

# **Electric Water Heater Conversions—Dancing with the Devil**

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## **ABSTRACT**

This paper presents a perspective on the impacts of electric water heater conversion, the theory of how/when conversions occur, and results from a one-year electric water heater conversion (WHC) program offered as part of Wisconsin's Focus on Energy pilot program. The program was included in the pilot because of the substantial benefits conversion programs offer customers, electric utilities, and the environment.

The WHC program was designed to stand alone, but also relied heavily on trade ally support. Initial program activities—screening for households with electric water heaters; targeting mailings to these households; once in the home, stickering existing electric heaters; and additional mass marketing—resulted in a poor response. The program was redesigned to leverage trade ally access to homes, expand geographic territory, target the do-it-yourself market, and discontinue untargeted mass mailings.

The evaluation had four major goals. Results for the first goal, develop performance measures, showed the redesigned program reached 56% of its target goal of 1,300 "commitments to convert". Results for the second goal, assess market effects by gauging changes in contractor business strategy, proved not to be measurable in the short 1-year timeframe. The third goal of identifying key market barriers established barriers related to homeowners, physical limitations of buildings, contractors, and other electric water heater promotion programs. The fourth goal was to recommend whether the pilot program should be offered statewide. Based on evaluation results, the recommendation was to discontinue the present program, modifying future designs to include enhanced incentives, direct installations, and collaborative partnerships.

## **Introduction**

### **Summary of Wisconsin's Focus on Energy**

Wisconsin's Focus on Energy (FOE) Pilot Program is an innovative energy efficiency program being administered through a collaborative effort involving (1) a state government agency, (2) a major electric utility, and (3) a regulatory agency. This collaboration was the outcome of several related events. Utility restructuring discussions in the state of Wisconsin resulted in the establishment of long-term market transformation goals for the state. In about the same time period, Wisconsin Public Service Corporation (WPS) approached the state's utility regulatory agency--the Public Service Commission of Wisconsin (PSCW)--with the idea of making available funds the PSCW had previously earmarked for promoting energy conservation and demand side management. WPS proposed these funds be used to contract with an outside independent agency, which would be responsible for delivering conservation/energy-efficiency services in WPS's service territory. Wisconsin's Department of Administration indicated a willingness to be that agency through its Division of Energy (WDOE). The idea was that the WDOE would hire private contractors to deliver energy efficiency services throughout WPS's territory.

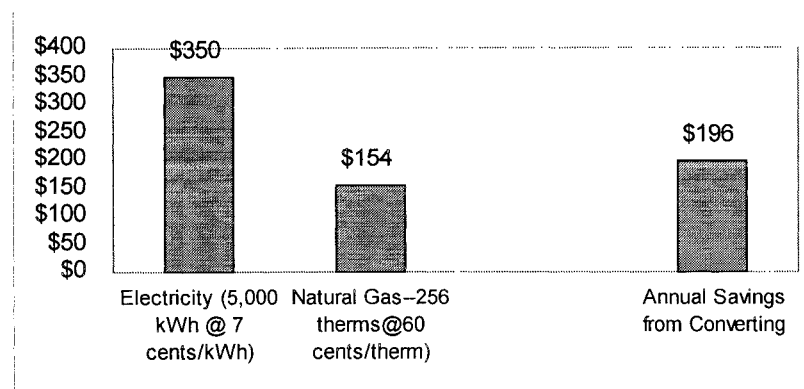
A Request for Proposal (RFP) was issued by the WDOE to select administrators and evaluators for the programs to be included in the FOE pilot. The original Request for Proposal identified four major types of programs--Energy Star Homes, Energy Star Appliances, a Commercial and Industrial Program, and a Marketing Program--as well as several innovative ones. The Electric Water Heater Conversion Program is an example of a small innovative program that has the potential for substantial long-term benefits for residential customers and the environment. Goals and suggested approaches were established for each element of the Electric Water Heater Conversion Program. Like all the other programs in the pilot, the overriding goal for the design of the conversion program was to achieve long-term market transformation as opposed to traditional conservation or "resource acquisition."

The FOE program was established with a significant evaluation component. For this particular pilot program, the goal of the evaluation was to identify the effective elements of the program design, the number of conversions, the energy savings, the impediments to greater success, and directions for improving program design and delivery.

### Importance of Electric Water Heater Conversion

This type of program has the potential for substantial long-term benefits for residential customers, the environment, and electric system reliability.

**Benefits to the Consumer.** The conversion of electric water heaters to a fossil fuel such as natural gas can significantly help to reduce a household's overall energy expenses. The graph below (Figure 1) presents the impact conversion can have on water heating expenses for the average Wisconsin family of 2.7 persons. This chart represents the average charges at the time of the pilot program. While natural gas prices have proven more volatile and have increased since the pilot program, consumers can still realize annual savings from conversion.



**Figure 1.** Annual Water Heating Costs for an Average Wisconsin Family

A second benefit is that natural gas water heaters take less time to recover than electric water heaters, making it less likely the household will run out of hot water.

**Benefits to Society.** Conversion to a fossil fuel offers several economic and non-economic benefits to society, including resource energy savings, and emissions reduction. Conversion benefits are also likely to be sustained over time.

The resource energy savings from conversion of electric water heaters to natural gas are substantial. Each kWh saved in the home saves about 11,500 Btu of coal resource energy, accounting for conversion efficiency plus transmission and distribution line losses. This corresponds to about one

pound of coal for each kWh saved. Electric water heaters use about 5,000 kWh annually, which represents about 2.5 tons of coal, or 57.5 MMBtu **per household**. A natural gas water heater in an average Wisconsin family household (2.7 persons) uses about 256 therms per year, or 25.6 MMBtu. Thus the net energy savings per household from conversion is about 32 MMBtu. Conversion of electric water heaters results in saving slightly more than half the resource energy of coal.

In regard to emission reductions, assuming the generation mix in Wisconsin at the time of the pilot, CO<sub>2</sub> emission savings due to conversion could be reduced by about 8,000 pounds per year or 4 tons of CO<sub>2</sub> per year for the average family in Wisconsin using 5,000 kWh to heat potable water.<sup>1</sup>

A third and important benefit to electric water heater conversion is the sustainability of this measure. The Energy Center of Wisconsin (ECW) conducts a survey of residential householders every two years. Among the questions asked of each respondent is whether the household has replaced a water heater in the last two years. Also included in the survey are questions about the fuel of the new water heater and the replaced unit. In 1997 and 1999, a total of 12 of 179 water heaters were converted from natural gas to electric – the rest kept fossil fuel.<sup>2</sup> The implication is that once a water heater is converted from electric to natural gas, the electric savings will likely last for the life of the house. This is in contrast to other technologies where the homeowners might first install efficient equipment but later regress to less efficient equipment – thus losing the environmental benefits in the long term (e.g., CFLs, faucet aerators).

**Electric System Reliability.** In this day of potential shortages of power in parts of the country, many states and utilities are looking for ways to reduce electric demand and increase supply by either building new power plants or purchasing energy from other suppliers. While there has not been recent research into the coincident demand of electric water heaters, historic data suggest that coincident demand is about 0.4 kW per electric water heater. That is, on average each electric water heater in Wisconsin contributes about 0.4 kW to the system demand during peak demand times. If all of the estimated 550,000 eligible Wisconsin electric water heaters were converted to gas, this would translate to about a 220 MW reduction in state electrical demand during historic on-peak hours, or a 1.6% reduction in the estimated current non-coincident demand of 13,750 MW.

However, there is evidence that the system load curves are changing. It appears that with the increasing saturation of air conditioning in homes and the prevalence of both spouses working, the system peak load is shifting to later in the day – after 6 p.m. Not only is the use of air conditioning in homes significant at this time, and driving this shift, but also the demand from electric water heaters is greater at this time of day than during the historic peak period of 10 a.m. to 6 p.m. Between 6 p.m. and 9 p.m. electric water heaters contribute around 1.1 kW per water heater on average compared to 0.4 kW during the 10 a.m. to 6 p.m. period. These higher, later contributions to peak are driven by evening cooking, baths, and showers.

It is possible that with the system peak demand shifting into the early evening, converting water heaters to gas could improve electric system reliability significantly by removing more than 220 MW from system demand. However, we caution that this hypothesis is based on older water heater use data and unverified shifts in system peaks among Wisconsin utilities. Additional research would be needed to develop more reliable estimates of the system reliability impacts of converting electric water heaters to fossil fuels.

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<sup>1</sup> State of Wisconsin Department of Administration Division of Energy, Focus on Energy I Pilot Study, "Development of Emissions Factors for Quantification of Environmental Benefits, Draft Report", May 9, 2001, prepared by PA Consulting Group.

<sup>2</sup> Energy Center of Wisconsin, "Appliance Sales Tracking, 1997/1999 Residential Survey", prepared by Opinion Dynamics Corporation.

**Summary of Benefits.** The following table summarizes the estimated benefits from converting water heaters in Wisconsin. These are "best estimates" based on past research into water heater use, profiles, and energy costs at the time of the pilot. The reader should keep in mind these estimates are based on Wisconsin parameters. They will be different in other states depending on typical lifestyle and generation parameters for that state. For example, in the Northwestern part of the country, up to 50% of electrical generation is from hydropower. In those states, CO<sub>2</sub> savings will be significantly lower based on these state's present generation mixes.

**Table 1.** Impacts of Converting Electric Water Heaters to Natural Gas in Wisconsin<sup>1</sup>

Persons in Household	Peak Demand Reduction (kW) <sup>2</sup>	Annual kWh Reduction	Annual Therm Increase	Annual CO <sub>2</sub> Savings (tons)	Home Cost Savings <sup>3</sup>
Two (2)	0.30	3,922	201	3.0	\$121
Three (3)	0.44	5,884	301	4.8	\$181
Four (4)	0.59	7,844	402	6.4	\$241
Five (5)	0.74	9,806	502	8.0	\$301

<sup>1</sup>The savings and environmental benefits of converting to LP gas or oil would be lower

<sup>2</sup>Based on an estimated 0.4 kW per home occupied by 2.7 persons, and during system peak 10 a.m. to 6 p.m.

<sup>3</sup>Based on \$0.60/therm, \$0.07/kWh

## Policy Issues

Regardless of the obvious benefits of conversion, there are costs to consumers and potential controversies. From the perspective of electric utilities, electric water heaters are often considered "base-load." Many electric utilities would rather use a load control strategy, which gets the water heater off line during peak periods but retains kWh sales during off peak. For this reason, many electric utilities have been reluctant to include electric water heater conversion in the array of energy efficiency measures they support. Furthermore, electric co-ops and municipals that depend on base-load growth have also been reluctant to support electric water heater conversion programs. For instance, many municipals provide income to their municipalities, thus helping to support a lower tax base. Municipals are often reluctant to field any program that might reduce their base-load sales. Worse, several Wisconsin municipal utilities are offering free electric water heaters to anyone converting from fossil fuels or installing one in a new construction project.

Thus, metaphorically speaking, those persons or organizations who understand the benefits to homeowners and society and wish to develop programs that will be challenged by organizations wanting to increase electric sales, rather than give them up, are likely to feel that they are dancing with the devil.

## Theory of Water Heater Conversion Pilot Program – Contractor's Perspective

### Program Theory

Past research and experience with water heater programs has shown that water heater conversion, like several other residential technologies, is primarily a replace-on-failure technology. Unfortunately, unlike some of these technologies, water heater replacement is also an "emergency replacement" technology. For example, although both water heaters and dehumidifiers are primarily replace-on-failure devices, when a dehumidifier fails, the homeowner does not perceive its replacement as a "must-fix-NOW" situation. In contrast, when a water heater fails, it must be fixed before the next shower/bath is needed.

In the initial program design phase, program staff believed there were at least two levels of barriers that could affect the success of the residential water heater conversion program: (1) barriers related to getting the customers' attention, and (2) barriers related to convincing them to convert when their water heater fails. Because of the urgency of replacement, program staff attempted to address the first barrier by leveraging program information through trade allies and others who had contact with the homeowner. It was believed that awareness had to be built and partnerships formed with local contractors who replace water heaters or the program would not have a chance of succeeding. Similarly, if the conversion program was to attempt to capture the do-it-yourself market, the local retail outlets for these units must also be involved as partners.

Furthermore, if the program incorporates high numerical goals within a short timeframe (as this pilot did), a large percentage of homeowners with electric water heaters must be targeted with awareness-building and incentive campaigns using a mass-marketing approach or direct intervention at the contractor or replacement market level. However, given the nature of a replace-on-failure technology, the need to achieve a high number of conversions quickly for the FOE program, and the limited program budget, general awareness-building techniques such as television and newspaper ads were not cost-effective for this program. Therefore, the original program design included an attempt to screen for households with electric water heaters and direct mass marketing (i.e., mailings, door hangers, canvassing) to these residences.

### **Program Design to Test Theory**

Based on the above theory, the FOE Water Heater Conversion (WHC) program was designed to be a stand-alone program that depended heavily on the support of plumbers, HVAC contractors, and LP dealers in targeted communities for educating customers on the benefits of conversion, and encouraging commitments to convert. As part of this education process, contractors were to place a sticker on the water heater showing the financial and environmental benefits of converting once their water heater failed. The sticker had two purposes. The first was to remind homeowners of the benefits of conversion so they would discuss this option with their local contractor when the water heater failed. The second purpose was to provide homeowners with the names of several contractors who understood the benefits and could perform the conversion when called. Any conversions that came immediately as a result of the program's education of the homeowner would be considered a bonus to the program.

In addition to planned recruitment efforts by program partners, customers in the target communities were recruited through mass marketing efforts. The objectives of the mass marketing were to provide leads on homes with electric water heaters and identify those homeowners who were interested in learning more about converting. Households with electric water heaters were offered a free home energy audit, which provided information on the benefits of converting as well as other ways to save on the home's energy bills. The original mass marketing included direct mail pieces, targeted door hangers, and door-to-door solicitations to communities with high percentages of electric water heaters. The sponsoring utility provided program implementers with billing data for all of its electric customers. Program implementers then used these data to identify communities with good potential markets (although program staff was not allowed to use the data to target specific customers).

The original program design was limited in that incentives (rebates) for conversions were not allowed. However, "gifts" (such as water-saving devices) were given to customers who responded to marketing pieces to get householders' attention. Program designers believed (and this was later confirmed) that competition for attention is very strong in direct mail and a "gift" is necessary to get people to even read program literature. Other types of gifts were also used during the course of the program, some of which were not related to saving energy. These included a handheld vacuum, \$10 gift

certificates to Home Depot, compact fluorescent lamps, and 500 NW Airlines frequent flier miles. The goal was to find gifts that might stimulate interest among homeowners.

Response to the initial partnering efforts and first mass marketing campaign was poor. As a result, program staff held focus group discussions to learn why they were failing to get the attention of homeowners. Two focus groups were held with homeowners who had electric water heaters in their homes--one group consisted of people the program had marketed to and the other included people who had not been contacted by the program. The lessons learned from these focus groups can be summarized in one overriding message: *“Don’t even try to get my attention regarding my water heater or hot water use – it is not important enough to me, compared to all other things going on in my life, to read your junk mail.”*

Given the failure of the mass marketing approach and initial contacts with contractors, the implementation contractor realized they needed to leverage the program’s needs with those who had access to the residence during the normal course of business. In December 1999, the program changed its focus and expanded its geographic territory in an effort to increase the participation rate among both consumers and contractors. The implementation contractor adopted several other approaches in an attempt to reach more electric water heating consumers in a variety of different geographical areas:

- Abandonment of untargeted direct mail approaches and the use of a more targeted marketing approach with utility name recognition (i.e., gas utilities who might be interested in increasing load). The revised program was successful in partnering with one gas-only utility. The utility agreed to insert a program solicitation card in the bill.
- Partnering with professionals already in the home who were delivering energy efficiency (i.e., energy service providers doing "direct install" programs for utilities), or some other type of services (i.e., plumbing, HVAC, water softener or testing) to homeowners.
- More aggressive relationships with then-present and new contractors
- Use of incentives for partners/contractors
- Targeting the "do it yourself" market

Program staff knew that any potential business partner would need an answer to “What’s in it for me?” Although it might be expected that contractors who install water heaters would be interested in getting more conversion work, early results from the program showed this was not the case. Even when customers are educated about the benefits, contractors do not typically push hard for conversions. If contractors encounter any barriers during a conversion, they quickly revert to straight replacement rather than risk losing a sale to the competition.

To get the interest of other potential partners, program implementers developed a two-tier incentive approach. In the first tier, potential partners were given \$25 for each “agreement to consider conversion” they got a customer to sign. For the customer, this card explained the benefits of converting. For program staff, it provided a way to track what they were expected to accomplish. For this incentive, potential partners were expected to 1) educate the customer about the benefits of converting, 2) place the “reminder” sticker on the water heater, 3) get the homeowner to sign the “conversion agreement”, and 4) give the homeowner a card telling them to send program staff a copy of the invoice when they converted, for which the homeowner would receive two “twisty” CFLs.

As part of this first incentive tier, each month partners were asked to send program staff all the agreement cards they had gotten signed and an invoice for payment. The second incentive tier provided another \$25 to the partner if their customer converted the water heater. Program staff was to alert the partner when the card and receipt arrived from the homeowner conversion. The partner would then invoice the program for the additional \$25.

Program staff also tried to get the attention of the do-it-yourself market. Home Depot in one of the targeted cities proved to be quite receptive to displaying point-of-purchase materials. Program staff developed banners, aisle cards, and tear-off forms for this campaign. Customers looking for electric

water heaters could send in the form to get more information about the benefits of converting and receive one of several gifts: water-saving devices, CFLs, or NW Airlines miles.

## **Evaluation Of The Water Heater Conversion Pilot Program**

### **Researchable Questions**

The FOE program was established with a significant evaluation component. Given the short implementation time period of the pilot, the evaluation team thought it unlikely that the implementation contractor could achieve lasting market effects. Thus, the evaluation was designed to focus on the first steps leading to market transformation—changes in conversion rates, changes in contractors' capabilities, and changes in contractors' business strategies. Specifically, the evaluation was designed to:

- Develop performance measures for each of the program services and associated delivery activities.
- Assess program market effects by determining what changes, if any, had been made in the business strategies of contractors that would result in lasting market effects.
- Identify key market barriers (among customers and contractors) to conversion.
- Assess the effectiveness of the program's design, including recommendations for full-scale implementation.

### **Research Design and Methodology**

The evaluation plan was structured around five functional activities—tracking and database management, measurement and verification, measurement of energy and demand savings, process evaluation, and evaluation of market effects. The evaluation included research with the following groups of market actors:

- participating customers (340 completed telephone surveys with customers who committed to converting their water heater)
- participating contractors (13 completed interviews with contractors who agreed to encourage conversions through the program)
- nonparticipating contractors (10 completed interviews)

In addition, in-depth interviews were held with the implementation contractor and the residential program administrator (WECC). The evaluation effort also included on-site visits with a random sample of 10% of the telephone survey participants. The purpose of the on-site visits was to verify the validity of the data collected through the telephone survey. Specifically, the on-site visits assessed whether the stickers had been installed, and if so, whether the low-cost/no-cost measures (e.g., water saving devices, CFLs) had been installed and were being used. For those telephone respondents who reported converting during the telephone interview, the on-site visit verified the fuel-switch and obtained qualitative information on the impact of the program on the customer's decision to switch.

In addition to the interviews and on-site visits, the following materials were also collected and reviewed--program plans (including assumptions, and changes over the history of the program), marketing plans, marketing materials, participation rates, and tracking system field descriptions and data parameters.

## Results

**Numerical Goals.** The program plan as submitted to the DOA included very specific quantitative goals to either convert or gain commitment to convert approximately 1,300 electric water heaters, to achieve a total of 6,500,000 kWh in committed electric savings during the program implementation period. According to program records, the program fell short of its desired goal, obtaining 710 commitments to convert and 16 conversions (56% of its target goal in terms of number of commitments/conversions and kWh savings).

During the evaluation period, however, it became apparent that the continual modifications made throughout the program to test other implementation strategies increased the effectiveness of the program in obtaining commitments to convert. The initial program design strategy, which relied on untargeted mass marketing to customers and developing partnerships with contractors, was not successful given the barriers to conversion and the reluctance of people to open their homes to contractors simply to talk about conversion benefits, even when a home energy audit was included as part of the package. Using the initial program design, the implementation contractor was only able to obtain about 13% of the desired number of conversions/commitments in the first 5-month period of the pilot.

After redesigning the program to rely on the support of a utility bill insert to customers, as well as ESCOs and HVAC contractors already in homes for other purposes, the participation rate increased significantly. In fact, during the seven months after redesign, the goal achievement on a monthly basis was almost 85%.

The evaluation noted one problem related to program design--the inability to accurately track conversions. This resulted in an underestimate of the number of conversions that occurred according to the implementation contractor. The offer of a free CFL to those who provided proof of conversion was not effective in encouraging customers to report a conversion. At the end of the program, the program implementation contractor only had information on 16 conversions. But telephone surveys with participants suggested that between 50-70 conversions had actually occurred during the short pilot period (the on-site visits confirmed participant self-reports). This number would likely have been higher if more time had passed before the evaluation surveys were conducted (about 6-8 months). Based on data from the 1997 ECW Appliance Sales Tracking Study<sup>3</sup>, less than 1% of the households surveyed had replaced an electric water heater with a fossil fuel water heater. Based on the data we collected in the telephone surveys with program participants, we found that between 7-10% of the households converted during the pilot year due to the program, which is a significantly higher percentage than the annual average.

**Market Transformation Goals.** Another primary goal of the program was to begin to develop a market infrastructure that increased future water heater conversions. As designed, the program depended heavily on the support of plumbers, HVAC contractors, and LP dealers for educating customers on the benefits of conversion, encouraging commitments to convert, and installing the conversions.

The implementation contractor constructed a large database of contractors who might be potential program partners. Despite this effort, contacts with plumbers, HVAC contractors and LP dealers were not successful in generating a large number of partners, even after offering an incentive for participation.

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<sup>3</sup> Energy Center of Wisconsin, "Appliance Sales Tracking, 1997 Residential Survey", prepared by Opinion Dynamics Corporation.



After discussions with some of these contractors, it became apparent that many had more work than they could handle and did not see any need to participate (especially if they thought additional paperwork would have to be done). Some contractors said they already regularly recommend fossil fuel water heaters, others said water heaters were such a small portion of their business they did not see any benefit to participation, and still others were hesitant to encourage conversions because of their unfamiliarity with power-vent technology. Due to the short duration of the pilot program and the lack of interest encountered, the evaluation concluded that the program did not have an impact on the business strategies of contractors that would result in lasting market effects, although household participants who committed to convert may have ultimately converted when their water heater failed.

**Barriers to Water Heater Conversions.** A goal of the evaluation was to identify the barriers (among both households and contractors) to converting. While none of these are surprising, they do illustrate the difficulties of designing a broad-based effective program with easily measured effects. Four primary types of barriers to conversion were identified during the evaluation:

- Homeowner barriers—these include the high cost of conversion, lack of awareness of the benefits of conversion, and a general apathy toward energy savings, especially if it meant replacing a working water heater. The “emergency” nature of replacement is a serious barrier. Most water heaters are replaced on an emergency basis when the householder notices a lack of hot water or finds a puddle of water on the floor. They need to replace the water heater immediately, and there is little time to consider various alternatives. The increased cost of converting compared to a simple replacement is also a substantial barrier. Because householders typically do not plan for water heater replacement, they usually do not have money set aside to cover the cost of an unplanned replacement. Because a new water heater must be purchased, homeowners frequently opt for the least expensive unit they can find. Any increased cost, such as converting from electric to gas, seems beyond the homeowner’s means even though this choice could result in long-term benefits.
- Physical barriers—these include a lack of natural gas lines, and structural constraints in the dwelling (e.g., insufficient ventilation, lack of a chimney). Although conversion from electricity to natural gas is the most common, other alternative fuels include propane and heating oil. Almost any house with an electric water heater has natural gas, propane, or heating oil available in the house. However, many householders do not recognize nor have ever considered converting electric appliances such as water heaters, clothes dryers, or kitchen ranges.
- Contractor barriers—these include lack of interest in conversion among contractors (and customers), and concerns some contractors have with power-vented water heaters. The majority of water heaters are replaced by plumbing contractors. In many jurisdictions, a plumbing permit is required to assure health and safety. The householder depends on the plumbing contractor’s direction and advice. If the plumber is not actively involved, the householder is unlikely to convert. Lack of financing offered by plumbers is also a barrier. If plumbers provided financing or allowed for monthly payments, householders might choose to convert more often. However, plumbers seldom provide for time payments, financing, or even credit card payment. Plumbers say they are not in the business of providing financing. They need to be paid immediately or when their office sends the bill.
- Program barriers—the most challenging program barriers relate to countering the efforts of opposing programs, such as municipal electric-water-heater giveaways, direct load control, and time of use programs.

## **Conclusions: You can't get to heaven by dancing with the devil!**

The benefits of fuel conversion programs are widely acknowledged. They offer a significant opportunity to reduce the utility expenses of the residential customer; they reduce coal consumption with the corresponding reduction in greenhouse gas emissions; and they play a role in increasing electric reliability by reducing peak demand requirements. They represent a heaven-sent opportunity.

But the evaluation of this program illustrates the difficulty of implementing an effective program when the parties involved have little interest in the program's success—plumbing contractors who see little to be gained, utilities that are not interested in reducing base-load end uses, and householders who are not interested in replacing a working unit or paying extra to convert.

To avoid dancing with the devil (that is, butting heads with those who do not want electric water heaters converted to fossil fuels), future conversion programs will have to demonstrate the benefits to public benefits funders and gain their imprimatur. There are enough natural barriers that will need to be overcome that it will be necessary to minimize opposition to the program in the first place.

However, future conversion programs will continue to face some "devilish" opposition. Opposing efforts by utilities that are interested in building electric load will work against future water heater conversion programs, an opposition that has proved to be very powerful for some state and federal programs. We conclude that the current design has insurmountable obstacles and is unlikely to be successful given the goals and limits set. Several modifications can be made that would enhance the likelihood of a successful program.

## **Recommendations for Future Design**

Recommendations for future design to increase the success of conversion programs are made at the household, community, partner, technology, and code level.

**Household Level.** Cost is one of the easiest barriers from a logistical perspective that must be overcome. The high cost of the conversion and longer payback period if fossil fuel prices increase over the long term will require some financial incentives for customers to be interested. This is also the barrier that must be removed first before a program can hope to overcome more challenging barriers such as the need to get hot water service restored quickly. Combining an incentive, which gets peoples' attention, with preparatory education of the benefits of converting, will be necessary for any water heater conversion program to succeed. A successful program will require an incentive that can be offered by the installer during the short time available to the owner during the decision making process. Replace-upon-failure programs have not successfully integrated energy efficiency improvements unless the barriers of lack of adequate decision making and funding have been overcome.

Another recommendation is not to overlook the "DIY" market. These do-it-yourself homeowners provide an opportunity to deliver a cost-effective program because they would do all the work and could finance the incremental cost of conversion. An innovative approach would be to provide a free natural gas water heater of the householder's choice distributed through one of the supply houses such as Sears, or Home Depot. Training on the proper installation of a converted unit can be provided in workshops and through the development of instruction sheets.

While some of these barriers can be overcome with program designs and long-term commitments to these programs, it is unlikely that a program will be able to overcome all barriers. For example, some homes were constructed in such a way that even with the potential of using a power-vented water heater, the cost to run the gas piping, move the water heater and run new water piping will cost more than the homeowner can justify. There is also a small fraction of the population that does not

like gas and will not have it in their house. A conversion program will not be able to sell these customers on the benefits of conversion.

**Community Level.** Building on-going awareness in communities with high percentages of electric water heaters will help the education component. Working with community organizations (such as local kids ice hockey teams) using incentives for each conversion and running local campaigns are a couple of approaches that should be considered.

**Partnering.** Partnerships with local contractors are another critical component of any water heater conversion program. The program must also make sure that the partnership makes business sense to the partner. This can be accomplished with a combination of continuous support and financial incentive to them. They may choose to use their incentive to buy down the cost of the conversion if this suits them, or they may not. Including other incentives such as promotions and contests will also capture their attention and commitment.

In addition to support and incentives, some contractors who replace water heaters have limited experience and confidence in installing power-vented water heaters – and some are not interested in ever acquiring these skills. The program should recognize that some of these contractors may never be interested in acquiring this skill, but for those who are, some training mechanism and assistance will be needed.

Any entity seeking to develop and deliver an effective water heater conversion program should look at and test other partnering approaches and opportunities. For example, teaming with LP and natural gas companies to leverage their information and relationships with their customers (which will be better than the relationship the program will come in with) proved to be effective (though on a very limited scale) in the pilot.

Partnerships with manufacturers or regional distributors of natural gas/LP water heaters is another idea that should be explored. They might have an incentive to push the more expensive power-vented water heaters, they already have established relationships with some local installers, and they would cover a larger geographic area than most water heater conversion programs.

Another potentially very lucrative partner not previously mentioned is the low-income weatherization industry. They have special opportunities and challenges related to helping their clients convert their water heaters. The public benefits sponsored water heater conversion program should look seriously about developing a partnership with this industry. Changes in low-income weatherization programs through changes in federal rules or the infusion of supplemental funds provide new opportunities to affect conversions on a large scale. The implementation of a wholesale direct-install electric water heater conversion program would result in substantial long-term benefits to low-income households and the environment. An additional long-term benefit to society is that households go in and out of the low-income eligibility designation over time. A sustained program could affect more households than just the low-income sector as these households move into the middle income sector and other households enter the low-income designation and become eligible for the conversion program.

**Technology Level.** One opportunity we have not fully investigated related to reducing energy costs and emissions potentially equivalent to converting water heaters to fossil fuels is replacing the straight electric water heater with a heat pump water heater. This offers interesting potentially strong benefits especially where the homeowner runs a dehumidifier in the basement for six months per year.

**Code Level.** Successful programs have included changes in codes and standards. For example, improved motor efficiency resulted from the National Energy Act. Improved water heaters resulted from earlier efficiency standards. Water heater fuel conversion has not been a success except in

California where it appears that Title 24 has indirectly all but eliminated the installation of electric water heaters.

### **Further Research Needs**

The lack of successes in a program with obvious large potential benefits implies that further research may be merited or changes in program design justified. Additional research is required to estimate the potential market for conversion when consideration is given to the full range of fossil fuels including natural gas, propane and heating oil. There is additional information needed on the coincidence curve for electric water heaters so that we can determine the impact on peak load reduction or system reliability from an aggressive electric water heater conversion program.

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