Energy Conservation and Fuel Conversion Among Homeowners

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March 15, 1983

ACKNOWLEDGEMENT

The author expresses appreciation for the financial assistance of the Department of Energy Mines and Resources (Ottawa) who funded this research. Also, Donna Brown proved to be a very capable research assistant supervising the field work, data entry and undertaking the computer calculation. Gordon Courage of the City of Winnipeg Planning Department prepared the sample of owner-occupied homes. George Chuchman, Lance Roberts, Brian Macpherson, Derek Hum and Monika Oepkes all were very helpful in refining the questionnaire. Don Sabourin provided valuable advice and the implementation of the binary choice models. Finally, appreciation must be extended to those respondents who completed the survey.

PREFACE

This report presents the main results of a study on the energy conservation and fuel conversion activities of 357 Winnipeg homeowners. Subsequent papers will be published in the next year.

I. INTRODUCTION

This report presents the results of a survey of homeowners and their energy conservation and fuel (home heating) conversion activities. Funded by the Department of Energy Mines and Resources (Ottawa) this project had three main objectives:

1. To describe and analyze the fuel conversion away from oil to gas, electricity, wood and other substitute energy. The object is to measure the degree to which such conversion is related to socio-economic variables. Measures of the probability of fuel conversion were also estimated.

2. To describe and analyze the energy conservation behaviour of homeowners and relate this to the socio-economic attributes of the household. Once again various measures of the probability of undertaking conservation were attempted.

3. To describe and analyze the attitudes of homeowners to a number of select energy policies enunciated by federal and provincial governments.

The research is motivated by questions emanating from policies enacted, primarily by the federal government. In particular, the research applies a number of behavioural choice models (multinominal logit and ordered probit) to the decision to conserve or convert from oil to other fuels. The Canadian Home Insulation Program (CHIP) and The Canadian Oil Substitution Program (COSP) as income conditioned grants (that is the grants are treated as taxable income) rest upon the assumption that many homeowners, especially those with low incomes require assistance to cope with higher energy prices. It is also conjectured that conservation is an "inferior" good. As income rises, participation in conservation and fuel conversion will decline. Also, these initiatives, while resting upon the model of consumer rationality as defined by economic theory, also are based upon the assumption that consumers, because of poor information, or imperfect financial markets, (each of capital) are unable to speedily adjust to new energy situations and require subsidization to make the "correct" economic decision.

The first and second of these assumptions finds some support in this research. The third, while not disputed by the results, is also not strongly supported.

The reader is cautioned against inputing too much into the research results and statistical tests. For the most part, few strong statistical associations were discovered between conservation and/or fuel conversion and a fairly complete vector of socio-economic variables. The firm conclusion which may be reached, at least within the context of this particular experiment, is that the decision to conserve and/or convert is complex. Certainly it may be based in part on purely economic considerations, but a complicated interplay of personal lifecycle (stage in the life of the household), age of the house and it's components (age of heating plant) as well as the education and "philosophy" of the heads govern these decisions. The limited scope of the research project afforded little direct view of this decision process.

Outline

The report is divided into the following sections.

II. Models of Economic Decision Making
III. Hypotheses To Be Tested
IV. Methodology, Questionnaire Design and Sampling Procedure
V. Main Descriptive Results
VI. The Relation Between Energy Conservation and Socio-Economic Attributes
VII. The Relation Between Fuel Conversion and Socio-Economic Attributes
VIII. Conclusion and Further Research

Several appendices are provided to supplement the main discussion.

II. MODELS OF ECONOMIC DECISION-MAKING APPLIED TO ENERGY CONSERVATION/CONVERSION

Much public policy is predicated upon an assumption that the consumer (voter, firm, household) is rational. Rationality in economics has a precise meaning, and does not address the fundamental issues of interest to philosophers and psychologists. Generally, the axiom of rationality relates to consistency of choice among alternatives and the assumption that all goods and services can be ranked by the consumer on a scale of preferences. Note that these assumptions are static. Most consumers do change their mind; therefore, alteration in consumption patterns over time is no violation of consistency. For this reason, direct testing of economic rationality is almost impossible.

The basic notion of importance here is that the decision to conserve or convert from one fuel to another depends upon a calculation and comparison of

the costs of conserving and/or converting and the reduction in the operating (heating and cooling) costs of running the house.

Energy Conservation

With respect to energy conservation, any one of a number of actions may be pursued. The homeowners may merely turn down/up the thermostat to reduce the heating/cooling cost. In this situation, lower energy costs are exchanged for less comfort. This type of short-term reaction is the result of a "substitution effect" dominating the decision; higher prices produce an unambiguous reduction in both energy consumption and comfort.

The typical response to higher energy costs actually evolves over a longer period, where insulation may be installed to reduce operating costs and/or to raise comfort levels. If lower operating cost is the only objective for the consumer, this longer-term decision can be represented as follows.

Let $C(t)$ be the cost of energy per time period ($t = 1,...n$) before conservation while $C^*(t)$ is the cost of energy per time period after upgrading. If the capital cost of renovation is k, and it is also assumed that the consumer accounts for the foregone interest earned on savings (assuming that the insulation is installed using personal resources), then the insulating will be done only if the discounted present value of the return from saving k is exceeded by the discounted present value of the costs. In other words:

$$k(1 + i\ (t))^n < \sum_{t=1}^{n} \frac{C(t) - C^*(t)}{(1 + i\ (t))^n} \qquad 1.$$

Another, (although not completely equivalent) way of saying this is that the interest earned must be exceeded by the reduced energy cost[1]. If the insulation is purchased using credit (where $r(t)$ is the lending rate, and $i(t)$ the borrowing or savings rate), then the decision rate becomes:

$$\sum_{t=1}^{n} \frac{k(t)}{(1 + r(t))^n} < \sum_{t=1}^{n} \frac{C(t) - C^*(t)}{(1 + i(t))^n} \qquad 2.$$

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1. It is possible for the interest earned in some time periods to exceed the energy cost reduction for those periods. This is why the present value formulation is more accurate. It is also common to discuss energy conservation/fuel conversion estimates in terms of the "payback period". This refers to the time required to pay back the investment. The greater the cost saving or the lower the interest rate, the shorter the pay back.

These formulations are simplistic in that the conservation decision is never merely a straightforward calculus between costs and savings. The model does not include a "forecast" by the consumer of their disposable income, energy costs and interest rate. Consumers most likely base conservation decisions on these factors, as well as less well identified phenomena such as lifestyle. Many households do not possess the savings to act in their long-term interest.

The inclusion of the concept of a future stream of disposable income complicates the model (the last complication which will be formalized in this report.) Assume that the consumer purchases a standard unit of energy (joule) measured as J(t), (joules per year), and with the price per joule denoted as p(t). If future income is denoted as I(t), then the decision to convert may be presented as:

$$\sum_{t=n}^{n} \frac{k(t)}{(1 + r(t))^n} < \sum_{t=1}^{n} \frac{Y(t)}{(1 + i(t))^n} - \sum_{t=1}^{n} \frac{p(t)J(t)}{(1 + i(t))^n} \qquad 3.$$

Expectations of future energy prices, disposable income, and interest rates all combine to complicate the decision to conserve.

With respect to fuel conversion all the above applies. In fact, by relabelling, the formulations can be transferred directly. However, the role of security of supply becomes a major factor. The possibility of interruption of any fuel source is always extant, but events during the past decade have increased the probability that some forms of energy may be unavailable at any price. This motivation for converting from oil to other forms of energy, while unquantifiable none-the-less is real. Certainly gas and electric companies have played on these somewhat nebulous considerations.

In summary, while economic theory can contribute to a clarification of the decision to conserve/convert, the actual decision process is complex, piece meal and evolutionary. Accordingly, the hypotheses to be tested in this study do not address the issue of consumer rationality but rather are rooted in more general conjectures about the relation between socio-economic variables and the decision to conserve/convert.

III. HYPOTHESIS TO BE TESTED

A number of distinct hypotheses are evaluated in this study:

1. There is a significant correlation between various energy conservation

activities and socio-economic variables such as income, age of head(s), educational level of heads and occupational status.

2. Conversion from oil to other fuels is also significantly related to these socio-economic variables.

3. The probability of energy conservation and fuel conversion is directly related, and increases with income, age, occupational status, etc.

In addition, the results reported below also present a considerable body of descriptive material, that is useful in assessing the extent to which a representative sample has undertaken certain conservation/conversion tasks. Finally, the analysis of energy policy attitudes is not presented in this study, but is available elsewhere[2].

IV. METHODOLOGY

The hypotheses enumerated above were evaluated using a mail-out survey of Winnipeg homeowners. The use of a survey procedure raises several important methodological questions.

First, the use of "self report" data is suspect since many respondents may either not recall, and even fabricate answers to mislead or fulfill the preconceptions of the researcher. In an area such as energy conservation, there is the distinct possibility that responses may be biased to reflect a greater degree of insulation activity than actually undertaken. Survey research data are often alleged to be "softer" than data collected from administrative data sets. An attempt was made to unite the survey information with a variety of administrative data, but only with partial success.

There is little question that the information on a "self report" data collection exercise may be distorted. Not only will the variance around the mean response be greater, but there will be bias of unknown degree. Several methods can be used to reduce this error; unfortunately all are relatively expensive. The researcher may elect to use an objective data source to confirm all, or part of the respondent supplied data. Unfortunately, were there complete objective data sets available, there would be no need to do a survey. Another procedure is to combine an energy audit with the survey, but this too is very

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2. See "Western Economic Review", Vol. 1 No. 3.

expensive. Also, since the audit is very intrusive into the privacy of the individual there is a danger that only those who had "conserved" would be willing to participate, thereby biasing the sample. In person interviews may be helpful, but again costs rise, and such surveys tend to reinforce quick answers to questions that may require some reflection and research on the part of the respondent.

A second problem is all survey research is subject to non-response. Refusal to participate in the survey can be minimized, but more difficult is the "item non-response," where certain questions are systematically avoided. The procedures used in this survey to reduce refusal are detailed in the appendix, however, some variables were impaired due to refusal to answer particular questions. In certain cases, this was due to misunderstanding on the part of the respondent, or others. Item non-response is related to perceived sensitivity of the subject matter. Questions on income are traditionally sensitive, but here, obtaining permission to access utility records were both refused by respondents in some cases, and by the gas company in all cases. Electricity utilities, however, did provide consumption data, but the data sets provided by Manitoba Hydro and Winnipeg Hydro are not completely compatible.

Third, a survey must of necessity be cross-sectional. Some argue that to properly capture the decision process for consumers requires longitudinal data. Undoubtedly there is a measure of truth in this, but again the high cost of money and time precludes use of such information in policy appraisal. There is the clear danger that cross-sectional variations will fail to produce behavioural insight available from examining time series data. This problem underlies this research, and contributes significantly to the comparatively tentative conclusions.

It is possible to view cross-sectional analysis as effecting long run response. Assuming that consumers are all alike, then the variations in income and other variables produces the complete range of policy response one would ever expect. Therefore, elasticities of demand (price and income) estimated from cross-sectional data can be interpreted as long-term. Longitudinal data, on the other hand, produces short-run responses because the variation is across time, and generally much less. The vast majority of survey research is cross-sectional, and is relatively weak in the evaluation of short-term responses to specific policy initiatives. On the other hand, cross-sectional surveys tend to be relatively powerful in the design of longer-run policy since they allow one

to reference the longer-term characteristics of consumer behaviour.

Finally, mail-out surveys have a number of peculiarities. In general, when compared to telephone and face-to-face interviews, they are relatively less expensive (although the cost advantage is less than commonly believed). Typically, they are shorter, since the survey instrument must stand on it's own. They are relatively good in situations requiring some reflection, and research on the part of the respondent. While all questionnaires are dependent upon the phrasing of questions, mail-out surveys must take great care in the design, staging and presentation of each separate request for information.

Perhaps the most important issue facing a mail-out survey is non-response. The typical response rate for a mail-out appears to be in the area of 20 - 30 per cent, a completely unacceptable state of affairs. Special techniques, involving instrument design, covering letter, follow-up and a telephone support service were all used in this survey, with the result that response was about 71 per cent. Given that the analysis of non-responders indicated they were similar (at least with respect to the variables examined) to the responders, it is possible to have a high degree of confidence in the representativeness of the sample. The specific design issues in the mail-out are discussed in the Appendix.

Obviously, the ideal is to have variations across the units of analysis (individuals, households, firms, etc.), as well as time.

Mail-out surveys are especially useful when the respondent may need to consult records or others in the household. In-person interviews, and certainly telephone surveys place pressure on the respondent and can certainly produce hasty and inaccurate answers.

One potential problem that emerged in the pre-test is that many people possess a rudimentary knowledge of energy matters. Comparatively few know what an "R value" is for example, let alone to what standards their houses conform. Terminology such as "set back thermostat", "triple pane" and "air vent deflector" are not widely known. The questionnaire had to either explain these terms, or suppress reference to them. A telephone service was maintained to answer any queries respondents may have had, and this appeared to assist about 15 per cent of the final response. None-the-less, the lack of technical knowledge on the part of the respondent sample, contributes to the apparent "softness" of the questionnaire. Note, that this impression is superficial since the actual content was insignificantly influenced by the omission of technical referents.

Sampling

The purpose of the survey is to measure the conservation and fuel conversion action of owners of residential housing; owners of apartments and recently converted condominiums were excluded. In most cases, there is no direct incentive for an owner of a condominium to invest in conservation measures. Owners of apartments clearly have a financial incentive to reduce operating costs, but inclusion would make the questionnaire and sampling procedure more complex and costly.

The sample frame being confined to single family homeowners was easily identified from the 1981 Winnipeg property tax roll. Systematic sampling was used to extract a total sample of 504[3].

The Instrument

A basic rule of questionnaire design is that additional questions will always occur to the investigators when the material has been sent to the printers. To prepare the best possible questionnaire, a substantial pre-test and evaluation phase was undertaken. The pre-test and questionnaire design began in February, 1982 and was preceeded by several consultations with other experts (academic and professional). As well, the survey was administered to "representative" people at hand. The local utility companies were also invited to comment on drafts of the survey, and several useful suggestions were received.

The second phase of the pre-test included a field test in two differing socio-economic areas[4] of Winnipeg. Respondents were being asked to assist in improving the questionnaire. It was at this stage that the special difficulties in technical knowledge (or lack thereof), on the part of respondents was isolated. Substantial revisions were incorporated to reduce the amount of specialized knowledge required. Subsequent analysis of the survey suggests that this was partially successful, with a significant minority appearing to

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3. Originally, the project called for a sample of 1,000, but this was reduced in the face of a lower amount granted than was requested.

4. River Heights is an upper-middle income area, and old St. Vital, a lower-middle income area were used. A total of twenty questionnaires were used in the pre-test.

misunderstand certain segments of the questionnaire. This may have implications for future surveys in this area.

The text and format of questions used appear in Appendix 2. A booklet format was used, to reduce the apparent "load" of answering the questions, as well as to encourage the impression of professionalism. A number of problems emerged from the administration of the questionnaire.

Specifically, with respect to layout, a small proportion of the respondents missed sets of questions due to oversight. Additional attention to layout, such as "flagging the next question" on the bottom right hand portion of each page may have avoided some of these oversights. Also, some respondents failed to understand certain questions. For example, the question concerning schooling caused some confusion, as the distinction between junior and senior high school was not made.

In general, there were few errors of commission, that is, the questionnaire seemed to encourage honest responses, and there was little mutilation of the returned forms, aside from the occasional attempt to suppress the identifying code[5].

It was decided not to increase response burden (thereby reducing the return rate) by asking detailed information on:

1. energy consumption;
2. house characteristics.

Rather, attempts were made to secure these data from utility companies and the municipality. To preserve the confidentiality and anonymity, the last question asked the respondent to initial if they agreed to allow access to their energy consumption data for the previous twelve months. The usual requirement for release of this information is a signed statement. Both electricity companies agreed to the weaker release, but the gas companies, and oil delivery firms refused to supply the information without a full signature. Accordingly, no data on natural gas consumption could be obtained.

The municipal assessment branch of the City of Winnipeg was also approached to supply data on the attributes of the house (age, structural details, market

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5. Fortunately, the return envelope was also numerically coded and this allowed the field supervisor to track those who had responded and who suppressed the identity numbers on the survey form.

value, etc.), but refused[6].

Although some attempt to gather these data in the questionnaire was attempted, it was felt more important to ensure good return rates by not increasing its length and complexity. The concise format, and the fact that respondents were not asked to spend any money raised response rates.

For the most part, then, the analysis relies upon the survey responses. This can produce distortions, since responses are not corroborated against secondary data sources. Since the objective of this analysis is to attempt to construct behavioural choice models of conservation and conversion, the problem may be less than apparent. Individual choice is a function of perceptions (based only in part on the current state of affairs). Models which seek to explain consumer choice solely on the basis of objective secondary information run the danger of misplaced concreteness. Despite the admitted "softness" of self-report survey data, it may be superior for the purposes of estimating behavioural choice.

Statistical Model

Modelling the consumer choice, or investor choice decision (the two are closely related in energy related decisions), has usually involved some form of probability model. The simplest possible model, uses a dichotomous dependent variable (a zero or one) in the standard regression format.

$$Y_i = a + \Sigma b_j X_j + e_i \qquad 4.$$

where $Y_i = (0,1)$, and X_i are the usual interval and dummy valued variables. This linear probability model has one important problem, namely it can produce predicted values of Y_i which fall outside the 0,1 range. The model appears as in Figure 1 where the problem of unacceptable values of $\hat{Y}_t$ is apparent.

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6. A separate branch (Environmental Planning) had prepared the sample and they too could not gain access to the required data.

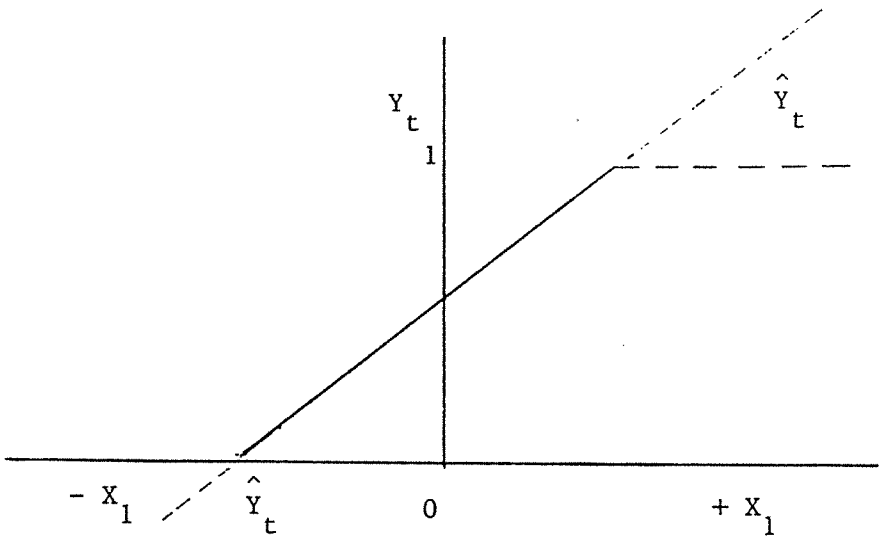


Figure 1

This "scaling" problem has produced a number of models which transform the variables to ensure that $\hat{Y}_t$ always lies within the theoretically acceptable range.

1. Probit/Logit

One of the most widely used classes of model are the probit/logit originally developed for bioassay problems with respect to drug toxicity. Because they were developed for a biological environment where sophisticated controls could be placed on the experimental situation, the data could be grouped by independent variable values, and frequency of occurrence of qualitative effect was defined to be the dependent variable. The key concept is that the probability of occurrence (P_t) is transformed from a function of the independent variables in the ($-\infty$, $+\infty$) range to the (0,1) range. More specifically:

$$\hat{P}_t = f(Z_t), \qquad 5a.$$

$$Z_t = X_t B, \qquad 5b.$$

$$\hat{P}_t = F(X_t B). \qquad 5c$$

where:

P_t is the conditional probability that $y = 1$ given X_t,

B is the set of regression coefficients,

X_t is the set of independent variables.

The probit model uses the cummulative distribution function of the standard normal function to effect the transformation .

$$P_t = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{X_t B} \exp(-\tfrac{1}{2}u^2)\,du \qquad 6.$$

The logit model is defined as:

$$\hat{P}_t = 1/(1 + e^{-X_t B}). \qquad 7.$$

This can now be estimated using OLS and P_t will lie on $(-\infty, +\infty)$. The parameters, B, are estimated using maximum likelihood for both the probit and logit models. A problem with the probit/logit model is apparent in that they pertain only to dichotomous choice.

V. MAIN DESCRIPTIVE RESULTS

This section of the report presents the results from a one way frequency analysis of the data. The highlights from the survey are presented below, and the results for each question are detailed in the Appendix.

The sample was drawn from the population of Winnipeg homeowners (as defined by the 1981 property tax roll for single detached homes). To the extent that some people had moved or otherwise were no longer at the home, the survey failed to make contact with a representative group. However, this accounts for about 9 per cent of the total non-response, or only 13 out of the total 146 non-responders.

Also, because only homeowners are surveyed, income and educational levels as shown in Tables 1 and 2, tend to be higher than were the entire population of Winnipeg surveyed.

TABLE 1

Income of Respondents

(Percentage of Respondents in Each Category, Preliminary Figures)

Under $10,000	8.4%	$30,000 - 32,499	3.2%
$10,000 - 12,499	4.9%	$32,500 - 34,999	4.3%
$12,500 - 14,999	4.9%	$35,000 - 37,499	4.9%
$15,000 - 17,499	7.2%	$37,500 - 39,999	2.9%
$17,500 - 19,999	5.5%	$40,000 - 42,499	4.9%
$20,000 - 22,499	5.5%	$42,500 - 44,999	2.0%
$22,500 - 24,999	4.9%	$45,000 - 49,999	2.9%
$25,000 - 27,499	9.0%	$50,000 - 59,999	5.2%
$27,500 - 29,999	7.5%	$60,000 or over	4.6%

No Answer 7.5%

TABLE 2

Educational Level of Adult 1 and Adult 2

(Percentage of Respondents in Each Category, Preliminary Figures)

Type of Schooling	Adult 1	Adult 2
Elementary	16%	11%
High School	38%	43%
Some University	8%	9%
Some Technical School	8%	4%
University Graduate	17%	8%
Technical School Graduate	7%	6%

House value (as estimated by the homeowner) reflects the fact that the sample was dispersed throughout the city as shown in table 3.

TABLE 3

Home Value of Respondents

(Percentage of Respondents in Each Category, Preliminary Figures)

0 - 19,999	0.9%	80,000 - 89,999	5.2%
20,000 - 29,999	1.7%	90,000 - 99,999	3.8%
30,000 - 39,999	9.0%	100,000 - 109,999	4.0%
40,000 - 49,999	10.4%	110,000 - 149,999	3.5%
50,000 - 59,999	15.9%	150,000 and over	0.9%
60,000 - 69,999	22.8%	Missing	12.7%
70,000 - 79,999	9.2%		

4.0 Attitudes Toward Energy Issues

Perhaps the most interesting aspect of the survey for both general reader and policy planner are the attitudes toward current energy issues. These were addressed in the first part of the survey and the questions and response patterns appear below.

Attitudes Towards Energy Policy

The question text appeared as below. Responses are noted. N/A refers to the percentage of item non-response.

"Since 1974 the federal and provincial governments have been very active in energy policy. These first questions are designed to provide information on how you feel about parts of this energy policy. Please circle the number for each question that most closely reflects your views."

TABLE 4

	Strongly Agree 1	Agree 2	Undecided 3	Disagree 4	Strongly Disagree 5
1. The energy industry in Canada should be owned by Canadians. N/A: 2.9%	43%	36%	10%	5%	3%
2. Since Canada has abundant energy supplies, Canadians should pay a lower price for fuel than people in countries where energy is scarce. N/A: 1.7%	48%	37%	5%	7%	2%
3. The government's present policy of taking 90% of the price of every gallon of gasoline in taxes is justified. N/A: 2.9%	13%	10%	10%	41%	32%
4. The federal government should get most of this revenue from gasoline. N/A: 4.9%	2%	15%	16%	40%	22%
5. The provincial government should get most of this revenue from gasoline. N/A: 5.2%	4%	19%	17%	36%	18%
6. Both levels of government should share equally in this revenue from gasoline. N/A: 4.6%	12%	40%	12%	23%	9%

	Strongly Agree 1	Agree 2	Undecided 3	Disagree 4	Strongly Disagree 5
7. If a government approved insulating material is proved unsafe, then it is the responsibility of the government to pay all costs in making safe a home which is insulated with this product. N/A: 2.6%	45%	30%	8%	11%	2%
8. New dams to produce hydro-electricity should be paid for by increasing hydro rates by 15%, rather than by increasing the public debt. N/A: 2.6%	10%	31%	24%	25%	8%
9. If we have another energy crisis and fuel supplies became short, government should ration fuel rather than let the price rise. N/A: 4.0%	17%	45%	14%	16%	4%
10. As a measure to increase employment, government policy ahould allow industry to pay lower electricity rates than homeowners. N/A: 3.5%	4%	27%	11%	38%	16%

Most respondents (79%) agreed (or strongly agreed) that the energy industry should be owned by Canadians. Also most (85%) felt that since we have abundant supplies our price should be lower than in areas where energy supplies are scarce.

Many respondents (73%) were in opposition to the large share of gasoline prices which are taken in taxes and this opposition was reflected in who should take this revenue. If any revenue is to be taken, some respondents (40%) felt both should share the revenue, while 23% were opposed to sharing. More detailed analysis is yet to be undertaken to fully understand this pattern of response.

There was strong feeling that the government is responsible for the ill effects of any approved insulating material, but a small group (13%) felt otherwise.

As to the question of financing new energy expansion such as hydro dams, 41% felt that rates should rise to "save" for the project, while 33% opposed this use of the electricity price mechanism. Many (62%) also felt that rationing was preferable to a price increase in the event of further energy shortages. Finally, the respondents (54%) did not feel that industry should obtain a concession on electricity rates as an employment creation incentive.

Opinion analysis is difficult. For example, the table (4) does not analyze the opinions by income, age, or education of the respondent. More than likely there are significant differences in opinions among different types of households based upon socio-economic factors.

Conservation Activities of Homeowners

A sizable portion of the respondents have engaged in substantial conservation activities. The average (mean) amount spent on energy conservation (of the present home) is approximately $1,117. Table 5 indicates the distribution of expenditures on energy conservation.

TABLE 5

Expenditures on Energy Conservation

"Now, we would like to get some idea of how much money you have spent on conservation activities and how you financed them.

1. Approximately how much have you spent on energy conservation (do not include changes to the furnace), on your home since you bought it?"

a.	$100 or less	13%	
b.	$101 - $250	6%	Approx. Mean = 1,150
c.	$251 - $500	15%	
d.	$501 - $1,000	16%	Standard Error = 52.5
e.	$1,001 - $1,500	15%	
f.	$1,501 - $2,000	10%	N/A: 3.2%
g.	$2,001 - $2,500	7%	
h.	over $2,500	14%	

Most respondents paid for this out of savings (51 per cent) or small expenditures from monthly incomes (34 per cent) and/or the Canadian Home Insulation Program (25 per cent). In general, the larger the expenditure, the more likely was a personal loan from a bank or CHIP to be used to assist in the financing. Only 4 per cent of the respondents indicated that they had made no expenditure at all on energy conservation. In most instances, there would be homeowners who had recently acquired a new home or a house which had been "retro-fitted".

FIGURE 1

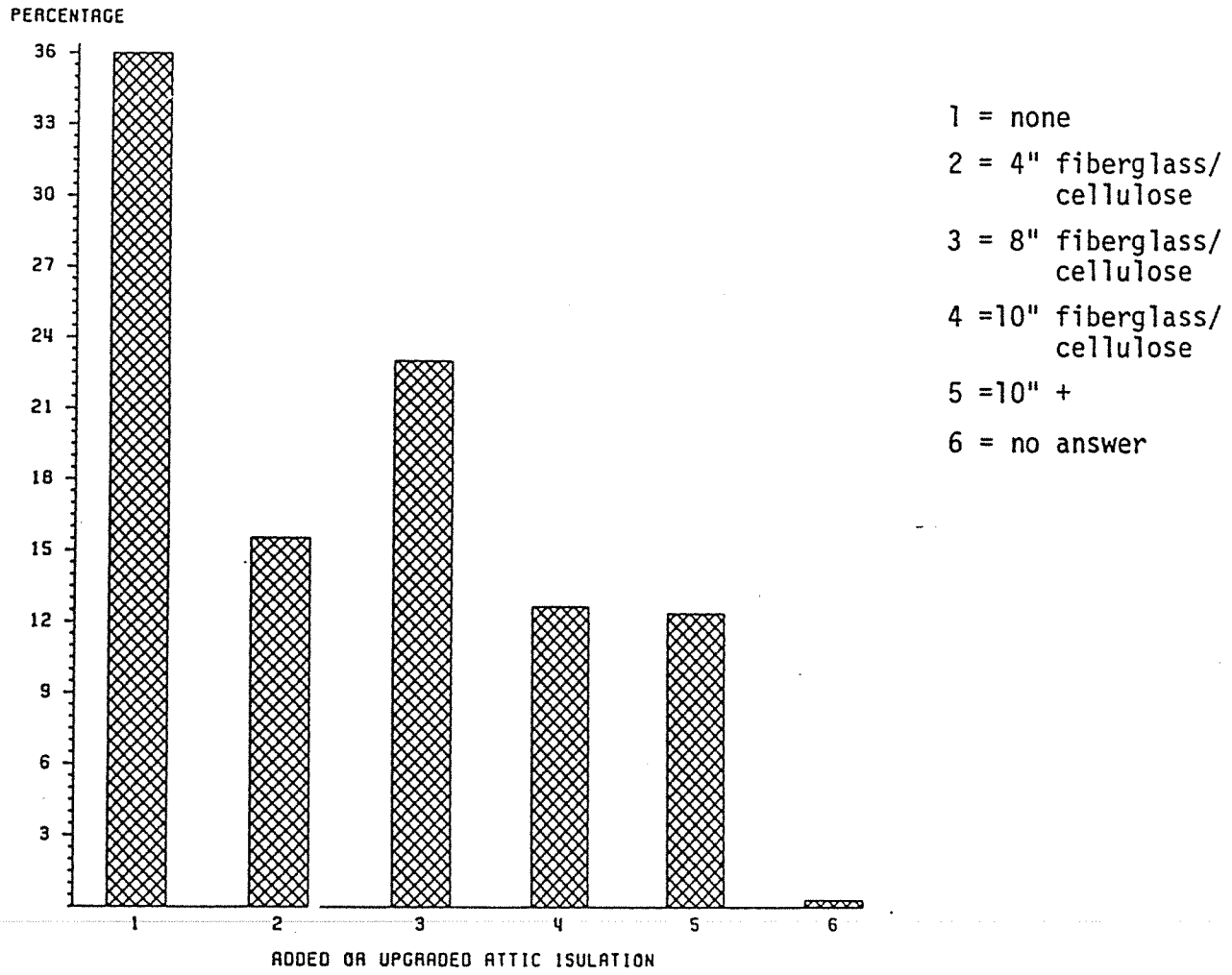
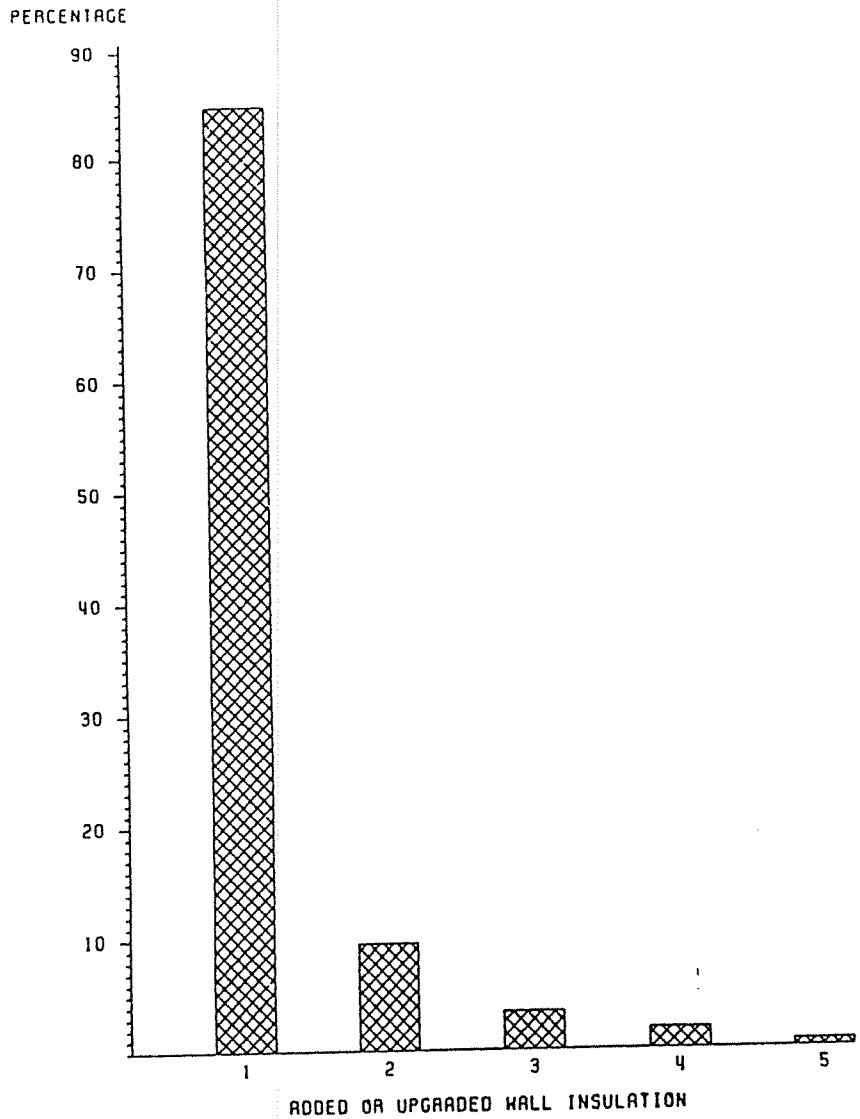
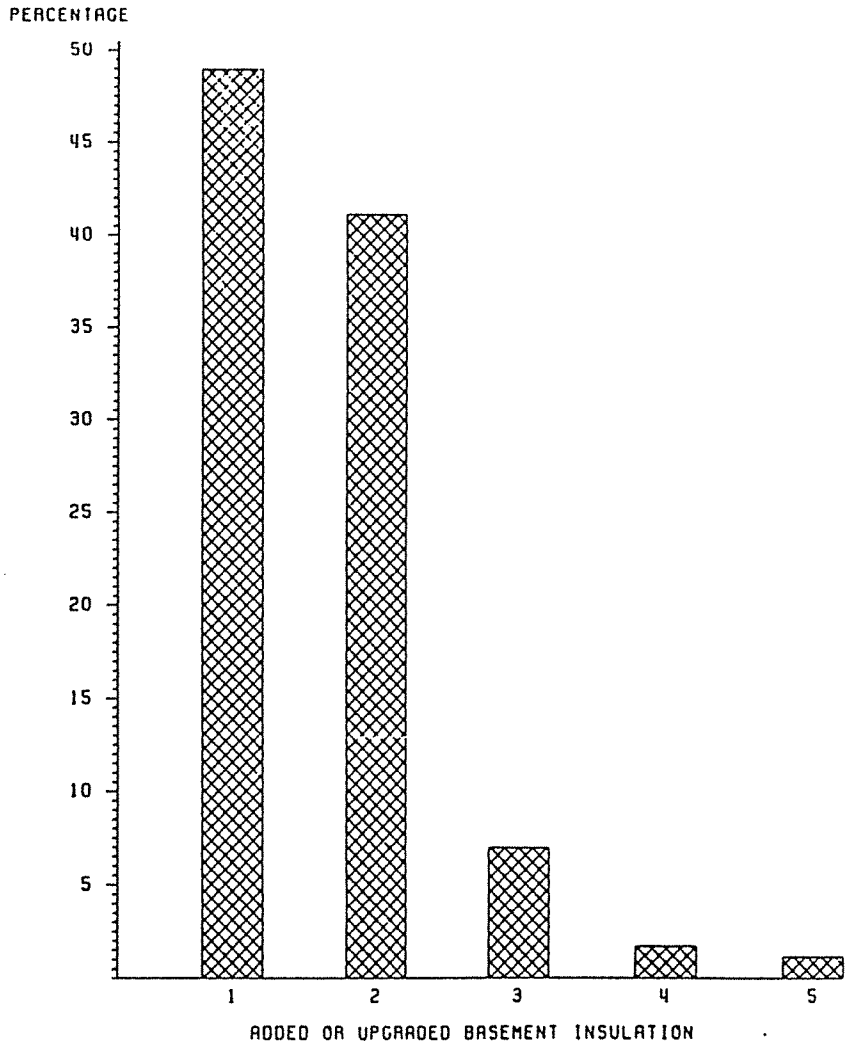


FIGURE 2



1 = none
2 = 4" fiberglass/cellulose
3 = 8" fiberglass/cellulose

FIGURE 3



4 = 10" fiberglass/cellulose
5 = 10" +

FIGURE 4

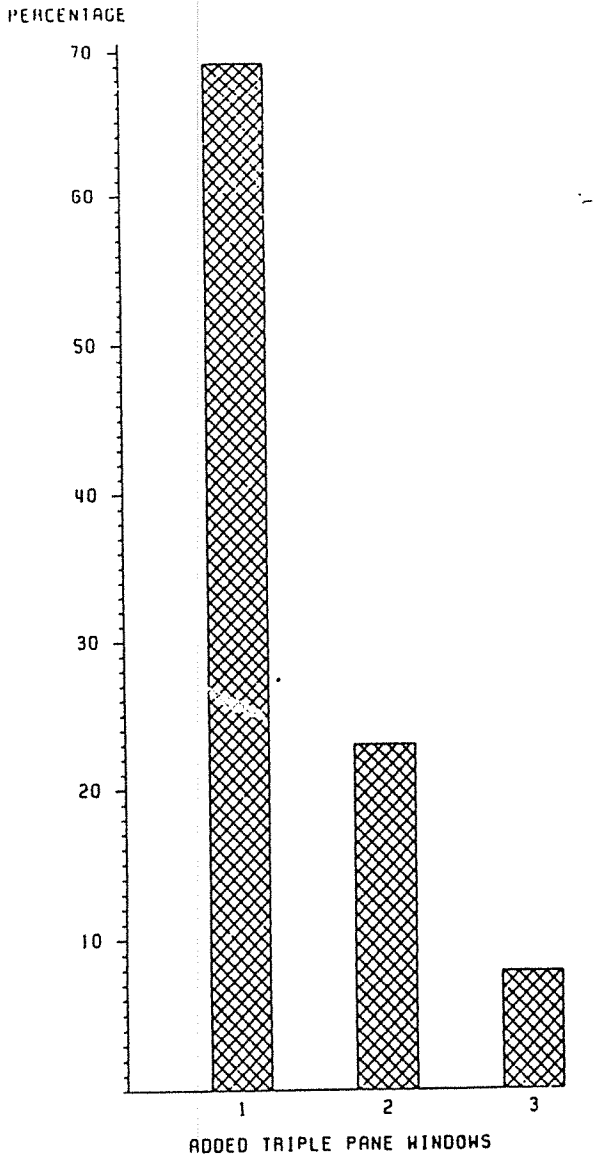
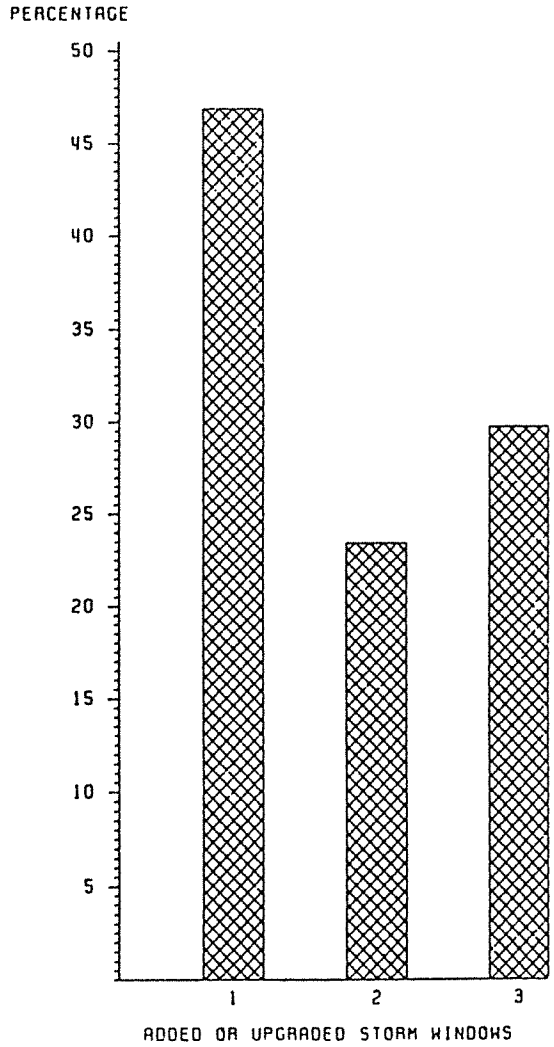


FIGURE 5



1 = none 2 = some 3 = all

FIGURE 6

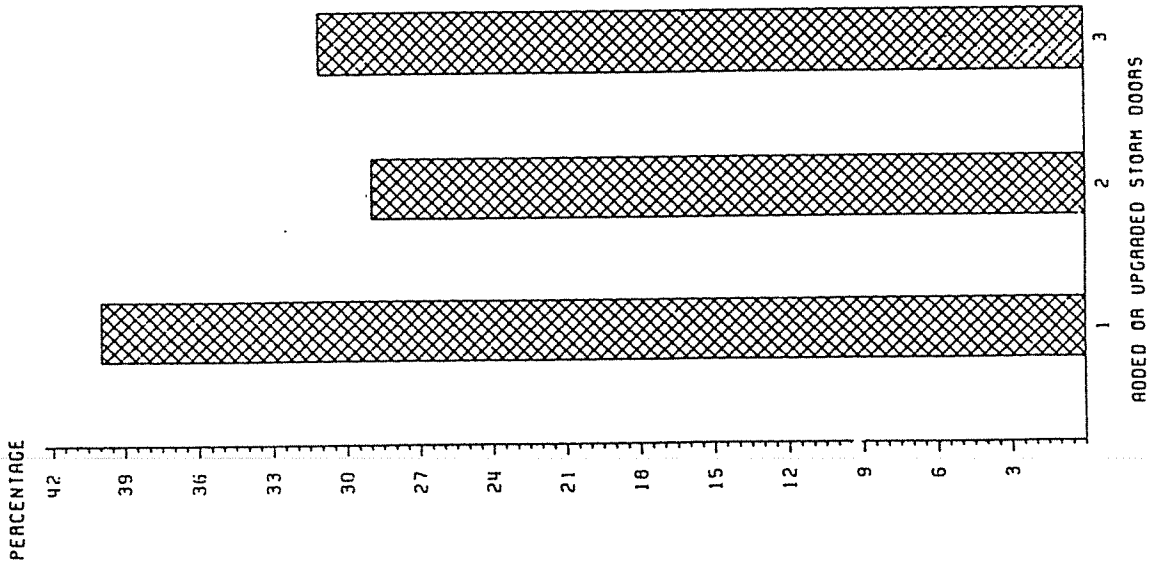
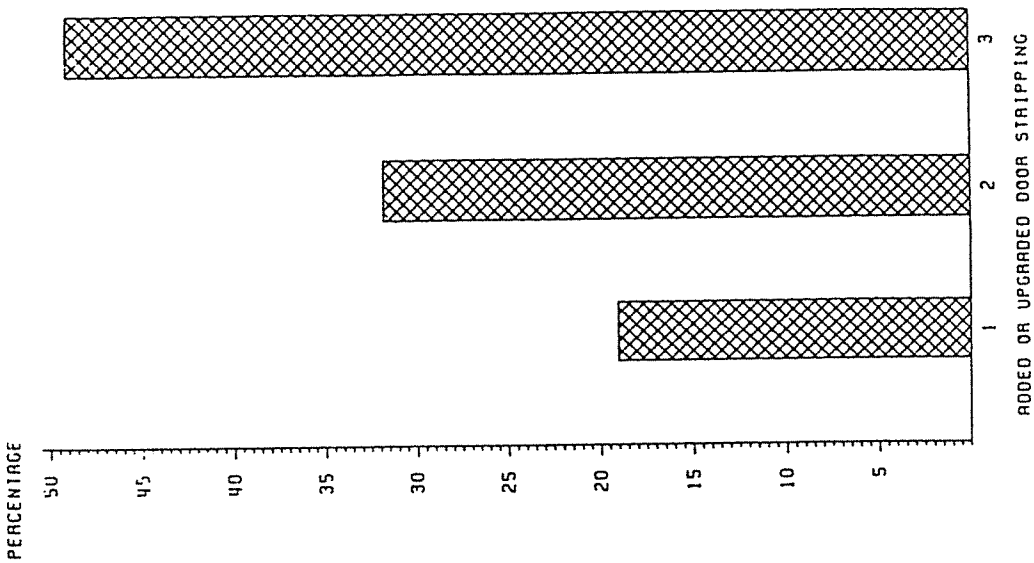
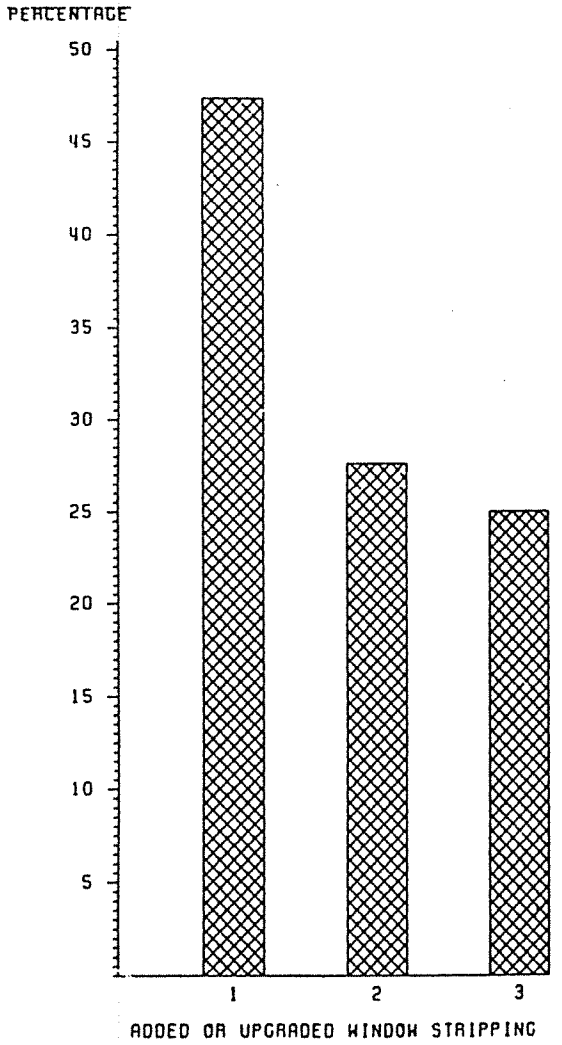


FIGURE 7



1 = none 2 = some 3 = all

FIGURE 8



1 = none 2 = some 3 = all

FIGURE 9

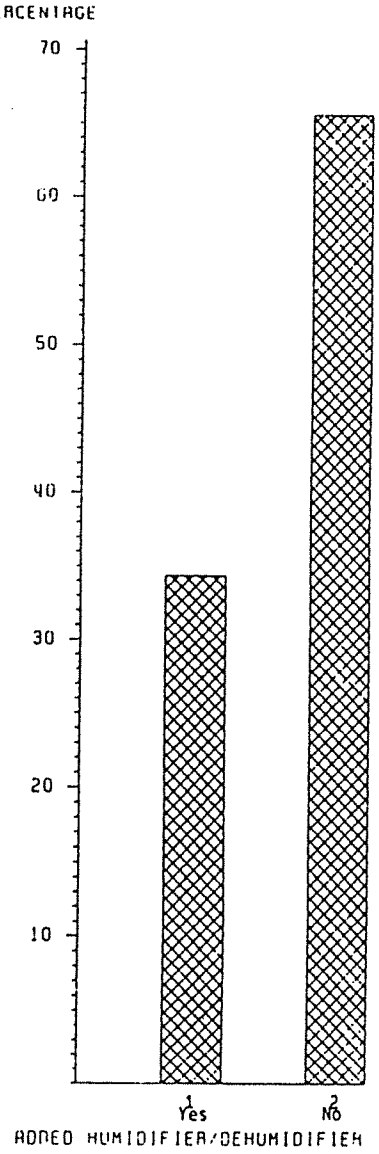


FIGURE 10

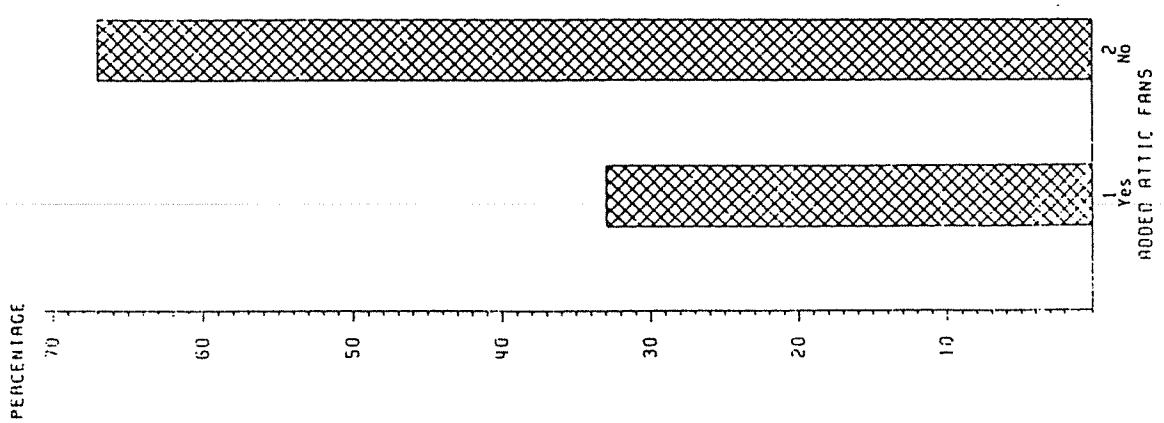
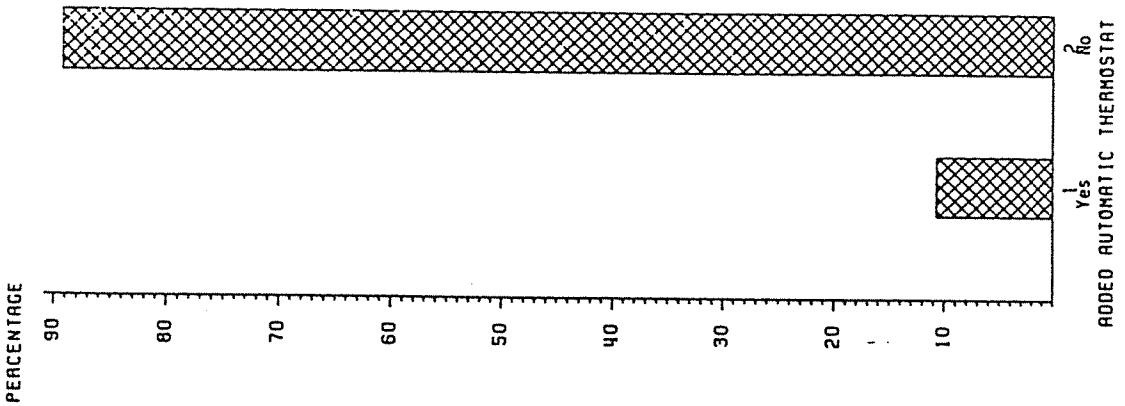


FIGURE 11



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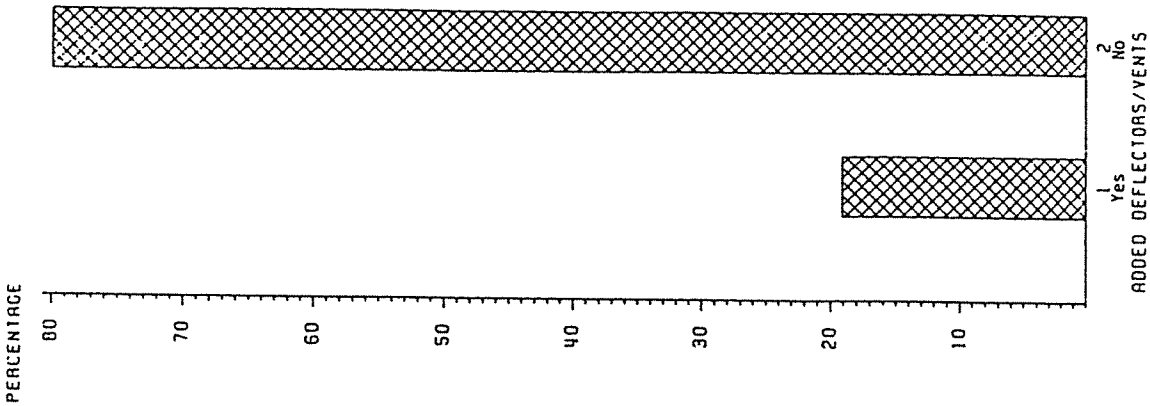


FIGURE 14

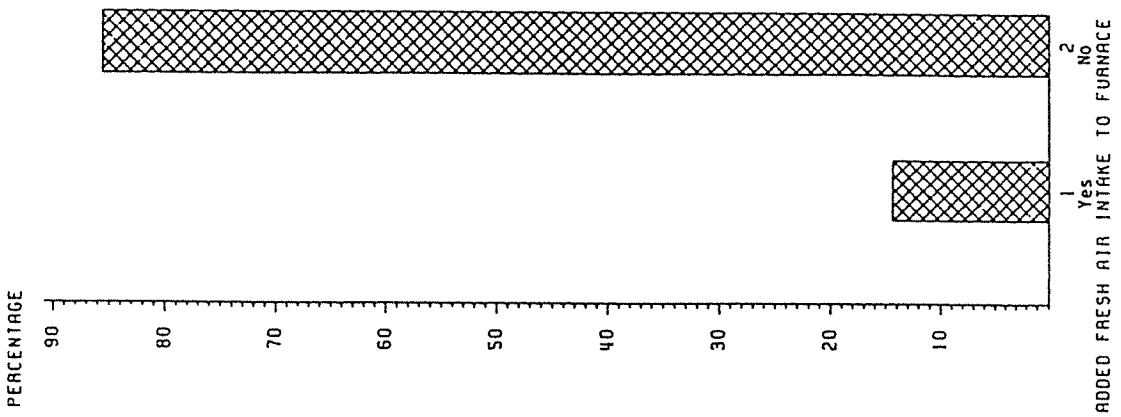


FIGURE 13

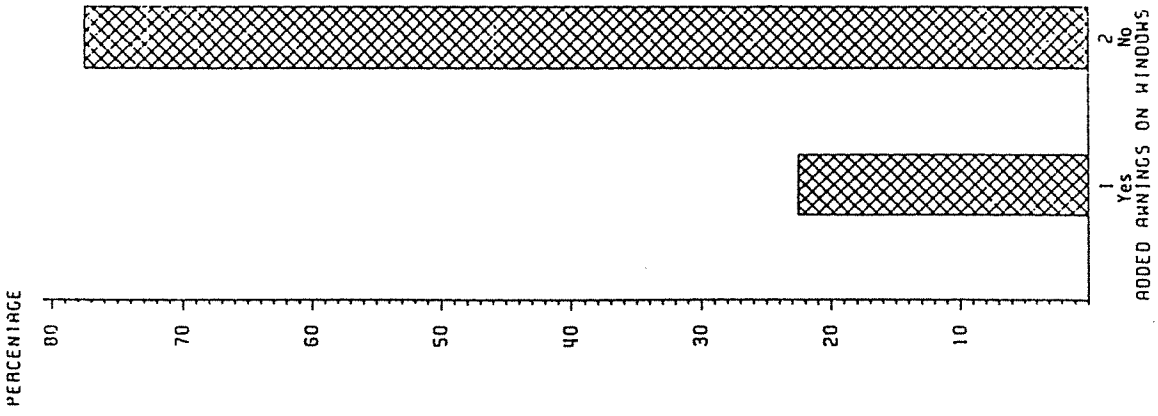
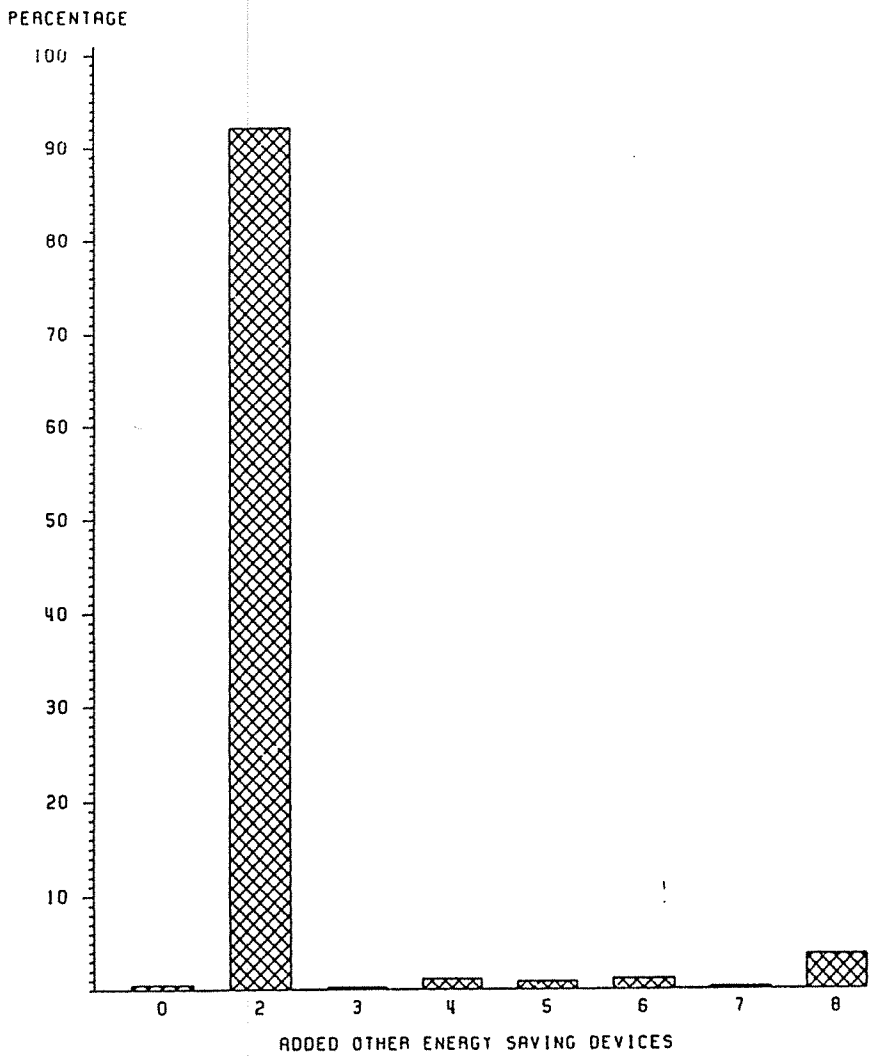


FIGURE 15



2 = no
3 = aluminum siding
4 = fireplace
5 = plastic on windows in winter
6 = wood burning stove
7 = solar collector
8 = other
0 = no answer

VI. THE RELATION BETWEEN ENERGY CONSERVATION AND SOCIO-ECONOMIC ATTRIBUTES

From Section V (especially Figures 2 to 16), it is apparent that a significant group in the sample have engaged in some form of energy conservation. The procedure used to analyze the propensity to conserve consists of two steps. First, each of the main conservation questions (Section III of the survey presented in Appendix 2), were rescaled. If the respondent reported no conservation activity at all for a given class of activity (such as attic insulation, basement upgrading, etc.), the dependent variable was set to 0. If at least some improvements were reported, the dependent variable was set to 1. Logit analysis was then used to estimate the relation between the dependent variable and a vector of independent variables.

Second, the responses on each question in Section III of the questionnaire were retained. If no conservation was reported, the dependent variable was set to zero. With each subsequent response value, the dependent variable was set to 1, 2, ... respectively, indicating the progressive degree of conservation activity undertaken. Since it is difficult to assign a strict interval between these various actions, although one is implied, multinominal logit was used to estimate the relation between the dependent variable and the vector of independent variables.

Logit Analysis

The independent variables employed in the analysis were:

EDI	= educational attainment of head 1
SEDEX	= Blishen occupational status scale
GRANT	= 0-1 variable indicating absence/presence of Manitoba government grant or CHIP grant
YEAR1	= number of years home has been owned in five year increments - a proxy for age of house
ATTIC1	= a step valued function ranging from 0 (no answer) to 3 for degree of attic insulation at time of home purchase
BASE1	= a step valued function ranging from 0 to 5 for degree of basement insulation at time of home purchase
WALLS1	= a step valued function ranging from 0 to 5 for degree of wall insulation at time of home purchase

TABLE 6a

Have you upgraded your attic insulation since time of home purchase?

Dependent Variable = 0 (no)
= 1 (yes)

Binary Logit

Independent Variable	Beta	Chi Square	P-Value
INTERCEPT	.075	.01	.92
YEAR1	.883	20.11	.00
GRANT	2.330	21.88	.00
ATTIC1	-.412	8.62	.03
SEDEX	-.026	4.36	.04

Model Chi Square 91.85
D = .318 ($\simeq R^2$)

Estimated Change in Probability Points for P = 50%

YEAR1	22.1%
GRANT	58.3%
ATTIC1	10.3%
SEDEX	.7%

TABLE 6b

Have you upgraded your basement insulation since time of home purchase?

Dependent Variable = 0 (no)
= 1 (yes)

Binary Logit

Independent Variable	Beta	Chi Square	P-Value
INTERCEPT	.342	.25	.61
YEAR1	.614	16.55	.00
GRANT	.049	.02	.88
BASE 1	-.219	5.59	.02
SEDEX	-.025	4.86	.03

Model Chi Square 30.84
D = .136 ($\simeq R^2$).

Estimated Change in Probability Points for P = 50%

YEAR1	15.3%
GRANT	1.0%
ATTIC1	-5.1%
SEDEX	0%

TABLE 6c

Have you upgraded your walls since time of home purchase?

Dependent Variable = 0 (no)
= 1 (yes)

Binary Logit

Independent Variable	Beta	Chi Square	P-Value
INTERCEPT	-.618	.38	.54
YEAR1	.577	8.80	.00
GRANT	.476	1.14	.29
WALLS 1	-.494	6.85	.01
SEDEX	-.032	5.68	.02

Model Chi Square 32.39
D = .142

Estimated Change in Probability Points for P = 50%

YEAR1	14.4%
GRANT	11.9%
ATTIC1	12.4%
SEDEX	.8%

Before interpreting these results, a word of explanation is in order. First, there was some degree of multicollinearity present. In particular, the variable CHIP a 0-1 variable indicating (whether a CHIP grant had been obtained) and GRANT 9a 0-1 variable indicating whether a Manitoba Home Insulation Loan had been obtained) have a correlation of 87. They also are 0-1 during variables producing erratic results when both are entered into the same model. As a result, both were combined into one variable 0 indicating no grant (CHIP or Manitoba Home Insulation Loan) and 1 for the presence of this form of aid.

Second, the estimation proceeded using a stepwise approach. Normally one would enter those variables which a priori conformed to theoretical expectations Here the existence of 0-1 variables and step valued functions produced multi-collinearity which was resolved using a selection of variables based upon statistical significance.

Finally, a word is in order about the calculation of the probability change.

For the logit model, it is customary to estimate the change in probability of doing something (here conservation) as a function of a change in one of the independent variables. Generally, the 50% point of the logit curve is used, as this is the point of greatest change in probability. In other words, each number in the lower part of figures 6a-c is computed according to:

$$\frac{dP}{dx} = (1 - P)(P)\,\hat{B}$$

For P = .5, we simply divide the estimated co-efficient by 4. The numbers which result are to be interpreted as changes in probability given unit change in the particular independent variable.

Generally, the results are statistically valid. The signs in all cases are correct, if surprising in some instances. The time the home has been owned has a very significant impact on all forms of home insulation. This variable may also be taken as a proxy for age, since this was not obtained from secondary sources.

The existence of government assistance is a significant explanation for attic insulation, but not for basements and walls. In all likelihood, this reflects the efforts of local insulation firms who first pushed attic insulation, and then only began to exploit other possibilities. Many "conservers" had by then exhausted their eligibility for these programs.

The various changes in probability points shown in the lower half of each table must be interpreted with some care. With reference to Table 6a, one would say (if the respondent had a 50-50 chance of undertaking attic insulation, then an increase in the time of homeownership would increase the probability of conservation by 22.1%. Clearly, the existence of the various grant programs has had a significant impact on influencing conservation behaviour, at least with respect to attic insulation.)

It is interesting to note that occupational status as measured by the Blishen scale (SEDEX) always has a negative impact on conservation. There are two explanations for this. First, occupational status is strongly correlated with income, and energy conservation is probably an "inferior" good - less is consumed as incomes rise. Second, much conservation activity is "do it yourself" which is likely to be undertaken by tradespeople rather than professionals.

Analysis of less significant insulation activities (such as adding tripane) was also done. Generally, few variables were significant. The only exception being the significance of the Manitoba Home Insulation Loan in the retrofitting of windows. This reflects the activity of local firms which repackaged the loan program to make it very attractive to those who were considering upgrading windows. A study which would be very interesting is how local and national firms exploited the energy crises to their advantage, and how consumer information was, thereby, influenced.

In summary, energy conservation is not strongly related to socio-economic attributes. Only a few variables were strongly related to conservation.

VII. THE RELATION BETWEEN FUEL CONVERSION AND SOCIO-ECONOMIC ATTRIBUTES

The federal government has placed a high priority in encouraging consumers to convert from oil to gas and other forms of home heating. Most homeowners in the sample had gas heat when they first purchased their home but 54 reported a conversion from oil to gas or electricity since they purchased their home. Table 7 shows the source of heat when the home was first purchased and the form of heating presently used.

TABLE 7
Percentage of Respondents Using Each Type of Home Heating (Preliminary Figures)

Heating Source	At Time Home Was Purchased	Present
Oil	20%	4%
Natural Gas	65%	91%
Electricity	1%	2%
Propane	.3%	—
Wood	.3%	.6%
Coal Furnace	10%	—

A similar model as was used for analyzing energy conservation was applied. The variable for fuel conversion was naturally constructed from questions in Section IV of the survey, and poses no conceptual difficulty. The dependent variable is 0 for no conversion and 1 for a conversion (either to gas, electricity, or wood from oil). The vast majority have converted to gas.

The independent variables used were:

YEAR1 = Year house was purchased (as a proxy for age of house)
SEDEX = Blishen scale for occupational status
INCOME = A scale indicating increments of $5,000 in income
HEATAGE = Age of heating plant at time of home purchase
ROOMS = Number of rooms
VALUE = Value of house in $5,000 increments
MONEY = Value of conservation work undertaken since home purchase

The results of a logistic regression of these variables is shown below in Table 8. Each of the variables has an *a priori* plausibility for inclusion in the model. As mentioned earlier, ideally the age of the home should be included, but instead YEAR1 is used as a proxy. The same qualifications mentioned above apply here.

Table 8

Dependent Variable = 0 (no conversion)
= 1 (conversion)

Binary Logit

Independent Variable	Beta	Chi Square	P Value
INTERCEPT	-2.78	1.69	.19
YEAR1	.91	9.49	.00
SEDEX	- .04	2.82	.09
INCOME	.19	2.32	.13
HEATAGE	.27	1.47	.23
ROOMS	- .30	.52	.47
VALUE	- .00	.31	.58
MONEY	- .11	.62	.43

Model Chi Square = 21.26

D = .107 ($\simeq R^2$)

Estimated Change in Probability Points
with P = .50

YEAR1	22.7
SEDEX	.8
INCOME	4.8
HEATAGE	6.5
ROOMS	7.5
VALUE	-
MONEY	2.8

Because of the small sample size, this equation has a low predictive power. Only one variable emerges as significant, namely YEAR1. SEDEX, the measure of occupational status and INCOME are also weakly significant. Inclusion of two correlated variables (r = .48) raises the overall predictive power of the model, and here does not appear to produce adverse multicollinearity. The interpretation of the estimated change in probability points is the same as before. Assuming the homeowner has a 50-50 chance of converting from oil to gas, then increasing the number of years the home has been owned by 5, increases the probability of conversion by 22%. Caution should be placed in these estimates.

The fact that most Winnipeg homes use gas as the main home heating source, as well as the recent introduction of the Canadian Oil Substitution Program contributes to the tentative nature of these results. Perhaps a repeat of the survey in a year or so may produce a stronger result. Also, the sample size would have to be increased.

VIII. SUMMARY AND CONCLUSIONS

In general, the survey reported here confirms what is generally known about conservation behaviour over the past several years. Typically, conservation is undertaken by middle income homeowners. Upper income households treat energy conservation as an "inferior good" while lower income homeowners appear not to be able to finance significant upgrading.

A strong result was that most of the "routine" upgrading such as weather stripping was done out-of-pocket. More ambitious projects were financed by savings, federal grants (CHIP) and bank loans in that order.

The core of the analysis in this study relates to the use of logit estimates of the "probability" that a homeowner would have upgraded based upon the socio-economic attributes of the household and house. Generally, the most significant variables in major upgrading (attic, walls and basements), were federal (CHIP) and provincial grants. Typically, CHIP grants were the significant variables in

attic basement wall upgrading, while provincial grants accounted for much of the variation in upgrading windows. The role of local contractors in this pattern is important. Contractors who specialized in renovation mounted a strong campaign to encourage the use of CHIP grants to upgrade basements. Insulation contractors were very aggressive in promoting CHIP to the homeowner for the purpose of upgrading walls and attics.

Finally, many window finishers promoted the provincial government grant. This was made more attractive by the fact that the grant could be repaid by a monthly surcharge on the electricity bill.

The analysis of oil to gas conversion was less satisfactory. Few variables were significant, and the overall explanatory power of the estimates were low. This may be explained by the fact that a low percentage of the respondents actually had to convert from oil. Also, many probably have converted over a period of time, for reasons not entirely related to high energy prices.

Generally, the sample is representative of the population, with a slight bias toward retired homeowners. This does tend to bias estimates upward of the actual conservation activities of Winnipeg homeowners. However, when weighted against the high response, this bias is tolerable.

More important is the difficulty in undertaking such research without the cooperation of all relevant agencies. The electricity utilities were helpful in assembling energy consumption data, but the gas utility insisted upon signatures to release their consumption data. Although a separate postcard, mailed directly to the utility by the respondent could have been used, considerations of response burden, and cost ruled this out.

Several important lessons can be drawn from this exercise, aside from the substantive results, which are largely confirmatory.

First, the technique of mail-out surveys is viable. Great attention to design, timing and follow-up can produce response rates comparable to more costly face-to-face survey procedures.

Second, without additional data from administrative data bases, the ability to establish sample quality (with respect to the analysis of non-response) and to reduce response burden is impaired. Third, secondary data sources in this case a separate energy audit undertaken after the mail-out has been completed, would substantially increase the usable data.

Finally, and most importantly, energy conservation, appears not to be a function of the common socio-economic variables commonly employed in the design

of policy. Aside from the number of children, none of the common variables such as income, occupational status, or education were consistently significant in explaining conservation activities. It appears as though conservation is a complex process, where consumption and investment decisions interplay with other factors. Policy design in this area, if it is to more precisely achieve stated objectives, must rely upon increasingly sophisticated analysis of human behaviour.

Further Research

The data base established in this exercise is capable of supporting additional research. In particular, an analysis using multinominal logit will be conducted. The technique of scaling the energy conservation variable from five intervals, indicating degree of conservation to a 0-1 basis, is crude and probably weakens the analysis.

The second project is to produce cross-sectional estimates of energy demand. The data, drawn from a random sample of homeowners, probably is a superior basis for undertaking this study, rather than a sample of utility customers, many of whom are not homeowners. Many of these cross-sectional studies undertaken by utilities suffer from poor response rates.

These studies will be undertaken in the next several months and published periodically.

APPENDIX 1

SURVEY QUESTIONNAIRE

ENERGY POLICY FOR HOMEOWNERS

INSTITUTE FOR SOCIAL AND ECONOMIC RESEARCH
Faculty of Arts
The University of Manitoba

WHO ARE WE?

The Institute for Social and Economic Research is located in the Faculty of Arts at the University of Manitoba. It engages in social science research, and undertakes such investigation for a number of government agencies. This research is executed on a grant from the Department of Energy, Mines and Resources (Ottawa).

WHAT IS THIS SURVEY FOR?

Energy policy is one of the most important areas of government activity. These questions are designed to provide university researchers with detailed information on how ordinary Canadians are coping with energy related problems. The research that results from these questions will be used to improve the effectiveness of government policy toward energy conservation and planning, and to design better programs to help homeowners in their energy conservation activities.

WHERE DID WE GET YOUR NAME?

Your name and address was selected randomly by a computer from the City of Winnipeg property tax records. 500 other homeowners have also received this questionnaire.

WHAT WILL BE DONE WITH THE QUESTIONNAIRES?

The information will be placed on computer tape, and once we have checked to see that this recording was correctly done, this questionnaire will be destroyed. All survey research at the University of Manitoba is supervised by an ethical review board to protect your privacy. ALL OF THE INFORMATION YOU GIVE US IS CONFIDENTIAL.

WILL I EVER BE ABLE TO SEE THE RESULTS?

Yes, at the end of the summer you will receive a copy of the summary report.

WHY SHOULD I ANSWER?

We know that you are busy and many people seem to be asking you questions and invading your privacy. But we think, because you own a home, your opinions are especially valuable to the government. Both the federal and provincial governments will be getting copies of our report, as will members of the provincial and federal parliaments. This is your chance to register your opinion on a vital issue facing Canadians and your chance to influence government policy and programs.

SECTION I

Since 1974 the federal and provincial governments have been very active in energy policy. These first questions are designed to provide them with information on how you feel about parts of this energy policy. Please circle the number for each question that most closely reflects your views.

	STRONGLY AGREE 1	AGREE 2	UNDECIDED 3	DISAGREE 4	STRONGLY DISAGREE 5
1. The energy industry in Canada should be owned by Canadians.	1	2	3	4	5
2. Since Canada has abundant energy supplies, Canadians should pay a lower price for fuel than people in countries where energy is scarce.	1	2	3	4	5
3. The government's present policy of taking 90¢ of the price of every gallon of gasoline in taxes is justified.	1	2	3	4	5
4. The federal government should get most of this revenue from gasoline.	1	2	3	4	5
5. The provincial government should get most of this revenue from gasoline.	1	2	3	4	5
6. Both levels of government should share equally in this revenue from gasoline.	1	2	3	4	5
7. If a government approved insulating material is proved unsafe, then it is the responsibility of the government to pay all costs in making safe a home which is insulated with this product.	1	2	3	4	5
8. New dams to produce hydro-electricity should be paid for by increasing hydro rates by 15%, rather than by increasing the public debt.	1	2	3	4	5
9. If we have another energy crisis and fuel supplies become short, government should ration fuel rather than let the price rise.	1	2	3	4	5
10. As a measure to increase employment, government policy should allow industry to pay lower electricity rates than homeowners.	1	2	3	4	5

SECTION II

Government energy policy has concentrated upon assisting homeowners to install insulation. The next set of questions relate to your present home, and its level of insulation when you bought it.

a. In what year did you buy this house? _____

b. Which of the following energy conservation features did your house have at the time you first bought it?

1. Storm Doors
   a. NONE
   b. SOME
   c. ALL
   d. CAN'T RECALL
2. Storm Windows
   a. NONE
   b. SOME
   c. ALL
   d. CAN'T RECALL
3. Triple Pane Windows
   a. NONE
   b. SOME
   c. ALL
   d. CAN'T RECALL

4. Weather Stripping on Exterior Doors

   a. NONE

   b. SOME

   c. ALL

   d. CAN'T REMEMBER

5. Weather Stripping on Windows

   a. NONE

   b. SOME

   c. ALL

   d. CAN'T REMEMBER

6. Attic Insulation

   a. NONE OR MINIMAL (SAWDUST, HORSEHAIR, ETC.)

   b. 4" OF FIBERGLASS OR CELLULOSE

   c. 8" OF FIBERGLASS OR CELLULOSE

   d. 10" OF FIBERGLASS OR CELLULOSE

   e. MORE THAN 10" OF FIBERGLASS OR CELLULOSE

   f. DON'T KNOW

7. Wall Insulation

   a. NONE OR MINIMAL (SAWDUST, HORSEHAIR, ETC.)

   b. 4" OF FIBERGLASS OR CELLULOSE

   c. 8" OF FIBERGLASS OR CELLULOSE

   d. 10" OF FIBERGLASS OR CELLULOSE

   e. MORE THAN 10" OF FIBERGLASS OR CELLULOSE

   f. DON'T KNOW

8. Basement Walls

   a. NONE OR MINIMAL (SAWDUST, HORSEHAIR, ETC.)

   b. 4" OF FIBERGLASS OR CELLULOSE

   c. 8" OF FIBERGLASS OR CELLULOSE

   d. 10" OF FIBERGLASS OR CELLULOSE

   e. PARTIAL IN REC-ROOM

   f. DON'T KNOW

   g. NOT APPLICABLE (NO BASEMENT)

9. At the time you bought this home which of the following energy management devices were already installed? Please circle <u>all</u> correct responses.

   a. AUTOMATIC THERMOSTAT (TO CHANGE TEMPERATURES DURING THE DAY)

   b. ATTIC FANS

   c. HUMIDIFIER/DEHUMIDIFIER

   d. HEAT DEFLECTORS OR HOT AIR VENT

   e. AWNINGS ON WINDOWS

   f. OTHER (SPECIFY)_____

<u>SECTION III</u>

Now we would like to ask you what insulation steps you have taken since you bought this house. Please circle the appropriate response in each category.

1. Added or upgraded storm doors

   a. NONE

   b. SOME

   c. ALL

2. Added or upgraded storm windows

   a. NONE

   b. SOME

   c. ALL

3. Added triple pane windows

   a. NONE

   b. SOME

   c. ALL

4. Added or upgraded weather stripping on exterior doors

   a. NONE

   b. SOME

   c. ALL

5. Added or upgraded weather stripping on windows

   a. NONE

   b. SOME

   c. ALL

6. Added or upgraded attic insulation

   a. NONE OR MINIMAL (SAWDUST, HORSEHAIR, ETC.)

   b. 4" OF FIBERGLASS OR CELLULOSE

   c. 8" OF FIBERGLASS OR CELLULOSE

   d. 10" OF FIBERGLASS OR CELLULOSE

   e. MORE THAN 10" OF FIBERGLASS OR CELLULOSE

7. Added or upgraded wall insulation

   a. NONE OR MINIMAL (SAWDUST, HORSEHAIR, ETC.)

   b. 4" OF FIBERGLASS OR CELLULOSE

   c. 8" OF FIBERGLASS OR CELLULOSE

   d. 10" OF FIBERGLASS OR CELLULOSE

   e. MORE THAN 10" OF FIBERGLASS OR CELLULOSE

8. Added or upgraded basement insulation

   a. NONE OR MINIMAL (SAWDUST, HORSEHAIR, ETC.)

   b. 4" OF FIBERGLASS OR CELLULOSE

   c. 8" OF FIBERGLASS OR CELLULOSE

   d. 10" OF FIBERGLASS OR CELLULOSE

   e. NOT APPLICABLE (NO BASEMENT)

9. Please indicate what energy management devices have been installed since you bought this house. (Do not include added or upgraded insulation).

   a. HUMIDIFIER/DEHUMIDIFIER

   b. ADDED ATTIC VENTILATORS AND/OR FANS

   c. AUTOMATIC THERMOSTAT (TO CHANGE TEMPERATURES DURING THE DAY)

   d. DEFLECTORS ON AIR VENTS

   e. AWNINGS ON WINDOWS

   f. FRESH AIR INTAKE TO EXISTING FURNACE

   g. OTHER (SPECIFY)_____

   _____

   _____

   _____

SECTION IV

Now, we would like to get some idea of how much money you have spent on conservation activities and how you financed them.

1. Approximately how much have you spent on energy conservation (Do not include changes to the furnace), on your home since you bought it?

   a. $100 OR LESS

   b. $101 - $250

   c. $251 - $500

   d. $501 - $1,000

   e. $1,001 - $1,500

   f. $1,501 - $2,000

   g. $2,001 - $2,500

   h. OVER $2,500

2. How did you pay for this? (Please circle more than one category if appropriate).

   a. NO EXPENDITURE

   b. SMALL EXPENDITURES OUT OF MONTHLY INCOME

   c. SAVINGS

   d. PERSONAL LOAN FROM BANK, CREDIT UNION OR OTHER SOURCE

   e. MANITOBA GOVERNMENT ENERGY GRANT (PAID ON HYDRO BILL)

   f. CHIP (CANADIAN HOME INSULATION PROGRAM)

   g. OTHER (SPECIFY)_____

      _____

SECTION V

This next section deals with home heating.

1. When you bought this house, what was the main form of heating? (Circle one response).

   a. OIL

   b. NATURAL GAS

   c. ELECTRICITY

   d. PROPANE

   e. WOOD STOVE

   f. COAL FURNACE

   g. OTHER (SPECIFY)_____

      _____

2. At the time you bought this house, how old was the heating system? (Circle one)

   a. LESS THAN 5 YEARS

   b. 6 - 10 YEARS

   c. 11 - 15 YEARS

   d. OVER 15 YEARS

   e. DON'T KNOW

3. What is the main form of home heating used now? (Circle one)

   a. OIL

   b. NATURAL GAS

   c. ELECTRICITY

   d. PROPANE

   e. WOOD

   f. OTHER (SPECIFY)_____

      _____

4. The amount of fuel your family uses is also important. (Please enter or circle the proper response below.)

   a. Approximately how much did you spend on electricity for May 1, 1981 - May 1, 1982?

      _____DOLLARS

   b. Approximately how much did you spend on oil heat?

      i. NOT APPLICABLE

      ii. _____DOLLARS

   c. Approximately how much did you spend on natural gas?

      i. NOT APPLICABLE

      ii. _____DOLLARS

5. How many bedrooms does your home have?

   a. 1

   b. 2

   c. 3

   d. 4

   e. 5

   f. 6 OR MORE

6. What is its approximate square footage to the nearest 100 sq. ft.?

_____

7. What type of house is it?

a. BUNGALOW

b. 1 1/2 STOREY

c. 2 STOREY

d. 3 STOREY

e. BI-LEVEL

f. SPLIT LEVEL

g. OTHER (SPECIFY)_____

8. Does it have a full basement?
(Circle one)

a. YES

b. NO

9. What is the typical setting of the thermostat during the winter?

a. DAY (DEGREES FAHRENHEIT)_____

b. NIGHT (DEGREES FAHRENHEIT)_____

10. What type of water heater do you have?
(Circle one)

a. GAS

b. ELECTRIC

c. OTHER (SPECIFY)_____

11. To the nearest $5,000.00 what is the estimated value of this house?

_____

SECTION VI

Finally, we would like to ask you some questions about your household. This will allow us to compare different households and precisely define to what extent present energy policies work.

1. What are the occupations of the adults (people 18 and over) who are full time residents in this house?

a. ADULT 1 _____

b. ADULT 2 _____

c. ADULT 3 _____

d. ADULT 4 _____

e. ADULT 5 _____

2. What is the highest education level attained by members of this household? (Check appropriate space).

	ADULT 1	ADULT 2	ADULT 3	ADULT 4	ADULT 5
a. ELEMENTARY	___	___	___	___	___
b. HIGH SCHOOL	___	___	___	___	___
c. SOME UNIVERSITY	___	___	___	___	___
d. SOME TECHNICAL SCHOOL	___	___	___	___	___
e. UNIVERSITY GRADUATE	___	___	___	___	___
f. TECHNICAL SCHOOL GRADUATE	___	___	___	___	___

3. Since children add greatly to energy costs please indicate the number of children you have in each age group normally living in your home. (If none, write "0").

_____UNDER 5 YEARS OF AGE

_____5 TO 13 YEARS OF AGE

_____14 TO 18 YEARS OF AGE

7

Many government energy policies are related to family income. To allow us to discover how well these policies are working for you, it is important that we obtain an idea of your family income. Please choose the category below that represents your annual family income, and circle the letter.

a. UNDER $10,000
b. $10,000 - $12,499
c. $12,500 - $14,999
d. $15,000 - $17,499
e. $17,500 - $19,999
f. $20,000 - $22,499
g. $22,500 - $24,999
h. $25,000 - $27,499
i. $27,500 - $29,999
j. $30,000 - $32,499
k. $32,500 - $34,999
l. $35,000 - $37,499
m. $37,500 - $39,999
n. $40,000 - $42,499
o. $42,500 - $44,999
p. $45,000 - $49,999
q. $50,000 - $59,999
r. $60,000 OR OVER

5. With your permission we are able to obtain data on your energy consumption (oil, gas, or electricity). This data can be used to complete the above information. Please initial in the space below if you wish to allow us to obtain this data. Remember, this data is all confidential, and no one, not even the utility company, will be able to connect your answers here with your name and address.

_____INITIALS

Is there anything else you would like to tell us about government energy policies or any of the other questions on this survey? If so, please use this space for that purpose.

Thank you for completing this survey. At the end of the summer you will be sent a report which summarizes the main results. The same report will be sent to members of parliament and of the provincial legislature.

APPENDIX 2

SAMPLE QUALITY AND NON-RESPONSE

Sample Quality

Whenever a survey samples a small percentage of a population, questions arise as to its representativeness. Although the sampling procedure used here (systematic random sampling of the Winnipeg property tax file) is generally robust (it will adequately represent populations even with small sampling proportion) there is the chance that high variances for particular variables may render some, or all of the statistical tests invalid.

In addition to questions of small sample size, the issue of non-response must be addressed. Even if a random sample is drawn, systematic failure in the response can invalidate the analysis. If certain groups fail to respond, then the results will invariably be biased.

This appendix presents analysis on both sample size and non-response. In general, it is concluded that the sample size of 357 out of 504 is sufficient, and only a slight problem with non-response exists.

Sample Size

To evaluate the sample size, a "monte carlo" trial was used. Random samples of 50, 100, 150 and 200 were drawn from the received responses. The coefficients of variation (standard deviation divided by mean) was computed for each variable. If this statistic stabilizes at sample sizes lower than ultimately used for each variable, it is safe to assume that the sample size of 357 is sufficient (provided there is no non-response bias.

Table 1 presents this information for the variables collected in the survey. It is clear that most of the variables stabilize at a sub-sample size of 150, indicating that the sample of 357 is sufficient. It should be noted, however, that analysis does, at times call for special cross-tabulations and cross-classifications. In these instances, sample sizes may prove inadequate. For example, in the analysis of oil to gas conversion, few of the respondents (54) had actually converted. This small proportion weakens considerably the power of tests which seek to discover significant differences between those who do and those who do not convert.

Coefficient of Variation Under Different Subsample Sizes

		n=50	n=100	n=150	n=250	n=357
Q1	CANADIAN OWNERSHIP OF ENERGY INDUSTRY	59.666	53.413	58.240	57.680	57.225
Q2	CANADIANS PAY LOWER FUEL PRICE	55.189	58.509	57.444	57.202	56.834
Q3	GASOLINE TAX JUSTIFIED	44.862	34.998	35.300	35.418	33.455
Q4	FED GOVT SHOULD GET REVENUE	47.328	39.902	39.625	39.809	36.996
Q5	PROV GOVT SHOULD GET REVENUE	53.397	42.507	42.009	44.249	40.579
Q6	BOTH GOVTS SHOULD SHARE REVENUE	52.701	52.204	52.846	51.256	49.932
Q7	GOVT RESPONSIBLE FOR BAD INSULATION	65.291	62.054	62.298	61.907	60.637
Q8	DAMS SHOULD BE PAID FOR BY HIGHER RATE	46.398	43.592	43.040	44.286	42.452
Q9	FUEL RATIONING BETTER THAN PRICE RISE	51.698	52.038	51.975	52.382	50.152
Q10	INDUSTRY SHOULD PAY LOWER ELECT RATES	44.460	40.039	39.324	41.453	40.352
YEAR	YEAR HOUSE PURCHASED	15.281	16.985	16.124	17.208	16.303
STORMD1	STORM DOORS THEN	22.561	24.449	23.964	25.130	25.091
WINDO1	STORM WINDOWS THEN	26.873	27.395	25.733	26.894	28.488
TRIPANE1	TRIPLE PANE WINDOWS THEN	44.284	39.220	39.155	37.013	35.875
DOORS1	WEATHER STRIPPING ON DOORS THEN	29.989	34.993	35.950	36.963	37.842
STRIP1	WEATHER STRIPPING ON WINDOWS THEN	53.984	50.700	50.732	48.639	49.187
ATTIC1	ATTIC INSULATION THEN	69.562	73.726	73.220	72.312	74.045
WALLS1	WALL INSULATION THEN	70.414	75.058	73.144	73.174	73.185
BASE1	BASEMENT WALL INSULATION THEN	85.431	89.761	89.744	89.793	88.805
AUTO1	AUTOMATIC THERMOSTAT THEN	33.902	34.427	34.207	34.007	33.510
FANS1	ATTIC FANS THEN	14.421	12.494	10.945	9.701	10.453
HUM1	HUMIDIFIER/DEHUMIDIFIER THEN	24.755	23.212	23.580	23.363	23.648
DEF1	HEAT DEFLECTORS/VENT THEN	23.744	24.750	24.585	24.795	24.916
AWNING1	AWNINGS ON WINDOWS THEN	14.421	15.291	14.904	16.464	16.174
OTHER1	OTHER ENERGY MANAGEMENT THEN	22.811	22.009	26.754	27.700	25.959
STORMD2	ADDED OR UPGRADED STORM DOORS	69.296	65.795	72.015	70.004	76.241
WINDO2	ADDED OR UPGRADED STORM WINDOWS	101.058	96.345	94.143	90.689	94.022
TRIPANE2	ADDED TRIPLE PANE WINDOWS	0.000	0.000	0.000	0.000	0.000
DOORS2	ADDED OR UPGRADED DOOR STRIPPING	34.587	31.099	31.253	32.756	33.459
STRIP2	ADDED OR UPGRADED WINDOW STRIPPING	86.451	87.345	94.143	92.898	94.979
ATTIC2	ADDED OR UPGRADED ATTIC ISULATION	72.503	59.574	74.166	73.204	73.506
WALLS2	ADDED OR UPGRADED WALL INSULATION	190.205	189.242	185.328	182.309	183.387
BASE2	ADDED OR UPGRADED BASEMENT INSULATION	97.052	85.525	87.740	90.269	94.413
HUM2	ADDED HUMIDIFIER/DEHUMIDIFIER	66.130	72.136	75.251	74.080	72.463
FANS2	ADDED ATTIC FANS	56.766	59.574	60.504	66.414	70.213
AUTO2	ADDED AUTOMATIC THERMOSTAT	33.672	33.501	33.445	36.380	34.672
DEF2	ADDED DEFLECTORS/VENTS	37.302	40.551	44.871	48.333	48.745
AWNING2	ADDED AWNINGS ON WINDOWS	53.648	58.026	58.443	57.696	54.012
FRESHAIR	ADDED FRESH AIR INTAKE TO FURNACE	47.328	43.863	44.871	39.847	41.017
OTHER2	ADDED OTHER ENERGY SAVING DEVICES	46.482	43.434	48.905	43.627	54.108
MONEY	MONEY SPENT FOR ENERGY CONSERVATION	54.997	48.797	49.451	48.854	50.474
NOEXP	NO EXPENDITURE	10.312	7.179	8.247	9.052	9.635
MONTHLY	PAID OUT OF MONTHLY INCOME	28.584	25.582	28.031	28.080	28.648
SAVINGS	PAID OUT OF SAVINGS	32.662	34.958	34.010	33.875	33.775
LOAN	PAID FROM PERSONAL LOAN	10.312	12.429	10.908	12.391	12.529
GRANT	MANITOBA GOVT. ENERGY GRANT	296.361	337.135	323.346	319.028	316.184
CHIP	CANADIAN HOME INSULATION PROGRAM	157.488	151.329	170.717	170.315	169.272
OTHER3	OTHER METHOD OF PAYMENT	20.620	15.228	12.371	17.524	18.835
OLDHEAT	FORM OF HEAT WHEN HOUSE BOUGHT	58.937	59.017	58.683	60.618	60.285
HEATAGE	AGE OF HEATING SYSTEM WHEN HOUSE BOUGHT	59.310	61.989	62.267	63.839	64.234
MAINHEAT	MAIN FORM OF HEAT NOW	14.741	13.633	21.812	18.703	17.040

		n=50	n=100	n=150	n=250	n=357
ELECT	MONEY SPENT ON ELECTRICITY	91.584	76.222	67.691	61.428	57.157
OIL	MONEY SPENT ON OIL	51.426	65.392	49.418	51.039	52.513
NATGAS	MONEY SPENT ON NATURAL GAS	30.905	36.415	35.632	37.648	39.176
ROOMS	NUMBER OF BEDROOMS	20.299	25.906	25.961	25.306	26.039
FEET	SQUARE FOOTAGE OF HOUSE	38.628	38.521	37.153	34.859	36.389
HOUSTYPE	TYPE OF HOUSE	80.807	79.587	77.157	78.445	76.535
BASEMENT		27.550	30.006	27.429	29.828	29.878
DAY	DAY SETTING OF THERMOSTAT	3.742	3.449	3.258	3.261	3.400
NIGHT	NIGHT SETTING OF THERMOSTAT	4.219	4.706	4.731	4.776	4.938
WHEAT	TYPE OF WATER HEATER	33.819	35.072	34.627	34.060	33.722
VALUE	ESTIMATED VALUE OF HOUSE	61.374	52.589	47.367	44.163	43.394
OCCU1		112.354	116.729	119.945	124.707	124.727
OCCU2		155.142	176.190	178.235	181.567	172.547
OCCU3		403.489	378.438	399.861	371.753	377.506
OCCU4		704.672	613.228	647.461	696.780	681.901
OCCU5		.	1000.000	940.025	1578.469	1332.227
ED1		53.278	51.772	51.319	50.856	50.451
ED2		54.570	55.238	56.502	53.753	53.551
ED3		183.851	190.235	201.411	221.510	218.146
ED4		308.965	301.511	344.878	379.033	394.653
ED5		707.107	742.338	730.450	809.870	797.725
CHIL5		243.070	254.404	240.350	248.721	241.317
CHIL13		143.999	156.649	166.979	179.508	176.044
CHIL18		235.702	235.892	250.325	240.561	233.454
INCOME		42.579	42.052	41.930	40.480	39.052
INITIALS		33.672	33.501	33.445	33.536	33.031

Non-Response

In the original design it was hoped to obtain administrative (assessment) data. This is valuable, not only for extending the range of analysis but also allows an evaluation of non-response. When all potential respondents can have data assembled on their characteristics, it is possible to evaluate to what extent responders differ from non-responders. Unfortunately, it was not possible to obtain much objective information prior to the survey, and the analysis must resort to more informal procedures.

The first step was to evaluate the geographical dispersion of the sample. In general, there was no apparent difference between the location of those who responded and those who did not.

The second step was to compare the sample in terms of income and house value to more general data bases. With respect to income (as shown in Table 3, Section V), the distribution of income corresponds to 1980 Revenue Canada data. In addition, the distribution of housing values corresponds to a priori expectation, although no reliable secondary data base exists with which to compare the 1982 data obtained on the survey.

There was an indication that a greater percentage of retired people responded (16%) compared to what would have been expected (some 11%). The sample was separated into two groups and difference of means tests applied to evaluate whether the retired subset is significantly unlike those who were still working. Basic frequency data on the two groups are presented below.

TABLE 2

RETIRED (N=58)	MEAN	STANDARD DEVIATION
INCOME [1]	2.44[2]	1.94
ROOM	2.68	.86
FEET	893.94	627.21
VALUE	47517.24	27980.72
YEAR	57.36	11.86
EDI	2.50[2]	1.55

TABLE 2 CONTINUED

WORKING (N=295)	MEAN	STANDARD DEVIATION
INCOME	5.16	3.00
ROOMS	3.07	.85
FEET	1041.45	631.23
VALUE	56086.44	33965.62
YEAR	69.33	13.23
EDI	2.79	1.75

1. See Appendix 3 for a precise definition of these variables.
2. Rescaled values, see Appendix 3.

Differences in means were tested according to the t test.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s\sqrt{\frac{1}{n_1} \quad \frac{1}{n_2}}}$$

where $s = \sqrt{\frac{(n_1-1)\sigma_{\bar{x}_1} + (n_2-1)\sigma_{\bar{x}_2}}{n_1 + n_2 - 2}}$

where $\sigma\bar{x}1$ is the standard deviation of the relevant populations. As shown below, for all values except education (EDI) the differences in the two groups are significant at the 5% level.

TABLE 3

T Tests of Differences Between Retired and Not Retired

Variable	t Value
INCOME	2.71
ROOMS	42.2
FEET	27.6
VALUE	25.45
YEAR	87.5
EDI	1.6

The next step is to evaluate whether there are significant differences in some of the main conservation activities such as attic insulation. Values of the t test are shown below in Table 4.

TABLE 4

		$t\ \bar{x}_1 - \bar{x}_2\ ^1$
ATTIC1	Attic insulation at time of purchase	- 38.01
ATTIC2	Attic upgrading since purchase	+ 1.46
BASE2	Basement upgrading since purchase	+ .37
WALLS2	Walls upgraded since purchase	+ 20.13
MONEY	Money spent on conservation	+ 23.84

1. Note: a positive t value indicates that retired homeowners did more of the stated activity; negative indicates less of the activity.

Retired homeowners appear to do somewhat more insulation. (Walls and money spent was significantly greater than non-retired homeowners). Furthermore, they had significantly less in the way of attic insulation at time of purchase. Finally, they also spent significantly more on energy conservation.

These results indicate that to the extent that retired homeowners are overrepresented in the sample, the statistical estimates reported in Section VI are biased upward. The extent of this bias is probably slight.

APPENDIX 3

CODEBOOK AND VARIABLE DESCRIPTION

1982 ENERGY SURVEY - CODEBOOK

Variable Name	Explanation
RESNO	Respondant number; an unique number assigned to each potential respondant before the surveys were sent out, and used from then on to identify each respondent. The numbers range from 001 to 503.
Q1	"The energy industry in Canada should be owned by Canadians." Possible responses are: "Strongly Agree" = 1 "Agree" = 2 "Undecided" = 3 "Disagree" = 4 "Strongly Disagree" = 5 No Answer = 0
Q2	"Since Canada has abundant energy supplies, Canadians should pay a lower price for fuel than people in countries where energy is scarce." Possible responses are: "Strongly Agree" = 1 "Agree" = 2 "Undecided" = 3 "Disagree" = 4 "Strongly Disagree" = 5 No Answer = 0
Q3	"The government's present policy of taking 90% of the price of every gallon of gasoline in taxes is justified." Possible responses are: "Strongly Agree" = 1 "Agree" = 2 "Undecided" = 3 "Disagree" = 4 "Strongly Disagree" = 5 No Answer = 0
Q4	"The federal government should get most of this revenue from gasoline." Possible responses are: "Strongly Agree" = 1 "Agree" = 2 "Undecided" = 3 "Disagree" = 4 "Strongly Disagree" = 5 No Answer = 0

Variable Name	Explanation

Q5 "The provincial government should get most of this revenue from gasoline."
Possible responses are:

"Strongly Agree"	= 1
"Agree"	= 2
"Undecided"	= 3
"Disagree"	= 4
"Strongly Disagree"	= 5
No Answer	= 0

Q6 "Both levels of government should share equally in this revenue from gasoline."
Possible responses are:

"Strongly Agree"	= 1
"Agree"	= 2
"Undecided"	= 3
"Disagree"	= 4
"Strongly Disagree"	= 5
No Answer	= 0

Q7 "If government approved insulating material is proved unsafe, then it is the responsibility of the government to pay all costs in making safe a home which is insulated with this product."
Possible responses are:

"Strongly Agree"	= 1
"Agree"	= 2
"Undecided"	= 3
"Disagree"	= 4
"Strongly Disagree"	= 5
No Answer	= 0

Q8 "New dams to produce hydro-electricity should be paid for by increasing hydro rates by 15%, rather than by increasing the public debt."
Possible responses are:

"Strongly Agree"	= 1
"Agree"	= 2
"Undecided"	= 3
"Disagree"	= 4
"Strongly Disagree"	= 5
No Answer	= 0

Variable Name	Explanation

Q9 "If we have another energy crisis and fuel supplies become short, government should ration fuel rather than let the price rise." Possible responses are:

"Strongly Agree"	= 1
"Agree"	= 2
"Undecided"	= 3
"Disagree"	= 4
"Strongly Disagree"	= 5
No Answer	= 0

Q10 "As a measure to increase employment, government policy should allow industry to pay lower electricity rates than homeowners." Possible responses are:

"Strongly Agree"	= 1
"Agree"	= 2
"Undecided"	= 3
"Disagree"	= 4
"Strongly Disagree"	= 5
No Answer	= 0

YEAR "In what year did you buy this house?" Responses are the year in which the respondant's house was purchased, in 2 digits, eg. "82" if the house was bought this year.

No Answer	= 00

STORMD1 "Which of the following energy conservation features did your house have at the time you first bought it?" "1. Storm Doors." Possible responses are:

"None"	= 1
"Some"	= 2
"All"	= 3
"Can't Recall"	= 4
No Answer	= 0

WINDO1 "Which of the following energy conservation features did your house have at the time you first bought it?" "2. Storm Windows." Possible responses are:

"None"	= 1
"Some"	= 2
"All"	= 3
"Can't Recall"	= 4
No Answer	= 0

Variable Name	Explanation
TRIPANE1	"Which of the following energy conservation features did your house have at the time you first bought it?" "3. Triple Pane Windows." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 "Can't Recall" = 4 No Answer = 0
DOORS1	"Which of the following energy conservation features did your house have at the time you first bought it?" "4. Weather Stripping on Exterior Doors." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 "Can't Recall" = 4 No Answer = 0
STRIP1	"Which of the following energy conservation features did your house have at the time you first bought it?" "5. Weather Stripping on Windows." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 "Can't Recall" = 4 No Answer = 0
ATTIC1	"Which of the following energy conservation features did your house have at the time you first bought it?" "6. Attic Insulation." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 "Can't Recall" = 4 No Answer = 0

Variable Name	Explanation

WALLS1 "Which of the following energy conservation features did your house have at the time you first bought it?" "7. Wall Insulation." Possible responses are:

"None or minimal (sawdust, horsehair, etc.)"	= 1
"4 in. of fiberglass or cellulose"	= 2
"8 in. of fiberglass or cellulose"	= 3
"10 in. of fiberglass or cellulose"	= 4
"More than 10 in. of fiberglass or cellulose"	= 5
"Don't Know"	= 6
No Answer	= 0

BASE1 "Which of the following energy conservation features did your house have at the time you first bought it?" "8. Basement Walls." Possible responses are:

"None or minimal (sawdust, horsehair, etc.)"	= 1
"4 in. of fiberglass or cellulose"	= 2
"8 in. of fiberglass or cellulose	= 3
"10 in. of fiberglass or cellulose	= 4
"Partial in rec-room"	= 5
"Don't Know"	= 6
"Not Applicable (no basement)"	= 7
No Answer	= 0

AUTO1 "At the time you bought this home, which of the following energy management devices were already installed?" "a. Automatic thermostat (to change temperatures during the day)." Possible responses are:

"Yes"	= 1
"No"	= 2
No Answer	= 0

Variable Name	Explanation
FANS1	"At the time you bought this home, which of the following energy management devices were already installed?" "b. Attic Fans." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
HUM1	"At the time you bought this home, which of the following energy management devices were already installed?" "c. Humidifier/ Dehumidifier." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
DEF1	"At the time you bought this home, which of the following energy management devices were already installed? "d. Heat deflectors or hot air vents." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
AWNING1	"At the time you bought this home, which of the following energy management devices were already installed?" "e. Awnings on windows." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
OTHER1	"At the time you bought this home, which of the following energy management devices were already installed?" "f. Other (specify)." Possible responses are: "No" = 2 "Fresh Air Intake to Furnace" = 3 "Space Heater" = 4 "Insulated Blinds" = 5 "Wood-burning stove" = 6 "Other" = 8 No Answer = 0

Variable Name	Explanation
STORMD2	"What insulation steps have you taken since you bought this house?" "1. Added or upgraded storm doors." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 No Answer = 0
WINDO2	"What insulation steps have you taken since you bought this house?" "2. Added or upgraded storm windows." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 No Answer = 0
TRIPANE2	"What insulation steps have you taken since you bought this house?" "3. Added triple pane windows." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 No Answer = 0
DOORS2	"What insulation steps have you taken since you bought this house?" "4. Added or upgraded weather stripping on exterior doors." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 No Answer = 0
STRIP2	"What insulation steps have you taken since you bought this house?" "5. Added or upgraded weather stripping on windows." Possible responses are: "None" = 1 "Some" = 2 "All" = 3 No Answer = 0

Variable Name	Explanation
ATTIC2	"What insulation steps have you taken since you bought this house?" "6. Added or upgraded attic insulation." Possible responses are: "None or minimal (sawdust, horsehair, etc.)" = 1 "4 in. of fiberglass or cellulose" = 2 "8 in. of fiberglass or cellulose = 3 "10 in. of fiberglass or cellulose = 4 "More than 10 in. of fiberglass or cellulose" = 5 No Answer = 0
WALLS2	"What insulation steps have you taken since you bought this house?" "7. Added or upgraded wall insulation." Possible responses are: "None or minimal (sawdust, horsehair, etc.)" = 1 "4 in. of fiberglass or cellulose" = 2 "8 in. of fiberglass or cellulose" = 3 "10 in. of fiberglass or cellulose" = 4 "More than 10 in. of fiberglass or cellulose" = 5 No Answer = 0
BASE2	"What insulation steps have you taken since you bought this house?" "8. Added or upgraded basement insulation." Possible responses are: "None or minimal (sawdust, horsehair, etc.)" = 1 "4 in. of fiberglass or cellulose = 2 "8 in. of fiberglass or cellulose = 3 "10 in. of fiberglass or cellulose = 4 "Not applicable (no basement)" = 5 No Answer = 0

Variable Name	Explanation
HUM2	"Indicate what energy management devices have been installed since you bought this house." "a. Humidifier/Dehumidifier." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
FANS2	"Indicate what energy management devices have been installed since you bought this house." "b. Attic ventilators and/or fans." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
AUTO2	"Indicate what energy management devices have been installed since you bought this house." "c. Automatic thermostat (to change temperatures during the day)." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
DEF2	"Indicate what energy management devices have been installed since you bought this house." "d. Deflectors on air vents." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
AWNING2	"Indicate what energy management devices have been installed since you bought this house." "e. Awnings on windows." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
FRESHAIR	"Indicate what energy management devices have been installed since you bought this house." "f. Fresh air intake to existing furnace." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0

Variable Name	Explanation
OTHER2	"Indicate what energy management devices have been installed since you bought this house." "g. Other (specify)." Possible responses are: "No" = 2 "Aluminum Siding" = 3 "Fireplace" = 4 "Plastic on Windows in Winter" = 5 "Wood-burning Stove" = 6 "Solar Collector" = 7 "Other" = 8 No Answer = 0
MONEY	"Approximately how much have you spent on energy conservation (Do not include changes to the furnace), on your home since you bought it?" Possible responses are: "$100 or less" = 1 "$101 to $250" = 2 "$251 to $500" = 3 "$501 to $1,000" = 4 "$1,001 to $1,500" = 5 "$1,501 to $2,000" = 6 "$2,001 to $2,500" = 7 "Over $2,500" = 8 No Answer = 0
NOEXP	"How did you pay for this?"* "a. No expenditure." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
MONTHLY	"How did you pay for this?"* "b. Small expenditures out of monthly income." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
SAVINGS	"How did you pay for this?"* "c. Savings" Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0

* refers to variable: "MONEY"

Variable Name	Explanation
LOAN	"How did you pay for this?"* "d. Personal loan from bank, credit union, or other source." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
GRANT	"How did you pay for this?"* "e. Manitoba Government Energy Grant (Paid on Hydro Bill)." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
CHIP	"How did you pay for this?"* "f. Chip (Canadian Home Insulation Program)." Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
OTHER3	"How did you pay for this?"* "g. Other (specify)." Possible responses are: "No" = 2 "Manitoba Housing Renewal Corp. grant" = 3 "Financial help from family" = 5 "Other" = 6 No Answer = 0
OLDHEAT	"When you bought this house, what was the main form of heating?" Possible responses are: "Oil" = 01 "Natural Gas" = 02 "Electricity" = 03 "Propane" = 04 "Wood Stove" = 05 "Coal Furnace" = 06 No Answer = 00

*refers to variable: "MONEY"

Variable Name	Explanation

HEATAGE — "At the time you bought this house, how old was the heating system?"
Possible responses are:

"Less than 5 years"	= 1
"6-10 years"	= 2
"11-15 years"	= 3
"over 15 years"	= 4
"Don't know"	= 5
No Answer	= 0

MAINHEAT — "What is the main form of heating used now?"
Possible responses are:

"Oil"	= 1
"Natural Gas"	= 2
"Electricity"	= 3
"Propane"	= 4
"Wood"	= 5
No Answer	= 0

ELECT — "Approximately how much did you spend on electricity for May 1, 1981 to May 1, 1982?"
Possible responses are the dollar figure spent on electricity during this period, coded as four digits. eg. $300 = 0300. No Answer = 0000. Not applicable = 0099.

OIL — "Approximately how much did you spend on oil heat?"
Responses are the dollar figure spent on oil for May 1, 1981 to May 1, 1982, coded in four digits eg. $600 = 0600. Not applicable = 0099 No Answer = 0000.

NATGAS — "Approximately how much did you spend on natural gas?"
Responses are the dollar figure spent on natural gas for May 1, 1981 to May 1, 1982, coded in four digits eg. $500 = 0500. Not applicable = 0099. No Answer = 0000.

ROOMS — "How many bedrooms does your home have?"
Possible responses are:

"1"	= 1
"2"	= 2
"3"	= 3
"4"	= 4
"5"	= 5
"6 or more"	= 6
No Answer	= 0

Variable Name	Explanation
FEET	"What is its (your home's) approximate square footage to the nearest 100 sq. ft.?" Responses are the number of sq. ft. the respondant estimates his/her home to be (many are not to the nearest 100 sq. ft.), coded as 5 digits, eg. 2500 sq. ft = 02500. No Answer = 00000.
HOUSTYPE	"What type of house is it?" Possible responses are: "Bungalow" = 01 "1 1/2 Storey" = 02 "2 Storey" = 03 "3 Storey" = 04 "Bi-level" = 05 "Split-level" = 06 "2 1/2 Storey" = 07 "Shanty/shack" = 08 No Answer = 00
BASEMENT	"Does it (your house) have a full basement?" Possible responses are: "Yes" = 1 "No" = 2 No Answer = 0
DAY	"What is the typical setting of the thermostat during the winter? Day:" Responses are the respondent's estimate of the daytime thermostat setting, coded in degrees Fahrenheit, eg. 70 degrees =70. No answer = 00. (Responses in celsius were converted to Fahrenheit for coding).
NIGHT	"What is the typical setting of the thermostat during the winter? Night:" Responses are the respondent's estimate of the nighttime thermostat setting, coded in degrees farenheit, eg. 70 degrees = 70. No Answer = 00. (Respondes in celsius were converted to Fahrenheit for coding).
WHEAT	"What type of water heater do you have?" Possible responses are: "Gas" = 1 "Electric" = 2 No Answer = 0
VALUE	"To the nearest $5,000.00, what is the estimated value of this house?" Responses are the respondant's estimate of the value of his/her house (not always to the nearest $5,000.00), coded in seven digits, eg. $250,000 = 0250000. No Answer = 0000000.

Variable Name	Explanation

OCCU1
OCCU2
OCCU3
OCCU4
OCCU5

"What are the occupations of the adults who are full time residents in this house? Adult 1, Adult 2, Adult 3, Adult 4, Adult 5. Responses are the occupations stated by the respondants as being held by the first, second, third, fourth, and fifth adults in the household. Where there were less than five adults, a blank was left by the respondant and coded as 0000. Codes for occupations are 4 digit 1980 CCDO codes, with some modifications. Modifications are:

"Invalid"	= 0001
"Housewife"	= 0002
"Retired"	= 0003
"Unemployed"	= 0004
"Student"	= 0005
"Occupation not clearly specified"	= 0007
"Volunteer"	= 0008

Other modifications were made when occupations were not specified in enough detail to be exactly matched to CCDO numbers. For example, in the survey a teacher of any type was assigned the code 2733, unless the type of teacher was specified by the respondant, although 2733 actually stands for "secondary school teacher." These modifications are:

"All engineers, unless otherwise specified"	= 2143
"All teachers unless otherwise specified"	= 2733
"Executive or Manager"	= 1130
"Civil Servant - (Fed. Prov. or Municipal)"	= 1113
"Mechanic"	= 8581
"Sales"	= 5135
"Sales Clerk"	= 5137
"Clerk, unless otherwise specified"	= 4197
"Labourer"	= 8718
"Construction Worker"	= 8798
"Nurse, unless otherwise specified"	= 3131

All of these modifications are very close to the CCDO designations. Any occupation not listed here is coded with its correct CCDO number. No Answer = 0000.

Variable Name	Explanation
ED1 ED2 ED3 ED4 ED5	"What is the highest education level attained by members of this household?" ED1 represents the level of education stated for the first adult, ED2 for the second, and so on up to ED5. Possible responses are: "Elementary (grades 0-7 or less)" = 1 "High School (grades 8-12 or high school graduate)" = 2 "Some university" = 3 "Some technical school" = 4 "University graduate" = 5 "Technical school graduate" = 6 No Answer, or variable left blank because there are less than 5 adults = 0
CHIL5	"Indicate the number of children you have in each age group normally living in your home. Under 5 years of age:" Responses are the number of children in the "under 5" age group living at the home, eg. "2 children" = 2. No answer, or no children in this age group = 0.
CHIL13	"Indicate the number of children you have in each age group normally living in your home. 5 to 13 years of age:" Responses are the number of children in the "5 to 13" age group living at the home, eg. "2 children" = 2. No answer, or no children in this age group = 0.
CHIL18	"Indicate the number of children you have in each age group normally living in your home. 14 to 18 years of age:" Responses are the number of children in the "14 to 18" age group living at the home, eg. "2 children" = 2. No answer, or no children in this age group = 0.

Variable Name	Explanation

INCOME

"Please choose the category below that represents your annual family income."
Possible responses in the original data are:

"under $10,000"	= 01
"$10,000 - $12,499"	= 02
"$12,500 - $14,999"	= 03
"$15,000 - $17,499"	= 04
"$17,500 - $19,999"	= 05
"$20,000 - $22,499"	= 06
"$22,500 - $24,999"	= 07
"$25,000 - $27,499"	= 08
"$27,500 - $29,999"	= 09
"$30,000 - $32,499"	= 10
"$32,500 - $34,999"	= 11
"$35,000 - $37,499"	= 12
"$37,500 - $39,999"	= 13
"$40,000 - $42,999"	= 14
"$42,500 - $44,999"	= 15
"$45,000 - $49,999"	= 16
"$50,000 - $59,999"	= 17
"$60,000 or over"	= 18
No Answer	= 00

Although the data appear in the above form in the database, an "if: then" statement has altered the categories for analytical purposes. The new categories for possible responses are:

"under $10,000"	= 01
"$10,000 - $14,999"	= 02
"$15,000 - $19,999"	= 03
"$20,000 - $24,999"	= 04
"$25,000 - $29,999"	= 05
"$30,000 - $34,999"	= 06
"$35,000 - $39,999"	= 07
"$40,000 - $44,999"	= 08
"$45,000 - $49,999"	= 09
"$50,000 - $59,999"	= 10
"$60,000 or over"	= 11
No Answer	= 00

INITIALS

With your permission, we are able to obtain data on your energy consumption (oil, gas, or electricity). This data can be used to complete the above information. Please initial in the space below if you wish to allow us to obtain this data.
Possible responses are the placing of the respondant's initials in the space = 1, or leaving the space blank (no initials) = 2.
All responses are coded as either 1 or 2.

Variable Name	Explanation
SEDEX	SEDEX is a variable which did not appear on the survey itself but was included in the data later. SEDEX stands for socio-economic index. The index used is from "A Revised Socio-economic Index for Occupations in Canada" by Bernard R. Blishen and Hugh A. McRoberts, in the Canadian Review of Sociology and Anthropology 13 (1) 1976. The scale is based on income, educational level, and prestige for occupations broken down by the CCDO. It is only an approximation like all scales of this sort but should be adequate for certain types of analysis. The SEDEX number was assigned according to the occupation given by the survey respondant for "Adult 1", since in most cases it can be assumed that the person listed as Adult 1 is the person who is considered the "family head" and thus has the largest part in determining the socio-economic position of the family. The scale used ranges from approximately 18.0 to approximately 75.0, with socio-economic position rising as the numbers on the scale rise. For more information on the index and its use, the researcher should refer to the above-mentioned article. Where no occupation was given by the respondant, or where no index number was obtainable for some other reason, SEDEX was coded as 00.0. Otherwise it was coded as the scale itself, eg. 27.4.
OILTOGAS	A variable created to separate those respondants who have converted their heating systems from oil to natural gas. It is equal to "1" if OLDHEAT = 01 and MAINHEAT = 2 (ie. the respondant had oil when the house was purchased and now has natural gas). Otherwise it is equal to "0".