

**Performance Tested Comfort Systems™**  
**Creating a Business Model for Northwest HVAC/  
Weatherization Contractor Training and Certification**

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**ABSTRACT**

This paper explains the development and value of a new training and certification model in the Pacific Northwest. The model represents a significant change in the energy efficiency community's approach to market transformation, incorporating two current trends: providing many services under one roof and applying a business model to what has traditionally been a public or government undertaking.

Research data indicate that retrofitting residential air distribution systems (ducts) is cost-effective from a utility's perspective only when bundled with other heating, ventilating and air-conditioning (HVAC) services. Further HVAC contractors have a greater incentive to provide retrofit services when they're part of a broader service portfolio. Consumers are better served when more attention is paid to the system-wide effects of air distribution system changes on energy efficiency and health. Finally, the Oregon tax credit program shows that contractors that retrofit ducts are successfully bundling other complementary services.

A systematic approach was developed to address energy-efficient residential HVAC, air distribution systems and weatherization. The approach required revising goals and objectives for market transformation and the chosen business model. The residential air distribution program was redesigned to create a self-sustaining Performance Tested Comfort Systems™ venture to fill a major need in the HVAC, air distribution and weatherization marketplace. At the same time, the venture established aggressive market transformation goals that will have a major impact in the initial four-state service area (Oregon, Washington, Idaho and Montana). Although this venture is in the start-up stage of business development, the paper concludes with a summary of early successes.

**Introduction**

This paper explains the development and value of a new training and certification model in the Pacific Northwest — one that moves from a traditional public energy program to a self-supporting venture.

The venture was originally designed to promote market transformation for retrofitting residential air distribution systems to make them energy-efficient. The Energy Efficient Residential Air Distribution Systems Program operated for a year and a half in 1998-1999 with a grant from the Northwest Energy Efficiency Alliance.

Research indicated that while the program saved energy, offered health benefits for consumers and provided new market opportunities for HVAC and weatherization contractors, it did not meet the cost-effective criterion of the major program sponsor — the member utilities of the Alliance. In addition, field researchers repeatedly confronted

additional major health and safety concerns related to residential electric and gas furnaces and heat pumps in research homes (Davis et al. 1999, 32-36).

To meet both the cost-effectiveness standard of the Alliance and the needs of consumers, program staff hired a consultant to write a detailed business plan and expand it to encompass a broader range of concerns in a more cost-effective package of services. The venture evolved from focusing only on ducts into a broader “one-stop” center for Northwest consumers, contractors and utilities. The program now provides information, referrals and certification for well-designed, sealed, safe and efficient air distribution systems and for HVAC systems and weatherization.

This paper first discusses development of the initial residential air distribution system program, including goals, market research and market barriers. Next, the paper covers the program’s aggressive and innovative research. Finally, the paper presents accomplishments of the Performance Tested Comfort Systems venture. While the program is still in early development, major implications already are emerging for the residential HVAC, air distribution and weatherization marketplace.

## **Background**

The impact of duct and heating system efficiency has been quantified through Bonneville Power Administration’s Residential Construction Demonstration Program. Efficiency improvements brought about by energy codes in the Pacific Northwest from 1991 to 1994 resulted in average energy savings of about 30 percent in residential buildings (Haskell & Schwartz 1995). This number is an important reference point. The energy loss associated with inefficient ducts and poor system design is equal to the sum of all of the efficiency gains achieved by the 1991 Oregon building code upgrade (Haskell & Schwartz 1995). Bonneville’s research shows that duct air losses in electric residential heating systems reduce nominal efficiencies by up to 50 percent (Haskell & Schwartz 1995). The effect is even more pronounced for heat pump systems.

To address the problem, in 1996 four Northwest state energy offices and Bonneville staff proposed an HVAC system research, training and certification project to the Electric Power Research Institute (EPRI). EPRI did not have sufficient funds at the time. In the fall of 1997, the proposal was submitted jointly to the Northwest Energy Efficiency Alliance and EPRI and was accepted. The first 18 months of the project was regional in scope, involving the entire regional utility/energy office infrastructure. The Oregon Office of Energy was selected as the primary contractor for the project. The original goals of the project were to:

- Establish energy-efficient residential air distribution (duct) system retrofitting as a viable and profitable business activity in the Northwest.
- Establish a sustained demand for efficient residential duct systems in new homes by changing expectations of homebuyers, builders, realtors and mortgage lenders for affordable, energy-efficient, safe and comfortable housing.
- Establish four key features for projects: 1) a sound technical basis on which contractors can improve the efficiency of residential duct systems; 2) an effective marketing strategy and marketing materials for contractors, energy service providers and trade allies; 3) training for contractors, their technicians and trade allies; and, integrating these three elements, 4) an independent, third-party certification business for performance-tested duct systems.

## **Market Barriers**

Previous research demonstrated that trained contractors can retrofit and build tight, efficient duct systems that added value for consumers (Haskell & Schwartz 1995). Despite the potential added value, contractors continue to install inefficient new systems and rarely upgrade existing duct systems. Transforming the market would require market demand from consumers and profitable business opportunities for contractors. It would also require overcoming market barriers:

- Consumers and contractors are unaware of the impact that air leakage in a home's central forced-air distribution system can have on energy, comfort, health and safety.
- Contractors are unaware of the degree to which their design and installation practices affect air leakage in residential forced-air space conditioning systems.
- Contractors lack the information and skills to profitably market duct system efficiency improvements in new construction and retrofit applications.
- Consumers, contractors, realtors and mortgage lenders lack clear and credible means of identifying and verifying the benefits of efficient duct system improvements.

In early 1998 a literature search and review of regional and national technician certification uncovered three primary issues related to market barriers:

- A lack of cooperation among competing national certification programs (ACCA and NATE) for HVAC installation, maintenance and air distribution systems.
- A lack of understanding about which installation practices offer the greatest energy savings.
- A need to emphasize in certification programs those installation practices that maximize system efficiency, safety and occupant comfort.

## **Market Failure**

Short-term benefits from energy savings alone can pay back the incremental costs of a more efficient duct system in two to three years. In some cases, particularly with cooling energy, better-designed ducts can almost double the delivery efficiency.

However, building departments perform minimum inspection and quality control for duct systems at best. HVAC and duct systems have generally been considered a low priority for regional utilities as well. Adoption of improved energy codes alone will not transform the market because there is no direct infrastructure to develop improved duct HVAC specifications. Nor is there an appreciation in the building industry for the potential cost/benefit of improved duct systems.

Ignoring duct system losses constitutes a market failure. Once homebuyers, HVAC designers and installers realize the enormous impact the duct system has on overall efficiency, the market failure can be mitigated. However, training, certification, tax credits and the effective marketing materials are necessary to help the education process.

## **Preliminary Market Research**

Space heating is the single largest end use of electricity in homes in the Northwest, representing 35 percent of electricity sales to the residential sector. Space heating also is the single largest end use of natural gas in homes in the Northwest. About 60 percent of homes in the region use electricity as their primary energy source for space heating. About 40 percent of electrically-heated homes have some form of forced-air heating equipment (electric furnace or heat pump). Because homes with electric forced-air space heating systems consume 15 percent to 25 percent more electricity for heating than homes with non-ducted systems, they represent a disproportionate share of the electric space heating use in the region. If the average consumption of forced air-heating systems is 25 percent greater than non-ducted homes, they consume half of the electricity used for residential space heating in the region (Northwest Power Planning Council, 1997).

## **Public Policy Initiatives by Oregon Office of Energy**

Parallel to the Alliance project, the Oregon Office of Energy proposed a tax credit that would support HVAC market transformation. In 1996, the Office of Energy facilitated legislation to give a tax credit for well-designed and sealed residential HVAC systems. The Oregon Legislature approved the tax credit. Next, the Office of Energy informed Oregon's utilities, home designers, 360 HVAC contractors and several hundred weatherization contractors that rules for the tax credit would be developed. In fall 1997, Office of Energy and Oregon State University Extension Energy Program staff developed the rules, the accompanying protocols and worksheets, and the required training and certification program. The tax credit took effect January 1, 1998.

A significant finding occurred upon review of the first tax credit applications and required itemized invoices for services. Staff found that heating and weatherization contractors were selling products and services other than those covered by the tax credit while they were at the home. In fact, only 23 percent of the work contractors did under the program was covered by the tax credit. This information bolstered the concept of training contractors in the house-as-a-system concept.

## **Alliance Self-Supporting Requirements**

The original proposal by the four Northwest states to the Alliance included writing a business plan for a third-party training and certification organization that would be self-supporting in five years. The Oregon Office of Energy hired a business consultant, Dowling Consulting Services Inc. (DCS), to perform the work. The business model DCS recommended includes charging contractors for training and an additional "label fee" for each certified system. The business model depends on the ability of contractors to profit from consumer demand for certified, performance-tested duct systems. Technicians and contractors trained by the third-party organization would then have a competitive edge.

To enhance this competitive edge further still, the self-sustaining organization is establishing a third-party certification and quality control system. The assumption is that consumers perceive value in credible certification programs such as Underwriters Laboratory and Good Housekeeping. When HVAC/weatherization certification is coupled with a sustained and regionally coordinated marketing plan and materials, it is anticipated that

certified contractors and technicians will be able to create customer demand and increase market penetration of residential duct system efficiency. As a result, others in the industry will be motivated to seek training and certification, thus generating sufficient demand for services to make the organization self-sustaining.

Since the project debut, more than 120 contractors and utility representatives have completed training and certification. The certification is for all fuels, so the market will be broad enough to support the certification organization.

### Research Goals

The Alliance required a cost/benefit study for the project to ensure that the HVAC/duct services are cost effective to the utility system and consumer. The Oregon Office of Energy hired Ecotope to perform the study employing the use of various service delivery mechanisms. These mechanisms focused on using Office of Energy and Oregon State University Energy Extension Service staff for training, recruitment and coordination for utilities. Targeted were utilities that had previously expressed interest, that had already developed duct retrofit programs or that wanted training, recruitment and other input from the regional duct program.

The goals of Ecotope's cost/benefit study were to:

- ❑ Provide a sufficiently diverse sample of regional housing to determine the nature and size of the market for duct retrofits, based on home characteristics (especially duct location and floor/crawl space insulation details).
- ❑ Determine the energy impact of duct retrofits in various parts of the region, especially in colder climates.
- ❑ Develop a cost/benefit analysis for duct retrofits in various geographical areas and combine the data into a regional assessment of the cost-effectiveness of duct retrofits in heating systems.
- ❑ Assess data collection and retrofit protocols that could be used for training and general application to the duct sealing market.

### Cost Effectiveness Research Results

The project study results compiled by Ecotope are in Table 1.

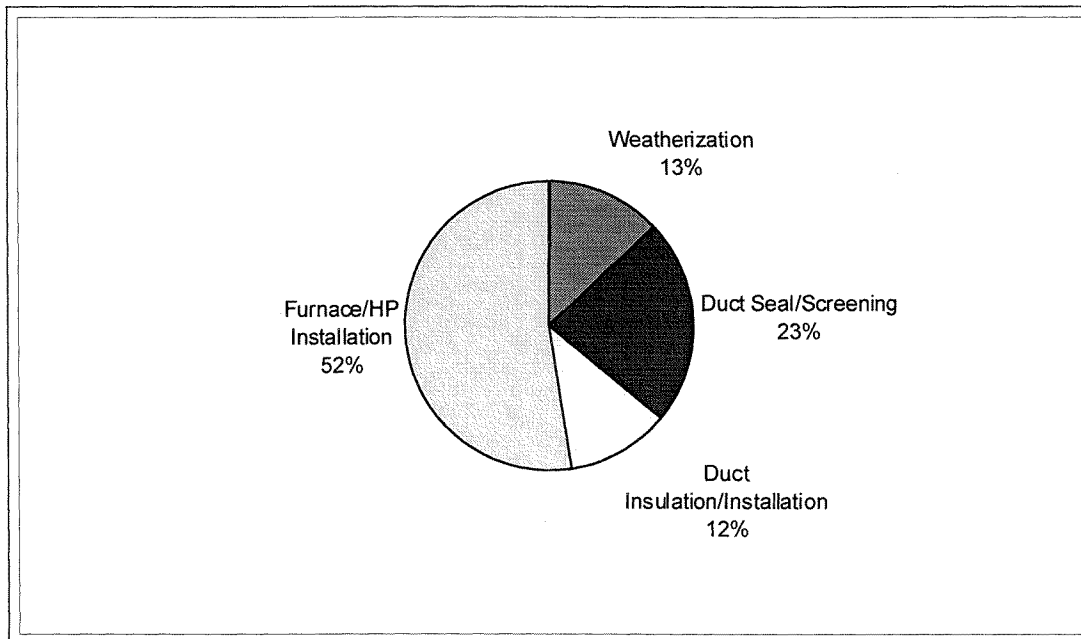
**Table 1. Utility Costs vs. Benefits**

<b>Cost/Benefit Per House Retrofit</b>	<b>Zone 1</b>	<b>Zone 2</b>
Number of homes modeled	67	24
Savings (kWh)	1597	2291
Cost (measure only)	\$400	\$400
Cost/Benefit (mils/kWh)	16	11
Cost (w/ screening and recruiting)	\$780	\$780
Cost/Benefit (mils/kWh)	32	22
Cost (w/ screen, recruit, & benefits)	\$580	\$580
Cost/Benefit (mils/kWh)	24	16
Zone 1 heating degree days base 65F 5500 or less		
Zone 2 heating degree days base 65F 5501-7500		

Overall program results suggest a savings rate of about 12 percent of the space conditioning energy. This savings rate is consistent among all of the large samples drawn for this project and consistent across climate zones. The savings levels represented are about 1,500 kWh in Zone 1 and about 2,300 kWh in Zone 2. Using this as a guideline, individual consumers can be offered a system with payback periods of three to four years for the duct retrofit measure. In cases where serious problems exist, savings two to three times the average observed levels could be expected. This can result in payback periods of as little as one year.

### Oregon Tax Credit Results

Oregon duct improvement tax credit receipts show that only about a third of the overall expenditures were directly related to ducts. HVAC contractors marketed and installed weatherization and heating system upgrade services as part of their duct assessment. For example, customers often upgraded their heating systems at the time the duct improvements were performed. In fact, many customers received the duct retrofit as an added service from the installer of new heating equipment.



**Figure 1. Invoices Received For Services Including Duct Sealing Submitted To The Oregon Office Of Energy (Baylon & Davis 1999)**

It would be difficult to ask code officials to test ducts. Performance-testing HVAC/ducts would require significant changes in the way inspection agencies do business, requiring both more time and money. Therefore, it appears more likely that the industry should be tapped to move into the HVAC/duct-testing market.

The key to enlisting utility support for a market transformation effort (such as programs for residential and other building standards) is to have institutions and tools

developed that can live beyond direct utility involvement. In effect, this means that an infrastructure that has its own economic reasons to exist must be built.

### Project Evolution

Once the cost benefit research was complete and the energy savings met the cost effectiveness levels required by the Alliance, the next step was to start a non-profit training and certification organization. Table 2 shows the current status of the training and certification offerings available from Performance Tested Comfort Systems™.

**Table 2. Performance Tested Comfort Systems™ Residential & Light Commercial Certification Program Offerings**

System Certification Category	Standards Completion Date	Training Curricula Completion Date	Training Available Date	Service Initiation Date
<b>Original Offering</b>				
<b>Duct Certification</b>	Done	Done	Currently Available	Currently
<b>Expanded Offerings</b>				
<b>AC/Heat Pump Diagnostics &amp; Maintenance (requires EPA license)</b>	To be developed under contract from Proctor Engineering by 7/20/2000	7/20/2000 (from Proctor Engineering)	9/1/2000 - In region tech training 7/20/2000 (Training for regional trainers)	9/1/2000
<b>Gas Furnace Maintenance</b>	To be developed under contract from Ecotope Inc. by 7/20/2000	7/20/2000	9/1/2000	9/1/2000
<b>Weatherization</b>	Draft completed 3/1/2000; Estimated completion date 9/1/2000	1/1/2001	3/1/2001	9/1/2001
<b>Light Commercial</b>	3/1/2001	6/1/2001	8/1/2001	12/1/2001

The Alliance Board on April 29, 1999, approved its staff's recommendation to continue the second phase of this venture. The approval endorsed setting up the Performance Tested Comfort Systems organization, and expanding its scope to include "heating systems, air conditioning, duct, and weatherization improvement services."

The evolution from a duct retrofitting venture to the Performance Tested Comfort Systems concept that also includes HVAC and weatherization services creates new business

and market transformation opportunities. Specifically, as a result of this program evolution, the following four benefits will occur:

1. Shifts emphasis from a single product focus to a systems focus
2. Increases market scope and opportunity for greater customer value
3. Leverages knowledge and information in addition to services
4. Improves the opportunity to create a long-term sustainable Performance Tested Comfort Systems venture

As a result of this program evolution, a mission statement was drafted for the venture:

The Performance Tested Comfort Systems venture will fill an important void in the current residential and light commercial HVAC, duct systems, and weatherization marketplace. The venture's mission is to be the indispensable source for state-of-the-art information related to safe, cost-effective, and healthy home heating, air conditioning, duct systems, and weatherization that consumers will turn to when purchasing decisions are required. This should provide consumers of Performance Tested Comfort Systems services tangible benefits in terms of reliability, energy and equipment cost savings, durability, health and safety. In order to accomplish this mission, the Performance Tested Comfort Systems organization has two primary business objectives: to create market transformation and to build a self-sustaining venture.

### **Market Transformation Criteria**

Market transformation and building a self-sustaining organization are central to this business concept. Market transformation will be measured against the following criteria. These market transformation criteria may require revision and elaboration over time.

1. High-performance tested and certified HVAC, duct, and weatherization products and services become important home characteristics to current and potential owners of residential homes, HVAC and weatherization contractors, utilities, lenders, and other key market participants.
2. 27,232 site built and manufactured homes in the four-state region have been certified for at least one major system component based on the Performance Tested Comfort Systems standards for HVAC, ducts and weatherization by Jan. 1, 2005. Additionally, 212 light commercial certifications will be issued by Jan. 1, 2005.
3. HVAC and weatherization contractors include duct testing and sealing as a routine service offering. This implies that duct inspection and remediation services in accordance with Performance Tested Comfort Systems standards are a profitable business opportunity with demonstrated and sustained market demand.
4. 15 percent of all HVAC contractors and 5 percent of all weatherization contractors within the venture region have Performance Tested Comfort Systems certified technicians by 2004. Most importantly, there will be an adequate supply of trained and certified Performance Tested Comfort Systems technicians in all venture geographic areas to meet consumer demand.



5. Residential energy rating systems include testing to meet Performance Tested Comfort Systems standards.
6. Combination HVAC safety inspections and duct testing become a routine part of the mortgage and home inspection process.

### **Progress to Date**

The venture's activities to date have provided the scientific and market knowledge required to accomplish the goals defined in the venture plan. A review of accomplishments include:

- ❑ Market research on the residential HVAC, duct system, and weatherization markets has indicated a significant market opportunity for the Performance Tested Comfort Systems venture(Xenergy, 1998).
- ❑ Research protocols and pilot studies (Phase 1) on duct system testing and sealing completed 2,374 sealed systems by Dec. 31, 1999 with many more systems tested. In addition, this research has led to the creation of the venture's first published standard and training curricula for duct systems (Baylon & Davis,1999).
- ❑ Development of a research and training network throughout the four state region served by the venture that will be the basis for future venture certification and technician training programs.
- ❑ Pilot studies involving regional utilities have provided important feedback and support as the Performance Tested Comfort Systems concept has been modified and refined. Regional utilities have been kept up to date and involved in the venture's development through personal visits, through involvement in the venture's advisory group, and through monthly written updates and reports.
- ❑ HVAC, duct system, and weatherization contractors and industry representatives have been involved in the development of the Performance Tested Comfort Systems concept. Currently 120 technicians in the region have been Performance Tested Comfort Systems trained and certified for residential duct systems. Additionally, 20 contractor firms have been licensed to participate in the Performance Tested Comfort Systems marketing program.
- ❑ Professional marketing materials, promotional programs, and marketing resources for utilities and contractors have been developed and are currently being used in the marketplace. There is on-going Performance Tested Comfort Systems training for utilities and contractors.
- ❑ The Performance Tested Comfort Systems organization has been incorporated and registered in the four Northwest states as a nonprofit organization. The board of directors has been formed and the venture manager hired. Key program intellectual property has been copyrighted.
- ❑ The Northwest Energy Efficiency Alliance decided on April 12, 2000, to fund a three-year regional marketing program for Performance Tested Comfort Systems.

These activities and accomplishments form a solid foundation for the long-term success of the project. Yet the Performance Tested Comfort Systems, Inc. nonprofit organization is only in the startup phase. During the three-year Alliance funding window, the organization must, among other things, secure office space, hire staff, set up a data base,

develop a labeling/certification system, market the program and win buy-in from utilities, contractors, suppliers and others. Many challenges lie ahead, but a successful PTCS program in the Northwest should transform HVAC, duct, and weatherization practices – not only in the region but in the national market as well.

## References

- Baylon, D. and Davis, B, December. 1999. *Residential Duct Sealing Cost/Benefit Analysis*. Salem, Oreg.: Ecotope, Inc for the Oregon Office of Energy, in Cooperation with the Northwest Energy Efficiency Alliance and Electrical Power Research Institute.
- Davis, B., Baylon, D., Francisco, P, Houseknecht, A., Borrelli, S., February. 1999. *Duct Sealing Pilot Program Results for Puget Sound Energy*. Seattle, Wash.: Ecotope, Inc. for Puget Sound Energy.
- Haskell,T., and Schwartz, L., July. 1995. *RCDP IV Final Report Improved Air Distribution Systems for Forced Air Systems*. Portland, Oreg.: Bonneville Power Administration.
- Xenergy,Inc., July. 1998. *Evaluation Baseline Report: Residential Air Distribution Systems Improvements-Draft*. Portland, Oreg.: Northwest Energy Efficient Alliance.