

# INDOOR AIR QUALITY: EVERYONE'S CONCERNED OR NOBODY'S CONCERNED

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Now that the cat is out of the bag that indoor air quality (IAQ) is a problem, it's amazing to note the gyrations made to ignore the problem. The public reaction is funny; it is sad. The gyrations are logical, to a point, only to become illogical. A person's health and well-being are primary goals of our society's laws and regulations (i.e., protection of public health). However, public attitudes reactions, and decisions are limiting factors to successful implementation of IAQ program elements.

This paper presents the fact and the fiction of consumer reactions to IAQ. It looks at some major sources of IAQ problems and the scientific, prescriptive solutions contained in our programs. We share some of the reactions to the IAQ measures. How is the homeowner reacting? What is the psychological impact? Does anyone care about the legal implications?

The results of this pilot study allowed us to identify consumer preferences, and in many cases, identify underlying rationales. In turn, this information was compared to existing IAQ utility program elements. It allowed us to evaluate program elements within the context of consumer reaction and identify which elements were accomplishing desired/intended reactions, and which were not. Several utility program redesign recommendations are provided.

Ms. Rowan is one of a nine member National IAQ committee whose purpose is to propose IAQ items for the Uniform Building Code. This paper also includes some of the results of that committee work as it relates to the focus of this paper.

Although this paper is based on experiences in the Pacific Northwest, we believe people are people, no matter where they live. Thus, you should find our lessons are of universal value.

## INTRODUCTION

A person's health and well-being are primary goals of our society's laws and regulations, (i.e., protection of public health). However, public attitudes reactions, and decisions are limiting factors to successful implementation of indoor air quality (IAQ) program elements. Since 1984, the Bonneville Power Administration has offered two programs for energy-efficient new homes to jurisdictions and utilities. How do these programs contribute to the degradation of IAQ? Not much, according to a recently published environmental impact statement. In fact, the homes contain special measures that provide for

an enhanced IAQ. However, despite these measures, the public reaction is still skeptical.

This paper presents the results of a pilot study conducted to discern public attitudes, reactions, and decisions pertaining to IAQ program elements. The specific "public" studied is a consumer of a new energy-efficient home. Consumer homes contain IAQ enhancement features and the consumer has been exposed to unique IAQ awareness opportunities (e.g., other than normal media exposures) that promote preventative mitigating actions.

A "Consumer Reaction Profile" and a "Consumer Reaction Survey" were developed to: (1) identify reactions to IAQ information and IAQ problems, (2) to evaluate existing program information and problem resolution features, and (3) to recommend subsequent program design changes in these two IAQ-related areas.

Although this pilot study represents a local experience, we are confident in the universality of its potential application. In turn, the results, conclusions, and recommendations will be useful in designing IAQ program features that sponsor maximum consumer participation.

## BACKGROUND--SETTING THE STAGE:

### What

Before we can study consumer reaction to IAQ, let's take a closer look at "what" the consumer is reacting to.

Because of the complex nature of IAQ, we have selectively narrowed the number of issues so that we can focus on reactions and their comparative meaning. Although the parameters are few, we feel they are diverse. They are ventilation, radon, formaldehyde, and electric and magnetic fields (E/MF). Although E/MF is not a traditional IAQ parameter, it does present adverse IAQ consumer concerns and reactions. Thus it provides a unique dimension to our study by allowing us to compare responses between traditional and non-traditional parameters.

### Who

We also need to identify "who" the consumer is in the context of IAQ. For purposes of this paper, the "consumer" is the occupant of a new energy-efficient electrically heated home.

All residents surveyed were living in homes that contained IAQ enhancements as compared to current practice homes. Specifically, these enhancements included construction features that provided source control for formaldehyde, moisture and odor (mechanical ventilation), combustion appliances (designated supply air), and radon. (See Figure 1.) Occupants had also received IAQ

informational material that identified what these pollutants were, their health effects, and how they could be controlled. They were also within a utility service area that received special informational material (e.g., brochures and booklets) on E/MF.

### How

**Consumer Reaction Profile.** In order to record consumer reaction, a Consumer Reaction Profile (Profile) was developed (Figure 2). The Profile was developed on the premise that consumers will react to one or both of two stimuli: information and problems.

Regarding information, the Profile identifies five specific types of information that the consumer could receive: general, specific, technical, health effects, and legal. The Profile then allows charting of an "action" or "no action" response to the information. This, in turn, allows one to determine whether the type of information triggers a positive or a negative action response.

Regarding the problem, the Profile depicts the problem mode of the consumer ("Yes, I have a problem. No, I don't have a problem.") If the consumer has a problem, the Profile indicates three possible reactions: preventative, reactionary, or no action. If the consumer has not identified a problem, the Profile also provides for curiosity reactions such as seeking more information in printed material and/or monitoring, if available for that specific IAQ parameter.

**Consumer Reaction Survey.** The Profile assisted documentation of the results of the Consumer Reaction Survey (Survey), Figure 3. The Survey was conducted by telephone with 50 new energy-efficient homeowners (response rate) throughout the greater Spokane metropolitan area, serviced by Washington Water Power.<sup>1</sup> One call was made to each residence; only one occupant of each residence was allowed to respond to the Survey.

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<sup>1</sup> The original sample size was over 500. However, program builders, contractors, and utility program new energy-efficient homeowners were excluded from the sample since they had received specific program IAQ training.

- Construction shall contain the following IAQ enhancement features:
- Mechanical ventilation system.
  - Radon source control preparatory measures.  
(sub-slab gravel; crawlspace ventilation)
  - Wood products made with urea-formaldehyde that meet product standards.
  - Combustion appliance outdoor air supply.
  - Exhaust fans in kitchens and bathrooms.

- Consumers shall be provided with:
- Offer of radon monitoring.
  - Indoor air quality information.

Figure 1. Bonneville Power Administration's New Energy-Efficient Homes Programs

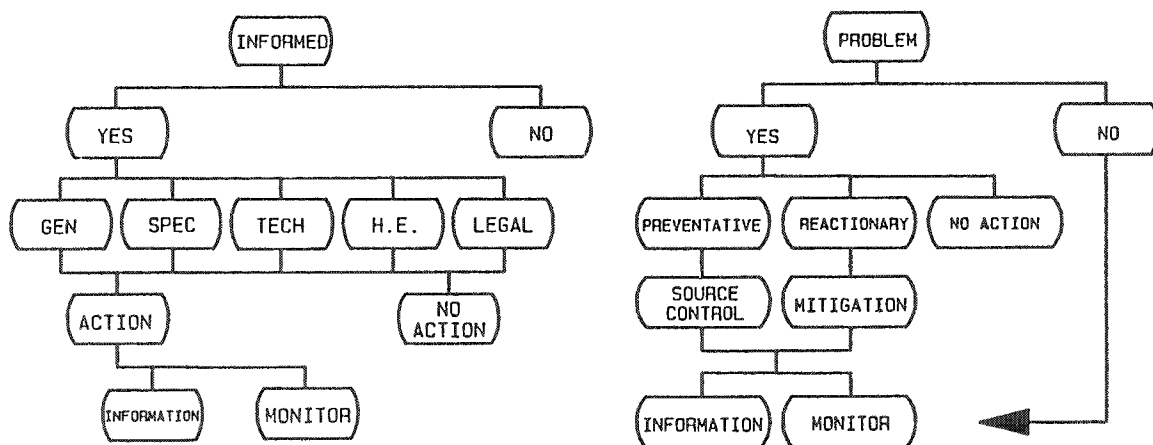


Figure 2. Consumer Reaction Profile

This service area is uniquely qualified for this type of survey because of (1) the high density of homeowners that have participated in Bonneville's new energy-efficient homes programs, (2) the highest percent distribution of indoor radon concentrations above 5 picocuries per liter within Bonneville's service area (Reference 2); and (3) the high level of exposure to endeavors by Bonneville and Washington Water Power to inform the public about electric and magnetic fields (E/MF).

The Survey allows identification of the consumer reaction/attitude of the four parameters: formaldehyde, ventilation, E/MF, and radon. This provides for individual assessment of the consumer reactions as they relate to available information and perceived problems.

## SURVEY RESULTS

### Word Association

Word association was Part I of four survey parts. This part allowed the consumer to mentally get involved with the IAQ subject matter and to test basic levels of knowledge. With the aforementioned programmatic opportunities for exposure to various IAQ concepts in mind, Part I allowed qualitative judgment/measurement of value of information.

Figure 4, "Results of Word Association," only records unique answers to exhibit a "mind set" of each parameter. Repetitive, common responses are not repeated (e.g., E/MF/dangerous power lines; radon/poison gas).

NAME:  
EDUCATION:  
CATEGORY: Super Good Cents \_\_\_\_ Comfort Choice \_\_\_\_ E/MF \_\_\_\_

1. Word Association: What comes to mind in 10 words or less?

IAQ:

Formaldehyde:

Ventilation:

Electric and Magnetic Fields:

Indoor Air Quality:

Radon:

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Formaldehyde - 1 Ventilation - 2 E/MF - 3 Radon -4  
Mark the appropriate number(s) in response to the following.

2. Are you informed?

- I am most informed about \_\_\_\_\_.
- I am least informed about \_\_\_\_\_.
- I would like to know more about \_\_\_\_\_.

Types of information I have received: General \_\_\_\_ Specific \_\_\_\_  
Technical \_\_\_\_ Health Effects \_\_\_\_ Legal \_\_\_\_

Types of information I would like: General \_\_\_\_ Specific \_\_\_\_  
Technical \_\_\_\_ Health Effects \_\_\_\_ Legal \_\_\_\_

Because of the information I have received, I have taken action on

3. The Problem.

- I know I have a problem with \_\_\_\_\_.
- I'm not sure if I have a problem or not with \_\_\_\_\_.

4. The Reaction.

- I fear more knowledge about \_\_\_\_\_.
- Why?
- I have taken action to prevent \_\_\_\_\_ reduce \_\_\_\_\_.

*Figure 3. Consumer Reaction Survey*

- IAQ - Radon; toxic items in the air; IAQ; freshness; non-pollutant; lack of dryness; alphabet.
- Formaldehyde - Glues in wood products may or may not be in home; bad; health problems; particleboard; foam insulation; toxic fumes; embalming fluid; harmful gas; poison; preservative; building materials; bad smell; stink; chemical; high school biology; unsafe; death
- Ventilation - Need for air exchange for toxic or humid air with fresh air; fresh air; condensation prevention; radon mitigation; circulation--air turnover; have good vents; breathing hard; air; good; great; air exchanger; open windows; fans; important--all houses need; air--we don't have enough of it.
- Electric and Magnetic Fields - Microwave and electric rays; may or may not be dangerous; wiring; intercom wire spacing; static; power lines; magnetic pulls; electricity; interference; magnets; fields around electrical conductors; compass.
- IAQ - IAQ; good; indoor pollution; headaches; toxic fumes; need; fresh air; very important; clean environment--no dust; need good air; air; good fresh air; air exchanger--ours is great; clean; air we breathe inside; exchanging interior for exterior air; highest on my list--highly required.
- Radon - Odorless; colorless coming from earth; infiltration; dangerous; lung cancer; normal occurrence; mitigation; radiation; radioactive decay; indoor pollution; cancer; harmful gas; concerned; mystery gas; new homes; poison gas; harmful; poison gas from ground; test kit cost going up--don't want it; gas seeps up through the soil; new home tested and we are looking pretty darn good; gotten to be common in last few years; we are all suspect for having in our homes; deadly gas; byproduct of uranium--the bomb stuff; run for your life.

*Figure 4. Results of Word Association*

#### Are You Informed?

Part II of the Survey, "Are You Informed?" serves to reveal which parameters occupants think they are informed about. The parameters are Formaldehyde (HCHO), Ventilation (V), Electric and Magnetic Fields (E/MF), and Radon (Rn). Participants have been provided fairly equivalent amounts of printed material on all parameters through utility programs. This material is beyond national and local media coverage.

Figure 5 summarizes the responses to the six questions asked in Part II of the Survey. The black bar to the left of each set indicates the ideal response level. The "ideal" response level is that which appears to be responsive to program IAQ information/features (e.g., aware of construction enhancements; knowledgeable about parameters to the extent covered in program informational materials.) [AUTHORS' NOTE: Two caveats are acknowledged as uncertainties of the results:

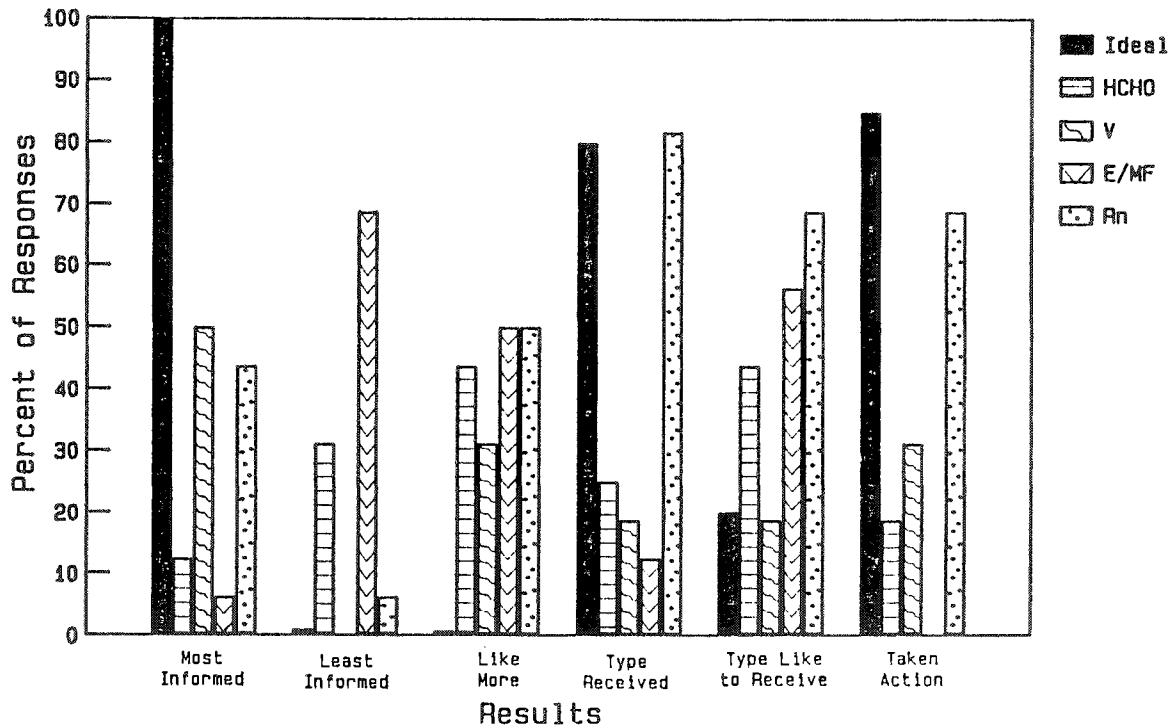


Figure 5. Are You Informed?

(1) Other sources of information exist such as independent or professional reading, word of mouth, etc., and (2) available information is comprehended and retained at widely different levels (from 0-100 percent). The four bars from left to right of each grouping indicate response levels for HCHO, V, E/MF, and Rn, respectively.

**Most Informed.** The level of expected response is 100 percent, since: (1) respondents received special informational materials on all parameters; and (2) respondents were encouraged to list all parameters about which they felt they were "comfortably informed". Ventilation was understandably the most popular response since respondents' homes are all equipped with whole house mechanical ventilation systems. However, only a 50 percent positive response seems to indicate they don't understand the system.

Radon was surprisingly low considering the above average concentrations of radon in this geographical area which have promoted an abundance of written information (e.g., media coverage, radon mitigation industry advertising.)

**Least Informed.** Since respondents have received an array of information on all parameters, the ideal baseline is set at near zero. Relatively speaking, there are no surprises in this grouping.

**Like More Information.** Again, the baseline is at near zero for the aforementioned reason. The response was quite diverse from the baseline. This will be addressed in greater detail in our conclusions.

**Type Received.** The baseline was set at only 80 percent to accommodate for the absence of any legal information in our programs. As expected in this geographical area, radon scored the highest, and exceeded our baseline target. The lack of acknowledgement of receiving information in the other parameters was disappointing, yet interesting.

**Type of Information Wanted.** Again, because no legal information was provided in our literature, the baseline acknowledges this. A healthy response is visible throughout this grouping. Technical, health effects, and legal information were the driving factors. (See Figure 6.)

	<u>Female - 44 Percent</u>	<u>Male - 56 Percent</u>
Most Informed	V and Rn	V, Rn, and HCHO
Least Informed	HCHO and E/MF	HCHO and E/MF
Like More	HCHO, E/MF, and ALL	Rn
Type Received	V and Rn (Gen., Spec., Tech., H.E.)	HCHO and Rn (Gen., Spec., Tech., H.E.)
Type Like to Receive	HCHO, E/MF and Rn (H.E. and Legal)	HCHO, E/MF, and Rn (Tech, H.E. and Legal)
Taken Action*	HCHO, V, and Rn	V and Rn

\* All houses have structural wood components of low emitting HCHO, mechanical ventilation systems, and radon source control preparatory measures. An equal percentage of male and female respondents were unaware of these features. Over 30 percent of all respondents were unaware.

Figure 6. *Are You Informed? Does Sex Make A Difference?*

**Taken Action.** Since consumer action to reduce or prevent E/MF is limited, the baseline has been adjusted accordingly. The high response to radon reflects knowledge of the preventative construction measures of subslab gravel and/or crawlspace ventilation, and/or the offer of free radon monitoring. Figure 7 shows a much lower rate for reduction than prevention.

#### The Problem and the Reaction

Parts 3 and 4 of the Survey Results, The Problem and The Reaction respectively, are summarized in Figure 7.

### CONCLUSIONS AND RECOMMENDATIONS

The "Consumer Reaction Profile" and the "Consumer Reaction Survey" were developed to (1) identify reactions to IAQ information and IAQ problems, (2) to evaluate existing program information and problem resolution features, and (3) to recommend subsequent program design changes in these two IAQ-related areas. Conclusions from the Consumer Reaction Survey are best presented in the same order as the Survey.

#### IAQ Information Reactions

**Word Association.** Part 1 of the Survey was Word Association to allow the consumer to mentally get involved with the IAQ subject matter and to test basic level of knowledge. This portion of the Survey revealed a broad range of understanding related to IAQ. Considering the unique amount of printed materials all of the Survey participants had received, the Survey results appear to indicate that most did not read these materials, nor were they aware of their existence. Most were not any more informed than the general public.

A case in point is a glossy 27-page booklet on IAQ that all respondents received in their new home kitchen drawer. With this in mind, only six of 50 respondents answered the Word Association for "IAQ"--we are not acknowledging the "alphabet" response.

The results indicate that the type of information and the method/timing of dispersal is not accomplishing the intended goals of actually informing the occupants and promoting preventative/mitigating actions.

	<u>Female - 44 Percent</u>	<u>Male - 56 Percent</u>
Know Problem	0	0
Not Sure	HCHO, E/MF, and Rn	V, E/MF, and Rn
Fear Knowledge*	0	HCHO**
Action-Prevent***	HCHO, V, and Rn	Rn
Action-Reduce	0	Rn

\* Almost 70 percent of total don't fear knowledge: 85 percent female.

\*\* 45 percent of male respondents fear knowledge.

\*\*\* 44 percent of total have not taken any action to prevent or reduce, even though they are not sure if they have a problem or not.  
55 percent of males and 43 percent of females chose preventative action.

22 percent of males and 14 percent of females chose reduction.

*Figure 7. The Problem and the Reaction*

#### Are You Informed?

Part 2 of the Survey dealt with the question: "Are you informed?" or specifically asked which parameters they felt most or least informed about and which they would like to know more about. The supposition that participants did not read the printed materials they have been provided through utility programs is again confirmed throughout this portion of the Survey results. Overall, consumers did not feel they were informed on most IAQ issues. They also desired information that they had already received. (See Figure 5 for more detail.) It was also evident that respondents who were well informed on a particular parameter were those who had a specific reason to pursue more information (self-initiated action).

These findings again reinforce the need for consumers to be actively seeking information or answers before they can make use of any informative materials.

#### IAQ Information Conclusions and Recommendations

People want to know about IAQ, but only in the context of what it means to them. In a time of information overload, people are receiving too much unfocused, impersonal information.

Our Survey results indicate that there is a strong preference for focused information--bottomline information that responds to health effects and legal implications for them.

In reality, the "appropriate" level of knowledge to provide the consumer is not so "cut and dried" when the various pollutants are considered. Thus, levels of knowledge must be considered independently for each. These levels could be categorized as High, Medium, and Low, as exhibited by the following examples. Radon is a Hi level of knowledge pollutant. Although there are still many questions to be answered, we do know the source and how to deal with it. Precedents have been provided regarding mitigation, health effects, and legal implications. Ventilation and formaldehyde are two Medium level examples. The overall awareness level of the consumer can be elevated regarding the potential adverse impact on their IAQ, however the level of resolution is still a consumer uncertainty. (e.g., When is ventilation adequate? Is my house okay regarding formaldehyde so long as it doesn't smell like my high school biology lab?) A Low level example is E/MF. The jury is still out on the health effects for both outdoor and indoor exposure, and how legal implications can be assessed without the health effects. Thus ignorance is understandable or



expected in this case: the consumer won't relate to the information until the bottomlines can be drawn.

Thus, we make the following program design recommendations for IAQ information.

1. Develop a one-page information sheet, preferably comprised of two or three bullets on each pertinent parameter. This will act as a quick consumer reference as to what is known and what can be done about it. Be sure to include health effects and legal information, if available.
2. Incorporate the information sheet into a "Request for More Information" format. Printed material has a better chance of being read if it is in response to a request. This also allows the consumer to dictate timing of receipt.
3. Distribute this information request sheet during the earliest stage of the program. (New energy efficient homes programs provide IAQ information after the home has been constructed. If provided at plan review, the consumer would have been able to make intelligent choices that may have enhanced IAQ beyond the program features, for example, cabinetry and furnishing decisions that take formaldehyde into consideration.)
4. Give people explicit options before construction, so that if they refuse, they are informed that it is much costlier to retrofit and that they are on their own (legally).

#### The Problem And The Reaction--Conclusions and Recommendations

The Survey results regarding the problem and the reaction to the problem are summarized in Figure 7.

The average term of occupancy of the Survey respondents is 1-2 years. They have successfully survived this term of occupancy without a "noticeable" IAQ problem.

It is interesting to note the reaction to radon in the context of a "noticeable" problem. All respondent homes are located within a geographic area of relatively high radon concentrations. Few have pursued the free offer of radon monitoring. Yet, the overwhelming response to "Do you have an IAQ

problem?" was "No." [Authors speculate that this denial may be due to fears such as liability, real estate devaluation, etc.]

Respondents were generally more open to preventative measures than reduction measures. Considering that all of these homes have already incorporated IAQ prevention/reduction measures, it appears that most respondents are assuming that these measures have been successful--a trust without knowledge philosophy.

This attitude is understandable when human nature is acknowledged. If there is knowledge of a problem, one feels obligated to act. Thus, the easy way out is to ignore sources of knowledge beyond short term adverse effects. Based on survey responses, it is interesting to note (per Figure 7) that men fear knowledge of a problem more than women. Authors speculate that this response probably stems from the psychological fear factor assumed by the males regarding "who" would actually be performing the followup work required if a problem was unveiled.

We have two program recommendations regarding the problem. (1) Source control requirements should be imposed whenever possible, practicable and warranted. (2) When it comes to IAQ, people will react positively to outside influences: self-initiative is rare. Imposed requirements create a level playing field for builders, etc., and also play on trust in existing institutions such as building codes.

Currently, the International Conference of Building Officials (ICBO) is considering several of Bonneville's utility new home program IAQ features for incorporation into the next version of the Uniform Building Code (UBC). The combustion appliance designated supply air requirement and the formaldehyde product standard for wood construction components have already been approved by ICBO's IAQ Committee. The Northwest Radon Construction Standard has been approved for further study as an Appendix to the UBC. Assure that the consumer is aware of the IAQ features, what they do and what they don't do. This could be accomplished by having the consumer sign a form that acknowledges their awareness and implied liability.

The Survey results indicated that respondents had a "blind faith" attitude toward the effectiveness of the IAQ features. This is definitely a false security attitude. The ventilation system needs operation and maintenance (minimal O&M) attention. It is not exactly a feature to be taken for granted throughout the life of the structure. The radon-related construction features of sub-slab gravel and/or crawlspace ventilation (passive) are only preparatory measures that provide for cost effective mitigation, if appropriate. They are not end-all/be-all measures that have resolved a problem. However, those respondents that were aware of these measures were naive to this reality.

Other Conclusions: (1) Follow-up survey focus groups, etc., to find out what were key factors for people who did take preventative/mitigating actions, and how do these people differ from those who failed to act, (2) what about renters and future owners?

## SUMMARY

This paper studies consumer reaction to indoor air quality (IAQ) in the context of their home. We have developed a Consumer Reaction Profile (Profile) that illustrates a variety of paths the consumer can take. The Profile was developed on the premise that consumers will react to one or both of two stimuli: information and/or problems. Subsequently, a Consumer Reaction Survey (Survey) was developed to gather information. The Survey was instrumental in allowing us to chart consumer reactions according

to the various paths of the Profile. Once charted, this information allowed us to identify consumer preferences, and in many cases, identify underlying rationales. In turn, this information was compared to existing IAQ utility program elements. It allowed us to evaluate program elements within the context of consumer reaction and identify which elements were accomplishing desired/intended reactions, and which were not. We were ultimately able to make several utility program redesign recommendations that provide twofold benefits: (1) time/cost savings for the utility, and (2) enhanced customer service.

Although this pilot study represents a local experience, we are confident in the universality of its potential application. In turn, the results, conclusions, and recommendations will be useful in designing IAQ program features that sponsor maximum consumer participation.

## REFERENCES

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