Market Progress Evaluation Report

SAV-AIR, No. 4

prepared by

MetaResource Group

report **#E03-108**

March 2003

NORTHWEST ENERGY EFFICIENCY ALLIANCE

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SAV-AIR MARKET TRANSFORMATION INITIATIVE

MARKET PROGRESS EVALUATION REPORT #4

Final Report

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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. SAV-AIR, LLC (SAV-AIR) was formed in 1997, and was selected by the Alliance in December 1998 as one of its initiatives. The *SAV-AIR Market Transformation Initiative* (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 benefits, but also non-energy advantages such as increased system reliability. The Alliance and the SAV-AIR team want the Initiative to evolve into a self-sustaining business that will continue this work into the future.

This *Market Progress Evaluation Report* (MPER) is the fourth of a series of assessments of SAV-AIR. It builds upon the previous three, thus some of the background and context from these previous MPERs are reiterated below for the convenience of the reader.

The report covers the activities of the SAV-AIR Initiative over the period of August 2001 through June 2002. Up to this point, SAV-AIR has:

- Shown progress towards the goals of the Initiative (see below for a description of current contract goals);
- Completed development of their product line and also recently extended it;
- Significantly increased their marketing activity;
- Stabilized cash flow;
- Assembled a staff of dedicated and very skilled people; and
- Retained the services of a marketing consultant to provide direction on SAV-AIR's marketing strategy and to make suggestions for capturing marketing and sales opportunities.

SAV-AIR still requires more sales to achieve financial stability, however. Therefore, some of the concerns raised in this report remain the same as in earlier MPERs.

B. Overview of SAV-AIR's Services and Goals

SAV-AIR provides comprehensive compressed air management systems and engineering services. The SAV-AIR approach includes monitoring and control of compressed air systems using sensors, computers, and software. Their advanced monitoring and control system is called the *PL2000*. They have also recently developed and tested a simpler control system, a compressor sequencer without monitoring capabilities, to round out their product line, designated the *PL1000*.

SAV-AIR has the expertise and specialized technology to evaluate existing equipment and engineer upgrades, and to provide ongoing monitoring and control of an entire compressed air system for large industrial customers. The result is increased compressed air system reliability, decreased compressed air costs, and management information for savings verification and decision-making. Because the SAV-AIR system is fairly high-tech and relatively expensive, their approach is primarily being adopted by customers with larger systems.

The SAV-AIR Initiative's goals, as described in their current contract with the Alliance, are outlined in brief in *Table ES-1* below. The table summarizes SAV-AIR's progress to date towards the contract goals and gives a brief description of ideas for moving forward to meet the goals. Most of the items are described further in the *Summary of SAV-AIR's Activities* and in *Issues and Recommendations*.

Table ES-1: SAV-AIR Contract Goals and Progress

CONTRACT GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
PURSUING SALES IN KEY MARKET SEGMENTS	The vast majority of sales are in wood products with little diversity.	Market diversity is important, but any sale is a priority at this point for SAV-AIR to succeed. Having regional reps will help achieve diversity.
UPDATING THE BUSINESS PLAN	The *Draft Business Plan* is not current nor does it include all elements described in the Alliance contract.	It is assumed that the business plan will eventually be crafted for outside investors. Sales are a priority at this point for SAV-AIR.
GROWING NON-UTILITY WORKING CAPITAL	SAV-AIR is not in a financial position in terms of sales to solicit outside capital.	There is a need to establish a sales history before soliciting capital.
ENERGY SAVINGS OF 10 MILLION KWH	Annual savings of 11.2 million kWh have been achieved.	This goal has been met.
ACHIEVING NON-ENERGY BENEFITS	Many projects have non-energy benefits, but these are only described anecdotally.	Non-energy benefits need to be documented thoroughly so that they can be quantified.
CREATING MARKET AWARENESS OF SAV-AIR	Awareness is fair among market actors but low among end-users.	SAV-AIR has developed a plan for a broad marketing campaign. It needs to be put into place.
ONGOING SERVICE CONTRACTS	No ongoing service contracts have been signed to date.	The market has shown little interest in ongoing service contracts. Bundling services with equipment may be a way to introduce the concept, but for now, sales are a priority for SAV-AIR.

C. Evaluation of the SAV-AIR Initiative

MetaResource Group 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 this assessment will be contained in five *Market Progress Evaluation Reports.* Note that information on the Alliance-sponsored *Compressed Air Challenge* (CAC) training, heretofore included with the SAV-AIR Initiative evaluation, is now included in the *Drive Power*

Initiative MPER #4,[1] which will be available on the Alliance web site in the fall of 2002.

MPER #4 builds on market research previously conducted by Pacific Energy Associates, Inc. (PEA) and Research Into Action, Inc. (RIA), as well as the research undertaken for MPER #1, #2 and #3. The specific objectives of this fourth MPER are to:

- Review SAV-AIR's status and report on their market approach.
- Describe MetaResource Group's adaptive management activities.
- Describe the evaluators' findings from the following interviews conducted for this report:
  - Regional compressed air market actors, including consultants, equipment distributors, and manufacturers' representatives;
  - SAV-AIR customers (referred to as participants);
  - Potential customers that did not go forward with SAV-AIR (referred to as nonparticipants);
  - Compressed air end-users not contacted by SAV-AIR; and
  - The SAV-AIR team and Alliance management.
- Identify key issues and make recommendations to address them.

Summary of Surveys for this MPER

A number of research tasks were conducted for this MPER. They are described in summary below, and in more detail in the body of the report.

[1] *Drive Power Market Transformation Initiative, Market Progress Evaluation Report #4,* by Currents Consulting, available fall 2002 at www.nwalliance.org.

Compressed Air Market Actors

Seventeen regional compressed air market actors were surveyed by phone in June 2002. These included four consultants providing compressed air services, six compressed air distributors, and seven representatives of compressor manufacturers. The purpose of the survey was to obtain insights into the current state of the market for compressed air services, and to assess attitudes towards and awareness of SAV-AIR.

SAV-AIR Potential Customer Interviews

Two interviews with potential SAV-AIR customers were conducted by telephone in July 2002. These customers received a SAV-AIR *Performance Evaluation* (or the equivalent) and a detailed proposal for the installation of the SAV-AIR monitoring and control system. The purpose of the survey was to understand why these potential customers did chose not to install the SAV-AIR system. They are referred to as *nonparticipants* in this report.

SAV-AIR Customer Interviews

Six interviews of SAV-AIR customers were conducted by telephone in July 2002, and one was submitted by mail. Each of these customers have received SAV-AIR services for system optimization and installed the *PL2000* compressed air monitoring and control system. This survey assessed energy and non-energy benefits, and satisfaction with the SAV-AIR approach and system. These customers are referred to as *participants* in this report.

Compressed Air End-Users

Telephone interviews were conducted with fifteen compressed air end-users throughout the region that had never been contacted by SAV-AIR. Three of them had relatively small compressed air systems for which the SAV-AIR system would not be appropriate, but the remainder had two or more compressors with a total horsepower over

250. This survey assessed awareness of compressed air costs, attitudes about system management, and awareness of SAV-AIR.

Alliance and SAV-AIR Staff Interviews

The Alliance Project Coordinator for the SAV-AIR Initiative and four staff from SAV-AIR, LLC were interviewed to collect information on the current status of the Initiative and prospective customers. One of the SAV-AIR staff interviews included a telephone discussion with their financial consultant.

D. Summary of SAV-AIR's Activities and Market Effects to Date

This section summarizes some of MetaResource Group's observations regarding SAV-AIR and then formalizes them in several tables describing early and progressive indicators according to the outline of the original *Evaluation Workplan*.

Observations and Conclusions

Test site and demonstration sites have been completed. By April 2000, SAV-AIR completed its prototype "alpha" test site. By June 2002, SAV-AIR had completed all six of the required regional "beta" demonstration sites and associated case studies.

A total of ten installations have been completed. SAV-AIR has completed ten monitoring and control installations (with the *PL2000* product), including the Beta sites, and two more are in construction.

SAV-AIR is part of a significant increase in the sales of high-end compressed air controls. Some very rough estimates of market size suggest that sales of major compressed air control systems in the Northwest region have been typically in the order of one or two systems per year – perhaps five in the

past two and a half years.[2] SAV-AIR has sold twelve systems in that time period, and also has been influential in three other sales (nonparticipants that choose alternatives to SAV-AIR after seeing their system). Most certainly, *Compressed Air Challenge* and utility incentive programs are also factors in this market increase. Still, at least six of the SAV-AIR installations are systems that would not have been installed without their involvement, so they are clearly a major market influence.

Table ES-2 below provides an overview of SAV-AIR's sales and installation activity through June 2002.

Table ES-2: SAV-AIR Activity through June 2002

PROJECT TIMING AND LOCATION	STATUS	*PHASE I* – PERFORMANCE EVALUATION	*PHASE II* – SYSTEM OPTIMIZATION	*PHASE III* – ONGOING SERVICES
BETA DEMONSTRATION SITES	Complete	9	6	0
	In Process	0	0	0
OTHER SITES IN-REGION	Complete	10	3	0
	In Process	0	2	0
OTHER SITES OUT-REGION	Complete	0	1	0
	In Process	1	0	0
TOTALS	Complete	19	10	0
	In Process	1	2	0

Energy savings from SAV-AIR projects are impressive. For the first eleven fully operational control projects, the compressed air energy savings have been excellent, ranging between 17% and 60%, with an overall average of

[2] Similar estimates were obtained from SAV-AIR and also from interpretations of market actor responses and research in the market for compressed air efficiency by PEA and RIA.

35%. The average savings for each project are just over one million kWh annually. These are measured savings, determined using the energy monitoring capabilities integrated into the SAV-AIR *PL2000*, SAV-AIR's advanced monitoring and control system.

No other compressed air monitoring and control companies have entered the regional market. In fact, Honeywell, a major competitor, may have less presence in the region than a year ago.

SAV-AIR is close to break-even but is not self-sustaining. SAV-AIR's cash flow is currently close to break-even with ongoing expenses, with a combination of income from fee-for-services consulting (independent of their product offerings), customer sales, utility rebates, and Alliance funding. However, they are not yet financially self-sustaining. There are two key findings on their business progress:

- They made only two major product sales in the first two quarters of 2002, while it is estimated that they need about one sale per month to make significant progress towards being self-sustaining.

- They have not yet secured additional financial supporters besides the original investors and the Alliance.

Use of the *PL2000* controls interface and system-monitoring information is uneven. An important element of the SAV-AIR approach for maintaining compressed air efficiency is the integrated monitoring capability that provides indicators of system performance. Some of the maintenance personnel at plants with the SAV-AIR system are making good use of the information on compressed air system performance provided by the SAV-AIR graphical user interface. But for a number of the customers interviewed, the system had just been installed and they said they do not know the new control system's capabilities well enough to use them fully. Although SAV-AIR does provide training on compressed air systems in general, and particularly for their controls, the value of the *PL2000* control interface may not be obvious to all customers from the start.

No ongoing services contracts have been sold. None of their customers have elected to purchase SAV-AIR's ongoing system monitoring services. It appears that there is not a robust market for these services. Customers indicate

they are satisfied with using the standard system displays available on the *PL2000* system.

Recent participants describe fewer quantified non-energy benefits than the four participants interviewed for the previous report. The latter described a wide range of non-energy benefits, and indicated that on average, the value of these benefits was similar in magnitude to energy costs savings. Although six of the seven SAV-AIR customers interviewed for this MPER could describe some non-energy benefits of the SAV-AIR system, only two were able to quantify them in terms of cost savings. Three also said the system was achieving better pressure regulation, but they could not articulate any monetary value from those benefits. For two of these participants, the systems are so new that they may not yet fully recognize that previous compressed air problems have been corrected.

Customer satisfaction is not uniform. In research for the previous MPER (#3), all four participants indicated excellent satisfaction and would recommend SAV-AIR. Two of the four nonparticipants were also very impressed with SAV-AIR's approach and would recommend SAV-AIR to others. Among the seven participating customers interviewed for this MPER, only six said that they were entirely satisfied, and just four would recommend SAV-AIR at this time.

Reasons for nonparticipation indicate mixed reviews of SAV-AIR. The nonparticipants interviewed for the previous MPER cited financial reasons and communications difficulties with the SAV-AIR team, but did not indicate they had chosen other service providers. However, both of the nonparticipants interviewed for this MPER *are* going forward with less expensive control approaches offered by other providers. Both cited price as the main reason they declined, but one also indicated SAV-AIR pushed their approach when the customer did not see it as appropriate or optimal for their needs. The nonparticipant responses indicate that SAV-AIR's reaction to customers who decline their services could be more diplomatic.

Although progress is being made by the Initiative, there are not yet clear market transformation results. The recent dip in the economy (especially in the region) and corporate consolidations that affected a major SAV-AIR customer were significant setbacks. The demand for monitoring and control in compressed air has not increased dramatically. Market demand at this time barely sustains SAV-AIR, much less encourages additional

competitors. Part of this is due to the poor market conditions. However, SAV-AIR continues to strive for success and its staff has a good attitude.

General Market Discussion Points

Awareness of SAV-AIR among regional market actors is growing. In the research for the previous MPER, of the fourteen regional and national experts interviewed, thirteen were aware of SAV-AIR and ten said that the approach has some or significant value. For this report, among the seventeen market actors interviewed, sixteen were aware of SAV-AIR, and of those, nine said they would recommend SAV-AIR, albeit with caveats. In addition, SAV-AIR was cited as one of the regional leaders in compressed air system optimization.

Few end-users know of SAV-AIR. Among the fifteen end-users interviewed, only one had heard of SAV-AIR. Still, six of those that had not heard of SAV-AIR thought that the comprehensive approach and ongoing monitoring was interesting

An increase in the use of microprocessor technology in new compressors makes SAV-AIR's approach less cutting-edge. Although there is still no direct competition in the region to SAV-AIR from comparable compressed air control and monitoring systems, the increased use of microprocessor technology in compressors and related equipment has "closed the gap" to some extent between SAV-AIR's most advanced offering (the *PL2000*) and what is available from major compressor manufacturers.

The increased use of microprocessors in air compressors may reduce the *apparent* differentiation between SAV-AIR's products and what customers see as typically available.

Market Effect Indicators

This fourth MPER updates the *early indicators* of market effects. These early indicators are development of the prototype "alpha" test site, delivery of *Phase I* and *II* services to six pilot or "beta" sites, and customers' expressed intent to implement system changes and ongoing monitoring (*Phase III*). As the second contract between the Alliance and SAV-AIR changes some of the project

goals, a few early indicators may be somewhat less relevant than they were in earlier MPERs, but are still included in *Tables ES-3* and *ES-4*, below.

This report also assesses *progressive indicators* of market effects. These are site implementation of *Phase I* 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 self-sustaining business.

Tables ES-3 and *ES-4*, below, provide an overview of findings on the *early* and *progressive* indicators. They also describe current concerns of the MetaResource team and suggested strategies for moving forward.

Table ES-3: Assessment of Early Indicators

EARLY 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 regional beta sites were originally selected, three withdrew, and six have received *Phase II* installation.	This goal has been met. Selection of the demonstration sites fulfilled a required contract element between the Alliance and SAV-AIR.
BETA SITE CUSTOMERS EXPRESS INTENT TO IMPLEMENT SAV-AIR'S RECOMMENDATIONS AND UNDERTAKE MONITORING	No customers have indicated significant interest in *Phase III* monitoring.	Financial pressure to make *Phase II* sales is taking precedence. We believe *Phase II* sales are the priority and that there may not be a robust market for ongoing monitoring.
BETA SITE CUSTOMERS EXPRESS INTEREST IN REPLICATING SAV-AIR SERVICES IN OTHER CORPORATE FACILITIES	One of the four companies indicating interest in replication has done so (it is responsible for seven of the ten completed installations and both of the current installations in process).	Only one company has replicated, and not based on an overall strategy, but rather because of an internal champion. SAV-AIR continues to pursue current customers that seem most likely to replicate. Replication remains a critical strategy for financial stability.

Continued

EARLY INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
ABILITY OF SAV-AIR TO STREAMLINE THE SALES AND DELIVERY PROCESS AS THE INITIATIVE PROGRESSES	SAV-AIR's sales manager and two territorial sales reps have been recruited since the last report. A lower-cost control system (the *PL1000* sequencer) may improve sales success with those customers that balk at *PL2000* pricing and are not interested in the monitoring features.	Awareness of SAV-AIR among end-users is low, lead-time for capital investments is long, and many end-users are unaware of how poorly their systems are functioning. All these factors make it a difficult market. Nevertheless, SAV-AIR has done much to streamline the sales process.

Table ES-4: Assessment of Progressive Indicators

PROGRESSIVE 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	Six completed success stories show good energy and non-energy benefits. SAV-AIR has begun to distribute the stories and has published them on their web site. The Alliance web site also has links to these documents.	This goal has been met. Still, information on SAV-AIR and its success stories need to be distributed more extensively. SAV-AIR is now implementing a plan to do so.
SUCCESSFUL IMPLEMENTATION OF SAV-AIR'S SERVICES UP THROUGH *PHASE II* AT NINE SITES	Nine in-region installations have been completed, including the six Betas. One out-of-region installation has been completed. Two in-region sites are in process.	This goal has been met. Completion of the nine in-region sites fulfills a required contract element between the Alliance and SAV-AIR.
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 market actors had heard of SAV-AIR. In the second interview, 93%, and in this third interview, 82% had heard of SAV-AIR and 60% would recommend it, albeit with caveats.	SAV-AIR appears to be on the way to achieving this goal. However, SAV-AIR's planned marketing activities should help considerably to raise its profile.

Continued

PROGRESSIVE INDICATOR GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
SUCCESSFUL LAUNCHING OF SAV-AIR AS A SELF-SUSTAINING BUSINESS	SAV-AIR is not yet financially self-sustaining, although it is close to break-even, based mostly on fee-for-services consulting independent of their product offerings. SAV-AIR has not yet secured other financial support.	Sales are needed. Critical to sales are: 1) a marketing strategy that considers both long-term and current market conditions; and 2) knowledgeable sales force. Regarding the latter, work needs to be done with the regional reps that have been selected.
CHANGES IN DIRECT AND PERCEIVED COMPETITION AFFECT SAV-AIR	Honeywell is no longer active in the region, Sarlin Balance has left the US, and EnergAir Solutions unsuccessfully competes here. More microprocessors are embedded in compressor equipment, and simple networking more common.	Even as SAV-AIR is on the verge of establishing legitimacy in the regional market, their need to quickly become successful remains. SAV-AIR needs to be seen as leading the market and having no peer.

E. Issues and Recommendations

Issues and recommendations for SAV-AIR are summarized very briefly here in approximate order of significance. Except for the last two, these do not include those already discussed in MPER #1, #2, and #3. More detailed descriptions of the *Issues and Recommendations* below are provided in *Section VII*.

Issue: Need for a Broad Marketing Campaign

Recommendation: SAV-AIR has developed a plan for a marketing campaign and should put it in place soon.

Issue: Customer Satisfaction

Recommendation: All problems with customer satisfaction need to be corrected quickly.

Issue: Low Awareness Among End-Users

Recommendation: SAV-AIR has developed a plan for a marketing campaign that tackles this general awareness issue.

Issue: Building Market Credibility

Recommendation: The marketing campaign should also address market actors, such as consultants, utility personnel, and compressed air equipment, vendors, distributors, and manufacturers.

Issue: Customers Not Fully Using Monitoring Capabilities

Recommendation: SAV-AIR needs to work with customers to determine how *PL2000* monitoring is used, and how to make it more useful.

Issue: Market Size

Recommendation: Recognize that original market projections may include a significant portion of users that may not utilize monitoring data.

Issue: Slow Sales

Recommendation: SAV-AIR is well aware of its need to make sales and should step up networking efforts if possible.

Issue: Alliance Involvement

Recommendation: Alliance staff should check in more regularly with SAV-AIR staff regarding the status of their efforts, and offer direct assistance to ensure initiative success.

Issue: Corporate Replication

Recommendation: Replication is a key strategy for success, but it has not been reliable. Assign resources to work on making this a more important sales driver.

Issue: Highlight Non-Energy Problems and Successes.

Recommendation: SAV-AIR should work with their customers to formally document their compressed air problems and the resulting non-energy benefits from the SAV-AIR system.

Issue: SAV-AIR Support for Compressed Air Challenge

Recommendation: All of SAV-AIR's customers should have heard about *Compressed Air Challenge* and should attend.

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* (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 benefits, but also non-energy advantages such as increased system reliability.

SAV-AIR, LLC (SAV-AIR) 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 and the SAV-AIR team want SAV-AIR to evolve into a self-sustaining business that will continue its work into the future.

SAV-AIR provides comprehensive compressed air management systems and engineering services. Compressed air is often called the "fourth utility" in industrial facilities, after electricity, natural gas, and water. It provides motive power for machinery, cooling, materials handling, and hand tools. It is a safe, flexible, and powerful resource, but one that is seldom run for low operating costs or best productivity.

The most important issues of industrial compressed air in relation to energy efficiency and management are:

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

2. Compressed air is a fundamentally inefficient energy trans-formation 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 compromised efficiency.

The SAV-AIR approach to compressed air management includes monitoring and control of compressed air systems using sensors, computers, and software. SAV-AIR has 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 services have three delivery phases:

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

  The current status of the compressed air system is determined with detailed metering and analysis, and recommendations are made for optimization.

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

  This includes installation of a *PL2000*, the SAV-AIR system for monitoring and control, along with any other necessary or recommended system improvements.

- ***Phase III* – Ongoing Services**

  This includes ongoing remote and some onsite monitoring, troubleshooting, and consulting to provide continued system optimization for the maintenance of energy savings and reliability.

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

Table 1, below, provides an overview of SAV-AIR's sales and installation activity through June 2002. They have completed nineteen *Phase I – Performance Evaluations* and ten *Phase II – System Optimizations* using their *PL2000* control and monitoring system.

Table 1: SAV-AIR Activity through June 2002

PROJECT TIMING AND LOCATION	STATUS	*PHASE I* – PERFORMANCE EVALUATION	*PHASE II* – SYSTEM OPTIMIZATION	*PHASE III* – ONGOING SERVICES
DEMONSTRATION SITES	Complete	9	6	0
	In Process	0	0	0
OTHER SITES IN-REGION	Complete	10	3	0
	In Process	0	2	0
OTHER SITES OUT-OF-REGION	Complete	0	1	0
	In Process	1	0	0
TOTALS	Complete	19	10	0
	In Process	1	2	0

General Findings

SAV-AIR Is Part of a Significant Increase in the Sales of High-End Compressed Air Controls

Some very rough estimates of market size suggest that sales of major compressed control systems in the Northwest region have been typically in the order of one or two systems per year – perhaps five in the past two and a half years.[3] SAV-AIR has sold eleven systems in that time period, and also has been influential in three other sales (nonparticipants that choose alternatives to SAV-AIR after seeing their system). Most certainly *Compressed Air Challenge* and utility incentive programs are also factors in this market increase. Still, at least six of the SAV-AIR installations are systems that would not have

[3] Similar estimates were obtained from SAV-AIR and also from interpretations of market actor responses and research in the market for compressed air efficiency by PEA and RIA.

been installed without their involvement, so they are clearly a major market influence.

Energy Savings from SAV-AIR Projects Are Impressive

For the first eleven fully operational control projects, the compressed air energy savings have been excellent, ranging between 17% and 60%, with an overall average of 35%. The average savings for each project are just over one million kWh annually. These are measured savings, determined using the energy monitoring capabilities integrated into the SAV-AIR *PL2000*.

Recent Participants Describe Fewer Quantified Non-Energy Benefits

The four participants interviewed for the previous report described a wide range of non-energy benefits and indicated that, on average, the value of these benefits was similar in magnitude to energy costs savings. Although six of the seven SAV-AIR customers interviewed for this MPER could describe some non-energy benefits of the SAV-AIR system, only two were able to quantify them in terms of cost savings. Three also described that the system was achieving better pressure regulation, but they could not articulate any monetary value from those benefits. For two of these participants, the systems are so new that they may not yet fully recognize that previous compressed air problems have been corrected.

Customer Satisfaction Is Not Uniform

In research for the previous MPER (#3), all four participants indicated excellent satisfaction and two of the four nonparticipants were very impressed with SAV-AIR's approach and would recommend SAV-AIR to others. Among the seven participating customers interviewed for this MPER, only six said that they were entirely satisfied and just four would recommend SAV-AIR at this time.

Reasons for Nonparticipation Indicate Mixed Reviews of SAV-AIR

The nonparticipants interviewed for the previous MPER cited financial and communications difficulties with the SAV-AIR team, but did not indicate they had chosen other service providers. However, both of the nonparticipants interviewed for this MPER *are* going forward with less expensive control approaches offered by other providers. Both cited price as the main reason they declined, but one also indicated SAV-AIR was biased in pushing their approach when it was not seen by the customer as appropriate or optimal for their needs. The nonparticipant responses indicate that SAV-AIR's reaction to customers who decline their services could be more diplomatic.

General Market Discussion Points

Awareness of SAV-AIR Among Regional Market Actors Is Growing

In the research for the previous MPER, of the fourteen regional and national experts interviewed, thirteen were aware of SAV-AIR and ten said that the approach has some or significant value. For this report, among the seventeen market actors interviewed, sixteen were aware of SAV-AIR, and of those, nine said they would recommend SAV-AIR, albeit with caveats. In addition, SAV-AIR was cited as one of the regional leaders in compressed air system optimization.

Few End-Users Know of SAV-AIR

Among the fifteen end-users interviewed, only one had heard of SAV-AIR. Still, six of those that had not heard of SAV-AIR thought that its comprehensive approach and ongoing monitoring were interesting.

An Increase in the Use of Microprocessor Technology in New Compressors Makes SAV-AIR's Approach Less Cutting-Edge

Although there is still no direct competition to SAV-AIR from comparable compressed air control and monitoring systems in the region, the increased use

of microprocessor technology in air compressors and related equipment has "closed the gap" to some extent between SAV-AIR's most advanced offering (the *PL2000*) and what is available from major compressor manufacturers.

The increased use of microprocessors in air compressors may reduce the *apparent* differentiation between SAV-AIR's products and what customers see as typically available.

Update of SAV-AIR Goals

The new contract between the Alliance and SAV-AIR outlines a number of requirements for SAV-AIR to fulfill which are considered by both parties 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 that is explicitly required in this new contract is for SAV-AIR to demonstrate its control and monitoring system at six regional sites for at least six months. SAV-AIR has met this requirement. The Initiative's additional goals as described in SAV-AIR's current contract with the Alliance are:

- Pursing sales in key market segments – including wood products, chemical, paper, petroleum, food, primary metals, mining, and microelectronics;
- Updating their business plan – including strategies for marketing, production/service, research and development, organization and management, and reaching financial goals;
- Growing their non-utility working capital;
- Achieving energy savings of 10 million kWh under the current contract;
- Achieving non-energy benefits in new installations;
- Creating market awareness and interest in SAV-AIR's products and services; and
- Securing 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 status of this task can be found in the following section.

In addressing the achievement of contract goals, *Table 2*, below, summarizes SAV-AIR's progress to date. It also includes a brief description of ideas for moving forward to meet the goal.

Table 2: SAV-AIR Contract Goals and Progress

CONTRACT GOAL	PROGRESS TO DATE	CONCERNS AND STRATEGY TO ACHIEVE
PURSING SALES IN KEY MARKET SEGMENTS	The vast majority of sales are in wood products with little diversity.	Market diversity is important, but any sale is a priority at this point for SAV-AIR to succeed. Having regional reps will help achieve diversity.
UPDATING THE BUSINESS PLAN	The *Draft Business Plan* is not current nor does it include all elements described in the Alliance contract.	It is assumed that the business plan will eventually be crafted for outside investors. Sales are a priority at this point for SAV-AIR.
GROWING NON-UTILITY WORKING CAPITAL	SAV-AIR is not in a financial position in terms of sales to solicit outside capital.	There is a need to establish a sales history before soliciting capital.
ENERGY SAVINGS OF 10 MILLION KWH	Annual savings of 11.2 million kWh have been achieved.	This goal has been met.
ACHIEVING NON-ENERGY BENEFITS	Many projects have non-energy benefits, but are only described anecdotally.	Non-energy benefits need to be documented thoroughly so that they can be quantified.
CREATING MARKET AWARENESS OF SAV-AIR	Awareness is fair among market actors but low among end-users.	SAV-AIR has developed a plan for a broad marketing campaign. It needs to be put into place.
ONGOING SERVICE CONTRACTS	No ongoing contracts have been sold to date.	The market has shown little interest in ongoing service contracts. Bundling services with equipment may be a way to introduce the concept, but for now, sales are a priority for SAV-AIR.

SAV-AIR Business Plan

Over about two years, between November 1999 and September 2001, SAV-AIR produced five drafts of its *Business Plan.*[4] The latest business plan of

[4] Dated November 22, 1999, May 9, 2000, July 12, 2000, July 6, 2001, and September 1, 2001.

September 2001 is described as a "revised draft." It was prepared to meet the requirements of the second contract between the Alliance and SAV-AIR.

The revised draft plan has incorporated some but not all of the recommendations outlined in MPER #3. Thus many of these previous recommendations still stand and no further review was done for this report. However, it appears that SAV-AIR is deliberately delaying final polishing of the business plan until the time is right to tailor it for potential outside funders.

SAV-AIR Marketing Activities

SAV-AIR has been much more active with marketing since hiring a sales manager and establishing relationships with two regional sales representatives, one for the Northwest and another for Southern California. The goal has been to create a general awareness of SAV-AIR products and services. Their marketing activities have included:

- **Appearance at twelve tradeshow-type venues in the Western U.S.** SAV-AIR had a booth at all of these venues. At two of them, SAV-AIR either presented a paper on compressed air management or was mentioned during other presentations. The venues included a forest products show, two Instrumentation, Systems, and Automation Society (ISA) events, and Plant Engineering and Maintenance shows. Attendance at four other tradeshows is planned for the rest of the year. These include: SEMICON West in San Francisco (no booth), the Plant Engineering & Maintenance Shows in Seattle and Northern California, and the National ISA show in Chicago.

- **Establishment of sales representation through two organizations,** one with territory in Oregon and Washington and another in Southern California.[5]

- **Compressed air training for SAV-AIR sales reps** has included providing information and training on compressed air fundamentals and SAV-AIR products and services to their two sales representative

[5] K-Tech Sales of Anaheim, CA and Frost Engineering of Woodinville, WA.

organizations. SAV-AIR staff and the sales representatives will also attend *Compressed Air Challenge* training when available.

- **Dissemination of information on the *Compressed Air Challenge*.** In particular, SAV-AIR has distributed regional CAC success stories to customers. Their plan has been to use the CAC classes to introduce their customers and potential clients to compressed air optimization.

- **A mailing to about 30 compressor air equipment distributors**, which included case studies, a brochure, and an invitation to the Las Vegas ISA show where SAV-AIR was presenting a paper on compressed air optimization.

Support for this increased marketing activity has been an important part of the "adaptive management" feedback provided by MetaResource Group. As directed by Alliance staff in an informal meeting in April 2002, MetaResource Group has been involved in helping SAV-AIR craft their marketing materials and brochures, develop case studies, and upgrade the web site. MetaResource Group has also provided a third-party review of SAV-AIR's entire marketing approach. The additional marketing elements below were part of MetaResource Group's adaptive management activities:

- **A comprehensive review of current and potential marketing activity by a third party technical marketing expert.** This review included recommendations that SAV-AIR establish a consistent identity, a repeatable corporate message, and an approach for using this identity and message to take the company to the marketplace. Adaptive management included recommending the third party marketing expert who conducted the review. A summary of the resulting report is contained in *Appendix B*.

- **A complete revision of promotional literature**, particularly the principal brochure used for mailings and for distribution at tradeshows. Adaptive management included direct guidance on content, format, and language.

- **Preparation of SAV-AIR project success stories**. Adaptive management included direct guidance on content, format, and language.

- **A major update of the SAV-AIR web site**, including the addition of new interactive features and a complete set of current marketing materials and case studies. Adaptive management included introduction to a web designer, recommendations, and a review of the final site.

- **Research of the air compressor sequencer market**, which was used for comparison to the final design of the SAV-AIR *PL1000*.

- **Revisions to a *Drive Power* success story** that described a potential SAV-AIR project that included motor management attributes.

C. Assessment of SAV-AIR's Marketing Activities

As described above, a third party expert with particular experience in technical marketing conducted a review of SAV-AIR's marketing activity. The resulting sixteen-page *Marketing Report* provided a brief overview of SAV-AIR's present marketing strategy and made suggestions for capturing marketing and sales opportunities. A brief outline of the report content is provided below and a more detailed summary that includes recommendations and observations is provided in *Appendix B*.

1. **Corporate Identity –** Corporate identity is a critical element, providing SAV-AIR with recognition of consistency, longevity, market penetration, innovation, and dependability.

2. **Marketing Strategy –** Revenue and repeat business will be generated by developing a strategy and budget to support sales of product and services, which will increase visibility and opportunities to promote SAV-AIR in current and future markets.

3. **Research –** Research is needed to understand target market trends, customers' needs and market position, identify opportunities in existing and future markets, and to inform on other issues.

4. **Business Development (Selling) –** In-house and outside sales people need training that is integrated with the representatives' primary interests and should include testing. Reporting and feedback mechanisms need to be provided.

5. **Collateral Materials –** Materials that identify, promote, and encourage the purchase of SAV-AIR products and services should be developed and distributed. Everything should be considered, including corporate presentations, business cards, brochures, product tear sheets, project "success stories," letterhead and envelopes, proposals, and project photographs. Customer quotes and letters of recommendation on the SAV-AIR products, and advertising formats should be formally designed.

6. **Media Presence –** It is important to link commercial media presence with promotional opportunities whenever possible – i.e., conferences and trade shows publications, or introduction of a SAV-AIR product. Press releases should be distributed for any new SAV-AIR products or significant sales events.

7. **Event Representation –** Events such as tradeshows and related venues provide sales opportunities, market recognition, and partnership development.

8. **Web Site –** New customers will research credibility through web sites, and existing customers will use web sites as a source of information and product support. Competitors and prospective allies or partners evaluate companies via their web sites.

II. Compressed Air Market Actors

Seventeen regional compressed air market actors were interviewed in June 2002 as part of the research conducted for this MPER. These market actors consisted of four consultants, six compressed air distributors, and seven representatives of compressor manufacturers. All were from the Northwest, except one national manufacturer representative. None of the market actors interviewed for this report has been questioned previously for this SAV-AIR Initiative evaluation. The list of interviewees is provided in *Appendix A*.

The overall purpose of the survey was to obtain insights into the state of, and any recent changes in the market for compressed air services and optimization. There were also questions assessing attitudes toward, and awareness of, SAV-AIR and their approach.

Major findings from the market actor interviews include:

- Every respondent described his own company as a leader in terms of offering a systems approach or optimization services.
- SAV-AIR was also cited as one of the regional leaders in compressed air system optimization.
- The respondents see the entire compressed air industry, including consultants and end-users, as becoming more systems-oriented in its thinking.
- The respondents believe most end-users consider compressed air expensive, but very few of them have an idea of operating costs.
- Variable speed drives for compressors and computer controls are the most significant efficiency innovations recently introduced.
- Most respondents (82%) had heard of SAV-AIR.
- Most respondents reserved opinion about the SAV-AIR approach (7 of 17), but more of them had generally positive comments than generally negative ones (6 vs. 4).

- Most respondents did not know enough about SAV-AIR to describe any specific concerns about its approach. Of those that did express some concern, most cited cost-effectivity.
- The majority of respondents said they did not know if SAV-AIR is cost-effective based on energy or non-energy benefits.
- Despite any of the negative points mentioned above, a majority of respondents would recommend SAV-AIR to customers in cases where they thought it was an appropriate solution.

A. Market Actor Descriptions

Table 3, below, has a summary of the services and service geography of the market actors interviewed. Firms and locations are provided in *Appendix A*.

Table 3: Market Actor Services and Geography

MARKET ACTOR	SERVICES OFFERED	GEOGRAPHY
CONSULTANTS	Mechanical engineering and compressed air consulting	Three regional, one national
DISTRIBUTORS	Compressed air equipment distributor/vendors and system consultants/designers Two also manufacturer some equipment	Four regional, one national, and one local
MANUFACTURERS	Compressed air equipment manufacturers Two also distribute directly and offer consultant/ designer services	Seven, all international

In general, all market actors interviewed said that they provide services and equipment for a wide range of industries and compressed air users and systems. All were more involved with large compressed air systems, typically those over

100 horsepower. Two of the manufacturers provide only rotary screw and reciprocating compressors (no centrifugal machines).

The four consultants said an average of 28% of their recent work involved compressed air system audits, short- and long-term monitoring, and specification of system controls. Of the thirteen distributors and manufacturers, five estimated that an average of 11% of their sales involve systems controls. Most of the remaining eight pointed out that most of their product lines were integrated with sophisticated onboard control systems.

B. Market Actor Findings

Below are detailed findings from the market actor interviews.

Most End-Users Consider Compressed Air Expensive, But Few Know Actual Costs

According to the observations of end-use market actors, most believe that over two-thirds of end-users regard compressed air as expensive. (The results by actor segment are shown in *Table 4*.)

Table 4: Market Actor Impressions Regarding End-Users

MARKET ACTOR	PORTION END-USERS CONSIDER CA EXPENSIVE?	PORTION END-USERS KNOW CA COSTS?
CONSULTANTS	2 - Most (>67%) 0 - Some (33-67%) 2 - Few (<33%) 0 - None	0 - Most (>67%) 0 - Some (33-67%) 1 - Few (<33%) 3 - None
DISTRIBUTORS	3 - Most (>67%) 2 - Some (33-67%) 1 - Few (<33%) 0 – None	1 - Most (>67%) 1 - Some (33-67%) 1 - Few (<33%) 3 - None
MANUFACTURERS	5 - Most (>67%) 1 - Some (33-67%) 1 - Few (<33%) 0 – None	0 - Most (>67%) 3 - Some (33-67%) 3 - Few (<33%) 1 - None

Despite this, market actors also believe that few (less than one-third or perhaps none) of the end-users actually know their compressed air costs.

Recent Efficiency Innovations in Compressed Air Are Seen to Be Variable Speed Drives and Controls

All respondents were asked what they were seeing as the most recent innovations in compressed air optimization or efficiency. Respondents most consistently cited the application of variable speed drives to air compressors, followed by sequencer and computer-based control systems. A number of other comments were made regarding controls, and a very wide range of other innovations was mentioned. These verbatim responses follow *Table 5*, which summarizes major responses.

Table 5: Recent Innovations in Compressed Air Market

INNOVATION	NUMBER OF RESPONSES	PERCENTAGE
VARIABLE SPEED COMPRESSORS	11	65%
SEQUENCER-TYPE CONTROLS	6	35%
COMPUTER-BASED CONTROLS	6	35%
COMPRESSED AIR MONITORING	3	18%
OTHER COMMENTS	12	71%
TOTAL	38	

Comments Regarding Controls as Innovation:

- *Sequencers that integrate different types of machines.*
- *Controls that pick compressor for capacity needs.*
- *Recent innovations in controls, including manufacturer embedded controls.*
- *Intermediate and demand controllers (five responses).*

Other Comments Regarding Innovation:

- *Maintenance monitoring systems that communicate with compressors.*
- *Updating controls to load/no load from modulation.*
- *Re-evaluation of pressure setpoints.*
- *Quincy/Rogers capacity gauge.*
- *Ingersoll-Rand Nirvana compressor with synchronous motor with no limits on restarts.*
- *Rogers now offering VFD retrofit on Quincy NW machines.*
- *Instead of pneumatic pilot some now using electronic transducer.*
- *Part load controls.*
- *Zero loss drains.*
- *Heated air dryers.*
- *Hybrid permanent magnet synchronous motors with VFD.*
- *Two-stage technology, demand controllers with PID loops.*

All respondents felt that they offer compressed air system optimization, and all but one (a distributor) considers their own firm to be in the lead in offering optimization services. *Table 6* lists others mentioned by respondents as leaders in optimization services. This includes all market actors – consultants, distributors or manufacturers. Three other firms mentioned by respondents could not be clearly identified in an Internet search and so are not shown.

Of major significance is that four respondents indicated that SAV-AIR was among the leading firms offering compressed air optimization. The only other firm mentioned as often was Rogers Machinery. Rogers has a long history of more than 50 years of service, is widely known throughout the region (with seven branch offices), and also offers their own line of compressors. The recognition of SAV-AIR as a leader in optimization came with a few concerns

about SAV-AIR, centered around respondents' perception that that SAV-AIR's recommended solution was always the same – their own control system.

Table 6: Leading Firms Offering Compressed Air Optimization

NUMBER OF RESPONSES	FIRM
4	Rogers Machinery (regional distributor and mfr.)
4	SAV-AIR
3	Ingersoll-Rand (manufacturer)
2	Atlas Copco (manufacturer)
2	Compression Engineering (regional consultant)
1 MENTION EACH FOR:	Cooper Turbocompressor (manufacturer) The remainder are consultants and distributors: Tom Taranto, ConservAIR Technologies, WI Air Perfection, Inc., Dixon, CA Christenson Electric, Portland, OR (offers EnergAir Solutions) Air Science, Phoenix, AZ Cate Equipment Co., Salt Lake City, UT Benz Compressed Air Systems, LA, CA Power Engineers

There Were Strong Indications That There is a Trend Toward Offering a Systems Approach or Optimization

Market actors were asked if manufacturers, distributors, consultants, and end-users seem to be thinking more about system optimization this year as compared with last. The results are shown in *Table 7*. Overall, about 70% of respondents said they perceive an increase in consideration of optimization, although some said that it is not consistent throughout the market. A number of respondents also suggested that for some players, talk of system optimization was not backed up by capability or appropriate action. We believe that this increase in optimization is a general nationwide trend, but that regional utility

program activity, the *Compressed Air Challenge*, and in some measure SAV-AIR are also playing a role in supporting optimization the Pacific Northwest.

Table 7: Increase in Optimization Thinking

MARKET ACTOR	YES	NO	DON'T KNOW
MANUFACTURERS	14	2	1
DISTRIBUTORS	13	3	1
CONSULTANTS	10	5	2
END-USERS	12	4	1

C. Market Actor Findings Regarding SAV-AIR

During each of the interviews, the interviewer briefly described the SAV-AIR approach as a comprehensive monitoring program with provision of: real-time information and control capabilities; monitoring of leakage rates and compressor operation; and ongoing optimization. Only about 60% of the experts and market actors interviewed for the first MPER said they had heard of SAV-AIR when provided with this description. At that time, they generally thought it sounded like a good concept, but wondered about its cost-effectivity. In the interviews for the MPER previous to this current report (MPER #3 for which many of the same persons were interviewed as for MPER #1) 93% had heard of SAV-AIR. In the research for MPER #4, with a never-before interviewed group, 82% had heard of SAV-AIR. Again, respondents expressed concerns about cost-effectivity.

All respondents were asked their opinions of the cost-effectivity of the SAV-AIR approach, in terms of both energy savings and for non-energy benefits (only four of the seventeen market actors had some first-hand experience with a SAV-AIR system). The majority of respondents said they did not know if SAV-AIR was cost-effective, and most of the positive comments on cost-effectivity came with some reservations. When reviewing the responses on cost-effectivity (shown in *Table 8*), the reader must also consider that caveats accompanied the 'yes' responses.

Table 8: Opinions of SAV-AIR Cost-effectivity and Recommendation

QUESTION	YES	NO	DON'T KNOW
SAV-AIR IS COST-EFFECTIVE IN TERMS OF ENERGY SAVINGS	6	4	7
SAV-AIR IS COST-EFFECTIVE IN TERMS OF NON-ENERGY BENEFITS	3	5	9
WOULD RECOMMEND OR SPECIFY SAV-AIR	9	3	5

Also shown in *Table 8* are results from asking market actors if they would ever recommend or specify SAV-AIR for their customers. A slight majority (52%) said that they would recommend SAV-AIR, and a substantial number (29%) said that they didn't know. Again, most of the positive comments on recommendations came with some reservations.

Respondents' verbatim comments are below. Some suggest that respondents have little actual understanding of the SAV-AIR approach, while others recognize issues that SAV-AIR continues to grapple with.

General Comments Regarding SAV-AIR:

- *The concept of controlling multiple compressors of different manufacturers in different locations is great. The only drawback is the cost. This has to cost less than $20,000 to make it something we can sell. They are doing a great thing, but sure hope they can get the price down.*

- *I think it's a good approach in a very limited number of applications where the savings are large enough to justify it. For most situations, it's gross overkill to put in their full-blown system. I agreed with their reports that did not recommend their controls.*

- *The concept seems to make sense to me in terms of real-time metering.*

- *It's a bunch of Rogers [Machinery] salesmen. They have made a control system not unlike everyone else's. Just trying to sell a product. SAV-AIR is a control system; I have ones that do the*

same. I'm not a supporter of pressure controllers at all. Have brochure in hand. About the same thing as Bay Controls.

- *Haven't looked at their literature, but looking at the Northwest (region), they will need a broad market approach to stay busy.*
- *I guess I haven't heard. Out here it is difficult to use that kind of system because we are remote. I don't know, we need to evaluate it more.*
- *That type of approach is very good.*
- *I think it's a good approach. It takes a systems approach. Anything that tends to operate the CA system as a 'system' I am strongly in favor of. Both supply and demand side.*
- *Don't see that it's been tested and proven by an independent third party. I am leery of it.*
- *When you only offer controls, controls may appear to be the best solution.*
- *I think that I don't know it that well, it's probably OK, but air systems are dynamic, and once the demands change they need to be reprogrammed to work. Not sure what they are monitoring remotely, and what that tells them. You could think that the system was running well, the kW not exceeding what it was, but does that tell you what is going on in the system? I don' think so.*
- *I think it makes sense. What you are probably going to see is manufacturers over time coming up with their own systems.*

Respondents were also asked if they had concerns about the SAV-AIR approach. Five had no concerns, including one that was *"None whatsoever."* Three of the voiced concerns were regarding the cost-effectivity of the SAV-AIR approach. The verbatim concerns about SAV-AIR are below.

Concerns about SAV-AIR:

- *These guys are kind of new on the block, some customers are not sure that this 'black box' approach is a safe investment if SAV-AIR*

goes out of business. A potential solution is to put all the technical details in trust.

- *Need to have lots of horsepower and a complex system to justify SAV-AIR.*
- *Concerned about cost-effectivity, it's quite expensive.*
- *No, have not got on bandwagon with pressure/volume controllers.*
- *A couple of [my concerns] are that no way that the system will work. It just will not work.*
- *Depends on if they are working with a single compressor distributor.*
- *Don't know enough to have concerns. Generally, I trust the people at SAV-AIR. I know that they would take a good systems approach and I would recommend them to anybody. Our [Control Brand] doesn't have the sophistication of SAV-AIR as it isn't customized like SAV-AIR is.*
- *It seems to be a very expensive solution. It appears to be more than is necessary to accomplish an energy efficient solution. I don't know that you could pick up leaks or added end-uses clearly. But that doesn't mean that the system is running properly. Some customers may be better off with efficient compressors rather than the expense of SAV-AIR.*
- *No, I don't think [I have any concerns]. It complements what we do as a manufacturer.*

D. Conclusions from Market Actors

The market actor results are very positive, considering the short time SAV-AIR has been active in the marketplace.

- **Awareness of SAV-AIR is high.** Fourteen out of seventeen (82%) had heard of SAV-AIR.

- **SAV-AIR is considered credible.** Respondents generally considered the SAV-AIR approach to be credible and technically appropriate – in fact, SAV-AIR was considered to be one of the regional leaders in system optimization.

- **SAV-AIR is recommended by a slim majority.** The most significant complement is that a majority, albeit slim, of market actors said they would recommend SAV-AIR if they believed it was an appropriate solution for a customer.

- **Market actors still have concerns.** Concerns remain regarding impressions that SAV-AIR's approach is biased, and that it is costly and perhaps not cost-effective.

- **The market is moving towards a systems approach.** The regional market for compressed air services appears to be moving towards an increased awareness of a systems approach and optimization. In fact, all actors regard themselves as leaders in optimization.

- **End-user knowledge and awareness are mixed.** It appears that even though end-users also have increased awareness of optimization and consider compressed air expensive, few of them have an idea of compressed air cost.

- ***Compressed Air Challenge* is impacting market actors, but end-user awareness is low.** Some of the improvements seen in knowledge and approach among market actors may be due to the *Compressed Air Challenge*. CAC seems to be having an impact on manufacturers, distributors, and consultants at least, even if end-users are generally not even aware of the training. The market seems to have a broad knowledge of technical innovation, some of which indicates that SAV-AIR will have more apparent competition from other control offerings.

II. Compressed Air Market Actors

III. Compressed Air End-users

A. End-User Survey and Description

To assess the general market for compressed air services, telephone interviews were conducted with fifteen compressed air end-users that had never been contacted by SAV-AIR. Three of them had relatively small compressed air systems for which the SAV-AIR system might not be appropriate, but the remainder had two or more air compressors with a total horsepower over 250. The overall purpose of the survey was to assess awareness of compressed air costs and attitudes about system management, and to assess awareness of SAV-AIR and their services.

Since completed surveys were available for all fifteen end-users, the results in this section include all respondents. The number of end-users is show by industry and location in *Tables 9* and *10*.

Table 9: Compressed Air End-Users by Industry

INDUSTRY	OVER 25O HP	UNDER 100 HP
PAPER AND PULP	1	
CHEMICALS AND ALLIED PRODUCTS	1	
WATER SUPPLY AND WASTEWATER	0	1
FOOD AND KINDRED PRODUCTS	3	1
LUMBER AND WOOD PRODUCTS	4	
PETROLEUM AND COAL	1	
PRIMARY METALS	1	1
MICROELECTRONICS	1	
TOTAL	12	3

Table 10: Compressed Air End-Users by State

STATE	OVER 250 HP	UNDER 100 HP
OREGON	4	1
WASHINGTON	5	1
IDAHO	1	1
MONTANA	2	
TOTAL	12	3

Major points from the compressed end-user interviews include:

- Two-thirds of the end-users regard compressed air as expensive, but only one-quarter claim to know its costs.
- The most often cited barrier to efficiency in compressed air system operation was a focus on production that only required that compressed air systems run – with few other objectives.
- Nearly half of the respondents have been approached by vendors or manufacturers in the last year for major upgrades or system optimization.
- Only one of the fifteen respondents had heard of SAV-AIR.
- Based on the description of SAV-AIR given by the interviewer, 40% of respondents said SAV-AIR's approach sounded useful, but a number of those had concerns about cost-effectivity.
- None of the compressed air end-users had heard of *Compressed Air Challenge*.

The average total horsepower for all 15 end-user sites was just over 700 HP, with an average of about four compressors each. The distribution of total compressor horsepower is shown in *Table 11*.

Table 11: Compressed Air End-Users Horsepower

TOTAL COMPRESSOR HP	NUMBER
LESS THAN 100 HP	3
100 TO 400 HP	6
400 TO 1200 HP	3
1200 TO 3000 HP	3
TOTAL	15

B. End-User Survey Results

Individual respondents were selected for interview because of familiarity with their compressed air system. Eight of the fifteen respondents held the title of maintenance manager, three were engineers, two were lead mechanics, one was a facility manager, and one was an operations manager.

Two-Thirds of the End-Users Regard Compressed Air As Expensive

Although the majority of end-users believed compressed air to be expensive, only one-quarter even had a rough idea of how much of their electric bill was from compressor operation.

Relatively Few End-Users Were Interested In Reducing Energy Costs

Most respondents said their objectives for running their compressed air system were to maintain continuous operation and improve production (80% for each). Many fewer were interested in reducing compressed air energy costs (33%). Other objectives for compressed air management are shown in *Table 12*.

Table 12: Compressed Air Management Objectives

OBJECTIVE	RESPONSES	PERCENTAGE
MAINTAIN CONTINUOUS OPERATION	12	80%
INSURE SYSTEM RELIABILITY	3	20%
ENSURE ADEQUATE SUPPLY OF AIR TO END-USES	1	7%
IMPROVED OR INCREASED PRODUCTION (FEWER REJECTS)	12	80%
CONTROL OR REDUCE ENERGY COSTS/ENERGY USE	5	33%
MEET PROCESS QUALITY STANDARDS	1	7%
OTHER – PRESSURE DEADBAND	1	7%
TOTAL	35	

For Compressed Air Management Practices, Most End-Users Use Short-Term Compressor Monitoring and Have An Informal Leak Repair Program

As noted earlier, only a small number track compressed air costs. *Table 13* shows compressed air management practices used by respondents.

Table 13: Compressed Air Management Practices

MANAGEMENT PRACTICE	RESPONSES	PERCENTAGE
SHORT-TERM COMPRESSOR MONITORING	13	87%
LONG-TERM COMPRESSOR MONITORING	5	33%
LEAK DETECTION	7	47%
LEAK REPAIR	14	93%
TRACKING COMPRESSED AIR COSTS	2	13%
IMPROVING CA SYSTEM CONTROL STRATEGIES	6	40%
USING FORMAL ANALYSIS TO JUSTIFY CA CHANGES / UPGRADES	4	27%
TOTAL	51	

Compressed Air End-Users Are Influenced Most by Vendor Recommendations

Experience within their own company is important and case studies are also influential. Interview results are shown in *Table 14*.

Table 14: Compressed Air Management Influences

INFLUENCE	RESPONSES	PERCENTAGE
WEB SITES	4	27%
ANOTHER COMPANY'S SUCCESS THROUGH CASE STUDIES	7	47%
EXPERIENCE WITHIN COMPANY THROUGH A PILOT PROJECT	8	53%
CONSULTANT RECOMMENDATIONS	5	33%
VENDOR RECOMMENDATIONS	10	67%
ARTICLES OR ADVERTISEMENTS IN A PROFESSIONAL PUBLICATION	6	40%
OTHER: "*47 YEARS OF EXPERIENCE*," AND "*GO WITH WHAT'S WORKED IN THE PAST*"	2	13%
TOTAL	42	

Results Were Mixed Regarding Probability of Replication

Regarding replication, of those companies with multiple plants, 33% said that replication of a successful compressed air improvement was very likely, and another 42% said it was somewhat likely. The remaining 25% thought it was not at all likely.

The Most Often Cited Barrier to Effective Compressed Air System Operation Was the Focus on Production

The need to maintain production was cited by 40% of respondents as a barrier to effective compressed air system operation. Respondents also cited a limited budget for efficiency, interestingly as often as other respondents said there were

no barriers to getting their system to run more effectively. Marketing approaches that address these barriers, especially the lack of focus on compressed air, may be effective. All responses to this question are shown in *Table 15*.

Table 15: Barriers to Effective Compressed Air System Operation

BARRIERS	RESPONSES	PERCENTAGE
NO BARRIERS	3	20%
NOT ENOUGH STAFF TIME	2	13%
NO BUDGET FOR ACTIVITIES RELATED TO IMPROVED EFFICIENCY	3	20%
EFFICIENCY MEASURES ARE TOO EXPENSIVE	1	7%
FOCUS IS ON PRODUCTION (KEEPING THINGS RUNNING)	6	40%
LACK OF ACCOUNTABILITY FOR COMPRESSED AIR COSTS	1	7%
LACK OF TECHNICAL EXPERTISE	1	7%
OTHER: – EDUCATING WORKERS REGARDING BLOWDOWN (2 RESPONSES) – RUN COMPRESSORS SO HARD THE OIL CONTAMINATES AIR DRYER – TOOK OVER OLD FACILITY AND CA NOT A PRIORITY	4	27%
TOTAL	21	

Nearly Half of the Respondents Have Been Approached by Vendors or Manufacturers in the Last Year for Major Upgrades or System Optimization

Those approached had the largest systems. Two of the seven contacts were made through utilities. Four of the seven purchased the upgrade that was proposed. Most went forward with the upgrade for energy savings or to control energy costs (five responses), and a few were interested in changes to

improve production. Most that did not go forward found the upgrades too expensive or not cost-effective.

Only One of the Fifteen Respondents Had Heard of SAV-AIR

This was someone that had heard of a SAV-AIR project at a Weyerhaeuser (formerly Willamette) facility. When all respondents were asked if the described SAV-AIR approach sounded useful to them, six of fifteen said "yes," but a number of those had concerns about cost-effectivity. All of those that said "yes" use some sort of outside training for compressed air. Six of the eight that said "no" believed that the SAV-AIR approach was not appropriate for their system – either due to their small size or the way they operated their compressors. Four of those eight did all their compressed air training in-house.

Not One of the Compressed Air End-Users Had Heard of *Compressed Air Challenge*

As noted above, there was a correlation found between those that have received outside training for compressed air (typically from vendors) and an interest in system management, controls, optimization, and monitoring. This finding was also observed in MPER #3.

C. Conclusions from Compressed Air End-Users

Plant Staff Being Stretched Thin Can Create Opportunity

The researcher on this project had great difficulty reaching and interviewing compressed air end-users. This was also the case for SAV-AIR participants and nonparticipants (end-users approached by SAV-AIR but who did not buy their services). We believe that this is indicative of current economic conditions, short plant staffing, and multiple job responsibilities. This may be a barrier for any type of improvement in management for energy efficiency, but may allow control upgrades to be sold on the basis of reducing the attention required to operate compressed air systems.

SAV-AIR Needs a Marketing Campaign

While nearly half of the respondents had been approached by vendors or manufacturers for major upgrades, no marketing information regarding SAV-AIR has reached any of them. Only one of the fifteen had heard of SAV-AIR by word of mouth. Since there appears to be some general interest in improving compressed air system management, SAV-AIR should proceed with a marketing campaign.

SAV-AIR Should Vigorously Promote Training to Create Knowledgeable Customers

The fact that two-thirds of the end-users regard compressed air as expensive, but only one-quarter know their compressed air costs, is indicative of the need for compressed air training. But none of them had heard of *Compressed Air Challenge*, one of the best training programs available. Further, those that had any outside training were more open to monitoring and system optimization. This suggests that promotion and support of CAC by SAV-AIR or others promoting system optimization is a critical element of a long-term strategy for building a customer base for the SAV-AIR system.

IV. SAV-AIR Nonparticipant Interviews

A. SAV-AIR Nonparticipants

Two telephone interviews with firms that decided not to become SAV-AIR customers were conducted in July 2002. Two other nonparticipants declined interviews. The respondents were from the primary metals and wood products industries. One of these 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*). The other customer received the performance evaluation and recommendation of SAV-AIR from a consultant.

Major points gleaned from the nonparticipant interviews include:

- Not all nonparticipants were willing (or had time) to be interviewed.
- Both nonparticipants who were interviewed elected to install an alternative control system at a lower cost; a control system that did not have monitoring capabilities.
- The respondents expressed some dissatisfaction with the SAV-AIR sales approach and described some communication difficulties with SAV-AIR.
- Despite the issues noted above, both nonparticipants expressed general positive comments about SAV-AIR. One of them was impressed with SAV-AIRs' responsiveness and would recommend them to other companies.
- Both of the nonparticipants expect reliability, reduced pressure fluctuations, and energy savings benefits from their alternative control systems.

B. Nonparticipant Results

Each of the nonparticipants interviewed had four or more air compressors, with an average total horsepower of about 700 HP. Both regard compressed air as an expensive part of their operations. In general, their management and

operations approach was to sustain constant pressure in their systems to maintain continuous operation. Each used manual operation to control their compressors.

It is significant that two other nonparticipants declined to be interviewed. This is significant because in the past (for MPER #3) all nonparticipants agreed to be interviewed. Both declining nonparticipants seemed busy and one stated so directly. The other said that SAV-AIR's *Phase I* evaluation could not prove any benefit. Both of the nonparticipants interviewed are now pursuing alternatives to the SAV-AIR *PL2000*. One has decided to purchase controls from another vendor and the other is implementing their own strategy using programmable logic controllers. Each of them has also implemented some of the other recommendations SAV-AIR had made for their compressed air system beside controls.

C. Compressed Air Training

Only one of the two respondents had heard of the *Compressed Air Challenge,* but he had not attended a class. Both respondents depended primarily on in-house (on the job) training on their compressed air systems for themselves and their staff. One of them occasionally used outside vendors to provide staff with informal training on equipment maintenance and operation.

D. Conclusions from Nonparticipants

No strong conclusions can be drawn from only two respondents. However, we note that each has elected to go with a less expensive alternative control system that does not have the monitoring or sophisticated control capabilities of the *PL2000*. Cost appears to be the main driver in selection of alternatives to SAV-AIR.

V. SAV-AIR Customer Interviews

Over the last eleven months since MPER #3 was prepared, there have been eight new SAV-AIR customers. Each participating customer has installed the SAV-AIR *PL2000* compressed air control and monitoring system and has also implemented other system upgrades. Seven of these participants were interviewed for this MPER #4, as the eighth plant was closed due to economic conditions. Six phone interviews were conducted in July 2002, and one survey was returned by mail. Six participants were from the same industry – primary wood products – while the seventh was involved in recreational transportation manufacturing. All seven participant experiences are discussed below.

These eight SAV-AIR customers have between one and five operational air compressors (standby units were not counted), with total capacity ranging from 150 HP to 750 HP, and an average installed capacity of 460 HP.

Six of the seven respondents regard compressed air as an expensive part of their operations. The other regarded it as "minor in the grand scheme of things." Just two of them had even a rough idea of their compressed air operating costs before working with SAV-AIR. Five felt it was useful for their company to know compressed air costs.

For these interviews, SAV-AIR introduced the researcher to their customers. Most often this was a maintenance supervisor, but respondents also included management staff. Because of their focus on maintenance, these respondents did not necessarily have a production or operation viewpoint and, conversely, the management staff did not necessarily know all details of the compressed air system.

A. Participant Experience with SAV-AIR

Prior to using the SAV-AIR approach, most participants had operated their systems manually in some fashion and one respondent said that they had some kind of sequencer. Most described their operational objectives as maintaining continuous operation and providing an adequate supply of air to end-uses. Prior to SAV-AIR, each had had occasional problems with adequate air supply (low pressure) and difficulties with system maintenance.

Table 16 shows the compressed air management objectives mentioned by participants. Those most often cited were maintaining compressed air operation, ensuring adequate air supply to end-uses, and controlling energy costs.

Table 16: Participant Management Objectives before SAV-AIR

OBJECTIVE	SELECTED	PERCENTAGE
MAINTAIN CONTINUOUS OPERATION	5	71%
ENSURE ADEQUATE SUPPLY OF AIR TO END-USES	5	71%
CONTROL OR REDUCE ENERGY COSTS / ENERGY USE	1	14%
MAINTAIN QUALITY OF AIR SUPPLIED (CLEAN AND DRY AIR)	3	43%
REDUCE MAINTENANCE AND REPAIR OF THE COMPRESSED AIR SYSTEM	1	14%
TOTAL	16	

Five of the seven respondents indicated that their objectives for management of their compressed air system have changed after working with SAV-AIR. One of the others said that did not know if their objectives would change, as the SAV-AIR system was not yet fully operational at their plant. The last respondent was from a new construction project that could not compare objectives before and after.

Five of the respondents had not previously done any compressor power monitoring, and six acknowledged that that information is now available to them from the SAV-AIR system. Three described that they had made improvements in their air leak detection and repair programs after working with SAV-AIR, and four are now using the SAV-AIR system to track compressed air costs, whereas they did nothing of the sort before. Verbatim comments on compressed air management changes are provided below:

- *[Our management objectives] are going to change. We are going to control it [compressed air costs], which we've never been able to do before.*

- *[We will] most definitely [make compressed air management changes]. Kind of opened our eyes to doing more preventative maintenance. We are now doing all stuff we are supposed to do on schedule. I think we are getting a more reliable system.*

- *Yes, with SAV-AIR, [our] guy goes around and reads daily trends, making sure it operates in an efficient manner. Before [the monitoring system was in place], it didn't get done.*

- *We want to minimize cost of electricity, which is fairly substantial anymore, and run the compressors in an efficient manner. [We] don't need to have them all running full bore, we can run just one. It's a tons better system.*

- *We do maintenance differently and operation is now automatic with SAV-AIR.*

Only one of the seven participants expressed limited interest in having SAV-AIR provide ongoing, long-term monitoring and management services (*Phase III*) for their compressed air systems, and one respondent was not even aware that it was available. The rest were not interested.

The participants were asked what influenced them most to adopt new compressed air management tools and approaches (s*ee Table 17*).

Table 17: Influences for Compressed Air Management

INFLUENCE	SELECTED
SAV-AIR'S RECOMMENDATIONS	3
VENDOR'S RECOMMENDATIONS	1
HEARING ABOUT ANOTHER COMPANY'S SUCCESS THROUGH CASE STUDIES	1
PEERS / PEER GROUPS / ORGANIZATIONS	1
CORPORATE ENGINEERING	1
CONSULTANT RECOMMENDATIONS	2
ARTICLES OR ADVERTISEMENTS IN A PROFESSIONAL PUBLICATION	2
RECOMMENDATION OF UTILITY	1

As they are SAV-AIR customers, it was not surprising that SAV-AIR was selected most often, but other vendors and consultants were also influential. One of the respondents noted that the implementation of SAV-AIR in his facility was by corporate directive. This individual also was the least aware of how the SAV-AIR *PL2000* control panel and monitoring data could be used for compressed air management.

There was no strong consensus from respondents on what was the most significant impediment to compressed air system optimization. Two respondents said that they experienced no barriers to effective compressed air system operation. Not enough staff time was selected most often, and most of the rest of the responses were one vote each. Five of the seven respondents felt that working with SAV-AIR would help them overcome the barriers they described. *Table 18* shows the results.

Table 18: Barriers to Effective Compressed Air Management

BARRIER	SELECTED
NOT ENOUGH STAFF TIME	3
NO BUDGET FOR EFFICIENCY	1
EFFICIENCY MEASURES TOO EXPENSIVE	1
PAYBACK REQUIREMENTS ARE TOO SHORT	1
FOCUS IS ON PRODUCTION	1
LACK OF ACCOUNTABILITY FOR CA SYSTEMS AND COSTS	1
LACK OF INFORMATION ABOUT CA SYSTEM PERFORMANCE	1
LACK OF TECHNICAL EXPERTISE	1
LACK OF TRAINING	1
NO BARRIERS TO EFFECTIVE OPERATION	2

B. Project Descriptions

Table 19 summarizes all eleven SAV-AIR projects to date, including those described in MPER #3. In each case, a *PL2000* control and monitoring system

was installed and the facility operations were essentially unchanged before and after installation of the SAV-AIR system. The measured savings percentage is of compressed air energy costs and the simple payback in the table is based on energy savings alone and does not include utility incentives, *Oregon Business Energy Tax Credits*, or the value of non-energy benefits. Note that two projects have closed due to economic conditions and that one project is not yet fully commissioned, so that savings are estimated rather than measured.

Table 19: In-Region Project Summary

PARTICIPANT	ANNUAL CA ENERGY COSTS			PROJECT		
	Before	After	Measured Savings	Included	Cost	Payback*
MINERAL PROCESSING	$175,000	$77,000	$98,000 (56%)	Controls, 3 compressors, dryer, receiver, new building, piping	$395,000 **	4.0
WOOD PRODUCTS A	$175,000	$120,000	$55,000 (31%)	Controls, receiver, dryer repair	$110,000	2.0
METALS CASTING	$193,000	$118,000	$75,000 (39%)	Controls	$30,000	0.4
CABLE MANUFACTURER (PLANT CLOSED)	$53,300	$28,200	$25,100 (47%)	Controls, one compressor	$52,000	2.1
PLYWOOD PLANT A	$120,000	$99,600	$20,400 (17%)	Controls, valve upgrades	$123,000	6.0
PARTICLE BOARD PLANT	$85,000 Estimated	$64,000	$21,000 (25%)	Controls and system design for Greenfield plant	$21,000	1.0

Continued

PARTICIPANT	ANNUAL CA ENERGY COSTS			PROJECT		
	Before	After	Measured Savings	Included	Cost	Payback*
WOOD PRODUCTS B	$118,000	$76,700	$41,300 (35%)	Controls, piping, receiver	$175,000	4.2
TRANSPORTATION MANUFACTURER	$82,500	$55,000	$27,500 (33%) Estimated	Controls, piping, receiver	$101,000	3.7
WOOD PRODUCTS C	$74,500	$30,000	$44,500 (60%)	Controls, dryer, piping, receiver	$138,000	3.1
WOOD PRODUCTS D	$104,400	$68,200	$36,200 (35%)	Controls, receiver	$122,500	3.4
PLYWOOD PLANT B	$120,700	$86,400	$34,300 (28%)	Controls, piping, dryer, receiver, move compressor	$103,000	3.0
WOOD PRODUCTS E (PLANT CLOSED) ***	$143,500	$114,200	$29,300 (20%)	Controls, receiver, two compres-sors	$80,000	2.7

* All project paybacks are from energy savings alone.

** Project costs were for a complete new compressed air system and a building that would have been needed, regardless of the efficiency project.

*** Project costs do not include two new replacement compressors.

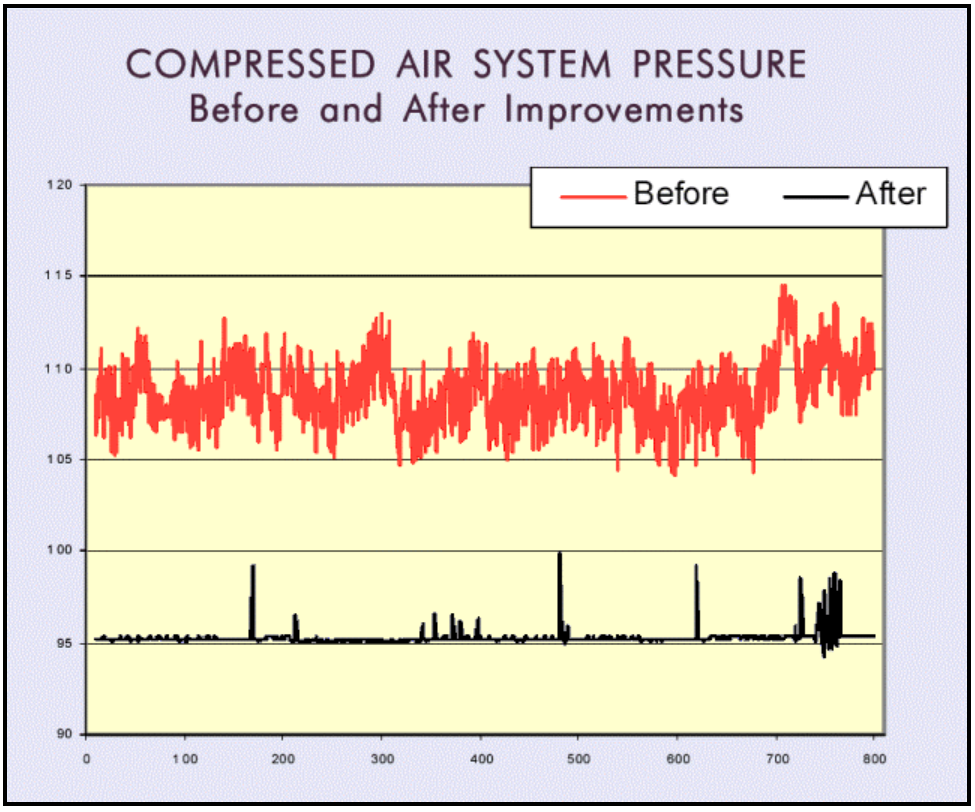
C. Non-Energy Benefits

Eight of the eleven SAV-AIR customers have also experienced some benefits beyond energy cost savings. A number believe that improved compressed air pressure regulation is essentially the only non-energy benefit and that there are no other cost savings or production advantages. For two of the plants, the

SAV-AIR system installation was too recent for the respondents to describe any other benefits. Descriptions of non-energy benefits are provided below.

The most often cited non-energy advantage of the SAV-AIR system is its ability to provide stable air pressure. The graph shown in *Figure 1*, below, provides an example the pressure variation before and after implementation of the SAV-AIR improvements for the Cable Manufacturer. Additional air storage or receivers were often a part of all the projects listed above. Although it is true that additional receiver capacity on its own can contribute to stabilizing pressure, most systems have much less receiver capacity than called for in typical design practice.

Figure 1: Pressure Variation Before and After SAV-AIR



Minerals Processing

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 (dry air). 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.

Metals Casting

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

In addition to the electrical energy cost savings shown in the table 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

With the SAV-AIR system, this plant was less apt to have production losses due to inadequate air pressure or air system shutdown. When production problems due to air pressure occurred before SAV-AIR, it was sometimes necessary to install a joint in the cable, or perhaps throw out 1,000 meters of specialized submarine communications cable. If this occurred once a year, the value of lost production would be $200,000 – four times the energy savings.

The maintenance staff also used the SAV-AIR monitoring system to quickly see if there were any problems with the air system. Compressor maintenance was also easier with the backup compressor that was installed as part of the SAV-AIR project. With the SAV-AIR system, they had increased reliability and

improved air pressure stability, which allowed them to reduce system pressure from 115 to 95 psig.

Wood Products A

Production has increased as a result of the SAV-AIR system, but as they made other improvements at the same time, it is 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.

Plywood Plant A

For this plant, in addition to stabilized pressure, there is now comprehensive control over the air compressors – previously these had been manually controlled and they had run continuously. Low pressure caused problems for some machines only a couple of times a year and no production was lost due to these incidents.

Transportation Manufacturer

For this manufacturing plant, the SAV-AIR system provided improved control so that fewer air compressors were needed. This freed up capital equipment (air compressors) for use at another corporate facility.

Wood Products D

This wood products plant was able to lower pressure with the improved regulation of the SAV-AIR system, providing even greater savings. A

quantifiable non-energy benefit was also related to better pressure control. Previously, low air pressure would shut down one of their production lines about once a week. Although the outage was only for a few minutes, some product was damaged when the machinery stopped. A rough estimate of the value of the lost product is $24,000 annually, about two-thirds of the energy cost savings.

Plywood Plant B

Low air pressure caused problems several times a week for a production line applying panel glue. Perhaps twenty panels would be ruined when this line tripped off on low air pressure. The lost product was valued at approximately $25,000 annually. This is about three-quarters of the energy cost savings.

Although not directly related to their control system, SAV-AIR also recommended and installed a new air dryer, resulting in improved air drying and safer plant operation. Before, the plant had problems with air-line freezing. Plant staff dealt with this by injecting methanol (an antifreeze) into the air lines, creating both a fire hazard and a hidden maintenance problem as the methanol damaged the seals of air valves and cylinders. They have already seen a benefit in reduced maintenance of these components.

D. SAV-AIR Satisfaction

Respondents were asked a series of seven questions about satisfaction with SAV-AIR's services. These seven respondents were only 80% positive in their satisfaction with SAV-AIR's services, compared to a 95% rating for the four customers surveyed in MPER #3. Two respondents said they were withholding some of their opinions of satisfaction until the installation was fully completed and they had more experience with the SAV-AIR system.

The major negative response was regarding delivery of services for the installation of a *PL2000*. As confidentiality of the customer was promised, details cannot be provided. Essentially this customer does not believe that there are energy savings and does not feel that the *PL2000* installation was completed according to their needs.

E. Compressed Air Training

Not one of the SAV-AIR participants had heard of *Compressed Air Challenge*. All of the respondents say that they rely on in-house or hands-on training for compressed air systems for their staff. Another has 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.

V. SAV-AIR Customer Interviews

VI. SAV-AIR Cost-Effectiveness Review

A. Introduction

As part of the review of the *SAV-AIR Market Transformation Initiative*, the evaluators periodically examine the assumptions upon which the initiative's cost-effectiveness is based. The last review of these assumptions was conducted for MPER #2; a final review will be prepared for MPER #5. The original cost-effectiveness assumptions were based on work by the Alliance and the original proposal for the SAV-AIR *Master Plan*.

This review of cost-effectiveness assumptions is a joint effort undertaken by SAV-AIR and MetaResource Group in that both provided data to help gauge the energy savings achieved through compressed air optimization, the total potential market, and the likelihood of this market to adopt the service. Relying primarily on projects that SAV-AIR has implemented, recommendations were developed for revising the program assumptions to reflect actual conditions and projections of market share and energy savings impacts through the year 2010.

The adoption of any recommendations to revise assumptions for the cost-effectiveness calculations should be the result of collective decision-making by the Alliance, SAV-AIR, and the evaluation team.

B. Cost-Effectiveness Assumptions

Cost-effectiveness assumptions refer to those factors that directly impact the overall estimates of program viability. The initial inputs used at the beginning of the SAV-AIR Initiative are shown in *Table 20*.

Table 20: Total Market Cost-Effectiveness Inputs

COST-EFFECTIVENESS INPUTS	
UNIT	Medium Compressed Air System Optimization
TOTAL NUMBER OF UNITS	938
MEASURE LIFETIME YEARS	10 years
NON-ENERGY BENEFITS SAVINGS/YEAR	$0 (initially assumed, although clearly non-zero)
COMPRESSED AIR EFFICIENCY IMPROVEMENT	25%
COMPRESSED AIR EFFICIENCY SAVINGS/ FACILITY/ YEAR (KWH/YEAR)	918,979
ONGOING SERVICES COST/ FACILITY/ YEAR	$14,400
CAPITAL COSTS	$36,200

Program expenditures are also included in cost-effectiveness assumptions and are presented below in *Table 21* for each of the years of the Initiative to date. These are approximate values based on the best information available. The costs should be revised to reflect actual invoiced amounts.

Table 21: Program Cost Inputs

INPUT CATEGORY	1999	2000	2001
TOTAL ALLIANCE PROJECT COSTS	$943,200	$851,600	$131,700
ALLIANCE EVALUATION	$46,700	$78,100	$25,500

Impact Estimates

At the time of proposal adoption, it was assumed that of the proposed 938 total potential facilities, 381 would be appropriate candidates for *SAV-AIR System Optimization,* which would result in 40 average megawatts (aMW) of savings during the period through 2010.

Baseline

The original cost-effectivity analysis assumed that there were 938 medium-sized industrial compressed air facilities in the Northwest, each with an average of 750 horsepower installed capacity, and each with the potential for efficiency improvement of 25%. The total annual electricity use for compressed air in the Northwest was estimated to be 3,400 million kWh. As mentioned above, the proposal estimated that 381 sites would encompass the total market penetration through 2010 for SAV-AIR.

C. Recommendations for Changes to Assumptions

This section presents recommendations for changes to be made to the baseline and to the original cost-effectiveness assumptions presented in *Table 20* above. A discussion of each of the recommendations follows the presentation of the recommendations in *Table 22*.

Table 22: Summary of Recommendations for Changes to Assumptions

INPUT	ORIGINAL ASSUMPTION	RECOMMENDATION
UNIT	One Industrial Air Compressor System (average of medium facility, 750 HP)	One Industrial Air Compressor System (average of SAV-AIR customers, 450 HP)
ESTIMATED TOTAL NUMBER OF UNITS	938	800
MEASURE LIFETIME, YEARS	10	10
COMPRESSED AIR EFFICIENCY IMPROVEMENT	25%	35%
NON-ENERGY BENEFITS	None considered	60% of energy savings
ANNUAL O&M COST	$14,400	$16,600
CAPITAL COST	$36,200	$120,000
MEASURE SAVINGS, KWH/YEAR	918,979	1,100,000
TREATED UNITS, 1999-2000	6	1
TREATED UNITS, 2001-2002		12
TREATED UNITS, 2001-2010	375	199

Project Size

It is recommended that the "treated unit" of a typical industrial air compressor system be set to the average size of SAV-AIR customers to date, which is 450 total compressed air horsepower. This would be considered at the high end of medium-sized compressed air systems.

Capital Costs

According to SAV-AIR, the average cost for the majority of *Phase II* installations is between $120,000 and $150,000. The average of all projects completed to date is at the low end of that range and is the current recommended value. The average cost often includes improvements, in addition to the *SAV-AIR PL2000* controls, which are needed to make each compressed air system fully functional. For example, projects have included new compressors, air dryers, receivers, and distribution piping modifications.

Operation and Maintenance Costs

Operation and maintenance costs are to be paid by the facilities for keeping control equipment up to date, in tune with current compressed air demands, and to ensure savings persistence. It was assumed that these ongoing operation and maintenance costs are represented by *SAV-AIR Phase III – Ongoing Monitoring Services*. The estimated costs of the ongoing monitoring services are estimated in the most recent *Business Plan* at an average value of $16,600. No customers to date have used the comprehensive *Phase III* services approach – instead they have elected to contract with SAV-AIR as needed for controls adjustment, at a cost of one or two thousand dollars per year. Additional information on the actual distribution of these operations and maintenance approaches will be researched for the final cost-effectiveness recommendations in MPER #5.

Lifetime of Measure

The lifetime of the measure is still assumed to be ten years.

Savings

The savings from the twelve projects to date have averaged 35% of compressed air costs, or 1,100,000 kWh annually, for the average system size of 450 HP.

Non-Energy Benefits

Eight of the twelve SAV-AIR projects completed to date have described some non-energy benefit, and four of the project sites have provided descriptions of monetary value beyond energy savings that resulted from the use of SAV-AIR controls. The average monetary value of non-energy benefits from these four projects is about 60% of the value of the energy savings.

Market Penetration

The 2010 market penetration has been revised downward from interpretation of interview results from the two most recent MPERs. Although the number of facilities that could utilize and purchase an advanced compressed air monitoring system like the *SAV-AIR PL2000* is larger, at about 400 units, than recommended in MPER #2, it appears that only a fraction of facilities will take advantage of such technology under any circumstances. A revised 2010 penetration of 200 treated units is recommended.

VI. SAV-AIR Cost-Effectiveness Review

VII. Issues and Recommendations

Issues and recommendations for SAV-AIR are summarized briefly here in approximate order of significance. Except for the last two, those issues that are essentially similar to those discussed in MPER #1, #2, and #3 are not included.

Issue: Need for a Broad Marketing Campaign

A number of the issues outlined below surround marketing issues. Awareness of SAV-AIR is limited among end-users and so a broad marketing push would be appropriate.

> ***Recommendation:*** SAV-AIR has developed a plan for a marketing campaign and should put it in place very soon. A general awareness campaign that includes a goodwill message, perhaps through public education (promotion of *Compressed Air Challenge*) might be effective in the long run. They should garner whatever support they can find from allies, customers, and the Alliance. This plan should also include the demonstration of the new *PL1000* compressor sequencer.

Issue: Customer Satisfaction

The finding that satisfaction with SAV-AIR is not uniformly positive among both participants and nonparticipants is of great concern for this start-up venture. The four customers interviewed for MPER #3 described high satisfaction, but only five of the seven customers interviewed for this MPER would recommend SAV-AIR without hesitation.

> ***Recommendation:*** All problems with customer satisfaction need to be corrected quickly and avoided or ameliorated in the future.

Issue: Low Awareness Among End-Users

Only one out of the fifteen compressed air end-users interviewed for this report had heard of SAV-AIR.

Recommendation: Marketing recommendations described in this report include establishing the long-term market identity and messages to be used, and other means for establishing market presence.

Issue: Building Market Credibility

SAV-AIR is now recognized by a majority of market actors as having a credible approach that is appropriate for some end-users. However, more market actors should hear about SAV-AIR, and all should have in-depth knowledge of SAV-AIR's achievements.

Recommendation: The current marketing effort should include targeting of regional market actors. They should be provided with success stories for all SAV-AIR installations, and SAV-AIR staff should be available to answer any of their questions or concerns.

Issue: Customers Not Fully Using Monitoring Capabilities

Some SAV-AIR participants are underutilizing the system monitoring capabilities of the *PL2000*. Ongoing monitoring is believed to be the best means of maintaining compressed air system efficiency over the long-term, and should be the main rationale for making the investment into the SAV-AIR product over a more simplistic approach that does not have monitoring capability.

Recommendation: Work with all customers to help them understand how the *PL2000* monitoring system works and how monitoring information can be best used. Upgrade system programming and information displays if the changes will expand the use of monitoring. Reconsider pricing of on-going support services or repackage them on a trial basis to prove their value to customers.

Issue: Market Size

Not all of the customers with sufficiently large compressed air systems to warrant the use of SAV-AIR's approach will be amenable to using the

information available from such a system. The majority of compressed air users, even the large ones, only want sufficient air to meet production requirements, and will not fully (or sometimes even partly) utilize the monitoring information available from products like the *PL2000*.

> ***Recommendation:*** Recognize that original market projections may include a significant portion of users that may not use monitoring data and whose compressed air control needs can be adequately met with a sequencer controller like the *PL1000*. Adjust business plans accordingly.

Issue: Slow Sales

SAV-AIR has made only two sales during the first two quarters of 2002, and yet needs about one per month on average to become self-sustaining.

> ***Recommendation:*** SAV-AIR is well aware of its need to make sales and should step up efforts further by networking intensively with allies, associates, and prospective customers, as well as pursing their current plans for marketing.

Issue: Alliance Involvement

SAV-AIR has been working diligently on marketing, sales, and technical development, but it might be helpful if the Alliance were more involved.

> ***Recommendation:*** Alliance staff should check in on a regular basis with SAV-AIR staff on the status of their efforts and offer direct assistance to help ensure initiative success.

Issue: Corporate Replication

Replication of SAV-AIR's services in multiple facilities has happened at only one company. One corporate customer is responsible for seven of the ten completed installations and both of the current installations in process. Further, these installations are not based on an overall strategy, but rather because there was an internal champion for the SAV-AIR services.

Recommendation: Replication is a key strategy for success in reducing cost of sales for SAV-AIR. SAV-AIR might consider gathering information from existing customers on how to best achieve replication and how much might be possible. Top-down direction from company management for purchases such as SAV-AIR do not appear to be uniformly effective. SAV-AIR might consider leveraging personal referrals between facilities that could be effective for replication.

Issue: Highlight Non-Energy Problems and Successes

Non-energy benefits are important to end-users and in some cases can be similar in magnitude to energy-cost savings. Non-energy benefits are also of particular importance in highlighting the capabilities of the *PL2000* and its monitoring features to both current and potential customers. However, end-users do not usually document their compressed air problems, and so are unlikely to note the resulting benefits from resolving these problems, let alone quantify them. Of the seven SAV-AIR customers interviewed for this MPER, only two could quantify non-energy benefits. By contrast, all four of the customers interviewed for MPER #3 described some non-energy advantage.

Recommendation: SAV-AIR should work with their customers to formally document their compressed air problems, their resolution, and the resulting non-energy benefits (in dollars if possible) from installation of the *PL2000* system. Information collected could include: problem description, production line or equipment involved, frequency of occurrence, duration, estimate of the value of lost production or staff time involved if possible, and the resulting benefits, both qualitative and cost-wise.

Issue: SAV-AIR Support for Compressed Air Challenge

The customer and market research for the evaluation reports, as well as common sense, tell us that it is an advantage to have educated customers. *Compressed Air Challenge* is an inexpensive, objective, and widely available compressed air training program. Among 24 interviews of SAV-AIR

participants and nonparticipants, and compressed air end-users, only one had heard of *Compressed Air Challenge*.

> ***Recommendation:*** All of SAV-AIR's customers should have heard about *Compressed Air Challenge* from SAV-AIR, and most should be planning on attending. SAV-AIR should support the CAC program by sending their existing customers, and perhaps even potential customers to local training. The Alliance should continue with the marketing efforts and class offerings for CAC.

Issue: Initiative Exit Strategy

The SAV-AIR contract with the Alliance is scheduled to end on May 31, 2003. In order to ensure that Initiative achievements are sustained in the future, some consideration should be given to how to transition the venture to being "on it's own." Both the Alliance and SAV-AIR could benefit from gradual changes to their relationship to maintain each of their interests. As this report was being finalized, some discussions regarding an exit strategy had taken place between the Alliance and SAV-AIR, but no decisions had been made.

> ***Recommendation:*** SAV-AIR and the Alliance should work together to formally develop an exit strategy for a smooth transition to a financially independent but cooperative relationship. A no cost contract extension would encourage involvement in near-term marketing activities, formal venture evaluation, and maintain financial stability with the budget remaining.

VII. Issues and Recommendations

Appendices

Appendices

Appendix A

Table A-1: Market Actors Interviewed

MARKET ACTOR	ACTOR TYPE	LOCATION
CASCADE ENERGY ENGINEERING	Consultant	Walla Walla, WA
DARDEN ENGINEERING	Consultant	Portland, OR
QEI ENERGY MANAGEMENT	Consultant	Beaverton, OR
SBW CONSULTING	Consultant	Bellevue, WA
AIR EQUIPMENT CO.	Distributor	Boise, ID
BECKWITH & KUFFEL, INC.	Distributor	Seattle, WA
DICKINSON EQUIPMENT CO., INC.	Distributor	Seattle, WA
MITCHELL, LEWIS & STAVER	Distributor	Redmond, WA
POWER SERVICE OF MONTANA	Distributor	Billings, MT
R & R COMPRESSOR SERVICE	Distributor	Kirkland WA
ATLAS COPCO	Manufacturer	Beaverton, OR
GARDNER-DENVER	Manufacturer	Enumclaw, WA
INGERSOLL-RAND AIR CENTER	Manufacturer	Auburn, WA
KAESER COMPRESSORS (NATIONAL REP)	Manufacturer	Fredricksburg, VA
KAESER COMPRESSORS (REGIONAL REP)	Manufacturer	Sacramento, CA
QUINCY NORTHWEST (ROGERS MACHINERY)	Manufacturer	Portland, OR
SULLAIR	Manufacturer	Kirkland, WA

Appendix A

Appendix B

THE MARKETING REPORT provided a brief overview of SAV-AIR's present marketing strategy and made suggestions for capturing marketing and sales opportunities. It provided a general roadmap as well as some specific suggestions for expansion of SAV-AIR's current marketing approach. The sixteen-page report delivered on May 5, 2002 was prepared by Diana Bjornskov, a consultant with extensive experience in technical marketing.

1. Corporate Identity

Corporate identity (how will the people, products, services of SAV-AIR be permanently identifiable, regardless of any changes in products, locations, etc.) is an important element that provides recognition of consistency, longevity, market penetration, innovation, and dependability. To achieve long-term recognition, a consistent identity, a single message, and a broad presence should be the marketing objectives.

SAV-AIR has already defined:

- Product marketing characteristics – *identifiable shape, size, and color*
- Recognizable logo
- Meaningful slogan

2. Marketing Strategy

A marketing strategy will generate revenue and repeat business by:

- Developing a strategy and budget for selling and supporting sales of product and services.
- Increasing visibility and opportunities to promote in markets served now and in the future.
- Promoting acceptance as best-in-class product, people, services and aftermarket care.

3. Research

Research is needed to understand target market trends, customers' needs and market position, identify opportunities in existing and future markets, and understand associated issues. Customer market research can show customers SAV-AIR's interest in solving their compressed air problems.

4. Business Development – Selling

In-house and outside sales people need training that is integrated with the representatives' primary interest, including being tested and compensated after a designated performance period. Provide standardized, scheduled reporting and feedback mechanisms

5. Collateral Materials

Develop and distribute materials that identify, promote, and encourage the purchase of SAV-AIR products and services. Ensure that materials are appropriate to users and venues. The following were reviewed:

- *PowerPoint* corporate presentation – *products and services*
- *PowerPoint* corporate presentation – *energy*
- Business cards
- Tri-fold brochure
- Product tear sheets
- Project description "success story" sheets

Materials that may exist but were not reviewed include:

- Letterhead and envelopes
- Proposals (solicited and unsolicited) – *cover, form, content*
- Staff resumes and bios

- Thumbnail project descriptions
- Project photographs
- Standardized proposal debrief questions (whether awarded or not)
- Customer quotes and letters of recommendation on the SAV-AIR products
- Advertising formats

6. Media Presence

It is important to link commercial media presence with promotional opportunities whenever possible – i.e., conference/trade show (show and trade newspapers). This can include:

- Introduction of a SAV-AIR product (newsletter and press releases, in local or trade press.
- Association events), or technical article (with advertising in the same issue), etc.

Media presence can include direct opportunities driven by SAV-AIR, and also indirect opportunities such as those created by other industry allies and representatives.

Objectives of any media presence will be recognition for technical excellence, market penetration, reliability, longevity, and availability.

- Trade Publications – writing articles that support SAV-AIR technology – is an inexpensive method of advertising
- Press Releases – *if SAV-AIR is creating, introducing, or selling a product*

7. Event Representation

Event representation provides:

- Sales Opportunities
- Market Recognition
- Partnership Development

8. Web Site

New customers will research your credibility through your web site. Existing customers will use your web site as a source of information and product support. Competitors and prospective allies/partners will evaluate you. As a first priority, ensure that SAV-AIR's corporate identity is captured on the web site. Use the web site to:

- Update
- Inform about educational opportunities
- Tell stories
- Show pictures
- List opportunities for customer savings
- Quote people

Appendix C

SAV-AIR Evaluation Part / Non-part Survey ***071002***

Introduction: My name is _____ with MetaResource Group, a research firm in Portland. We are doing research for the Northwest Energy Efficiency Alliance, a group 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 OR you considered buying SAV-AIR], we'd like to talk to you and get your feedback on the services. Would it be possible to arrange an interview sometime in the next week or so? It will take 30 to 45 minutes. ARRANGE APPOINTMENT. 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.

General Interviewee Information

Contact Name:	
Title:	
Company:	
City and State:	
Telephone:	
Email:	
Industry:	
Serving Utility:	

IF 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 web site.

Throughout this interview we will be talking about "compressed air system optimization." By this we mean detailed assessment, analysis, monitoring, and changes to the entire compressed air system – compressors, auxiliaries, controls, distribution, leaks, and end-uses.

Compressed Air System Description

Q1. Can you describe the air compressors used in your facility?

Compressor ID	Compressor HP/status (op/standby)

Q2. Do you regard compressed air operating costs as expensive?
□ Yes □ No □ Couldn't Say

Q3. Before starting your work with SAV-AIR, did you actually know the cost to operate your compressed air system?

Yes		
No		

Q4. IF NO: As a result of working with SAV-AIR, do you now have an idea?

Yes		
No		

Q5. 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

Q6. Could you please describe what the management approach was for your compressed air system before you started working with SAV-AIR?

Q7. Before working with SAV-AIR, what would you say were your objectives in managing your compressed air system? **[Probe from list, but don't read.]**

Y_1 Maintain continuous operation
Y_2 Ensure adequate supply of air to end-uses
Y_3 Improved or increased production (fewer rejects)
Y_4 Maintain quality of air supplied (clean and dry air)
Y_5 Control or reduce energy costs/energy use
Y_6 Reduce capital costs (fewer compressors required)
Y_7 Meet process quality standards
Y_8 Improve safety
Y_9 Reduce maintenance and repair for process machinery
Y_{10} Reduce maintenance and repair of the compressed air system

Q8. Skip.

Q9. Have your objectives for managing your compressed air system changed at all since you started working with SAV-AIR? IF YES: In what way?

Q10. Would you say the change in objectives is related to working with SAV-AIR?
□ Yes □ No □ Couldn't Say

Q11. 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 SAV-AIR?**	**Now doing or plan to do?**	**IF YES: Result of work w/ SAV-AIR?**
Compressor monitoring	$_1$ Y N DK	Y N DK	Y N DK
Leak detection & repair	$_2$ Y N DK	Y N DK	Y N DK
Tracking compressed air costs	$_3$ Y N DK	Y N DK	Y N DK
❑ Improving system control strategies	❑ $_4$ Y N DK	❑ Y N DK	❑ Y N DK

Q12. Skip.

Q13. Skip.

Q14. Skip.

Q15. Skip.

Q16. Are you considering an arrangement with SAV-AIR for long-term monitoring and management services?
☐ Yes ☐ No

Q17. What influences you the most in terms of adopting new compressed air management tools or approaches? [Prove from list, do not read.]
Y_1 books
Y_2 web sites
Y_3 peers/peer groups/organizations
Y_4 CAC or other CA classes
Y_5 Hearing about another company's' success through case studies
Y_6 Experience from within your company through a pilot project
Y_7 Consultant recommendations
Y_8 SAV-AIR's recommendations
Y_9 Vendor's recommendations
Y_{10} Articles or advertisements in a professional publication
Y_{11} Other _____

Q18. Skip.

Q19. Skip.

Q20. What were the top two barriers to more effective operation of your compressed air system? *[Probe from list, do not read.]*

Y_1 Not enough staff time

Y_2 No budget for activities related to improved efficiency

Y_3 Efficiency measures are too expensive

Y_4 Payback restrictions are too short

Y_5 Focus is on production (keeping things running by any means necessary)

Y_6 Lack of accountability for the compressed air systems or costs

Y_7 Lack of information about the performance of the system

Y_8 Lack of management buy-in

Y_9 Lack of technical expertise

Y_{10} Lack of training

Y_{11} Other _____

Q21. Skip.

Q22. Do you think working with SAV-AIR has or will help you overcome any of these barriers?

□ Yes □ No □ Couldn't Say

Q23. Skip.

Q24. Have you implemented all of SAV-AIR's recommendations?

□ Yes □ No □ Couldn't Say

Q25. Skip.

Q26. What features do you particularly like in the compressed air control panel and software used by SAV-AIR?

Q27. 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.]

Q28. IF ANY BENEFITS: Can you provide any anecdotes or assign a value to these additional benefits?

SAV-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)

Q29. So far SAV-AIR has delivered useful information about system function, system efficiency, and opportunities for improvement.
☐ Yes ☐ No

IF ANSWERED NO, ASK WHY:

Q30. SAV-AIR's periodic reports on my compressed air are useful and appropriate for my needs.
☐ Yes ☐ No

IF ANSWERED NO, ASK WHY:

Q31. The SAV-AIR team is easy to work with.
☐ Yes ☐ No

IF ANSWERED NO, ASK WHY:

Q32. 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:

Q33. 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:

Q34. SAV-AIR has identified potential non-energy benefits that are important to our plant.
☐ Yes ☐ No

IF ANSWERED NO, ASK WHY:

Q35. So far I am satisfied with SAV-AIR's services.
☐ Yes ☐ No

IF ANSWERED NO, ASK WHY:

Q36. I would recommend SAV-AIR's services to other plants in my company without hesitation.
☐ Yes ☐ No

IF ANSWERED NO, ASK WHY:

Q37. I would recommend SAV-AIR's services to colleagues at other companies without hesitation.
☐ Yes ☐ No

IF ANSWERED NO, ASK WHY:

Q38. What's the main reason you decided [to work OR not to work] with SAV-AIR?

[SKIP FOR NONE]

Q39. So far, what do you like best about SAV-AIR's services?

Q40. Do you have any concerns or questions about SAV-AIR? IF YES: What?

Training

Q41. How do you usually accomplish training for your staff on compressed air systems?
Y1 In-house
Y2 Vendor training courses
Y3 Utility training courses
Y4 Colleges/vocational schools
Y5 Professional associations
Y6 Don't provide compressed air operation training
Y7 Other: .....

Q42. Have you heard of the Compressed Air Challenge?
□ Yes □ No [Skip to49.]

Q43. Have you participated in CAC training?
□ Yes □ No

Q44. 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?

Q45. In your opinion, how could the CAC training be improved?

Q46. What did you like best about the CAC training?

Q47. What might you expect to gain from a more advanced CAC training course (Level II)? YNothing

Q48. Were any improvements implemented in your plant because of the CAC training?

Yes – What were they?	
No – Why not?	

Q49. Have you ever heard of PSAT, the Pumping System Assessment Tool, offered by Oak Ridge National Laboratories?

□ Yes □ No

Q50. Is there anything else you'd like to add about your compressed air system or experience with SAV-AIR?

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

Appendix D

SAV-AIR Evaluation – End-user Survey ***6-17-2002***

Introduction: I am _____ of MetaResource Group, a research firm in Portland. We are doing research for the Northwest Energy Efficiency Alliance, a consortium of Northwest utilities and public energy agencies. We are asking operators of industrial compressed air systems questions about their systems. Your individual responses will be kept confidential. Summary reports on this evaluation will eventually be on the Alliance web site. The questions take about 15-20 minutes. Is now a good time to talk?

By participating in this survey end-users like you will help to influence new approaches and training for improved management of compressed air systems. There are potential energy cost savings and also the possibility of improving overall productivity through new approaches to compressed air system operation.

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 also end-uses.

Q1. Could you confirm your name and job title for me?

General Interviewee Information

Contact Name:	
Title:	
Company:	
City and State:	
Telephone:	
Industry:	

Compressed Air System Description

Q2. What is the total horsepower of all air compressors in your system?
____ Hp (Exact or Approximated?)

Q3. How many air compressors do you have on line in your plant?
..... number (Do not count non running backup units.)

Q4. Do you regard compressed air as an expensive part of your operations?
□ Yes □ No □ Don't Know

Q5. Do you have a rough idea of how much of your electric bill comes from compressed air?

Yes – What is it?		*[Percentage]*
No		

Q6. Do you think it would it be useful to your company to know compressed air costs?

Yes – Why?	
No – Why not?	

[If less than 150 Hp, skip to Q17.]

Compressed Air System Management and Maintenance

Q7. What would you say are the objectives for managing your compressed air system? [Don't read list, but probe to get a couple.]

□1 Maintain continuous operation
□2 Insure system reliability
□3 Ensure adequate supply of air to end-uses
□4 Improved or increased production (fewer rejects)
□5 Maintain quality of air supplied (clean and dry air)
□6 Control or reduce energy costs/energy use
□7 Reduce capital costs (fewer compressors required)
□8 Meet process quality standards
□9 Improve safety

□10 Reduce maintenance and repair for process machinery
□11 Reduce maintenance and repair of the compressed air system
□12 Other _____

Q8. I'd like to read a list of compressed air management practices. Tell me if you are doing any of these.

Approach/Tool	**Doing This?**
1.Short-term compressor monitoring	Y N DK
2. Long-term compressor monitoring	Y N DK
3. Leak detection	Y N DK
4. Leak repair	Y N DK
5. Tracking compressed air costs	Y N DK
6. Improving CA system control strategies	Y N DK
7. Using formal analysis to justify CA changes or upgrades.	Y N DK

Q9. What influences you the most in terms of adopting a new compressed air strategy? *[Read list and check all that apply.]*
□1 web sites
□2 Hearing about another company's success through case studies
□3 Experience from within your company through a pilot project
□4 Consultant recommendations
□5 Vendor recommendations
□6 Articles or advertisements in a professional publication
□7 Other _____

Q10. 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.]*
□1 Very likely
□2 Somewhat likely
□3 Not at all likely IF NOT AT ALL: Why not? _____
□4 Don't have any other plants

Q11. What barriers do you face in getting your compressed air system to run more effectively? *[Don't read list, but probe to get a couple.]*

- □1 Not enough staff time
- □2 antiquated system
- □3 No budget for activities related to improved efficiency
- □4 Efficiency measures are too expensive
- □5 Payback restrictions are too short
- □6 Focus is on production (keeping things running by any means necessary)
- □7 Lack of accountability for the compressed air systems or costs
- □8 Lack of management buy-in
- □9 Lack of technical expertise
- □10 Lack of training
- □11 Other _____

Efficiency / Optimization Services

Q12. In the past year or so have you talked with any compressed air consultant or vendor about major upgrades or system optimization, especially for reducing compressed air energy costs?

□ Yes □ No □ Don't Know

Q13. What kind of company was it that you talked with? *[Read list as necessary.]*

- □1 Compressed air equipment vendor
- □2 Independent consultant
- □3 Energy services company
- □4 CA equipment manufacturer
- □5 Other _____

Q14. Did you purchase any products or services from this company?

□ Yes □ No □ Don't Know

Q15. Why did you purchase the service? *[Prompt from list as necessary. Skip to Q17.]*

- □1 Energy savings
- □2 Improve control over production
- □3 Improve efficiency in production
- □4 Improve safety
- □5 Increase reliability
- □6 Increase compressed air quality
- □7 Insure adequate supply of air to end uses
- □8 Improve company's environmental practice
- □9 Improve maintenance
- □10 Control or reduce energy costs
- □11 Reduce capital costs
- □12 Meet plant quality standards
- □13 Other _____

Q16. Why didn't you purchase this service? *[Prompt from list as necessary.]*

- □1 Too expensive
- □2 No budget
- □3 Skeptical of energy savings estimates
- □4 Can do it ourselves, in-house
- □5 Presented to management; management did not approve
- □6 Still considering
- □7 Other _____

Q17. [READ THIS.]

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.

Q17. Have you heard about SAV-AIR before this survey?

□ Yes □ No □ Don't Know

Q18. How did you hear about SAV-AIR?

- □1 Word of mouth from _____(if known)
- □2 SAV-AIR representative
- □3 Other person within company
- □4 Consultant
- □5 Vendor
- □6 Articles or advertisements in a professional publication
- □7 Other _____

Q19. Does this SAV-AIR approach sound like it might be useful for your facility?

Yes – Why?	
No – Why not?	

Training

Q20. How do you usually accomplish training for your staff on compressed air systems? [Read list – check all that apply.]

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

Q21. Have you heard of Compressed Air Challenge training?

□ Yes □ No □ Don't Know

Q22. Have you, or someone else in your organization participated in Compressed Air Challenge training?

□ Yes □ No □ Don't Know

[Skip to 25 if No or Don't know - - Skip to 24 if someone else.]

Q23. In what way did the CAC class influence you the most? Or, What was the most important thing that you learned from the class?

Q24. Were any improvements made in your plant because of the CAC training?

Yes – What were they?	
No – Why not?	

Q25. Have you heard of the Pumping System Assessment Tool (PSAT) training for monitoring and optimization of pumping systems?
□ Yes, heard □ Yes, have taken □ No □ Don't know

[Skip to 28 if No or Don't know]

Q26. In what way did the PSAT class influence you the most? Or, What was the most important thing that you learned from the class?

Q27. Were any improvements made in your plant because of the PSAT training?

Yes – What were they?	
No – Why not?	

Q28. May we contact you once more so we can learn more about your continued observations and opinions of compressed air services?
□ Yes □ No □ Don't Know

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

Appendix D

Appendix E

CONSULTANT/MANUFACTURER/VENDOR SURVEY 06/12/2002

Name / Company _____

Phone Number _____

City, State _____

Email _____

Title / Activities _____

Contact Date _____

INTRODUCTION: My name is _____ and I'm with MetaResource Group, a research firm in Portland. We are doing research for the Northwest Energy Efficiency Alliance, a group of Northwest utilities and public energy agencies. I'd like to ask you some questions about changes in the compressed air market because of your knowledge of the industry. [IF RECONTACTING: I spoke to you earlier on this subject.] All of your individual responses will be confidential. This research report will be made available publicly on the Alliance web site. The questions will take about 20 minutes. Is this a good time?

Throughout this survey we will be talking about "compressed air system optimization." By this we mean detailed assessment, analysis, monitoring, and changes to the entire compressed air system – compressors, auxiliaries, controls, distribution, leaks, and end-uses.

Q1. CONFIRM LOCATION AND TITLE OF RESPONDENT
City _____
State _____
Title _____

Q2. TYPE OF COMPANY (Check most appropriate – multiple if necessary. Probe if it would help.)

- □1 Compressed air equipment manufacturer
- □2 Compressed air equipment distributor/vendor
- □3 Mechanical engineering consultant
- □4 Compressed air system consultant/designer
- □5 Other (specify_____)

Q3. Are you a local, national, regional, or international company?

□1 Local □2 National □3 Regional □4 International

(For consultants)

Q4. In general, what kind of compressed air consulting services do you provide? (Probe if necessary.)

- □1 Compressed air system audits or assessments
- □2 Short-term monitoring
- □3 Long-term monitoring
- □4 Specification or recommendation of system controls
- □5 Other

_____

_____

Q5. What is the business type and typical system size of your clients?

_____

_____

(For manufacturers and vendors)

Q6. I'm going to read you a list of compressed air system services. Please tell me which ones you offer.

- □1 Compressed air system audits or assessments
- □2 Short-term monitoring
- □3 Long-term monitoring
- □4 Specification or recommendation of system controls
- □5 Sales of system controls
- □6 Installation of system controls
- □7 Sales of air compressors
- □8 Installation of air compressors
- □9 Anything else? _____

(For consultants)

Q7. Very approximately, what portion of your consulting involves compressed air services? _____

(For manufacturers and vendors)

Q8. Very approximately, what portion of your sales are from compressed air system controls? _____

Q9. How many compressed air end users do you think regard compressed air operating costs as expensive?

□1 Most>67% □2 Some>33% □3 Few □4 None □5 DK

Q10. How many compressed air end users do you think actually know the cost to operate their compressed air system?

□1 Most>67% □2 Some>33% □3 Few □4 None □5 DK

Q11. What are you seeing as the most recent innovations in compressed air optimization? [Probe on the following topics and for others.]

□1 Variable speed drive compressors
□2 Sequencer type control systems
□3 Computer-based control systems
□4 Compressed air monitoring and reporting
□5 Short-term system measurement
□6 Other _____

Q12. At the beginning of the survey we defined compressed air system optimization as detailed system assessment, analysis, monitoring, followed with changes to the entire system, including end-uses where appropriate. Would you say you offer compressed air system optimization?

□ Yes □ No □ Don't know

Q13. IF YES: Would you consider your firm to be leading firm in compressed air system optimization?

□ Yes □ No □ Don't know

Q14. Who do you think are [other] leading [manufacturing/vendor/consulting] firms in the compressed air industry in terms of system optimization?

_____
_____
_____

Q15. Over the past year or so, do you think that compressed air equipment manufacturers, vendors, consultants, and customers are thinking more about optimization? For example, are people more often pursuing a systems approach that includes controls and end-use modifications? (Ask for each type.)

Manufacturers	**Vendors**	**Consultants**	**Customers**
□ Yes	□ Yes	□ Yes	□ Yes
□ No	□ No	□ No	□ No
□ Don't know	□ Don't know	□ Don't know	□ Don't know

(For consultants)

Q16. How often do you specify or recommend compressed air controls? Would you say…

□$_1$ Often>67% □$_2$ Occasionally>33% □$_3$ Seldom □$_4$ Never

_____

_____

(For manufacturers and vendors)

Q17. Do you feature a line of compressed air controls? More than one brand?

□ Mfr_____ □ Our own □ None

_____

_____

I have a few questions about Compressed Air Challenge training.

Q18. Have you attended a Compressed Air Challenge training course?

□ Yes □ No

Q19. Do you have any thoughts or comments about the course?

_____

_____

Q20. Do you know of any other compressed air training that is going on in the region currently? What are your thoughts about what else is being offered?

_____

_____

Q21. In terms of providing the knowledge and skills customers need to improve their compressed air systems, do you think Compressed Air Challenge does an excellent, good, fair, or poor job?
□ excellent □ good □ fair □ poor

Q22. Can you give any specific examples of positive changes customers have taken because of attending a CAC course?

_____

_____

Q23. Have you ever heard of PSAT, the Pumping System Assessment Tool, offered by Oak Ridge National Laboratories?
□ Yes □ Attended □ No

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 optimization of a compressed air system.

Q24. Had you heard of SAV-AIR?
□ Yes □ No (skip to Q30)

Q25. What do you think about the SAV-AIR concept and approach?

_____

_____

Q26. Do you have any concerns about the approach that SAV-AIR is taking?

_____

_____

Q27. What have you heard from anyone that has had first-hand experience SAV-AIR?

_____

_____

Q28. Do you have an opinion about the cost-effectivity of the SAV-AIR approach, in terms of energy cost savings?

_____

_____

Q29. Do you have any thoughts about the cost-effectivity of the SAV-AIR approach, in terms of non-energy benefits?

_____
_____

Q30. What firms, if any, do you think offer a similar type of control product as SAV-AIR?

_____
_____

Q31. Would you ever recommend or specify SAV-AIR for your customers?
□ Yes □ No □ Don't know

_____
_____

Q32. Have you tried anything like the SAV-AIR approach yourself?
□ Yes □ No

_____
_____

Q33. 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

Thank you for your help. I appreciate you spending time talking with me.