SAV-AIR MARKET TRANSFORMATION INITIATIVE

MARKET PROGRESS EVALUATION REPORT #3

Final Report

Funded By:

Prepared For:

Dr. Philipp Degens

The Northwest Energy Efficiency Alliance

Prepared By:

Steven Scott, P.E.
Fred Gordon

Pacific Energy Associates, Inc.
1920 Mulberry Avenue
Portland, Oregon 97214
(503) 233-6543

December 31, 2001

Table of Contents

Executive Summary I

A. Introduction I

B. Evaluation of the SAV-AIR Initiative II

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

Market Environment VI

Market Effect Indicators VI

D. Issues and Recommendations IX

SAV-AIR Issues and Recommendations IX

Compressed Air Challenge Issues and Recommendations XI

I. SAV-AIR Effort and Status 1

A. Overview 1

B. Assessment of SAV-AIR's Efforts and Market Effects 2

Update of SAV-AIR Goals 5

SAV-AIR Business Plan 6

SAV-AIR Presentations 8

II. Compressed Air Expert Survey 11

A. SAV-AIR Findings 11

B. *Compressed Air Challenge* Findings 15

III. Competitor Survey 17

A. Market Actors 17

B. Compressed Air Services Offered 18

C. Other Product Offerings 22

D. Other Service Offerings 22

E. Reported System Benefits 24

F. Demand for Compressed Air Services 24

IV. SAV-AIR Nonparticipant Interviews 27

A. SAV-AIR 27

B. Compressed Air Training 28

Table of Contents

V. SAV-AIR Customer Interviews 31

A. Participant Experience with SAV-AIR 31

B. Project Descriptions 34

C. Non-Energy Benefits 35

Metals Casting 36

Cable Manufacturer 36

Wood Products 37

D. SAV-AIR Satisfaction 37

E. Compressed Air Training 38

VI. Compressed Air Challenge Observations 39

A. Observation of CAC Level 1 Training 39

First Wave CAC Participant Results 40

B. Compressed Air Challenge Success Stories 43

C. Other CAC Issues 44

Promoting the Training 44

Level 2 Training Offering 45

VII. Issues and Recommendations 47

A. SAV-AIR Issues and Recommendations 47

Issue: Document Customer Compressed Air Problems 47

Issue: Complete Development of Monitoring Interface 48

Issue: Prepare Case Studies 49

Issue: Use Non-Energy Benefits in Sales/Marketing Approach 49

Issue: Provide Case Studies to Regional Experts 50

Issue: SAV-AIR Support for *Compressed Air Challenge* 50

Issue: Make the SAV-AIR Web Site a Compressed Air Information Resource 51

Issue: All-inclusive Marketing Approach 51

B. *Compressed Air Challenge* Issues and Recommendations 52

Issue: Garnering Utility and Vendor Support for CAC 52

Issue: Promoting CAC Training 53

Appendices

Appendix A: List of Expert Firms Interviewed
Appendix B: Competitor Interview Guide
Appendix C: Nonparticipant Survey
Appendix D: Participant Survey
Appendix E: Expert Survey

Table of Contents

Executive Summary

A. Introduction

The Northwest Energy Efficiency Alliance (the Alliance) is a non-profit group of electric utilities, state governments, public interest groups, and industry representatives committed to bringing affordable, energy-efficient products and services to the marketplace. The *SAV-AIR Market Transformation Initiative* was undertaken by the Alliance to change the way compressed air (CA) end-users and service providers view and manage their systems, and in doing so achieve not only energy efficiency benefits, but also non-energy advantages such as increased system reliability.

This *Market Progress Evaluation Report* (MPER) is the third in a series of assessments of the *SAV-AIR Market Transformation Initiative* (SAV-AIR). The work in this report builds upon the work done in the previous reports, MPER #1 and #2. Some of the background and context presented in the *Executive Summary* and the *Introduction* of MPER #1 and #2 are reiterated below for the convenience of the reader.

SAV-AIR, LLC, formed in 1997, provides integrated compressed air management systems and engineering services. The SAV-AIR approach includes real-time monitoring and control of compressed air systems, resulting in increased reliability, decreased costs, and management information for verification and decision-making.

The Alliance has supported the *SAV-AIR Market Transformation Initiative* with two phases of funding, for a total of approximately $2.27 million over a contract period that began in December 1998, and will go until May 2003.

This report covers the activity of the SAV-AIR initiative over the period from August 2000 through July 2001. SAV-AIR, LLC has shown progress toward goals of the Initiative, has all but completed development of their product line, and their sales activity is growing significantly. However, SAV-AIR is not "out of the woods yet" in terms of their financial development, and therefore some of the issues and concerns stated in this report remain the same as those found in earlier MPERs.

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 area 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 negative impacts on production and even less efficiency.

Support of the *SAV-AIR Market Transformation Initiative* was undertaken by the Alliance to change the way compressed air end-users and service providers view and manage this "fourth utility." 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.

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 results of our assessment of this market transformation will be contained in five *Market Progress Evaluation Reports*.

The specific objectives of this third MPER are to:

- Review SAV-AIR's current status and report observations on their market approach;

- Report on interviews with regional and national compressed air experts;

- Report on interviews with SAV-AIR customers;

- Report on interviews with potential customers that did not go forward with SAV-AIR;

- Report on interviews with other firms that provide automated compressed air monitoring and controls;
- Continue to assess the Alliance-sponsored *Compressed Air Challenge* (CAC) training program; and
- Identify key issues and make recommendations to address them.

This MPER #3 builds on market research previously conducted by PEA and Research Into Action, Inc. (RIA), as well as the research undertaken for MPERs #1 and #2. The new research includes the following surveys:

Compressed Air Expert Survey: Fourteen national and regional compressed air experts were interviewed from November 2000 through January 2001. The overall purpose of the survey was to obtain insights into the state of, and any recent changes in the market for compressed air optimization. There were also questions about training, including *Compressed Air Challenge*.

Compressed Air Control Competitor Survey: Five firms that offer automated compressed air control and monitoring were interviewed from April through June of 2001. The overall purpose of the survey was to understand the market for automated compressed air control and monitoring and to assess the relative capabilities of each product offered.

SAV-AIR Potential Customer Interviews: Four interviews with potential SAV-AIR customers were conducted by telephone in April 2001. These four potential customers received a *SAV-AIR Phase I Performance Evaluation* and a detailed proposal for the installation of a SAV-AIR monitoring and control system. The overall purpose of the survey was to understand why potential customers did not choose to install the SAV-AIR system.

SAV-AIR Customer Interviews: Four interviews of SAV-AIR customers were conducted by telephone in June and July 2001. Three of the interviews were with 'new' clients and the fourth interview was a follow-up discussion with the first firm to use SAV-AIR. The overall purpose of the survey was to assess non-energy benefits and satisfaction with the SAV-AIR approach and system.

Compressed Air Challenge Attendee Survey: Forty-five attendees of *Compressed Air Challenge Level 1* courses returned mail surveys soliciting interest in attending the CAC *Level 2* course and to see if those attending the training had made changes to their compressed air system as a result the class.

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

SAV-AIR is continuing to work towards meeting the goals of the Alliance, as well their own interests, in establishing a self-sustaining business of managing and optimizing industrial compressed air systems. Although SAV-AIR has not yet proven to be financially self-sustaining, they are currently close to break-even for their ongoing expenses, based on a combination of income from customers, utility rebates, and Alliance funding. However, regarding their fiscal status, SAV-AIR has not yet secured other financial supporters besides the original investors and the Alliance.

Regarding regional demonstration sites for their compressed air monitoring and control system, as of July 2001, SAV-AIR had completed four of the six sites required by the Alliance. To complete their agreement with the Alliance, SAV-AIR needs to document their operation and savings at each of six sites for a minimum of six months[1]. *Table ES-1* below provides an overview of SAV-AIR's field activity to July 2001. In terms of their total number of projects, SAV-AIR has completed five control and monitoring installations and five more are in process.

Interviews at each of the four sites where SAV-AIR projects were installed indicate excellent client satisfaction, with energy savings as predicted or greater. SAV-AIR also has capitalized on relationships with electric utilities for financial support of their projects, both for the initial performance evaluation and the controls installation.

[1] In December 2001, SAV-AIR was preparing final commissioning documentation for the last of the six required demonstration sites.

Table ES-1: SAV-AIR Activity July 2001

PROJECT TIMING AND LOCATION	STATUS	*PHASE I* – PERFORMANCE EVALUATION	*PHASE II* – SYSTEM OPTIMIZATION	*PHASE III* – ONGOING SERVICES
BETA	Complete	9	4	0
	In process	0	2	0
POST-BETA IN-REGION	Complete	4	0	0
	In process	4	4	0
POST-BETA OUT-REGION	Complete	0	1	0
	In process	1	0	0

The SAV-AIR monitoring and control system has demonstrated excellent energy savings – so far compressed air energy savings has ranged between 31% and 56%, with an average of 42%. Annual energy savings for the projects in the Northwest region are detailed in *Table ES-2*.

Table ES-2: Project Energy Savings

PARTICIPANT	ANNUAL ENERGY SAVINGS	
	kWh Savings	Percent Savings
MINERAL PROCESSING	1,829,000	56%
WOOD PRODUCTS	1,316,000	31%
METALS CASTING	1,550,000	39%
CABLE MANUFACTURER	592,000	47%

Survey results indicate that, besides measured energy savings, there have been significant production and maintenance benefits at each of the demonstration sites. These other benefits are very specific to the process, industry, and even to a particular facility. Because of variations in the value and kind of non-energy benefits, and the fact that there have been

only four installations to date, only the most general conclusions can be made. However, it would appear that the value of non-energy benefits is, on average, similar in magnitude to energy-cost savings. The non-energy benefits include reduced maintenance costs, improved productivity, and enhanced product quality.

Market Environment

A broad conclusion from the survey of SAV-AIR's competitors and research presented in prior MPERs, is that there are a handful of firms marketing compressed air systems with monitoring and control capabilities analogous to the SAV-AIR system.

However, potential competitors with comparable compressed air control systems are not particularly active in the Northwest market. In general, the needs of the compressed air market for optimization are so large that the few competitors in the U.S. with similar capability rarely bid against one another. Without the Alliance being involved in SAV-AIR, no other firm would likely be offering the services that SAV-AIR provides in the Northwest over the next few years.

Compressed Air Challenge appears to be an effective means of increasing the market for compressed air efficiency consultant services and for stimulating in-plant efficiency actions. However, based on Northwest feedback and experience elsewhere, its success appears to be dependent on an aggressive personal recruiting effort. In the Northwest region, the market penetration of the *Level 1* training so far, particularly for end-users, is perhaps no better than 5%.

Seven "success stories" were developed from information on actions taken by persons attending the *Compressed Air Challenge* training. The annual energy savings that these seven sites attributed to the *Compressed Air Challenge* training totaled nearly $200,000.

Market Effect Indicators

This third MPER updates the *early indicators* of market effects. These early indicators are primarily concerned with SAV-AIR's internal progress in developing the prototype 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. As the second contract between the Alliance and SAV-AIR changes some of the project goals, these early indicators are somewhat less relevant than they were in earlier MPERs.

This report also assesses SAV-AIR's status regarding *progressive indicators*. These concern demonstration site implementation through *Phase III*, 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 into a viable business.

Tables ES-3, and *ES-4*, below, provide an overview of SAV-AIR's field activities up to July 2001, and the status regarding both the early and progressive indicators. The tables also describe current concerns the PEA team has and suggested strategies for moving forward.

Table ES-3: 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	A comprehensive prototype site demonstration was made in April 2000.	This goal has been met.
SIX INDUSTRIAL FACILITY BETA SITES SELECTED BY THE THIRD QUARTER OF 1999	Nine sites were selected as of July 2001; three have been withdrawn and six have received *Phase I* evaluations.	Four sites have implemented *Phase II* and two are in process. Completion of these six demonstration sites remains a required contract element between the Alliance and SAV-AIR.
SUCCESSFUL IMPLEMENTATION OF SAV-AIR'S SERVICES UP THROUGH *PHASE II*	Four *Phase II* installations of the SAV-AIR system have been completed.	The completion of six demonstration sites is a required contract element between the Alliance and SAV-AIR.
		Continued
BETA SITE CUSTOMERS EXPRESS INTENT TO IMPLEMENT SAV-AIR'S RECOMMENDATIONS AND UNDERTAKE MONITORING	Several beta site customers have indicated a willingness to consider proposals for *Phase III* monitoring; however, there are no contracts to date.	SAV-AIR is considering several strategies for negotiating contracts for *Phase III* monitoring. At this point, demonstration of *Phase III* delivery and value is more important than financial considerations.

PROGRESS INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
BETA SITE CUSTOMERS EXPRESS INTEREST IN REPLICATING SAV-AIR SERVICES IN OTHER CORPORATE FACILITIES	Actions and statements of three of four *Phase II* sites indicate interest in replication. One beta site company has become a multiple-site customer.	SAV-AIR is pursuing current customers that are the most likely to pursue additional sites – this is a critical strategy for financial stability.
ABILITY OF SAV-AIR TO STREAMLINE THE SALES AND DELIVERY PROCESS AS THE INITIATIVE PROGRESSES	SAV-AIR hired their first sales manager in June 2001. Third-party delivery of services is under development.	Financial stability for SAV-AIR in the short-term depends on being able to quickly deliver *Phase I* and *II* services, and new sales should be to the most desirable customers.

Table ES - 4: 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 completed *Phase II* projects show excellent energy and non-energy benefits, but no formal case studies or success stories have been prepared.	SAV-AIR should complete formal case studies (consider MPER #1 recommendations), prepare summary success stories, and pursue marketing suggestions in this and earlier reports.
THE COMPRESSED AIR INDUSTRY AND END-USERS RECOGNIZE SAV-AIR'S PRODUCTS AND SERVICES AS CREDIBLE, UNBIASED, AND TECHNICALLY ACCURATE	In the first interview, 60% of experts and distributors had heard of SAV-AIR. In the second interview, 93% of experts had heard of SAV-AIR and 70% felt that the SAV-AIR approach had value, but more than 50% wanted more information.	SAV-AIR should distribute case studies to regional experts, publish these results on the web site, and distribute success stories liberally.
		Continued
SUCCESSFUL LAUNCHING OF SAV-AIR AS A SELF-SUSTAINING BUSINESS	SAV-AIR is not yet financially self-sustaining but is close to break-even, based on income from customers, utilities, and the Alliance. SAV-AIR has not yet secured other financial support.	The future of utility incentives should be well understood and third party financing must be pursued. As noted above, short-term stability requires quickly delivering *Phase I* and *II* services, and new sales should be to the most desirable customers.

D. Issues and Recommendations

The most important issues and recommendations for both SAV-AIR and *Compressed Air Challenge* are summarized here in approximate order of significance. Most outstanding issues essentially similar to those made in *MPER #1 and #2* were not included. More detailed descriptions of these *Issues and Recommendations* and others are provided in *Section VII*.

An outstanding issue from MPER #2 that should be noted is the recommendation made previously for changes to the Alliance's cost-effectiveness assumptions. Updates for some of the values should come from the most current version of SAV-AIR *Business Plan* and other financial planning documents. A three-way meeting between SAV-AIR, the Alliance, and the evaluation team should be considered to best resolve these values.

Other outstanding issues from MPER #1 merit further attention. These regard the viability of SAV-AIR as a successful business. SAV-AIR needs a capital infusion to maintain financial viability and needs to fine-tune marketing efforts to overcome problems due to the length of the sales cycle. It appears that both of these concerns are being addressed by SAV-AIR in some fashion, but, as they have not been formally resolved, they remain a concern.

SAV-AIR Issues and Recommendations

Document Customer Compressed Air Problems

SAV-AIR needs to formally document all of the problems customers have with their compressed air systems, and the impact of these problems on production. The benefits for compressed air optimization beyond energy cost savings are often best described anecdotally and quantitative information is not always available. However, the anecdotes should be methodically documented.

It is recommended that SAV-AIR collect descriptions of compressed air related problems and how they might be (or were) resolved by the SAV-AIR system to help define non-energy benefits.

Complete Development of Monitoring Interface

SAV-AIR's customers want the SAV-AIR system integrated with their own plant automation system. A key reason that SAV-AIR was selected for Alliance funding was the benefit of the ongoing monitoring it offered. Completing the monitoring interface development would maximize the usefulness of this aspect of SAV-AIR for customers.

SAV-AIR should complete the planned enhancement to enable data monitoring over the Internet. This upgrade will put the SAV-AIR system on a direct par with similar equipment offered by other manufacturers.

Prepare Case Studies

Case studies were identified by experts and SAV-AIR customers as one of the best influences for compressed air optimization.

SAV-AIR should prepare and publish formal case studies for each of the SAV-AIR installations.

Use Non-Energy Benefits in Sales/Marketing Approach

The value of non-energy benefits is similar in magnitude to energy cost savings. However, non-energy benefits do not appear to play a central role in SAV-AIR's current equipment sales, nor do they seem to be a factor in the sales of analogous equipment by competitors.

Non-energy benefits could play a larger role in sales and could be a way to differentiate SAV-AIR from its' competition. Documenting these benefits could prove useful in closing sales or in developing a unique market image.

Provide Case Studies to Regional Experts

Industrial consultants, utility engineers, and efficiency organization personnel are influential in the regional market for efficient compressed air and their knowledge of the full range of efficiency technologies is important.

These market actors should be provided with case studies for each installed SAV-AIR system, and SAV-AIR staff should be made available to answer any of their questions. Some of these "experts" could potentially become distributors for SAV-AIR, and need to be brought on board with other information as well.

Compressed Air Challenge Issues and Recommendations

Garnering Utility and Vendor Support for CAC

The market penetration of the *Level 1* training, particularly for end-users, remains limited. It appears that the benefits for attending CAC training well outweigh the costs, and utilities and vendors should be willing to support CAC because of this.

The cost-effectivity of support for the *Compressed Air Challenge* training should be analyzed and presented along with CAC success stories to utilities and compressed air equipment vendors. Based on this documented success, full support for hosting and promotion of all levels of CAC training should be requested.

Promoting CAC Training

Success of *Compressed Air Challenge* training is highly correlated to the accountability of utility field organizations for recruiting. Personal invitations from utilities and vendors for CAC training are critical to its continued success in the region.

I. SAV-AIR Effort and Status

A. Overview

The Northwest Energy Efficiency Alliance (the Alliance) is a non-profit group of electric utilities, state governments, public interest groups, and industry representatives committed to bringing affordable, energy-efficient products and services to the marketplace. The *SAV-AIR Market Transformation Initiative* was undertaken by the Alliance to change the way compressed air end-users and service providers view and manage their systems; and in doing so, achieve not only energy efficiency-related benefits, but also non-energy benefits such as increased system reliability. 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 was selected by the Alliance in December 1998 as one of its initiatives. SAV-AIR's first contract with the Alliance began in December 1998, and continued through December 2000, with ongoing commitments by SAV-AIR for demonstration of their approach through December 2001. The second contract began in May 2001 and will end in May 2003. The Alliance has supported the *SAV-AIR Market Transformation Initiative* over both contracts for a total of approximately $2.27 million.

SAV-AIR provides integrated compressed air management systems and engineering services. The SAV-AIR approach includes real-time monitoring and control of compressed air systems involving sensors, computers, and software. They have the expertise and specialized technology to evaluate existing equipment, engineer upgrades, and provide ongoing 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 service approach is comprised of three delivery phases:

- ***Phase I – Performance Evaluation***

  The current status of the compressed air system is determined through detailed metering and analysis. Recommendations are made for system optimization.

- ***Phase II – System Optimization***

  This includes SAV-AIR monitoring and control system installation, along with other recommended system improvements.

- ***Phase III – Ongoing Services***

  This includes training, ongoing remote monitoring, troubleshooting, and consulting to provide continued system optimization. This assures that energy savings and reliability are maintained.

B. Assessment of SAV-AIR's Efforts and Market Effects

SAV-AIR is continuing to work towards meeting the goals of the Alliance, as well their own interests, in establishing a self-sustaining business of managing and optimizing industrial compressed air systems. Although SAV-AIR hasn't yet proven to be financially self-sustaining, they are currently close to break-even for their ongoing expenses, based on a combination of income from customers, utility rebates, and Alliance funding. Certainly more projects would mean more success for SAV-AIR, and there is a clear trend toward accelerating sales.

Also pertinent to their financial status, SAV-AIR has not yet secured other financial supporters besides the original investors and the Alliance. For some backers, it is possible that the matching funds from the Alliance may make SAV-AIR a more attractive investment.

As described in MPER #2, the intention for SAV-AIR and the Alliance is for the beta projects to formally demonstrate the capability of the SAV-AIR approach and for SAV-AIR to gain market experience and credibility. In terms of regional demonstration sites for their compressed air monitoring and control system, as of July 2001, SAV-AIR has completed four of the six required sites. (The completion of six beta demonstrations remains a required part of the contract between the Alliance and SAV-AIR.) Two other beta sites are currently in process. *Table 1*, below, provides an overview of SAV-AIR's field activity to date. In terms of the total number of projects, SAV-AIR has completed five control and monitoring installations, and five more are in process.

Table 1: SAV-AIR Activity July 2001

PROJECT TIMING AND LOCATION	STATUS	*PHASE I* – PERFORMANCE EVALUATION	*PHASE II* – SYSTEM OPTIMIZATION	*PHASE III* – ONGOING SERVICES
BETA	Complete	9	4	0
	In process	0	2	0
POST-BETA IN-REGION	Complete	4	0	0
	In process	4	4	0
OUT OF REGION	Complete	0	1	0
	In process	1	0	0

Over the past eleven months, the overall market activity of SAV-AIR has increased substantially. Whereas during their first twelve months, SAV-AIR performed a total of five performance evaluations (*Phase I* audits that lead to proposals for their system), during the past eleven months they accomplished eight. And although it took SAV-AIR approximately a year to get their first system optimization installed, four more installations were completed in the last eleven months.

Although no *Phase III – Ongoing Services* contracts have been signed to date, SAV-AIR does provide support services on an as-needed basis.

SAV-AIR is finding utility incentive support for a majority of its projects. For example, more than 90% of their *Phase I – Performance Evaluation* projects are supported financially by utility efficiency programs and are therefore not a cost-of-doing-business.

Although SAV-AIR may be breaking even through utility support for individual projects, PEA does not believe that there should be concern about the odds of financial success as a non-subsidized service. This is especially true as utility support for efficiency is increasing over the next few years and may provide a further transitional cushion for SAV-AIR to establish its place in the market. The implications of utility financial support for SAV-AIR projects are positive. However SAV-AIR needs to consider that these incentives may end. The availability of utility financial incentives complicates the assessment of SAV-AIR as a stand-alone

business. SAV-AIR will gravitate to opportunities where financial incentives are available, so it may be some time before they intensively market a significant number of stand-alone projects.

Findings at each of the four sites where SAV-AIR projects were installed indicate excellent client satisfaction, with energy savings as predicted or greater. The SAV-AIR monitoring and control system has demonstrated substantial compressed air energy savings – so far ranging between 31% and 56%, with an average of 42%. Annual energy savings have totaled nearly 5.3 million kWh for the four Northwest projects, resulting in average energy cost savings of over $60,000 and an average payback of 2.3 years.

The previous MPER suggested that non-energy benefits might be more readily identified, and perhaps even quantified, after additional beta sites were on-line. The evidence now in hand indicates that besides measured energy savings, there have been significant production and maintenance benefits at each of the beta sites. As might be expected, these other benefits are very specific to the process, industry, and even to a particular facility. Because of the variations in value and types of non-energy benefits, and because there have been only four installations to date, only the most general conclusion can be made. A consistent benefit of the SAV-AIR system appears to be that staff at the plants no longer have to be as concerned with management and operation of their compressed air systems as they did before its installation.

It would appear that the value of non-energy benefits is, on average, similar in magnitude to energy cost savings. These benefits can involve reduced maintenance costs, improved productivity and product quality, reduction of other utility costs (such as water), capital cost savings, and some very indirect operational improvement benefits. However, non-energy benefits do not appear to play a central role in current equipment sales, nor do they seem to be a factor in the sales of analogous equipment by competitors.

At plants with the SAV-AIR system in place, the production/maintenance personnel are making use of the information on compressed air system function provided by the SAV-AIR graphical user interface. In the research for this report, customer perceptions of the value of system optimization through the use of automated monitoring and control seemed to be greater than many experts would have expected.

SAV-AIR has had some negative response to their marketing message and communications approach. The hiring of a new marketing manager may help improve this situation. Specific suggestions include a clearer approach to introducing the benefits to each customer, and efforts to focus on solving compressed air problems. Conveying that SAV-AIR is a systems approach to compressed air problems is especially important, as many customers (and vendors) are accustomed to thinking in terms of component-based solutions.

Update of SAV-AIR Goals

The new contract between the Alliance and SAV-AIR outlines a number of requirements for SAV-AIR to fulfill. These were selected as important milestones for SAV-AIR becoming a self-sustaining business, and as important elements in achieving regional market transformation for compressed air efficiency.

An element carried over from the previous contract and specified in this new contract is that SAV-AIR will demonstrate the SAV-AIR control and monitoring system at six regional sites for at least six months. The four installed sites described in this MPER will likely meet part of this requirement. Other progress indicators for market transformation that are described in the contract are:

- **Sales in Key Market Segments** – including wood products, chemical, paper, petroleum, food processing, primary metals, mining, and microelectronics
- **Clarification of the Business Model** – an element of the project tasks described below
- **Updated Business Plan** – another element of the project tasks described below
- **Non-Utility Working Capital** – third-party funding
- **Energy Savings Target of 10 Million kWh Annually**
- **Achieve Energy and Non-Energy Benefits in New Installations**
- **Overall Awareness of the SAV-AIR Products and Services**

- **Overall Interest in SAV-AIR Products and Services**
- **Ongoing Service Contracts**

In addition to the progress indicators described above, there are also specific tasks outlined in the contract scope of work. Each of the following contract tasks includes a deliverable. The tasks are:

- **Project Schedule, Management and Budget Plan**
- **Business Plan**
- **Organization and Management Plan**
- **Marketing Plan**
- **Sales and Training Plan**
- **Financial Plan**
- **Operational Plan**
- **Reports**

As the deliverables for each task described above are prepared, they will be reviewed in subsequent MPERs. One of the tasks, the *Business Plan*, has already been prepared in draft form and a discussion of the current state of this task follows.

SAV-AIR Business Plan

There have been four versions of the SAV-AIR *Business Plan* produced so far: dated November 22, 1999; May 9, 2000; July 12, 2000; and the latest, July 6, 2001. The latter is a work in progress as of the writing of this report. It is a first draft version intended to meet the requirements of the second contract between the Alliance and SAV-AIR.

Because of this, this MPER discusses a moving target, and the final version will likely take care of any shortfalls described herein. Several general issues are addressed below. They are: clarity of purpose, outlining of goals, and examples of achievements. A more significant

issue is how the *Business Plan* addresses the Alliance requirements in the new contract and scope of work.

The new contract scope of work outlines a business plan that includes the following five elements: Organizational *and Management Strategy, Marketing Strategy, Production Strategy, Operations Strategy,* and *Financial Strategy*. The *Draft Business Plan* only addresses two of these elements directly by name: *Marketing Strategy*, and *Financial* (strategy). The *Production*, *Organizational*, and *Management Strategy* have been initially included as part of sections titled *"The Offering," "Company Overview,"* and *"Team."* However, this draft business plan does not yet seem to address *Operations Strategy*. It is suggested that subsequent versions of the *Business Plan* address these required elements specifically by name.

Clarity of Purpose

Although the *Business Plan* is a requirement of the Alliance contract, the purpose the Alliance had in mind when requiring the development of a business plan was the success of SAV-AIR as an independent business. For any fledgling enterprise, having a plan for where things are, and where things are going, is critical to success.

Beyond meeting SAV-AIR's own internal planning needs, and the contract requirements of the Alliance, the *Business Plan* is also a vehicle for securing third-party investment or debt financing. Although these two purposes are certainly implied in this draft version of the *Business Plan*, it may be reasonable to make them explicit in any introduction, so readers (and users) of the plan understand what the primary drivers were in its preparation.

Examples of Achievements

SAV-AIR has demonstrated success with their approach and product line – this is no longer a development project as the SAV-AIR system is meeting customer needs and exceeding customer expectations every day at more than one site. This success should be described in the *Executive Summary* and in the body of the *Business Plan*. This is especially important for potential investors. Examples of installed projects, achievements, and customer satisfaction can be touted in a success story format for this

audience. These descriptions of success can set the tone to demonstrate the competence and experience of SAV-AIR.

What might also be emphasized to potential investors is that SAV-AIR customers to date have included a number of Fortune 500 companies and companies that are prominent in their fields. This diversity in industries also shows that the SAV-AIR strategy for broadly applying their approach to CA across all industries is successful.

Other Business Plan Issues

Several other issues might be brought forth in the *Business Plan,* as they may be of interest to potential investors and also help SAV-AIR document some of its assets for itself. These issues might include reasons why the SAV-AIR approach and control system is unique in the market, and the current status of strategic relationships with significant industrial customers, electric utilities, and regional compressed air equipment vendors.

In addition to these issues, the benefits of the SAV-AIR system go beyond energy-cost savings. Other benefits may be significant to some customers, perhaps more important than energy cost savings. Some mention of these non-energy benefits could be made in the *Business Plan* as well.

The value of a distribution network for SAV-AIR is another topic to be explored, especially for the benefit of potential investors. How a distribution scheme might be structured, who would be selected as distributors, the pricing to be used, and the margins on sales should also be included as part of the *Business Plan.*

SAV-AIR Presentations

A presentation on SAV-AIR products and services was observed in June 2001, prior to the hiring of the SAV-AIR sales manager. This personnel addition will undoubtedly change the approach and materials used in these general audience presentations. Nevertheless, some observations may be beneficial for consideration in future presentations.

Since many industrial plant personnel tend to ignore their compressed air system unless it is causing problems, a compelling success story can be a

critical start to any presentation. SAV-AIR has now had a number of successful installations, and the presentations should include success stories from currently installed sites. Along with the real "story" of the project, a simple business case explaining project economics and energy savings should be included. Showing actual monitored data for pressure variation and energy savings would be very useful, but anecdotes that relate the productivity, reliability, and maintenance benefits are also important.

The audience can be engaged early by asking them about problems they have with their own compressed air systems. Control problems, pressure variations, air quality, and reliability issues are likely common among almost any group of end-users. Problems with compressed air systems, rather than the features and benefits of the SAV-AIR system, could be the focus of the presentation.

As suggested in the recommendations, bringing up *Compressed Air Challenge* training will be seen as promoting the interests of all compressed air users – no matter how small. The presentation could also include action items for improvements in operation and maintenance approach that the audience might do on their own. For example, through energy savings, regular replacement of air filters more than make up for the filter cost.

The presentation currently does not describe the approaches typically used for control of industrial compressed air systems. A brief introduction here would give an opportunity to compare SAV-AIR's approach to compressor sequencers. Besides making it clear that the SAV-AIR system can work with any brand of compressor, it should also make clear that it can operate and manage all major brands of centrifugal, reciprocating, and rotary screw machines.

I. SAV-AIR Effort and Status

II. Compressed Air Expert Survey

Fourteen national and regional compressed air experts were interviewed from November 2000 through January 2001. The overall purpose of the survey was to obtain insights into the status of any recent changes in the market for compressed air optimization. There were also questions about training, including the *Compressed Air Challenge*.

Twelve of the 14 experts interviewed for this report had been interviewed preciously (December 1999) for MPER #1, and six had been interviewed for the 1998 PEA/RIA study. Among the fourteen experts: four worked for utilities, five were consultants (or consultants who also distribute equipment), two worked for government, and three worked for energy efficiency organizations. Seven of the fourteen were from the Northwest; the remaining seven were from throughout the U.S. A list of expert organizations interviewed is provided in *Appendix A*.

A. SAV-AIR Findings

During each of the interviews, the SAV-AIR approach was described as a comprehensive monitoring program with: provision of real-time information and control capabilities; monitoring of leakage rates and compressor operation; and provision of ongoing optimization. About 60% of experts and market actors interviewed for the first MPER said they had heard of SAV-AIR. At that time, they generally thought it sounded like a good concept, but wondered about its cost-effectivity. In this second round of interviews it was not surprising that all but one respondent (93%) had heard of SAV-AIR, since most had previously been interviewed. In the second round interviews, most respondents (70%) felt that the SAV-AIR approach had "some" or "significant value," particularly for long-term sustained optimization. Still, more than one-half of the respondents noted that they lacked the information or case study results to make conclusions about SAV-AIR.

The expert respondents were asked if they had heard of any increase in activity by firms that specifically offer control improvements, system audits, or optimization. Seven believed that there were some increases in activity and interest in optimization, one feeling that compressor manufacturers were taking some initiative. Four said that they did not know, and three said that there has been no change.

Those firms mentioned as providing optimization services included Honeywell, SAV-AIR, Rogers Machinery, Darden Engineering, and some regional electric utilities. Five compressed air equipment manufacturers were also mentioned as becoming more involved in optimization and efficiency. These were: Rogers Machinery (which also offers a line of compressors), Atlas Copco, Quincy, Sullair, and Ingersoll-Rand.

The experts were asked what other benefits besides energy-cost savings they believed would be important to plant operators and managers. The benefit most often mentioned was compressed air reliability, followed by improved product quality and clean, dry compressed air. The third most frequently mentioned benefit was reducing maintenance costs. But, one respondent suggested: "None of these are important compared to energy cost savings." The results are summarized in *Table 2*.

Table 2: Benefits Beyond Energy Cost Savings

BENEFIT	SELECTED
IMPROVED COMPRESSED AIR RELIABILITY	12
IMPROVED PRODUCT QUALITY	7
MEETING COMPRESSED AIR QUALITY STANDARDS (DRY, CLEAN AIR)	7
MAINTENANCE COST SAVINGS	4
DETERMINE COMPRESSED AIR COSTS	2
IMPROVED SAFETY	2
ASSIGN COMPRESSED AIR COSTS TO DEPARTMENTS	1
OTHER – MEETING PRODUCTION QUOTAS, FREE UP COMPRESSED AIR CAPACITY, UNIFORM PRESSURE	Single mentions

The experts were asked about the most significant barriers to comprehensive system optimization (*see Table 3*). The barrier most often mentioned, accounting for about one-quarter of responses, was lack of accountability for compressed air costs. The second most mentioned barrier was the plant staff's focus on production, followed by difficulty in showing the value of compressed air improvements. These responses all

have in common the issue of awareness. This supports the contention that compressed air is most often ignored, and invisible.

Table 3: Barriers to System Optimization

BARRIER	SELECTED
LACK OF ACCOUNTABILITY FOR COMPRESSED AIR SYSTEM COSTS	6
FOCUS ON PRODUCTION	4
SHOWING VALUE, ESPECIALLY TO MANAGEMENT	3
TECHNICAL EXPERTISE TO PERFORM ANALYSES	2
ABILITY TO FUND CAPITAL	2
NO PERCEIVED NEED (SYSTEM RUNS, WHAT'S THE PROBLEM?)	2
STAFF TURNOVER	1

In addition to the barriers that were suggested to the experts, there were three additional barriers to optimization that they offered. These were: not enough understanding of the system or process needs, a reluctance to take the time and make the effort, and no awareness of what a properly operating system looks and works like.

A number of suggested barriers were not selected by any of the experts. These included: no actual need (new systems well-designed already), technical expertise needed for monitoring, ability to fund services, attitude toward outside experts, and restrictions on project payback or return on investment. The last barrier is of particular interest, as it is often suggested that economic criteria stymie compressed air efficiency projects. The experts feel that this is not a barrier.

The experts were asked who they felt might be the best person to reach within an organization to promote compressed air optimization. Plant managers and maintenance supervisors were the most often selected, with these two contacts getting over half of the responses. Five of the experts thought that contacts in two different areas in an organization would be most effective: at the corporate level (often finance) and at the operator level (*see Table 4*).

Table 4: Best Facility Contact for Compressed Air Optimization

BEST FACILITY CONTACT	SELECTED
PLANT MANAGER	6
MAINTENANCE SUPERVISOR	4
CORPORATE FINANCIAL OFFICER	3
COMPRESSED AIR OPERATOR	2
CORPORATE MANAGEMENT	2
PLANT ENGINEERING	1

As a follow-up to the question about the best contact in an organization, the experts were asked what they thought would be the best way to reach them with information about compressed air optimization. As *Table 5* shows, case studies were felt to be the best way to provide information on optimization, especially if they demonstrated success in the same industry. Word-of-mouth from peers was also judged to be effective way to communicate the benefits of compressed air optimization.

Table 5: Best Method to Provide Optimization Information

BEST METHOD	SELECTED
CASE STUDIES	7
SUCCESS IN THEIR OWN INDUSTRY	4
WORD OF MOUTH FROM PEERS	4
SUCCESS IN OTHER INDUSTRIES	2
SPECIFIC ASSOCIATIONS, EFFICIENCY AGENCIES, OR UTILITIES	2
VENDOR REPRESENTATIVE	2
COMPRESSED AIR CHALLENGE	2
CONSULTANT RECOMMENDATION	2

B. *Compressed Air Challenge* Findings

All of the experts had heard of *Compressed Air Challenge*, and there was a considerable amount of ambivalence toward the program. In fact, one-half of all the experts had neutral comments about CAC *Level 1*; the other half had positive comments of some kind. However, despite the number of neutral comments, more than half (64%) felt that *Level 1* CAC training has had a positive impact on the knowledge, skills and actions of compressed air end-users.

II. Compressed Air Expert Survey

III. Competitor Survey

A. Market Actors

Five firms that offer automated compressed air control and monitoring were interviewed to understand the market and to assess the relative capabilities of each competitive product offered.

Competitors to SAV-AIR include firms offering the full range of compressed air optimization services and not just a sophisticated control and monitoring product. Each competitive firm might be considered to be in one of three classes:

1. *Automated Compressed Air Control and Monitoring* – identified here as ACACM

2. *"Sequencers" for Compressor Control* – distinguished by simple pressure control of multiple compressors in a single location

3. *Compressed Air Audit/Short-Term Monitoring and One-Time System Enhancements*

The competitor firms discussed in this report are only the firms with analogous *product* capability. We acknowledge that SAV-AIR is also competing in the region with firms offering alternatives to a comprehensive monitoring and control product. We believe that SAV-AIR is capturing energy savings that these firms might not, in that SAV-AIR is reaching customers that would otherwise go without compressed air optimization, and that the SAV-AIR approach has the potential (not yet fully demonstrated) for greater persistence of savings. Although these other "competitors" are relevant in the market, the focus of the research at this time was on similar products.

A broad conclusion from this survey and research presented in prior MPERs is that there are a handful of firms marketing compressed air systems with monitoring and control capabilities analogous to SAV-AIR's system. Some of these systems may be somewhat more advanced, in terms of integration into whole-facility process controls and Internet capability.

Potential competitors with similar compressed air control systems are not particularly active in the Northwest market. In addition, it appears that the market for compressed air system optimization is so large, and there are so few players, that most prospective customers will not have knowledge of competitors.

Northwest "competitors" in terms of system optimization are primarily selling leak detection and remediation, system studies (sometimes with short-term monitoring), system improvements and control enhancements, and some intermediate controls based on monitored data. However, only one of them is implementing system-wide, permanent, integrated monitoring and the control capability and reporting for management use similar to what SAV-AIR provides. In many situations, SAV-AIR's unique offerings afford a much better opportunity for long-term and enhanced savings over more piecemeal approaches. In general, the needs of the compressed air market for optimization are so large that the few competitors in the U.S. with similar capabilities rarely bid against one other.

B. Compressed Air Services Offered

While there are a handful of ACACM firms in the country, based on our research, virtually all of the Northwest competition comes from the other categories. These less-integrated monitoring and control approaches have been shown to provide savings that overlaps significantly with that experienced through SAV-AIR projects. For example, like SAV-AIR, these approaches have been used to reduce overpressure, install receivers, change pipe sizes and design, fix leaks, replace poorly designed blowdown valves, improve operations and maintenance, establish more appropriate compressor sizes, and make other control adjustments.

The ACACM approach distinguishes itself in that monitoring is permanent, and monitoring and control are integrated. It provides a permanent management system for compressed air. This is intended to:

- Make the reliability and function of the approach more transparent;
- Lead to improved savings persistence, especially with respect to leaks, compressed air operations enhancements, and adjustments to changes in process operation and configuration; and

- Produce additional savings through the ability to use integrated monitoring and analysis capability to fine-tune compressor operations based on real-time feedback.

The research for this MPER focused on potential ACACM competitors, to better understand SAV-AIR's place in the market for these high-end services. It consisted of five telephone interviews, conducted in May and early June 2001, with firms that offer some type of ACACM capability. The firms interviewed included: Honeywell, Ingersoll-Rand, Ingersoll-Rand Baltimore Air Center (formerly Mottley Air Power, an independent equipment vendor), Bay Controls, and SAV-AIR.[2] In addition to interviews with the ACACM firm directly, interviews of their customers were planned, but not completed because the firms declined to provide references.

The interviewer made it clear to the five firms that the information they provided would be made public in this report, but without any attribution to individual firms. None of the firms declined to participate in the interview as a whole, although several of the respondents passed over a few of the questions. Although no direct questions were asked about the financial viability of these firms, every indication is that these competitors are financially successful and that they are making successful inroads in their geographic and market segments. The three ACACM firms with primary activity outside of the Northwest region were not aware of the activities of SAV-AIR, nor of the Northwest Energy Efficiency Alliance.

All of the ACACM firms have some description of their product line and services available on the Internet. For several however, the information is difficult to find and does not have enough detail for one to gain a clear understanding of the advantages of their products and services. None had a particularly compelling sales pitch on the Internet, although for such a complex product/service it might be difficult to convey features and benefits through this medium.

[2] Another ACACM firm that previously operated in the U.S. (Sarlin Balance, based in Finland) was not included in this research. They no longer maintain an office in the U.S. and their efforts to find a representative for their product here have fallen through.

All five of the products offer monitoring capabilities of some kind, with one focusing primarily on compressor "health" (a combination of critical compressor operating parameters, including oil temperature and pressure, and motor current), another on system pressure, and the rest on the air system as a whole. All of the products offer some type of remote monitoring capability, with only one offering control and monitoring over the Internet. Four of the products were described as including comprehensive control capabilities, ranging from sophisticated sequencing to "optimization." Four of the products use a local area network as the means for exchanging control and monitoring data between different parts of a plant. All of the products are microprocessor-based, with internal computing capability ranging from programmable logic controllers, to proprietary controllers, to PC-based systems.

Several customers of SAV-AIR (and one potential customer that declined a proposal) have brought up concerns about the proprietary nature of SAV-AIR software, and the inability of the customer to make changes to operating parameters. It should be noted that all of these ACACM companies have a proprietary approach, particularly for their control algorithms. Although not all responded to the question on this subject, it appears that most ACACMs believe that their product provides a unique solution to automating compressed air control and monitoring.

Because the vast majority of industrial compressed air systems are designed, maintained, and operated with little awareness of energy costs, any of these control systems, when properly applied, will substantially reduce energy expenses. Each of the approaches moves an industrial compressed air system closer to a theoretical efficiency "optimum."

The descriptions of the products according to each of the ACACM are included below, along with *Table 6*, which compares the most important features. Note that the primary product purpose was as interpreted by the interviewer from the entire scope of the interview. All of the products look to increase compressed air system reliability and stabilize system pressure.

- *Product 1:* A computer-based demand expander and compressor controller with remote monitoring and integration into plant automation systems.

- *Product 2:* A networked, compressed air monitoring system for the "health" of compressors, dryers, and related equipment with optional remote monitoring.

- *Product 3:* A PLC (programmable logic controller) compressor sequencer with optional monitoring and networking capability.

- *Product 4:* A networked compressed air system controller that offers remote and Internet control and monitoring.

- *Product 5:* A PC-based networked monitoring and control system for distributed compressed air systems that provides ongoing optimization and optional remote monitoring.

Table 6: ACACM Product Features

PRODUCT	NETWORK CAPABILITY	PLANT AUTOMATION INTERFACE	SYSTEM MONITORING	INTERNET CAPABLE	PRIMARY PRODUCT PURPOSE
1	Yes	Yes	Yes	No	CA management and energy efficiency
2	Yes	Yes	Yes	No	CA system equipment health
3	Optional	No	Optional	No	Compressor sequencing
4	Yes	No	Yes	Yes	CA management and energy efficiency
5	Yes	Pending	Yes	Pending	CA management and energy efficiency

All of the products offered some type of compressed air monitoring capability. This function was most often turned over to the customer. Only two of the ACACM firms provide any form of ongoing services, and then only on occasion.

C. Other Product Offerings

Each of the ACACM firms offers some other compressed air-related products besides their control and monitoring products and services. Two of the ACACM firms are independent companies and their compressed air control and monitoring products are their primary business, although their solutions may include compressed air system equipment provided by others. It should be noted that the controls of these two firms are more comprehensive in several ways than the others surveyed.

One of the ACACM companies is a major manufacturer of a complete range of compressed air equipment products and offers their monitoring systems as an integrating component for their product line.

Another ACACM firm offers a comprehensive line of industrial plant and building automation products, with its compressed air control system providing specialized capability for that aspect of industry.

The last of the ACACM firms was a vendor that was just purchased by a major air compressor manufacturer. It is not clear how their compressed air control product line will be integrated into that of its new parent company.

D. Other Service Offerings

Each of the ACACM firms was asked about other types of services that they might provide. In general, these companies tend to focus on their core offering of compressed air controls, with some services in the area of general compressed air engineering also offered, but usually in conjunction with their control products. *Table 7* summarizes the results.

Table 7: Other Services Offered

OTHER SERVICES	SELECTED
GENERAL COMPRESSED AIR ENGINEERING	4
COMPRESSED AIR AUDITS AND PERFORMANCE ASSESSMENT FOR CONTROLS	4
LEAK DETECTION	2
COMPRESSED AIR EQUIPMENT SALES AND SERVICE	1
LEAK REPAIR SERVICES	1

Any ACACM is dependent on a range of measurements of the status and performance of the compressed air system under control. The sensors installed range from pressure alone for the "sequencer" product to a full range of compressor health and air system information for some of the other control products. Some firms also occasionally include sensors for compressed air system auxiliaries such as heat rejection equipment. *Table 8* describes the sensors installed with the ACACM systems.

Table 8: Monitoring Sensors Installed

SENSORS INSTALLED	SELECTED
PRESSURE	5
COMPRESSOR KW	4
AIR FLOW	4
TEMPERATURE	3
DEWPOINT	3
COMPRESSOR CURRENT	2
COMPRESSOR OIL, GAS MONITORING (CO, VOC, ETC.), COOLING TOWER, PUMPS, DRYER	Single mentions

Four of the five ACACM firms at times also include modifications to the compressed air system when installing their monitoring and control

system. Modifications are typically required because existing compressed air components cannot support efficiency upgrades to the controls, or they are performed to take advantage of complimentary efficiency opportunities. *Table 9* summarizes the system modifications typically made. One firm seldom makes changes to the compressed air system when installing their controls.

Table 9: Other System Modifications

OTHER SYSTEM MODIFICATIONS	SELECTED
PIPING MODIFICATIONS	4
RECEIVERS	3
CONTROLLERS	3
DRYERS	3
COMPRESSORS	3

E. Reported System Benefits

The respondents were asked what range of energy cost savings they typically see resulting from the application of their controls. The range was wide, as might be expected, with a minimum and maximum quoted from zero to 75%. The average minimum was 5% savings and the average maximum provided was just over 50%.

In addition to energy cost savings, respondents were also asked what other benefits their customers typically would expect to see. Three mentioned compressed air reliability, two mentioned maintenance benefits, two mentioned plant automation/process diagnosis capability, and there was also one mention each of compressed air quality (drier, cleaner air) and safety.

F. Demand for Compressed Air Services

All agreed that energy costs, particularly with recent rate increases on the West Coast and in other regions, were considered to be a trend driving

market demand for their ACACM products. Three respondents also mentioned the increased use of plant automation systems and the trend toward collecting management information on all plant systems. There was a difference of opinion in regards to any influence of the *Compressed Air Challenge*. Two believed that the CAC was making no difference in demand for their products, while another thought that it was a driver to some extent.

None of these ACACM firms seem to have any limitations in their potential market because of the offerings of any other ACACM firm described here. The penetration of automation of any kind for the overall control compressed air systems is very limited, estimated by respondents at less than 10%. For the most part, these firms were more often competing against compressor sequencers, or against limitations in the capital funding capability of their customers, than against any other ACACM firm. Although one of the five ACACM firms interviewed is active in the Northwest region, it appears that the number of potential customers is great enough that SAV-AIR and this firm have yet not directly competed against each other.

III. Competitor Survey

IV. SAV-AIR Nonparticipant Interviews

A. SAV-AIR

Four interviews with potential SAV-AIR customers were conducted by telephone in April 2001. Each participant was from a different industry – metals mining, food processing, transportation manufacturing, and high tech manufacturing. These four potential customers received a SAV-AIR *Phase I – Performance Evaluation* and a detailed proposal for the installation of SAV-AIR monitoring and controls (*Phase II – System Optimization*). For various reasons, each of these potential customers chose not to install the SAV-AIR monitoring and controls.

All four of these nonparticipants had three or more air compressors, with a total horsepower appropriate for SAV-AIR controls. Only two of the four regarded compressed air as an expensive part of their operations. The two that *did not* consider compressed air to be expensive still had an idea of their compressed air operating costs before working with SAV-AIR. In general, the management and operations approach for compressed air for each of these customers was to maintain constant pressure in their system.

For the most part, the problem that these firms were trying to solve in their compressed air system was reducing energy costs. Particular concerns about safety, reliability, system monitoring, and pressure stability were also problems that the nonparticipants wanted to have addressed. For each of them, SAV-AIR would have provided a comprehensive solution to resolve these problems with their CA systems.

The nonparticipants were asked what influences them most for the adoption of new compressed air management tools and approaches (s*ee Table 10*). Case studies, experience within their company in a pilot project, and vendors were the most influential. It is interesting that even though these customers chose not to proceed with installation of the SAV-AIR system, one listed SAV-AIR as an influence.

One of the facilities has ceased operation. A second plant has a freeze on all capital expenditures. These two cited their internal financial situations for not going forward with the SAV-AIR installation. The other two plants are now working with another compressed air contractor on system optimization. They cited communication difficulties and unexpected

pricing adjustments as part of their reasons for not going forward with SAV-AIR.

Table 10: Influences for Compressed Air Management

INFLUENCE	SELECTED
HEARING ABOUT ANOTHER COMPANY'S SUCCESS THROUGH CASE STUDIES	4
EXPERIENCE FROM WITHIN YOUR COMPANY THROUGH A PILOT PROJECT	4
VENDOR'S RECOMMENDATIONS	3
PEERS/ PEER GROUPS/ ORGANIZATIONS	2
CAC OR OTHER COMPRESSED AIR CLASSES	2
CONSULTANT RECOMMENDATIONS	2
BOOKS	1
WEB SITES	1
SAV-AIR'S RECOMMENDATIONS	1
ARTICLES OR ADVERTISEMENTS IN A PROFESSIONAL PUBLICATION	1
OTHER – INDUSTRY ACCEPTED PRACTICES AND RETURN ON INVESTMENT	1

In contrast to the uniformly positive opinions of participants described later in this report, two of the four respondents felt that they had some difficulty in communicating with SAV-AIR, and that SAV-AIR was not able to explain adequately how savings are achieved with their system. These two respondents also felt that SAV-AIR could not demonstrate the savings, and that the basis for some of the savings were not feasible in their facility. It should be noted that all of these contacts were prior to the hiring of the new SAV-AIR sales manager.

B. Compressed Air Training

None of the four respondents had heard of the *Compressed Air Challenge*, and none of them described training for themselves or their staff that went beyond occasional in-house exposure to compressed air systems.

IV. SAV-AIR Nonparticipant Interviews

IV. SAV-AIR Nonparticipant Interviews

V. SAV-AIR Customer Interviews

Four interviews of SAV-AIR customers were conducted by telephone in June and July 2001. Three of the interviews were with new customers and the fourth interview was a follow-up with the first SAV-AIR purchaser, who had been interviewed earlier. Each participant is from a different industry – metals casting, primary wood products, minerals processing, and cable manufacturing. The four participant experiences are discussed below.

A. Participant Experience with SAV-AIR

Each of the four SAV-AIR customers has three oil-flooded screw air compressors, with total capacity ranging from 350 HP to 950 HP, and the average installed capacity being 600 HP. All regard compressed air as an expensive part of their operation, but only one had any idea of their compressed air operating costs before working with SAV-AIR.

Prior to SAV-AIR, the management and operations approach for compressed air varied somewhat between these facilities, but all operated their system manually in some fashion. Each had problems with adequate air supply (low pressure) and difficulties with system maintenance.

Table 11 shows the compressed air management objectives mentioned by participants. Those most often cited were maintaining compressed air operation, serving end-users with adequate air, and control of energy costs.

Table 11: Participant Management Objectives

OBJECTIVE	SELECTED
MAINTAIN CONTINUOUS OPERATION	4
ENSURE ADEQUATE SUPPLY OF AIR TO END-USES	4
CONTROL OR REDUCE ENERGY COSTS / ENERGY USE	3
MAINTAIN QUALITY OF AIR SUPPLIED (CLEAN AND DRY AIR)	2
REDUCE MAINTENANCE AND REPAIR OF THE COMPRESSED AIR SYSTEM	2
IMPROVED OR INCREASED PRODUCTION (FEWER REJECTS)	1

Choices for management objectives that were **not** selected by participants included:

- Reduce Capital Costs – fewer compressors required
- Meet Process Quality Standards
- Improve Safety
- Reduce Maintenance and Repair for Process Machinery

Even with information from only four customers and just fourteen compressed air experts, an interesting exercise was to compare the opinions of benefits beyond energy cost savings from the two groups. Although some of the experts undoubtedly have had direct experience with automated compressed air monitoring and control systems, probably none have used one on a regular basis. Conversely, in the case of customers, each one of them has daily contact with the SAV-AIR system. A comparison of opinions expressed can be found in *Table 12* below. (Note that determining costs and assigning costs for compressed air relate to overall costs and departmental costs, respectively.)

Table 12: Benefits Beyond Energy Cost Savings

OTHER BENEFITS	END-USERS	EXPERTS
DETERMINE COMPRESSED AIR COSTS	100%	14%
IMPROVED COMPRESSED AIR RELIABILITY	100%	86%
MAINTENANCE COST SAVINGS	75%	29%
IMPROVED PRODUCT QUALITY	50%	50%
MEETING COMPRESSED AIR QUALITY STANDARDS (DRY, CLEAN AIR)	50%	50%
ASSIGN COMPRESSED AIR COSTS TO DEPARTMENTS	0%	7%
IMPROVED SAFETY	0%	14%

Although just a few experts felt that knowing compressed air costs were a benefit, all the customers felt that it was useful. The results of the two

groups are quite close regarding benefits of product quality, reliability, and clean, dry air. Their responses diverge again regarding the value of maintenance cost savings. Three-quarters of customers felt that maintenance cost savings was a benefit, where just over one-quarter of the experts thought it would be.

These differences seem to be attributable to the actual use by customers of the SAV-AIR system and the monitored data results. Maintenance staff at these customer sites have come to depend on the SAV-AIR graphical display to indicate any problems with their compressed air systems, and they have found the reporting functions on costs and system efficiency useful. There may also be some desire by them to affirm their own decisions to participate.

None of the participants expressed great interest in having SAV-AIR provide ongoing, long-term monitoring and management services (*Phase III*) for their compressed air systems. Three of the four would entertain and consider a proposal and perhaps go forward with ongoing monitoring on a trial basis, while the fourth felt that his system is so simple that monitoring would have little value.

The participants were asked what influenced them most to adopt new compressed air management tools and approaches (s*ee Table 13*). As they are SAV-AIR customers, it was not surprising that SAV-AIR was selected most often, but other vendors were also influential. Three of the four participants emphasized that their utility or energy service company representative was critically important to the success of the SAV-AIR project. Support from these sources came in the form of an initial recommendation and through financial and technical support of the project.

With regard to barriers to effective optimization of the compressed air system, there was no strong consensus from respondents on what was the most significant impediment. Lack of accountability for compressed air system and costs, and lack of access to technical expertise were each mentioned twice as barriers by respondents.

Table 13: Influences for Compressed Air Management

INFLUENCE	SELECTED
SAV-AIR'S RECOMMENDATIONS	4
VENDOR'S RECOMMENDATIONS	3
CAC OR OTHER CA CLASSES	2
HEARING ABOUT ANOTHER COMPANY'S SUCCESS THROUGH CASE STUDIES	2
WEB SITES	1
PEERS / PEER GROUPS / ORGANIZATIONS	1
EXPERIENCE FROM WITHIN YOUR COMPANY THROUGH A PILOT PROJECT	1
CONSULTANT RECOMMENDATIONS	2
ARTICLES OR ADVERTISEMENTS IN A PROFESSIONAL PUBLICATION	1

B. Project Descriptions

Table 14 provides an overall summary of the projects' achievements. In each case, the facility operations were essentially unchanged before and after installation of the SAV-AIR system. The simple payback in the table is based on energy savings alone, compared to the cost of the system, and does not include utility incentives, Oregon Business Energy Tax Credits, or the value of non-energy benefits.

For each of these projects, the energy benefits of the controls and related upgrades were considered an attractive investment, with paybacks of about two years, except for one project that involved a complete upgrade of the compressed air system. This project included three new compressors, an air dryer, receiver, and a new building to house all the equipment; thus the payback, including these other items, is four years.

Table 14: In-Region Project Summary

PARTICIPANT	ANNUAL ENERGY COSTS			PROJECT		
	Before	After	Measured Savings	Included	Cost	Payback (Years)
MINERAL PROCESSING	$175,000	$77,000	$98,000 1,829,000 kWh (56%)	Controls, three compressors dryer, receiver, new building, new distribution piping	$395,000*	4.0
WOOD PRODUCTS	$175,000	$120,000	$55,000 1,316,000 kWh (31%)	Controls, receiver, dryer repair	$110,000	2.0
METALS CASTING	$193,000	$118,000	$75,000 1,550,000 kWh (39%)	Controls	$30,000	0.4
CABLE MANUFACTURER	$53,300	$28,200	$25,100 592,000 kWh (47%)	Controls, one compressor	$52,000	2.1

* Costs are for a complete new compressed air system and building that would have been needed regardless of the efficiency project.

Three of the projects also received efficiency incentives from their local electric utility. One of the respondents commented that, although a compressor sequencer would also have been a cost-effective option for their compressed air improvements, the SAV-AIR system was worth the additional cost because he believes it provides increased savings of 10% to 15% over other control approaches.

C. Non-Energy Benefits

Three of the industrial plants have also experienced some benefits beyond energy cost savings. These benefits are related to production improvements or maintenance savings. Anecdotes regarding the other benefits are described below. For these participants, a general conclusion

could be that on average, non-energy benefits of the SAV-AIR controls are similar in magnitude to the energy benefits.

The mineral processing plant does not have any part of their process that is critically dependent on air pressure or air reliability – their benefits beyond energy relate primarily to improved air quality (dryness). Improvements to the air dryer was an element of the overall compressed air improvement project, but was not otherwise related to the SAV-AIR controls. Specific benefits for each of the three other projects are discussed below.

Metals Casting

Sometimes casting robots dropped molds when the compressed air system switched from one compressor to another. If it is assumed that this would happen once a year to ten robots with molds costing $5,000, the annual cost savings could be $50,000. It was noted that they haven't had a problem with their compressed air system since the SAV-AIR controls were installed.

In addition to the electrical energy cost savings shown in *Table 14*, above, the control system reduced water costs for air compressor cooling by $20,000 annually. Another benefit that is indirectly related to this controls project concerns electrical upgrades in the plant. With the elimination of one compressor from regular lead/lag status to backup, the plant was able take the time to rewire the local motor control center to resolve problems with fuses that would often blow when compressors started.

Cable Manufacturer

This plant is now less apt to have production loss due to inadequate air pressure or air system shutdown. When it happened in the past, it was sometimes necessary to install a joint in the cable, or perhaps throw out 1,000 meters of specialized submarine communications product. If this occurs once a year, the value of lost production would be $200,000 – four times the energy savings.

The maintenance staff now can use the SAV-AIR monitoring system to quickly see if there are any problems with the air system. Compressor maintenance is also easier with the backup compressor that was installed as part of the SAV-AIR project. With the SAV-AIR system there is

increased reliability and improved air pressure stability, which has allowed them to reduce system pressure from 115 to 95 psig.[3]

Wood Products

Production has increased as a result of the SAV-AIR system, but as they made other improvements at the same time, it would be impossible to say how much of increase is directly attributable to SAV-AIR. The SAV-AIR controls have improved the maintenance situation and decreased maintenance costs, as there are fewer failures in the air cylinders due to consistent air pressure. The customer believes that maintenance costs have gone down about one-third for their equipment that uses compressed air.

Also, with the SAV-AIR monitoring panel, maintenance of the air system is easier as problems are detected and displayed. Major air leaks and compressor alarms are caught before they become major problems. They no longer worry about the air system – the SAV-AIR controls have relieved staff of the burden of operating the compressed air system manually.

D. SAV-AIR Satisfaction

The four respondents were overwhelmingly positive in their satisfaction with SAV-AIR's services. The negative responses were significantly qualified – one was regarding the interpersonal skills of one of the SAV-AIR team members and the other was regarding the lack of identification of non-energy benefits by SAV-AIR in their proposal. The high level of satisfaction is leading directly to repeat business with these existing customers. Some comments about what was appreciated most about SAV-AIR services were:

- *They respond to problems, they are easy to reach; they come when needed.*

[3] A 2 psig pressure reduction typically reduces CA energy costs by 1%.

- *Excruciating detail in their approach.* (Note that this customer meant this positively.)
- *SAV-AIR got us 10-15% extra savings over other controls.*
- *Cost savings.*

E. Compressed Air Training

Only one of the respondents had heard of the *Compressed Air Challenge* and had been through the *Level 1* course. This respondent suggested that the material he learned in the *Level 1* training was important to his eventual working with SAV-AIR to install their controls.

Three of the four have training on compressed air systems for their staff that includes occasional in-house exposure; two have received training from a compressed air equipment vendor, and one from their local utility. One also cited training provided by SAV-AIR on their control equipment and another was looking to arrange such a training session.

VI. Compressed Air Challenge Observations

Compressed Air Challenge (CAC) appears to be an effective means to increase the market for compressed air efficiency consulting services and for fomenting in-plant efficiency actions. However, based on Northwest feedback and experience elsewhere, its success appears to depend on an aggressive, in-person recruiting effort. In some other regions, this has been undertaken by industrial customer representatives at utilities. In some cases, this was a result of regulatory incentives to utilities for filling the classes. In the Northwest, such regulatory incentives are not in place, and the recruiting effort does not appear to have been as consistent or intensive as in some areas where the classes are filling more quickly.

This evaluation of the *Compressed Air Challenge* includes observation of a CAC *Level 1* training course, conducting a mail survey of CAC attendees, and generation of success stories of CAC experience.

A. Observation of CAC Level 1 Training

The CAC *Level 1* training course *"Fundamentals of Compressed Air Training"* was attended and observed in October 2000, in Longview, Washington. There were seventeen class participants. The class seemed initially to be reluctant to discuss their compressed air problems, but this lessened by the afternoon session. In an off-line discussion with the course instructor, he described that often smaller groups are less forthcoming and less involved in class discussions. Apparently it frequently takes about 20 participants before a full and open discussion of compressed air issues takes place.

Most of the attendees were maintenance staff for industrial plants in the Longview area. Several of them have very large compressed air systems (one with seven compressors and another with 20), and two of the firms used centrifugal machines, which is somewhat unusual in the Northwest.

It was noted that the *Level 1* materials did not include much focus on production, product quality, or other non-energy benefits of making modifications to compressed air systems. For most of the attendees there may be little benefit in reducing energy costs (many may not see the bills or even know energy costs). But it may make a difference if they can

improve reliability, avoid capital purchases, or improve pressure regulation or air quality.

This position can be contrasted with the impression offered earlier in the report from firms offering automated compressed air control and monitoring products. They suggest that energy cost savings is a dominant factor influencing sales of their high-end control systems. This likely follows from the decision-making position of plant managers concerned about overall plant costs, while those attending CAC training have line production or maintenance responsibilities that do not encompass energy costs.

Altogether, the *Compressed Air Challenge Level 1* training had a well thought out curriculum, excellent handout and presentation materials, and an effective instructor. The course materials closed with action elements – likely an important part in getting attendees to implement what they have learned.

First Wave CAC Participant Results

The attendees of *Compressed Air Challenge Level 1* courses offered in 1999 and 2000 were surveyed by mail for interest in attending the CAC *Level 2* course. The survey had two intended outcomes. First, to understand when and where a *Level 2* course might be best attended, and secondly, to see if those participating in the *Level 1* course felt that they had made any changes to their compressed air system as a result of attending the training. The latter is the focus of the discussion in the following paragraphs.

There were 329 surveys mailed. The survey offered a $50 discount on attendance at a future CAC course for those responding. Forty-five surveys were returned, an overall response rate of 14%.

The responses by geographic location (state) and by year of CAC attendance were proportional to the attendee population. These are described in *Tables 15* and *16*.

Table 15: Year Level 1 Course Attended

YEAR LEVEL 1 ATTENDED	POPULATION PERCENT	SURVEY RESPONSE PERCENT
1999	43%	42%
2000	57%	58%

Table 16: Attendee Location, State

ATTENDEE LOCATION	POPULATION PERCENT	SURVEY RESPONSE PERCENT
CALIFORNIA	1%	0%
UTAH	4%	4%
MONTANA	9%	11%
IDAHO	18%	20%
OREGON	32%	24%
WASHINGTON	33%	38%
OTHER	2%	2%

Based on inspection of company name, the attendees were assigned one of three business types: end-user, institution, or vendor. Universities, utilities, and other political entities that were deemed not to have significant compressed air utilities were included among the institutions. Consultants and compressed air distributors were included together with vendors. Compared to the population, there was a somewhat higher response rate from vendors and a lower response rate from institutions, but a proportional response from the most important target audience of the CAC training, end-users. These results are described in *Table 17*.

Table 17: Attendee Type

ATTENDEE TYPE	POPULATION PERCENT	SURVEY RESPONSE PERCENT
END-USER	71%	69%
INSTITUTION	17%	11%
VENDOR	12%	20%

The survey asked if the respondent had applied *Level 1* course material to their compressed air system and if they would be willing to share their story. (These success stories are discussed below.) Thirty-four of the 45 respondents, or 76%, had applied something from what they learned in the *Level 1* course. It should be noted that there is probably a high level of self-selection bias among respondents. That is, those who applied the materials would be more likely to respond. Therefore, these results are probably not representative of the entire population of attendees.

Of those that applied something they had learned, eighteen were willing to share their story. As five of these were vendors or institutions (electric utilities), their stories may not be as useful in a case study context as those from end-users. These results are summarized in *Table 18*.

Table 18: Applied Level 1, Willing to Share CAC Success

ATTENDEE TYPE	APPLIED LEVEL 1?	WILLING TO SHARE?	APPLIED OF TOTAL RESPONSES	WILLING TO SHARE OF APPLIED
END-USER	25	13	42%	52%
INSTITUTION	3	2	40%	67%
VENDOR	6	3	33%	50%
TOTAL	**34**	**18**	**76%**	

More than two-thirds of respondents were interested in attendance in the CAC *Level 2* course for themselves or others in their organization. Again,

because of self-selection bias, this is not likely representative of the entire population of attendees.

B. Compressed Air Challenge Success Stories

From the eighteen survey respondents who said they would be willing to share their application of CAC *Level 1* material, thirteen of the eighteen were contacted. (The five others did not respond to email and telephone messages.) From those thirteen contacts, eight "success stories" were developed, with the savings attributed to increased awareness and actions taken because of *Compressed Air Challenge* training totaling nearly $200,000 annually. One of the success stories could not be published due to internal company policies, so only seven were made available for distribution.

The projects tackled as a result of attending the CAC training vary widely. Two of the respondents obtained incentives from the serving electric utility, all the other projects were financed internally. The more ambitious respondents installed capital improvements like new compressors and dryers, major control upgrades, or all-new distribution piping. Others approached their system from an operation and maintenance viewpoint, with savings from compressor scheduling, leak repair, and pressure reductions. *Table 19* summarizes the success story results.

The results of the CAC survey described above tell us that three-quarters of respondents applied something from the CAC training, and 71% of respondents were end-users. Thus, a high estimate of those attending CAC training in 1999 and 2000 that may have applied something from the class would be attendees from 170 industrial plants. A low estimate might be based on the actual success stories prepared, 8 of 45 respondents, or those from about 42 industrial plants.

Table 19: CAC Success Story Summary

SUCCESS STORY INDUSTRY	ANNUAL COST SAVINGS	MEASURES IMPLEMENTED
LAMINATED VENEER LUMBER PLANT	$5,000	Compressor scheduling, leak repair, pressure reduction
CUSTOM SMALL PARTS	$2,500	Leak repair, air receiver

MANUFACTURER		
DIMENSIONAL LUMBER MILL	$92,600	Replacement of all distribution piping, new air dryer
HIGH-PERFORMANCE PLASTICS MANUFACTURER	$12,500	New compressors and air dryer, distribution piping, pressure reduction
AMMUNITION MANUFACTURER	$15,500	Relocated air receiver, leak repair, pressure reduction
SPECIALTY LUMBER MILL	$1,000	Leak repair
AUTOMOBILES SAFETY RESTRAINT MANUFACTURER	$65,000	Improved compressor and dryer controls, leak repair, pressure reduction
TOTAL	**$194,100**	
AVERAGE SAVINGS PER PROJECT	**$27,700**	
AVERAGE SAVINGS PER NON-CAPITAL PROJECT	**$6,000**	

C. Other CAC Issues

Promoting the Training

Note that in PEA's work in the Northeast, the success of *Compressed Air Challenge* training is highly correlated to the accountability of utility field organizations for recruiting. Where there is no field organization at utilities, attendance is lower. Also, where there are regulatory incentives for utility recruitment, attendance is excellent. A suggestion to attend from a known representative at a utility seems to be the most effective way to recruit.

Utility recruitment and personal invitations to promote CAC training is also supported by the expert interviews described earlier in this report. Most of the experts felt that personal contact by utilities and vendors were the best ways to promote the CAC training.

Level 2 Training Offering

A significant effort went into planning and preparing for the first *Compressed Air Challenge Level 2* training in the Northwest, initially scheduled for June 2001, in Portland. The survey described earlier was used to determine the best location and time for the class offering. However, the *Level 2* class was canceled for lack of interest, as the audience was relatively small and consisted of only a few compressed air end-users. Note that a *Level 2* training class in Connecticut was also canceled recently due to limited registration, but classes in Massachusetts, where there are performance incentives for utilities to recruit, have proceeded as scheduled.

After careful consideration, the first *Level 2* class for the Northwest was rescheduled for September 2001, in Seattle. It was felt that rescheduling the class will help those organizing CAC in the region deliver a better product and that it would allow more opportunities to market the training.[4]

[4] As of December 2001 no CAC Level 2 class has been scheduled in the region.

VI. Compressed Air Challenge Observations

VII. Issues and Recommendations

Issues and recommendations for both SAV-AIR and the regional effort for *Compressed Air Challenge* are summarized below in approximate order of significance. Most outstanding issues essentially similar to those made in *MPER #1 and #2* were not included.

One outstanding issue from MPER #2 that should be noted is the recommendation made previously for changes to the Alliance's cost-effectiveness assumptions. Updates for some of the values should come from the most current version of SAV-AIR *Business Plan* and other financial planning documents. A three-way meeting between SAV-AIR, the Alliance, and the evaluation team should be considered to best resolve these values. The previous MPER suggested updates to the following cost-effectiveness parameters:

- Overall market size,
- Average facility size,
- Capital costs and operations and maintenance costs, and
- Energy and non-energy benefits.

Revision of other aspects of the cost-effectiveness approach may become evident as these are discussed.

Other outstanding issues from MPER #1 merit further attention. These regard the viability of SAV-AIR as a successful business. SAV-AIR needs a capital infusion to maintain financial viability and needs to fine-tune marketing efforts to overcome problems due to the length of the sales cycle. It appears that both of these issues are being addressed by SAV-AIR in some fashion, but as they have not been formally resolved, they remain a concern.

A. SAV-AIR Issues and Recommendations

Issue: Document Customer Compressed Air Problems

From the SAV-AIR customer interviews, it was not clear that SAV-AIR fully understood all of the problems customers had with their compressed

air systems, and what the impact of these problems might be on production. The benefits for compressed air optimization beyond energy cost savings are often best described anecdotally and quantitative information is not always available. However, the anecdotes should be methodically documented. As is described earlier in this report, non-energy benefits are important to end-users, and are of a magnitude similar to that of energy cost savings.

Recommendation

Potential and in-process customers should be interviewed to collect descriptions of compressed air-related problems, and the results should be carefully documented. Even if frequency of problem occurrence cannot be accurately determined, or hours of maintenance time to correct air-related problems are unknown, any evidence of their existence should be documented. When later discussions or formal interviews bring up the issues, knowing whether they were (or were not) resolved by the SAV-AIR system or what other improvements were made will help describe the value of production or maintenance benefits.

Issue: Complete Development of Monitoring Interface

Several of SAV-AIR's customers are interested in integrating the information gathered using the SAV-AIR system with their own plant automation system. The internal directive by SAV-AIR management to freeze product development and work on sales has been important to SAV-AIR's recent success; however, the monitoring interface is the last piece to make the product complete. A key reason that SAV-AIR was selected for Alliance funding was the benefit of ongoing monitoring. Completing the monitoring interface development would maximize the usefulness of this aspect of SAV-AIR for customers.

Recommendation

It is understood that the development of this plant automation interface is underway and it is expected to be available to customers by September 2001. In addition to local automation system interfaces, SAV-AIR should also complete the planned enhancement to enable data monitoring over the Internet. Both of these upgrades will put the SAV-AIR system on a direct

par with similar equipment offered by other manufacturers, and will address significant needs of customers.

Issue: Prepare Case Studies

Case studies were identified by experts and SAV-AIR customers as one of the best influences for compressed air optimization. There are now four installations of the SAV-AIR system in the region, one of them in place for nearly a year. This is a reasonable breadth of projects for potential customers and others to see either a success in their own industry or to see how SAV-AIR can solve a variety of compressed air problems.

Recommendation

Prepare and publish formal case studies for each of the SAV-AIR installations. The outline provided in *Appendix C* of MPER #1 should be useful in organizing such a case study.

Issue: Use Non-Energy Benefits in Sales/Marketing Approach

It appears that the value of non-energy benefits is similar in magnitude to energy cost savings. These benefits involve reduced maintenance, improved productivity and product quality, reduction of other costs (such as water), capital cost savings, and some very indirect operational improvement benefits. However, non-energy benefits do not appear to play a central role in SAV-AIR's current equipment sales, nor do they seem to be a factor in the sales of analogous equipment by competitors.

Recommendation

The value of non-energy benefits could play a larger role in sales and could be a way to differentiate SAV-AIR from its competition. Documenting these benefits as they are encountered, even if only informally or anecdotally, could prove useful in closing sales or in developing a unique market image.

Issue: Provide Case Studies to Regional Experts

Industrial consultants, utility engineers, and efficiency organization personnel are very influential in the regional market for efficiency services, including compressed air. Although they may not be in a position to purchase, specify, or perhaps even recommend one product over another, their opinions carry weight and their knowledge of the full range of efficiency technologies is important.

Recommendation

These market actors should be provided with case studies for each of the four installed SAV-AIR systems, and SAV-AIR staff should be made available to answer any of their questions. Obviously, these individuals do not need a sales pitch, nor should most of them be considered as potential lead generators. This is a situation where a formal and technical case study will be the most appropriate vehicle for communicating the success of the SAV-AIR approach (see previous recommendation).

Some of these experts could potentially become distributors for SAV-AIR, and need to be brought on board with other information. This would include how they can benefit from specifying the SAV-AIR system and how their customers can benefit from using it.

Issue: SAV-AIR Support for *Compressed Air Challenge*

Among those industrial customers that have received a proposal from SAV-AIR, there is at least one consistent difference between those that chose to do business with SAV-AIR and those that did not. This difference was the firms' commitment to compressed air training for its staff. *Compressed Air Challenge* is an inexpensive, objective, and widely available compressed air training program. This is also suggested in *Task 4b* from the new *SAV-AIR Contract Scope of Work.*

Recommendation

SAV-AIR could support the CAC program by sending their existing customers and their potential customers to local training. As an alternative for market contacts for which the SAV-AIR approach may not be appropriate, SAV-AIR could recommend CAC training. And like other

compressed air equipment vendors, they can have their sales staff attend the training regularly, especially any training where their customers might also be present. To uphold the objectivity of the CAC training, it would not be appropriate to promote SAV-AIR's particular product or approach during the course, but by answering questions (if they arise), it could help attendees gain an understanding of the value and methods for compressed air control and monitoring.

Issue: Make the SAV-AIR Web Site a Compressed Air Information Resource

The research in this report suggests that educated customers are more likely to pursue compressed air optimization projects. (Note however, that few currently use the Internet for compressed air information.) If the SAV-AIR web site were a resource for pursuing compressed air efficiency, those using it would come to consider SAV-AIR to be an unbiased source of information on the subject. Several of the other firms that offer automated compressed air control and monitoring provide some objective information, although it is difficult to find.

Recommendation

The information provided on the SAV-AIR web site could include items on the *Compressed Air Challenge*, the value of leak management, success stories for all types of compressed air optimization, and the value of proper operation and maintenance. Links to the web sites of a variety of air compressors and associated equipment could be provided. Of course, SAV-AIR case studies should also be offered, although it should be noted that the information currently provided on the SAV-AIR web site for the mineral mill is not a formal case study, but more a success story summary.

Issue: All-inclusive Marketing Approach

Although SAV-AIR's target market are plants with large and complex compressed air systems, SAV-AIR should consider broadening their marketing approach to include information that would be useful to anyone with a compressed air system. Providing general edification on the subject of compressed air will assist with SAV-AIR's credibility in the market and will have long-term marketing benefits.

Three rationales support an all-inclusive approach. These are the learning benefits from using examples from smaller systems, the fact that personnel tend to change positions often and may sooner or later have responsibility for a larger system, and the general truth that upgraded knowledge and understanding in any arena raises awareness and demand for SAV-AIR products and services.

Recommendation

During general audience presentations, it is suggested that the "pitch" used be more inclusive. This is meant to include all persons that manage compressed air systems, no matter if the systems would usually be considered too simple or small to benefit from the SAV-AIR approach.

For example, during the presentations, potential SAV-AIR customers with large, complex compressed air systems will often appreciate and benefit from information directed at those attending that have simple systems. Examples from simple systems can make fundamental points more clearly. The method for doing the basic calculation to determine operating costs for a small compressor may not be familiar to all, and a simple example is always useful.

B. *Compressed Air Challenge* Issues and Recommendations

Issue: Garnering Utility and Vendor Support for CAC

A number of dedicated individuals from utilities and equipment vendors have been making significant contributions to the regional effort for *Compressed Air Challenge* training. Still, the market penetration of the *Level 1* training, particularly for end-users, is very limited, perhaps only 5% or less after two years of effort. From the CAC survey and the success stories collected, it appears that a simple benefit/cost ratio for end-users may be at least 1.5, and likely much better. For utilities, logistical support of such a windfall of energy savings should be a no-brainer. For vendors, educated customers are usually desirable.

Recommendation

The cost-effectivity of support for the *Compressed Air Challenge* training should be analyzed, even as a back-of-the-envelope calculation. This evidence, along with the CAC success stories and a refined market penetration estimate, should be packaged into a persuasive memorandum directed at mid-level management at utilities and compressed air equipment vendors. This memo could be delivered by hand, and would request their complete support for hosting and promotion of all levels of CAC training, and the staff time needed to make it happen.

Issue: Promoting CAC Training

In PEA's work in the Northeast, the success of *Compressed Air Challenge* training is highly correlated to the accountability of utility field organizations for recruiting. Where there is no field organization at utilities, attendance is lower. Also, where there are regulatory incentives for utility recruitment, attendance is excellent. A suggestion to attend from a known representative at a utility seems to be the most effective way to recruit.

Utility recruitment and personal invitations to promote CAC training are also supported by the expert interviews described earlier in this report. Most of the experts felt that personal contact by utilities and vendors were the best ways to promote the CAC training.

Recommendation

The involvement of utility and vendors in promotion of the CAC training is critical to continued success of the training in the region. Personal invitations from a known party are widely felt to be the most effective way to recruit for these classes.

VII. Issues and Recommendations

Appendices

Appendix A: List of Expert Firms Interviewed

Appendix B: Competitor Interview Guide

Appendix C: Nonparticipant Survey

Appendix D: Participant Survey

Appendix E: Expert Survey

Appendices

Appendix A

Expert List for the SAV-AIR Evaluation

EXPERT AFFILIATION, LOCATION	INTERVIEWED FOR MPER #1	INTERVIEWED FOR MPER #3
AIROMETRIX, DENVER, CO	√	√
AMERICAN COUNCIL FOR AN ENERGY EFFICIENCY ECONOMY, WASHINGTON, DC	√	√
BONNEVILLE POWER ADMINISTRATION, PORTLAND, OR	√	√
CAROL HATCH AND ASSOCIATES, PORTLAND, OR	√	√
ENERGY CENTER OF WISCONSIN, MADISON, WI	√	√
LBL/DOE COMPRESSED AIR CHALLENGE, WASHINGTON, DC	√	√
OSU EXTENSION, CORVALLIS, OR	Declined Interview	√
PUGET SOUND ENERGY, BELLEVUE, WA	√	√
ROGERS MACHINERY, PORTLAND, OR	Not Contacted	√
SCALES ENGINEERING, CARLE PLACE, NY	√	√
SEATTLE CITY LIGHT, SEATTLE, WA	√	√
SOUTHERN CALIFORNIA EDISON, LOS ANGELES, CA	√	√
STRATEGIC ENERGY TECHNOLOGIES, INC., ACTON, MA	√	√
WASHINGTON ENERGY OFFICE, OLYMPIA, WA	√	√

Appendix A

Appendix B

SAV-AIR Evaluation Competitor Survey 04-27-01

General Information

CONTACT NAME:	
TITLE:	
COMPANY:	
CITY AND STATE:	
TELEPHONE:	
EMAIL:	

I'm with a research firm and I'm calling regarding the market for compressed air monitoring and control products. I'm doing the research on behalf of the Northwest Energy Efficiency Alliance who as part of their energy efficiency initiatives has provided funding to SAV-AIR, a compressed air monitoring and control company. You may have heard of it. I have a short structured interview of about 20 minutes that I'd like to go through with you.

I understand that you might not be comfortable discussing your products and services with me. None of my questions are about pricing, number of customers, or market share of your individual firm. I want to assure you that SAV-AIR and my client will only see the publicly available reports containing the summary results of this research. The reports contain no attribution; your name will not be associated with any of your responses. Of course, you can choose not to answer any of the questions I might pose, or to not talk with me at all.

If you like, I can provide you with email links directly to the two reports already published on SAV-AIR and also to a compressed air market study for the region. I can also notify you when the report containing these interview results are available.

[PROVIDE – MPER#1, MPER#2, MARKET STUDY, SAV-AIR.]

Would you consent to this interview?

First I have some questions about your product line:

1. Could you describe your compressed air monitoring and control system product, especially how you believe it is different from other, similar products?

2. How does your compressed air monitoring and control system fit in with other products and services your company offers?

2a. How about with other compressed air products and services?

3. Do you offer…

   - ❑ General compressed air engineering
   - ❑ Equipment sales and service
   - ❑ Leak detection
   - ❑ Leak repair services

4. What sensor hardware do you typically install with your equipment?

   - ❑ Pressure
   - ❑ Temperature
   - ❑ Compressor current
   - ❑ Compressor kW
   - ❑ Air flow (how many?)_____
   - ❑ Other?

5. Who provides oversight of the compressed air system control following installation, you or your customers?

[IF MONITORING]

6. How is information gathered and shared with your customers?

7. What kind of ongoing monitoring do you typically provide and for how long?

8. How have customers used the monitored information? Any unexpected uses?

And now I have some questions about how you assess potential projects for your compressed air monitoring and control system:

9. What sizes and types of compressed air systems do you usually work with?

10. [IF NOT ANSWERED]

- How about in terms of total HP…
- Number of compressors…
- Types of compressors…
- Or industry focus?

10a. Any types of CA systems that you would not recommend a customer install your system on??

11. Do you typically do any CA system modifications when installing your monitoring and control system?

- Yes

- No

IF YES: What compressed air system modifications do you typically perform along with installation of your equipment?

12. [IF NOT ANSWERED]

- How about receivers…
- Controllers…
- Dryers…
- Compressors…
- Piping modifications…

13. What is a typical range of energy cost savings that you've seen from your projects? PERCENT

14. Have your customers seen specific non-energy benefits?

- Yes
- No

IF YES: Can you describe those?

And I have some questions about how you see the market for compressed air control and monitoring products and services:

15. About what percent of industrial compressed air systems would you say are have monitoring and control systems installed by you and other companies like yours?

16. One year from now, what percent do you estimate will have them?

16a. How about in five years?

17. What do you see as the main challenges in increasing the market penetration for monitoring and control systems?

18. What do you see as trends driving the market demand for CA M&C systems?(e.g. Energy costs, plant automation (SCAD, CMMS, EAM etc.), cheaper and better sensors and software, greater knowledge of CA systems due to CAC and higher skilled labor force industry consolidation),

19. Would you say the recent changes in energy prices on the West Coast have had no impact, some impact, or substantial impact on customers' interest in products such as yours? How about the impact on actual numbers of installations?

20. If you are willing, I would like an introduction to one of your customers, perhaps one that is a particular success?

    Name_____ Company_____

    Phone number_____ Email [if recommended]_____

Those are the questions that I have for you, thanks very much for talking with me. Are there any additional comments you would like to make?

Appendix B

Appendix C

SAV-AIR Evaluation Nonparticipant Survey 04-20-01

General Interviewee Information

CONTACT NAME:	
TITLE:	
COMPANY:	
CITY AND STATE:	
TELEPHONE:	
EMAIL:	
INDUSTRY	

DO USUAL INTRODUCTIONS AND ALSO SAY THE FOLLOWING:

Our mission is to understand the interests of industries that have large compressed air systems and also to evaluate the progress made by SAV-AIR in introducing their monitoring and control concepts. Your individual responses will be kept confidential from other companies and from SAV-AIR. Summary reports on this evaluation may be made available on the Alliance web site, but your comments will never be associated with your name.

Throughout this survey we will talk about "compressed air system optimization." By this we mean detailed evaluation, analysis, and changes to your entire compressed air system - compressors, auxiliaries (air dryers, filters), controls, distribution, leaks, and end-uses.

COMPLETE INFO BLOCK ABOVE BEFORE CONTINUING.

Compressed Air System Description

1. If you can, tell me about the size and status of the air compressors used in your facility. By status I mean whether they are primary, standby, or backup.

COMPRESSOR HP &TYPE	COMPRESSOR STATUS
	Primary/Standby/Backup
	Primary/Standby/Backup
	Primary/Standby/Backup
	Primary/Standby/Backup
	Primary/Standby/Backup

2. Do you regard compressed air as an expensive part of your operations?

   - ❑ Yes
   - ❑ No
   - ❑ Couldn't say

3. Before starting to work with SAV-AIR, did you have a rough idea of how much of your electric bill was compressed air?

   - ❑ Yes
   - ❑ No
   - ❑ Couldn't say

4. IF NO: As a result of working with SAV-AIR, do you now have an idea?

YES		
NO		

5. IF YES: Do you believe that it's useful to know your compressed air costs?

YES	

NO	

6. IF NO: Would you find it useful to know your compressed air costs?

YES – WHY?	
NO – WHY NOT?	

Compressed Air System Management and Maintenance

7. Could you please describe the management approach or objectives for management of your compressed air system?

8. Are you satisfied with the way your compressed air system operates now?

YES	
NO – WHY NOT?	

9. Have your objectives for managing your compressed air system changed at all since you worked with SAV-AIR? IF YES: In what way?

10. Now I'd like to read a list of compressed air management practices. I'll then ask you about whether you have done before working with SAV-AIR or plan to do it in the future.

APPROACH/TOOL	A. ALREADY DOING BEFORE WORKING WITH SAV-AIR?	B. NOW DOING OR PLAN TO DO?	C. IF YES: RESULT OF WORK WITH SAV-AIR?
1. SHORT-TERM MONITORING OF LOAD OR CURRENT	Y N DK IF YES, SKIP TO NEXT PRACTICE.	Y N DK	Y N DK
2. LONG-TERM MONITORING OF LOAD OR CURRENT	Y N DK	Y N DK	Y N DK
3. LEAK DETECTION	Y N DK	Y N DK	Y N DK
4. LEAK REPAIR	Y N DK	Y N DK	Y N DK
5. TRACKING COMPRESSED AIR COSTS	Y N DK	Y N DK	Y N DK
6. IMPROVING SYSTEM CONTROL STRATEGIES	Y NX DK	Y N DK	Y N DK
7. ASSIGNING CA COSTS TO COST CENTERS	Y NX DK	Y N DK	Y N DK
8. USING FORMAL ANALYSIS TO JUSTIFY CHANGES (RATHER THAN BUYING MORE COMPRESSORS)	Y N DK	Y N DK	Y N DK

11. IF USE MONITORING: Could you describe the monitoring you do on your compressed air system? (PROBE: By yourself? By outside contractors?)

12. What influences you the most in terms of adopting new compressed air management tools or approaches?

- ❑ 1 books
- ❑ 2 web sites
- ❑ 3 peers/peer groups/organizations
- ❑ 4 CAC or other CA classes
- ❑ 5 Hearing about another companies success through case studies
- ❑ 6 Experience from within your company through a pilot project
- ❑ 7 Consultant recommendations (besides SAV-AIR)
- ❑ 8 SAV-AIR's recommendations
- ❑ 9 Vendor's recommendations (besides SAV-AIR)
- ❑ 10 Articles or advertisements in a professional publication
- ❑ 11 Other _____

13. If a compressed air improvement works well for you, how likely is it that your company would implement it in other plants? Would you say… (READ LIST)

- ❑ Very likely
- ❑ Somewhat likely
- ❑ Not at all likely IF NOT AT ALL: Why not? _____

14. What barriers do you face in getting your compressed air system to run more efficiently?

15. Do you think working with SAV-AIR could have helped you overcome this barrier? IF YES: In what way?

YES, IN WHAT WAY?	
NO	

16. Did you adopt any of SAV-AIR's recommended changes to your system?

17. Besides what was recommended by SAV-AIR, are you making other changes to achieve system optimization? (PROBE: Staff with appropriate decision making responsibilities are communicated with and involved; work orders, purchase orders, contracts, etc. drawn up as necessary for system changes.)

18. Are you working with another compressed air contractor on system optimization?

YES	
NO	

19. IF YES: Which company?

20. The benefits from compressed energy savings are easy to measure. But improvements may have other benefits to your plant and production. What do you see as other benefits? [PROBE: reduced production downtime, reduced production waste, predictable CA system maintenance, ability to focus on core business, etc.]

SAV-AIR Satisfaction

The next series of questions deals with your experiences with SAV-AIR and your satisfaction with their services. I'm going to read you a series of statements. Please respond to each statement with "no" if you disagree and "yes" if you agree. You may also respond with "don't know." (FOR EACH 'No" RESPONSE, ASK WHY)

21. Did SAV-AIR provide useful information about system function, system efficiency, and opportunities for improvement?

    - ❑ Yes
    - ❑ No
    - ❑ Don't Know

    IF ANSWERED NO, ASK WHY:

22. Was the SAV-AIR team easy to work with?

    - ❑ Yes
    - ❑ No
    - ❑ Don't Know

    IF ANSWERED NO, ASK WHY:

23. Did the SAV-AIR team have the skills and knowledge to meet your needs for compressed air system management?

    - ❑ Yes
    - ❑ No
    - ❑ Don't Know

    IF ANSWERED NO, ASK WHY:

24. Did SAV-AIR clearly explain and quantify the potential energy benefits of the recommended system improvements versus costs?

    - ❑ Yes
    - ❑ No
    - ❑ Don't Know

    IF ANSWERED NO, ASK WHY:

25. Did SAV-AIR identify potential non-energy benefits that are important to your plant?

    - Yes
    - No
    - Don't Know

    IF ANSWERED NO, ASK WHY:

26. Would you recommend SAV-AIR's services to other plants in your company?

    - Yes
    - No
    - Don't Know

    IF ANSWERED NO, ASK WHY:

27. Would you recommend SAV-AIR's services to colleagues at other companies?

    - Yes
    - No
    - Don't Know

    IF ANSWERED NO, ASK WHY:

28. Do you have any concerns or questions about SAV-AIR? IF YES: What are they?

29. What is the main reason you did not move forward in your work with SAV-AIR?

Training

30. How do you usually accomplish training for your staff on compressed air systems?

- ❑ 1 In-house
- ❑ 2 Vendor training courses
- ❑ 3 Utility training courses
- ❑ 4 Colleges/vocational schools
- ❑ 5 Professional associations
- ❑ 6 Don't provide compressed air operation training
- ❑ 7 Other: _____

31. Have you heard of the Compressed Air Challenge?

- ❑ Yes
- ❑ No *[Skip to 35.]*

32. Have you or your staff participated in CAC training?

- ❑ Yes
- ❑ No

33. [IF ATTENDED CAC] In what way did the CAC class influence you the most? Or, What was the most important thing that you learned from taking the class?

34. Were any improvements implemented in your plant because of the CAC training?

YES – WHAT WERE THEY?	
NO – WHY NOT?	

35. Is there anything else you'd like to add about your compressed air system or your experience with SAV-AIR?

Thank you for spending the time to talk to me about your experiences with SAV-AIR.

Appendix D

SAV-AIR Evaluation Beta Survey 05-16-00

Planned for in-person interviews.

Introduction: I am _____ of Pacific Energy Associates, a research firm in Portland. We are calling on behalf of the Northwest Energy Efficiency Alliance, a consortium of Northwest utilities. The Alliance is currently sponsoring a number of customer services, one of which is SAV-AIR. Because you're a SAV-AIR customer, we'd like to talk to you and get your feedback on the services. Would it be possible to arrange an in-person interview sometime in the next few weeks? It will take about 45 minutes. ARRANGE APPOINTMENT. Just to let you know, your individual responses will be kept confidential from other companies and SAV-AIR. Summary reports on this evaluation may be made available on the Alliance website. Thank you and I look forward to meeting with you.

General Interviewee Information

CONTACT NAME:	
TITLE:	
COMPANY:	
CITY AND STATE:	
TELEPHONE:	
EMAIL:	
INDUSTRY	
SERVING UTILITY	

WHEN ON SITE, DO USUAL INTRODUCTIONS AND ALSO SAY THE FOLLOWING.

As I mentioned when I called you, your individual responses will be kept confidential from other companies and SAV-AIR. Summary reports on this evaluation may be made available on the Alliance website.

Throughout this survey we will talk about "compressed air system optimization." By this we mean detailed evaluation, analysis, and changes to the entire

compressed air system - compressors, auxiliaries (air dryers, filters), controls, distribution, leaks, and end-uses. Does this definition work for you?

Compressed Air System Description

1. Can you confirm the air compressors used in your facility?

COMPRESSOR ID	COMPRESSOR HP/STATUS

2. Do you regard compressed air as an expensive part of your operations?

   - ❑ Yes
   - ❑ No
   - ❑ Couldn't say

3. Before starting your work with SAV-AIR, did you have a rough idea of how much of your electric bill came from compressed air?

YES		
NO		

4. IF NO: As a result of working with SAV-AIR, do you now have an idea?

YES		
NO		

5. Do you find it useful to your company to know your compressed air costs?

YES – WHY?	
NO – WHY NOT?	

Compressed Air System Management and Maintenance

6. Could you please describe what the management approach was for your compressed air system before you started working with SAV-AIR?

7. Before working with SAV-AIR, what would you say were your objectives in managing your compressed air system?

8. Before working with SAV-AIR were any of the following also objectives for managing your compressed air system?

   - ❑ Maintain continuous operation
   - ❑ Ensure adequate supply of air to end-uses
   - ❑ Improved or increased production (fewer rejects)
   - ❑ Maintain quality of air supplied (clean and dry air)
   - ❑ Control or reduce energy costs/energy use
   - ❑ Reduce capital costs (fewer compressors required)
   - ❑ Meet process quality standards
   - ❑ Improve safety
   - ❑ Reduce maintenance and repair for process machinery
   - ❑ Reduce maintenance and repair of the compressed air system

9. Have your objectives for managing your compressed air system changed at all since you started working with SAV-AIR? IF YES: In what way?

10. So would you say the change in objectives is related to working with SAV-AIR? IF YES: In what way?

11. Now I'd like to describe a number of compressed air management approaches and tools. First, I'd like to know if you were already doing them before starting to work with SAV-AIR. Then I'm going to ask you if you plan to start doing them in the future, and whether that decision is a result of working with SAV-AIR.

APPROACH/TOOL	ALREADY DOING BEFORE WORKING WITH SAV-AIR?	NOW DOING OR PLAN TO DO?	IF YES: RESULT OF WORK WITH SAV-AIR?
1. SHORT-TERM MONITORING OF LOAD OR CURRENT	**Y N DK**	**Y N DK**	**Y N DK**
2. LONG-TERM MONITORING OF LOAD OR CURRENT	**Y N DK**	**Y N DK**	**Y N DK**
3. LEAK DETECTION	**Y N DK**	**Y N DK**	**Y N DK**
4. LEAK REPAIR	**Y N DK**	**Y N DK**	**Y N DK**
5. TRACKING COMPRESSED AIR COSTS	**Y N DK**	**Y N DK**	**Y N DK**
6. IMPROVING SYSTEM CONTROL STRATEGIES	**Y NX DK**	**Y N DK**	**Y N DK**
7. ASSIGNING CA COSTS TO COST CENTERS	**Y NX DK**	**Y N DK**	**Y N DK**
8. USING FORMAL ANALYSIS TO JUSTIFY IMPROVED OPERATION AND MAINTENANCE RATHER THAN BUYING ADDITIONAL COMPRESSORS	**Y N DK**	**Y N DK**	**Y N DK**

12. IF USED MONITORING: Could you describe the type of monitoring you did before working with SAV-AIR? (PROBE: By yourself? By outside contractors?)

13. Do you plan to make any changes to your monitoring approach as a result of working with SAV-AIR?

YES		
NO		

14. IF YES: What types of changes?

15. IF DIDN'T DO MONITORING BEFORE, BUT NOW PLAN TO: What type of monitoring do you plan to do?

16. Do you plan to enter into a contract with SAV-AIR for long-term monitoring and management services? IF YES: What will it involve? IF NO: Why not?

17. What influences you the most in terms of adopting new compressed air management tools or approaches?

- ❑ Books
- ❑ Web sites
- ❑ Peers/peer groups/organizations
- ❑ CAC or other CA classes
- ❑ Hearing about another companies success through case studies
- ❑ Experience from within your company through a pilot project
- ❑ Consultant recommendations
- ❑ SAV-AIR's recommendations
- ❑ Vendor's recommendations
- ❑ Articles or advertisements in a professional publication
- ❑ Other _____

18. If a compressed air improvement that works well for you, how likely is it that your company would implement it in other plants? Would you say… (READ LIST)

    - ❑ Very likely
    - ❑ Somewhat likely
    - ❑ Not at all likely IF NOT AT ALL: Why not? _____

19. Before working with SAV-AIR, what barriers did you face in getting your compressed air system to run more efficiently?

20. Were any of the following barriers to more effective operation of your compressed air system? *[Read from list.]*

    - ❑ Not enough staff time
    - ❑ No budget for activities related to improved efficiency
    - ❑ Efficiency measures are too expensive
    - ❑ Payback restrictions are too short
    - ❑ Focus is on production (keeping things running by any means necessary)
    - ❑ Lack of accountability for the compressed air systems or costs
    - ❑ Lack of information about the performance of the system
    - ❑ Lack of management buy-in
    - ❑ Lack of technical expertise
    - ❑ Lack of training
    - ❑ Other _____

21. What were the top two barriers to effective operation of your compressed air system?

22. Do you think working with SAV-AIR has or will help you overcome any of these barriers? IF YES: In what way?

23. What have been SAV-AIR's main recommendations for system improvement and optimization?

24. Do you plan to implement any additional SAV-AIR recommendations? IF YES: Which ones? How soon? IF NO: Which ones? Why not?

25. Besides what was recommended and implemented by SAV-AIR, are you making other changes to achieve system optimization? (PROBE: Staff with appropriate decision making responsibilities are communicated with and involved; work orders, purchase orders, contracts, etc. drawn up as necessary for system changes.).

26. What features would you like to the see in the compressed air control panel and software used by SAV-AIR?

27. In addition to providing compressed air management information and energy cost savings, the SAV-AIR system may have other benefits to your plant and production. What do you see as other benefits? [PROBE: reduced production downtime, reduced production waste, predictable CA system maintenance, ability to focus on core business, etc.]

28. IF ANY BENEFITS: Can you provide any anecdotes or assign a value to these additional benefits?

S**AV-AIR Satisfaction**

The next series of questions deals with your experiences with SAV-AIR and your satisfaction so far with their services. I'm going to read you a series of statements. Please respond to each statement with "no" if you disagree and "yes" if you agree. You may also respond with "don't know." (FOR EACH 'No" RESPONSE, ASK WHY)

29. So far SAV-AIR has delivered useful information about system function, system efficiency, and opportunities for improvement.

    - ❑ Yes
    - ❑ No

    IF ANSWERED NO, ASK WHY:

30. SAV-AIR's periodic reports on my compressed air are useful and appropriate for my needs.

    - ❑ Yes
    - ❑ No

    IF ANSWERED NO, ASK WHY:

31. The SAV-AIR team is easy to work with.

    - ❑ Yes
    - ❑ No

    IF ANSWERED NO, ASK WHY:

32. The SAV-AIR team has the skills and knowledge to meet our needs for compressed air system management.

    - ❑ Yes
    - ❑ No

    IF ANSWERED NO, ASK WHY:

33. The SAV-AIR team has clearly explained and quantified the potential energy benefits of the recommended system improvements versus the costs.

    - ❑ Yes
    - ❑ No

    IF ANSWERED NO, ASK WHY:

34. SAV-AIR has identified potential non-energy benefits that are important to our plant.

    - ❑ Yes
    - ❑ No

    IF ANSWERED NO, ASK WHY:

35. So far I am satisfied with SAV-AIR's services.

    - ❑ Yes
    - ❑ No

    IF ANSWERED NO, ASK WHY:

36. I would recommend SAV-AIR's services to other plants in my company without hesitation.

    - Yes
    - No

    IF ANSWERED NO, ASK WHY:

37. I would recommend SAV-AIR's services to colleagues at other companies without hesitation.

    - Yes
    - No

    IF ANSWERED NO, ASK WHY:

38. What's the main reason you decided to work with SAV-AIR?

39. So far, what do you like best about SAV-AIR's services?

40. Do you have any concerns or questions about SAV-AIR? IF YES: What?

Training

41. How do you usually accomplish training for your staff on compressed air systems?

- ❑ In-house
- ❑ Vendor training courses
- ❑ Utility training courses
- ❑ Colleges/vocational schools
- ❑ Professional associations
- ❑ Don't provide compressed air operation training
- ❑ Other: _____

42. Have you heard of the Compressed Air Challenge?

- ❑ Yes
- ❑ No *[Skip to 37.]*

43. Have you participated in CAC training?

- ❑ Yes
- ❑ No

44. In what way did the CAC class influence you the most? Or, What was the most important thing that you learned from taking the class?

45. In your opinion, how could the CAC training be improved?

46. What did you like best about the CAC training?

47. What might you expect to gain from a more advanced CAC training course (Level II)?

    - ❑ Nothing

48. Were any improvements implemented in your plant because of the CAC training?

YES – WHAT WERE THEY?	
NO – WHY NOT?	

49. May we contact you periodically so we can learn more about your continued observations and opinions of compressed air services and your experience with SAV-AIR?

    - ❑ Yes
    - ❑ No

Thank you for spending time talking with me. This information is important to promoting effective and efficient compressed air operation in the region.

Appendix E

SAV-AIR Expert Survey

General Interviewee Information

CONTACT NAME:	
TITLE:	
COMPANY:	
CITY AND STATE:	
TELEPHONE:	
EMAIL:	
TITLE	
ACTIVITIES	
CONTACT DATE	

Contact Log

DATE	TIME	RESPONSE	NOTES

INTRODUCTION: My name is _____ and I'm with 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. [IF RECONTACTING: I spoke to you back in December on this subject. Again, your individual responses will be confidential. Reports on this evaluation will be made

available publicly on the Alliance web site. The questions will take about 20 minutes. Shall we talk now?

[FOR THOSE ALREADY CONTACTED: Some of my questions are identical to those asked in the earlier survey.] 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.

COMPANY CHARACTERISTICS

1. CONFIRM LOCATION OF RESPONDENT

   City _____

   State _____

2. TYPE OF COMPANY (Check most appropriate).

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

3. YOUR MARKET AREA

   - ❑ Local
   - ❑ National
   - ❑ Regional
   - ❑ Global
   - ❑ Utility Service Territory

[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. [FOR THOSE ALREADY ANSWERING DURING LAST SURVEY – CONFIRM ONLY AND ASK ACTIVITY CHANGE QUESTIONS.]

   [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 the Same". You can also answer "Don't know."

SERVICE	YOUR FIRM OFFERS?	YOUR ACTIVITY CHANGE LAST 6 MOS.? (MORE/ LESS/SAME)	OTHER FIRMS ACTIVITY CHANGE LAST 6 MOS.? (MORE/ LESS/SAME)	CUSTOMER ACTIVITY LAST 6 MOS.? (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	Y / N	M / L / S / DK	M / L / S / DK	M / L / S / DK

UPGRADES				

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?

_____

_____

- ❑ Don't know the Northwest Region
- ❑ Don't know

6. What activities have you heard about and from what firms?

_____

_____

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

- ❑ 1. XCEED by Honeywell
- ❑ 2. Airometrix
- ❑ 3. XpandAIR and TargetAir by Zeks
- ❑ 4. SAV-AIR
- ❑ 5. Rogers Machinery
- ❑ 6. Other _____
- ❑ 7. Other _____

7. Have you heard about other innovations in the compressed air industry? Especially any involving monitoring, controls, optimization, and other services?

7a. Any other regional industry trends, consolidations, other companies moving in, etc.?

8. Some industries tend be more innovative about compressed air improvements. What industries do you feel are particularly innovative? Who are the leading firms, especially in this region? [Ask each respondent to speak to the industries they know best.]

   - ❑ High Technology_____
   - ❑ Fabricated Metals_____
   - ❑ Aerospace_____
   - ❑ Chemicals_____
   - ❑ Pulp & Paper_____
   - ❑ Food Products_____
   - ❑ Wood Products_____
   - ❑ Other Industry_____

9. Compressed air optimization can include aspects of a management tool, capital costs, and ongoing operating expenses. Who do you feel might be best to reach within an organization about compressed air optimization?

   - ❑ 1. Compressed air operator
   - ❑ 2. Maintenance Supervisor
   - ❑ 3. Plant Manager
   - ❑ 4. Corporate Management
   - ❑ 5. CFO
   - ❑ 6. Other_____

10. With that person in mind, what do you think is the best way to reach them with information about compressed air optimization?

    - ❑ 1. Case studies
    - ❑ 2. Success in their own industry
    - ❑ 3. Success in other industries
    - ❑ 4. Word of mouth from peers
    - ❑ 5. Specific associations
    - ❑ 6. Vendor representative
    - ❑ 7. Consultant recommendation
    - ❑ 8. Other_____

11. 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?

    - ❑ 1. Technical expertise to perform analyses?
    - ❑ 2. Technical expertise for monitoring?
    - ❑ 3. Ability to fund services?
    - ❑ 4. Ability to fund capital?
    - ❑ 5. Attitude toward outside experts?
    - ❑ 6. Focus on production?
    - ❑ 7. Lack of accountability for compressed air system costs in plant?
    - ❑ 8. Restrictions on project payback, return on investment?
    - ❑ 9. Staff turnover?
    - ❑ 10. No actual need (new systems well designed already)
    - ❑ 11. No perceived need by customer (system works, what's the problem?)
    - ❑ 12. Other_____

12. Which do you see as the TWO most important barriers to overcome for promotion of compressed air efficiency?

    _____

13. Some plants might make compressed air system improvements that save energy costs, but that also include other benefits that may sometimes be just as important. What other benefits do you believe would be important to plant operators and managers?

- 1. Accurately determine compressed air costs
- 2. Assign compressed air cost to departments
- 3. Improve product quality
- 4. Improve CA system reliability
- 5. Meeting quality standards in plant for compressed air
- 6. Improved safety
- 7. Other_____
- 8. Other_____

13a. Which do you see as the TWO most important non-energy benefits?

14. Again, 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 _____

14a. Any other "experts" in compressed air that you would recommend we might talk with?

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.

15a. [For new contacts only: Are you aware of CAC?]

- ❑ Yes
- ❑ No

15. Do you have any comments or feedback on the current state of the CAC Level I training program?

_____

_____

16. How about any comments or feedback on the current state of the CAC Level II training program?

_____

_____

17. Do you believe the Compressed Air Challenge training has had an impact the knowledge, skills, and actions of customers?

- ❑ Yes

- ❑ No

IF YES: What impact do you think it has had? (Seek specific examples.)

18. How can we make sure that end-users get to know about and attend CAC classes?

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.

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

- ❑ Yes
- ❑ No [Skip to 24.]

20. What do you think about the SAV-AIR concept and approach?

21. In your opinion, does long-term monitoring of large compressed air systems like SAV-AIR have value for ongoing system optimization? Would you say long term monitoring has… (READ LIST)

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

22. Why?

_____

_____

23. What types of customers do you think SAV-AIR would be good for?

_____

_____

23a. What firms if any do you think offer the same type of services as SAVAIR?

_____

_____

24. Can we contact you perhaps once more for this study, so we can learn about your continued observations and opinions regarding compressed air services?

- ❑ Yes
- ❑ No

25. If you are interested in learning more about SAV-AIR, I can send you by email a pointer to a report prepared earlier this year for the Alliance. Email_____

Thank you for spending time talking with me. If you are interested, compressed air, motor, and other industry studies are available on the Alliance web site.

Appendix E