

**Comparing residential energy conservers and consumers:
Local programs need all income groups to achieve Kyoto targets**

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ABSTRACT:

The Government of Canada ratified the Kyoto Protocol on December 17, 2002, but over 100 Canadian municipalities had joined the International Council for Local Environmental Initiatives' (ICLEI) Cities for Climate Protection (CCP) campaign up to a decade earlier. A low-cost home energy rating system (HERS) evaluation and individualized energy plan was provided to Kitchener households. Natural gas consumption in the year prior to the evaluation was compared with that in the year following. Overall, a 5% reduction was achieved, but individual responses varied widely. Three groups of households were identified: the conservers, the consumers and the steady middle group. Situational and psychological factors were evaluated. Conservers (30% of households) had higher initial consumption levels and achieved two-thirds of the identified potential savings. Consumers (12% of households) had higher ownership rates of high efficiency furnaces and water heaters and demonstrated the rebound effect of increased demand for energy services. Low income groups were the most likely to behave as conservers (42%) while high income groups were the least likely to be conservers (13%) and the most likely to be consumers. Local programs need to be inclusive of all income groups to increase participation and implementation rates by systematically reducing barriers (financial, knowledge, trust) or increasing incentives (financial, regulatory or social) if the desired goal (e.g. Kyoto target) is to be achieved.

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Introduction

The Government of Canada ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change on December 17, 2002. As one of the 122 countries to either ratify or approve accession to the Protocol, Canada is expected to reduce greenhouse gas (GHG) emissions to 6% below 1990 levels by 2008-2012 (UNFCCC, 2004). The Protocol has not come into force by early 2004, but the ratification decision marks a significant step in the evolution of Canadian climate change policy as the majority of Canadian scientists, policy-makers and the public recognise the threat of climate change to both ecological and economic systems. Rather than wait for agreement at the international level, action is being taken at the local level. Over 100 Canadian municipalities joined the International Council for Local Environmental Initiatives' Cities for Climate Protection campaign (ICLEI, 2004) through the Federation of Canadian Municipalities' Partners for Climate Protection (PCP) (FCM, 2004a). The cities agreed to initiate a five milestone framework to review, document and implement plans to reduce emissions from their operations as well as those by their wider communities.

Actions taken at the city level highlight the growing importance of cities in environmental and economic policies (Kousky and Schneider, 2003). In Canada, the Federation of Canadian Municipalities is an influential advocate for environmental strategies and policies to improve the well-being of their citizens. These municipal initiatives reveal cities as a key player in the pursuit of national sustainable development goals. Leach (2000) explained how local authorities in the United Kingdom were assigned responsibility for achieving national residential energy efficiency targets without receiving additional resources. A similar challenge faces Canadian municipalities who were assigned new responsibilities in the downloading of service responsibilities during the 1990s. One means to implement programs without full funding is through partnerships.

The importance of community-based research where universities, cities and other stakeholders work together to investigate effective ways for cities to move towards a more sustainable model of development has been reported previously (Savan and Sider, 2003). This paper reports on a project where the City of Kitchener (a PCP member) partnered with the neighbouring cities of Cambridge and Waterloo, Kitchener Utilities, the Regional Municipality of Waterloo, Kitchener-Wilmot Hydro, two other electric utilities, a green community organization (Elora Centre for Environmental Excellence) and the Faculty of Environmental Studies at the local university to form the Residential Energy Efficiency Project (REEP) (FCM, 2004b; Parker et al., 2000a). The project acted as the local delivery agent of the Canadian government's home energy rating system (HERS), *EnerGuide for Houses*, in which a detailed residential energy evaluation, a rating on the 100 point scale, and an individualized energy plan for improvements are provided to the homeowner (OEE, 2004). Local participation rates were the highest in the country by the second year of the project, but critical questions remained: did the information enable residents to reduce their emissions, and if so who responded?

The strategies used to successfully engage residents in the project have been reported previously (Kennedy et al., 2000; Parker et al., 2003). This paper examines actual changes in consumption after households participated in the project. The magnitude of residential energy consumption and greenhouse gas (GHG) emissions in Canada is reviewed to set the context for the study. Then the classical ‘theory of reasoned action’ is reviewed along with recent research to identify situational and psychological factors expected to influence environmental behaviour. The relationships among variables in models predicting self-reported environmental behaviour based on values and attitudes typically offer less explanatory power when actual behaviour is measured (Olli et al., 2001; McMakin et al., 2002). To better understand who is likely to actually reduce energy consumption, residents are divided into three groups based on their behaviour (conserver / steady / consumer). Comparisons are made to identify the groups responding to information programs and those needing additional incentives to overcome barriers.

National Policy and Emission Trends

Canadian policy on climate change has steadily evolved from the international Conference on the Changing Atmosphere held in Toronto in 1988 when the gathered scientists, policy makers, politicians and environmental specialists called for a 20% reduction in CO₂ emissions from 1988 levels by the year 2005 (WMO, 1988, p.297). The goal was to achieve 10% in energy efficiency gains through conservation and 10% through substitution to less carbon intensive fuels. The City of Toronto became the first government to adopt an emissions reduction target in 1990 when it unanimously passed a resolution setting the 2005 target as 20% below 1988 levels (Harvey, 1993; Kousky and Schneider, 2003). The city adopted many initiatives to try and move towards its target while facing the demands of continued population and economic growth. The City of Kitchener, located 100 kilometers south-west of Toronto, faced a similar challenge - how to achieve the desired low emission future from the current high consumption position.

The residential sector in Canada is estimated to account for 17-20% of total GHG emissions (ERG, 1998; Harchaoui, 2003). Despite being the third largest source of GHG emissions (after transportation and industry), the residential sector has improved its energy efficiency (space heating energy per unit of floor space) by a factor of three over the last century and this trend of increased average residential energy efficiency is expected to continue (Parker et al., 2003). The Energy Research Group prepared a business-as-usual scenario in which the residential sector direct CO₂ emissions in Canada declined from 43 million tonnes (mt) in 1990 to 38 mt in 2010 for a decline of 12% (ERG, 1998). In other words, the residential sector was expected to exceed the Kyoto target without any special initiatives. Adopting policies to promote efficiency would reduce direct emissions by a further 8 mt to 30 mt in 2010. NRCan studies also expected direct residential emissions to decline (NRCan, 1997; NRCan, 1999). The technical potential for savings has been documented by the analysis of national household surveys (CREEDAC 2000) and HERS studies (Parker et al., 2000b). However, the expected trends of improved efficiency and reduced emissions in the residential sector were not

achieved in the 1990s because demand grew faster than efficiency gains (NRCan, 1999; Parker et al., 2000a).

Demand-side management (DSM) was proposed as a means to reduce consumption and the Ontario Energy Board required natural gas supply companies to deliver DSM programs as part of their agreement for monopoly supply networks in particular markets. The DSM information campaigns mounted by gas companies include bill inserts and web pages that are attractive, informative and provide links to additional resources (Enbridge Gas, 2004; Union Energy, 2004). The links include a self-assessment site where people can assess the energy performance of their home and identify actions to improve efficiency. Despite the range of information available, these programs have been judged a failure by environmental organizations as average residential demand in Ontario declined by less than that in neighbouring jurisdictions where subsidized DSM programs did not exist (1.2% per year decline across six jurisdictions including Ontario, 1984-99 vs. 1% per year for Ontario company A, 1995-2002, and 0.8% per year for Ontario company B, 1993-2002) (Rubin and Adams, 2003).

Political and policy differences are also common in the energy arena. Although the federal government was advocating improved energy efficiency in Canada's residential sector, its 'model' building code was not adopted by the 13 provinces and territories. Instead, the Conservative government of Canada's most populous province, Ontario, revised the building code in 1997 with reductions in wall and basement insulation standards (Rowlands et al., 2000). In 2003 a new provincial Liberal government was elected and in 2004 it announced an intention to create a 'culture of conservation' (McGuinty, 2004). The change in provincial government may facilitate greater collaboration, but, the primary arena for conservation action remains local communities.

Previous studies (Powers, et al. 1992) have called for targeted rather than general conservation information programs. The federal government of Canada developed the *EnerGuide for Houses* program (administered by the Office of Energy Efficiency, Natural Resources Canada) to provide a personalized plan of action to reduce residential energy consumption and GHG emissions (OEE, 2004). This program was delivered in the City of Kitchener by the Residential Energy Efficiency Project (REEP). The cost to households (\$Cdn 25) was subsidized by local municipal and utility partners and the federal government's *EnerGuide for Houses* and Climate Change Action Fund programs to reduce the financial barrier and encourage participation (actual delivery costs were \$Cdn 350) (Kennedy et al., 2000). The program was successful in attracting participants, but what factors influenced whether or not they actually reduced consumption?

Behaviour, situational and psychological factors

To achieve the desired reduction in GHG emissions through voluntary initiatives such as residential retrofit programs requires a thorough understanding of the complex processes that lead to individuals taking action. An extensive literature in behavioural psychology reports on the many factors influencing personal energy use decisions (Stern, 1992). The classical 'theory of reasoned action' by Fishbein and Ajzen (1975) sets a framework

where the gap between expressed values and associated actions is shown to be influenced by a series of situational and psychological factors. Many studies have used this framework to study environmental behaviours ranging from recycling (Barr et al., 2003) to self-reported energy investment, management and curtailment (Scott et al., 2000). However, recent studies recognize the bounded nature of the assumed rationality at the core of the classical framework and incorporate additional features such as social context to enhance the range of situational variables studied (Olli et al., 2001).

Situational variables include home ownership, length of tenure, potential for energy savings, socio-demographics, knowledge, experience and social context (Scott et al., 2000; Stern, 1992). Home ownership is considered important to benefit from energy efficiency investments as many renters have the utilities included in their rent. The length of ownership and expected ownership can influence energy decisions. Ferguson's study (1993) of households installing insulation under the Canadian Home Insulation Program of the 1970s and early 1980s found that age of house was a stronger variable to predict participation than socio-demographic factors. Potential energy savings are also important. If a house already has a super-insulated building envelop and a high efficiency furnace, the opportunities for improving energy efficiency are much less than in a house with poor insulation and an old furnace.

Socio-demographics have been widely studied with Ferguson (1993) concluding that energy retrofitters in Canada are more likely to be older and wealthier (although the correlation was not strong). Age is considered important in selecting thermostat settings (Schwarz and Taylor, 1995) because the elderly often prefer higher room temperatures for comfort and health reasons and parents of young children may make similar decisions.

Knowledge of the environmental issue and available behavioural responses have been emphasised as an important prerequisite to environmental actions by Hines et al. (1986) and Granzin and Olsen (1991). In this study, the respondents were provided with a four-page energy plan that identified actions to upgrade their house. However, the knowledge of what to do may still not be sufficient. As Geller (1992) argues, simply providing information has not consistently proved effective in enabling homeowners to take action.

The psychological or personal variables that influence environmental behaviour can be divided into several categories. Motivations, perceptions of environmental threats and the efficacy of taking action are considered important (Barr et al. 2003). The perception of subjective norms and social pressures can also be important. Barriers to action can be situational or psychological.

Three motivations for energy conservation were defined by Darby (1999) as cost savings, comfort and environmental concern. The first two were considered more important although overlaps may exist. Overall, home energy decisions are influenced by perceptions as well as cost factors.

Method

“(Evaluator A) was very knowledgeable and helpful. Also, I'm delighted you hired a co-op student, he did a good job as well!” Written comment by a ‘steady’ respondent.

This study combines technical, social and consumption data from a group of Kitchener households (Kitchener 2001 population = 190,000; households = 72,000) who participated in the Residential Energy Efficiency Project (REEP) between September 2000 and August 2001 (RMoW, 2003). The technical data for the houses was generated by a detailed HERS evaluation conducted by a team of two, a certified evaluator and an energy intern (student). The evaluation provided a detailed energy plan for the homeowner. This plan combined with the verbal advice given by the evaluator should enable the homeowner to set priorities and select the most effective upgrades to improve the energy efficiency of their home.

During the evaluation, the intern asked a member of each household if they would authorize the collection of their consumption data and complete a survey. Monthly consumption data were obtained for 420 houses and the level of consumption in the year prior to having the evaluation (year 1: Sept. 1999 - Aug. 2000) was compared with the consumption in the year following the evaluation (year 3: Sept. 2001 - Aug. 2002).

A survey covering situational and psychological factors was administered during the September to April heating season. In many cases, the household member would complete the survey while the evaluation was underway, but in other cases, the survey was completed later and mailed to the university in the pre-addressed and stamped envelop provided. A total of 140 completed surveys were returned from the 322 surveys distributed (43% response rate, or 33% of the complete study group).

Analysis and Discussion

The general consumption trend was identified, the sample divided according to changes in consumption levels and comparisons made among three groups. Natural gas consumption among the 420 households rose by 4% in the colder winter of year 2 and then declined by 10% in warmer winter of year 3. The overall 7% reduction was adjusted to a real decline of 5% (adjusted for heating degree days reported at Waterloo-Wellington Airport) (EC, 2003). The pattern among individual households varied widely from this average.

Greater insight into the consumption patterns of residents can be gained by dividing the households according to their change in consumption. Three groups were formed (Table 1). Households that varied their consumption by less than 10% between years 1 and 3 were considered to be part of the ‘steady’ group. This group accounted for 58% of households and achieved a modest 1% reduction in their adjusted natural gas consumption on average.

Another group of households made reductions in natural gas consumption of 10% or more (between years 1 and 3, adjusted for degree days). The evaluation identified technical upgrades that would reduce natural gas consumption by 29%, on average, so the actual decline of 19%, represents two-thirds of the identified potential. This reflects a substantial achievement for this 30% segment of households. They are termed ‘conservers’ and demonstrated an ability to translate the information provided to them into energy conservation action.

Table 1. Comparison of technical factors, potential and actual savings by group

Factor \ Group	Conservers	Steady	Consumers	*
		mean		
Year built	1964	1964	1965	
Area (m ²)	210	208	216	
Gas consumption (modeled m ³ /yr)	3985	3724	3381	*
Potential gas savings (m ³ /yr)	1170	1028	764	**
Potential gas savings (%)	-29	-28	-23	**
Actual gas savings (%)	-19	-1	25	
CO ₂ emissions (t/yr) ¹	14.8	14.2	13.7	
Potential CO ₂ savings (t/yr)	2.4	2.1	1.6	**
n =	128	242	50	

note *: t-test for equality of means (conservers vs. consumers), significance * < 0.05, ** < 0.01

note 1: kg CO₂ = electricity (kWh) * 0.75 kg/kWh + gas (m³) * 1.88 kg/m³

In contrast to the conservers, another group of households demonstrated their ability to consume more gas with an increase between year 1 and 3 of 10% or more. These 50 households (12% of total) were informed of opportunities to save 23% of their gas consumption. However, instead of declining, the households had an average 25% increase in gas consumption (heating degree day adjusted) and are classified as ‘consumers’.

Technical potential for savings

Situational variables that could influence gas consumption patterns include the age and size of the house. Table 1 compares the average size and age of the houses in the three groups. In contrast to many other studies, no significant differences were found in the age or size of the houses in each group. Having defined the groups by their actual change in consumption, it is not surprising to find the conserver group having attributes of significantly higher initial gas consumption, greater potential for gas savings and CO₂ emission reductions than the consumer group.

The study also examined the type and efficiency of the furnace and the domestic hot water system. The furnace is the most important single component of a residential heating system and Table 2 presents distribution data and efficiency ratings for different furnace types by household groups. The data were first examined for five furnace types, but two of the furnace categories only had a single house and resulted in six cells having expected frequencies below 5. These two cases were removed and the remaining 418 cases revealed significant differences. In particular, the consumer group was twice as likely as the other two groups to have a high-efficiency condensing furnace. This ownership of a high-efficiency furnace at the start of the study eliminated one common means for them to reduce consumption further.

Table 2. Furnace ownership by group

Type (efficiency %)	Conservers	Steady	Consumers	total
		% of group		
Conventional (78%)	54	50	28	48
Induced draft (80%)	20	21	10	19
Condensing (94%)	27	29	62	33
Total	100	100	100	100
n =	127	241	50	418

Pearson Chi-Square = 22.96, df = 4, significance <0.01

A similar analysis was performed for domestic hot water systems. In this case there were four types of systems, but since one type (direct vent heaters) only had 10 cases, it was removed and the analysis completed for the three most common systems. Significant differences were found. The consumer group was again twice as likely to have the more efficient induced draft (46% vs, 20%) or electric (10% vs. 6%) water heater than the study population as a whole. The presence of higher efficiency furnaces and water heaters also explains why the initial level of gas consumption was lower among the consumers. The higher ownership rate of electric water heaters among the consumer group also indicates an opportunity for five of the households to switch from electricity to gas as their source of energy for water heating and possibly explain why gas consumption went up in those cases.

Socio-demographics

Another important set of situation factors influencing energy consumption are socio-demographic. Standard socio-demographic factors were examined, but no significant differences in average age or gender of respondents were found between groups. Educational levels were high with 55% of conservers, 44% of steady customers, and 63% of the consumers having household members with university degrees. Household composition varied by group with the consumer households significantly more likely to

have children and teenagers (in 29% and 35 % of households, respectively) (Table 3). This supports the findings by Schwartz and Taylor (1995) where the presence of children or elderly was more likely to result in higher thermostat settings.

Table 3: Socio-demographic profiles by group

Attribute \ Group	Conservers	Steady	Consumers	Total
		% of group		
Household members by age				
Children (1 or more)*	11	24	29	21
Teens (1 or more)*	14	14	35	16
Adults (20-64 yrs) (0)	23	16	35	20
Adults (1-2)	57	71	56	66
Adults (3-4)	20	12	6	14
Seniors (65+ yrs) (1 or more)	26	24	35	26
n =	35	87	17	139
Household income (\$Cdn)				
1-39K	31	14	20	19
40-59K	28	24	33	26
60-79K	16	27	20	23
80-99K	19	21	7	18
100K +	6	14	20	13
	100	100	100	100
n =	32	78	15	125

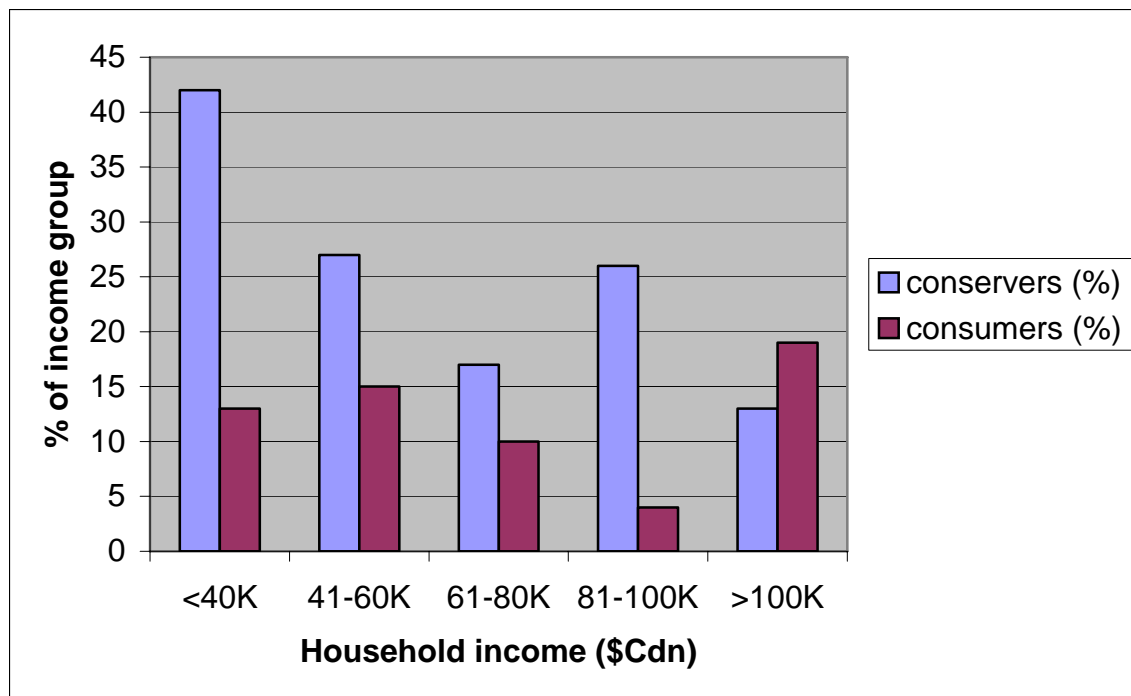
Pearson Chi-Square, * significance = 0.10

Differences between groups were observed that warrant further investigation. Suggested attributes of conserver households include, fewer with children, a larger percentage with three or four adults, higher degrees and income under \$40,000. The appearance of a larger share of conserver households reporting income under \$40,000 (31% vs. 18% for all respondents) while a larger share of the consumer households reported income above \$100,000 (20% vs. 13% for all respondents) is counter to the standard finding of income being positively correlated with environmental behaviour. An explanation may be found by combining the demographics with the technical attributes of heating systems. The consumer households had already invested in high efficiency furnaces and water heaters. Their post-evaluation options included increasing the range of services provided by gas

appliances (e.g. stoves, driers, pool heaters) or increasing the temperature for children or the elderly in the household. These personal choices would illustrate the energy ‘rebound’ where the savings gained from increased efficiency in space heating (e.g. high efficiency furnace) or water heating are offset by increased consumption of energy services (Greening et al., 2000).

Figure 1 illustrates how the gas consumption patterns differed across income groups. Among the 125 households reporting household income level, 26% belonged to the conserver group. However, the lowest income group was over-represented (42%) while the highest income group was under-represented (13%). This implies that lower income households were more likely to convert the information obtained from a HERS into a reduction in fuel consumption and the associated GHG emissions.

Figure 1: Percentage of conservers and consumers in each income group



The gas market context for this differential response by income groups was a series of natural gas price increases and decreases. Current natural gas commodity prices doubled from $\$0.15/m^3$ to over $\$0.30/m^3$ during year 2 when evaluations were conducted and then declined during year 3 to $\$0.16/m^3$ by April 2002. Some households may have held long-term gas contracts that kept their price stable during this period. The increase in gas prices and its volatility increased the incentive for lower income households to reduce consumption because energy costs represented a larger proportion of their expenditures.

Combining the educational and income profile of conserver households reveals two groups (Table 4). The literature predicts that a cohort with higher education and income levels will take energy conservation action. In addition to this group, a second group of

households with more modest income and educational backgrounds also reduced their energy consumption. This broadening of the range of socio-demographic attributes among conservers should be kept in mind when designing energy conservation programs.

Table 4: Household income and education profile of conservers

Income \ Education	High school	College	Some univ.	Degree	Higher degree
\$Cdn	% of conserver households				
<40K	6	6	10	6	0
41-60K	3	10	0	6	10
61-80K	3	3	0	6	3
81-100K	3	0	0	3	13
>100K	0	0	0	3	3

n = 31

Knowledge is another situational factor identified in the literature. Households were asked if they ‘had received and read energy savings material’ before the REEP visit (e.g. from utilities’. A significant difference was found with 94% of conserver households responding yes, while 71% of the consumer households responded yes. These high positive response rates reflect the availability of energy efficiency information and the need for multiple exposures before action is taken. Overall, the situational factors highlight important differences between the conserver and consumer groups.

Perceived environmental threat and response efficacy

Psychological factors are also important in determining the likelihood of people taking action. For example, the perception of environmental threat has been identified as influencing action (Baldassare and Katz, 1992). Most respondents (75%) agreed or strongly agreed with the statement ‘I am concerned about how climate change will affect future generations of Canadians’. Nearly twice as many agreed (41%) as disagreed (24%) that ‘climate change is the most important environmental issue facing Canada’. However, no significant differences were found between groups.

Although the efficacy of personal action has been found significant in other studies (Barr et al., 2003), the respondents consistently reported strong agreement with responsibility to conserve energy (91%) and individual action making a national impact (81%). No significant differences between groups were found.

Motivations

“We have to conserve more energy.” Written comment by a ‘consumer’ respondent.

The reported motivations revealed great consistency across the groups in their selection of the most important reason for having a HERS evaluation. Respondents were asked to identify their top three reasons from a list of eight. The economic benefits of lower energy bills were by far the most common response by all groups (62% of all respondents). The second most common choice for the top reason was to gain advice on a specific problem or project (11%), closely followed by the desire to increase home comfort (10%). Consistency in motivational priorities was shown as the second and third most important reasons were respectively, the most common choice for respondents' second reason (specific advice, 27% of total) and third reason (home comfort, 29% of total). In comparison, 21% of respondents listed climate change as one of their top three reasons. However, the consistent 5th place ranking among the eight reasons indicates that climate change was much less important than lower bills, specific advice or home comfort for all three groups. Concern about smog and reducing the need to build new power stations were even lower on the list of reasons. No statistically significant differences were found between the groups, however, the selection of the second most important reason was more frequently an environmental reason (climate change, smog or the avoidance of constructing new power stations) among the conservers (23%) than among the consumers (0%). This supports Darby's (1999) findings that economic savings and comfort are more important than environmental reasons, however, it also suggests that the secondary role of environmental reasons as a motivation to have energy evaluations should continue to be considered in future studies.

Barriers

“The REEP Home Energy Evaluation was very good. I wish I had the finance and income to take advantage of all their suggestions.” Written comment by a ‘steady’ respondent.

Barriers, or reasons preventing or limiting homeowners from taking action, may explain some of the differences between attitudes and behavior reported above. Respondents were asked to rate eight potential barriers on a five point likert scale (1 = very important, 5 = not important). Chi-square tests were conducted to measure differences in response rates among the groups. Again, consistency was found with six of the eight barriers showing no significant differences among the three groups (takes too long, lack skills, lack information, lack time, too much mess, and unconvinced about benefits). Two factors were rated differently by the three groups. The cost barrier (cost of upgrades was too high) generated uneven responses with 39% of steady customers rating it as very important (1), while 59% of the conservers rated it as important (2), indicating that it was not perceived to be as strong a barrier to those who actually reduced their consumption. In contrast, the consumer group was twice as likely (20%) as the other groups to rate cost as not important in preventing them from taking action. This view is consistent with their previous investment in high efficiency furnaces and water heaters. Another potential barrier is planning to move within five years. Planning to move was generally considered not important (61% of total) as a barrier, but the conservers (38%) were less likely to hold this view. All groups expect to live in their current house for a long period (16 years for the conserver and steady groups, 13 years for the consumers). Overall, the rating of most barriers was similar.

Possible sources of inconsistency between the reported attitudes and the behaviour (energy conservation or lack of conservation) taken include: the attitudes reported by the respondent (average age = 54 years) not being shared by other members of the household who adopt different energy consumption lifestyles (e.g. a teenager taking long showers); and a socialization process during the evaluation where respondents give the answer they believe is desired instead of their independent attitude.

Conclusion

This study found that 30% of households (conservers) participating in a home energy rating system (HERS) evaluation responded by reducing the consumption of their primary heating fuel (natural gas) by 19% (or two-thirds of the identified savings potential) in the following year. This finding supports the optimism that such programs can assist communities and countries achieve their Kyoto Protocol targets. However, another 12% of households (consumers) increased their average consumption by 25% and effectively offset many of the gains achieved. A middle group remained relatively steady in their consumption (less than 10% change). The overall reduction in gas consumption across all households in the study was a modest 5% in the year following the evaluation. The 5% reduction per participating household is less than the national target of a 6% reduction below 1990 levels. Even if participation was universal, and no new houses were added to the stock, the target would not be achieved. This stands in contrast to the potential energy savings of 28% identified by the HERS. If voluntary programs only achieve results of this magnitude among their participants, the overall result is certain failure for the community and country. The gap between the technical potential for savings and the actual savings achieved highlights the need to enable more residents to move from the 'consumer' behaviour of increased energy use to 'conserver' behaviour of reduced energy use and emissions.

The situational factors facing each group differed. Not surprisingly, the conserver group had higher initial energy consumption and greater potential savings than the consumer group. However, neither the age nor the size of house differed significantly across the groups as opportunities for savings were found in all building size and age categories. Further differences were found in the heating systems as consumer households were twice as likely to have already installed high efficiency furnaces and water heaters. This suggests that some of the consumer households are demonstrating the rebound effect where the savings from energy efficiency investments are converted into demand for additional energy services.

The socio-demographic attributes of the groups showed several differences as well. Although average age of respondent did not differ among groups, the composition of households did. The consumer households were more likely to have children, teenagers and seniors, thus supporting the findings of previous studies. Fewer of the conserver households had children, but more of them had three or four adults in the household.

Environmental attitudes were remarkably similar among the groups with large majorities agreeing with the need to take action and conserve energy. Some of this consistency in responses may be an artifact of the study population as they were in the process of having a HERS evaluation. Differences were found in energy conservation knowledge with 94% of conservers reporting that they had received and read energy conservation material previously. This indicates that a single exposure is unlikely to change behaviour and that multiple exposures are required. In the case reported, gas utilities and the federal government operated energy efficiency information programs during the study period. The Ontario provincial government is expected to join the list of providers of conservation information as it strives to create a 'culture of conservation'. However, while multiple exposures are important, it is suggested that the general campaigns need to include effective community-based social marketing and local delivery designed to overcome financial, information and trust barriers to enable people to make changes to their homes and lifestyles.

Income levels demonstrated an unusual pattern with the lowest income group exhibiting the highest rate (42%) of conserver behaviour. This finding is counter to the usual result of income correlating positively with environmental behaviour. It also has direct relevance to policy advisors and local decision makers. If lower income households are the most motivated to convert the advice from HERS evaluations into action, then programs that encourage their participation (such as the low price for evaluations in the case study reported in this paper) should be offered as widely as possible. It also suggests that low-income retrofit programs can be effective means to reduce GHG emissions and should be implemented.

Higher income groups are considered more likely to invest in high efficiency technology, however, the rebound effect may also be greatest among this group where the energy savings are followed with increased demand for other energy services. Further studies are needed to better understand and design comprehensive investment strategies in energy savings across many energy service categories to ensure that the savings in one are not lost through increased demand for others.

Voluntary programs can encourage individual action to reduce GHG emissions. However, the response rates are typically limited both in participation and implementation. The federal government's announcement of a financial incentive program in 2003 should increase participation rates. However, to create a 'culture of conservation' governments will have to enable both the early adopters as well as the mainstream of society to take action. Only with increased participation rates and the implementation of recommended upgrades can voluntary programs succeed in meeting local and national targets.

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