Market Baseline Evaluation Report Executive Summary

Evaporator Fan VFD Initiative

prepared by

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Baseline Market Assessment
Of The Evaporator Fan VFD Initiative

Market Progress Evaluation Report #1

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The Northwest Energy Efficiency Alliance

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I. EXECUTIVE SUMMARY

A. Background to VFD Initiative

The use of Variable Frequency Drives (VFDs) on evaporator fans in refrigerated warehouse applications has the potential to produce significant energy savings when compared to other means used to regulate temperature. Estimated energy savings after 10 years is 18.3 aMW[1]. However, very few refrigerated warehouse facilities currently use the VFD technology. The Evaporator Fan VFD Initiative (the Initiative) began in early 1998 with the **goal** of making VFDs an industry standard on evaporator fans in refrigerated warehouses in the Pacific Northwest.

In order to make VFDs an industry standard the Initiative will have to overcome several **market barriers** including:

- Lack of information to evaluate the return on investment from the installation of evaporator fan VFDs;
- Uncertainty regarding the impact on fruit quality in warehouses where fruit is stored;
- Uncertainty regarding adequate air flow distribution in large refrigerated rooms;
- Fear of evaporator fan motor burnout induced by VFDs;
- The generally conservative nature of facility owners.

The **definition of success** for the Initiative is that by the end of the year 2000 five percent more refrigerated warehouse facilities install evaporator fan VFDs than would have in the absence of the Initiative. By the end of 2007, use of evaporator fan VFDs becomes standard practice (increase in penetration at 31% of warehouses and 47% of fruit storage facilities).

[1]Calculations and assumptions used to estimate energy savings over the 10 year period are included in Appendix A.

Progress indicators include:

- Development of a comprehensive database of refrigerated warehouse facilities in the Northwest;
- Participation in field trials at 30 sites over the first two years of the Initiative and two comprehensive installations;
- Field trials and installations successfully achieve cost-effective savings while maintaining or improving product quality;
- Information on results is disseminated broadly in the industry and to consulting engineers;
- Facilities outside of Initiative participants begin to use the technology.

The Initiative is undertaking several types of activities including field trials, information exchange with vendors and contractors, and information dissemination with refrigerated warehouse owners and operators. Cascade Energy Engineering (Cascade) is the implementation contractor for the Initiative.

One of the key elements of the Initiative is that it is designed to result in sustainable market transformation, meaning that the Initiative will set market forces in motion which in turn will make VFDs an industry standard and that this will continue even after Initiative activities have ceased. Experience with refrigeration control systems suggests that the types of activities being undertaken by the Initiative have a good chance of success. Ten to fifteen years ago penetration of control systems was virtually non-existent. Academic research on fan cycling was conducted and demonstrated lower energy usage and a positive impact on fruit quality. This information was disseminated among key refrigeration contractors who were convinced of the merits and began to promote such systems. Within ten years, an estimated 80% of facilities had gone to computer controls. In addition, Cascade points out that the economics of computer controls and VFDs are similar. Therefore, it is reasonable to expect that by conducting well documented field trials and then disseminating information among vendors, contractors, and facility owners a similar type of transformation in evaporator fan VFD technology will likely occur.

B. Evaluation of the Initiative

Macro International (Macro) was hired by the Northwest Energy Efficiency Alliance to perform an evaluation of the Initiative. The main **goals of the evaluation** are to track progress in overcoming market barriers, adoption of the technology (actual and potential) and the extent to which VFDs have become an industry standard that will be sustained after the Initiative ends. To this end, the evaluation consists of several activities including evaluation of data from field trials, interviews with field trial participants, interviews with vendors and contractors and interviews with facility owners and operators. The evaluation also includes the establishment of a baseline against which Initiative progress can be tracked. A table outlining all evaluation activities and indicating the status of each activity is included in Appendix B.

Evaluation reporting includes a Market Progress Evaluation Report at the end of each of the three years of the Initiative. The Market Progress Evaluation Reports include a characterization of the market, progress in relation to baseline measures, findings from research activities conducted during the year, an assessment of progress made towards completing Initiative tasks, an assessment of progress made towards achieving the Initiative's overall goals and conclusions and recommendations. This document represents the first Market Progress Evaluation Report and covers activities begun or completed in 1998. Since this is the first Market Progress Evaluation Report it will also include many of the baseline measurements.

C. Key Findings

- Table 1, below, summarizes the **progress indicators** for the project, the extent to which they have been met and expected future activities.

Table 1
Status of Initiative in Meeting Progress Indicators

Progress Indicator	Status	Future Plans
Comprehensive database of refrigerated warehouse facilities developed	Construction of a Microsoft Access database is complete. Data on approximately 60 warehouse facilities has been entered.	Data on additional facilities will be entered as it is collected (typically done when Cascade personnel visit a facility)
Participation in field trials of 30 sites over first two years of Initiative & 2 comprehensive installations	12 CA* facilities are participating in field trials in the first year of the Initiative. Field trials are summarized in Appendix C. Recruitment of regular storage facilities has been difficult with potential costs exceeding expectations. No regular storage field trials have begun.	Recruitment of regular storage facilities for the first year of the Initiative is continuing. Recruitment for facilities for the second year of the initiative will begin later in the calendar year. There is currently no information on opportunities for comprehensive installations.
Field trials & installations successfully demonstrate energy savings while maintaining or improving fruit quality	1 test room opened. Insufficient results to date to be able to draw conclusions.	Field trials will be completed in spring '99, at which time data will be analyzed.
Information on results disseminated broadly in the industry	Information dissemination/exchange with vendors & contractors so far has largely consisted of informal contacts (i.e. in the course of field trial installations rather than formal presentations). There has been little information dissemination among facility owners	Information dissemination activities will become more concerted and focused once the results of the field trials are available and there is a compelling "story to tell". It is anticipated that a more structured plan for information dissemination will be developed at that time.
Facilities outside the Initiative begin to use the technology	To date there is no evidence that Initiative activities have resulted in decisions to use the technology by facilities not participating in Initiative activities. It is probably too soon to expect this since field trial results are not available and information dissemination activities have been limited	Once field trials results are available and information is disseminated more broadly it is anticipated that facilities outside of the Initiative will begin to use the technology

* See Chapter III - Market Characterization for discussion of Controlled Atmosphere (CA) and regular storage facilities.

- An estimate of **energy savings** for the facilities involved in the field trials is located in Table 2. The estimates are for annual energy savings assuming a seven month average storage

season. Estimates were developed by Cascade and are based on ongoing data collection. The results indicate that the two facilities which were already using aggressive fan cycling prior to involvement in the Initiative have much more limited potential for energy savings. This is significant since anecdotal information suggests that more facilities than initially expected, particularly larger facilities, are employing some type of aggressive fan cycling.

Table 2
Estimated Savings for Field Trials

Facility	Facility Type	Reduced Load Evaporator Control	Rated Full Speed Fan Power (kW)	Average - VFD Savings (kW)	Energy Use Savings (kWh)	Savings Relative to Rated Fan Power
Blue Bird	CA Storage (Pears)	Constant - All Fans	6.8	4.3	21,869	63.3%
Blue Star	CA Storage (Pears)	Constant - All Fans	9.2	6.5	33,395	71.3%
Columbia Reach	CA Storage (Apples)	Constant - All Fans	5.7	3.7	18,860	64.7%
Hansen	CA Storage (Apples)	Constant - All Fans	12.6	7.8	40,087	62.2%
Holtzinger	CA Storage (Apples)	Constant - 50% Fans	11.1	3.6	18,308	32.2%
McDougall	CA Storage (Apples)	Fan Cycling - Very Aggressive (20% Duty Cycle)	11.5	0.7	3,702	6.3%
Olympic	CA Storage (Apples)	Fan Cycling - Aggressive (33% Duty Cycle)	7.5	0.6	2,910	7.6%
Stemilt- Detailed	CA Storage (Apples)	Constant - All Fans	7.5	4.8	24,735	64.3%
Stemilt -Simple	CA Storage (Apples)	Constant - All Fans	7.8	5.1	25,954	65.4%
Trout - Detailed	CA Storage (Apples)	Constant - 50% Fans on Limited Basis	12.2	7.7	39,153	62.8%
Trout- Simple	CA Storage (Apples)		6.7	1.1	4,676	16.4%
Valley	CA Storage (Apples)	Constant - All Fans	8.7	5.8	29,789	67.3%
Totals			107.3	51.7	263,437	48.2%

Source: Cascade Energy Engineering

- Interviews with personnel at those facilities that have previously installed evaporator fan VFDs suggest that the **barriers that have been identified are valid**.

- The interviews with facilities that have previously installed evaporator fan VFDs also suggest that **energy savings have met or exceeded expectations**. The benefits derived from trying the technology are significant enough to convince at least some portion of facilities to go

ahead with additional installations on their own, with no financial incentives (most had received some type of financial incentives for the initial installation).

- **Cascade has done a good job of selecting, approaching and offering field trial participation to facilities**. An interview with one of only three facilities that decided not to participate in the field trials suggests that the offer by the Initiative had less to do with the decision not to participate than did circumstances at the facility. The interviewee suggested that he was very interested in seeing the results of the field trials and that the results could affect future decisions regarding use of evaporator fan VFDs.

- All of the facilities that had previously installed evaporator fan VFDs before the Initiative started (including the facility which chose not to participate in field trials) report that **there is a big learning curve and that the initial set up was not without problems**. In particular, they cite the fact that the electricians need to be well versed in the installation procedure. Currently, there are few electricians who possess the proper experience and expertise to successfully install a VFD.

- **One facility** which is currently involved with the Initiative field trials **has opened trial and control rooms and the preliminary results suggest positive impacts on fruit quality for the room with evaporator fan VFDs.**

D. Conclusions and Recommendations

1. Conclusions

- **There has been insufficient time for the Initiative to impact the market beyond field trial facilities** - successful results from field trials will form the key argument in overcoming most of the market barriers. The results are also integral to forming messages for information dissemination and exchange activities. Therefore, until the results are analyzed and disseminated, there is likely to be little change in penetration of evaporator fan VFDs in the broader market.

- **For CA field trials to be successful it will be very important to establish non-energy benefits** - preliminary (and somewhat anecdotal) information suggests that more of the facilities that are using control systems are pursuing aggressive fan cycling strategies than initially expected, lowering the potential benefit from energy savings. Therefore, non-energy benefits will play a more important role in the decision making process. This will also be the case in areas where energy costs are relatively low.

- **Cascade has done a good job of setting up CA field trials but has been less successful at setting up regular storage field trials** - Cascade has set up ten simple and two detailed field trials (the difference being that the detailed trials will involve much more rigorous and detailed measurements which might be needed to answer questions from some customers, vendors, contractors or other parties). No regular storage field trials have been initiated due

primarily to higher installed cost estimates than were anticipated (many of the facilities which are good candidates are larger than anticipated).

- **Preliminary data suggests that the initial installation process seldom goes smoothly** - this information came from a small sample of people who had evaporator fan VFDs installed prior to the inception of the Initiative, and one person who was offered participation in the initiative but chose not to participate (this facility had previously installed evaporator fan VFDs on their own). All of the people indicated that they had both technical and scheduling problems.

- **Preliminary data suggest positive results** - Although it is very preliminary, estimated energy savings (Table 2) and fruit quality results from one facility (Table 4) suggest results which would be consistent with initial expectations. In addition, interviews with facilities already using the technology indicate that energy savings expectations were consistently met or exceeded and that non-energy benefits were also recognized.

2. Recommendations

- **At this point there shouldn't be any major changes to the implementation plan for the Initiative** - until results from the field trials are available there is not enough information to suggest making changes. However, when the results are available it would be appropriate to review the plan taking into consideration the extent to which the results meet, exceed, or fail to meet expectations.

- **Regular storage field trials need to be implemented** - given the significance of results from field trials it is important that regular storage facilities are also represented.

- **Cascade and Macro need to develop mechanisms for capturing and measuring non-energy benefits beyond fruit quality** - Preliminary evidence suggests that issues such as less maintenance (more up-time), fewer demands on staff, and a quieter work environment are noticed by facility personnel. Therefore, when evaluating field trials it will be important to make sure that these areas are not overlooked.

- **Development of a preliminary communications plan should be undertaken** - although most of the information dissemination activities will not take place until after results are available, if the results are positive it will be important that there is as little delay as possible in getting the message out. Some activities, such as presentations at trade shows or conferences require advance planning.

- **Macro, Cascade and the Alliance need to come to a better understanding of how market effects will be measured** - At this point it is unclear how changes in penetration rates and associated energy savings will be measured beyond qualitative assessments.