected as an instructor, consider having them teach classes that are outside of their service territory, or use co-instructors. When possible, avoid having co-sponsors also provide the instructors.

Issue: Low Attendance by End-Users (Customers)

PEA's review of class attendance records for the Northwest indicated that end-users comprised a majority of participants, but only marginally so at 57%. While this is comparable to national results, transforming the compressed air market to efficient use is to a great degree dependent on end-users' awareness of the advantages of comprehensive management strategies. In the SAV-AIR section of the survey, vendors expressed a reluctance to provide optimization services until their customers request them. Some respondents also expressed concerns that promotion at the CAC classes to end-users is inadequate.

Recommendation:

We recommend re-examining the current strategy for promoting CAC classes to end-users. Mail promotional materials directly to individuals within a particular company, rather than to the company in general. Follow up the mailings with phone calls to encourage attendance and to determine barriers to attendance. Hire a marketing manager (this could be an educational institution or non-profit organization) that is not connected to a vendor or manufacturer to carry out promotional tasks, assist the sponsors,

and maintain a database of end-users. For geographically dispersed industries, consider co-funding travel costs.

Issue: Reaching End-Users Not Able to Attend Off-Site Classes

Some end-users will never be able to attend a CAC class. Reasons may include lack of training funds, company policies that preclude training outside of the corporation, lack of time, or just an attitude against allowing staff to train off site. Empowering these customers with the tools to make informed decisions about intelligent management of their compressed air systems is challenging.

Recommendation:

Consider developing training videos and/or a CD-ROM to accommodate end-users that, for whatever reason, are not able to attend off-site training classes. The caveat in doing this is that end-users who normally can attend offsite training classes may use this as a substitute. They may see the video or CD-ROM as "just as good" as going to an actual class. In addition, the effectivity of such training media in lieu of participatory in-class venues should be investigated.

Issue: Supporting Implementation of the CAC System Approach at the Plant Level

The CAC *Level I* class conveys fundamental compressed air information and sound compressed air management practices. It provides students with application tools such as a seven-step action plan for implementing the systems-approach in their plants. Yet some survey respondents expressed concerns about information learned in the classroom ever getting implemented at the plant. One vendor is concerned that unless there is follow up with each end-user, the information learned will never be put into practice. In part, this happens because managers are not well informed about the CAC efforts and importance of taking a systems-approach to managing their compressed air. Thus, managers are often not supportive of their staff spending time or money putting into practice what they have learned in a class.

Recommendation:

To help solve this problem, the classes should also include an action plan and materials for selling the systems-approach to management. Attendees need to define what barriers they might see to "making it happen" in their plant and develop some strategies for overcoming the barriers. When they leave the class, they should have a clear understanding of what they need to do first to begin to make what they have learned standard practice for their plant.

I. Introduction

The goal of the *SAV-AIR Market Transformation Initiative* is to achieve energy-efficient operation of compressed air systems in the Northwest through the development of a viable, self-sustaining, compressed air system management service.

As described in the *Evaluation Workplan*[7] presented by Pacific Energy Associates, Inc. (PEA), the objectives of the evaluation are to:

- Assess the market transformation achievements of SAV-AIR; and
- Assist with "adaptive management" of the SAV-AIR venture.

This *Market Progress Evaluation Report* (MPER #1) comprises the deliverable for *Task 2: Enhanced Market Characterization*[8] in the *Evaluation Workplan*. This is the first of four reports tracking and describing the progress and market transformation achievements of the *SAV-AIR Initiative* (SAV-AIR).

The MPER #1 provides a comprehensive look at the compressed air market including an estimation of the market potential for SAV-AIR services. In characterizing the market, the report builds on market research previously done for the Alliance. This was conducted by PEA and Research Into Action, Inc. (RIA)[9] through a new round of expert[10] and market actor[11] telephone interviews. PEA also performed in-depth, in-person interviews with the SAV-AIR team and key Alliance staff for the project. As described in the methodology section of this report, some of the interviews are re-contacts of those interviewed for the PEA/RIA study, and some are new contacts.

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[7] Pacific Energy Associates. *SAV-AIR Market Transformation Initiative Evaluation Workplan – Final*. July 1999.

[8] Ibid, pp. 4-10.

[9] Pacific Energy Associates, Inc. and Research Into Action, Inc. *Research in the Market for Compressed Air Efficiency*. June 4, 1999.

[10] Including national experts working in utilities and energy-related organizations (e.g., ACEEE) as well as consultants.

[11] Defined as vendors, distributors, and consultants.

The interviews were used to develop a detailed description of the *SAV-AIR Initiative*, and to assess its progress to date towards affecting change in the compressed air market. Consistent with the Alliance's evaluation policies, this report also offers assistance in *adaptive management*, meaning that the PEA team provides interim feedback and guidance on particular issues or materials. This feedback builds on two previous memoranda prepared by PEA: the first provided input and suggestions on two SAV-AIR customer proposals;[12] the second was a review of SAV-AIR's business plan outline.[13] The findings of each of these memoranda are briefly summarized in this report.

Finally, the report contains an assessment of the regional *Compressed Air Challenge* (CAC) training.

Interviews are currently being conducted with 25 large compressed air customers. The findings from these interviews will be reported in the second MPER, and used to ground-truth the findings from the first MPER, particularly with regard to market characterization, customer barriers, and beta site activities.

This report consists of the following sections:

Executive Summary

I. Introduction

II. Methodology and Approach

III. The SAV-AIR "Story"

IV. Assessment of SAV-AIR's Market Effects to Date

V. The Compressed Air Market

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[12] *Memorandum* dated September 6, 1999, from Steven Scott and Jennifer Stout of PEA to Blair Collins of the Alliance and Bill Annen of SAV-AIR, titled *SAV-AIR Proposal Review*.

[13] *Memorandum* dated December 9, 1999, from Steven Scott and Jennifer Stout of PEA to Blair Collins and Heidi Hermenet of the Alliance, titled *SAV-AIR Business Plan Review.*

I. Introduction

VI. Market Potential for SAV-AIR Services

VII. Market and Program Planning Assumptions Used as a Basis for Program Funding

VIII. Assessment of Compressed Air Challenge (CAC) Training

XI. Issues and Recommendations

I. Introduction

II. Methodology and Approach

To complete the first *Market Progress Evaluation Report* (MPER #1), the PEA evaluation team employed the following methodology and approach:

- A review of secondary sources was conducted to characterize the market and provide information on the market potential for SAV-AIR (including number of customers and potential energy savings). The key source in characterizing the market was the compressed air market research conducted previously for the Alliance by Pacific Energy Associates, Inc. in 1998.[14] Market potential information was largely drawn from the recently completed Northwest motors study conducted by Xenergy and Easton.[15] Comparisons were made to a recently completed compressed air market study from New England,[16] and a prior national study.[17] Materials for prior Northwest and national compressed air initiatives, including *AIRMaster* and *Compressed Air Challenge* were also reviewed.

- Interviews were conducted with twelve compressed air service providers. The PEA evaluation team contacted the same vendors and distributors that were interviewed for PEA's prior study, plus three additional contacts. *Appendix A* provides a list of the vendors and distributors interviewed and the interview protocol.

- Interviews were also conducted with twelve compressed air experts, six of whom were originally interviewed for the 1998 PEA/RIA market research study. Some of the experts interviewed for the PEA/RIA report are no longer involved in compressed air issues or declined to be interviewed. Six additional experts were included in this research. *Appendix A* provides a complete list of

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[14] Pacific Energy Associates, Inc. and Research Into Action, Inc. *Research in the Market for Compressed Air Efficiency*. June 4, 1999.

[15] Xenergy/Easton. *Northwest Energy Efficiency Alliance: Assessment of Industrial Motor Systems Market Opportunities in the Pacific Northwest*. September 1999.

[16] Aspen Systems Corporation, *Compressed Air Systems Market Assessment and Baseline Study for New England,* November 1999. AMSG 7921-001.

[17] Xenergy. *United States Industrial Electric Motor Systems Market Opportunities Assessment*. December 1998, USDOE.

experts interviewed, with an indication of whether they were interviewed for this MPER, the 1998 PEA study, or both. *Appendix B* provides the interview protocol.

- In-person interviews with two key members of the SAV-AIR team.
- In-person interviews with two managers of *the SAV-AIR Initiative* from the Alliance.
- On-site observation of the SAV-AIR prototype site.

The interview results were used to enhance the market characterization, develop a detailed description of the *SAV-AIR Initiative*, and assess the Initiative's progress to date towards affecting change in the compressed air market.

Regarding the latter, the *Evaluation Workplan* describes "early indicators" and "progressive indicators" of market change.[18] These indicators are defined here, and assessed in *Section IV*.

"Early indicators" are defined as progress in developing, testing, and "proving" the SAV-AIR services. Specifically, early indicators focus on:

- Development of what is called the "prototype" (or alpha) test site; and
- Progress in marketing and implementing the SAV-AIR services at six "beta" (i.e., pilot) sites. Specifically, PEA is defining "early indicators" for the beta sites as:
  - Implementation through *Phase II* of the five service delivery "phases" defined by SAV-AIR in its *Master Plan*.[19] The phases are described in detail in *Section III* of this report. Implementation through *Phase II* means completion of a detailed audit, installation of temporary

[18] Note that this is a more specific and somewhat modified definition of early indicators for the beta sites than originally provided in the PEA *Workplan*.

[19] *SAV-AIR Master Plan Presentation*, Evaluation Kick-off Meeting, June 1999.

monitors, assessment of baseline energy usage, estimation of energy savings, and recommendations for system improvements.

- Expressed intent by beta site customers to implement some or all of the recommendations at their facility and undertake continuous, long-term monitoring.

- Expressed interest by beta site customers in replication of the services at their other facilities.

- Ability of SAV-AIR to streamline the sales and delivery process as beta site implementation progresses.

Because the delivery of SAV-AIR's services is in a relatively formative stage, this report primarily focuses on the early indicators described above, although a brief assessment of progressive indicators is also provided. A more detailed assessment of the progressive indicators will be a focus of the *MPER #2*. Progressive indicators are defined as:

- Beta site customers' continued progress towards changing their attitudes and practices, as evidenced by implementation of some or all of SAV-AIR's system improvements and completion of contractual agreements to have SAV-AIR undertake monitoring to ensure maintained savings (implementation of *Phases III* through *V*).

- Development of successful case studies.

- Market effects as evidenced by changes in competitor activities and recognition by market actors of SAV-AIR's services as credible, unbiased, and technically accurate.

- Provision by non-Alliance sources of at least 50% of the matching funds for development and implementation of the SAV-AIR *Master Plan.*

- Successful development of SAV-AIR into a self-sustaining business.

III. The SAV-AIR Story

This section covers the following:

- A description of SAV-AIR's history, technical approach, and services
- A report on the status of SAV-AIR's efforts to date
- A review of SAV-AIR's business approach and analysis

A. History, Approach, and Service Description

The goal of the *SAV-AIR Market Transformation Initiative* is to achieve energy-efficient operation of compressed air systems in the Northwest through the development of a viable compressed air system management service. Based on the goals stated by the Alliance, the SAV-AIR program's success will be defined by the creation of a self-sustaining business entity able to provide comprehensive compressed air management services. The goal is for SAV-AIR's services to be accepted practice by market actors[20] who will recognize the value of whole-system efficiency rather than component-specific efficiency, as well as the benefits of long-term monitoring and reporting.

SAV-AIR provides integrated compressed air management systems and engineering services. They have expertise and specialized technology to evaluate existing equipment, engineer upgrades, and provide monitoring and control of an entire compressed air system. The result is an increase in compressed air system reliability, decreased compressed air costs, and management information for verification and decision-making.

The SAV-AIR approach includes remote monitoring and control of compressed air systems involving sensors, computers and software. Although some off-the-shelf systems might have been marginally adequate

[20] Market actors include end-users of compressed air services (i.e., large industrial customers), manufacturers of compressed air equipment, and equipment and service providers. The latter includes auditors, consultants, vendors, energy service companies, etc.

for this approach, SAV-AIR desired to have a system that addressed the specific needs of compressed air systems and their expertise in managing and operating these systems. Thus the SAV-AIR venture included extensive product development in terms of sensors, remote computers, networks, customized software, and databases. The advantages of this development are expected to be reduced implementation costs and responsiveness to customer requirements that other systems could not achieve.

SAV-AIR, LLC was formed in 1997 to develop and implement integrated compressed air management systems that minimize production costs and increase energy efficiency. The Alliance chose SAV-AIR as a market transformation initiative in December 1998 through a competitive bid process. SAV-AIR's contract with the Alliance began on March 1999, and is to continue through December 2000. According to the Alliance staff interviewed, SAV-AIR's proposal stood out from the four other compressed air proposals submitted because of its comprehensive, whole-system-optimization approach, along with its ongoing monitoring and reporting to maintain system efficiency over time. The Alliance staff said the proposal demonstrated an understanding of the market, including why practices have not changed substantially, and what it will take to change them. The proposal suggested that developing long-term relationships with customers and providing turnkey services were key to market change.

In the interviews, the Alliance staff also emphasized that the individual SAV-AIR team members are key to the Initiative's potential for success. Team members have a powerful combination of well-established business relationships with large industrial customers, strong sales skills, in-depth understanding of whole-system optimization, and hands-on technical skills in both system hardware design and installation, and software development.

The SAV-AIR team largely echoed what the Alliance staff said regarding their service approach. According to the team, the thinking behind their approach is that measuring compressed air system inefficiencies, and their costs, will make compressed air an "accountable" aspect of a company's production. SAV-AIR argues that without long-term measurement and monitoring of the entire compressed air system, customers do not know the cost and production impact of compressed air inefficiencies and operation practices, and will have little drive to optimize system efficiency and reliability. SAV-AIR claims that their approach is unique in that it

considers the overall system rather than individual components, and provides continuous, verifiable measurement and reporting to identify and confirm efficiency improvements. The SAV-AIR team feels improvements in productivity and product quality are also potential benefits of the SAV-AIR system.

SAV-AIR is targeting facilities with 400 horsepower or more of compressed air from multiple machines. SAV-AIR describes its core mission as the following:

- Development and demonstration of the SAV-AIR monitoring and control system at six sites in the Pacific Northwest; and
- Launching a self-sustaining business to provide compressed air management systems (a principal element of market transformation).

The following description of the SAV-AIR delivery process is based on interviews with SAV-AIR and a review of their *Master Plan* prepared for the Alliance:[21]

Phase I: Survey and Proposal

- Conduct walk through of compressed air system
- Evaluate existing equipment and efficiency opportunities
- Install temporary monitors for power usage, flow, and pressure
- Collect data through several production periods; develop preliminary estimates of savings, capital costs, and payback

Phase II: SAV-AIR Audit

- Develop a monitoring and installation plan

[21] *SAV-AIR Master Plan Presentation*, Evaluation Kick-off Meeting, June 1999.

- Install sensors and a communication node
- Determine baseline system energy usage utilizing the SAV-AIR monitoring system
- Analyze energy savings and make recommendations for system improvements

Phase III: System Improvements

- Implement recommended system improvements
- Inspect and verify installation

Phase IV: Post-Audit

- Verify system operation and energy usage
- Provide post-analysis reporting

Phase V: Continued Monitoring and Services

- Perform continual remote monitoring
- Conduct staff training for reliability and efficiency
- Recommend and implement additional system improvements as needed

The Alliance and SAV-AIR anticipate their approach will result in both energy cost savings and non-energy benefits. They described the following potential non-energy benefits, depending on a customer's particular circumstances:

- Reduction of capital costs by prolonging compressor lives through reduced leaks and shortened cycle times.
- Reduction of capital costs by increasing system efficiency to the point that a compressor can be taken offline and used as a spare.

- Avoiding the need for new compressor purchases, even as facility needs increase.

- Reduction of system maintenance costs (although in some cases these costs may increase due to sub-optimal O&M).

- Increased compressed air system reliability and pressure stability, which may in turn decrease interruptions to production.

- Optimization of compressed air usage might increase throughput by removing compressed air-induced bottlenecks.

- Reduction of per unit production costs.

- Support of a company's larger environmental objectives.

It is important to recognize that SAV-AIR is not the only firm promoting compressed air system optimization, and their approach is not the only approach. Our interviews with vendors indicate that just about everyone in the industry says they are doing optimization, although some of the claims sound more like wishes than statements of fact. Below is a summary of current compressed air services and initiatives:

- A number of technical consultants nationally are providing studies that involve system observation, metering, analysis, and improvements.

- Some consultants, particularly those engaged in sophisticated applications of intermediate controls, are providing permanent computer monitoring and control of end-use devices and receiver controls. Other consultants, including one in the Northwest, appear to be offering short-term, multi-point monitoring for purposes of system optimization.

- The *Compressed Air Challenge*, a national initiative supported by the Alliance, offers compressed air system efficiency training.

- The Bonneville Power Administration (BPA) has supported the development of software to assist with compressed air system studies (*AIRMaster*).

- Federally supported Industrial Assessment Centers (including at least one in the Northwest) and other government and utility efforts have supported compressed air studies with similar overall goals.

B. Differences in the SAV-AIR Approach

Based on our conversations with the SAV-AIR team, our observations of the prototype site, and our review of existing compressed air services through market actor interviews and secondary sources, there do appear to be a number of important differences between SAV-AIR's proposed approach and that of their competitors'. However, there is a critical caveat to our assessment: *SAV-AIR is still in a relative formative stage in terms of service development, testing, and delivery*. Thus, key features that will distinguish SAV-AIR from its competitors have yet to be fully proven in the field, both technically and in terms of business viability. These same features will likely create potential sales and delivery challenges, as described below:

- SAV-AIR's proposed services comprise a comprehensive, long-term management tool rather than a one-time, or even periodic, hardware or information fix. This may allow SAV-AIR to provide more tangible and sustained feedback to customers regarding opportunities to save energy.

- Because of the long-term nature of the services and the detailed monitoring strategies, SAV-AIR may be able to better maintain savings and to capture more energy savings than their competitors. In addition, savings should not be nearly as vulnerable to changes at customers' plants over time (i.e., staff turnover and reductions) or simply from lack of staff attention to compressed air.

- Features of the SAV-AIR system *may* result in significant non-energy benefits that may not be available, or may not be demonstrable, with other approaches.

- SAV-AIR will provide customers with a multipurpose management tool that is more sophisticated and costly than competitors' services. Selling such an approach will require marketing to upper levels in the client's corporation as well as to multiple levels. While high-level sales are more difficult,

obtaining buy-in at the management level may ultimately help SAV-AIR provide and demonstrate broader benefits such as increased reliability, production quality, and production volume in select circumstances, as management would care more for these than energy cost savings.

- SAV-AIR enjoys financial support provided by the Alliance, and in-kind and direct investments from their two investment partners (Century West Engineering and Air Logic). They also have taken advantage of grant funding provided by local utilities to support their beta-site projects. While the ultimate goal is that SAV-AIR becomes a self-sustaining business entity, this support provides a unique window of opportunity to develop, refine, test, and then conclusively demonstrate, a comprehensive and technically complex service without the immediate need to generate a positive cash flow.

- SAV-AIR is designing software that when fully developed should simplify compressed air system modeling, data analysis, and reporting. The objective is to make it possible for SAV-AIR staff, and perhaps even technically sophisticated customers, to perform these tasks, even though they may not have the in-depth expertise of the core SAV-AIR team. That is, the software will in essence be an expert system that incorporates many of the skills and knowledge of the core team members.

- The team is also developing software features that will allow multiple parties at different locations to troubleshoot compressed air system problems at a particular plant by providing continuous, real-time, multi-point system measurement.

- SAV-AIR is not a compressed air equipment or controls vendor, so their recommendations are not biased by the desire to sell particular capital equipment.

- It is also worth noting that SAV-AIR is different from past utility-sponsored programs because it is being treated by the Alliance as not only a market transformation effort, but also as a business venture unto itself.

Because SAV-AIR's approach is comprehensive and long-term, it will be technically challenging to develop and refine. It also will probably be difficult and time-consuming to sell, and may require efforts at multiple levels of customers' organizations. It may also require new and innovative contractual arrangements, since ongoing monitoring and O&M involve financial commitments different from, and more complicated than, a one-time purchase such as an audit or equipment. It will be complicated to deliver as well. It will require getting involved in the production process at plants, making it necessary to gain the confidence of both floor staff and management. These challenges are already becoming evident at the beta sites currently under development.

These factors may be balanced by the unique advantages noted above. In particular, the potential value of non-energy benefits from the SAV-AIR services, in terms of increased production reliability and volume, and decreased per-unit cost could far outstrip energy savings at some customers' facilities. While SAV-AIR may sell its services based on energy benefits at some plants, our review of the market indicates that these additional benefits are essential if SAV-AIR is to sell to a large number of Northwest customers.

As we discuss later in this section, it remains to be seen if SAV-AIR's services can be offered to customers in a way that is manageable and ultimately profitable. On the revenue side, how much SAV-AIR will charge and how much customers will be willing to pay for initial and ongoing compressed air services of this scope remains to be demonstrated. On the cost side, a key issue is how effectively the SAV-AIR team can streamline their service, sales, and delivery. Their success in this regard will be critical to the Initiative's business viability as SAV-AIR moves from the beta-site phase into full rollout.

C. Status of the Prototype Site

SAV-AIR's first step was to design and construct the "prototype test site." This is not an industrial site per se; rather it is a small, self-contained compressed air system that the SAV-AIR team is using to develop and extensively test its controls and monitoring equipment. The prototype site is located at the Oregon Advanced Technology Center (OATC) in Wilsonville, Oregon.

SAV-AIR planned to have the prototype site operational by the Second Quarter of 1999. Choosing components for the site took longer than SAV-AIR anticipated; thus the first internal rollout demonstration took place at the end of September, about three months later than expected. This demonstration included some features of the data analysis and remote monitoring software packages, but did not include the *Graphical User Interface* (GUI) screens. SAV-AIR says these are under development, and should be fully functional at their first beta site by the end of February 2000.

SAV-AIR is continuing to develop its software packages. Based on cursory observation by the evaluation team, the remote-host software is a graphical interface that allows users to move and place icons depicting compressed air system components (i.e., compressors, dryers, receivers) and instruments (for pressure, flow, and temperature transducers). The remote-host software allows SAV-AIR staff to graphically depict a compressed air system, and design and oversee its remote monitoring. The software also allows any user (including the customer), no matter where they are located, to see the same image of the system's operation. SAV-AIR says that as new field engineers join the SAV-AIR team, they will need only minimal training to use the software to build and understand a visual model of a customer's compressed air system and how SAV-AIR's monitoring is integrated into it. This will allow the core SAV-AIR team to leverage their compressed air knowledge to provide services more extensively, and more cost-effectively.

There seems to be some differences in the perceptions of the purpose of the prototype site between the Alliance staff and the SAV-AIR team. Both said the prototype site is a facility for testing SAV-AIR's controls and monitoring equipment, as well as their software. Both also see the prototype site as a valuable training tool for new SAV-AIR staff. However, the Alliance staff we interviewed were under the impression that the prototype site will function as a fully-operational demonstration site, where customers can observe and get hands-on experience with the SAV-AIR equipment and software. The SAV-AIR team did not indicate that it was their intention to use the prototype site in this way, although they did say they might consider off-site customer demonstrations using the remote-host software.

D. Status of the Beta Sites

Concurrent with development of the prototype site, SAV-AIR is also developing beta sites. These are essentially pilot customer projects. When customers are solicited as beta site participants, they are informed that they are part of a service development effort, but they also pay some amount for the services.

SAV-AIR's strategy is to develop and implement beta projects that can be leveraged to other companies in the same industry, and initially more importantly, to other facilities within the same company. They want to be able to develop and roll out their services "behind the corporate veil" in the early stages of the business. This approach will greatly reduce sales costs and help them focus on smoothing out implementation issues. In terms of identifying potential beta customers, SAV-AIR is first approaching those with whom they already have established relationships. They are also targeting industries with significant opportunities. One such sector is the wood products industry, because plants generally have substantial compressor loads and often manage those loads poorly. The first customer SAV-AIR has approached is a profitable wood products firm, and an acknowledged industry leader, having survived the industry shakeout of the last two decades. There may be other leverage opportunities through alliances with ESCos and utilities.

The initial SAV-AIR approach focused on first developing a complete understanding of their customers' compressed air needs and the system providing it. Then, making engineering and operations and maintenance upgrades as necessary. And finally, providing monitoring oversight to ensure that predicted savings were achieved. An essential element, compressed air system control, was initially left to the customer. However, several of their first customers asked specifically for SAV-AIR to incorporate control of their compressed air systems into their sensors, hardware, and software. Although not all customers appeared to have the same interest in direct control by the SAV-AIR system, meeting this need was critically important for some beta customers, and so the capability was included.

The addition of control capabilities driven by specific customer requirements added substantially to the development budget and also included an additional two to three months of effort by core staff. Some of

the delays in demonstration of the prototype site can be attributed to development of these additional features.

Six beta sites have been slated by the Alliance as demonstrations for the SAV-AIR initiative. The two SAV-AIR *Master Plan Phases* that are used to describe status for these beta sites *are Phase I: Survey and Proposal* and *Phase II: SAV-AIR Audit*. The project status is summarized in *Table 1* below.

Table 1: Status of Beta Test Sites

BETA SITE	SITE DESCRIPTION	STATUS
1	Wood Products	Phase II contract
2	Mineral Mill	Phase I agreement
3	Mine	Phase I agreement
4	Transportation Equipment	Phase I agreement in negotiation
5	Food Processor	Phase I agreement
6	Semiconductor	Phase I agreement in negotiation

For the *Beta 1* site (wood products), a *Phase II* contract is in place, meaning that SAV-AIR has completed *Phase I (Survey and Proposal)*, and is in the process of conducting the detailed facility audit for *Phase II*. At *Betas 2, 3,* and *5*, agreements are in place for SAV-AIR to do a walk-through and develop preliminary estimates of savings and project costs. For one of these three, the walk-through has been completed and a proposal has been submitted. At *Betas 4* and *6*, they are in discussions regarding agreements to do *Phase I*. No project has yet reached *Phase III (System Improvements)*.

With customers' permission, the beta sites will also be used to develop case studies to promote SAV-AIR's success to other customers within the same industry, and to customers in other industries to a lesser extent. SAV-AIR and the Alliance hope these case studies will demonstrate energy savings, and also at least qualitatively identify specific potential non-energy benefits. While energy benefits are significant, and are the primary benefit used to meet the investment criteria for any organization,

the non-energy benefits should be such that, even without being accurately quantified, they make the project highly desirable. It is likely that the extent of achievable non-energy benefits at a customer's facility will not be clearly understood until the SAV-AIR project has been installed for some time.

Each beta project is discussed below for its potential to be a useful case study for SAV-AIR to leverage for sales at additional sites, and to provide useful examples of non-energy benefits.

Beta 1: Wood Products Manufacturer

Beta 1 has excellent potential as a case study. This facility can be used as an example for other facilities under the same ownership and to the many other regional firms in the same business.

Leverage: Because there are other related facilities under the corporate umbrella, and the corporation facilitates communication on these energy-related issues, there is excellent leverage within the company. As this company is regarded as an industry leader, there is also leverage potential to other companies in the wood products industry who watch this corporation for trends.

Non-Energy Benefits: There are some potential but not-yet-assessed non-energy benefits for *Beta 1*. Initial observations suggest that interaction in the pneumatic controls and actuators may allow production machinery to operate faster with more constant air pressure.

Beta 2: Mineral Mill

Beta 2 may decide to only purchase select elements of SAV-AIR's service, rather than a comprehensive package. However, SAV-AIR has a verbal commitment from the customer for proceeding with *Phase I*, and the potential benefits to the customer appear to be outstanding. The *Phase I* study will include a complete redesign of their compressed air system using the SAV-AIR technology. This site should be a good case study because their current compressed air system is in poor condition.

Leverage: This company has a number of facilities in this country and worldwide. They are currently undergoing a significant upgrade of the

facility, which includes the compressed air plant. Leverage to other plants seems possible.

Non-Energy Benefits: The facility is in dire need of a complete upgrade of their compressed air system. Improved reliability and reduced maintenance and operation liabilities will be clear benefits. In addition, a number of compressors are being leased. With a new compressed air system these costs will be eliminated.

Beta 3: Hard-Rock Mine

Beta 3 may have some use as a case study, even though there are relatively few mines in the Pacific Northwest. Because it is a large facility with a complex compressed air system, it could make an impression on other users of similar systems.

Leverage: As there is a limited number of mines in the region, work with this beta customer will not apply directly to a large Northwest audience. There are also no other plants under the same ownership in the region. However, the project may have leveraging potential with the local utility, who may be interested in partnering with SAV-AIR in selling compressed air services to other large industrial customers in their service territory. The local utility has made clear its intention in this area, and has funded a portion of the project.

Non-Energy Benefits: There may be some environmental benefits though better management of the compressed air system. There will also be some safety advantages in continuously monitoring the system and making the system improvements SAV-AIR has already identified through their *Phase I* walk-through.

Beta 4: Transportation Equipment

This will be a good general case study for other manufacturing businesses. The case study can feature the initial rationale for interest in the SAV-AIR approach – quality control over torque.

Leverage: There may be leverage opportunities with other transportation manufacturing businesses and perhaps also with the parent company of this particular corporation.

Non-Energy Benefits: As mentioned above, upgrading to higher quality standards for repeatable torque will require a known and stable air pressure. This is a seldom-considered, non-energy benefit for high quality compressed air management and monitoring.

Beta 5: Food Processing Facility

Beta 5 should be an excellent case study, as the food processing industry is a large user of compressed air and any food-processing example will translate clearly to others in the same industry.

Leverage: This plant is owned by a large corporate food processor. Thus, there is good potential for replication at the company's other plants. In addition, the region's many other food processing companies may consider using SAV-AIR's services or adopting a similar approach.

Non-Energy Benefits: Outsourcing compressed air services to SAV-AIR will enable staff to focus on their core business.

Beta 6: Semiconductor Plant

Beta 6 should result in a very useful case study for making sales to other high-tech plants, and also as a powerful demonstration to any potential customer that SAV-AIR can deliver to the exacting standards of this industry. This facility should be a good project for gaining experience with oil-free compressors and demonstrating the efficiency potential of this specialized type.

Leverage: The visibility of this customer in the industry, and more importantly, meeting their specialized needs, will likely leverage sales to other semiconductor plants, as well as to other plants owned by the same firm.

Non-Energy Benefits: The SAV-AIR team believes their services could result in a quantifiable improvement in system reliability. This may allow them to take an air compressor offline or retire a now-redundant machine.

E. Observations Regarding the Beta Sites

The SAV-AIR team members are finding that the sales cycle is longer than they anticipated, despite well-established business relationships; it is taking at least six months from initial contact to a signed contract. They acknowledge that they need to shorten that time. What is not clear is whether the length of the sales and delivery process can be substantially reduced as the services evolve and are streamlined, or whether the process is simply inherently longer than they anticipated because it involves comprehensive services and requires multi-level sales. Additionally, the sales cycle must deal with internal requirements for capital expenditures and each firm's specific investment cycle.

The SAV-AIR team noted that management politics of individual companies present constant challenges when selling the SAV-AIR services, in terms of determining whom to approach and what strategy to use. SAV-AIR team members say they are learning that customers' rationale for implementing projects is not always simply economic. The team is trying to use that understanding to their advantage.

The Alliance staff said that the length of time to establish a contract was not a surprise, and they are not particularly concerned that only one beta site has an established *Phase II* contract at this point. They noted that the interest on the part of this beta site customer in possibly implementing the services at multiple national sites is particularly important and significant as an indicator of market change. They also pointed to the willingness of one backer to put a substantial amount of money on the table in support of another beta site as a very positive indicator of SAV-AIR's progress.

At the same time, the Alliance staff acknowledged that the venture faces some substantial hurdles in terms of whether it will successfully make it from a start-up venture to a self-sustaining business. Some of the hurdles Alliance staff described were:

- SAV-AIR is banking on the assumption that customers will buy the concept of "if you can measure it, you can manage it." It is not clear whether, and how much, customers will pay for expertise beyond what is provided by equipment manufacturers, even though manufacturers can be biased.

- It is not clear how SAV-AIR's revenues versus costs will ultimately pencil out. It is anticipated that development, sales, and delivery costs will go down substantially over time. Although shortening the sales process might occur, ultimately it will just need to be accounted for as part of their business. Controlling these factors obviously will be key to having the cash flow to make the venture financially viable.

- Alliance staff said the data analysis and remote monitoring software is still under development, although they are confident that the SAV-AIR team has the necessary expertise and skills to deliver to customers when they need to.

SAV-AIR has established in-house procedures for tracking sales and delivery costs for the beta sites. At the one beta site now under development, cost overruns have occurred in the installation of some equipment, partly because of the customer's stringent requirements for electrical projects. SAV-AIR has absorbed these costs, taking them out of their working capital.

One minor technical difficulty occurred when SAV-AIR arranged to send metering transducers to a customer with what the team believed were clear manufacturer instructions for installation. The customer could not make the equipment work correctly, and returned it to SAV-AIR. SAV-AIR said they learned from the experience not to send out any equipment to customers until it has been installed and tested on the prototype site first. In a related comment, they also said it was a constant challenge to stay abreast of the available technology for building industrial controls.

Interestingly, the SAV-AIR team reports that customers have been particularly interested in the potential non-energy benefits they hope to achieve from the SAV-AIR services. One customer is focusing on the environmental benefits of the services. Safety issues and product quality control are also potential areas for improvement mentioned by some customers.

Regarding competitors, the SAV-AIR team reports that so far they have not found themselves going head-to-head with their competitors in terms of service features and delivery capability. However, they said the marketing and sales capabilities of their closest competitors can be formidable. The SAV-AIR team said their competitors have a knack for

making products with fewer features than SAV-AIR sound superior. The SAV-AIR team says their greatest challenge is convincingly and succinctly describing to customers how they are different from the competition. This is a critical point and highlights the importance of moving as quickly as possible to develop the beta sites and document the results through in-depth case studies.

When asked how competitors might undermine the SAV-AIR concept, the team said their competitors might tell customers that the SAV-AIR services are too expensive, too "fancy," and too complex, that ongoing monitoring is an unnecessary frill that does not provide meaningful savings or benefits. Competitors will probably say that with annual monitoring they can achieve the same results as SAV-AIR for less. SAV-AIR remarked that while this might be true in some respects, in reality no one follows through and does effective monitoring on an annual basis (even in most cases, leak detection). That is primarily because customers' business environments are dynamic: new people are hired, companies reorganize, and customers may just plain forget to follow through on actions that will maintain the savings achieved from system efficiency improvements. Because of the ongoing nature of SAV-AIR's service, and the fact that a contract will be in place with the facility management, they believe the SAV-AIR concept will survive staffing and organizational changes at customers' facilities, and thus have improved persistence. The client also will get constant reports of the benefits, critical to demonstrating the ongoing value of the services.

F. SAV-AIR's Marketing and Business Planning Efforts

In the previous section, a number of business planning issues were touched on: targeting and leveraging beta site customers; managing development, sales, and delivery costs; determining service pricing and revenues; and knowing the competition. In this section, we review SAV-AIR's more formal marketing and business planning efforts.

To date, SAV-AIR has done the following activities related to planning their marketing strategy and business approach:

- Developed their marketing materials (i.e., brochure, logo, presentations, etc.) in order to articulate their services and highlight how they differ from competitors.

- Created a draft outline of their business plan, which includes their marketing plan.

- Created a draft business analysis spreadsheet.

The second two activities are described and assessed in more detail below.

Business Plan Outline

In December 1999, PEA's evaluation team reviewed the first "formal" business plan outline provided by SAV-AIR and the Alliance.[22] PEA's *Evaluation Workplan* originally stated that the evaluation team would review SAV-AIR's "marketing" plan. However, the outline provided to the evaluation team covered the elements of a full business plan, which is appropriate and necessary, since a marketing plan should be a subset of a business plan. Thus, PEA broadened its review to the entire business plan outline.

Based on their review, PEA concluded that in the business plan, the SAV-AIR team and the Alliance need to convey more about SAV-AIR's identity and how it will make money by meeting customers' needs. To help flesh out the plan, PEA provided some background on basic elements of a business plan, drawn from our experience in developing business plans for energy service companies (ESCos) and from two business planning texts (Holtz 1994 and Malburg 1994, listed in the attached bibliography).

PEA suggested the following three areas that are the most critical near-term business planning steps for the SAV-AIR team and the Alliance:

[22] Memorandum dated December 9, 1999, from Steven Scott and Jennifer Stout of PEA to Blair Collins and Heidi Hermenet of the Alliance, titled *SAV-AIR Business Plan Review*.

1. Describe and define SAV-AIR's core services in terms of how they will meet customer needs and wants, and help them solve key problems they face in their businesses. Create a mission statement.

2. Assess the marketing plan – take stock of where the team is now in its marketing efforts compared to where it needs to be. Is it going after the right customers? Does it know how big its target markets are and what share it thinks it can achieve? Does it know how that bears on the long-run viability of the business?

3. Develop ballpark cost and revenue projections and a rough pricing strategy to see how, and if, the proposed services will make money.

Business Analysis Spreadsheet

Following the review of the business plan, PEA learned that SAV-AIR has also created a draft business analysis spreadsheet which covers some of the elements described above, specifically market size, and costs and revenue projections. The spreadsheet is a work in progress and therefore specific assumptions of the analysis are not assessed in this report. SAV-AIR has retained the services of a business-planning consultant to help them with the next iteration of the analysis.

The current spreadsheet contains the following:

- A definition of the target market, and an estimate of its size in terms of number of customers, as well as potential energy savings. SAV-AIR based this analysis primarily on the national and Pacific Northwest motor studies conducted by Xenergy/Easton. In this spreadsheet, SAV-AIR defined their target market as customers with over 750 horsepower of compressors (although for the beta sites, they are including medium-sized customers); they estimated that there are about 190 large sites in the Pacific Northwest. They also did further analysis and breakdown by compressor size and industry.

- Estimates of average potential energy savings from the SAV-AIR services and what that represents in terms of cost savings based on $0.03 per kWh. The savings estimate was based on the Xenergy/ Easton study, as well as on the team's expertise.

- Estimated market penetration over seven years.
- Assumed project payback.
- Estimated costs for, and projected revenues from, project sales and delivery. These estimates feed into a cash-flow analysis.

Our early review of this draft spreadsheet indicates that SAV-AIR is wrestling with many of the core issues related to assessing and tracking the businesses' viability. It contains most of the elements we believe are necessary for a full financial analysis. PEA will review the next iteration when it is available. We encourage SAV-AIR to continue to refine and detail their estimates of costs and income based on the beta sites, as well as defining how much they plan to charge customers for services.

One additional note is that, while we understand SAV-AIR's reluctance to try to quantify non-energy benefits (e.g., reduced per-unit production costs and reduced plant downtime), SAV-AIR might consider incorporating a very conservative estimate of these benefits into their business analysis. These benefits are likely to be of far greater value to customers than energy savings alone. Note that we are not suggesting quantifying non-energy benefits in customers' individual proposals. Obviously, any quantification can only occur once SAV-AIR services are well underway at a facility and extensive data have been collected. However, SAV-AIR can describe potential non-energy benefits qualitatively. For example, if a customer indicates that variation in pressure for a certain machine causes it to go off line, and the SAV-AIR control and system improvements will clearly overcome that pressure variation problem, then that should be stated without any quantification of benefit.

IV. Assessment of SAV-AIR's Market Effects to Date

A. Indicators of Progress

To set the context for this section, below is a recap of the overarching goal of SAV-AIR, how success in achieving that goal is defined, what PEA believes are useful indicators of progress towards achieving those goals, and an assessment of progress on each of these.

- ***Goal:*** Achieve optimized energy efficiency operation of compressed air systems in the Northwest through the development of a viable compressed air system management service.

- ***Definition of Success:*** Creation of a self-sustaining business entity able to provide continuous application of compressed air management systems. Four significant market barriers that currently exist will be overcome: technical expertise, funding, attitude, and accountability. SAV-AIR's services will be accepted practice, and market actors (end-users, manufacturers, and vendors) will recognize the value of whole-system efficiency rather than component-specific efficiency.

This evaluation uses *early* and *progressive* indicators to assess the market effects of the *SAV-AIR Initiative*. These were described in detail in *Section II, Methodology and Approach.* To recap, *early indicators* are defined as progress compared to goals in developing, testing, and proving the SAV-AIR service – specifically development of the prototype site – and marketing and implementation of the services through *Phase II* for a number of targeted beta customers. This first report focuses on progress on early indicators because the Initiative is in a relatively formative stage in terms of development and delivery. Evidence of progressive indicators is also briefly assessed, but will be focused on in detail in *MPER #2*.

Early indicators are described in *Table 2* below; progressive indicators are described in *Table 3*. An assessment of the status of these indicators is provided.

Table 2: Assessment of Early Indicators

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
ONE PROTOTYPE SITE OPERATIONAL BY THE SECOND QUARTER OF 1999	There was a prototype site physical demonstration to the Alliance in August 1999, and a prototype site plus basic (but not full) software demonstration in-house to SAV-AIR in September 1999.	Suggest a comprehensive demonstration of the complete control and monitoring system sometime during the 1st Quarter of 2000.
SIX INDUSTRIAL FACILITIES BETA SITES SELECTED BY THE THIRD QUARTER OF 1999	Four sites have been selected as of January 2000, and have received *Phase I* services. Two sites remain in negotiation.	The initial schedule may have been unrealistic. It may be more important to bring one site through to completion than to accelerate efforts at other sites. To the extent that both can be done in parallel, SAV-AIR should continue to push for agreement completions for the two sites in negotiation.
SUCCESSFUL IMPLEMENTATION OF SAV-AIR'S SERVICES UP THROUGH *PHASE II*	A *Phase II* installation of the SAV-AIR system is in progress at one of the current beta sites.	This is a critical-path item to financial success. SAV-AIR should continue with project implementation as quickly as possible. PEA will assess benefits and conduct customer interviews after SAV-AIR's system has been in place for several months.
BETA SITE CUSTOMERS EXPRESS INTENT TO IMPLEMENT SAV-AIR'S RECOMMENDATIONS AND UNDERTAKE MONITORING	SAV-AIR indicates that customers plan to commit to the entire package of services. However, they are not contractually obligated to do so at this point.	PEA will conduct customer surveys over the next several months to assess the level of customer interest in SAV-AIR's recommendations and their monitoring services.
BETA SITE CUSTOMERS EXPRESS INTEREST IN REPLICATING SAV-AIR SERVICES IN OTHER CORPORATE FACILITIES	SAV-AIR selected the beta sites with replication potential in mind. Indications are that all six beta-site owners are strongly interested in replication.	PEA's customer surveys will also assess the level of customer interest in replication.

Continued

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
ABILITY OF SAV-AIR TO STREAMLINE THE SALES AND DELIVERY PROCESS AS THE INITIATIVE PROGRESSES	SAV-AIR developed new marketing materials in January 2000. First project implementation is currently underway, but sales are taking longer than anticipated. SAV-AIR is actively tracking sales and delivery costs and is acutely aware of the importance of streamlining.	The next months are critical. SAV-AIR should consider focusing on the most amenable prospects and continue to streamline sales and delivery.

Table 3: Assessment of Progressive Indicators

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
DEMONSTRATION OF THE BENEFITS OF SAV-AIR SERVICES AT SIX BETA SITES THROUGHOUT THE PACIFIC NORTHWEST THROUGH CASE STUDIES AND OTHER MEANS.	Four beta sites are under contract but not operational, so case studies have yet to be written. However, all four sites show good potential to serve as case studies for both energy and non-energy benefits.	SAV-AIR should continue to push towards completion of at least one beta site so they can demonstrate and document benefits. A recommended case study approach is included in *Appendix C*.
THE COMPRESSED AIR INDUSTRY AND END-USERS RECOGNIZE SAV-AIR'S PRODUCTS AND SERVICES AS CREDIBLE, UNBIASED, AND TECHNICALLY ACCURATE.	60% of the 24 experts and distributors interviewed for this report have heard of SAV-AIR. They believe the SAV-AIR approach has value, but withhold judgment about its cost-effectiveness.	PEA will periodically survey experts, distributors, and end-users to assess opinions of SAV-AIR's services.
NON-ALLIANCE SOURCES PROVIDE AT LEAST 50% IN MATCHING FUNDS FOR BOTH DEVELOPMENT AND IMPLEMENTATION OF THE *SAV-AIR MASTER PLAN*.	Third parties, either utilities or ESCos, have committed some funding towards several of the beta sites.	SAV-AIR will continue to monitor budget and proposals. PEA will report on status in a later MPER when more information is available.
		Continued

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
SUCCESSFUL LAUNCHING OF SAV-AIR AS A SELF-SUSTAINING BUSINESS.	Commitment has continued from SAV-AIR's two major funders and the Alliance. SAV-AIR is in the process of creating a business plan, including a revenue analysis, and has enlisted the assistance of a business consultant.	SAV-AIR should continue to hone its business analysis, determine a pricing strategy, and track and streamline costs. PEA will review and provide feedback on the next iteration of the business analysis.

V. The Compressed Air Market

Two sources of information were used to analyze and describe the market for compressed air services: secondary sources, and primary data collected through surveys conducted for this report.

One of the key sources of secondary information on the market for compressed air services is a study conducted in 1998 for the Alliance by Pacific Energy Associates, Inc. (PEA) and Research Into Action, Inc. (RIA).[23] This study involved the review of 15 compressed air-related documents, and interviews with 12 regional experts and 26 market actors (consulting engineers, ESCos, Energy Service Providers, compressed air equipment distributors, and one manufacturer's representative).

This *Market Progress Evaluation Report* built on the PEA/RIA study by conducting follow-up phone interviews with 12 national experts and 12 market actors. (Customer interviews will be conducted and reported on as part of *Market Progress Evaluation Report #2*.)

Six of the 12 experts interviewed for this report had been interviewed previously for the 1998 PEA/RIA study. Among the 12 experts: 4 worked for utilities, 4 were consultants (or consultants who also distribute equipment), 2 worked for government, and 2 worked for energy efficiency organizations. Five of the 12 were from the Northwest; the remaining 7 were from throughout the country. The list of expert interviewees is provided in *Appendix A*.

Among the 12 market actors interviewed for this report, 10 were equipment distributors and 2 were consultants. Nine of those 12 were the same as those interviewed for the PEA/RIA study; 3 were new. The list of market actor interviewees is provided in *Appendix A*.

[23] Pacific Energy Associates and Research Into Action. *Research in the Market for Compressed Air Efficiency*. June 4, 1999.

A. Summary of Findings

The following key findings are based on the PEA/RIA research, as well as the follow-up interviews conducted for this report:

- Most customers and service providers do not currently optimize their compressed air systems, so there are significant savings opportunities.

- Most customers spend little time thinking about compressed air system efficiency, and have limited faith in their existing service providers to address the issue.

- Only the top national compressed air efficiency consultants approach systems in a truly comprehensive way. By contrast, many other service providers, including other consultants, vendors, and even utility programs achieve most of their savings from compressor equipment and controls.

- Many service providers say they are doing "system optimization," but at the same time do not offer the key service elements of true system optimization. In general, compressed air services remain fragmented, while customer needs are integrated.

- Many service providers are considering becoming more active in compressed air system efficiency, but indicate they will not move forward until they see definitive increases in customer interest.

- A combination of recruitment, training, education, and demonstration might lead to significant market transformation among large systems (over about 500 HP). In this case, market transformation means sustainable, increased levels of system retrofit and monitoring activity – independent of any subsidy.

- 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.

- About 60% of experts and market actors interviewed for this report said they had heard of SAV-AIR. They generally thought it

sounded like a good concept, but wondered about its cost-effectivity.

B. Nature of Opportunities

Based on the findings from the PEA/RIA study, 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 long-term monitoring to identify the benefits and the appropriate strategy, and to maintain savings over time.

Technical opportunities include:

- Improved system operations and maintenance, including leak reduction;
- Compressor improvements;
- Better compressor unit control and sequencing;
- Improved cooling and dehumidification systems;
- Design and mechanical improvements to distribution piping and system configuration; and
- Improved end-use applications of compressed air.

C. Status of Compressed Air Services

Compressed air services can come from a number of alternative routes. Below is a description of the service providers in the market, and a broad assessment of the extent to which they are providing comprehensive compressed air efficiency and optimization services.

Manufacturers

There are about five major compressed air equipment manufacturers active in industries the Northwest. They are: Quincy Northwest (Rogers), Gardner-Denver, Sullair, Ingersoll-Rand, and Kobelco. Compressed air firms have not traditionally focused on efficiency as a profit center. The industry currently lacks standards for published data to rate system efficiency. Some have viewed efficiency as in conflict with their goals of selling compressors.

Past practices and attitudes notwithstanding, there are clear indications that many of the manufacturers are now viewing efficiency as a *potential* profit center. Several factors are driving this: the volume of compressor sales in the U.S. is decreasing; money is being made (nationally) on efficiency, and *Compressed Air Challenge* and other supporters are providing a catalyst for manufacturers to focus on efficiency. Decreased air compressor sales may be due to changes in the U.S. industrial base and perhaps the impact of efficiency efforts.

We have been told that at least one firm is providing marketing "spiffs," or credits, in some parts of the country when their equipment sales people identify opportunities for system analysis and optimization. This is a significant change, although it is unclear whether it is occurring in the Northwest.

Distributors

The PEA/RIA research indicated that there are a few dozen retail distributors of equipment and services in the Northwest, with perhaps ten dominating sales. Some provide customer operations and maintenance services, and most provide efficient compressors on request, but their focus on efficiency is limited, particularly at the broader system level.

Although not directly comparable to the PEA/RIA study results, the follow-up interviews confirmed that none of the ten service providers that described themselves as distributors appear to be able to offer what could be considered a fully-comprehensive, system-optimization approach. (The

two consulting firms were an exception. The results of these interviews are described below.) All of the distributors but one *said* that they offer "system optimization services," but none said they did any long-term monitoring of the compressed air system.[24] Often their services lacked a number of key elements of system-optimization services. In an extreme example, a distributor said he did system optimization, but he did not do system audits, leak detection and repair, short or long-term monitoring, or load shape surveys. The only other services he said he provided were equipment sales, controls, and system design and efficiency upgrades.

Thus, it appears that distributors may often say they do system optimization, but really do not. They may look at a number of facets of a customer's system if they do an audit, but this is not indicative of a truly integrated approach where the service provider works with the customer over a period of time to optimize their system and maintain benefits. Rather, it is more of a fragmented "pay as you go" approach. Further, the overall impression, even from this latest round of interviews, is that very few service providers are monitoring a customer's compressed air system day-to-day because they do not have a tool that will allow them to do this cost-effectively.

Another study reviewed for this report (conducted in the Northeast) noted that usually distributors have only one or two experts on system-wide compressed air efficiency issues, and those persons are rarely field sales representatives. Field representatives have strong customer relationships, but focus on large equipment sales.[25] Some manufacturers privately state that they consider many of their distributors to be woefully undereducated about system management.

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[24] A study conducted in the Northeast region resulted in similar conclusions, where only one consultant demonstrated tangible efforts at offering system-wide efficiency services: Aspen Systems Corporation. *Final Report Compressed Air Systems Market Assessment and Baseline Study for New England.* p. 41.

[25] Aspen Systems Corporation. *Final Report Compressed Air Systems Market Assessment and Baseline Study for New England,* p. 36 and p. 41.

Consultants

In their previous research, PEA and RIA found that the Pacific Northwest has a relatively large number of consultants (about twelve) who provide varying types and levels of compressed air services. However, the services tend to be fragmentary, while customer compressed air needs tend to require integrated services. The PEA/RIA study reported that, with the exception of one firm that had a combined metering/engineering approach, none of the firms interviewed appeared to have a truly integrated approach including comprehensive system analysis, turnkey implementation services, long-term monitoring, and ongoing O&M to optimize performance and sustain efficiency.

In the interviews for this report, two firms identified themselves as consultants. Both appeared to offer an integrated approach. In contrast to the distributors interviewed, these two firms said they offer all the service elements that make up comprehensive system optimization, including long-term monitoring. However, neither appeared to have software that came close to the sophistication of that being developed by SAV-AIR.[26] It is difficult to know how to interpret what seems to be an increase from one firm in the previous PEA/RIA study to two firms in this study that appear to be offering integrated services. The survey questions were asked in a somewhat different way, and the list of respondents was slightly different.

PEA/RIA also noted in their previous research that some existing consultants are often affiliated with, and promote, specific products – a practice that tends to narrow the focus of, and may lead to inappropriate, recommendations.

It is also important to note that SAV-AIR's perceived competitor in the region is Honeywell, a company with a very well-developed marketing approach and a long history of commercial and industrial services. Honeywell has developed control approaches for compressed air (*XCEED*) and has implemented them in the Northwest. They were by far the most often mentioned as being active in the survey of Experts and Distributors.

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[26] Honeywell's Commercial Energy Management and Controls system is probably the closest counterpart. However, Honeywell was not interviewed, so it is unclear whether they have a similar software tool for compressed air.

However, Honeywell was recently purchased by Allied Signal, and there are substantial reorganizations expected.

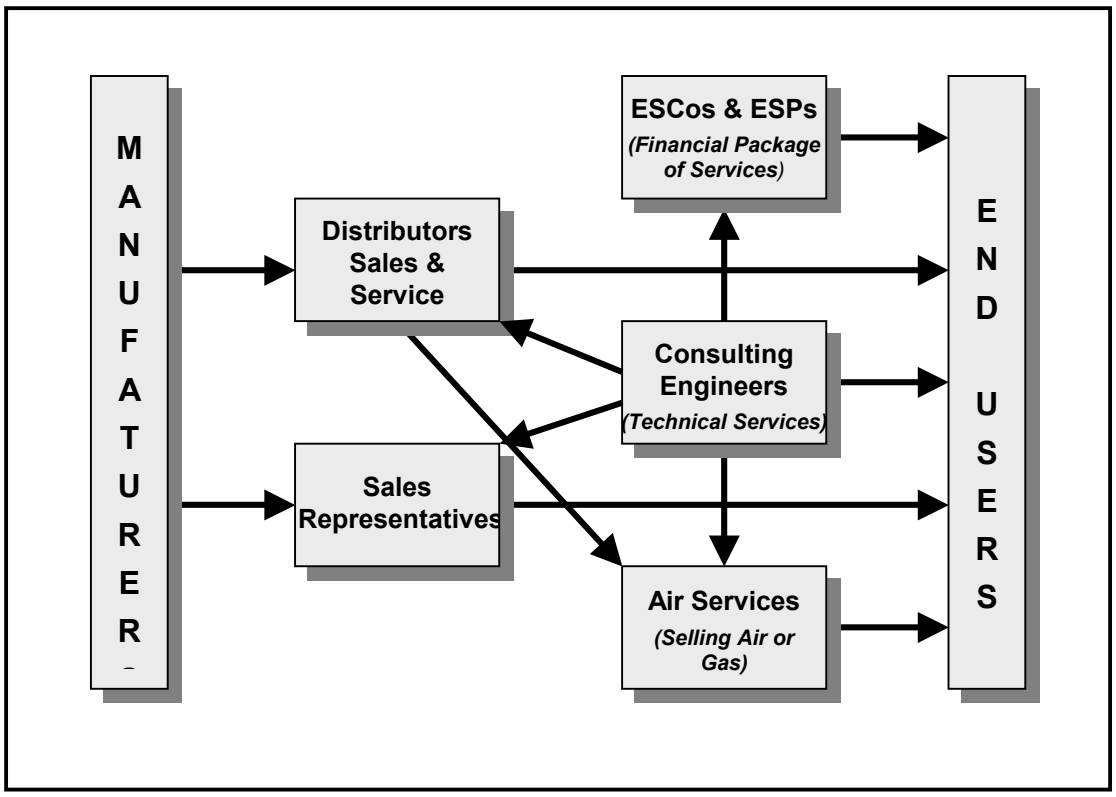
Energy Service Companies

A handful of energy service companies (ESCos) and energy services providers (ESPs) market turnkey or performance-guaranteed compressed air services. For most ESCos and ESPs, these services are offered as part of broader energy services offerings. Based on the previous PEA/RIA research, only one company, Honeywell, has been actively pursuing compressed air efficiency in the Northwest, dealing primarily with large systems. However, this company is no longer actively marketing in the region.

Compressed Gas Companies

Figure 1 diagrams the service flows between market participants in the Pacific Northwest.

Figure 1



A few Compressed Gas companies sell various industrial gasses, including compressed air. These companies deal primarily with large manufacturers with diverse industrial gas needs and are the newest players in the compressed air market. Their role is the least defined. The one firm PEA/RIA learned the most about was just becoming aware of compressed air energy efficiency and has no existing capability in this area.

D. Volume of Compressed Air Services in the Pacific Northwest

The interviews conducted for the PEA/RIA study indicated that about a year ago, there was a small volume of compressed air services being offered in the Northwest (relative to the magnitude of low-cost opportunity), and there were no concrete plans to expand the level of services. While several parties were poised to expand their offerings, they were waiting for evidence of increased customer demand.

Table 4: Estimated Volume of Compressed Air Services

SERVICE	PROVIDER	VOLUME (PROJECTS/YEAR)	PERCENT OF TOTAL PROJECTS
SYSTEM EFFICIENCY SURVEYS	Consultants, ESCos	20	16%
SYSTEM LOAD MONITORING	Consultants, ESCos	7	6%
COMPRESSOR CONTROLS/ SEQUENCING	Consultants, ESCos, some Distributors	9	7%
COMPRESSOR AUXILIARY ENHANCEMENTS**	Mostly Distributors	59*	48%
SYSTEM O&M	Consultants	9***	7%
PIPING DESIGN	Consultants, Distributors	14*	11%
PROCESS TOOL ASSESSMENT	Consultants	6	5%

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

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

*** In addition to distributor services.

At that time, PEA/RIA developed estimates of the general magnitude of service offerings in the Northwest *(as shown in Table 4)*. These estimates involved significant judgment and should be considered to be useful at assessing the *magnitude* of activity, but not the precise level.

PEA/RIA also asked whether respondents were hoping to expand business in specific areas. *Table 5* shows the results of this survey.

Table 5: Estimated Volume of Compressed Air Services

SERVICE	PERCENT OF CA SERVICE PROVIDERS WHO WANT TO EXPAND BUSINESS
SYSTEM EFFICIENCY SURVEYS	56%
SYSTEM LOAD MONITORING	50%
COMPRESSOR CONTROLS/SEQUENCING	69%
COMPRESSOR AUXILIARY ENHANCEMENTS**	57%

SYSTEM O&M	64%
PIPING DESIGN	33%*
PROCESS TOOL ASSESSMENT	56%

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

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

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 centered on other customer objectives.[27]

For the interviews conducted for this study, the distributors and consultants were asked a series of questions about market activity for nine different compressed air services. They were asked which services they currently offer and whether their activity levels have changed over the last twelve months. The results for changes in activity level are summarized below in *Table 6*.

Table 6: Changes in Service Activity Levels

YOUR ACTIVITY CHANGE?	SAME	LESS	MORE
EQUIPMENT PARTS AND SALES	30%	30%	40%
SYSTEM AND EQUIPMENT MAINTENANCE			
– LEAK DETECTION	50%	0%	50%

[27] Lack of service activity also has characterized other regions. In a study of the Northeast, it was noted that the market for compressed air services is not active, considering the number of financially viable (i.e., cost-effective) opportunities. This was based on 30 customer interviews, rather than on interviews with suppliers. It was found that less than 10% of customers had had studies conducted over the last two years to identify compressed air savings opportunities, and only one third had ever received such a study, with many initiated by utilities. It is also interesting to note that there is a lack of market activity even though the cost of electricity in the Northeast is 2-3 times higher than in the Northwest.

– LEAK REPAIR	43%	0%	57%
SYSTEM CONTROLS IMPROVEMENTS			
– ENHANCED INDIVIDUAL CONTROLS	30%	0%	70%
– COMPRESSOR SEQUENCING CONTROLS	18%	0%	82%
SYSTEM AUDITS	33%	11%	56%
SYSTEM MONITORING			
– SHORT-TERM	30%	10%	60%
– LONG-TERM	67%	0%	33%
– LOAD SHAPE SURVEY	56%	0%	44%
SYSTEM OPTIMIZATION	36%	0%	64%
SYSTEM DESIGN AND EFFICIENCY UPGRADES	17%	8%	75%

Because changes in service activities are self-reported and the sample size is very small (12), accuracy of reported results for service providers as a whole cannot be verified. However, respondents report installations of sequencing controls, system design and efficiency upgrades, and enhanced individual controls were the services they have increased the most over the last year (82%, 75%, and 70% respectively). Because distributor self-interest would favor "looking busy" on optimization, we think that these estimates of increased activity should be viewed as optimistic or at the high-end.

Also of interest, only 33% of respondents reported that their long-term monitoring activity increased. One further finding of interest is that 30% of distributors said they are selling less equipment than they did last year.

Experts, as well as distributors and consultants, were also asked whether they thought there had been changes over the last year in the level of optimization and related compressed air activities in the broader market.

Among the experts, five said there was some increase and five also said that there was no particular increase. The remaining two didn't know. Among the market actors, six said there was some increase and five said that there was no particular increase. The remaining one didn't know.

Respondents were also asked which firms or products/services they believe have been more active in the past year. This question was open-ended; specific firm names were used to probe and clarify only. Among market actors, there were only eight responses. Among experts, there were a total of 39 responses. The results are summarized below in *Tables 7* and *8*.

Table 7: Companies Market Actors Regard as More Active

INCREASED ACTIVITY NOTED	NUMBER OF RESPONSES	PERCENT
SAV-AIR	2	25%
HONEYWELL	2	25%
XPANDAIR AND TARGETAIR	1	13%
ROGERS MACHINERY	1	13%
JOHNSON CONTROLS	1	13%
AIR LOGIC	1	13%
TOTAL	8	

Table 8: Companies Experts Regard as More Active

INCREASED ACTIVITY NOTED	NUMBER OF RESPONSES	PERCENT
CONSERVAIR	6	15%
HONEYWELL	6	15%
AIRMASTER SOFTWARE WSU	3	8%
AUDITAIR	3	8%
CASST *(COMPRESSED AIR SCREENING TOOL)* SOFTWARE ECW	3	8%
INGERSOLL-RAND	3	8%
AIROMETRIX	2	5%
GENERAL LEAK DETECTION	2	5%
GENERAL LEAK REPAIR	2	5%
SARLIN BALANCE	2	5%
SAV-AIR	2	5%
OTHERS	5	13%
TOTAL	39	

E. Awareness of SAV-AIR

Experts and market actors interviewed for this study were also asked if they had heard of SAV-AIR. They were read a short paragraph describing the basic concept and services that SAV-AIR will offer. Among experts, nine of twelve (75%) had heard of SAV-AIR. Among market actors, six of twelve (50%) had heard of SAV-AIR.

When asked to comment on, or make suggestions about the concept, the responses were similar to those for long-term monitoring – respondents felt it was a good idea, but wondered if its benefits would outweigh its costs, and whether customers would buy it. Experts made the following remarks:

- *"Sounds like a good idea for baseline data collection and audit. Case studies would be good to help understanding."*
- *"I believe that offsite service has problems. Users do not want outsiders monitoring a critical production activity. It's difficult to measure leaks in plants that are never shut down."*
- *"Get costs of implementing down."*
- *"Don't think many can afford SAV-AIR."*
- *"Think it will be interesting to try."*
- *"Cost/benefit ratio is a major concern. Capacity to take action based on monitored performance must exist for SAV-AIR to succeed."*

Market actors had the following comments:

- *"Good idea if cost are kept down."*
- *"Good concept. Don't truly understand it. Not read anything on it."*
- *"There may be some value to the concept but it's cheaper to just hang more horsepower on the system."*
- *"Interesting concept (device?) for multi-compressor installations. If cheap enough, a lot will buy it."*
- *"This has already been offered years ago by Allen Bradley. When they offered trending analysis. It's already happening."*
- *"To sell it, it needs to be done by someone with unbiased objectives – not attached to a particular compressor manufacturer and not a vendor of equipment."*
- *"The individuals analyzing the results had better be very knowledgeable on current solutions to problems."*
- *"It may be very expensive due to heavy instrumentation. May be Ok for very large customers."*

- *"Sounds like a good concept."*

F. Service Provider Perceptions of End-Users

For both the PEA/RIA study and this report, equipment distributors and consultants were asked about their perceptions of end-users' compressed air practices and barriers to market change. End-users were not interviewed directly, although PEA plans to do a series of customer interviews for the next MPER.

The equipment distributors and consultants interviewed for the previous PEA/RIA market research study consistently described customer practices in the following way:

- Compressed air is generally a low priority among plant management issues. Manufacturing issues (product volume, quality, and reliability of production) dominate the scarce time of plant staff. Even in big plants, the level of attention paid to the compressed air system varies.

- Operation and maintenance is largely neglected, and system efficiency is rarely considered; distributors are called when there is a crisis.

- A few of the more efficiency-minded customers occasionally perform checks for system leaks, but few customers maintain a regular program of leak-detection and repair, and very few survey for inappropriate end-uses.

- There is little accountability for the cost of compressed air. Most customers do not know their electric costs for compressed air; so most purchase decisions are based on speed and first cost.

- 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 when the payback is unclear, yet mistrust recommendations provided for free by vendors. A significant investment in long-term metering and analysis is also a tough sell.

- 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.

These findings were echoed by the 24 distributors, consultants, and experts interviewed for this report. Distributors remarked they have not had much opportunity to provide comprehensive optimization services because customers do not ask for them. Respondents were asked why some plant managers often are not motivated to control compressed air system energy costs. Fourteen mentioned that lack of accountability for compressed air costs is a problem. Six said managers simply focus their attention elsewhere, specifically on production. Others mentioned lack of knowledge, concerns over cost-effectivity of system improvements, staffing limits, funding, and risk aversion.

While managers do not appear to have much interest in controlling system *energy* costs, they do show more potential interest in non-energy benefits. The SAV-AIR team reports that the beta site customers are focusing on the potential non-energy benefits they hope to achieve from the SAV-AIR services. Specifically, customers have mentioned environmental issues, safety issues, product quality control, and improving the operation of their compressed air systems in order to prolong the system's life.[28]

In the surveys conducted for this report, respondents were also asked about their perception of the value of long-term monitoring to customers, as this is a key feature distinguishing SAV-AIR from its competitors. Seven of the twelve experts believe long-term monitoring would have "significant" value for ongoing system efficiency; the remaining five said "some." Among market actors, six said "significant," five said "some," and one "no value." Those that said it had value believe it is an important tool in assuring persistence of savings, controlling systems, and creating

[28] The importance of non-energy benefits was also stressed at the *1995 Motor Challenge Roundtable on Market Transformation Strategies*. Participants, who included a number of industrial customers, indicated that energy efficiency is usually not a major issue with end-users when making purchasing decisions. End-users generally only make changes to their systems when they are not satisfied with the capacity or reliability of the system or when a change makes good economic business sense. (U.S. Department of Energy. *National Market Transformation Strategies of Industrial Electric Motor Systems*. May 1996. p. 37.)

accountability for compressed air costs. Several qualified their statements, saying that the value of monitoring depends on how well it is done, and that it is most useful and appropriate for large customers and dynamic systems. For those respondents with a less positive view, several made the comment that long-term monitoring costs too much, and that a good control system should be adequate.

Below are some verbatim comments of interest from experts regarding long-term monitoring:

- *"Helps people see what's happening over time. Leaks, malfunctions, changes and improvements are shown."*
- *"Absolutely critical. Leaks are no longer the opportunity. Control improvements are an equal or better opportunity for compressed air savings."*
- *"Monitoring keeps people on target. Without it, people tend to forget. Also, if information is published, they will pay attention."*

Below are some verbatim comments from market actors. It is evident that market actors generally believe it is valuable, but some question whether the benefits are worth the costs:

- *"Personnel changes require long-term monitoring for continuity. Insures persistence. But is cost equal to the value is the question."*
- *"Big money savings related to it."*
- *"Because leaks need to be detected over time. Persistence issue."*
- *"In our market, the cost to monitor is just too high when energy is so cheap."*
- *"Don't really need this if they have good control. The controls adjust for the changes."*
- *"Long-term monitoring is only good if the system is dynamic. If adding loads on to the system after the audit or optimization, you then need to know how this changes things."*
- *"People waste money and they don't know it."*

- *"Compressed air systems have disruptions. Can't just look at flows and amps over time. It works if done thoroughly and with expertise to avoid disruptions of the compressed air system."*

- *"System controls go out of calibration over time and leaks become prevalent."*

- *"We can monitor customer's compressors from our office. Monitoring acts as an early warning system for problems."*

Compressed air distributors and experts were also asked about their perception of whether customers could benefit from certain services. Fifteen of 22 respondents said over 90% of customers with large compressed air systems (over 500 HP) could benefit from audit and system optimization. Six said over 75%, and one said 20%. Two did not know.

Results were more mixed for long-term monitoring. Regarding the percent of large customers that could benefit, eleven respondents said over 90%. Three said over 75%, one 60%, and one said 25%. Six said they could not say. When asked what percentage of customers would actually invest in long-term monitoring, eight respondents said 33% or fewer, and four said 50% or fewer customers would actually invest. One respondent said 75%, one 60%, and one 100%. Eight said they did not know.

It is interesting to note the juxtaposition of the market actors' perception that long-term monitoring is of value to customers, with such mixed opinion about customer willingness to invest in this service. It further highlights what might be called the compressed air "vicious cycle." Customers are reluctant to invest in comprehensive system optimization because the benefits have not been conclusively demonstrated to them. But many are unwilling to invest in the kind of long-term monitoring that will show those benefits. However, the Alliance's and other funders' support of SAV-AIR provides a potential window of opportunity in the market to marry customer interest with demonstrated benefits through the beta sites and resulting case studies, and so break down these barriers.

G. Market Barriers

The PEA/RIA study investigated barriers to compressed air system efficiency. Their research indicated that 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 operation and maintenance 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 providers 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, service providers 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 (i.e., those associated with major manufacturing processes). So, even large compressed air opportunities often receive a low priority for internal attention and funding.

Respondents to the surveys conducted for this report were asked what they believe are the top two customer barriers to comprehensive system optimization. Seventeen respondents mentioned a lack of education and awareness regarding compressed air costs and the potential benefits of system optimization. Eleven mentioned ability to fund the capital and

service investments as a major barrier. Other barriers mentioned included lack of accountability for compressed air system costs (5), concerns over cost-effectivity (3), staff turnover (1) and inadequate staffing (1), availability of expertise (1), and managers' focus on production (1). Distinctions were not made by compressor size.

Another study in the Northeast region emphasized very similar barriers, but also did not distinguish between customer sizes. The study particularly emphasized the need for customer education. Suppliers cited this as the second-largest barrier and customers interviewed reported eagerness to attending training sessions.[29] A host of market barriers discussed in a Department of Energy study published in 1996 also largely echo those discussed above.[30] One further market barrier of interest mentioned in several sources was that compressed air systems are usually considered part of customers' operational/ maintenance budgets, so capital budget-type financial analysis techniques are rarely applied to compressed air system investments.[31]

Respondents for this report were also asked about how helpful various potential outcomes of a compressed air system analysis and improvement project would be in motivating customers to fund such a project. The ranking was from "very helpful" (5) to "not at all helpful" (1). As can be seen from *Tables 9* and *10* below, determining plant-wide and per-unit compressed air costs, improving compressed air reliability, and capital investment reduction were ranked by both experts and market actors as being in the top four desired project outcomes.

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[29] Aspen Systems Corporation. *Final Report Compressed Air Systems Market Assessment and Baseline Study for New England.* pp. 44.

[30] U.S. Department of Energy. *National Market Transformation Strategies of Industrial Electric Motor Systems*. May 1996. pp. 36-37.

[31] Easton Consultants, Inc. *Strategies to Promote Energy-Efficient Motor Systems in North America's OEM Markets – Air Compressor Systems.* April 12, 1994.

Table 9: Helpfulness of System Analysis Components to Experts

COMPRESSED AIR ANALYSIS AND IMPROVEMENT PROJECT RESULT, RANKED BY AVERAGE SCORE	SCORE
4. IMPROVED CA RELIABILITY	4.4
1. DETERMINE PLANT-WIDE AND PER-UNIT COST	4.3
3. IMPROVED PRODUCT QUALITY OR FEWER REJECTS	4.1
8. CAPITAL INVESTMENT REDUCTION	4.0
9. REDUCTION IN MAINTENANCE TIME	3.5
2. ASSIGNMENT OF CA COST TO DEPARTMENTS	3.4
5. MEETING CA QUALITY STANDARDS	3.3
6. IMPROVED SAFETY	3.0
7. REAL-TIME INFORMATION	2.9
10. SUPPORT POLICY FOR OUTSOURCING	2.8

Table 10: Helpfulness of System Analysis Components to Distributors

COMPRESSED AIR ANALYSIS AND IMPROVEMENT PROJECT RESULT, RANKED BY AVERAGE SCORE	SCORE
9. REDUCTION IN MAINTENANCE TIME	4.3
8. CAPITAL INVESTMENT REDUCTION	4.3
1. DETERMINE PLANT-WIDE AND PER-UNIT COST	4.3
4. IMPROVED COMPRESSED AIR RELIABILITY	4.1
5. MEETING COMPRESSED AIR QUALITY STANDARDS	4.0
7. REAL-TIME COMPRESSED AIR INFORMATION	3.4
6. IMPROVED SAFETY	3.4
3. IMPROVED PRODUCT QUALITY OR FEWER REJECTS	3.4
2. ASSIGNMENT OF CA COSTS TO DEPARTMENTS	3.1
10. SUPPORT POLICY FOR OUTSOURCING	2.3

V. The Compressed Air Market

VI. Market Potential for SAV-AIR Services

PEA did not perform an extensive study of the size of the Pacific Northwest market for SAV-AIR, but used secondary data to create a broad picture of how large the market is in terms of savings potential and customers. The analysis should be regarded only as indicative of market size. Market size and savings potential should continue to be assessed and confirmed by the Alliance and SAV-AIR as field activity continues.

A. Secondary Sources of Data on Savings Potential and Cost

There have been two major studies of compressed air savings potential in the Northwest. One conducted by Battelle Pacific Northwest Labs in 1994 analyzed data from the *National Energy Analysis and Diagnostic Center Energy Audit Survey* (EADC), a federally-funded, university-based service. Another more recent study was conducted for the Alliance by Xenergy and Easton as part of the *Assessment of Industrial Motor Systems Market Opportunities in the Pacific Northwest* (Xenergy). [32]

A summary of the savings estimates by sector as a portion of total compressed air savings is presented in *Table 11*. Each of these studies used reasonable and accepted methodologies to arrive at savings by industrial sector, yet they achieved strikingly different results, both in terms of percent savings represented by each sector, and the total savings in average Megawatts (AMW), which are different by almost a factor of two.

Some of the sector differences can be attributed to the fact that the EADC study combines many major categories into an "Other" designation and leaves some categories blank (see *Table 11*). The Xenergy study was based on national motor loads rather than compressed air itself, and thus includes some blower loads (for example, for Water Supply and

[32] Xenergy/Easton. *Northwest Energy Efficiency Alliance: Assessment of Industrial Motor Systems Market Opportunities in the Pacific Northwest.* September, 1999

Wastewater) that are not appropriate to assign to compressed air savings. The EADC work, on the other hand, did not include some important industries. For example, the primary metals industry is not included, while most of those plants have large compressed air systems that typically have good opportunities for efficiency.

Table 11: Estimated Percent of Total Compressed Air Savings by Industrial Sector

INDUSTRIAL SECTOR	XENERGY PERCENT OF TOTAL SAVINGS	EADC PERCENT OF TOTAL SAVINGS
PAPER AND PULP	10%	27%
CHEMICALS AND ALLIED PRODUCTS	26%	9%
MINING	4%	--
WATER SUPPLY AND WASTEWATER	22%	--
FOOD AND KINDRED PRODUCTS	4%	--
LUMBER AND WOOD PRODUCTS	7%	27%
PETROLEUM AND COAL	5%	--
MICROELECTRONICS	2%	--
PRIMARY METALS	4%	--
AIRCRAFT AND PARTS	6%	5%
OTHER	11%	32%
TOTAL	100%	100%
TOTAL (AMW)	93	169

Each study had different definitions for efficiency improvements as well. The EADC work was based on audit results that concentrated on low and no-cost measures, while the Xenergy work included savings from control improvements and more efficient components. The Xenergy work was also scaled from their national motor study by employment ratio and focused on determination motor energy use rather than savings potential.

These savings estimates are reasonable to be used as a beginning for market assessments and should likely not be considered to be "the truth." Differences in methodology, approach, and source data are likely explanations of the differences found, and reconciliation of the values is probably not a useful exercise.

B. Size of the Market

In their previous research, PEA/RIA collected data from contractors, engineering consultants, and experts regarding the number of compressors of different sizes in the market, and their concentration by industry. These data were considered important in particular because the size of the compressed air system may be a key market segmentation criterion for delivery of services.

PEA/RIA asked each respondent to tell them the number of customers he or she knew of with compressor systems in various size ranges, and then to indicate the industries that dominated each range. About seven respondents provided information. Responses varied in their detail and in their expressed confidence in their own answers. There were some quite large ranges in responses. Ultimately, the PEA/RIA research team made a judgment of market size based on a combination of the responses, their own judgment, and market knowledge. Therefore, these numbers should be considered approximate. The resulting data is presented in *Table 12*.

Table 12: Reported Size of the Air Compressor Market

SYSTEM SIZE	MINIMUM NUMBER OF CUSTOMERS	MAXIMUM NUMBER OF CUSTOMERS	TEAM JUDGMENT ON NUMBER OF CUSTOMERS
GREATER THAN 2000 HP	2	150	100+
1000 TO 2000 HP	5	150	200+
500 TO 1000 HP	10	200	500+
200 TO 500 HP	20	3000	1,500+
LESS THAN 200 HP	100	10,000	3,000+

Table13 presents percentages of horsepower by size class, based on the mean and "team judgment" estimates. While the precision of the data used to develop this calculation is weak, the pattern is striking enough that it is probably meaningful; systems under 500 HP are about half of the total horsepower of compressed air.

Table 13: Assessment of Percentage of Horsepower by Size Class (based on mean estimates)

SYSTEM SIZE	PERCENT OF HP*
GREATER THAN 2000 HP *(SYSTEMS ASSUMED TO AVERAGE 2500 HP)*	14
1000 TO 2000 HP	17
500 TO 1000 HP	21
200 TO 500 HP	30
LESS THAN 200 HP *(SYSTEMS ASSUMED TO AVERAGE 100 HP)*	17

* Percentages do not add up to 100 due to rounding.

It may be possible that this overstates the importance of smaller systems because smaller systems may run for fewer hours, resulting in smaller electric loads. Even if the data were adjusted to compensate for this, the overall number of systems less than 500 HP and their potential for load impact would be difficult to dispute.

Respondents from the PEA/RIA study provided information on industries that dominate each size category. Their responses suggest that pulp and paper, aircraft manufacturing, electronics, aluminum, wood products, and food processing are the largest users of compressed air systems of all sizes.

VII. Market and Program Planning Assumptions Used as a Basis for Program Funding

As part of the review of the market for industrial compressed air, the assumptions and cost-effectiveness analysis for the SAV-AIR initiative are presented here. The SAV-AIR team is currently developing a detailed business plan that includes the most current market size, sales, cost, and savings data. It is anticipated that SAV-AIR will eventually provide information that could be used to drive a more precise cost-effectiveness calculation.

A. Cost-Effectiveness Assumptions

The cost-effectiveness assumptions that directly impact the overall estimates of program viability are presented in *Table 14*. These come from SAV-AIR's original proposal.

Table 14: Cost-Effectiveness Assumptions

COST-EFFECTIVENESS INPUTS	
Unit	**One Industrial Air Compressor System (average of medium facilities)**
Estimated Total Number of Units	938
Measure Lifetime, Years	10
Non-Energy Benefits	None considered
Annual O&M Cost	$14,400
Capital Cost	$36,200
Measure Savings, kWh/year	918,979
Treated Units, 1999-2000	6
Treated Units, 2001-2010	375

B. Recommendations for Changes to Assumptions

SAV-AIR is currently working to develop a proforma balance sheet analysis that uses their most recent information on market size, plant size, savings potential, and penetration potential. This is now an informal internal worksheet. SAV-AIR is currently working to complete it, and to describe and document its underlying assumptions. SAV-AIR will be working with an outside business consultant and PEA over the next several months to refine and finish this balance sheet analysis. With this in place, recommendations will be made for changes in cost-effectiveness analysis assumptions.

It is likely that recommended changes will include re-estimates of market penetration and capital cost estimates. The cost-effectiveness analysis now in use shows only medium-sized facilities as targets for SAV-AIR. This should be updated to reflect that currently the largest compressed air systems are attractive targets for the SAV-AIR approach.

Energy Savings

The first beta site is expected to become operational in February 2000. With this in place, energy savings estimates may possibly be updated.

Non-Energy Benefits

SAV-AIR did not consider any non-energy or production benefits in its current business analysis spreadsheet. However, once even the first beta site is operational, quantitative non-energy benefit information may become available. The most likely benefits will be productivity-related, with higher throughput due to more reliable air pressure.

VIII. Assessment of Compressed Air Challenge Training

A. Introduction

PEA performed a related, but independent, study assessing training programs of the *Compressed Air Challenge* (CAC). A complete description of CAC and additional findings from a review of Northwest CAC activities is provided in *Appendix D*. During the interviews of compressed air experts and market actors for the SAV-AIR study, PEA included questions about the *Compressed Air Challenge*. Of particular interest were any changes in market position, attitudes, or awareness brought about by the *Compressed Air Challenge*.

This section considers whether the *Compressed Air Challenge* is affecting how industrial customers with large compressed air systems think about and manage their compressed air systems. It is important to examine CAC's effect on large industrial customers because SAV-AIR targets this market sector. It is necessary to understand how the impact of CAC may in turn affect perceptions of SAV-AIR. It should be noted that this early assessment is based on interviews with compressed air experts and market actors (distributors and consultants). The second MPER will include results of 25 end-user telephone surveys on their opinion of the CAC training. The second MPER will also include further analysis of the registration information gathered by the Energy Center of Wisconsin. This data will be analyzed to assess the type of attendees at the Northwest trainings in terms of industry and title.

B. CAC Evaluation Approach and Methodology

PEA's evaluation of the CAC for this first MPER includes gathering, reporting, and synthesizing information, and making observations based on the following activities:

- Conducting telephone interviews with 12 Northwest compressed air market actors (10 distributors and 2 consultants);
- Conducting telephone interviews with 12 regional and national compressed air experts; and

- Reviewing a report prepared by the Energy Center of Wisconsin (ECW) that tabulated an end-of-course survey of attendees and their opinions on the training in each Northwest location where courses have been conducted.

PEA's survey inquiries for CAC consisted of fourteen questions within the larger SAV-AIR market study survey instrument. The questions were specifically developed to evaluate the CAC's *Level I* training program in the Northwest region, as well as to assess whether there have been any broad changes in the market awareness as a result of the training. A copy of the survey instrument is provided in *Appendix B*. There were also questions about the new *Level II* training currently under development.

C. Key Findings from CAC Surveys

Introduction

The following highlights the findings from the survey of 12 experts in the compressed air field and 12 vendors of compressed air services and equipment for this report. The highlights are divided into the following categories:

- Awareness of Program and Training Courses
- Perceived Impact of the Level I Training Course
- Future Training Needs and Next Steps

Awareness of Program and Training Courses Among Vendors and Experts

Both the CAC program and the *Level I* training course were well known among the experts and market actors interviewed. All twenty-four had heard of the *Compressed Air Challenge* and only one expert and one distributor had not heard of the *CAC Level I* training course. About 50% of the respondents played a role in the *Level I* training as sponsors, participants, or both. A majority (67%) said they had customers that participated in the training.

Respondents had varying opinions and observations about the *Level I* training. Some felt it was too basic while others felt there was too much information for a one-day course. Most notably, although the training is meant to be vendor-neutral, this was not the perception of some of the respondents. One of the main concerns expressed was that there was instructor or course equipment bias. The following comments from three vendors attending the training express this concern:

- *"Compressor vendors shouldn't be doing the training. Manufacturers shouldn't be on the board either. This is not right."* [Note that this vendor was also a co-sponsor.]

- *"The training was seeded with incorrect information, not current information. The presenters were from one manufacturer. It was biased."*

- *"Course needs to be less biased. Bias, selling one machine over another. Particular distributors are too dominant as players."*

Regarding *Level II* training, only 10 of the twenty-four respondents had heard of the *Level II* training and only 4 (all experts) commented directly on the training content.

- *"More interesting that Level I training with some calculations. But still not enough information for attendees to be able to do all that needs to be done. Recommend that a second day be spent in a plant."*

- *"Equally as impressive as Level I. It's unbiased training, vendor neutral."*

- *"I have concerns. There are good basic materials in the course, but whether the curriculum has been refined enough or if they [the developers] have erred on the side of expeditiousness is the question."*

- *"Disappointed in it. Doesn't meet the level that it needs to and doesn't meet the needs of end-users. It needs a lot more work."*

- *"Not enough of the interests of customers [end-users]. This is a marketing problem on behalf of CAC."*

Perceived Impact of the Level I Training Course

Those respondents (n=19) familiar with the *Level I* training course were asked about the impact that they felt the training course had on end-users. Ten felt it had "some" impact and four expressed it had "a lot" of impact. Only three of the respondents felt the training had no impact.

Twelve of the respondents commented on the type of customer most likely to be impacted. The comments were too varied to determine a dominant customer type other than large. The following comments are notable:

- *"Most likely larger customers with multiple facilities. Cross facility training can spread the information through a company."*
- *"The customers impacted the most have a management structure and internal support for this type of project."*
- *"Larger industries or those with a larger portion of the load in compressed air. Industries with some project management specialization."*

Respondents were also asked about the level of impact that the training course had on market actors (distributors and consultants). Ten of the respondents felt it had "some" impact while five felt it had "a lot" of impact. Only three of the respondents felt the training had no impact.

Future Training Needs and Next Steps

About 80% of the respondents feel that there is a need for more training in the compressed air industry. All but two respondents gave opinions on what future training should look like. Their comments ranged from needing more CAC-type training to needing more detail and focus on practical application of the material presented in the class.

Interestingly, a few took the opportunity to once again express their concerns about vendor/manufacture bias in the way that current classes are delivered. They suggested that classes in the future be completely objective. Three of the respondents were not as concerned about course content as the need for better promotion of CAC training.

When asked about next steps a variety of answers were given. However, several of the answers included implementation as a training focus. The following comments are of particular interest:

- *"I like the CAC approach in general. The levels offered are reasonably progressive. But, training doesn't get people out into the plants. Need a hands-on approach."*

- *"Give people tools to actually determine the performance of their air compressors. Need to quantify their air leaks and usage. People are motivated by dollars."*

- *"Have end-users identify costs in their own facility. Go beyond the maintenance people to the accounts payable people and management."*

- *"Need to contact the end-users and actually have them put into practice what they learned. This is a persistence issue."*

VIII. Assessment of the Compressed Air Challenge Training

IX. Issues and Recommendations

Issues and recommendations in this section include first those for SAV-AIR followed by a number for the *Compressed Air Challenge*. These recommendations are in no particular order of importance.

A. SAV-AIR Issues and Recommendations

Issue: Developing Financial Momentum

A critical question is whether SAV-AIR can build and maintain the financial momentum that will enable it to move from the start-up venture phase into a self-sustaining business. The team's business intuition, customer relationships, sales capabilities, and technical skills are very strong and have carried them with good success so far. More recently, the team has been developing a draft business analysis, actively exploring options for capturing revenues. They are using the beta sites to track costs and explore potential pricing strategies.

Recommendation:

We recommend that SAV-AIR continue with the more formalized business planning process it has begun. SAV-AIR's plan to enlist the services of a business-planning consultant is a good idea. The Alliance and the PEA evaluation team are also sources to draw on for business planning and technical assistance. SAV-AIR particularly needs to continue to analyze and streamline sales and delivery costs, and to formalize a pricing strategy. SAV-AIR might also consider incorporating a conservative estimate of non-energy benefits into their business analysis.[33]

[33] Note that we are not suggesting quantifying non-energy benefits in customers' individual proposals.

Issue: Length of Sales Cycle and Delivery Process

This issue relates directly to the business analysis. The SAV-AIR team members are finding that the sales cycle is longer than they anticipated; despite well-established business relationships, it appears to take about six months from initial contact to a signed contract.

It would seem that the original marketing plan was unrealistic, given the obtrusive involvement in customers' processes, the capital investment required, and the developmental state of the product. It is not clear that the length of the sales and delivery process can be substantially reduced, even as the services evolve and are streamlined. We suspect that the sales and delivery process may be inherently longer than SAV-AIR anticipated because of the nature of the services.

Recommendations:

- SAV-AIR should continue to closely track sales costs at the beta sites. They should analyze where both sales and delivery might be getting bogged down and where the process could be streamlined.

- SAV-AIR must quickly size up whether a customer is a good candidate for, and genuinely interested in, the type of long-term services they offer. They already appear to be doing this effectively for the beta sites.

- As the team is already discovering, services of this breadth must be sold strategically at multiple levels. Each sales effort must be explicitly tailored to the concerns of the party being targeted, and with an eye to the role and leverage of the person in the company.

- High quality, high profile case studies of both energy and non-energy benefits are a very valuable sales tool. SAV-AIR must continue to push aggressively towards beta site completion to be able to develop case studies.

Issue: Contractual Arrangements for Ongoing Monitoring

As noted earlier, one critical difference between SAV-AIR and other service providers is that their ongoing monitoring agreement and relationship with customers should ensure savings persistence. However, in the current sales and contractual arrangements, there is no formal "conversion" of a SAV-AIR installation to a SAV-AIR monitoring contract.

Recommendation:

SAV-AIR believes that customers should be continually reminded of the value of ongoing monitoring services, but they need to experience the value first in order to continue. SAV-AIR might consider that future *Phase II* contracts include provisions for low- or no-cost monitoring for some period. SAV-AIR might also consider selling customers ongoing monitoring and control as a package with their *Phase II* contracts. This monitoring could be used as a marketing tool to sell customers this service package.

Issue: Case Studies and Evaluation Reports

SAV-AIR clearly sees the value and importance of the case studies for their sales efforts and for the Alliance's market transformation goals. Given their project commitments, and that they are still in the early stages with many beta sites, they have not yet had the opportunity to develop and finalize the content or format of the case studies. However, in order to ensure that the case studies will be of greatest value, some data collection and planning need to be done while the beta sites are being approached.

Recommendation:

To assist the SAV-AIR team with planning the case studies, PEA has provided recommendations regarding case study content, format, and audience in *Appendix C*. This provides for case studies appropriate for different levels within an organization.

Issue: Purpose of the Prototype Site

The Alliance staff we interviewed were under the impression that the prototype site will function as a fully-operational demonstration site where customers can observe and get hands-on experience with the SAV-AIR equipment and software. The SAV-AIR team did not indicate that it was their intention to use the prototype site in this way, although they did say they might consider doing off-site customer demonstrations using the remote host software.

Recommendation:

While the evaluation team does not consider this difference in perception to be of particular concern, the Alliance and SAV-AIR staff should clarify this so as to bring each party's expectations in line. One question to consider is, if the prototype site is not used for full customer demonstrations, where might this be done?

Issue: Need for Greater Clarity on Beta Site Timelines and Goals

SAV-AIR had planned to recruit six beta sites by the third quarter of 1999. As of January 2000, four sites have been recruited and one of those has progressed to *Phase II*. The remaining two are in the negotiation phase. However, it is not clear what the Alliance's near-term expectations are in terms of how far in the delivery process SAV-AIR is expected to go, and by when. If the ultimate goal is to use the beta sites as case studies to demonstrate savings, at least one project will have to progress rapidly in the near future in order to develop the content for these studies.

Recommendation:

The Alliance and SAV-AIR should set some specific and realistic goals for the next six to twelve months. Our recommendation would be that the SAV-AIR team focus most intensely on moving the wood products site along (ideally through *Phase V*) so a case study can be developed. To the extent that SAV-AIR can continue to push at the same time for *Phase I* agreement completion for the two sites in negotiation, they should also do this. However, they may want to consider a cut-off date and identify alternate sites.

B. Compressed Air Challenge Issues and Recommendations

This discussion pertains to *Compressed Air Challenge* (CAC), a national effort to encourage compressed air system optimization through promotion, training, certification,[34] and improved information on equipment efficiency. As part of PEA's interviews for the SAV-AIR evaluation, we asked questions focusing on the CAC training.

Issue: Vendor Neutrality and Instructor Selection

Vendor neutrality is a clearly stated goal for the CAC program. However, some of the experts and vendors surveyed for this report repeatedly expressed concerns that the course is biased. Some perceive a vested interest on the part of the instructors, in that particular compressors are represented more often and as better than others. They felt that because the instructors are from one manufacturer, they appear to dominate the program, thus giving them an unfair sales advantage. One service provider had heard that in order to be selected as an instructor you had to be a co-sponsor.

The perceptions and opinions expressed on this issue must be considered carefully in light of the fact that they were voiced by experts (who are often consultants and service providers) and vendors (distributors of equipment). It is also important to be aware of the significant distrust in the industry. PEA will be revisiting these issues after the end-user surveys are completed. Since end-users are the primary target audience for the CAC, their opinions will carry the greatest weight. However, on a cautionary note, it is important not to discount the vendors' concerns around these issues just because they may be in direct competition with those sponsoring and instructing the class. Service providers are important players since they often bring the end-users to training through their recommendation. If vendors feel (whether by experience or rumor) that the classes are biased and instructors are unfairly chosen, they may influence their customers against attending the classes.

[34] Certification of analysts is a future goal.

Recommendation:

Maintaining vendor neutrality is critical to the credibility and success of the CAC program. The instructor selection process should be reviewed to ensure vendor neutrality. CAC might consider using only instructors with no connections to a particular manufacturer or equipment distributor. Those with a high degree of technical knowledge do not always make the best trainers. If a vendor is selected as an instructor, consider having them teach classes that are outside of their service territory, or use co-instructors. When possible, avoid having co-sponsors also provide the instructors.

Issue: Low Attendance by End-Users (Customers)

PEA's review of class attendance records for the Northwest indicated that end-users comprised a majority of participants, but only marginally so at 57%. While this is comparable to national results, transforming the compressed air market to efficient use is to a great degree dependent on end-users' awareness of the advantages of comprehensive management strategies. In the SAV-AIR section of the survey, vendors expressed a reluctance to provide optimization services until their customers request them. Some respondents also expressed concerns that promotion at the CAC classes to end-users is inadequate.

Recommendation:

We recommend re-examining the current strategy for promoting CAC classes to end-users. Mail promotional materials directly to individuals within a particular company, rather than to the company in general. Follow up the mailings with phone calls to encourage attendance and to determine barriers to attendance. Hire a marketing manager (this could be an educational institution or non-profit organization) that is not connected to a vendor or manufacturer to carry out promotional tasks, assist the sponsors, and maintain a database of end-users. For geographically dispersed industries, consider co-funding travel costs.

Issue: Reaching End-Users Not Able to Attend Off-Site Classes

Some end-users will never be able to attend a CAC class. Reasons may include lack of training funds, company policies that preclude training outside of the corporation, lack of time, or just an attitude against allowing staff to train off-site. Empowering these customers with the tools to make informed decisions about intelligent management of their compressed air systems is challenging.

Recommendation:

Consider developing training videos and/or a CD-ROM to accommodate end-users that, for whatever reason, are not able to attend off-site training classes. The caveat in doing this is that end-users who normally can attend offsite training classes may use this as a substitute. They may see the video or CD-ROM as "just as good" as going to an actual class. In addition, the effectiveness of such training media in lieu of participatory in-class venues should be investigated.

Issue: Supporting Implementation of the CAC System Approach at the Plant Level

The CAC *Level I* class conveys fundamental compressed air information and sound compressed air management practices. It provides students with application tools such as a seven-step action plan for implementing the systems-approach in their plants. Yet some survey respondents expressed concerns about information learned in the classroom ever getting implemented at the plant. One vendor is concerned that unless there is follow up with each end-user, the information learned will never be put into practice. In part, this happens because managers are not well informed about the CAC efforts and importance of taking a systems-approach to managing their compressed air. Thus, managers are often not supportive of their staff spending time or money putting into practice what they have learned in a class.

Recommendation:

To help solve this problem, the classes should also include an action plan and materials for selling the systems-approach to

management. Attendees need to define what barriers they might see to "making it happen" in their plant and develop some strategies for overcoming the barriers. When they leave the class, they should have a clear understanding of what they need to do first to begin to make what they have learned standard practice for their plant.

Appendices

Appendices

Appendix A

Expert List for the PEA Market Study and SAV-AIR Initiative Evaluation

EXPERT NAME	INTERVIEWED FOR PEA/RIA	INTERVIEWED FOR BOTH	INTERVIEWED FOR SAV-AIR
BILL SCALES, SCALES ENGINEERING, CARLE PLACE, NY	√	√	√
BABU JOSEPH, SOUTHERN CALIFORNIA EDISON, LOS ANGELES, CA			√
ANDREW DELASKI, CONSORTIUM FOR ENERGY EFFICIENCY, BOSTON, MA	√		Not Interviewed
JOHN VRANIZAN, CAROL HATCH AND ASSOCIATES, PORTLAND, OR	√	√	√
CRAIG CIRANNY, BONNEVILLE POWER ADMINISTRATION, PORTLAND, OR	√		Not Interviewed
CHRIS MILAN, BONNEVILLE POWER ADMINISTRATION, PORTLAND, OR			√
NIKHIL GANDHI, STRATEGIC ENERGY TECHNOLOGIES, INC., ACTON, MA	√	√	√
TIM NEWCOMB, SEATTLE CITY LIGHT, SEATTLE, WA	√		Not Interviewed
DENNIS PEARSON, SEATTLE CITY LIGHT, SEATTLE, WA	√		Not Interviewed
JIM HEALY, SEATTLE CITY LIGHT, SEATTLE, WA			√
AIMEE MCKANE, LBL/DOE COMPRESSED AIR CHALLENGE, DC	√	√	√
KAREN MEADOWS, ENERGY CENTER OF WISCONSIN, MADISON, WI			√
GREG WHEELER, OSU EXTENSION, CORVALLIS, OR	√		Declined Interview
BRUCE MEDERIS, ASSOCIATION OF FACILITY ENGINEERS, CINCINNATI, OH	√		Not Interviewed

Continued

EXPERT NAME	INTERVIEWED FOR PEA/RIA	INTERVIEWED FOR BOTH	INTERVIEWED FOR SAV-AIR
BOB ZDEBSKI, ELECTRIC LEAGUE OF THE PACIFIC NORTHWEST, BELLEVUE, WA	√		Not interviewed
NEAL ELLIOTT, AMERICAN COUNCIL FOR AN ENERGY EFFICIENCY ECONOMY, WASHINGTON, DC	√	√	√
SCOTT STROUP, AIROMETRIX, DENVER, CO	√		√
AL DUNLAP, PUGET SOUND ENERGY, BELLEVUE, WA			√
GIL MCCOY, WASHINGTON ENERGY OFFICE, OLYMPIA, WA	√	√	√

Vendor List for the July 1998 PEA Market Study and the SAV-AIR Evaluation

VENDOR/DISTRIBUTOR NAME	INTERVIEWED FOR PEA/RIA	INTERVIEWED FOR BOTH	INTERVIEWED FOR SAV-AIR
BRUCE ODEGAARD, DICKINSON EQUIPMENT, SEATTLE, WA	√	√	√
DAVE JOLLY, BECKWITH & CUFFEL, VANCOUVER, WA	√	√	√
BILL LIVINGSTON, BECKWITH & CUFFEL, SEATTLE, WA			√
GARY BECKWITH, BECKWITH & CUFFEL, SEATTLE, WA	√		
HARRY WALP, MITCHELL, LEWIS & STAVER, REDMOND, WA	√	√	√
JANN OSTERBURG, AIR EQUIPMENT, BOISE, ID	√	√	√
JIM DAGSLAND, MITCHELL, LEWIS & STAVER, PORTLAND, OR	√		
JOHN SAVOY, INGERSOLL-RAND, VANCOUVER, WA	√		
LOU CUFFEL, BECKWITH & CUFFEL, SEATTLE, WA	√		
LYLE WELLS, ROGERS MACHINERY RETIRED, PORTLAND, OR	√	√	√
MIKE SMELTZER, ROGERS MACHINERY, PORTLAND, OR	√	√	√
JERRY CROUSE, PORTLAND COMPRESSOR, PORTLAND, OR			√
BEN RICHARDS, R&R COMPRESSOR, KIRKLAND WA	√	√	√
RICK BELL, PNEUMATIC, SPOKANE, WA	√	√	√
ROB LOGSDON, COMPRESSED AIR PRODUCTS, VANCOUVER, WA	√	√	√

Continued

VENDOR/DISTRIBUTOR NAME	INTERVIEWED FOR PEA/RIA	INTERVIEWED FOR BOTH	INTERVIEWED FOR SAV-AIR
ERIC BESSY, COMPRESSED AIR SPECIALISTS, PORTLAND, OR			√
ROBERT HARDER, MISCO, BOISE, ID	√		

Appendix B

SAV-AIR Evaluation

EXPERT SURVEY **12/16**

Name / Company _____

Phone Number/City, State _____

Title / Activities _____

Contact Log

DATE	TIME	RESPONSE	NOTES

Introduction: I am _____ of Pacific Energy Associates, a market research firm in Portland. We are conducting a research project for the Northwest Energy Efficiency Alliance, a consortium of Northwest utilities and public energy agencies. We are asking those with specialized knowledge of the compressed air industry questions about changes in the market. Your individual responses will be confidential. Reports on this evaluation will be made available publicly on the Alliance website in a few months. The questions take about 20-30 minutes. Is now a good time to talk?

Throughout this survey we will be talking about "compressed air system optimization." By this we mean detailed evaluation, analysis, and changes to the entire compressed air system – compressors, auxiliaries, controls, distribution, leaks, and end-uses. Is this definition okay with you?

Company Characteristics

1. CONFIRM LOCATION OF YOUR COMPANY

City _____

State _____

2. TYPE OF COMPANY (Check most appropriate).

- ❑ Compressed air equipment distributor
- ❑ Mechanical engineering
- ❑ Compressed air system consultant/designer
- ❑ Other (specify_____)

3. MARKET AREA

❑ Local ❑ National ❑ Regional ❑ Global

[The following question is for Distributors only, not for Experts.]

4. I have a series of questions about the services that your firm and other firms provide. These questions also address the changes in market activities that are driven by customers or others. I would like to start by understanding which of the following services your firm offers *(begin in column 1)*. Please answer YES or NO as I read the list.

[After answering about column 1] Now I would like to ask you about changes in activity in the last 12 months or so for your firm, changes in activity for other firms, and changes in customer activity for each of these services. The activity change, if you know about it, can be described as "More, Less, or Same."

SERVICE	YOUR FIRM OFFERS?	YOUR ACTIVITY CHANGE LAST 12 MONTHS? (MORE/ LESS/ SAME)	OTHER FIRMS ACTIVITY CHANGE LAST 12 MONTHS? (MORE/ LESS/SAME)	CUSTOMER ACTIVITY LAST 12 MONTHS? (MORE/ LESS/SAME)
EQUIPMENT PARTS AND SALES	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
SYSTEM AND EQUIPMENT MAINTENANCE				
LEAK DETECTION	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
LEAK REPAIR	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
SYSTEM CONTROLS IMPROVEMENTS				
ENHANCED INDIVIDUAL CONTROLS	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
COMPRESSOR SEQUENCING CONTROLS	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
SYSTEM AUDITS	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
SYSTEM MONITORING				
SHORT-TERM	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
LONG-TERM	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
COMPRESSED AIR LOAD SHAPE SURVEY	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
SYSTEM OPTIMIZATION: AN INTEGRATED APPROACH TO AUXILIARIES, CONTROLS, DISTRIBUTION, LEAKS, END-USES	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK
SYSTEM DESIGN AND EFFICIENCY UPGRADES	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK

5. Considering the Northwest Region only, in the past twelve months or so, have you heard of any increase in activity by firms that specifically offer control improvements, system audits, leak detection and repair, or optimization services?

_____

_____

(Check firm and service, probe and suggest if necessary.)

- ❑ Sarlin Balance
- ❑ XCEED by Honeywell
- ❑ ConservAIR by ConservAIR
- ❑ XpandAIR and TargetAir by Zeks
- ❑ AirMaster, Washington State University Extension
- ❑ AuditAir by AuditAir, Ontario, Canada
- ❑ MonitAIR™, ManagAIR™, and DirectAIR™ by Air Technologies
- ❑ Compressed Air System Screening Tool, Energy Center of Wis.
- ❑ SCADA and Internet monitoring by Ingersoll-Rand
- ❑ Audits, monitoring, and optimization by SAV-AIR
- ❑ Leak detection services
- ❑ Leak repair services
- ❑ Other _____

6. What activity have you heard about?

_____

_____

7. In your opinion, does long-term monitoring of large compressed air systems have value for ongoing system efficiency enhancement or optimization? Would you say long term monitoring has… *(READ LIST)*

   - ❑ Significant value
   - ❑ Some value
   - ❑ Little value
   - ❑ No value whatsoever
   - ❑ Couldn't say
   - ❑ Refused

8. Why?

   _____

   _____

9. In your opinion, what percentage of regional customers with large compressed air systems (500 HP and up) would benefit from a detailed compressed air system audit and system optimization?

   ❑_____ % ❑ Couldn't say ❑ Refused

10. Of these same customers, how many would benefit from long-term monitoring that leads to system optimization?

    ❑_____ % ❑ Couldn't say ❑ Refused

11. What percentage of those customers that would benefit from long-term monitoring do you feel would seriously consider making the investment in monitoring and optimization?

    ❑_____ % ❑ Couldn't say ❑ Refused

12. What kinds of customers are these? *(Probe for industry, size, and attitude.)*

13. In regards to compressed air system optimization services, what do you see as barriers to comprehensive optimization?

14. I'm going to read a list of potential barriers to comprehensive system optimization. Please tell me if YOU see any of these as a barrier?

- ❑ Availability of technical expertise to perform efficiency analyses?
- ❑ Technical expertise for monitoring?
- ❑ Ability to fund services?
- ❑ Ability to fund capital?
- ❑ Attitude toward outside experts?
- ❑ Focus on production?
- ❑ Lack of accountability for compressed air system costs in plant?
- ❑ Expense of ongoing monitoring services?
- ❑ Restrictions on project payback, return on investment?
- ❑ Lack of customer knowledge?

15. Which two of these do you see as the most important barriers to overcome for promotion of compressed air efficiency?

16. Some plant managers are not often motivated to control compressed air system energy costs. Why do you think that is?

17. If plant managers are not motivated to control compressed air energy costs, how do you think can management attention be captured? *(PROBE: What benefits or concerns should be emphasized?)*

18. Now I'm going to read a list of items that could be part of a compressed air system analysis and improvement project. For each item, tell me if you think it would be "very helpful" "helpful" "somewhat helpful," "not very helpful," or "not at all helpful" in motivating a customer to fund such a project. *[Alternatively use a scale of one to five. One being not at all helpful and five being very helpful.]*

Very Not

- ❑ Determine plant-wide and per-unit compressed air cost
- ❑ Assignment of compressed air cost to departments
- ❑ Improved product quality or fewer rejects
- ❑ Improved system reliability (less compressed air down time)
- ❑ Meeting quality standards in plant for compressed air
- ❑ Improved safety
- ❑ Provision of real-time compressed air information such as pressure, flows, and compressor operation
- ❑ Capital investment reduction (e.g. needing fewer compressors)
- ❑ Reduction in maintenance time needed for compressed air
- ❑ Support company policy for staff outsourcing

19. Who else would you recommend that we talk with that knows a great deal about compressed air system optimization?

Name / Company _____

Phone Number/City _____

Title / Activities _____

20. Would you have any suggestions as to customers that would be amenable to being contacted by us to ask similar questions about compressed air services?

Name / Company _____

Phone Number/City _____

Title / Activities _____

I now have a few questions about the *Compressed Air Challenge*. The Compressed Air Challenge is a voluntary collaboration of industrial users, manufacturers, distributors, operating personnel, consultants, efficiency organizations and utilities. All are interested in helping companies realize the benefits of smart compressed air system management. Together they have developed a one-day training seminar the **Fundamentals of Compressed Air Systems.**

[Additional information about the CAC objective benefits –

1. Increased trainees' awareness of the benefits of better management of compressed air systems;
2. help communicating those benefits to associates and decision-makers;
3. provides "product and vendor neutral" solutions;
4. help developing a specific action plan for managing their compressed air systems; and
5. has already reached over 1,400 people with Level I training.]

21. Are you aware of the *Compressed Air Challenge*?

❑ Yes ❑ No *[Skip to 34.]*

22. Are you familiar with the CAC Level I training program – Fundamentals of Compressed Air Systems?

❑ Yes ❑ No *[Skip to 26.]*

23. Do you have any comments or feedback that would be useful to our evaluation?

_____

_____

24. Were you a participant or co-sponsor of the CAC training?

❑ Participant ❑ co-sponsor ❑ Neither

25. Did any of your customers participate in the CAC training?

❑ Yes ❑ No

26. Are you aware of the Level II training program that is being piloted currently by the Compressed Air Challenge?

❑ Yes ❑ No *[Skip to 28.]*

27. Do you have any comments or feedback that would be useful to our evaluation?

_____

_____

28. In the Northwest region there have been several compressed air training programs in the past offered by Utilities, vendors, etc. Have you been to any of these classes?

If so whom was it offered by? _____

Where and when was it offered (approximately)? _____

If you have attended the CAC course how did this other training compare to the CAC course?

_____

_____

29. Do you think the *Compressed Air Challenge* training has the potential to impact the knowledge, skills, and activities of customers?

❑ Yes ❑ No

IF YES: Do you think it has had an impact and if so, what impact do you think it has had? (A lot, some, little, none.)

30. Do you have a sense of what industries or types of customers have been most impacted? Any different than the national scene?

_____

_____

31. Do you think *Compressed Air Challenge* training has had any impact on the knowledge, skills, and activities of suppliers, distributors, and consultants?

❑ Yes ❑ No

IF YES: What impact do you think it has had? (A lot, some, little, none.)

_____

_____

32. Do you see a need for more CAC-type training, or perhaps different training?

❑ Yes ❑ No

Explain why and what it would look like:

_____

_____

33. Now that training has been offered, what do you feel is the next step necessary to continue increasing awareness of the benefits of compressed air efficiency?

_____

_____

34. In the Northwest Region there have been several compressed air training programs offered by utilities and vendors, etc. Have you attended any of these training classes?

❑ Yes ❑ No

If so, whom was it offered by _____

_____

Where and when was it offered (approximately)? _____

_____

The Northwest Energy Efficiency Alliance, for whom this survey is being performed, is supporting a long-term compressed air monitoring and optimization service called SAV-AIR. SAV-AIR will implement a comprehensive monitoring program and provide real-time information and control capabilities to their customers. They will monitor leakage rates, compressor operation, and provide ongoing recommendations for the optimization of their customer's compressed air system.

35. Had you heard about SAV-AIR before this survey?

❑ Yes ❑ No *[Skip to 38.]*

36. Do you have any feedback or suggestions about the SAV-AIR concept?

_____

37. Do you know if any utility programs or activities related to compressed air efficiency have been introduced in the past six months? Would it make sense for SAV-AIR to participate in any of these activities, or perhaps even be a partner?

38. Do you see any national changes in the compressed air industry that may eventually impact Northwest regional efforts for optimization or other services?

39. What would make a difference in the replication of compressed air efficiency improvements, both within and across corporations?

40. Do you mind being contacted periodically so we can learn about your continued observations and opinions of compressed air services?

❑ Yes ❑ No

Thank you for spending time talking with me.

Appendix C

Case Study Recommendations

In order to capitalize on success and leverage on experience, near-term marketing materials need to reach prospective customers with the right information. Case studies of beta sites are elementally important to this. In order to ensure that the case studies will be of greatest value, some data collection and planning need to be done while the beta sites are being approached.

Case studies generally highlight the most exciting findings that show quantifiable results. Case studies may range from slick one-pagers for marketing purposes to detailed 25-page white papers for publication and presentation at conferences. For upper-management and executives, slicker, one-page, easy and quick to read case studies are often best. For academics or project engineers, details on approach with lots of charts and graphs is often preferable. In other words, know the audience and what is important to them.

As the SAV-AIR sales process seems to follow the multi-level sales approach used for energy services, a case study that transparently meets the needs of that diverse audience may be appropriate. Alternatively, different case studies might be prepared for Chief Financial Officers, Plant Managers, and Maintenance Leads. Suggestions for each audience are:

- *CFO, President, and Board Chair:* Give a succinct, non-technical one-page (two-sided) slick presentation. Focus on the bottom line in terms of dollar savings, payback, or return on investment. Point out any quantifiable production benefits clearly – perhaps even before energy savings benefits. Basic education on the "fourth utility"' needs to be addressed.

- *Plant Managers:* In addition to the information above, further technical detail is necessary. The "how and why" need to be explained. As this audience is especially risk adverse, reliability and reversion to manual control could be mentioned to ease their concerns. A more complete description of the impact of their compressed air system on energy costs, capital investment, and potential productivity should be included.

- *Maintenance Leads:* The information for both audiences above should be included, but with less focus on economic benefits. This audience will need to clearly understand how it will impact their positions. They may need to have some control of the SAV-AIR process in order to feel secure. Details should be included on the technical approach, what they might be expected to provide or coordinate, and the use of outside contractors.

To encourage broad dissemination of the case studies, it is recommended that some form also be published and available on the Internet.

A case study format should include at minimum:

- Background – *why SAV-AIR? the Alliance connection etc.*
- Plant Description – *type, industry etc.*
- Compressed Air System Description
- SAV-AIR Approach – *how different*
- Key Findings that lead to quantifiable results or improvements – *include both energy and non-energy benefits*
- Conclusions, Lessons Learned and Next Steps

Beyond this, and depending on the audience, a case study might include a description of the compressed air industry and barriers to getting the concept into the industry, along with possible solutions.

The following outlines the content for a larger beta site report from which a case study could be extracted.

I. Executive Summary ***(briefly describes the project and highlights the key findings)***

A. Background

B. Objectives

C. Approach

D. Conclusions or Key Findings (quantify where possible)

E. Recommendations

The executive summary needs to include a brief discussion on what makes a project unique and what makes this approach unique. The executive summary may be the only thing that key decision-makers look at.

II. Body of the Document

A. Introduction and Purpose of the Project

B. Description of the Facility (plant) and CA System

1. Size

2. Location

3. Primary Use

4. System (in this case compressed air) description

C. Copy of the Project Plan Outline

1. Scope (what the project includes [i.e., a detailed study or audit, installation of diagnostics, etc.] and doesn't include [limits])

2. List of team members and responsibilities (include everyone outside and inside the organization)

3. A detailed list of tasks and schedules (this could also include a CPM diagram)

4. Description of the diagnostic approach (compressed air management tool)

5. Description of ongoing support by SAV-AIR

D. Findings

1. Audit findings (leading to what decisions)

2. Diagnostic findings over a period of time. What was found, what was implemented and what were the results and benefits (savings, improved product, improved safety, improved O&M, etc.)?

E. Recommendations (this section may include capital improvements that are not funded as part of the project, training for O&M staff, etc.).

III. Appendices

This may include the following and may be in a separate volume from the main report:

- Full Audit Report
- Any Forms Used to Gather Information
- Diagnostic Tables, Graphs, Charts Supporting Implementation Decisions
- All Progress Reports
- Meeting Notes
- Copies of Important Communications and Memos

Documenting the project process from start to finish is imperative for developing a detailed final report and case study. Every part of the process and finding, no mater how small or inconsequential, should be documented. This documentation should include before and after photographs (when appropriate and permitted), before and after production impacts, and before and after energy impacts. All information should be gathered from the viewpoint of prospective customers.

Appendix D

Compressed Air Challenge Program Overview

The *Compressed Air Challenge* (CAC) is a voluntary collaboration of industrial users, manufacturers, distributors, operating personnel, consultants, efficiency organizations, and utilities. Together they have developed a nationwide effort consisting of training programs, materials, and instructors to increase awareness of the benefits of intelligent compressed air system management. Their target audience is industrial end users, consultants, and vendors/distributors of compressed air services and equipment.

The *CAC Level I training – Fundamentals of Compressed Air Systems* – is the current centerpiece of the CAC efforts. The *Level I* training intends to:

1. Increase attendees' awareness of the benefits of better management of compressed air systems;

2. Help attendees communicate those benefits to associates and decision-makers;

3. Provide "product and vendor neutral" solutions; and

4. Help attendees develop a specific action plan for managing their compressed air systems.

CAC's *Level I* training has already reached over 1,400 people nationwide. The *Level II* training course is currently under development and is scheduled to be piloted in the Midwest in May. The *Level III* training curriculum is in its formative stages.

Other elements of the CAC program consist of a *Sourcebook*, a web site, and an 800-number. The *Sourcebook* is an in-depth reference that supplements the *CAC Level I* training. Its full content is posted on the web site.

The web site, *www.knowpressure.org*, contains the CAC objectives and training calendar. Plans to include other technical resources are currently under way.

The toll-free telephone number "clearinghouse" (1-800-862-2086) is staffed by the Washington State University Extension Service. Located in Olympia, Washington, the CAC clearinghouse is an element of the Office of Industrial Technology (OIT). They can answer general questions and provide *Sourcebook* order forms and training information. The CAC clearinghouse is supported by the Department of Energy who also provides support for the *Motor Challenge Program* and its clearinghouse at the same toll-free number.

CAC Program Status for the Northwest Region

The information presented in this section comes from a report by the Energy Center of Wisconsin (ECW) on results from evaluation forms completed by attendees of the *Level I* training, reviewing the *Compressed Air Education Survey* (needs assessment) by Barbara C. Burrell, Ph.D. It also comes from discussions with Blair Collins, Project Coordinator at the Alliance. The Alliance works with the CAC regional Advisory Committee to conduct the classes.

According to the ECW report, a total of 109 people attended the CAC *Level I* training classes offered in the Northwest. Attendance in the Northwest compares favorably to the national attendance result for high-density areas. Six Northwest classes occurred at six different geographical locations throughout the region:

- Boise, ID
- Missoula, MT
- Portland, OR
- Seattle, WA
- Spokane, WA
- Eugene, OR

Data collected from the Eugene class is not part of the ECW report and therefore is not included here.

Each attendee was asked choose a category that best described their market position. *Table D-1* presents information on the types of attendees and clearly demonstrates that the end-users had the highest representation (57%, N = 84) of all of the attendee types.

Table D- 1: CAC Training Attendee Types*

TYPE ATTENDEE	PERCENT OF TYPE
HOST	10%
CONSULTANT	11%
DISTRIBUTOR	10%
END USER	57%
MANUFACTURER	7%
OTHER	6%

* Information is not available on how (or if) there is overlap between the host category and other categories. Percentages may not add up to 100 due to rounding

The first round of CAC *Level I* training classes were well received by those attending the classes. Each attendee was asked to rate the training from poor to excellent. Ninety-five percent (N = 98) rated the training above average to excellent. The vast majority of attendees also said that they would recommend the training to a colleague.

A majority of the attendees rated the class above average to excellent and felt that course objectives were met.

The one-day class length, with classes being held in different locations throughout the Northwest region, follows the preferences of those responding to the *Education Needs Assessment Survey*

The primary focus of the CAC training content is operating, maintaining, and evaluating energy use of compressed air systems. This follows what the majority of the respondents to the education needs survey felt are the most important aspects for training.

Up to five *Level I* classes and one *Level II* class are currently being planned to begin in the spring of 2000. The *Level II* classes will include more in-depth information on the system-based approach to compressed air management. *Level III* classes are also under development. *Level III* will include the new *AIRMaster Plus* software and is initially intended for compressed air service providers rather than end-users.

Appendix E

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