MARKET ANALYSIS FOR HEALTHY AIR HVAC SYSTEMS IN CALIFORNIA*

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Abstract: This paper highlights the results of an assessment of the potential market for a commercial product that integrates strategies and systems for improved indoor air quality into an environmentally friendly HVAC unit. The healthy air unit combines ventilation and recirculation strategies with equipment to clean and condition air into a home's central system. This healthy air unit provides the opportunity for more effective indoor air quality and could be integrated with the HVAC products that meet the latest energy-efficiency standards, thereby providing a healthier and more energy-efficient, convenient, and affordable solution for consumers.

Key Words: ***heat pumps, compressor, efficiency, indoor air quality, indoor air pollution, HVAC***

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1 INTRODUCTION

Indoor air quality (IAQ) problems in homes are primarily due to sources that release gases or particles into the air. Inadequate ventilation can worsen the problem, as well as high temperature and humidity levels (Fig. 1). Effects from exposure to indoor air pollution can include irritation of the eyes, nose, and throat; headaches; dizziness; and fatigue. Exposure can exacerbate the symptoms of some diseases, for example, asthma. Other effects of exposure to indoor air pollution—some respiratory diseases, heart disease, and even cancer—can occur years after exposure or only after long or repeated periods of exposure. Improving the indoor air quality in your home is a good preventative step to take even if no symptoms are obvious (EPA 2007).

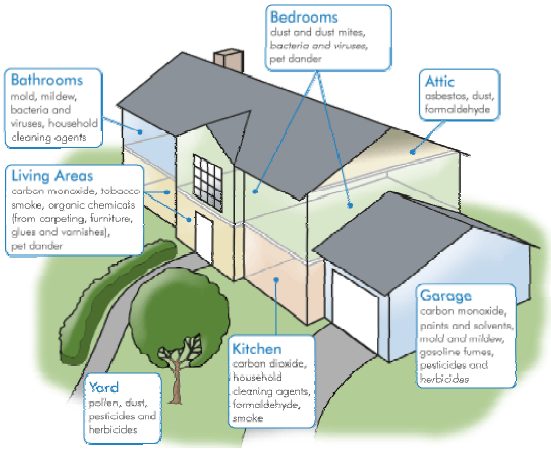

Fig. 1. Contributors to indoor air pollution. Source: Brown, S.K. (1997), *National State of the Environment Report—Indoor Air Quality*, SoE Technical Report Series, Canberra: Department of Environment, Sports & Territories.

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Did You Know:

- 96.7% of North American homes have at least 1 of 6 common IAQ problems.
- The most rampant indoor air problem is particle allergens (dust, dander, pollen, spores, bacteria, etc.) — it occurs in 91% of all homes.
- In children aged 5 to 17 years, asthma is the leading cause of school absence, with over 14 million school days lost to this disease.

Source: airadvice.com, 2008

Homeowners today are increasingly interested in improving the indoor air quality (IAQ) in their homes. There is a large variety of products available for home use, from tabletop dehumidifiers and purifiers to whole-house particulate filtration systems. Unfortunately, buying individual pieces of equipment can be expensive, and the pieces often fail to work together to improve the overall indoor environment.

A commercial product that integrates strategies and systems for improved IAQ into an environmentally friendly heating, ventilation, and air conditioning (HVAC) unit—a "healthy air unit," or HAU—could provide a healthier, more energy-efficient, convenient, and affordable solution for consumers. The HAU would combine ventilation and recirculation strategies with systems to clean and condition air into the central HVAC system—thereby taking advantage of a system that already extends throughout the home and treats most of the home's circulating air. Thus configured, the HAU would offer the opportunity for more effective IAQ improvement and could be integrated with the HVAC products that meet the latest energy-efficiency standards. However, data on consumer preferences and beliefs were needed to help move the technology from the laboratory to the marketplace.

2 PURPOSE

The purpose of this work was to develop a better understanding of the potential consumer market for a HAU. Our objectives were to:

- identify potential consumers for the HAU technology;
- determine consumer beliefs and preferences concerning IAQ; and
- identify factors in consumer decisions to purchase HVAC and air-cleaning technologies.

3 APPROACH

Data on consumer preferences and beliefs are important elements in moving technology from the laboratory to the marketplace. Through the California Energy Commission's Public Interest Energy Research (PIER) Program, Oak Ridge National Laboratory was tasked with identifying potential consumers for the HAU technology, determining consumers' beliefs and preferences concerning IAQ, and identifying factors in consumers' decisions to purchase HVAC and air-cleaning technologies. To accomplish this, ORNL teamed with UNICO Inc., to analyze a sample of the target audience of California consumers to determine product attributes/enhancements they are willing to pay for when making a purchase decision among available HVAC systems. The team also identified relevant interactions between the market research and the PIER R&D project to revise California ventilation standards.

To understand the HVAC market and its connection with IAQ, we began by documenting IAQ issues and treatable pollutants in California. Then we researched the California market for HVAC systems, along with Title 24 and issues surrounding that legislation. We reviewed housing market, population, health issues, and climates by region. Despite our original assumption that households with an allergic or asthmatic resident would consider buying this product, the response from those who did *not* suffer from allergies was overwhelmingly

favorable. Using U.S. Census, the California Energy Commission, and California Air Resource Board (ARB) data with reasonable assumptions about the replacement market, we calculated that such households represented a market of 200,000 HVAC units per year, or 27% of the entire HVAC market in California.

In a separate phase of our project we conducted discussions with 20 HVAC market intermediaries—builders, utilities, organizations, and HVAC contractors. Based on these talks, we drafted an information tool (Fig. 2) that was administered to three groups:

- The first group (25 allergy patients) was contacted through a large allergy clinic in California that agreed to help with the analysis.
- The second group included home tour attendees (47 prospective or current homeowners). The home tour sponsors were builders and contractors who work with the DOE Building America Team; they agreed to distribute the information tool to tour attendees.
- The third group consisted of 335 homeowners who were contacted by the marketing department of UNICO.

Homeowner Information Tool for "Healthy Air" HVAC Feedback

Your responses to the following questions will assist the California Energy Commission learn more about what is important to you as a California homeowner/ resident about your home's heating and cooling systems and indoor air quality (IAQ). The results will be compiled and individual responses will remain anonymous. Thanks for your time in contributing to this study.

Which characteristics in your opinion would best describe healthy indoor air? Check all that apply.

- o Comfortable (temperature and humidity)
- o Fresh (not stale – plenty of oxygen)
- o Odor free (no objectionable smells)
- o Pollutant free (pollen, mold, smoke, chemicals)
- o Other_____

Do you currently suffer from respiratory or other health conditions? Yes / No Are these conditions affected by the air in your home? Yes / No

Do you currently use filters and/ or other devices to treat your indoor air? Yes / No If yes, describe the filters and/or devices you are using. _____ Do these filters and/or devices treat rooms and/or an entire house? Room / Entire house

Would you be interested in a whole house heating and cooling system that provided "healthy air" with the characteristics you described in item 1 above (comfortable, fresh, odor free, pollutant free, other)? Yes / No

If such a whole house system were available, how much more would you be willing to pay for the "healthy air" system improvements?

- o $500 - $1,000
- o $1,000 - $2,000
- o $2,000 - $4,000

What other incentives might encourage you to purchase a "healthy air" whole house heating and cooling system?

- o Income tax deduction as medical expense
- o Partial coverage under medical insurance
- o 5-year product warranty
- o Other _____

When would you most likely install/upgrade to a "healthy air" whole house heating and cooling system?

- o Buying a newly constructed home
- o Remodeling your existing home
- o Replacing your worn-out heating and cooling system
- o Responding to acute medical conditions in your household
- o Other _____

Fig. 2. Information tool distributed in the market assessment.

From the responses received from the three groups above, the project team was able to assemble information about the IAQ issues important to consumers and the costs consumers would be willing to pay to address those issues. The results are interpreted and summarized in the report *Market Assessment for Healthy Air HVAC System in California* (Lapsa et al. 2007). Although these results are not meant to represent the entire state of California, they allowed the team to determine whether there was significant consumer interest in the HAU among California homeowners.

3.1 Market Analysis Groups

We researched the three market groups and trends in each group relative to energy-efficient technology in the home: consumers, builders, and contractors. These are briefly summarized below.

3.1.1 Consumers

The building industry is changing as homebuyers become more demanding. “In California, in particular, consumers are looking for technology solutions that will help them battle high energy costs, natural disasters, and water scarcity. The competitive advantage will go to the builders who can offer greater affordability, comfort, and durability in their homes. New technologies can deliver a lot of that,” says Carlos Martín with the Partnership for Advancing Technology in Housing, a federal program designed to promote innovation that leads to higher-quality, more-affordable homes (*California Builder Magazine* 2005).

A relatively small percentage of HVAC service and retrofits (less than 5% by current estimates) are the result of an energy management decision by the homeowner. As the costs of electricity, home heating oil and natural gas rise, homeowner energy management may be a growing reason for HVAC service/retrofit. Furthermore, public education is still limited in this area. (National Energy Management Institute [NEMI] 2004).

3.1.2 Builders

Today’s homebuilders now seek to include some advanced technology in their homes, according to a new survey of 400 U.S. builders. Programmable thermostats, security systems, and zoned HVAC systems top the list of most frequently offered products. Name, reputation of company, and product quality outweigh pricing as top reasons why builders select specific manufacturers’ products to offer their buyers. (Parks Associates 2004). Recent research by the U.S. Department of Housing and Urban Development shows that builders consider several factors when deciding to use new technologies:

- Can the technology be easily incorporated into their current process of homebuilding?
- Have other builders reported success with the technology?
- Have homebuyers accepted the technology?
- Is the new technology easy to install and operate?
- Do manufacturers stand behind the product? Do they have a reliable supply chain?

3.1.3 Contractors

The HVAC industry is highly fragmented and defined by a large number of contractors. There are an estimated 75,000 plumbing, heating and air-conditioning special trade contractors in the United States. Small firms dominate these contractors. Only 8% have 20 employees or more, but they account for over half (56%) of all business done.

Residential contractors specializing in HVAC only number about 20,000. These firms employ more than 130,000 workers. Over the next 5 to 7 years, an additional 25,000 to 30,000

HVAC mechanics are likely to be added to the industry, according to the Bureau of Labor Statistics (NEMI 2004).

Perhaps the most significant development in the residential HVAC market is industry consolidation, in part due to changing market structures. Considerable consolidation has occurred among residential HVAC contractors, and manufacturers and distributors are moving further downstream to the homeowner and have also seen significant consolidation.

Contractors are an important element in the promotion of high-efficiency HVAC systems. According to the Electric & Gas Industries Association (EGIA), "Due to the high cost of HVAC replacement, most … contractors typically promote the lowest cost alternative in order to 'close the deal' … they know that in the end, the majority of customers will opt for the lowest total cost solution." Presenting the benefits of environmentally friendly, high efficiency HVAC systems on an equal footing with cost benefits would go a long way towards encouraging homeowners to consider efficiency as well as cost. EGIA recommends that California Public Utilities Commission increase and sustain funding of contractor training and education programs. "A well-trained and motivated statewide network of home improvement contractors is critical to unlocking the untapped potential that exists throughout California for the replacement of inefficient residential space conditioning with high efficiency HVAC solutions" (EGIA 2003).

3.2 Feedback from Market Intermediaries

Our intermediaries, including utilities, builders, HVAC contractors and manufacturers, and organizations, were almost all favorable towards the healthy air HAU. These favorable attitudes and other important feedback are summarized in the responses below.

- Utilities specifically noted that the HAU should meet EER minimums to be reviewed for a rebate program, be affordable, have clearly discernable benefits, and be ENERGYSTAR®–compliant.

- Contractors expressed interest in the HAU, noting that payback would have to be clear for them to stand behind it.

- Manufacturers indicated the need for non-invasive and quality service maintenance. Homeowners do not want to deal with difficult or messy replacement filters or parts. In addition, the ability to control humidity, temperature, and ventilation levels and other comfort features is important. Manufacturers perceived an increasing consumer interest in IAQ and have responded by developing more systems that can be integrated with their heating and cooling units. They indicated that most consumers are interested in these systems if they have health issues. They also acknowledged that residential consumers are interested in reliability and comfort.

- Builders noted that the HAU would have to be cost-competitive, that the cycle time for incorporating HAU into the building process would have to be reasonable, and that the HAU would have to offer a substantial improvement in air quality. Builders also recognized the correlation between tightness of construction and IAQ. They also mentioned that residential customers are concerned with security and therefore do not open windows for ventilation. Security is therefore another value that can contribute to consumer interest in IAQ.

- Organizations expressed interest in the HAU because of the energy savings and IAQ impacts. Specifically, organizations linked the unit's favorable acceptance with cost-efficiency and effectiveness, reasonable cost, clear advantages over currently available air treatment systems (central and portable), scientific verification of

benefits, reduced generation of dust, improved odor of air generated, ease of maintenance, and an accessible filter.

Among the market intermediaries, the utilities received the least feedback from residential consumers about IAQ, perceiving residents to be most interested in comfort and cost. Both contractors and builders indicated that residential consumers are knowledgeable about some IAQ factors and are most interested in IAQ if they are older and/or experiencing health problems (especially allergies and asthma). Overall, these intermediaries acknowledge that IAQ is only one benefit consumers associate with an HVAC system and is not necessarily a high-priority consideration.

Other important marketing factors mentioned through discussions with intermediaries about market adoption of IAQ systems include the following:

- The sales force must be trained to effectively explain the benefits of IAQ systems.
- Consumers need to be better educated about IAQ, particularly with regard to comfort and security
- Systems must be maintained effectively to ensure performance.
- Actual interviews with consumers reflect greater overall interest in IAQ across market sectors (and not just those with health or age issues) than perceived by the most of the market intermediaries. The exception is among the organization intermediaries, which largely represent health concerns or consumer advocacy positions. Their responses closely align with the consumer responses.
- This disconnect between perceptions of key market intermediaries and consumer interest in IAQ reveals much opportunity for better marketplace intervention through more education of intermediaries about consumer interests, as well as better information for consumers about marketplace options. The California Energy Commission could provide a forum to more effectively engage intermediaries in the interests of consumers.
- As discovered in our earlier attempts to support greater market adoption of other energy-efficient products, consumers have multiple criteria when selecting a system, and are not often willing to accept any one attribute without the benefit of the others. Consumer values that have been cited by intermediaries include overall air comfort, system reliability, and ease of maintenance. In addition, intermediaries pointed out that residents keep their windows closed to enforce personal security, thus exacerbating problems from indoor air pollutants. Thus, personal security is a consumer value that affects IAQ. All these values should all be considered when developing a new product.

3.3 Feedback from Consumers

The analysis performed by the project team indicates a market in California for an integrated HVAC system that improves IAQ, significant opportunities to improve air quality in California, and a favorable outlook for an integrated HVAC system that would provide a HAU for homeowners.

The project team distributed the information tool developed in this project (Fig. 1) among three different groups of consumers, receiving responses from 407 homeowners about IAQ and its effect on health. The team also wanted to gauge consumer feelings about installing an HAU in their homes. The results are summarized graphically by groups:

- One group (n=25) consisted of patients from an allergist's office waiting room.
- A second group (n=47) was drawn from a home tour (prospective homebuyers/remodelers).

- A third and largest group comprised 335 homeowner members of The National Trust for Historic Preservation, a non-profit organization focused on preserving America's architectural heritage.

These groups were then combined (n=407) to show results for all respondents.

The survey data showed that California consumers are interested in a new HVAC technology that supports improved IAQ and are willing to pay a premium price for it. The original assumption—that only households with an allergic or asthmatic resident would consider buying this product—did not hold: the response from those who did not suffer from allergies was overwhelmingly favorable. Consumer response confirmed the assumption that people would buy an HAU when equipping a new home or replacing a failed HVAC. People also responded that they would be likely to install, or upgrade to, an HAU when remodeling or responding to a health condition in the home. Conclusions regarding the market for the potential HAU technology are listed below:

- Overall feedback from three groups of California residents indicates that 74% are interested in an integrated HVAC system that improves IAQ. The data show that an HAU must provide comfortable, fresh, odor- and pollutant-free air. Across the board, homeowners value all of these qualities for indoor air.

- A total of 66% of the respondents indicated a willingness to pay at least a $1000–$2000 premium for an HAU, which the team considers a potentially viable price range.

- Sectors relating to remodeling, replacement, or responding to acute health condition form the bulk (77%) of the HAU market, with 19% associated with new home construction. Therefore, the technology must be easily adapted to a wide range of existing physical conditions.

- Of the respondents, 71% are non-allergy sufferers, indicating that there is a strong market for IAQ among those without major health issues.

- Residents are most likely to install an HAU system when replacing their old system. Therefore, contacts with the local contractors who usually install replacement systems are important. This supports the importance of having a trained installation and sales force.

- Survey participants assigned almost equal value to each of the attributes they associated with "healthy" air: comfort, freshness, odor-free, and pollutant-free. Ensuring that a new HVAC system addresses these attributes is therefore critical. It should be noted that the attribute of comfort was also identified by intermediaries as important. Comfort could therefore be a springboard for marketing efforts by these groups, as well as a point of understanding for consumers.

- Consumer respondents who currently use devices to treat air are in the minority (38%). However, among the group with allergies/respiratory conditions use of devices is high (71%). These statistics confirm the strong market potential for a new IAQ system, and point to a need for more consumer education on this issue.

- Those who use devices are familiar with filtration systems, with a slightly larger group 53%) using filters that treat an entire house and a smaller group (47%) using filters to treat a room. versus a room. However, the survey does not indicate whether some respondents actually use both types of filtration. Also, it should be noted that allergy-

sufferers have a greater tendency to use room units (60%) versus entire-house filtration (40%). This higher percentage of room use is much higher than for non-allergy sufferers (47%). This statistic suggests that allergy suffers may perceive room systems to be more effective than entire-house systems for dealing with health conditions. When developing a new whole-house system, comparing its performance to that of room systems would be especially beneficial for people with health issues. In addition, it is not clear that consumers understand the concept of whole-house systems. When communicating with consumers about a new HVAC system, it is important to use terminology that consumers will understand. Certainly comparing benefits with room and entire house filtration could be a starting point.

4 CONCLUSIONS

In its preliminary data analysis, the project team assumed that only households with an allergic or asthmatic resident would consider buying this product, and then only when equipping a new home or replacing a failed HVAC. Using data from the U.S. Census, California Energy Commission, and California Air Resources Board (ARB) with reasonable assumptions about the replacement market, the team calculated that such households represented a market of 200,000 HVAC units per year, or 27% of the entire HVAC market in California.

However, after analyzing information from consumers, the team determined that this market estimate was too low. The predicted favorable response from asthma and allergy sufferers was accompanied by an unexpectedly positive response from consumers who did not suffer from allergies. Further, 66 percent of respondents expressed a willingness to pay a price premium of $1000–$2000 for an HAU.

These data indicate significant opportunities to improve air quality in California through an integrated HVAC system that would provide a HAU for homeowners. In fact, the market may be as large as 370,000 units per year, or approximately 50% of the annual HVAC market in California. This encouraging estimate—along with the very favorable responses to the HAU—suggests that efforts to develop such a system and educate consumers and market intermediaries about the product could prove extremely valuable.

5 RECOMMENDATIONS

The following findings can be used to guide the HAU development process:

- The HAU should meet EER minimums to be reviewed for a rebate program, be affordable, have clearly discernable benefits, and be ENERGYSTAR®–compliant.
- Elements that would increase marketability include non-invasive maintenance, quality service, the potential for substantially improved air quality, and the ability to control humidity, temperature, and ventilation levels and other comfort features.

The following findings can guide efforts to market the HAU:

- IAQ is only one benefit perceived from an HVAC system. Marketing materials and training should also emphasize the HAU's cost-efficiency and effectiveness, reasonable cost, reliability, scientific verification of benefits, reduced generation of dust, improved odor of air generated, and ease of maintenance.
- Residents are most likely to install an HAU system when replacing their old system. Therefore, contacts with the local contractors who usually install replacement systems are important. This supports the importance of having a trained installation and sales force.

- When communicating with consumers about a new HVAC system, it is important to use terminology that consumers will understand.
- Marketplace intervention could be enhanced through more education of intermediaries about consumer interests, as well as better information for consumers about marketplace options.

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