IMPOSED CHOICE PURCHASES OF ENERGY USING EQUIPMENT FOR INSTALLATION IN NEW HOUSING

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The views presented in this paper are those of the author and do not necessarily reflect the views or positions of the Department of C.C.A.

PREFACE

This study of the decision making processes used by builders in their purchases of energy using equipment for the residential sector was carried out with the support of the Consumer Research and Evaluation Branch, Consumer and Corporate Affairs Canada. Special thanks are due to Dr. John Evans, Mr. Lee McCabe, and Mr. Carman Cullen for their encouragement and guidance.

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ABSTRACT

This report contains the findings of an investigation into the decision making processes used by intermediaries, such as builders and utilities, in their purchases of energy using equipment for installation in new housing. In addition to reporting the results of clinical and survey research in this area, the study evaluates alternative policy options in terms of the likelihood of their implementation leading to reduced energy consumption in the residential sector.

The report considers three categories of energy using equipment: water heaters, furnaces and space heating equipment, and major kitchen and laundry appliances. In each case, market and technological trends are reviewed together with estimates of the annual energy consumption attributable to "imposed choice" purchases made by intermediaries for installation in new housing. The decision making processes and criteria used by intermediary purchasers are discussed for each of the three equipment categories.

The report concludes that the energy consumed by imposed choice equipment purchases is a highly significant component of total residential sector consumption. However, builders currently make their purchase selections principally on the basis of price and reliability, with little or no attention paid to comparative energy performance.

To encourage purchases of more energy efficient equipment, it is recommended that policymakers work primarily to upgrade product standards to reflect technological improvements which can contribute to greater energy efficiency, and also work to incorporate these upgraded product standards in national, provincial, and municipal building codes. It is also recommended that, in addition to supporting the educational efforts of builder trade associations, the Federal Government further investigate the feasibility of energy performance labelling for water heaters, furnaces, and space heating equipment. The use of financial incentives and disincentives to encourage purchases of more energy efficient equipment is not recommended.

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Chapter 1: EXECUTIVE SUMMARY

This study focuses on purchases of three categories of energy using equipment for installation in new housing. These equipment categories are water heaters, furnaces and space heating equipment, and major kitchen and laundry appliances. Emphasis is placed upon purchases made by intermediaries such as builders and utilities rather than upon purchases made by individual consumers at the retail level. For this reason, the equipment purchases discussed in this study are characterized as "imposed choice" purchases, meaning that they are selected by intermediaries and imposed upon the purchasers or tenants of new housing units.

The major objectives of the study were to estimate the annual level of energy consumption accounted for by imposed choice purchases of the three equipment categories; to investigate the decision making processes and criteria used by builders and other intermediaries when making imposed choice purchases; and to assess on a preliminary basis the merits of alternative public policy interventions designed to encourage the specification of more energy efficient equipment in imposed choice purchase decisions. Field research of both a clinical and survey nature was undertaken to address these objectives.

The principal conclusions of the study are:

1. The annual energy consumption of equipment purchased in 1978 on an imposed choice basis represents 48 percent of the energy consumption attributable to all 1978 purchases of equipment across the three sepcified product categories. In addition, the annual energy consumption of 1978 imposed choice purchases represents 3.1 percent of total secondary energy consumption within the residential sector.

2. Energy saving design modifications for all three categories of equipment have been and will continue to be researched and developed. However, commercialization of the more energy efficient models may be slowed by manufacturer perceptions of the risks involved in new product introductions, and by uncertainty regarding the willingness of purchasers to pay higher prices for more energy efficient models.

3. In the case of some imposed choice purchases for which builders are financially responsible, other parties may

select the equipment. Plumbing contractors and consulting engineers (in the case of apartment buildings) may be involved in the selection of water heating equipment. Heating and electrical contractors and consulting engineers may be involved in the selection of space heating equipment.

4. Builders regard price and reliability as the most important selection criteria for purchases of all three categories of equipment. The comparative energy efficiency of equipment options is almost never considered.

5. The price sensitivity of the builder results in corresponding price sensitivity at all other levels in the channel of distribution. For example, plumbing wholesalers and plumbing, heating, and mechanical contractors also buy equipment on a price basis; even though they may be knowledgeable about the relative energy efficiency of different equipment options, competition for builder business is such that price remains the overriding consideration.

6. The energy using equipment required for installation in new homes is fairly standardized. In a mature market situation of this nature, manufacturers commonly compete on the basis of price and delivery. Operating on narrow margins, they have few resources available for investment in new product research, development, and introductions. The larger manufacturers, however, regard the introduction of more energy efficient models positively as a means of achieving higher unit margins.

7. If introduced, energy efficient models are expected to receive earlier adoption in the replacement market (where consumers and plumbing or heating contractors are principally responsible for decision making) than in the new housing market (where price sensitive builders are primarily responsible for decision making). As consumers purchase these models in the replacement market, some builders may be encouraged to install them in new housing for promotional purposes in the same way as some builders have used insulation as a selling aid. However, builders frequently order energy using equipment for new housing developments in bulk quantities direct from the manufacturer; they do not wish to risk installing new, relatively untried equipment, particularly when it is more expensive and they doubt their ability to pass on the incremental cost to <u>all</u> potential buyers of their housing units.

8. With respect to public policy interventions designed to reduce the energy consumption accounted for by the three

categories of equipment addressed in this study, builder respondents to the survey ranked raising energy efficiency performance standards and tax credits for purchases of energy efficient equipment as likely to promote the most energy savings. Information programs of a general and brand specific nature were ranked next, followed by a graduated sales tax on energy using equipment according to level of efficiency.

9. Despite builder interest in a tax credit program, the use of financial incentives and disincentives to influence imposed choice purchases is not recommended. Builders are unlikely to incorporate energy efficiency considerations in their purchase decision making as a result of financial incentives, such as tax credits related to the energy performance ratings of the equipment which they purchase. The costs of energy using equipment preinstalled in new housing are about five percent of total construction costs. Any tax credits are likely to be too small to persuade the builder to devote additional time to the decision making process with respect to these equipment purchases. To achieve an adequate incentive, it might be necessary to set the tax credit at a level above the value of the energy savings achieved through the specification of a more energy efficient equipment option. An additional incentive would exist if the builder believed that he could pass on to a home buyer any incremental costs associated with the purchase of more energy efficient equipment as well as gain the tax credit.

Other problems associated with implementing this policy option in addition to setting the appropriate incentive schedule include:

a. There is no clear relationship within a particular product category between the energy efficiency of equipment options and their prices. Any tax credit would have to be related to each model's energy performance rating rather than to the retail price. The builder, accustomed to purchasing on a price basis, might find this approach more complex and, therefore, less appealing.

b. A tax credit might encourage manufacturers to price their energy efficient models higher than would otherwise be the case because, if adopted, the tax credit could reduce the builder's price sensitivity.

c. A tax credit program would probably have to be available to consumers as well as to builders, otherwise builders

might attempt to establish themselves as unofficial intermediaries between manufacturers and end consumers interested in buying energy efficient models. Administrative costs of the program would increase greatly if it were applicable to consumers as well as to builders.

d. In order for any tax credit scheme to be implemented, brand specific information of the type required for an energy labelling program would have to first be generated.

Tax credits have been used with some success as incentives to consumers to purchase insulation. However, in this case, the objective has been to persuade consumers to purchase the product -- a much less complex objective than to persuade consumers to purchase a more energy efficient brand within a product category as would be the objective in the cases of water heaters, furnaces and space heating equipment, and kitchen and laundry appliances.

10. Builders are unlikely to treat energy efficiency as a more important purchase criterion solely in response to general information programs sponsored by the Federal Government. In the area of general information programs, it is recommended that any Federal Government action:

a. Be taken in cooperation with the Housing and Urban Development Association of Canada (and, in Quebec, with the Provincial Home Builders Association) to maximize source credibility, to insure effective information delivery, and to insure consistency of the information communicated with that supplied to builders through other trade association information programs.

b. Recognize that there may be actions other than the purchase of energy efficient equipment which builders might take when designing and constructing new residential housing offering potentially greater energy savings. Information regarding the energy performance of equipment options should, therefore, be incorporated into a broader information program dealing with all aspects of housing design and construction related to energy conservation.

c. Be supportive of the efforts of the Canadian Electrical Association to develop a Certification Program for Energy Efficient Homes which would incorporate certain standards for the efficiency of preinstalled energy using equipment and which could, if implemented, sensitize consumers to acquiring a home with this Certification. Through consequent market pressures, builders might be encouraged

to specify energy using equipment with a view to insuring that their new homes received the Certification.

11. An energy performance labelling program for water heaters, furnaces and space heating equipment, and major kitchen and laundry appliances (such as the Energuide program) should not be expected to directly impact upon the decision making processes of builders. Builders do not commonly see the equipment which they buy prior to purchase, as consumers do when comparing brand alternatives in a retail store. There are, nevertheless, several arguments in favor of an energy performance labelling program:

a. To the extent that the salience of energy efficiency as a purchase criterion is increased among consumers as a result of energy labelling, market pressures may prompt builders to consider energy efficiency as well as price in their purchase decision making.

b. Labelling programs would require manufacturers to develop (in accordance with standardized test procedures) brand specific energy performance information of the type necessary for any general information tax credit or graduated sales tax program. In other words, brand specific energy performance information is a necessary prerequisite for the effective implementation of a wide range of other policy interventions.

c. An energy performance labelling program may be expected to prompt equipment manufacturers to closely scrutinize the energy performance of their existing models. Labelling would probably accelerate the introduction and aid the marketing of more energy efficient models.

Any energy performance labelling program would be applicable to all models manufactured for both the builder and retail segments of the market. Therefore, such a program must be evaluated in terms of impact upon brand options and purchases in the total market (including new and replacement purchases by consumers) rather than in the "imposed choice" segment alone.

12. The Federal Government can most effectively facilitate the purchase of more energy efficient equipment by builders through:

a. Developing equipment performance standards which place a greater emphasis on energy efficiency, and insuring that such standards are incorporated into the National and Provincial Building Codes as rapidly as possible with the proviso that Canadian equipment manufacturers have adequate time for necessary retooling to meet these

upgraded standards (such that increased dependence on imported equipment does not result). Higher performance standards would apply to all equipment, destined for both the retail and builder segments of the market. Procedures for setting standards are already in place. Manufacturers are familiar with and responsive to the concept of upgrading standards for energy efficiency. Builders have few objections to the principle of setting standards for energy using equipment or of incorporating such standards in building codes; since compliance is mandatory, no builder is placed at a competitive disadvantage in terms of his construction and equipment costs.

b. Raising the salience of energy conservation among consumers, educating them towards a greater understanding of the percentages of residential sector consumption accounted for by space heating, water heating, and major appliances. Consumer education should emphasize the energy savings which can accrue from regular equipment maintenance, and thereby reduce some of the "mystery" associated with furnaces and water heaters. If successful, such an education program could raise the salience of energy efficiency as a decision making criterion for consumers in the replacement market. As a result, consumers purchasing new homes may increasingly question builders on the energy efficiencies of preinstalled equipment and treat the quality of this equipment as an indicator of the overall quality of the dwelling - thereby prompting some builders to install the more energy efficient models.

13. In two specific areas, the Federal Government can attempt to directly influence imposed choice purchases of energy using equipment:

a. Government procurement contracts for energy using equipment to be installed in new public housing could include energy performance specifications. All residential construction financed under the National Housing Act could also be required by the C.M.H.C. to have equipment installed which meets these specifications.

b. The utilities (particularly the gas utilities) sell or rent energy using equipment preinstalled in new housing and available in the replacement market. Federal and Provincial Governments can, through moral suasion and other forms of leverage, attempt to persuade the utilities to become early adopters of the more energy efficient models as they appear on the market.

Chapter II: INTRODUCTION

A. Residential Sector Energy Consumption and "Imposed Choice" Purchases

The residential sector accounts for approximately twenty percent of total secondary energy consumption in Canada.[1] Although this proportion has been slowly declining, energy conservation scenarios view the residential sector as an area where substantial incremental energy savings can be made.[2]

Space heating and water heating comprise seventy percent and eighteen percent respectively of total residential energy consumption.[3] Major kitchen and laundry appliances are assumed to account for eight percent of consumption, the remaining four percent being consumed by other household appliances and lighting.

Hitherto, the efforts of public policymakers to reduce energy consumption in the residential sector have generally addressed the individual homeowner or tenant. Publications from the Office of Energy Conservation such as 100 Ways to Save Energy advise consumers on how to use and maintain energy using equipment with a view to minimizing consumption. And with the advent of the Energuide Labelling Program, consumers now have information which enables them to discriminate among alternative brands of a particular appliance on the basis of energy consumption.

A significant percentage of residential sector energy consumption stems from equipment in the purchase of which the consumer or end user is not involved. New housing is sold or rented to consumers with space heating and water heating equipment preinstalled by the builder, subcontractor, or utility. In some cases, certain kitchen and laundry appliances may also be preinstalled in new housing. With the exception of a small number of custom-built houses, the purchaser or tenant is unlikely to influence the decision making processes for preinstalled energy using equipment. Similarly, landlords rather than tenants are likely to be principally responsible for the replacement of existing energy using equipment in rental accommodation.

These equipment decisions in which the role of the ultimate consumer is limited or non-existent may be characterized as "imposed choice" purchases. Examples of imposed choice purchase decisions may be identified beyond the residential sector. Fleet purchases of automobiles by car rental companies, for example,

limit the range of rental options available to the consumer. Imposed choice purchases vary in the degree to which consumer choice is limited, and in the degree to which the consumer can compensate for the constraints on choice by controlling the level of energy used by the equipment. In a modern apartment building, for example, the temperature level maintained by the space heating system is likely to be centrally controlled by building management. At the same time, the frequency and manner in which a stove is used is totally at the discretion of the tenant.

B. Research Objectives

The following principal objectives were established for the study:

1. To determine the number of imposed choice purchases of energy using equipment installed in new Canadian housing in 1978, and to estimate the annual energy consumption of this equipment.

2. To investigate the decision making processes resulting in imposed choice purchases of energy using equipment for new housing. The decision making processes for three categories of equipment were studied: water heaters, furnaces and space heating equipment, and major kitchen and laundry appliances. The principal elements of the decision making process analyzed in each case were:
   a. Whether or not to make an imposed choice purchase of a particular equipment type.
   b. What fuel to specify for equipment once the decision to make an imposed choice purchase is made.
   c. What brand and type of equipment to purchase.

3. To establish the relative importance of energy consumption versus other product attributes in influencing the decision making process for each category of imposed choice equipment purchases.

4. To assess, on a preliminary basis, the merits of alternative public policy interventions designed to encourage imposed choice purchases of more energy efficient equipment for new housing.

C. Scope of the Study

The following limitations on the scope of the study should be noted:

1. Three principal categories of equipment are addressed - furnaces and space heating equipment, water heaters, and major kitchen and laundry appliances. Within the third of

these categories, the study examines purchases of stoves, refrigerators, dishwashers, washing machines, and clothes dryers. Other appliances (such as freezers and window air conditioners) for which the annual numbers of imposed choice purchases are extremely low are not treated.

2. The study focuses on imposed choice purchases for new housing units. It is true that replacement equipment purchases of an imposed choice nature are made by landlords for existing rental housing. The nature of these imposed choice purchases in the replacement market for each of the three categories of equipment is briefly discussed. The emphasis of the study, however, is on builder purchases and installations in new housing.

3. A second and less significant category of imposed choice purchases not extensively discussed in the study is the purchase of commercial grade laundry appliances for installation in apartment buildings. These purchases are frequently made not by the builder but by a laundry equipment specialist with whom the builder contracts the operation of the apartment building laundry room.

4. There are numerous approaches available to reduce energy consumption in new residential housing in addition to influencing purchases of energy using equipment as defined above. The nature of building construction and design, the level of insulation, and the quality of weather stripping and caulking all impact upon the energy consumption of the home. These and other factors are summarized by Knelman (1975).[4] This study makes no attempt to conduct a comparative cost-benefit analysis of attempting to influence builder decisions in these areas versus builder decisions with respect to purchases of energy using equipment. Nor are the interactive effects on domestic energy consumption resulting from the mutual influence of equipment purchases and other aspects of construction considered.

5. This study does not address the impact on residential energy consumption of the manner in which consumers use imposed choice energy using equipment following installation.

6. Current and future technological developments designed to increase the energy efficiency of each equipment category are briefly discussed to clarify the likely availability of more energy efficient equipment options in the future.

Despite these limitations, the study does not focus exclusively on the perspective of the builder in the imposed choice purchase

process. It is possible that policymakers can influence the builders' decision making process by applying leverage at some other point in the channel of distribution from manufacturer to end consumer. Consequently, an attempt is made to apply a channel system approach to the formulation of policy recommendations by exploring the perspectives of other parties in addition to those of builders.

Notes to Chapter II

1. In its review of Detailed Energy Supply and Demand in Canada for 1975, Statistics Canada documented Domestic and Farm energy consumption of 1,162,693 billion B.T.U. representing 19.75 percent of total secondary energy consumption of 5,886,210 billion B.T.U. (Catalogue 57-505, p. 27).

2. Cited in Energy, Mines, and Resources Canada, Energy Conservation in Canada: Programs and Perspectives, Report EP77-7, 1977, p. 11.

3. Op. cit., p. 17.

Chapter III: RESEARCH METHODOLOGY

A. Overview

In the absence of published material regarding imposed choice purchases of energy using equipment for new housing, the nature of the research undertaken for this study was necessarily descriptive. Field interviews and a mail questionnaire were the two principal approaches used in addition to an investigation of secondary data sources. Figure III-1 diagrams the sequential research process undertaken for this study.

B. Phase 1: Preliminary Interviews with Builders

A series of field and telephone interviews was first conducted with three building firms headquartered in the London, Ontario, area. The principal purpose was to explore, on a preliminary basis, the decision making criteria and processes used by builders in determining the energy using equipment to be preinstalled in their new housing units. Both small and large firms were interviewed. One of the firms was a builder-landlord responsible for multiple unit (apartment) as well as single family dwelling developments.

The original research proposal called for a depth analysis of the decision making processes used to select energy using equipment for a small sample of new housing developments, of both the multiple unit and single family dwelling varieties. Case studies of particular developments proved to be unnecessary since:

1. Executives of the three building firms were readily able to indicate the standardized procedures used to specify energy using equipment. These procedures appeared to vary only as a function of the size and type of development.

2. The decision making processes were found to be considerably less complex than anticipated. For example, certain professional groups (architects and consulting engineers) were found to exert minimal influence on the specification of energy using equipment. Given the apparent simplicity of the decision making process, it was decided that detailed case studies of particular equipment selection decisions for new housing developments were not necessary.

C. Phase 2: Preliminary Questionnaires

Sufficient information was obtained from the initial builder interviews to warrant the development of a survey instrument designed to elicit from a broader sample the information required to answer the study objectives. The instrument was exploratory in nature and, accordingly, included several open-ended response questions. It was mailed with a personally signed cover letter to eight building firms of varying sizes (in terms of numbers of units constructed annually) in Ontario during August, 1978. The firms were randomly selected from a trade directory. Because the questionnaire was particularly lengthy, recipients of the instrument were telephoned one week after the mailing in order to clarify the purpose of the study, to explain that the questionnaire was exploratory and therefore a preliminary version, and to encourage their response. Six responses were received, providing useful qualitative information. These responses also helped to determine the content, structure, and length of the mail questionnaire described in Phase 4.

Simultaneously, a preliminary questionnaire was developed and mailed to eight equipment manufacturers. It was believed necessary to ascertain the degree to which equipment options currently on the market within each product category varied in terms of energy usage, and the degree to which anticipated product development was likely to influence the level of inter-brand differentiation on energy efficiency. In addition, the questionnaire to manufacturers explored their perceptions of the decision making processes used by builders to select the energy using equipment preinstalled in new housing units. A similar telephone follow-up was conducted, and six responses were received.

D. Phase 3: In-Depth Field Interviews

Responses to the preliminary questionnaires, particularly to the open-ended questions, suggested that the decision making process leading to selections of energy using equipment for new housing varied by equipment category and by type of housing. It was decided that these variations warranted further field research prior to any nationwide survey of builders being undertaken.

In addition, the previous two phases of the research suggested that, in order to arrive at appropriate and implementable policy recommendations, attention should be paid to the attitudes and motivations of all the parties involved in the distribution of

energy using equipment for installation in new housing including equipment manufacturers, plumbing, heating, and mechanical contractors, utilities, and trade associations, as well as builders.

Accordingly, in-depth field interviews were conducted in Ontario and Quebec with:

- Three major manufacturers of kitchen and laundry appliances.
- One major manufacturer of furnaces and space heating equipment.
- A major gas utility and a major electric utility.
- Two plumbing and heating contractors.
- Equipment manufacturer, utility, and builder trade associations.

Field interviews were also conducted with officials and scientists of Energy, Mines, and Resources Canada. Telephone interviews were conducted with executives of trade associations and manufacturers not scheduled for in-depth field interviews, as well as with officials of Statistics Canada and the Central Mortgage and Housing Corporation.

As a result of the field research conducted during Phase 3:

1. A variety of perspectives was obtained from all channel system members on the decision making processes for imposed choice purchases of energy using equipment.

2. The feasibility of alternative policy interventions could be assessed in terms of the impact upon and the likely reactions of all channel system members.

3. The content of the survey instrument used in Phase 4 could be designed to test and to build upon the tentative conclusions derived from the Phase 3 research.

E. Phase 4: Mail Questionnaire Survey

On the basis of information collected during prior stages of the research, a questionnaire was developed for mailing to builders throughout Canada during March, 1979. The purpose was to confirm and add to the tentative conclusions of the field research through a national survey. Specifically, the questionnaire was designed to elicit quantifiable responses from builders in all provinces on the following:

1. Attitudes, knowledge, and behavior regarding energy conservation measures in general and particularly with respect to energy using equipment in the home. (Note: For purposes of comparison, some questions in the instrument

replicated those used in the Consumer and Corporate Affairs Canada 1978-79 survey of the general public's attitudes, knowledge, and behavior regarding energy conservation.)

2. The role of various parties in the purchase decisions for energy using equipment installed in new housing, and the relative importance of various criteria in determining the products purchased.

3. Attitudes regarding the degree of responsibility for improving energy conservation in the residential sector which should be assumed by different parties, and attitudes towards various public policy interventions designed to promote the selection of more energy efficient equipment for installation in new housing.

4. The functional responsibility of the respondent within his firm, the firm's size in terms of numbers and types of housing units constructed in 1978, and the province in which the respondent's firm was headquartered.

The questionnaire was developed initially in English. Its content and structure were reviewed by Housing and Urban Development Association of Canada executives. A French translation of the English version was made by Réalités Canadiennes (the French arm of Canadian Facts), and was checked by representatives of the Provincial Home Builders Association of Quebec. Copies of both questionnaires are presented in Appendix A. The French version was mailed to builders in Quebec. The English version was mailed to builders in all other provinces.

A cover letter was mailed with each questionnaire. The English and French versions of this letter are presented in Appendix B. Two approaches were used to motivate the recipient to complete and return the questionnaire:

1. A twenty-five cent donation to the research fund of the Housing and Development Association of Canada or the Provincial Home Builders Association of Quebec was offered for each completed response.

2. Questionnaires were to be returned anonymously, but respondents were invited to write their names and addresses on the questionnaire if they wished to receive a copy of the results of the survey.

Sponsorship of the research study by Consumer and Corporate Affairs Canada was not mentioned in the cover letter since it was believed that this might deter some questionnaire recipients the interest of survey recipients, the cover letter discussed the research objectives. Respondents were, therefore, sensitized to

the energy issue by the cover letter and this may have influenced their responses.

The questionnaires, cover letters, and pre-stamped return envelopes were mailed in March, 1979, to a total sample of 3,430 builders across Canada. Of these, 2,230 individual names and addresses were drawn from the mailing list of the Housing and Urban Development Association of Canada. This portion of the sample received the English version of the questionnaire and included builders from all provinces except Quebec. English version questionnaires were mailed under separate cover. The remaining 1,200 names and addresses of Quebec builders were drawn from the mailing list of the Provincial Home Builders Association of Quebec. This portion of the sample received the French version of the questionnaire as an enclosure with the March newsletter of the Association. It was hoped that builders who received the French questionnaire would receive the impression that the study was endorsed by the Provincial Home Builders Association and would, as a result, be more inclined to complete the questionnaire. The response rate to the English questionnaire could not benefit from this a similar "source credibility" effect since, at the request of H.U.D.A.C., it was mailed under separate cover and did not accompany a H.U.D.A.C. newsletter.

It is believed that the questionnaire was mailed to individuals representing firms responsible for at least eighty-five percent of the new housing units built in Canada in 1978. The greater fragmentation of the residential construction industry in Quebec explains why the sample size in that province appears disproportionately high relative to the sample size for the rest of Canada. Trade association executives indicated that there was a minimal number of cases where two or more individuals at the same building firm were included on the mailing lists.

Given the anticipated statistical analyses to be conducted on the questionnaire responses, the sample size may appear unnecessarily large. The size of the sample was a function of the following considerations:

1. A response rate of between ten and twenty percent to mail questionnaires is commonly anticipated from professional and trade samples. The previous phases of the research had indicated that builders tend to be entrepreneurial and time sensitive and, therefore, not easily motivated to complete a mail questionnaire.

2. The length of the questionnaire was thought likely to reduce the response rate. It was decided to aim for fewer responses to a longer questionnaire rather than more responses to a shorter and less detailed questionnaire.

3. The trade associations from which the mailing lists were obtained could not easily mail the questionnaire to randomly derived subsamples drawn from these lists. In addition, they perceived that all their members received the questionnaire for reasons of equity.

4. The questionnaire was, in itself, a sensitizing and educational instrument. Given the objective of the research study to establish means by which builders could be persuaded to specify more efficient energy using equipment, it was believed that the questionnaire could in itself serve as an information and persuasion vehicle.

5. Dissemination of the questionnaire was delayed until after the February, 1979, H.U.D.A.C. national conference. However, the March mailing coincided with the period when builders are busy making their construction plans for the building season. It was believed that the timing of the mailing might reduce the response rate.

6. The quality (in terms of the validity of the names and addresses) of the mailing lists available for the study was not known, although the H.U.D.A.C. list had recently been updated.

One week after the initial mailing, a reminder postcard was mailed to the portion of the total sample drawn from the H.U.D.A.C. mailing list. This postcard is reproduced as Appendix C. Due to the size of the Quebec sample, it was believed that sufficient responses would be forthcoming without the expense of a reminder postcard being necessary.

Ideally, it would have been appropriate to conduct telephone interviews with a small sample of non-respondents to the mail questionnaire with the purpose of checking their responses on key questions with those of the builders who returned their questionnaires. Due to the understandable reluctance of the trade associations to release their mailing lists for this purpose, follow-up interviews to investigate the possibility of response bias could not be conducted. Accordingly, it is possible that the respondents may not in aggregate accurately represent the attitudes, knowledge, and behavior of the larger builder population.

Chapter IV: ENERGY USING EQUIPMENT: MARKET AND TECHNOLOGICAL TRENDS

A. Water Heaters

1. Market Statistics and Trends

In 1978, approximately 530,000 water heaters of the standard tank variety were sold for installation in residential housing.[1] About 32 percent of these (169,000) were installed in new housing units, the remaining 68 percent (361,000) being replacement purchases.

The number of tank type water heaters installed in new housing is less than the total number of housing completions (reported as 246,533 in 1978[2]) because apartment suites are not usually equipped with individual water heaters. For purposes of analysis, it is assumed that each of the single detached, semi-detached/duplex, and row housing units completed in 1978 (151,994) was equipped with a single water heater. In actuality, a small number of duplex and row housing units may have been equipped with less than one water heater per unit.

Three approaches were used to provide hot water for the 94,539 apartment units completed:

- The water heating function is performed by commercial grade boilers and other space heating equipment for heaters were installed in apartment buildings in this category. Currently, there is a trend towards installing separate equipment to perform the space heating and water heating functions. The reason is that energy inefficiencies occur during the summer months when boilers are only required to perform the water heating function.

- The water heating function for a further 20 percent of units is performed by high efficiency generators with separate storage tanks. A water heating system of this type is most frequently installed in high rise apartment buildings with over one hundred suites.

- The remaining 60 percent of units are served by commercial grade tank type water heaters. To estimate the number of water heaters falling into this category, one manufacturer uses a ratio of four apartment units to one water heater. Thus, 60 percent of the 94,539 apartment

units completed in 1978 would be served by 14,180 commercial grade tank type water heaters.

About 65 percent of the tank type water heaters sold for residential installations in 1978 were electric, 33 percent were gas fired, and 2 percent were oil fired. The corresponding percentages for the total stock of water heaters installed in Canadian dwellings are 52 percent for electric, 34 percent for gas, and 12 percent for oil.[3] The mix of water heaters installed in terms of type of fuel is a function of at least three factors:

- Industry structure: There are four principal Canadian manufacturers of tank type water heaters. These four manufacture both gas and electric water heaters and are almost indifferent as to the relative proportion of each which they sell. Only one of these four firms also manufactures oil fired water heaters. The oil fired water heater market is served by an array of smaller firms which lack the resources required to mount an aggressive promotion campaign to secure a larger market share. Commercial grade water heaters are principally manufactured by three firms servicing the requirements of apartment buildings, hotels, schools, hospitals, and other institutions.

- Mix of Housing Starts: There is a relatively lower penetration of gas water heaters in single detached dwellings and a relatively lower penetration of electric water heaters in apartment buildings. The geographical balance of housing starts is also of importance since consumers, for example, are more receptive to gas water heaters in certain provinces (notably Alberta and Ontario).

- Nature of Purchase: Commonly, water heaters purchased as replacements are of the same type as those which they replace. A disproportionate number of water heaters purchased by consumers from mass merchandisers tend to be electric.

The channels of distribution for standard tank type water heaters sold either for installation in new housing completions or as replacements for obsolete heaters in existing housing are diagrammed in Figure IV-1:

- About 60 percent of water heaters are sold through the traditional channel of distribution from manufacturer to plumbing wholesaler to plumbing contractor to builder or consumer.

- Some 20 percent of water heaters are shipped from the manufacturers direct to mass merchandisers, home improve-

ment chains, and other major retailers. This segment of the market is expanding. The water heaters supplied through this distribution channel are bought primarily by consumers in the replacement market, though some plumbing contractors may find it cheaper or more convenient to deal with a mass merchandising outlet than with a plumbing wholesaler. The water heaters sold by manufacturers through these outlets are predominantly electric.

- The remaining 20 percent of water heaters are shipped to gas and electric utilities which rent or sell the equipment to individual homeowners or landlords. Of these water heaters, about 70 percent are gas fired and 30 percent are electric.

- The relative percentages of oil fired water heaters flowing through these various distribution channels is somewhat different. Two-thirds of oil fired water heaters are shipped from manufacturers to oil companies who either lease or sell through the builder (in the case of new housing) to the homeowner or landlord. The remaining third flow through the traditional distribution channel from manufacturer to plumbing wholesaler to plumbing contractor to end consumer.

- Whereas 60 percent of standard tank type water heaters are sold through the traditional distribution channel, some 70 percent of commercial grade units are shipped via wholesalers. The remaining 30 percent are shipped to gas and electric utilities. No commercial grade equipment is sold through mass merchandisers.

The trend towards an increasing percentage of replacement sales of water heaters being made through the mass merchandisers is likely to continue. The more units sold by the mass merchandisers, the more price competitive they can become in comparison with plumbing contractors. Many plumbing contractors are having to act as subcontractors to the mass merchandisers and utilities to install the equipment which they either sell or rent. The guaranteed nature of this business is such that the plumber's fee per installation is lower than when he deals directly with the individual consumer. In addition, he loses the opportunity to take a markup on resale of the equipment to the consumer. Thus the plumber must install more water heaters than before to cover his fixed costs.

The increasing involvement of mass merchandisers in the replacement market also has serious implications for plumbing wholesalers. Their control over the channel of distribution is

being eroded. Because they buy in bulk, the mass merchandisers can obtain their water heaters at prices below those at which water heaters are sold to plumbing wholesalers. The manufacturers, in an effort to retain the support of the plumbing wholesalers, are attempting to restrict their direct shipments to private label brands, leaving the mass merchandisers to buy manufacturer brands through the traditional distribution channel (i.e., the plumbing wholesaler) if they so desire. Given the consumer's probable lack of sensitivity to or awareness of manufacturer brand names, this distinction seems unlikely to stem the growth of the mass merchandiser's involvement in the sale of such an attractive high ticket product category as water heaters. Lacking the resources and marketing skill of the mass merchandisers, the plumbing wholesalers appear unlikely to be able to respond. A franchised chain of plumbing outlets may, however, develop involving a plumber franchisee selling directly to consumers as well as to other plumbers and benefiting from the price discounts which the chain could secure by buying water heaters in bulk from the manufacturers.

While the distribution of water heaters through mass merchandisers is increasing, distribution through the utilities is decreasing. In times of energy shortage, it is perceived as politically inappropriate for the utilities - particularly the electric utilities - to be publicly promoting the sale and rental of water heaters.

The electric utilities became involved in the water heater business for several reasons. The water heater load could stabilize the supply system, make the operation of generating and transmission facilities more economical, and add to the revenues generated from running electricity lines into new subdivisions. The gas utilities justified their involvement in the water heater business on the grounds of a greater abundance of supply and better transmission efficiency of gas than electricity. In addition, the gas utilities argued a competitive disadvantage vis à vis the electric utilities since all residential housing requires electricity for lighting and wall sockets but not necessarily gas. The competition between the gas and electric utilities led to various incentives being offered to builders from the inauguration of rental programs (which meant that the builder incurred no capital carrying cost on the water heater between purchase and sale of tne house) to threats that the electricity supply for a new subdivision would be run in above ground (which might detract from the aesthetics of the area and, therefore, from property values). The competition among the utilities also prompted product innovations. Because of the faster recovery rate of the gas water heater, the Cascade electric water heater was developed with a higher capacity and higher wattage elements than traditional electric water heaters.

As electricity supplies have become relatively constrained compared to supplies of natural gas, the electric utilities have gradually divested their involvement in the water heater business. Divestment offers the advantage of freeing up the capital otherwise invested in rental water heaters. In the Maritimes, however, where electricity rates are particularly high, New Brunswick Hydro continues to rent water heaters for one dollar per month to make electric water heating more economically attractive to consumers. Ontario Hydro ceased to offer new water heaters on a rental basis in 1976, though the utility continues to arrange for about 2,000 replacement installations in rural areas each year. Half of these units are purchased directly from the manufacturer and installed by a plumbing contractor on a subcontract basis. The remaining units are both acquired and installed by plumbing contractors.

With some exceptions, involvement in water heater rentals is now confined to the larger gas utilities with a heavy penetration of the residential sector in their respective market areas. In such areas, a high proportion of the water heaters installed in new housing continue to be gas models. As a result, the utilities' promotion of gas water heating benefits them economically not only through the sale of more gas but directly through the sale and rental of gas water heaters.

2. Energy Consumption

An accurate calculation of the energy consumed by water heaters installed in housing completed in 1978 would require the following information:

- The relative proportions of water heaters of various fuel types, sizes, and performance specifications installed in each of the four categories of residential housing.

- The average level of household hot water demand for each of the four categories of residential housing.

In the absence of this detailed information, an estimate of average annual household energy usage for water heating has been computed by dividing the number of households into the 18 percent of total residential sector energy consumption used for water heating.[4] On this basis, annual household energy consumption for water heating is estimated at 30,125,916 Btu.[5]

Energy consumption for water heating in the 246,533 dwelling units completed in 1978 can therefore be estimated at 7,427,032,449 Btu or 3.37 percent of the energy used for water heating by all 7,320,000 Canadian households.

These estimates are suspect for two reasons. First, the mix of housing completions in 1978 does not reflect the mix of the total housing stock:

	1978 Completions[6]	Housing Stock[7]
Single detached	43.1%	58.4%
Semi-detached/duplex/row	18.6%	8.4%
Apartment and Other	38.3%	33.2%

If single detached housing units consume more energy than the other two categories on average, the estimate for energy consumption to heat water in dwellings completed in 1978 is probably excessive since it is derived from an average consumption figure for the total housing stock. In addition, it may be surmised that the water heating equipment in established housing is less energy efficient than the equipment installed in new housing, particularly in those cases where it has not been properly maintained. Once again, the implication is that the estimate is slightly excessive.

Also of interest is the percentage of annual energy consumption of all tank type water heaters sold in 1978 accounted for by the imposed choice installations in new housing completions. In 1978, 169,000 tank type water heaters sold for installation in new housing served a total of 246,533 dwelling units. As previously noted, about 40 percent of new apartment units were not served by tank type water heaters and the remaining 60 percent were served by these water heaters in a ratio of approximately one water heater to every four apartment units. Applying the same ratio (169,000 : 246,533) to the total number of tank type water heaters sold in 1978, it appears that the 530,000 unit sales served 773,151 dwelling units. In other words, water heating equipment sold in 1978 is responsible for performing this function in 773,151 households. If annual average household energy consumption for water heating is assumed to be 30,125,916 Btu, 1978 water heating equipment sales account for an annual energy consumption of 23,291,882.080 million Btu.

This computation ignores differences between the mix of housing completions in 1978 and the mix of the total housing stock. Since apartment units constitute a higher percentage of completions (38.3) than of stock (33.2), it is likely that the total number of households serviced by equipment installed in 1978 is overestimated. In addition, the computation has not

considered differences in the average economic life for standard and commercial grade water heaters or differences in the mix of the housing stock across geographical areas (variations in the nature of the water supply result in varying replacement rates for water heaters in different areas of the country).

3. Energy Saving Design Options

In a recent report on water heaters, Consumer's Research magazine concluded that "there has been a gradual trend to uniformity in both gas and electric models of most manufacturers."[8] An analysis of the energy usage of models tested by Consumer Reports revealed ten and seven percent spreads in annual energy consumption of similarly sized units of gas and electric water heaters respectively.[9]

American manufacturers have recently been broadening their product lines to include models with higher energy efficiency which generally carry correspondingly higher prices. Canadian manufacturers have hesitated to commit themselves to the manufacture of similar models for the following reasons:

a. Due to the smaller size of the Canadian market, the critical mass of demand necessary to warrant production of new energy efficient models has to constitute a higher percentage of the total available market than in the United States. The broader the product line, the lower the opportunity to exploit scale economies to reduce costs.

b. Manufacturers are uncertain whether consumers will pay higher prices for the more energy efficient models. The United States Federal Energy Administration forecast a 5.2 percent decline in demand for electric water heaters by 1980 if energy saving design improvements (with consequent price increases) were applied to all models sold. On the other hand, a faster replacement rate and a 4.7 percent increase in unit demand by 1980 were projected for gas water heaters.[10]

c. The mature nature of the technology involved in the production of water heaters is such that any design improvements can be readily matched by competitors.

d. The market shares held by the four principal manufacturers of tank type water heaters have remained relatively stable for several years. A common desire to avoid destabilizing the industry may constitute a disincentive to the introduction of new energy efficient models.

Despite these constraints, one major Canadian water heater manufacturer has recently launched an energy efficient electric water heater with three inches of insulation and an outside thermostat which can be regulated by the consumer. The additional insulation is believed to reduce heat loss by about 35 percent.[11]

A further impetus to the production of more energy efficient equipment is being provided by the gas utilities. Traditionally, gas water heaters have been promoted on the basis of the Cascade program by the electric utilities. The gas utilities are now emphasizing energy cost as well as recovery rate. From the viewpoint of system efficiency, the gas utilities are particularly concerned to maximize the market penetration of gas water heaters, particularly among households which currently use gas for space heating. The adoption by the gas utilities of energy cost arguments in their promotional efforts will stimulate the development and marketing of more energy efficient gas water heaters. Although the electrical utilities are unable for political reasons to engage in similar promotional efforts, they are likely to support the development of more energy efficient electric water heaters to prevent any increase in the market share of gas water heaters.

The Canadian Gas Research Institute, funded by the gas utilities, has developed and tested a water heater giving recovery efficiency of between 82 and 85 percent, up from 70 percent in standard water heaters. Standby losses of between 3.5 and 4.0 percent with pilots and lower than 3 percent with electric ignition are claimed. The unit is believed to be the only Canadian designed gas water heater which can meet the hourly standby loss, thermal recovery efficiency, and insulation requirements proposed in the National Research Council's Code for Energy Conservation in New Buildings and the ASHRAE 90-75 standard. In addition to offering improved efficiencies, as reported in Table IV-1, the CGRI unit has proved to be more durable than standard models in corrosive water areas, high hardness areas, and high water conductivity areas. Design features of the new unit are summarized in Table IV-2.

Table IV-3 presents the energy saving options for gas water heaters identified by the United States Federal Energy Administration (1977) and by Wilson (1978). The projected evolution of gas water heaters is summarized in Table IV-4. Among the wide range of design modification possibilities, three seem most likely to be applied to production models over the next three years:

Insulation: In addition to increasing the thickness of water heater insulation and insuring that the floor of the water

heater is also insulated, manufacturers are increasingly likely to shift from fiberglass to polyurethane insulation. Due to the demand for fiberglass for roof insulation, the price has risen to the point where use of polyurethane has become economical, particularly because one third of a thickness of polyurethane provides equivalent insulation to a thickness of fiberglass. If the thickness of the insulation is lessened, the amount of steel required, the weight of the water heater, and transportation costs, are correspondingly reduced.

Spark Ignition: The substitution of automatic spark ignition for pilot lights on gas water heaters is less cost effective in terms of energy savings than added insulation. However, a running pilot light causes some energy transfer to the water being stored. In addition, spark ignition can create a condensation which will reduce the durability of the steel tank.

Thermostat: Commonly, the water heater thermostat is set by the manufacturer and is not accessible to the consumer. A reduction in the factory temperature setting and the addition of a thermostat control to the outside of the tank could readily be implemented by manufacturers.

Independent of the product specifications, the efficiency of water heaters can be influenced by other factors. The water heater must be appropriately sized in relation to the likely demand on the equipment. Its location in the home may also bear upon performance efficiency. Whereas electric water heaters can be located near the point of water use such that standby loss is minimized, gas and oil water heaters offer less flexibility since they must be located with access to a chimney. In Europe, gas water heaters are commonly installed at the point of water use and triggered by a flow switch. Thus, a portion of the standby loss is saved through the elimination of water storage. In addition, the main burner does not have to reheat stored water following standby losses. These "instantaneous" water heaters do, however, have several performance limitations which will prevent their widespread adoption in Canada.

Whereas the performance specifications and design of the water heaters installed in new residential housing are under the control of the manufacturers, their sizing and location are determined in accordance with building codes by the builders and their subcontractors. The level of energy usage is further determined by the demand which consumers place on the equipment. Any energy policy designed to conserve energy used for water heating must recognize that all these parties

contribute to determining the overall level of consumption. In addition, there are system improvements to be explored such as capturing and recycling the heat in the water which is drained away after use.

The energy saving options open to manufacturers of electric water heaters are summarized in Table IV-5. Since all electric water heaters now depend upon totally immersed heating elements, opportunities to increase the efficiency with which heat is transferred to the water in the tank are limited. The future evolution of electric water heaters has been analyzed by Wilson (1978) and is reported in Table IV-6. A plug-in electric water heater is an improbable innovation since it is unlikely that the electrical utilities can provide the necessary level of power to operate the equipment through wall sockets. In addition, strenuous opposition from the plumbing trades to such an innovation could be expected.

Oil water heaters are more expensive than both gas and electric models and require the purchase of a storage tank. The additional cost stems from the need for a forced draft, pressure atomizing burner. An electric pilot is required and some start-up and sooting problems may occur at low firing rates. The average efficiency of 75 percent is higher than that currently achieved by a standard gas model due to the oil firing being accomplished by forced draft. One Canadian manufacturer is currently trying to obtain approval for a more energy efficient model which achieves between 78 and 85 percent efficiency as a result of additional insulation and improvements to the oil burner. Energy saving options for oil water heaters are presented in Table IV-7.

Potential energy savings for the three types of water heaters are summarized in Table IV-8.

B. Furnaces and Space Heating Equipment

1. Market Statistics and Trends

Statistics Canada monitors the percentages of Canadian households whose space heating requirements are furnished by particular types of equipment and by particular fuels. The 1978 statistics are reproduced in Table IV-9. There are three principal types of equipment used for space heating:

Hot air furnaces: Of the shipments made in 1978, 71 percent were gas furnaces, 24 percent were oil furnaces, and 5 percent were electric furnaces. There is a trend away from oil furnaces towards gas furnaces for installations in new housing, due to the relative price and availability of the

two fuels. Two manufacturers dominate production of hot air furnaces in Canada, both oil and gas.

Steam or hot water furnaces: 1978 shipments were divided approximately equally between oil fired and gas fired furnaces. Contrasting this ratio with that for the stock of hot water furnaces in Canadian households (from Table IV-9) again illustrates the current trend from oil to gas. There are two main Canadian manufacturers of gas hot water furnaces.

Baseboard electric: Although the electrical utilities are restraining their promotion of electrical heating in response to political pressures, baseboard electric remains the preferred mode of space heating in certain geographical regions, notably Quebec. Three Canadian manufacturers share most of the baseboard electric market.

The type of space heating and the fuel selected for new housing installations is influenced by a similar set of factors to that proposed for water heaters.

Table IV-10 estimates the numbers of dwelling units completed in 1978 which are serviced by each of these three types of space heating systems.[12] An attempt has been made to distinguish between hot water furnaces and commercial grade boiler systems. The latter are used almost exclusively in the heating of apartment buildings, although a minority of row housing developments are also heated in this manner. The principal conclusion to be drawn from Table IV-10 is that the forced air furnace is the dominant source of space heating in new residential housing, except in the apartment category where baseboard electric commands the highest share.

The total numbers of dwelling units installed with each of the four categories of space heating equipment may, in some cases, be greater than the numbers of equipment units sold. For example, in the case of duplexes, it is likely that one furnace frequently services both households. Thus, the number of households serviced exceeds the number of units sold. In addition, apartment buildings are frequently served by a battery of boilers. The ratio of apartment units to boilers is not available but may be estimated at approximately twenty to one.

Sixty percent of total space heating equipment shipments are believed to be sold for installation in new housing, the remaining 40 percent being sold to replace existing equipment. This estimate is based upon data for forced air furnaces. In 1978, 171,000 forced air furnaces were sold, of which an esti-

mated 61 percent (104,210) were installed in new housing. This 60:40 ratio has been assumed to hold true for the other three categories of space heating equipment. Differences in the economic lives of the various equipment categories and shifts in the relative percentages of new dwellings equipped with each category have not been taken into account.

Channels of distribution for hot water and forced air furnaces are diagrammed in Figure IV-2. The percentage of furnaces being sold through mass merchandisers and other retailers direct to consumers in the replacement market is significantly less than the corresponding percentage of water heater sales. The distribution channels for baseboard electric equipment are presented in Figure IV-3. A small percentage of baseboard electric purchases for installation in new housing are made by owner-occupiers adding units to those supplied by the builder.

2. Energy Consumption

To accurately calculate the energy consumed for space heating purposes in the housing units completed in 1978 would require information on:

- The relative proportion of space heating equipment of various fuel types, sizes, and performance specifications installed in each of the four categories of residential housing.

- The average level of household energy demand for space heating purposes for each of the four categories of residential housing.

- The number of households within each of the four housing categories whose space heating and water heating needs are serviced by the same system.

Detailed information of this nature is not available. Recording total household consumption of a particular fuel type on an individual meter does not permit a utility to determine the relative proportions of total consumption contributed to by different energy using equipment. Thus, average annual household energy consumption for space heating has been computed by dividing the number of households into the 70 percent of total residential sector energy consumption used for space heating.[13] On this basis, annual household energy consumption for space heating is estimated at 117,156,341 Btu.

Energy consumption for space heating in the 246,533 dwelling units completed in 1978 can therefore be estimated at 28,822,904,220,000 Btu, or 3.37 percent of the energy used for

space heating by all 7,320,000 Canadian households. As in the case of the water heating estimates, this figure is suspect for two reasons. First, the mix of housing completions in 1978 does not reflect the mix of the total housing stock, upon which the average household energy consumption estimate is based. Second, the space heating equipment in established housing is likely, as a function of age and technological development, to be less energy efficient than the equipment installed in new housing. The implication flowing from these two possible sources of error is that the average annual household energy consumption for space heating purposes is likely to be lower for new housing than for existing housing.

Also of interest is the percentage of annual energy consumption of all space heating equipment sold in 1978 accounted for by those imposed choice installations in new housing completions. Industry estimates indicate that 60 percent of furnaces sold in 1978 were installed in new housing, the remaining 40 percent being sold to replace equipment in existing housing. An assumption has been made that a similar ratio holds true for boiler and baseboard electric installations. To the extent that the average economic life of these types of equipment differs from that of furnaces, replacement purchases may constitute a higher or lower percentage of total equipment sales. In addition, historical variations from one year to another in terms of the percentages of new dwellings equipped with certain types of space heating may also influence the current new installation/replacement installation ratios. These differences have not been considered. Given the assumption that the 246,533 dwelling units completed in 1978 absorbed 60 percent of space heating equipment sales, the total number of dwelling units in which equipment sold in 1978 was installed may be estimated at 410,724. Further assuming annual average household energy consumption of 117,156,341 Btu, the space heating equipment sold in 1978 would account for 48,138,368.950 million Btu on an annual basis.

3. Energy Saving Design Options

The energy efficiency of the furnace is largely a function of the design of the complete heating system. In the case of forced air furnaces in particular, the ducting, dampers, and terminal fittings must be sized so as to minimize heat losses and reductions in pressure. The efficiency of the heating system (meaning the delivery of heat within the home when and where it is needed) rather than that of the furnace alone is of prime importance to the consumer.

Improvements in furnace design must be compatible with heating system technology, must meet safety standards, should not require

additional or complicated maintenance to sustain efficiency, and should not require substantial price increases with long payback periods.

The Canadian Gas Research Institute has attempted to meet these and other criteria in designing a furnace with 90-95 percent efficiency as against 60 percent efficiency achieved by most gas furnaces currently available. The CGRI claims that the higher capital cost of this furnace is recoverable within three years due to lower energy consumption. The features of the CGRI furnace are summarized in Table IV-11.

Specific figures for the percentage savings achievable through each design modification are not readily available. The switch from pilot to electric ignition is estimated to save 7-10 percent in energy consumption. The incorporation of a high efficiency burner may result in energy savings of up to 30 percent. Modulating burners, with retention heads, offer the flexibility of firing the furnace within a range at the level appropriate to provide adequate heat for the home. In the case of a conventional burner, a reduction in the firing rate would reduce the steady state efficiency of the furnace. Modulating burners are currently available only on commercial grade furnaces for apartment buildings.

Design modifications to furnaces to improve energy efficiency occasionally result in problems which must be resolved prior to commercialization. For example, if a heat exchanger condenses the water in the combustion products, the resulting condensate may contain diluted sulphuric acid, thereby presenting a problem of safe disposal into the sewer system.

The end use efficiency of oil fired furnaces currently exceeds that of gas fired furnaces, due to the higher hydrogen content of natural gas. On the other hand, the gas furnace lends itself to lower firing rates than the oil furnace, rendering the former more attractive for installation in homes requiring relatively low heat.

Energy saving design modifications for oil fired furnaces have been evaluated by Hayden, Braaten, and Brown (1978). The conclusions of their field tests are presented in Table IV-12. The United States Department of Housing and Urban Development has suggested a more conservative 10 percent energy savings resulting from the incorporation of a high speed flame retention burner.[14] The U.S. Department of Energy has indicated that a reduction in nozzle size and modification of the oil furnace extraction system can save 14 percent of energy consumption.[15]

The Canadian Government is discouraging the oil companies from promoting the use of oil for home heating. Accordingly, the oil companies are concentrating on the development of more energy efficient furnaces. Although the potential for energy savings appears to be greater for gas than for oil furnaces, the research program being undertaken at the Combustion Research Laboratories of Energy, Mines and Resources Canada has yielded several design improvements. The oil companies are also training their service personnel to instal energy saving retrofit equipment on existing furnaces in order to sustain sales revenue at a time when unit sales of new equipment are decreasing. It appears, however, that a more frequent maintenance schedule is required in the case of oil rather than gas furnaces to sustain efficient operation. The reason is that gas furnaces do not depend on mechanical fans or pumps to feed fuel and air into the furnace as oil furnaces do. In addition, because of the clean burning characteristics of gas furnaces, carbon build-up on the heat exchanger is less than with oil furnaces.

The conversion rate of electricity as a heat source is such that any design improvements to baseboard electric systems would have minimum impact in terms of increased energy efficiency. The principal contribution of electricity to energy conservation in the area of space heating may derive from its use as the power source for most heat pumps. Approximately 4,000 heat pumps were installed in Canadian homes in 1978. Their market penetration has been delayed by high prices, the poor design of early models, a lack of skilled service personnel, and the need to have properly designed duct work in order to fully capitalize on the heat pump's benefits. In addition, it has been suggested that the payback period on a heat pump is longer in Canada than in a warmer climate since the heat pump acts as a reverse cycle air conditioner absorbing heat from the outside environment at temperatures down to 0° celsius. Given these problems, it is believed that the market penetration of heat pumps in Canada will continue to lag that in United States.[16]

C. Major Kitchen and Laundry Appliances

1. Market Statistics and Trends

a. Refrigerators: The Canadian Appliance Manufacturers Association in its 1979 Industry Forecast has reported that unit sales of refrigerators in 1978 totalled 616,000.[17] The total number of households with electric refrigerators, as reported by Statistics Canada, is 7,276,000.[18]

Of total sales, 20.6 percent (127,000 units) were sold to the builder segment. Included in this figure are direct shipments from manufacturers to builders (estimated at 110,000 units[19]) and sales through kitchen equipment specialists supplying the building trade (estimated at 17,000 units).

The remaining 79.4 percent of sales were made through retail outlets. A very small but indeterminable fraction of these were probably made to small builders lacking access to a kitchen equipment specialist.

Major appliance manufacturers further subdivide the builder market into three segments:

- Purchases of refrigerators and ranges by builders from kitchen equipment specialists and other supply houses or direct from the manufacturer (if order quantities are sufficient to warrant direct shipments) account for 60 percent of sales to the builder segment.

- Approximately 26 percent of refrigerator and range sales to the builder segment are installed in new Federally assisted (Central Mortgage and Housing Corporation) and Provincially assisted (for example, the Ontario Housing Corporation) housing, under the Public Housing, Federal-provincial Rental and Sales Housing Projects, Assisted Home Ownership and Direct Government Housing programmes. Equipment specifications may, in some cases, be set by government procurement officers, although there appears to be a trend away from this practice. These housing categories form a subset of the 40 percent of new housing financed under the National Housing Act. This percentage is declining as the qualifying property value ceiling has not risen in sympathy with housing prices. The curtailment of the Assisted Rental Program may have a further dampening effect. All new housing financed under the N.H.A. must meet C.M.H.C. construction and equipment standards.

- The remaining 14 percent of refrigerator and range sales to the builder segment are installed in mobile homes. Of 17,000 mobile homes sold each year in Canada, some 1,300 are imported with refrigerators (but not ranges, due to installation regulations) already installed. Thus, sales of ranges to the mobile home market slightly exceed sales of refrigerators.

C.A.M.A. reported that, in 1978, "Builder sales remained relatively stagnant". Sales to the builder segment are not expected to grow "unless governmental policies change to promote new housing development in both single and multiple dwel-

ling accommodations".[20] Sales of all major appliances to the builder segment are closely related to the levels of housing starts and completions.

In 1978, 23.2 percent of refrigerators sold were of the manual defrost variety.[21] However, it is estimated that 38 percent of sales to the builder segment were manual defrost refrigerators.[22] This type of refrigerator is frequently specified for low income government financed housing developments because of its lower price. The argument of energy conservation is likely to sustain this policy. A decreasing percentage of manual defrost refrigerators is expected to be sold to the private sector portion of the builder segment, reflecting the general increase in consumer demand for the frost free feature.

The principal channels of distribution for refrigerators and other major kitchen and laundry appliances are diagrammed in Figure IV-4. In more detailed form, Figure IV-5 summarizes the distribution of the 616,000 refrigerators sold in 1978 in terms of four dimensions:

- Purchases for installation in new housing units versus replacement purchases (including purchases of second refrigerators).
- Purchases for installation in owner occupied versus rented housing units.
- Purchases made by homeowners, builders, and landlords.
- Purchases made from retailers, builder supply houses (including kitchen equipment specialists), and direct from refrigerator manufacturers.

b. Ranges: C.A.M.A. has reported 533,000 unit sales of ranges in 1978, of which 508,000 were electric and 25,000 gas.[23] The total number of households equipped with electric and gas ranges are 6,437,000 and 652,000 repectively.[24]

Of total sales, 22.5 percent (120,000 units of electric ranges) were sold to the builder segment. Included in this figure are direct shipments from manufacturers and sales through kitchen equipment specialists in similar proportions to those reported for refrigerators. The refrigerator and range markets are similar in terms of the percentage of total sales channelled through the builder segment and in terms of saturation of Canadian households. Almost all new housing units are equipped with a range as well as a refrigerator. The distribution pattern summarized for refrigerators in Figure IV-5 can, therefore, be treated as approximating the distribution system for ranges.

Fewer ranges than refrigerators were shipped to the builder segment in 1978 for two reasons. First, the average economic life of ranges exceeds that of refrigerators.[25] A very small proportion of total sales to the builder segment are replacement sales as opposed to sales for installation in new housing units. Because of the difference in economic life, the number of replacement ranges sold to the builder segment is fewer than the number of replacement refrigerators.

The second reason for the discrepancy in numbers is that a small (though indeterminable) number of gas ranges is sold to the builder segment. For reasons explored in Chapter V, the penetration of gas ranges in the builder segment is lower than the overall penetration level of 4.7 percent of annual sales. However, in Alberta and Ontario, where household penetration of gas ranges exceeds ten percent,[26] a small percentage of new housing units (probably single detached homes) may be equipped with gas ranges.

c. Dishwashers: C.A.M.A. has reported unit sales of 291,000 dishwashers in 1978. The total stock of dishwashers in Canadian households is 1,742,000.[27] C.A.M.A. expects the growth of dishwasher sales (at 4.6 percent annually between 1979 and 1984) to outpace the rate of new household formations.

An estimated 30,000 units were sold to the builder segment direct from manufacturers and through kitchen equipment specialists and builder supply houses. Sixty percent of these are believed to have been installed in new apartments, condominiums, and row housing. The remaining forty percent were installed in new single detached homes.[28] It may be assumed that all units sold to the builder segment were for new housing, since the replacement market for dishwashers is still in its infancy. In addition, it is likely that all sales to the builder segment were of built-in rather than portable models.

Built-in dishwashers accounted for 57.0 percent of total sales. This percentage is expected to increase as more installations of built-in dishwashers are made in new housing units. Builders regard a built-in dishwasher as a visible differentiating feature in new housing units with substantial consumer appeal.

A high percentage (52.6 in 1978) of dishwashers sold in Canada are imported.[29] Sales statistics for this product category are, consequently, somewhat less reliable than for refrigerators and ranges.

d. Clothes Washers: Unit sales in 1978 numbered 473,000.[30] Statistics Canada has reported that 4,323,000 Canadian households have automatic washers.[31]

1978 sales to the builder segment direct from manufacturers and via supply houses amounted to 18,900 units. All builder installations in new housing may be assumed to be automatic washers rather than conventional (wringer and twin-tub) washers.

A similar number of automatic washers of the coin operated variety (18,450) was sold in 1978 for installation in hotels, restaurants, hospitals, laundromats, and apartment laundry rooms. Assuming a ratio of one automatic washer to every twenty apartment units, and assuming installations covering the 94,539 apartment units completed in 1978, sales of coin operated washers for the laundry rooms of new apartment buildings may be estimated at 4,725 units.[32] Frequently, the builder will delegate the equipment selection decision and operational responsibility to a contracted laundry room operator. The commercial grade washers installed in laundry rooms usually have fewer features, shorter cycles, and better maintenance than regular equipment so do not require earlier replacement.[33]

There is a trend towards installation of compact laundry systems (stackable washers and dryers) in new luxury apartments and condominiums due to their economical floor space requirements and lower operating costs. Prices are expected to stabilize with Canadian production. Some new row house condominiums which previously would not have been equipped with washers and dryers, and some new apartments which previously would have been equipped with laundry rooms, may now have compact laundry systems installed. The percentage of total sales shipped to the builder segment may be expected to rise slightly as a result. Shipments of coin operated equipment for apartment laundry rooms will fall correspondingly. Although the operating costs of compact laundry systems are lower than those for normal sized equipment, the net effect of their installation in individual suites of apartment buildings on energy consumption is likely to be unfavorable, since easier access will prompt more frequent usage.

e. Clothes Dryers: Unit sales of electric dryers and gas dryers totalled 389,000 and 13,000 respectively in 1978.[34] Dryer sales are below washer sales due to their longer lifespan.[35] Dryer saturation reached 59.4 percent of Canadian households (4,331,000) in 1978. Gas dryers are sold principally in Alberta and Ontario.

C.A.M.A. estimates that 5.1 percent (19,840) of 1978 sales of electric dryers were shipped to the builder segment. Coin operated sales are estimated at 12,840 units.[36] Since the average economic life of dryers exceeds that of washers, and since the drying cycle is often shorter than the washing cycle,

many apartment laundry rooms are equipped with fewer dryers than washers. Thus, twenty-five percent of total coin operated washer and dryer sales are assumed to be installed in new apartment building laundry rooms in both cases. Consequently, coin operated dryer installations in 1978 are estimated at 3,210 units.

Sales of gas dryers to the builder segment are not reported by C.A.M.A., but are assumed to mirror electric dryer shipments. Thus, 5.1 percent of 1978 gas dryer shipments (660 units) and one quarter of the 3.3 percent of coin-operated units (110 units) are believed to have been installed in new residential housing.

2. Energy Consumption

The annual levels of energy consumption for which 1978 unit sales of each of the five major categories of kitchen and laundry appliances are responsible are summarized in Table IV-13. The assumptions upon which the calculations are based are outlined in the Notes to the Table.

Builder segment sales in 1978 accounted for 14.3 percent of total appliance sales. The annual energy consumption of units sold to the builder segment represents 17.5 percent of the annual energy consumption of all units sold in 1978. The difference in numbers is explained by the fact that a disproportionately higher number of unit sales to the builder segment are of refrigerators and ranges which consume more energy on a unit basis than each of the other three categories of appliance.

On the basis of Statistics Canada data regarding the number of households equipped with each of the five major appliances plus the annual energy usage estimates presented in Table IV-13, the total annual energy consumption accounted for by major kitchen and laundry appliances has been calculated as 77,508,500 million Btu.[37] Thus the 1,134,482 million Btu consumed by appliances sold to the builder segment in 1978 accounts for 1.46 percent of annual kitchen and laundry appliance consumption.

3. Energy Saving Design Options

The major Canadian appliance manufacturers interviewed for this study reported that they are actively researching possible energy saving design modifications for each of the five categories of major kitchen and laundry appliances. Hitherto, technological improvements to these appliances have frequently been in the form of additional features which have consumer appeal but which also result in higher energy consumption. For example, premium priced refrigerators now offer automatic ice makers and chilled water dispensers as well as the now standard butter compartments.

The advent of the Energuide labelling program is thought likely to accelerate the development and introduction of energy saving design changes. Allocation of research and development funds among the appliance categories is likely to reflect the sequence in which appliances are scheduled to enter the Energuide program.

a. Refrigerators: Three sources were used to compile the summary of design modifications likely to result in energy savings presented in Table IV-14. The design changes reported by the United States Federal Energy Administration were identified by the National Bureau of Standards. They were evaluated on the basis of contribution to energy efficiency, impact on retail cost, and impact on material usage in order to arrive at a production weighted estimate of energy savings and a percentage target for energy efficiency improvement by 1980.

Table IV-14 indicates that the most significant savings are achievable through improved insulation (the substitution of polyurethane foam for fiberglass). Incremental or improved insulation also reduces the required size and running time of the compressor at a time when compressor prices are rising.

The United States Federal Energy Administration forecast a 1.2 percent decline in demand for refrigerators by 1980 if all models were modified as indicated in Table IV-14 due to the higher prices which would result. This forecast is especially pertinent to an evaluation of whether or not refrigerator manufacturers are likely to enthusiastically pursue the design modifications indicated.

Energy savings achievable through elimination of the frost free feature have been estimated at twenty-nine percent (Hoskins, Hirst, and Johnson, 1978). This design modification has not been included in Table IV-14 because of its impracticality from the standpoint of market acceptability. The Canadian Appliance Manufacturers Association reported that only 23.2 percent of refrigerator sales in 1978 were of the manual defrost variety. In addition, it must be emphasized that the alleged energy savings associated with manual defrost refrigerators depend upon regular defrosting of the ice on the evaporator by the consumer.

b. Ranges: Design modifications which could reduce the energy consumption of newly manufactured ranges are summarized in Table IV-15. If these modifications were implemented, the United States Federal Energy Administration forecast a 0.5 percent decline in demand for electric ranges and a 3.4 percent increase in demand for gas ranges by 1980.

Appliance Manufacturer magazine estimated achievable energy savings for electric ranges of between eight and twenty percent, and savings for gas ranges at between forty-three and fifty percent.[38]

Two features available on selected new ranges have been criticized on the grounds that they add to energy consumption:

- Self-cleaning ovens appeal to the consumer's desire for convenience, but have to be raised to very high temperatures for the cleaning operation to be effectively performed. The annual incremental energy consumption associated with the self-cleaning oven feature is, however, only about four percent.[39] The Canadian Appliance Manufacturers Association report 1978 sales of ranges with self-cleaning ovens at 21.5 percent of total sales, and forecast that penetration will increase to 36.0 percent by 1984.[40]

- The glass and ceramic surfaces of smooth top ranges have insulating properties with the result that more energy is required to transmit the same level of heat as transmitted by an open element range. C.A.M.A. estimates that seven percent of 1978 sales were of the smooth top variety.[41]

c. Dishwashers: The level of hot water usage and the use of energy to dry dishes are the two principal areas of concern regarding energy consumption by dishwashers. Possible sources of energy savings through design modifications are presented in Table IV-16. The United States Federal Energy Administration forecast a 5.9 percent demand decline by 1980 associated with implementation of these changes due to the upward impact which they would have on dishwasher prices.

d. Clothes Washers: Areas of concern from an energy usage standpoint include the level of hot water usage, the number of cycles and hot water rinses, and the necessity of the two speed washer feature. Possible design changes and the energy savings associated with them are summarized in Table IV-17. A 6.3 percent increase in demand by 1980 was forecast by the United States Federal Energy Administration if these improvements were implemented due to the accelerated rate of replacement which would be associated with the advent of more energy efficient models.

e. Clothes Dryers: The principal area of concern regarding the energy used by clothes dryers is the continous heat required. The scope for energy savings is, however, quite

limited, as indicated in Table IV-18. The use of heat exchangers to lessen heat losses associated with exhaust air is not regarded as a practical design modification, at least in the short-term.

The United States Federal Energy Administration estimated that a one percent decline in demand for electric dryers and a 4.2 percent increase in demand for gas dryers by 1980 would be associated with implementation of the design improvements which they reported.

Appliance Manufacturer magazine estimated achievable savings for electric clothes dryers at between six and fourteen percent, and savings for gas clothes dryers at between fourteen and twenty percent.

D. Conclusion

The preceding review suggests that, in the case of all three categories of equipment, design modifications to improve energy efficiency have been identified and await further investigation by manufacturers as a prelude to their incorporation in commercial models.

Table IV-19 presents estimates of energy consumption in 1978 for each equipment category. Three estimates are presented in each case. For example, an estimate is first calculated for the energy consumption of all space heating equipment in 7,320,000 Canadian households. Second, the energy consumption attributable to all the space heating equipment sold in 1978 (assuming annual usage) is estimated. This figure includes consumption attributable to purchases of equipment for replacement purposes as well as to purchases for installation in new housing. Third, the energy consumption attributable to imposed choice purchases of space heating equipment sold in 1978 (assuming annual usage) is estimated. A similar set of three figures is presented for the two remaining equipment categories.

Assuming that the percentages of residential sector secondary energy consumption accounted for by the three categories of equipment are 70 percent (space heating), 18 percent (water heating), and 8 percent (major kitchen and laundry appliances), their combined consumption in 1978 amounted to 96 percent of the 1,225,120,617 million Btu attributable to the residential sector. All equipment installed in 1978 requires on an annual basis an amount of energy equivalent to 6.4 percent of total secondary residential sector energy consumption, while 3.1 percent represents the energy input required on an annual basis by the imposed choice purchases of energy using equipment installed in residential housing in 1978.

The energy consumption accounted for by 1978 imposed choice installations (as defined in this study) is therefore about 48 percent of the energy consumption attributable to all installed equipment sold in 1978. On a disaggregated basis, the corresponding percentages are 60 percent (space heating), 32 percent (water heating), and 18 percent (major kitchen and laundry appliances). The disparity between equipment categories is accounted for by two factors. First, the percentages of new dwellings which are offered for sale or rental with equipment preinstalled on an imposed choice basis varies from one category to another. In particular, a lower percentage of major kitchen and laundry appliance purchases fall into the imposed choice category. Second, variations in the economic life of different types of equipment and, hence, in their replacement rates explain the contrast between space heating and water heating. Since water heaters have a shorter average economic life than forced air furnaces and other types of heating equipment, a higher percentage of water heater sales are for replacement purposes. Thus, the percentage of energy consumption accounted for by water heaters sold in 1978 which is attributable to imposed choice purchases is lower than the corresponding percentage of space heating energy consumption similarly attributable.[42]

Notes to Chapter IV

1. The statistics reported in this section are estimates based upon manufacturer interviews, unless otherwise noted.

2. Central Mortgage and Housing Corporation, Canadian Housing Statistics, March, 1979, p. 9.

3. Statistics Canada, Household Facilities and Equipment, May 1978, p. 23.

4. Source: Energy Mines and Resources Canada, Energy Conservation in Canada: Programs and Perspectives, Report EP77-7, 1977, p. 20

5. 18 percent of 1975 residential sector energy consumption is 209,284,740 million Btu. The number of households in 1975 was 6,947,000. Source: Energy, Mines and Resources Canada, An Energy Strategy for Canada (Summary): Policies for Self Reliance, 1976, p. 20.

6. Statistics Canada, Household Facilities and Equipment, December, 1978, p. 19.

7. Central Mortgage and Housing Corporation, Canadian Housing Statistics, March, 1979, p. 9.

8. "Water Heaters", Consumers Research, January, 1978, p. 17-22.

9. "Water Heaters: Gas and Electric", Consumer Reports, March 1976, p. 168-169.

10. Federal Energy Administration, "Energy Conservation Program for Appliances," Federal Register, 42: 136 (July 15, 1977), Part III, 36671-2.

11. Manufacturer interview.

12. Based upon manufacturer interviews and data from Table IV-9 indicating that the number of dwelling units whose space heating is derived from hot water furnaces and boiler systems is about 44 percent of the number heated by forced air furnaces. This relationship is sustained in the estimates for the first three categories of housing.

13. Source: Energy, Mines and Resources Canada, Energy Conservation in Canada: Issues and Perspectives, Report EP77-7, 1977, p. 20.

14. U.S. Department of Housing and Urban Development, "In the Bank or Up the Chimney," U.S. Government Printing Office, Washington, D.C., 1977.

15. U.S. Department of Energy, "How to Improve the Efficiency of Your Oil Fired Furnace," U.S. Government Printing Office: Washington, D.C., 1978.

16. Based on interviews with heating contractors.

17. op. cit., p. 21

18. Statistics Canada, Household Facilities and Equipment, May 1978, p. 27.

19. Manufacturer estimates.

20. op. cit., p. 21.

21. op. cit., p. 24.

22. Manufacturer estimate.

23. op. cit., p. 31.

24. Statistics Canada, op. cit., p. 27.

25. Fisheries and Environment Canada, Waste Management Branch, Product Durability Study: Major Appliances and Tires. Report EPS3-EC-77-21, November, 1977, p. 50.

26. C.A.M.A., op. cit., p. 32.

27. C.A.M.A., op. cit., p. 39.

28. Manufacturer estimates.

29. C.A.M.A., op. cit., p. 42.

30. C.A.M.A., op. cit., p. 43.

31. Statistics Canada, op. cit., p. 27.

32. Manufacturer estimate.

33. Fisheries and Environment Canada, op. cit., p. 60.

34. C.A.M.A., op. cit., p. 43.

35. Fisheries and Envrionment Canada, op. cit., p. 50.

36. C.A.M.A., op. cit., p. 47.

37. Additional assumptions to those noted in Table IV-13 to calculate this figure are that (a) 35 percent of the residential refrigerator stock is of the manual defrost variety, and (b) 4 percent of the residential clothes dryer stock is gas powered.

38. "Appliance Energy Efficiency," Appliance Manufacturer, March, 1977, pp. 40-59.

39. The Office of Energy Conservation, Energy, Mines and Resources Canada, in a handbook 100 Ways to Save Energy estimates annual energy consumption of a standard range at 1,200 kwh, and consumption of a range with a self cleaning oven at 1,250 kwh.

40. op. cit., p. 34.

41. op. cit., p. 34.

42. The limited number of replacement purchases of an imposed choice nature (i.e., purchases by landlords) have been excluded from the imposed category choice for the purposes of the space heating and water heating computations presented in Table IV-19. The energy consumption attributed to imposed choice installations in these two cases should, therefore, be regarded as somewhat conservative.

Chapter V: DECISION MAKING PROCESSES AND CRITERIA

This chapter reports the findings of the qualitative field research regarding the decision making processes leading to equipment specifications and purchases for installation in new housing. Unless otherwise indicated, evidence and conclusions are drawn from interviews with industry executives.

For each of the three categories of equipment, the decision making processes and criteria leading to imposed choice purchases are first analyzed. Next, the replacement market is briefly considered in terms of purchases by both landlords and consumers. In order to evaluate the likelihood of a successful market introduction of more energy efficient models within each equipment category, it is necessary to have an understanding of the total market, including replacement sales as well as sales for installation in new housing. In addition, it is vital to understand the perspectives and relative power of all members of the distribution channel for a particular equipment category. For purposes of illustration, an in-depth discussion of the likely attitudes and responses to the advent of more energy efficient water heaters on the part of each group in the channel of distribution is provided. The approach, and many of the factors considered, can readily be applied by the reader to the cases of furnaces and space heating equipment, and major kitchen and laundry appliances.

A. Water Heaters

1. Imposed Choice Purchases for New Housing

The decision making process for purchases of water heaters commonly employed by builders for new housing is diagrammed in Figure V-1. The process involves two principal decisions: the selection of the fuel to be used for water heating, and the selection of a contractor (or in some cases, a utility) who will be responsible for installation of the equipment.

When deciding which fuel to specify for water heating equipment in the construction of one or more single family dwellings, there are several considerations which the builder may weigh:

a. Equipment Costs: Gas water heaters are usually more expensive than electric water heaters. Both are cheaper, however, than oil water heaters, which also require an additional outlay for a storage tank. To minimize his capital carrying costs, the builder may be more attracted to a cheaper type of water heater. If the builder is

constructing dwellings as part of a public housing program, he is likely to be operating on very tight margins and may, as a consequence, be especially sensitive to equipment costs. Alternatively, if the builder specifies a more expensive gas or oil water heater, he must be confident that he can pass on the extra cost of the water heater to the potential homeowner and not put his housing units at a price disadvantage versus competitive housing units in which cheaper equipment is installed.

b. Operating Costs: Unless he intends to rent the dwelling and pay utilities out of the rental charge, the builder has no direct interest in the operating costs of the water heater which is installed. However, to the extent that consumers are familiar with relative energy costs in a particular area, the ease with which a builder can sell or rent his housing units may depend in part upon the fuel type of water heater installed. In the Atlantic Provinces, for example, high electricity rates have made more expensive oil fired water heaters increasingly acceptable.

c. Consumer Preferences: Gas water heaters are commonly installed in new housing in areas where gas is widely used in the home (such as Ontario and Alberta) and where consumers are, therefore, familiar and comfortable with gas fired equipment. In other geographical areas where gas is less familiar, some consumers could react negatively to a house with a gas fired water heater for fear of safety hazards. To avoid unnecessarily deterring potential purchasers of their houses, many builders specify electric rather than gas water heaters in the case of single family dwellings. In contrast, the penetration of gas water heating in new apartment buildings is much higher. Actual and potential tenants of apartment buildings do not see individual tank type water heaters in each apartment unit, and in most cases are unlikely to know whether their water is heated by gas, electricity, or oil. The fear of a safety hazard associated with gas fired equipment does not, therefore, influence the decision on whether or not to rent a particular apartment.

d. Local Patterns: In selecting the fuel for water and space heating, the builder of a small housing project or a single family dwelling in a subdivision already partially completed may well follow the existing trend in this regard. The trend is likely to be a good reflection of consumer preferences, and to follow it is to act in the interests of convenience and of ease and rapidity of installation.

e. Installation and Servicing: An equivalent amount of time is required to install an electric or a gas water heater.

The installation of an oil fired water heater is more complex because of the venting system and because the heater requires connecting tubing and an electric outlet. Consequently, the builder who specifies oil fired water heaters in his request for bids is likely to incur higher installation costs per unit. The complexity of the equipment may, in addition, bear upon the servicing costs. The builder would be unwise to install a type of water heater demanding more frequent or more complex servicing to maintain performance, especially if he believed that these facts might be known by some potential purchasers of his houses.

f. Fuel for Space Heating: The choice of fuel for water heating often matches that for space heating in the interests of conveniently managing the installation of power services and the heating system. Occasionally, a builder may depart from this decision making pattern. For example, he might decide to install a gas fired indoor-outdoor furnace to save floor space inside a new housing unit. He might, however, install an electric water heater because a gas model would require the extra cost and labor involved in running a vent from the furnace.

g. Utility incentives: In certain geographical areas, utilities are involved in the sale and rental of water heaters for installation in new housing. Because of the relative availability of natural gas, the builder is now more likely to be contacted by a gas utility than by an electric utility. The gas utility may offer to arrange for the installation of gas water heaters on a rental basis. The availability of rental units means that the builder has free use of the capital which would otherwise be tied up in water heaters from the time of their purchase to the time of sale of his new housing units. A further advantage of rental water heaters from the builder's standpoint is that, in the event of a subsequent breakdown of the water heater, the homeowner is likely to complain to the utility rather than to the builder. As well as simplifying the decision making process for the builder, the availability of rental water heaters from utilities appears to be viewed favorably by homeowners. Consumers do not have to confront the lump sum financial outlay involved in purchase of a water heater, and they feel assured of good service in the event of any breakdown since the utility owns the equipment. The major gas utilities install four rental units for every one they sell in the new housing market, and seven to one in the replacement market.

A similar set of considerations guide the builder of an apartment building in his selection of the fuel to specify for water heating. The only noteworthy differences are:

a. Since an individual tank type water heater is not usually installed in each unit of an apartment building, the builder is more likely to specify gas water heating because the problems of perceived safety hazards and higher per unit equipment costs do not hold as much weight.

b. If the builder employs a consulting engineer to assist in the design of his apartment building, the fuel selection decision is likely to be influenced by the consulting engineer's personal preference or by comparative life cycle costing analysis based on fuel charges and equipment costs. As a hedge against possible shortages of one fuel, some luxury apartment buildings are being constructed with dual systems (for example, gas water heating, gas make-up air, and electric baseboard space heating).

c. The major gas utilities have a rental program for commercial grade water heaters for apartment buildings. Utility representatives will calculate the hot water requirement for the apartment building, specify the number of commercial grade water heaters needed, calculate the rental cost, and arrange for installation of the equipment by a contractor. The involvement of the utilities in water heater rentals for apartment buildings is less significant than for single family dwellings.

Once the fuel decision is taken, the builder must arrange for the delivery and installation of the appropriate equipment. Assuming that the builder is constructing housing in an area where the gas utility is not actively involved in the sale or rental of water heaters, he will commonly solicit bids from two or more mechanical contractors (in the case of apartment buildings) or plumbing contractors (in the case of single family dwellings). In the case of some housing developments, the builder may seek a single bid for the space heating and duct work as well as water heating from prospective contractors, particularly when the choice of fuel for space and water heating is the same. In all cases, the builder is looking for a single bid price which covers installation charges as well as equipment costs.

The builder's request for bids is accompanied by details of the number, size, and fuel type of the units required. On the basis of prior experience, the builder may have a particular preference for one manufacturer's brand, in which case he may specify "Brand X or equivalent." However, such a specification does not place at a disadvantage bids which specify the brands of other manufacturers. Most builders are concerned to insure that the brands of water heaters installed are those of tested and reputable manufacturers who are not likely to exit the in-

dustry, leaving consumers with worthless warranties and builders with potential liability to correct service problems on the equipment within the five year coverage of the homeowner's warranty. Although the builder's request for bids does not usually specify a particular brand, it generally indicates the Canadian Standards Association performance standards and building code ordinances with which the potential contractor must comply in selecting his equipment and pricing the installation. The builder's request for bids almost never specifies any energy performance ratings for the equipment except in so far as these are implied in CSA standards.

The contractors' bids are quoted in terms of price at the time of project completion, possibly six months or more ahead. To complete their bids, contractors must approach the one or two plumbing wholesalers with which they each do business to obtain prices for the specified equipment. In selecting the plumbing wholesalers with which he does business, the contractor may be mindful of the wholesaler's proximity to the job on which the contractor is bidding, the size of the firm in relation to the size of the job, and the wholesaler's dependability for quoting prices which are likely to be operative at the time of delivery.

The prices quoted by the wholesaler will be partly a function of how much he needs the prospective business offered by the contractor, and partly a function of his relationship with the manufacturer(s) who supply him with water heaters. Depending upon the relative duration, stability, and unit volume of his supplier relationships, one plumbing wholesaler may be able to strike a better price than another with a particular water heater manufacturer.

Those plumbing wholesalers approached by a contractor commonly quote prices to the contractor guaranteed for thirty days. Adding the lowest equipment quote to his projected installation costs, the contractor arrives at the bid which he submits to the builder. If successful, the contractor commonly returns to the plumbing wholesaler who submitted the lowest equipment quote to ask him if his price still stands. If it does, a formal contract is completed between contractor and wholesaler. If the original quote does not still stand (either because the wholesaler underestimated the cost or because of a change in manufacturer prices), the contractor is likely to once again obtain quotes from several wholesalers. It is quite possible that a different plumbing wholesaler may be successful in this second round. In the interests of managerial convenience, the water heater business associated with a particular housing contract will almost always be assigned by the contractor to one plumbing wholesaler rather than be divided among several.

Although builders receive direct shipments from kitchen and laundry appliance manufacturers, they do not receive direct shipments from water heater manufacturers. There are several reasons for this:

a. With the exception of gas appliances and dishwashers, the installation of major kitchen and laundry appliances requires less expertise than the installation of water heaters. The contractor is likely to be more familiar with installation procedures for equipment which he himself has purchased. The builder would prefer to avoid giving the contractor the opportunity to blame any breakdown on the equipment which he, the builder, purchased rather than on the quality of the contractor's installation.

b. Direct shipments of appliances from manufacturers to builders are generally for installations in multiple unit apartment buildings. The economies associated with such direct shipments do not exist in the case of water heaters. Water heating in most modern apartment buildings is provided by commercial grade boilers, not by individual tank type water heaters installed in each apartment.

c. Mechanical and plumbing contractors usually mark up the water heaters which they purchase from their plumbing wholesalers and resell to builders. In the absence of this mark-up, the contractors would have to increase their installation charges to maintain current profit levels.

d. Mechanical and plumbing contractors have, in many cases, long standing relationships with plumbing wholesalers. Direct shipments from manufacturers to builders would reduce the margins obtained by wholesalers on the resale of water heaters. The wholesalers are perhaps less likely to give good service to contractors who are willing to install equipment for utilities, mass merchandisers, or builders who have purchased water heaters direct from manufacturers. In addition, the wholesalers can pressure a manufacturer against shipping directly to builders by threatening to drop his line and substitute that of a competitor.

2. Replacement Purchases

Approximately 68 percent (361,000 units) of water heaters sold in Canada in 1978 were purchased as replacements for existing equipment. Due to the variable corrosive effects of the water in different geographic regions, the percentage of the total market accounted for by replacement purchases varies from one area

to another. For example, the average longevity of a tank type water heater in Ontario is ten years, whereas in Saskatchewan the average longevity is two and a half years.

In most households where the hot water supply is furnished by tank type water heaters, the equipment is not visible to consumers on a day-to-day basis. Most consumers are unfamiliar with the technology of water heaters. For both these reasons, they are unlikely to have their water heaters periodically checked for signs of corrosion or potential breakdown. Attention is usually focused on the water heater when it fails to supply the required level of hot water. Faced with an emergency situation, the consumer's principal objective is to remedy the situation as fast as possible.

If the consumer knows which firm originally installed the water heater, he is likely to seek repair service from this organization. The shorter the time period between installation and breakdown, the more likely he is to take this course of action. If the water heater is rented from a utility or oil company, the consumer is likely to contact the owner for service. If the water heater is not rented and the original equipment supplier is unknown, several alternative courses of action are open to the consumer. The chosen course of action is, in many cases, likely to be a function of the type of fuel used to operate the water heater:

a. If the water heater is powered by gas, the consumer is likely to call the gas utility especially if the consumer is sensitive to the safety hazards associated with gas. Despite the low profitability to the utility of providing service assistance and irrespective of whether or not the utility is involved in the water heater rental business, the utility will willingly provide service to the consumer to insure that the safety record for gas fired equipment is sustained. If the consumer's water heater must be replaced, the gas utility will either offer the consumer a rental unit or direct the consumer to a gas showroom or alternate source of supply. An additional motivation for the involvement of the gas utilities in responding to water heater service calls is their desire to insure that any replacement water heater which may have to be installed be gas fired. Because of the unplanned nature of the replacement purchase, the consumer often prefers to rent the water heater from the gas utility (where possible) because of the lower immediate cash outlay involved. The emergency nature of the situation further implies that most consumers will aim to simplify their decision making processes. They are unlikely to shop around or consider alternative brands, fuels, or equipment sizes unless the unit being replaced has patently failed to meet durability or performance expectations.

The involvement of utilities in the sale and rental of water heaters varies substantially from one province to another. Consumer's Gas and Union Gas estimate that they are responsible for at least 75 percent of gas water heater replacement installations (including sales and rentals) in their market areas. The consumer who acquires a replacement unit through a utility is unlikely to either specify or question the brand of equipment which the utility supplies to him. Rather than using their own service personnel, the utilities generally subcontract replacement installations of water heaters to plumbing contractors.

b. The owner of an electric water heater is less likely than the owner of a gas water heater to call the appropriate utility in the event of an equipment breakdown, primarily because the safety risk is not considered to be as great and because the electrical utilities have a lower profile in the renting and servicing of water heaters. The consumer is likely to call a plumbing contractor, known from previous experience, recommended by a friend, or located through the Yellow Pages. If a replacement installation is required, the plumber will offer to obtain the necessary equipment and may quote a price to the consumer. Given the emergency nature of the situation, the consumer is unlikely to be price sensitive or to probe the plumber on the relative energy efficiency of alternative brands. The plumber commonly ob- tains the replacement equipment from a plumbing wholesaler except in rural areas, where, in the absence of a wholesaler, he may obtain his water heaters through a retail outlet. Because of the customer's relative price insensitivity and because he can add a percentage to his equipment cost, in- dividual house calls of this nature are more profitable to the plumber on a per installation basis than subcontracted work for utilities or builders in the price sensitive new installation market.

c. The owner of an oil fired water heater is likely to call the oil company which supplies him with fuel on a regular basis. Alternatively, he may call a plumbing contractor. Because the share of market held by oil fired water heaters is only two percent, some plumbers do not service or repair oil fired water heaters, and many plumbing wholesalers do not carry them. However, the problem of equipment availability is not acute since usage of oil fired water heaters is concentrated in certain regions such as the Atlantic Provinces in response to high electricity rates.

The alternative responses outlined above for consumers are equally applicable to intermediaries purchasing replacement water heaters. Since equipment breakdowns are likely to occur on an individual basis, landlords who may own many rental units nevertheless have to deal with individual repair and replacement decisions as they occur. Two differences between landlords and consumers may be highlighted in their approaches to water heater breakdowns:

i. The landlord has to deal more frequently with repair and replacement decisions involving energy using equipment. His procedures for reacting to equipment breakdowns are probably better established than those of the individual consumer. For example, the landlord may do business on a regular basis with a particular plumber and be able to have him respond to a service call faster than he would for an individual consumer.

ii. Not being personally affected by the equipment breakdown, the landlord is in a position to consider alternative replacements. The length of time he intends to remain as landlord of the dwelling and whether or not he is responsible for paying the energy costs associated with usage of the equipment would determine whether durability and energy efficiency considerations might complicate a replacement decision which would characteristically be made on a purely price basis.

If a consumer or landlord is do-it-yourself oriented, he may repair or replace the water heater himself. A direct involvement of this nature is likely only if the water heater is electric (rather than gas fired). The consumer can purchase water heaters at the retail level from mass merchandisers, plumbing and heating equipment stores, or large hardware outlets and home improvement centres. An estimated 75,000 water heaters are sold each year at the retail level. It is, however, not known what percentage of these are purchased by small plumbers, particularly in rural areas, who may not have access to a plumbing wholesaler.

An increasing percentage of water heater sales for replacement purposes are being made through mass merchandisers for a variety of reasons:

i. The consumer does not have to know how to install equipment which he purchases from a mass merchandiser. Not only do the mass merchandisers offer same day delivery and installation. They have plumbers subcontracted at a flat rate to install the equipment for the consumer. The more units sold by the mass merchandisers, the more price competitive and appealing they become.

ii. Because of the unplanned nature of the replacement water heater purchase, and because of the rising costs of plumbing services, consumers are becoming more price sensitive. Although the emergency nature of the situation does not allow the consumer time for much shopping around, he may check his newspaper to see whether any mass merchandiser is holding a sale on water heaters. Mass merchandisers have found that, if they have such a sale in progress, they capture a very high percentage of the replacement business involving direct purchases by consumers on a particular day. In addition, sales on water heaters are apparently successful as store traffic builders leading to the sale of other merchandise.

iii. As consumers become more energy conscious and more knowledgeable about the nature and technology of energy using equipment in the house, an increasing number may gain the confidence necessary to enable them to buy their own replacement water heaters. If they wish to install the equipment themselves, the availability of flexible fittings is greatly facilitating do-it-yourself installations. In addition, greater awareness of the operational details of water heaters will enable some consumers to anticipate possible breakdown of their existing equipment and, therefore, to plan their replacement purchase decision in more detail in advance.

iv. Consumers are used to dealing with mass merchandisers on a regular basis and, in many cases, will have bought other household appliances from them. They may have less experience and confidence in dealing with plumbers. The major mass merchandisers offer their own private label brands of water heaters with warranties equal to or greater than those offered on name brand equipment, the implication being that, as brand owners, they stand committed to the quality of their water heaters.

3. Purchases of Energy Efficient Models

a. Introduction

In this section, the availability of more energy efficient water heaters alongside the standard models is assumed. Manufacturer interviews indicate that a price premium of at least 15 percent for the energy efficient models may be expected.

The level of market penetration acheivable by the more energy efficient water heaters is evaluated in terms of the likely attitudes and responses of seven groups within the channel of distribution. It is concluded that the replacement market will lead the new installation market in its adoption of the more energy efficient models. This second market is extremely sensitive to purchase price and is likely to remain so. There may, however, be a growing segment of the replacement market which is energy conscious and more sensitive to life cycle costs than to initial purchase price.

b. Perspective of the Manufacturer

Competition among water heater manufacturers is based primarily on price, and to a much lesser extent on delivery and after sales service. The product category is mature and the manufacturing technology is relatively stable. Consequently, the margins which a manufacturer can obtain on his water heaters are thin. The erosion of factory prices is further threatened by the increasing dependence of manufacturers on bulk orders from a few large mass merchandisers and utilities.

The manufacturers are interested in the marketing of more energy efficient water heaters for two reasons. First, it will be possible to obtain a higher purchase price and, therefore, a higher absolute unit margin for an energy efficient model. Second, the advent of another basis for competition (i.e. energy efficiency) offers the manufacturer the opportunity to reduce the dependency of his marketing success solely on the price at which he chooses to sell.

Certain barriers do, however, exist which may limit or delay the widespread market introduction of energy efficient water heaters:

i. Since water heater manufacturers currently operate on very thin selling margins, they do not have substantial funds available for new product development or for capital investment in tooling to manufacture new models. While the Canadian subsidiaries of U.S. companies have the benefit of research and development conducted by their parent companies, the small Canadian manufacturers are more resource constrained. It is noteworthy that the research and development activity for energy efficient gas water heaters in Canada is centred on the Canadian Gas Research Institute, and is funded by the gas utilities, not by the manufacturers.

ii. It is customary for the approval of all Canadian water heater manufacturers to be obtained before a new product

standard is introduced. Due to their lack of capital to compete, the smaller manufacturers may attempt to delay their approval of any new standards necessitated by the possible introduction of more energy efficient models.

iii. For sales of an energy efficient water heater to be sufficient to make product introduction profitable, the manufacturer must attempt to change the preoccupation of the builder, the plumbing wholesaler, and the plumbing contractor with initial purchase price. The manufacturer is, however, highly dependent for his sales volume on the plumbing wholesaler, and his ability to change the wholesaler's buying criteria must be doubted. The reason is that the typical plumbing wholesaler carries two or three brands of water heaters, rather than all brands. Since the number of water heaters sold each year is a function of housing starts and failures of existing equipment, the manufacturer can do nothing to increase total industry or primary demand. His sales volume depends on his selective demand or market share within the industry. Selective demand depends largely on the number of plumbing wholesalers whom the manufacturer can persuade to carry his brand through meeting their sales criteria.

Water heater manufacturers therefore lack the leverage in the distribution channel to "push" more energy efficient models through the plumbing wholesaler to the plumbing contractor and builder. Alternatively, manufacturers may consider attempting to "pull" the energy efficient models through the distribution channel by stimulating consumer demand. The principal barriers here are the manufacturers' lack of resources and experience to mount successful consumer advertising programs. A further deterrent to any one manufacturer launching a consumer advertising campaign is that, in the absence of consumer loyalty to or recognition of his brand, his advertising would educate the public regarding the existence of the energy efficient models to the benefit of competitors' sales as well as his own. The development through advertising of consumer preference for manufacturer brand names could, however, provide a defense against increasing manufacturer dependence on sales of private label water heaters to mass merchandisers. Where the funds available for marketing communications are limited, they should be used by the manufacturer to disseminate performance specifications for his energy efficient models to plumbing wholesalers, plumbing con- tractors, and builders, which might include life cycle cost in- formation. The consumer in the replacement market could effect- ively be reached through a public relations (rather than paid advertising) campaign highlighting the availability and performance characteristics of the new models.

Manufacturers expect the replacement market to lead the new housing market in the adoption of more energy efficient water heaters. One Canadian manufacturer about to introduce an energy efficient model is projecting a twenty percent share of the replacement market but only a three percent share of the new housing market within two years.

c. Perspective of the Plumbing Wholesaler

The objective of the plumbing wholesaler is to always have in stock the supplies needed by plumbing and heating contractors. He stocks a broad range of products, of which the water heater category is but one. His ability to be fully knowledgeable about all the brands and equipment options within a particular product category is, therefore, limited.

To insure secure supplies, plumbing wholesalers commonly stock two brands of water heaters. The perceived lack of product differentiation within the category means that the administrative complexity and expense involved in stocking a full range of all manufacturer brands is not warranted. In order to sustain distribution of their products, manufacturers have to be highly sensitive to the demands of the plumbing wholesalers.

The plumbing wholesaler is not, therefore, obliged to accept and push the products which a manufacturer wishes him to sell. If there is no demand from his customers for energy efficient water heaters, there is no reason to stock them. A manufacturer might offer the plumbing wholesaler a higher margin on the more expensive energy efficient models to persuade him to push these to his customers. However, in the context of his overall business, the incremental margins might not be sufficient to warrant the plumbing wholesaler carrying the extra inventory.

In conclusion, the plumbing wholesaler has considerable power in the traditional channel of distribution for water heaters. However, there is no obvious economic incentive to motivate him to educate either himself or his customers about the performance capabilities of energy efficient water heaters.

d. Perspective of the Plumbing Contractor

As a specialist, the plumbing contractor is likely to be more knowledgeable about water heating equipment than the plumbing wholesaler, and to be more receptive to information about new energy efficient water heaters. However, some plumbers, particularly those in business for themselves, may not have the

time to follow technological improvements and may sooner continue to install the standard water heaters with which they are familiar on the basis of experience.

In the new housing market, the price basis for competition is such that, in order to obtain contracts, the plumber must meet the builder's specifications at the lowest price possible. Even if he had the time, the knowledge, and the interest, the plumber would probably be unable to persuade the builder to consider more expensive energy efficient equipment. In the new housing market, the plumber's discretion, in terms of the equipment he can install, is circumscribed by the builder's cost sensitivity and any previous negative experiences with particular brands. In addition, a builder-landlord who will be responsible for maintenance after installation will not wish to install a new and untested energy efficient water heater which may not be as easily serviced as a standard model.

When plumbers install water heaters for mass merchandisers and utilities, they are not involved in the purchase selection decision for the equipment. Hence, they have no ability to influnece equipment specifications in these segments of the new housing and replacement markets.

The plumber's best opportunity to influence equipment purchases is in the replacement market when he deals directly with a consumer or landlord. He can inform the consumer of the equipment options available, including any energy efficient models. If these models are more expensive than the standard models, the plumber's absolute margin on reselling them to the consumer may be higher. Given this economic incentive, manufacturers of energy efficient water heaters might find it worthwhile to inform plumbers about the performance features of these models and the payback periods to the consumer before the incremental purchase prices are matched by energy cost savings.

e. Perspective of the Builder

The builder has traditionally abrogated to the plumbing contractor or utility the decision on which brand of water heater to install. There are two principal reasons for this:

i. Given the number of decisions which a builder must make in constructing a house, and the fact that a water heater installation may cost around $150, the decision on which brand of water heater to install becomes relatively unimportant.

ii. The builder does not have the time or motivation to inform himself about the performance characteristics of the various models of water heater available. Not with-

out some justification, he probably perceives all models which meet relevant CSA standards to be similar - hence he buys on a price basis.

Assuming the introduction to the market of more energy efficient water heaters, there are two circumstances under which the builder might become interested in comparative energy efficiency as well as comparative price:

i. If a builder intends to remain as the landlord of a property once completed, and if utilities will be included in the rent, the installation of more energy efficient water heaters could reduce his utility bills. If these water heaters are more expensive, the builder will need to have some understanding of life cycle costing to gauge the comparative economic value of his decision options.

ii. A builder may specify the installation of energy efficient water heaters if he believes that he will thereby be able to differentiate his housing units from those of competitors, and recover the incremental cost of this equipment through a correspondingly higher selling price or rental fee.

In the second case, the builder's motivation is his perception of the degree to which consumers are interested in energy efficient equipment being installed in new housing. The current emphasis on lowest price as a purchase criterion throughout the channel of distribution for water heaters is ultimately a reflection of the price sensitivity of consumers with regard to the purchase or rental of housing. Two types of builder are likely to be interested in the purchase and installation of energy efficient water heaters, assuming that these are priced higher than equivalently sized standard models:

i. Small builders of expensive customized houses whose purchasers are likely to be less price sensitive than most consumers. In such cases, the builder can plan with the purchaser the specifications of the equipment to be installed. Thus, the builder can be sure that he can pass on to the purchaser the incremental cost of an energy efficient water heater. The number of customized homes is, however, less than one percent of new housing completions.

ii. Large builders of speculative housing developments who have successfully differentiated some of their

housing units on the basis of added insulation and consequent energy cost savings. Some of these builders may attempt to differentiate a proportion of the homes which they build on the basis of total energy efficiency stemming from both the nature of the equipment and amount of insulation installed. The building firms which have the financial resources to experiment in basing the appeal of a proportion of their new housing on energy efficiency are also likely to have organized marketing departments which can work either directly or through a real estate firm to stimulate consumer interest and demand.

One factor constraining the adoption of energy efficient water heaters in the new housing market is that the builder of a housing development commonly contracts for the installation of one particular model of water heater in all of the housing units in the development. He cannot conveniently specify that some of the housing units be fitted with energy efficient models to cater to conservation conscious consumers, and that the remainder be fitted with non energy efficient models to cater to price conscious consumers. Apart from the builder's likely inability to project the relative demand of these two consumer segments, he may receive a lower discount from the water heater manufacturer if he splits his order among several models. Thus, the acceptance of energy efficient water heaters in the new housing market probably requires the existence of a much higher level of consumer acceptance than is needed to generate sales in the replacement market where each unit is purchased individually.

f. Perspective of the Utility

Each year, the major gas utilities involved in the sale and rental of water heaters request bids from the manufacturers on a portfolio of models of various sizes. Contracts are commonly awarded on a price basis. In order to avoid dependence on a single source of supply, the business of each utility is usually allocated among two or three manufacturers. The relative shares assigned to these manufacturers may shift from year to year according to the comparative price bids and to the prior delivery and service performance of the companies.

How will the gas utilities react to the availability of energy efficient water heaters? It would be inappropriate to expect the utilities to replace all of their existing rental units with new energy efficient models. Apart from the capital loss involved in the premature retirement of obsolete equipment, the utilities do not have the service manpower to accomplish such a retrofit task.

In addition, it is unlikely that the water heater manufacturers could add sufficient capacity to meet the needs of such a retrofit program.

A more difficult issue to resolve is whether an energy conscious consumer who is currently renting a standard water heater should be encouraged to contact the utility and request that it be replaced by an energy efficient model. Such requests would place an unplanned service and financial burden on the utility. If the consumer was charged for the retrofit and, furthermore, charged for the higher price of the energy efficient model through an increased rental, he would be unlikely to press the utility to install a more energy efficient water heater.

These considerations do not apply to new housing or replacement installations of water heaters arranged by the utilities. However, the utilities have several concerns regarding the specification of energy using models for future installations:

i. Energy efficient water heaters are likely to be at least 15 percent more expensive than standard models. Thus, if they specified energy efficient models, the utilities would have to invest proportionately more capital in the same number of rental units. However, substantial early purchases of the energy efficient models by the utilities could lead to price reductions.

ii. Water heater rental rates are set to provide the utility with the same rate of return on assets as is obtained from other areas of the utility's business. Because of their higher capital cost, the utilities, therefore, may wish to charge higher rentals on the energy efficient models. Thus, two rental charges, one for the standard models, one for the energy efficient models, would be operative concurrently, potentially complicating billing administration.

iii. Whereas some energy conscious consumers might willingly pay the utility more for an energy efficient water heater, other customers (whether homeowners, landlords, or builders) might expect to be offered a choice between the energy efficient model and a lower priced standard model. To offer such a choice would complicate the utility's procurement of water heaters since the relative demand for both types would have to be forecast. In addition, order splitting might jeopardize the discount obtained by a utility from the manufacturer on quantity purchases.

iv. Gas water heaters are already more expensive than electric water heaters. If a gas utility could only offer

a higher priced energy efficient model, the price sensitive builder might specify electric or oil water heaters rather than gas. Alternatively, he might attempt to persuade the gas utility to install rental rather than presold units in his new housing units.

v. Because of the number of units which they purchase each year, the utilities are highly concerned about the performance of the new energy efficient water heaters. In particular, they wish to be certain that the somewhat greater technical complexity of these models will not result in a corresponding increase in service problems. In the event of breakdowns, consumers are likely to call the gas utility rather than a plumbing contractor. The installation of equipment of proven reliability will insure that the utility is not overburdened with relatively unprofitable service calls. In addition, frequent breakdowns of the energy efficient gas water heaters, with accompanying safety hazards, could potentially detract from the consumer image of gas as a fuel source for the house. It should also be noted that the utilities are concerned about the accuracy of the energy efficiency performance data on the new water heaters to insure that no misleading advertising claims are made to consumers.

vi. The utilities have traditionally purchased their water heaters from the manufacturers on a price basis. The inclusion of energy efficiency considerations would complicate the established decision making process.

It is sometimes argued that, as fuel suppliers, the utilities have little interest in energy conservation or in the promotion and installation of more energy efficient equipment. However, the gas utilities are not permitting a current abundance of supply to detract from the need to take a longer time perspective. By virtue of being responsible not only to their shareholders but to the public at large through provincial Energy Boards, the utilities are judiciously avoiding any promotional campaigns which might implicitly encourage consumers to increase their energy consumption. Many of the gas utilities contribute to the funding of the Canadian Gas Research Institute, and some of these companies are currently testing energy efficient water heaters in the field.

On the basis of this evidence, it is likely that the utilities involved in the sale and rental of residential water heaters will adopt the energy efficient models in advance of builders. Since the power utilities are perceived to be a regulated industry within the public domain, policymakers are better able to exert

moral suasion or possibly to mandate the installation of energy efficient models in the case of the utilities than in the case of the builders.

As indicated previously, such a mandatory approach could reduce the marketability of the gas water heater and prompt those gas utilities currently involved in the sale and rental of water heaters to leave the business. However, such a drastic move seems unlikely, given the concern of the gas utilities to maintain their market penetration in the residential sector. To the extent that the utilities do become less involved, the installations which they would have carried out will revert to the principal channel of distribution (i.e. manufacturer through plumbing wholesaler and plumbing contractor to builder or consumer). As already pointed out, the penetration of the energy efficient models into the new housing market will be particularly difficult to accomplish via the principal channel of distribution. If business shifts from one channel of distribution to the other in this manner, the potential energy savings associated with mandating that the utilities only install energy efficient water heaters are correspondingly reduced.

The plumbers installing water heaters for the utilities as subcontractors receive a flat rate per installation. Assuming that the installation of an energy efficient model takes no more time than the installation of a standard model, the particular type of water heater with which the plumber has to work is irrelevant to him. However, if a mandate to the utilities to install only energy efficient models resulted in a cutback in utility arranged installations, these plumbers would have to become more involved in subcontracting their services to mass merchandisers or in developing their private businesses with individual builders and consumers.

g. Perspective of the Mass Merchandiser

Mass merchandisers are becoming increasingly interested in the sale of water heaters to complement their lines of domestic appliances. Water heaters are high ticket items which offer high margins to the retailer. In addition, the technology of the equipment is quite simple, such that minimal customer callbacks and after sales service can be expected.

The mass merchandisers are particularly interested in the development of energy efficient models by the water heater manufacturers. Differentiated on the basis of their energy efficiency, these models can command higher prices and margins for the retailer. In addition, private label versions of the energy

efficient models would help the mass merchandiser to create consumer preference for his private brand and might generate a halo effect to the benefit of his entire line of water heaters.

In order to successfully promote energy efficient models to consumers, the mass merchandisers must insure that their salesmen are knowledgeable about the relative performance capabilities of the range of models offered. For two reasons, the mass merchandisers may be expected to show initial restraint in their promotion of energy efficient models in consumer advertising:

i. They are uncertain about the legitimacy of energy performance related claims, and about the perceived value of this information to consumers. They wish to avoid any criticism that their advertising is misleading to the ill-informed consumer.

ii. They depend upon plumbers to install the equipment which they sell. The aggressive marketing of water heaters might incur the hostility of the plumbing trade, with whom the mass merchandisers are effectively in competition in the replacement market.

Any evidence of increasing consumer interest in the energy efficiency of water heaters will stimulate the mass merchandisers to stock energy efficient models and to advertise their availability to accelerate the increase in consumer demand. Unlike the water heater manufacturers, the mass merchandisers have the experience and financial resources to mount effective consumer advertising campaigns.

The mass merchandisers sell their water heaters primarily as replacements to consumers and landlords. Except to the extent that their promotional efforts stimulate overall consumer interest in and demand for energy efficient water heaters, sales through mass merchandisers will not affect the rapidity with which energy efficient water heaters penetrate the new housing market.

h. Perspective of the Consumer

To most consumers, the water heater is a mysterious appliance, a piece of equipment which is preinstalled in new homes, in the selection of which they were not involved, and which commonly attracts their attention only when it fails to function as expected. Few prospective homeowners or tenants are likely to take note of the water heaters installed in the homes which they view. Due to the existence of some consumer awareness of differential fuel costs, some consumers may inquire about what type of fuel operates the water heater and about the water heater rental charge, if applicable. They are, however, unlikely to inquire

about the energy efficiency of the equipment or to treat the model of water heater installed as a criterion in selecting a home. It is much more likely that consumers would treat the quality of the preinstalled kitchen appliances than the quality of the water heater as a possible surrogate for the overall quality of the house. In the case of apartment units as opposed to single family dwellings, an individual water heater is not installed in each unit, so the prospective purchaser or tenant is even less likely to concern himself with the quality or efficiency of the water heater in evaluating the accommodation.

The salience of the water heater could be enhanced if consumers could be educated that:

i. the water heater is technologically simple.

ii. the fuel costs associated with water heating constitute a considerable portion of the household energy bill.

iii. there are differences in the energy efficiency of water heaters currently on the market and that the degree of differentiation is likely to increase.

iv. through regular inpsections, they can sustain the efficiency and longevity of their water heaters as well as anticipate possible equipment breakdowns.

The diffusion of energy efficient water heaters depends largely on the salience of the water heater itself to the consumer, and on the relative importance attached to energy efficiency in the evaluation of alternative models. As already indicated, it is likely that energy efficient models will initially attract more interest in the replacement market from individual consumers than in the new housing market. Consumers familiar with the concept of life cycle costing who intend to stay in the home for which they are buying a replacement water heater beyond the duration of the payback period are most likely to be initially attracted by the energy efficient models. In addition, there is probably a minority segment of consumers who will be interested in the purchase of energy efficient models for image reasons irrespective of the economics.

The attraction of energy efficient water heaters, whether electric, gas, or oil, is likely to be related to the levels of power rates in a particular geographic area. As a result, the market penetration of energy efficient models will probably vary from one province to another.

The penetration of the energy efficient models in the new housing market will depend largely upon the degree of consumer interest

which they generate in the replacement market. To the extent that consumers begin to question builders or their real estate agents about the energy efficiency of equipment installed in their new housing units, some builders may consider experimenting with the installation of energy efficient models as a selling tool in some of their higher priced new dwellings.

B. Furnaces and Space Heating Equipment

1. Imposed Choice Purchases for New Housing

The decision making process for purchases of furnaces and space heating equipment commonly employed by builders for new housing is diagrammed in Figure V-2. The process is similar to that for water heaters in that it involves two principal decisions: the selection of the fuel to be used for space heating purposes which determines to some extent the type of space heating equipment to be specified, and the selection of a contractor who will be responsible for obtaining and installing the equipment.

In deciding upon which fuel to specify for space heating purposes, the builder is likely to consider the same set of factors already discussed in Chapter V:A:1 which influence the fuel decision for water heating equipment. Additional considerations specific to the space heating fuel decision are:

- Modular housing manufacturers prefer electric baseboard because it can be preinstalled in factory modules. Forced air furnaces can generally be easily installed in a modular bungalow basement on site, but the manufacturer gains more value added from equipment preinstallations at the factory.

- In view of possible fuel shortages, the potential convertibility of a space heating system from one source of fuel to another is becoming increasingly important. Oil forced air furnaces, for example, are relatively easy to convert to a gas or electric fuel supply. In contrast, hydronic systems are not broadly convertible. A thorough analysis of the comparative convertibility of space heating systems has been documented in a recent report to the Central Mortgage and Housing Corporation.[1] The recognition of potential fuel shortages is also prompting some builders of new apartment buildings to incorporate the actual or potential use of several fuels in the design of their space and water heating systems.

- In certain provinces, tenders for government housing contracts, particularly those catering to the low income

segment, may specify a particular type of space heating equipment. To minimize capital outlays, baseboard electric is frequently specified although its operating costs may be higher than those of other space heating systems.

- Although most utilities do not sell or rent furnaces and space heating equipment for installation in new housing, they do attempt to influence the fuel selection decision. For example, Manitoba Hydro has promoted electric baseboard in new housing except in areas where power lines are operating at capacity. Similarly, rural consumers and builders in Saskatchewan know that favorable electricity rates exist for consumers who install electric baseboard or an electric furnace. The oil companies, under pressure not to stimulate demand for home heating oil, have reduced their promotion of oil fired furnaces for new housing installations in recent years, in favor of funding the development of high efficiency replacement units through the Combustion Research Laboratories of Energy, Mines and Resources Canada.

Energy operating costs may be of special relevance as a criterion for fuel selection for those builders of apartment units who intend to remain as landlords after completion of their buildings. These builders are likely to be more concerned with energy operating costs, particularly if they plan on paying tenants' utility bills out of rental fees. Energy costs for an apartment building can amount to ten percent of the landlord's total operating costs, or between five and ten percent of annual rental revenues. Ordinarily, the apartment units in new buildings are not individually metered for several reasons:

- The expense of installing a meter in each apartment.

- Consumer preference for the inclusion of utility costs in the rental fee. This approach enables the consumer to budget his expenses in advance with certainty. In those apartment buildings where the rental units are of standard sizes, tenants may reasonably be confident that the landlord can equitably allocate the total utility costs among the rental fees for each apartment unit.

- The introduction of an individual metering program in an apartment building can produce problems of equity. Since hot air rises, units of equivalent size on higher floors are likely to incur lower utility costs than units on lower floors. Similarly, corner apartment units with additional external wall facings are likely to incur higher utility costs. To adjust rental charges to reflect different utility costs for apartments of equivalent size would be extremely difficult for the landlord.

- To minimize administrative costs, utilities prefer to bill the landlord alone for the whole apartment building rather than to bill each tenant individually, even though, in some areas, anomolies in the rate structure are such that a utility's revenues could increase with individual metering despite the projected decline in energy consumption.

- Gas fired heating systems would be placed at a competitive disadvantage to electric baseboard if individual metering was mandated for apartment buildings. The costs of additional piping exceed those of additional wiring. Moreover, an individual temperature meter would have to be installed in each apartment unit under a gas heating system to minimize billing inequities from one unit to another.

The existence of rent controls in certain areas is encouraging some builder-landlords to look more favorably on individual metering of apartment units. The principal argument in support of individual metering is, however, the potential conservation of energy. One report suggests that "Apartment buildings that employ bulk electrical metering typically use 20-40 percent more electricity than those buildings in which each apartment has an individual meter."[2] The implication here is that less energy is used when, through individual metering, the onus of responsibility is shifted from builder-landlord to consumer. However, for reasons already outlined, the widespread adoption of individual metering in apartment buildings appears unlikely. Thus, in specifying the space and water heating equipment to be installed in their new apartment buildings, builder-landlords will continue to have an incentive to consider the energy operating costs of equipment alternatives.

Once the fuel decision is taken, the builder must arrange for the delivery and installation of appropriate equipment. The builder's fuel selection invariably holds true for all the housing units in a particular project. If a builder has decided to install electric baseboard heating, he has two options:

a. Solicit bids from two or more electrical contractors covering both equipment and installation costs. The electrical contractor can obtain the equipment from a wholesaler, or, depending on the size of the firm, direct from the manufacturer. In either case, the electrical contractor must approach his source(s) of supply for price quotations prior to submitting his bid to the builder.

b. Approach baseboard electric manufacturers for price quotations and simultaneously solicit installation bids from electrical contractors. One Canadian manufacturer involved in both the production of baseboard electric and major kitchen and laundry appliances has successfully contracted with the builders of some apartment buildings for the direct shipment of units in both categories.

If a builder has decided to install oil or gas fired furnaces or boiler systems, he has to solicit bids from the appropriate contractors (including heating, ventilation, and sheet metal contractors). The firms invited to bid are commonly chosen on the basis of reputation and the builder's prior experience with their duct work and furnace installations. In requesting bids, the builder specifies the fuel type and nature of the equipment as well as a project completion time frame. A specific manufacturer's model "or equivalent" may be specified. As in the case of water heaters, the naming of a particular brand does not preclude or place at a disadvantage bids costed on the basis of another manufacturer's model. Finally, potential contractors are required to bid on the basis that their proposed equipment and installation procedures meet Federal and Provincial product standards and building codes governing, for example, the frequency of air changes and furnace safety with respect to flue gases. In some cases, the builder may specify the size of the furnace required in his request for bids. In other cases, he may provide the contractor with relevant information about the size of the dwelling units and seek his assistance in determining the appropriate furnace size. Many building codes imply that the furnace should be sized in accordance with good engineering practice without detailing how this should be done. Uncertainties regarding correct furnace sizing occasionally result in contractors proposing and installing oversized equipment which will not run at optimal efficiency. And in the case of housing developments which include several single family dwelling designs, all units may be installed with furnaces correctly sized for only those units with the heaviest heating demands.

Following similar procedures to those outlined in the case of water heaters, contractors bidding on a housing contract generally contact their suppliers as input to costing their bids. Assuming that the parameters specified in the request for bids are satisfied, the contract is generally awarded to the lowest bidder. A builder-landlord may also consider the details of any service contract proposed by a contractor in assessing his bid, although many large builder-landlords have their own service departments. Once selected, the successful contractor or, in

some cases, contractors prepare to arrange for the delivery and installation of the equipment as specified by the builder.

2. Replacement Purchases

Approximately 40 percent of furnaces and space heating equipment sold in Canada in 1978 were purchased as replacements for existing equipment. Any minor inter-regional variations in this percentage are due to differences in the relative proportions of dwellings heated by equipment using different fuels and to minor differences in the longevity of different types of equipment.

Replacement purchases of furnaces and space heating equipment constitute a lower percentage of total sales than in the case of water heaters. There are three reasons for this. First, the average longevity of furnaces is greater than that of water heaters. Secondly, longevity is a function of regular maintenance, and consumers and landlords are becoming increasingly sensitive to the importance of such maintenance. Thirdly, the higher capital outlay required for a furnace versus a water heater is such that repair (rather than replacement) becomes a more viable option in the event of a breakdown.

In other respects, furnaces and water heaters are similar. Consumers are probably equally unknowledgeable about both, and the breakdown of either is treated as an emergency situation. The patterns of consumer response in the event of a breakdown are also similar. The consumer may contact the heating contractor responsible for the original installation, if known. Alternatively he may contact the gas utility in the case of a gas fired furnace, or the oil supply company in the case of an oil fired furnace. In those cases where heating is supplied by an electric furnace or by electric baseboard equipment, the consumer or landlord is likely to contact an electrical rather than heating contractor.

If a service call indicates that a replacement purchase is necessary, the heating contractor commonly quotes the consumer a complete price for equipment and installation. Given the emergency nature of the situation, the consumer is unlikely to secure additional quotes from other contractors. He is more time sensitive than price sensitive, and is likely to believe that a replacement furnace of the same size and fuel will be the easiest and, therefore, the quickest to install. In some cases, however, the rising cost of oil vis à vis gas may induce some consumers to switch from one type of furnace to the other. The length of time between furnace purchases is such that a consumer is unlikely to express a particular preference for the brand of furnace currently installed.

If the initial service call is made by the gas utility or oil company serviceman, and a replacement furnace is deemed necessary, he will arrange for the installation. For several years, the major gas utilities curtailed their efforts to sell gas furnaces in the replacement market. However, gas heating installations in the replacement market declined at the same time as heat pumps were being heavily promoted. Now, major utilities such as Union Gas are once again advertising gas space heating and employing representatives to sell gas furnaces in the replacement market. Heating contractors may believe that they are losing potential furnace sales to the utilities as a result. However, the utilities are claiming that their advertising is stimulating primary demand for gas furnaces so that the heating contractors are not losing equipment sales. Although some utilities are still involved in furnace sales, they are no longer involved in furnace rentals.

In the case of an oil supply company, the replacement furnace would probably be sold or leased directly to the consumer by the company. The utilities and oil supply companies commonly subcontract equipment installations to heating contractors who do not have sufficient business with individual consumers. Due to the comparatively low profitability of this subcontracted business, heating contractors may sometimes be inclined to assign their less experienced personnel to these jobs.

The decision making processes of consumers and landlords with respect to replacement purchases of furnaces with the exceptions noted for water heater purchases. To the extent that the landlord must be responsive to his tenants, a breakdown in the supply of heat (particularly during winter) represents an emergency situation for both parties. The landlord is, however, more likely to have an established relationship with an electrical and/or heating contractor. He is also likely to have his criteria for replacement purchases established in advance and to take a more active role in the specification of the equipment to be installed, particularly in the case of expensive replacement heating units for apartment buildings.

The trend towards replacement sales of furnaces through mass merchandisers is less pronounced than it is for water heaters. Several explanations may be advanced:

a. The technological complexity of furnaces may be perceived by consumers to be higher than that of water heaters.

b. The majority of replacement purchases of furnaces are of gas fired equipment, which the do-it-yourself consumer is more reluctant to install.

c. Since the annual number of replacement purchases of furnaces is considerably less than the number of replacement water heater purchases, the turnover which mass merchandisers could expect on their inventory and the price discounts which they could obtain from manufacturers would both be less than in the case of water heaters.

A further effect of the replacement market being a minority percentage of the total is that the heating contractor has not been particularly interested in developing the merchandising skills necessary to address the needs of consumers and landlords in this market segment. Heating contractors have not, for example, been interested in or involved in educating consumers to be interested in regular servicing. New installations are relatively simple compared to the complexities often associated with servicing and repair work. Although all new dwellings have heating equipment preinstalled, the heating contractor does not come into contact with the homeowner or tenant so there is no opportunity for him to establish an ongoing service relationship.

Increasing consumer demand for regular furnace maintenance has prompted the oil companies and gas utilities to upgrade the capabilities of their personnel in the areas of service procedures and furnace retrofitting. They recognize the advantage of an ongoing service relationship with a customer; when the time comes for replacement of the existing furnace, the consumer will be more likely to continue with the same fuel. The oil companies are responding to an additional motivation. Due to the supply constraints on oil, the oil companies are not in a position to actively promote the installation of oil rather than gas fired furances in new housing. They, therefore, are concentrating on maintaining their current customer base and on increasing their overall revenues through furnace servicing and retrofitting.

In order to maintain their current level of independence in the channel of distribution, heating contractors will have to take a stronger interest in furnace servicing. Otherwise, they are increasingly likely to become merely subcontractors to oil companies, gas utilities, and to a lesser extent mass merchandisers. Through regular servicing, heating contractors have an opportunity to build up ongoing relationships with consumers. The heating contractor may be able to forecast a furnace breakdown in advance, giving the consumer time to research alternative replacement options. In any event, an ongoing service relationship is likely to lead the consumer to call the heating

contractor in the event of a breakdown and to give him the replacement order, if necessary.

The continued existence of a strong group of independent heating contractors in the channel of distribution is essential of more energy efficient furnaces are to penetrate the replacement market. Despite protestations to the contrary, there must remain some doubt about the enthusiasm with which the oil companies and utilities, as fuel suppliers, will embrace more energy efficient models. In addition, they are likely to continue to buy a single model in bulk quantity from the manufacturer rather than to split the order among several models, some more energy efficient than others. By way of contrast, the heating contractor is frequently operating on a one-to-one basis with an individual consumer to whom he may be able to sell a more energy efficient, higher priced, model. By so doing, the heating contractor can take a higher absolute markup than if he were to sell the consumer a standard model. In addition, the heating contractor may in certain circumstances be able to hasten the replacement cycle for furnaces when the energy savings achievable through installing a new model prior to a complete breakdown of an existing model are sufficiently large. Despite these considerations, however, the number of installations of more energy efficient furnaces is likely to be more a function of consumer demand than of heating contractors taking the initiative.

C. Major Kitchen and Laundry Appliances

1. Imposed Choice Purchases for New Housing

As indicated in Figure V-3, the decision making process for installations of major kitchen and laundry appliances in new housing involves four issues:

- Which, if any, appliances to install.
- In the cases of ranges and clothes dryers, which fuel to specify.
- What other equipment specifications to establish.
- Which source(s) of supply to use.

In deciding which appliances to install, the builder is guided to some extent by the expectations of the consumer segments at which the new housing is targeted. A range and a refrigerator are almost always preinstalled in new housing units intended for rental to consumers. It is unusual for only one of these two basic appliances to be preinstalled. Since apartment tenants are frequently mobile consumers with modest incomes, the availability

of a range and refrigerator already installed by the landlord represents a financial and logistical convenience. Most prospective tenants of newly constructed rental accommodation expect to find these two basic appliances at least preinstalled. Preinstallation of ranges and refrigerators by builders is, therefore, a competitive necessity.

An increasing percentage of luxury apartment and row housing units are being fitted with built-in dishwashers for purposes of product differentiation. However, it continues to be rare that new rental housing units have a washing machine and/or clothes dryer preinstalled. Most new apartment buildings have laundry rooms providing an equivalent number of washers and dryers, usually in the ratio of one appliance to every twenty rental units.

This equipment is often purchased not by the builder but by a laundry room operator to whom the landlord assigns responsibility for making the facility available to his tenants.

A significantly lower proportion of new housing units constructed for sale rather than rental include appliances installed by builders. There are two reasons for this. First, with the exception of first time home purchasers, most homeowners already have their own kitchen and laundry appliances. Prospective purchasers of a new dwelling do not, therefore, view preinstalled appliances as a necessary prerequisite, as potential tenants of rental accommodation do. In addition, Canadian consumers tend to move house more often than their appliances need to be replaced. Second, appliance costs cannot generally be included in the price of a home for purposes of obtaining a mortgage. In the United States, where appliance costs can be included, a much higher percentage of new housing units for sale have appliances preinstalled than in Canada.

In the Western Provinces, particularly Alberta, the percentage of new housing units for sale with appliances preinstalled is significantly higher than in the rest of Canada. Several explanations may be relevant. First, the practice of preinstalling appliances is long established and regarded as normal. Second, there is considerable cross-border migration between Alberta and the United States where consumer expectations are that appliances be installed in new housing for sale. Third, the penetration of gas ranges in new housing is higher in Alberta than elsewhere in Canada. Because they have to be professionally connected to the gas supply, gas ranges do qualify for inclusion in the purchase prices of new housing for mortgage purposes. Fourth, builders may be better able to secure discounts from appliance retailers for installations in new housing than those elsewhere in Canada.

Since built-in dishwashers have to be connected by a professional to the plumbing system, their cost is also considered for mortgage purposes. An increasing percentage of new housing units for sale are now fitted with dishwashers for purposes of product differentiation. Indeed, in some new housing units, a built-in dishwasher may be the only appliance preinstalled by a builder. Washing machines and clothes dryers are rarely preinstalled in new housing for sale except in the case of luxury condominiums where, for reasons of space efficiency, compact top-on-bottom washers and dryers may be built into kitchen service areas.

The second issue facing the builder is the type of fuel to be used to power the appliances which he decides to install. Specifically, in the cases of ranges and clothes dryers, the builder can choose between gas and electric appliances.

The fuel selection decision for appliances is subordinate to the fuel selection decision for space heating and water heating. Only in the event that gas is selected to power the heating system will a builder consider a gas range or clothes dryer. In those areas of the country where a high percentage of existing and new housing units are heated by gas, the consumer acceptability and penetration of gas ranges is at its highest. For example, about 20 percent of single family dwellings in the market area of a major Ontario gas utility have gas ranges installed.

Those gas utilities aiming to increase their penetration of the range market to augment total gas consumption appeal to individual consumers on the following bases:

a. Gas range operating costs are lower than those for electric ranges.

b. Gas ranges facilitate superior cooking. Moisture retention in the food being cooked is superior to that achieved with electric ranges. Heat control may also be more precise.

c. The safety hazards associated with the use of gas ranges are exaggerated. Whereas the pilot light indicates whether a gas range is switched on or off, black heat is retained on the hot plates of electric ranges after the coloration has disappeared.

d. Gas ranges may be more durable than electric ranges. It has been suggested that price competition among several manufacturers of electric ranges may prompt reductions in

overall quality. In contrast, the quality of gas ranges is thought less likely to be compromised since there is only one main Canadian manufacturer.

The availability of natural gas is such that the gas utilities can aggressively promote gas ranges to consumers. Additional penetration of the range market by gas models may occur in selected geographical areas. Market penetration is, however, likely to be significantly higher among consumer purchasers of ranges than among builder purchasers:

a. The prices of gas ranges exceed those of electric ranges. Due to the price sensitivity of builders, this fact represents a substantial deterrent to builder installations.

b. Builders do not want to deter potential purchasers or tenants of their newly built dwellings by installing gas ranges, when comparable electric ranges are acceptable to all consumers. In those geographical areas where consumer preferences are evenly split between gas and electric, the builder is likely to either install an electric range or not install any equipment, leaving the choice to the individual purchaser or tenant.

c. Consumer preferences are largely a function of prior experience. Single adults or young married couples are often introduced to independent cooking using the ranges installed in rented apartments. For reasons already stated, installation of electric ranges in new apartment dwellings is the norm. Once consumers become used to working with electric ranges in the early stages of the family life cycle, it is harder for the gas utilities to convert them to the idea of cooking with a gas range.

d. Building codes require the installation of electric sockets, but not gas outlets, in the kitchens of new housing units. An electric appliance, moreover, is easier to install than a gas appliance. If a consumer purchases a new house with a gas range installed, and later has to sell the house, he will incur the cost of disconnecting and reconnecting the appliance elsewhere. Alternatively, if the gas range is to be sold with the house, some prespective purchasers may not view this as an incremental benefit.

e. The existence of only one manufacturer of gas ranges in Canada implies that supply and capacity may not exist to meet any substantial increase in builder demand. A further implication is that direct shipments from the manufacturing plant to remotely located builders are likely to involve unacceptably high delivery costs.

For these reasons, the penetration of gas appliances in the builder segment of the market is likely to be considerably below the penetration level achieved in the individual consumer segment of the market, particularly in the case of installations in new apartment units.

The third task is to set the specifications for the appliances which are to be preinstalled. These specifications are usually set by the builder or, if the accommodation is for ultimate rental, by the future landlord if different from the builder. Unlike water and space heating equipment, kitchen and laundry appliances are highly visible to prospective purchasers and tenants of new housing units. Accordingly, if the builder or developer is a large firm, the marketing department is likely to be substantially involved in setting the specifications.

In the case of refrigerators, for example, the builder must determine the number required, the size, the color, the door swing, and the nature of the defrosting system. The more expensive the housing unit, the more likely the builder is to specify additional luxury features for the appliances to be installed. Whether they purchase direct from manufacturers or at the retail level, builders are likely to be more concerned about the brand name of the appliances which they select than they are when choosing water or space heating equipment. Because major kitchen and laundry appliances are highly visible to prospective purchasers and tenants of new housing units, they may act as a surrogate for the quality and attractiveness of the entire dwelling. In order to merchandise their dwellings, builders are therefore cognizant of the value of installing brand name equipment. Depending upon the income bracket at which a new housing unit is aimed, the brand names and features of the preinstalled appliances will vary.

To state that appliances sold directly by manufacturers to builders for preinstallation in new housing are invariably stripped down versions of retail models with the "trim" removed is an over-generalization. Due to the potential impact of appliances on the prospective purchaser or tenant's evaluation of a dwelling, many builders do not consider it wise to install stripped down models. "Dedicated" models of several brands are sold direct to the builder segment of the market, but the primary reason for their existence is to facilitate separate identification and sales tracking of models being shipped direct to builders.

Builders do not specify energy performance standards for the equipment which they wish to purchase. And manufacturers

indicated that bid requests issued for government financed housing rarely include energy performance standards for kitchen and laundry appliances. The fact that the penetration of manual defrost refrigerators is greater in the builder market than in the retail market is not a tribute to the energy consciousness of builders but, rather, a reflection of the builder market's inclusion of purchases for low-income housing and for new apartment units, many of which are rented to individuals with comparatively low household incomes. Although builder-landlords of new housing where utilities are included in the rental might be likely to be sensitive to the comparative energy consumption of alternative brands of a particular appliance, this is not currently the case. The builder does not have such information readily available, nor the time or interest to assemble it. In addition, energy costs constitute part of annual operating costs deductible for tax purposes.

The builder's potential sources of supply for appliances depend in part upon the number of housing units which he is building. The level of competition between appliance manufacturers is such that any residential housing project involving more than twenty-five units is likely to attract the interest of manufacturer representatives. These salesmen monitor residential construction projects through Southam Building News and similar publications with a view to bidding on direct shipments of appliances from manufacturers to builder for contracts over a certain size. The minimum number of housing units being built in a single project necessary for an appliance manufacturer to be interested in arranging a direct shipment appears to be lower in Quebec than in Ontario, presumably because of the greater fragmentation of the residential construction industry in Quebec.

There are two reasons why manufacturers establish de facto minimum order quantities for direct shipments. First, direct shipments from manufacturer to builder become uneconomical when relatively few units are involved. Second, manufacturers have encountered cases of spurious builders attempting to secure direct shipments of appliances at quantity discount prices with a view to reselling them at a profit to individual consumers. Builders not qualifying for direct manufacturer shipments usually purchase their appliances from builder supply houses, kitchen equipment specialists, or mass merchandisers. Since the small builder purchasing a few units each year is unlikely to be able to obtain much of a discount off the standard retail price to the consumer, there is less direct financial incentive for him to preinstall major appliances.

In the case of a residential construction project involving more units than the threshold established for direct shipments,

manufacturer salesmen will contact the builder for preinstallation. The builder commonly solicits bids from two or more manufacturers on the basis of their reputation for price, reliable performance, and on-time delivery. If the quality of the housing development is such that the builder feels that the brand name of the equipment installed may be of importance to prospective purchasers and tenants, this consideration may also help to determine which manufacturers are invited to bid. In addition, the reputation of a manufacturer's salesman and his historical relationship with a particular builder may also be influential. In the case of large residential projects, manufacturers not invited to bid may nevertheless submit bids.

Manufacturers submit bids which include delivery, uncrating, all Federal and Provincial taxes, and, ordinarily, service for one year after purchase. In almost all cases, the builder will choose the manufacturer who submits the lowest bid. The exceptions to this practice usually stem from one of two considerations:

a. If a builder has elected to install electric baseboard space heating, he may be attracted to a firm which can supply both electric baseboard and electric appliances.

The convenience of dealing with one firm for both categories of equipment and the possibility of striking a favorable deal on the price of the electric baseboard may be sufficient to compensate for a price quotation on the appliances in excess of the lowest bid.

b. The reputation of a particular manufacturer for product reliability and high quality after sales service may also compensate for a quotation in excess of the lowest bid. The interest of builder-landlords in the reliability of the equipment which they purchase is obvious. But even builders who anticipate selling their dwellings have to be concerned with equipment reliability due to the fact that most appliances are warrantied for one year whereas builders must live up to a five year minimum warranty on their new housing.

Although certain manufacturer brands of kitchen appliances are believed to appeal to particular consumer segments, it is unlikely that a builder will be targeting a new housing development in such a focused manner that these brand preferences become important in shaping the manufacturer selection decision.

Likewise there is no evidence that comparative energy efficiences are used as input to the decision making process. This is partly due to the fact that the builder does not have easy access to such information or the time to process it. In addi-

tion, large builders are unlikely to see the appliances which they order before they are installed, whereas small builders buying their equipment at the retail level would be more likely to be exposed to, for example, Energuide labels in the purchase selection process. In general, however, unless builders include energy performance standards or requests for energy performance information in their requests for bids, there is little chance that energy efficiency will be considered as a purchase selection criterion.

The large builder is likely to select just one manufacturer from whom to purchase all categories of appliances which he has decided to preinstall. The exception may be purchases of washers and dryers for a new apartment building laundry room which, by virtue of having to be commercial grade, might be supplied by a different manufacturer. It is more convenient for a builder to deal with one manufacturer in terms of receiving shipments and arranging for warranty servicing. In addition, manufacturer discounts are likely to be maximized under this approach. A larger builder can spread his business among several manufacturers if he so wishes by distributing his contract awards on a project by project basis. A final reason for placing the entire order for a particular housing project with one manufacturer is the need to insure that the colors of the different appliances installed in the same kitchen match perfectly.

Appliance manufacturers regard the builder market as more volatile than the end consumer market since it depends directly upon the level of housing starts. Each manufacturer's level of unused production capacity determines his degree of interest in the builder market, the level of his bids, and the minimum number of units which he may consider for direct shipment contracts. When builder business adds to capacity utilization at the margin, price discounts are feasible which permit manufacturers to quote prices on their own brands below those offered by mass merchandisers on private label models.

Mass merchandisers in Canada do not compete for large builder orders with direct shipments from manufacturers, as occurs in the United States. Two expalnations may be relevant:

a. The perceived differentiation between manufacturer name brand and private label appliances may be greater in Canada than in the United States. Installation of private label equipment might, therefore, needlessly detract from the quality of the housing unit as perceived by prospective purchasers and tenants.

b. The contract departments of Canadian mass merchandisers have traditionally focused on the hotel and office furnishing markets. As for the new housing market, the

emphasis has been on sales of home furnishings such as carpeting rather than on appliance sales. There is perhaps a currently underexploited opportunity for Canadian mass merchandisers to move into contract dealing with builders, particularly of new apartment or row housing complexes, to supply appliances.

With the exception of gas appliances and built-in dishwashers, installation of appliances once delivered by the manufacturer or retail supplier presents no problem for the builder. In the case of water heating and space heating equipment, other parties distinct from the builder are responsible for the installation of the equipment. Hence, they play a role in the decision making process. In the case of appliances, the comparatively simple installation procedures mean that electrical and plumbing contractors are not usually involved in the equipment selection decision. As reported in Table V-1, a Maclean-Hunter Research Bureau study indicated that the largest percentage of appliances preinstalled in new housing was selected by the builder or intended landlord.

2. Replacement Purchases

Whereas space and water heating equipment is installed in all new housing, the preinstallation of major kitchen and laundry appliances, as indicated in Chapter IV:C:1, is far from being common practice, particularly in the case of new single family dwellings. Thus, a larger percentage of the market for major appliances is accounted for by consumer rather than intermediary purchases than is the case for either water heating or space heating equipment. As already indicated, consumer buying criteria for major kitchen and laundry appliances can substantially influence the decision making processes of intermediaries.

A Canadian survey of consumer purchase criteria for major appliances found energy usage to be an infrequently mentioned criterion.[3] And a survey of refrigerator purchasers found no subjects volunteering energy usage as a purchase criterion. In addition, consumers were found to be unwilling or unable to trade operating cost savings for the convenience of frost free operation.[4] Both of these studies were conducted prior to the introduction of the Energuide labelling program. However, they suggest that energy efficiency is not a significant buying criterion for either first-time or repeat purchasers of major kitchen and laundry appliances in the consumer market. To the extent that intermediary purchases of appliances in the replacement market are likely to be influenced by the purchase criteria of consumers, the prospect of comparative information on energy consumption guiding the purchases of intermediaries in the replacement market appears remote.

Intermediary purchases in the replacement market are principally made by landlords of rental accommodation, including both single and multiple family dwellings. About 20 percent of the ranges and refrigerators sold in Canada in 1978 were purchased by landlords as replacements. There are two reasons why this estimate may seem high:

a. The longevity of appliances in rental accommodation is adversely affected by the less careful usage and maintenance of the equipment by tenants. Thus, the proportion of appliances sold for installation in rental units which are replacements is higher than the corresponding porportion in non-rental units.

b. Apartment unit completions peaked at 98,932 in 1969.[5] Given an average life expectancy for major kitchen and laundry appliances of approximately ten years, there is currently a strong market for replacement purchases by intermediaries reflecting apartment completion rates a decade ago.

Given the frequent changes in ownership of large apartment buildings, the landlord initiating a replacement purchase is unlikely to be the original builder responsible for the initial appliance installation. Thus, there is unlikely to be any carry-over of manufacturer loyalty from initial to replacement purchase. The landlord is likely to determine the required quality level of the replacement appliance to be installed on the basis of the income group at which the accommodation is targeted. With this constraint, the landlord can be expected to purchase on a price basis, with some consideration given to the reputed durability and comparative warranty terms of brand alternatives. Energy operating costs are unlikely to figure in the purchase decision. The extent to which they do is a function of whether the rental unit is individually metered or not, the length of time the landlord expects to own the building, and the degree to which he perceives the installation of energy efficient appliances as an attractive rental feature.

A landlord usually replaces appliances on a piecemeal basis as breakdowns occur or as apartments are vacated. Sometimes, he might replace appliances in an apartment building gradually on a floor by floor basis. Such major replacement programs usually follow a change in building ownership, whereby the new landlord wishes to substantially upgrade the quality of the units. Under most rent control ordinances, renovations of this nature do permit correspondingly higher rentals to be charged, a factor which may sometimes reduce the landlord's price sensitivity for his equipment selections.

Since replacements are commonly made in a piecemeal fashion, most intermediary purchases of this nature are made at the retail level. Direct shipments from appliance manufacturers only occur if the landlord is undertaking a major replacement program. A builder-landlord who receives direct shipments for installations in new housing may sometimes inflate his order to include a few additional units which he may need as replacements in his existing buildings. It is estimated that only about five percent of replacement purchases of ranges and refrigerators made by intermediaries are secured via direct shipment from the manufacturers.

The advent of the Energuide labelling program is likely to influence intermediary purchasers of appliances moreso in the replacement than in the new housing market. Builders who order direct shipments of appliances from manufacturers rarely see the equipment (and, therefore, the label information on the equipment) which they purchase. Landlords who purchase replacement appliances on a piecemeal basis at the retail level are just as likely as consumers to be exposed to Energuide information.

A comparatively small number of replacement appliance purchases is made each year not by landlords but by operators of apartment building laundry rooms who usually own and service the installed coin-operated units. These operators are often appliance dealers who are very knowledgeable about the equipment which they select and install. In deciding upon a replacement unit, their perceptions of the durability of alternative brands as well as their prices are the most important considerations. In a laundry room where several washers and dryers of the same model are installed, the operator may decide that machine servicing will be facilitated if replacement units are also of the same brand and model. Since energy operating costs are commonly borne by the landlord, the laundry room operator has little interest in introducing energy efficiency as an equipment selection criterion for replacement purchases.

Notes to Chapter V

1. Scanada Consultants, Canada Domestic Heating Equipment Vs. Energy Resources, Report to the Central Mortgage and Housing Corporation, June 1977.

2. Science Council of Canada, Canada as a Conserver Society, Report No. 27, September, 1977, p. 45.

3. F.R. Denham, N. Fairhead, and P.L. Fontaine, Major Domestic Appliances and Automobile Tires: Environmental and Economic Impacts of Product Durability, Report to Energy, Mines, and Resources Canada, 1977.

4. C. Dennis Anderson, "Consumer Behavior and Energy Information Labels for Home Appliances," in Proceedings of the Canadian Academy of Administrative Sciences, 1977.

5. Central Mortgage and Housing Corporation, Canadian Housing Statistics, March, 1979, p. 9.

Chapter VI: THE BUILDER PERSPECTIVE: SURVEY RESEARCH

A. Response Rate and Respondent Profile

This chapter reports the results of the mail questionnaire survey of builders previously discussed in the Research Methodology section of Chapter III.

Approximately 3,430 questionnaires were mailed, 2,230 in English and 1,200 in French. A total of 475 usable returns were received, representing a response rate of 13.8 percent. A few additional completions arrived after the established cut-off date (three weeks after the mailing of the follow-up postcards). These were not included in the analysis. The level of response was considered satisfactory, given the expectations outlined in Chapter III. However, the low level of response in absolute terms raises the legitimate question of response bias, the implication being that the sensitivity of respondents to the energy issue might be greater than that of non-respondents. As explained in Chapter III, standard controls for response bias could not be incorporated in this study. The interest of respondents in the questionnaire subject matter is perhaps highlighted by the fact that almost 25 percent of them requested a copy of the survey results.

Of the 475 returns, 92 were French questionnaires and 383 were English. The response rate for the French questionnaire was only 7.7 percent, compared to 17.2 percent for the English questionnaire. The difference should not be interpreted as indicating that Quebec builders are necessarily less concerned about the energy issue. Rather, the difference in response rates is probably better explained by the differential quality of the mailing lists obtained from the two trade associations and by the fact that no follow-up postcards were mailed to Quebec builders because of the substantial initial sample size.

The Housing and Urban Development Association of Canada estimates that about 80 percent of Canadian builders construct fewer than six units each year. The national construction average is estimated to be in the range of fifteen to eighteen units per builder per year.[1] Data permitting a direct comparison between these figures and those for the respondent's firms were not collected in the survey. However, Table VI-1 summarizes the number of housing units constructed by respondents' firms in 1978 for each of four categories of housing. Examining the statistics for single detached units alone indicates that a mere 36.8 percent of respondents constructed fewer than six units in this

category. The implication here is that larger building firms are over-represented relative to smaller builders in the sample of respondents. This conclusion is reinforced by additional evidence:

- Only 22.7 percent of respondents checked the 0-5 units box for all four housing categories. However, 55.5 percent of respondents checked a maximum of one box in the 6-20 units range while checking the 0-5 units box for the three remaining housing categories. This latter figure suggests that although the smaller firms are under-represented, there is a good representation of medium sized building firms among respondents.

- A high 35.4 percent of respondents indicated that their firms also act as landlords (Question 7a). Due to the capital investment involved, most builder-landlords tend to be larger sized firms. Table VI-2 supports this conclusion.

The profile of respondents was examined on two other dimensions. First, the role of respondents within their firms was investigated to ascertain whether or not there were significant minorities of respondents representing particular managerial functions. It was believed that functional biases could have influenced responses to questions concerning the relative importance of product attributes. Table VI-3 indicates that very few respondents identified themselves as having specialist functions within their firms.

Second, respondents were asked to check the provinces where the head offices of their firms were located. Results are presented in Table VI-3. The percentages of total housing completions in 1978 for each of the five geographic areas were: British Columbia - 11.8; Maritimes - 4.2; Ontario - 35.3; Prairies - 25.7; and Quebec - 23.0.[2] Inter-provincial response variations were examined for all questions included in the survey, and are reported where statistically significant.

B. Personal Attitudes, Knowledge, and Behaviors

In order to more completely understand the bases for the decision making processes used by builders, it was considered useful to gather information on the respondents' personal attitudes towards the energy issue, their knowledge of potential energy savings and residential sector energy usage, and the actions which they or their households had taken to conserve energy.

First, respondents were asked for their perceptions regarding the ease with which their personal energy usage could be reduced. As

indicated in Table VI-4, almost three-quarters of respondents agreed that it was probably not that difficult to reduce their energy usage. This level of agreement probably implies a high degree of receptivity to information on how to save energy. And this conclusion is, perhaps, supported by the fact that 75 percent of builder respondents stated that they had read a Government publication on energy conservation.

The survey further explored whether or not respondents had taken certain conservation-oriented actions in the context of their households. As indicated in Table VI-4, the percentages of affirmative respondents varied substantially from one action to another. The actions taken by the least number of respondents (insulation purchase, furnace modification, and purchase of a smaller car) proved - not surprisingly - to be those involving the heaviest financial commitment.

In general, significant differences between respondents representing large and small firms were not uncovered. The exceptions were:

- 86 percent of respondents from large firms agreed with statement (a) compared to 70 percent of respondents from small firms (X^2 = 14.30079, d.f. - 1, significance = 0.001).

- 70 percent of respondents from large firms agreed with statement (b) compared to 59 percent of respondents from small firms (X^2 = 4.63955, d.f. = 1, significance = 0.05).

- 34 percent of respondents from large firms agreed with statement (d) compared to 47 percent of respondents from small firms (X^2 = 7.62638, d.f. = 1, significance = 0.001).

The direction of the differences was not, however, consistent across all three cases.

Table VI-5 reports the percentages of subjects responding affirmatively to each of the ten statements, classified according to where the head offices of their firms were located. Four statements with significantly different response patterns were identified. Builders in the Atlantic Provinces and Ontario more frequently claimed to have spent money on insulation or to have kept the thermostat lower. Perhaps reflecting comparative energy costs, Prairie Province builders appeared significantly less likely to have added up their heating bills. However, more builders from the Prairie Provinces than from the other four areas claimed to have cleaned or changed their furnace filters.

In summary, no consistently significant inter-regional differences appeared which would warrant conclusions being drawn that builders in one area of the country are more energy conscious in their personal and household behavior than builders in another area.

The number of actions which respondents claimed to have taken was found to be related to information exposure. Builder respondents were classified as "consumers" or conservers" depending upon the number of affirmative responses to the eight statements [(c) through (j)] listed in Table VI-4. Conservers were found to be more likely to have read a Government publication on energy conservation, as reported in Table VI-6.

The statements included in Question 1 of the instrument were also included in a survey of 4,732 consumers sponsored by the Consumer Research and Evaluation Branch of Consumer and Corporate Affairs Canada. Responses to the same questions in the consumer survey are presented in Table Vl-7 for purposes of comparison. In general, the builder sample appears to be more conservation oriented than the consumer sample, assuming no difference in the degree to which members of each sample attempted to provide socially acceptable responses.

A similar comparison between builder responses and consumer responses was made on the basis of respondents' knowledge of the percentage energy savings obtainable by modifying either the usage or features of in-home energy using equipment. Respondents in the builder sample were presented with the seven actions listed in Table VI-8. The results indicate a tendency for builders to significantly underestimate the achievable levels of energy savings, except in the cases of the thermostat setback and added water heater insulation options for which the correct response ranges were, relative to the other options, the lowest.

Five of the seven actions listed in Table VI-8 were replicated in the DCCA/CREB survey. The consumer responses are classified in Table VI-9. A comparison of the two Tables indicates that:

- A higher percentage of builders than consumers was willing to attempt an answer to each question. The mean percentage of builders attempting a question was 76.5 percent compared to 46.0 percent for the consumer sample.

- Among those attempting the questions, the percentages of consumers whose responses fell into the correct ranges were not consistently higher than the corresponding percentages of builders, or vice versa. However, a higher percentage of consumers than builders who attempted to estimate the fuel savings of furnace modification and adding storm windows etc. fell into the correct ranges.

- Consumer and builder respondents displayed a similar tendency to underestimate the energy savings obtainable in each case. However, a more significant minority of consumer respondents overestimated the energy savings obtainable in four cases.

Respondents were further classified according to whether their energy savings knowledge was "good" or "poor" on the basis of their responses to the seven questions listed in Table VI-8.[3] Regional differences in terms of the percentages of respondents with good and poor knowledge levels were identifed and are reported in Table VI-12. The highest percentage of builders with a good energy savings knowledge was found in Ontario, the lowest in Quebec.

Differences in the level of energy savings knowledge displayed by respondents were also found to be associated with the size of the firms which they represented. As indicated in Table VI-10, large builders more frequently showed a good energy savings knowledge than small builders. Any information or education programs directed at builders should take account of this difference.

Respondents were not only questioned on their knowledge of potential energy savings associated with specific actions. They were also asked to estimate residential sector energy consumption as a percentage of total energy consumption, and to estimate the relative percentages of residential sector energy consumption accounted for by each of six categories of energy using equipment within the home. The results are presented in Table VI-11. Conclusions are:

- Builders significantly overestimate the contribution of the residential sector to total energy consumption. In terms of motivating them to conserve energy, this misperception is probably of advantage to the public policymaker.

- Builders tend to underestimate the energy used by furnace and heating equipment. While the mean percentage estimate for water heater energy consumption was within the correct range, the mean percentage estimates for appliances and lighting were inflated. Such misperceptions can result in an inappropriate emphasis being placed upon certain energy conserving activities (such as turning lights off), stemming from the belief that these activities result in a higher level of energy conservation than is actually the case. If public policymakers wish to influence builders (or consumers) to purchase more energy efficient equipment, the maximum response in terms of

energy savings is likely to be achieved if they have an accurate knowledge of the relative percentages of residental consumption accounted for by the different categories of equipment.

Respondents were classified according to whether their knowledge of residential sector energy use was "good" or "poor" on the basis of their responses to the seven items listed in Table VI-11.[4] There were statistically significant differences in the percentages of respondents falling into the good and poor knowledge categories on a regional basis. As indicated in Table VI-12, the highest percentage of builders with a good knowledge of residential sector energy use was found in British Columbia and the lowest in Quebec.

There was also a significant difference between respondents representing large and small building firms in terms of their knowledge of residential sector energy use. Once again, large builders appeared more likely to display a good level of knowledge, as reported in Table VI-13.

Respondents were also asked whether they would rate themselves higher in knowledge than most people about how much energy they used. A total of 52.6 percent responded positively, 37.4 percent negatively, and 9.4 percent replied that they did not know. The percentage of affirmative responses varied by the locations of respondents' firms with over 60 percent of respondents from the Atlantic Provinces, British Columbia, and Ontario agreeing with the statement, compared to 50 percent of Prairie respondents and only 32.6 percent of Quebec respondents ($x^2 = 26.45985$, d.f. = 8, significance = 0.001).

The degree to which builders (or consumers) believe that they already know how much energy they use, when in fact they do not, could present a barrier to the effectiveness of energy information and education programs. Responses to the self-perception of energy usage knowledge question were crosstabulated with "good" and "poor" classifications of energy savings knowledge derived from subjects' responses to the seven items listed in Table VI-8. The results, reported in Table VI-14, indicate that 32 percent of those who rated themselves higher in knowledge than most people had a good knowledge of potential energy savings, whereas a slightly lower 25 percent of those who did not rate themselves higher in knowledge in fact had a good knowledge of potential energy savings. These results suggest that there may be a substantial group of builders (and, possibly, consumers in general) whose confidence in their relative knowledge of energy usage is not matched by their actual knowledge of the potential energy savings which can be obtained by making certain equipment or usage modifications.

C. Decision Making Processes

Each of the three equipment categories is analyzed in terms of the relative role of different decision makers in the equipment selection process; the relative importance of different selection criteria; and the perceived differentiation of brands within each equipment category in terms of their energy efficiency.

1. Water Heaters

Those respondents whose firms had constructed single family dwellings (including semi-detached, duplex, and row housing) in 1978 with water heaters preinstalled were asked to state the percentages of water heaters selected by each of six groups, one of which was the respondent's firm. Table VI-15 presents the mean percentages of units selected by each of these groups. Confirming the conclusions of the qualitative research, the data point to the respondent's firm and to plumbing contractors as being principally responsible for water heater equipment selections.

Table VI-15 also presents the mean percentages of units selected by each of six groups for water heaters installed in new apartment dwellings. The respondent's firm and the plumbing contractor once again emerge as the principal decision makers. However, the consulting engineer also assumes prominence due to the relative complexity of designing the space and water heating systems for high rise apartment complexes.

Not surprisingly, the mean percentages allocated to consulting engineers by large builders were significantly greater than the mean percentages allocated by small builders.[5] Reflecting this result, respondents who displayed good as opposed to poor energy savings knowledge allocated a significantly higher mean percentage to consulting engineers[6] and a significantly lower mean percentage to plumbing contractors.[7]

Table VI-16 shows the mean percentages of water heaters selected by different groups for installation in new single family dwellings broken down by the head office locations of respondents' firms. Table VI-17 presents the same data for water heaters installed in new apartment dwellings. The results indicate the existence of significant inter-regional differences, stemming primarily from the involvement of the utilities in water heater sales and rentals in Ontario and the Atlantic Provinces.

Moving from the decision makers to the decision making criteria, Table VI-18 presents the mean importance rankings of factors

influencing purchases of water heaters based upon 327 completed responses to Question 10. Price and reliability emerge as the two most important factors, with energy efficiency viewed as being of relatively little importance. These findings confirm the tentative conclusions of the qualitative research.

As indicated in Table VI-19, the mean importance rankings varied significantly according to the head office locations of respondents' firms on five of the seven factors. Builders in the Prairie Provinces were more concerned with reliability than price, probably reflecting the acute impact of water quality on the economic life of a water heater in that geographical area. The relatively low cost of energy in the Prairie Provinces may explain why builders in this region ranked energy efficiency lowest in importance as a selection criterion for water heaters.

The second group of builders whose mean rankings differed significantly from the norm were those in Quebec. Compared to builders in the other four areas, they were relatively less price conscious, although price retained its position as the most influential attribute. This finding may reflect the greater fragmentation of the home construction industry in Quebec and the relative inability of the small builder to invite tenders from several sources of supply and to choose from among them on a price basis.

Table VI-20 shows how the mean importance rankings varied between small and large building firms. As suggested previously, the only statistically significant difference between the two groups occurred in the relative importance attached to price. Small builders viewed price as a less important criterion than large builders. There was no significant difference in the relative importance assigned by the two groups to energy efficiency.

Subjects were also asked to indicate on a four point scale how similar or dissimilar they perceived each of seven categories of equipment to be in terms of the relative energy efficiencies of the brand alternatives within each category. The results, reported in Table VI-21, indicate that 85 percent of respondents regarded water heaters as being moderately or very similar in terms of comparative energy dfficiency. It is usually the case that consumers must perceive inter-brand differentiation on a particular product attribute for it to assume an important role in purchase decision making. Thus, it was hypothesized that those respondents who viewed water heaters as dissimilar would be more likely to rank energy efficiency higher in importance as a selection criterion. Table VI-22 supports this hypothesis. The implication here is that actual differentiation among brands of water heaters (or brands of any of the equipment categories) in terms of their energy efficiency is of no value unless such

differences are perceived by potential purchasers. The availability of new more energy efficient models must be effectively communicated to potential purchasers before energy efficiency will assume more importance as a selection criterion.

2. Furnaces and Heating Equipment

Those respondents whose firms had constructed single family dwellings in 1978 with furnaces and heating equipment preinstalled were asked to indicate the percentages of units selected by each of six groups. Table VI-23 presents the mean percentage of units selected by each of these groups. The respondent's firm and the heating contractor emerge as the most significant decision makers.

Similarly, Table VI-23 also presents the mean percentages of units selected by each of six groups for furnaces and heating equipment installed in new apartment dwellings. While the respondent's firm remains the principal decision maker, consulting engineers and electrical contractors assume an importance equivalent to that of heating contractors. The mean percentages reported in Table VI-23 should not be interpreted as meaning that these four groups are characteristically all involved in any one equipment selection decision. Rather, the mix is a reflection of inter-regional differences in fuel preferences and the relative complexity of apartment building installations. For example, baseboard electric is more popular for new apartment installations than for new single family dwellings - hence, the higher mean percentage of units specified by electrical contractors in the case of apartments. A further difference between the two types of construction is the relatively greater complexity inherent in the design and installation of space heating systems for high rise apartment buildings - hence, the higher mean percentage of units specified by consulting engineers in the case of apartments.

Not surprisingly, the mean percentages allocated to architects[8] and consulting engineers[9] by large builders were significantly greater than the mean percentages allocated by small builders. Reflecting this result, respondents who displayed good as opposed to poor energy savings knowledge allocated a significantly higher mean percentage to consulting engineers.[10]

Table VI-24 shows the mean percentages of furnaces and heating equipment selected by different groups for installation in new single family dwellings broken down by the head office locations of respondent's firms. Table VI-25 presents the same data for

furnaces and heating equipment installed in new apartment dwellings. The results suggest that electrical contractors assume responsibility for a greater percentage of equipment selections relative to heating contractors in those areas (Atlantic Provinces, British Columbia, and Quebec) where electricity is more widely used in home heating.

Moving from the decision makers to the decision making criteria, Table VI-26 presents the mean importance rankings of factors influencing purchases of furnaces and heating equipment based upon 371 completed responses to Question 9. Once again, price and reliability emerge as the two most important factors, with energy efficiency being viewed as relatively unimportant.

As indicated in Table VI-27, the mean importance rankings varied significantly according to the head office locations of respondents' firms on six of the eight factors. Mirroring the results for water heaters, builders in the Prairie Provinces were more concerned with reliability than with price, and this concern was perhaps reflected in the greater importance which they attached to brand name. Prairie Province builders again ranked energy efficiency lower than any other group as a purchase criterion. Quebec builders again appeared to treat purchase price as relatively less important. Along with builders from the Atlantic Provinces, however, they tended to rank energy efficiency higher in importance than did builders from the other three areas.

Table VI-28 shows that the mean importance rankings varied significantly depending upon whether respondents were attached to small or large building firms. As they did with respect to water heaters, the large builders again ranked purchase price higher in importance. By virtue of being able to offer large contracts involving multiple installations for tender, the degree of price difference on bids may often be greater than the spread which a small builder can identify by shopping around.

Large builders often purchase large quantities of the same equipment for installation throughout a housing development. Hence, their somewhat greater concern with availability. Their greater concern with the warranty may reflect the fact that the large builder category includes most of the builder-landlords who are responsible for maintaining the heating equipment for their tenants after it is installed. This group is clearly more likely to be concerned with the warranty terms on the installed equipment.

Large builders rated energy efficiency significantly lower in importance than did small builders. Knowledge is apparently not

a helpful predictor of behavior. The respondents representing large builders, as previously reported, scored significantly higher than the small builder respondents in terms of knowledge of potential energy savings and knowledge of residential sector energy usage.

Table VI-21 indicates that 76 percent of respondents regarded furnaces and heating equipment as being moderately or very similar in terms of their comparative energy efficiency. As illustrated previously in the case of water heaters, respondents who perceived furnaces to be dissimilar in terms of their energy efficiency ranked this attribute higher in importance as a selection criterion, and vice versa. These results are presented in Table VI-29. Reflecting these findings, those respondents previously classified as "conservers" (on the basis of their responses to eight of the statements in Question 1) were more often found to perceive dissimilarity among furnaces and heating equipment than were "consumers."[11]

3. Major Kitchen and Laundry Appliances

Unlike water heaters and furnaces and heating equipment, the preinstallation of major kitchen and laundry appliances by builders in new housing is discretionary, particularly in the case of new single family dwellings (including duplexes and row housing). Table VI-30 first presents the percentages of survey respondents who preinstalled each of eight types of equipment in single family dwellings built in 1978. Table VI-30 also lists the mean percentages of single family dwellings built by this subset of respondents in which each type of equipment was preinstalled.

A higher percentage of large builders than small builders was found to have preinstalled refrigerators,[12] stoves,[13] washing machines[14] and clothes dryers[15] in single family dwellings built in 1978. And, as indicated in Table VI-31, a higher percentage of builders in the Prairie Provinces and British Columbia preinstalled refrigerators, stoves and dishwashers than did builders in the other three regions. Those respondents whose firms had installed major kitchen and laundry appliances in new single family dwellings constructed in 1978 were asked to state the percentages of preinstalled appliances which were selected by each of five groups. The mean percentages presented in Table VI-32 indicate that imposed choice appliance purchases are almost always selected by the respondent's firm. When particular appliances are not preinstalled, the decision on the equipment to be used is made by the homeowner. The results

in Table VI-32 should not be interpreted as implying that builders and prospective homeowners collaborate on the selection of appliances to be installed.

Similarly, Table VI-32 also presents the mean percentages of units selected by each of five groups for major kitchen and laundry appliances installed in new apartment dwellings. The higher percentage of equipment selections made by the respondent's firm in this case reflects the fact that major appliances are preinstalled in a higher percentage of new apartments than new single family dwellings. In the case of apartments which are sold as condominiums rather than rented, homeowners (classified in the "Other" category in Table VI-32) rather than landlords are the alternative group responsible for equipment selections.

In the case of appliance installations in new single family dwellings, significant differences were found to exist between respondents representing large and small builders. Large builders allocated a lower mean percentage of equipment selections to homeowners[16] and a correspondingly higher mean percentage to themselves.[17] These results reflect the fact that major appliances are more often preinstalled in the substantial public and private housing developments undertaken by large builders. Unlike the small builder, the large builder can secure sizeable quantity discounts on large orders of appliances and he can afford the capital carrying cost on the appliances he purchases pending disposal or sale of his dwellings.

Table VI-33 shows the mean percentages of water heaters selected by different groups for installation in new single family dwellings, broken down by the head office locations of respondents' firms. The results clearly indicate that the tendency for builders to preinstall major kitchen and laundry appliances varies substantially by region. The higher preinstallation rate in the Prairie Provinces and British Columbia is reflected in the higher mean percentages of equipment selection decisions made by the respondents' firms. As might be expected, given the relative predominance of small builders in Quebec, the mean percentage allocated to respondents' firms is the lowest of the five figures.

Table VI-34 presents the same data for major kitchen and laundry appliances installed in new apartment dwellings. Due to low cell sizes, no definitive conclusions can be drawn. However, the geographical differences appear less acute in this case than in the case of installations in new single family dwellings.

Moving from the decision makers to the decision making criteria, Table VI-35 reports the mean importance rankings of factors

influencing purchases of major kitchen and laundry appliances based upon 182 completed responses to Question 11. Mirroring the decision making patterns already reported for water heaters and furnaces, price and reliability again emerged as the two most important factors, with energy efficiency ranking alongside appearance/color as lowest in importance.

As indicated in Table VI-36, the mean importance rankings varied significantly according to the head office locations of respondents' firms on two of the eight factors. Builders in the Prairie Provinces again rated energy efficiency lower in importance than other respondents, and rated appearance/color higher in importance. Builders in the Atlantic Provinces also followed this pattern, but the low cell size in this case prohibits definitive conclusions being drawn.

The mean importance rankings varied according to the size of the respondents' firms for only two of the factors, as shown in Table VI-37. As in the cases of water heaters and furnaces, large builders ranked price as a more important factor in determining appliance selections than did small builders. As in the case of furnaces, large builders ranked energy efficiency lower in importance than did small builders. Since the small builder is perhaps more dependent upon his local reputation to sell the houses he builds, he may be somewhat more concerned with consumer satisfaction after the sale. Such satisfaction may, in part, be related to the energy operating costs for the equipment which the builder installed.

Table VI-21 indicates the percentages of respondents who perceived each of five appliance categories to be similar or dissimilar in terms of energy efficiency. Although not addressed in detail in this study, window air conditioners were included as one of these five categories. A greater percentage of respondents (36.8) perceived the brands within this category to be dissimilar than those within any other category. A roughly similar number of respondents perceived dissimilarity to exist on the energy efficiency dimension for each of the four major appliance categories addressed in this study. The Energuide labeling program had apparently not caused any shift in perceptions as of the time of the study, March, 1979.

Builder respondents classified as "conservers" more often perceived refrigerators,[18] stoves,[19] and window air conditioners[20] to be dissimilar than did those classified as "consumers." Predictably, builders who preinstalled refrigerators[21] and stoves[22] in dwellings constructed for sale more often perceived the brands within each of these two categories to be dissimilar in terms of their energy efficiency.

Perceptions of appliance (dis)similarity did not vary significantly by region, with the exception that builders in British Columbia more often perceived washing machines (42.0) and clothes dryers (39.2) percent to be dissimilar in terms of their energy efficiency.

D. Attitudes Towards Public Policy Intervention

Builders were asked for their opinions regarding action taken by Government and business on the energy issue. Their responses to three attitude statements, presented in Table VI-38, indicate considerable support for Government intervention and expenditures to encourage energy conservation. Table VI-39 reports responses to these three statements from the builders classified according to the location of their firms. Respondents in British Columbia, the Prairie Provinces, and Quebec, more often agreed that most businesses are not doing anything about energy conservation than did respondents from the other two geographical areas. Builders representing firms located in the Prairie Provinces appeared to be most negative towards Government intervention to address the energy issue.

Next, the builders were asked what percentage of responsibility should be assumed by each of thirteen groups for the task of reducing the residential energy consumption of the three categories of equipment addressed in this study. The mean percentage of responsibility allocated to each group is reported in Table VI-40. Respondents collectively indicated that principal responsibility should rest with Manufacturers of Equipment, Consumers, and Government Agencies in that order. With these three groups excepted, the builder respondents allocated a greater level of responsibility to themselves than to any of the remaining groups. Table VI-41 presents the mean percentages allocated to different groups broken down according to the location of respondents' firms. Quebec builders allocated significantly more responsibility to electrical contractors and consulting engineers than did builders whose firms were located in the other four areas. However, they also allocated significantly less responsibility to manufacturers, and, together with builders from the Prairie Provinces, to consumers.

Finally, respondents rank ordered a set of actions which the Government might take to promote energy conservation with respect to energy using equipment in the residential sector. Respondents were asked to rank nine policy interventions according to the level of energy savings which they were likely to generate if implemented. As indicated in Table VI-42, the set of interventions included mandatory, persuasive, financial, and non-financial approaches. Reflecting the builders' conclusion

that equipment manufacturers should assume principal responsibility for reducing the energy consumption of their products, raising energy efficiency performance standards for new equipment was regarded by respondents as the intervention likely to generate the largest energy savings. The tax credit option was ranked second overall, followed by several education and information disclosure programs. Receiving the least support were increased funding of manufacturer research and development, a graduated sales tax, and annual furnace inspections. Thus, in aggregate, respondents did not especially favor one type of public policy intervention. The three most highly supported options included mandatory/non-financial (performance standards), persuasive/financial (tax credits), and persuasive/non-financial (information programs) approaches.

Few inter-regional differences in mean rankings were evident from the results presented in Table VI-43. Government development of an information campaign for builders in cooperation with builder trade associations received significantly less support in Ontario, perhaps because respondents had knowledge of activities of this nature already being undertaken by the Toronto based national office of H.U.D.A.C. Government funding of manufacturer research and development received a significantly higher level of support in Quebec. As indicated in Table VI-44, some statistically significant differences between the opinions of large and small builders were identifiable. Large builders, who order equipment in bulk quantities, saw more value in the tax credit proposal than did small builders. Their lower enthusiasm for energy labelling and information disclosures may result from their being less likely than small builders to visually compare different models and brands before making their purchases.

Notes to Chapter VI

1. Interviews with H.U.D.A.C. executives.

2. Central Mortgage and Housing Corporation, Canadian Housing Statistics, March, 1979, p. 5.

3. A respondent who provided two or fewer answers in the correct range was classified as "poor" in energy savings knowledge. A respondent who provided between five and seven answers in the correct range was classified as "good."

4. A respondent who provided three or fewer answers in the correct range was classified as "poor" in residential sector energy use knowledge. A respondent who provided between four and seven answers in the correct range was classified as "good."

5. Large builders 27.9759 (n = 83), small builders 8.0435 (n = 23), T test significant at the 0.05 level.

6. Builders with good energy savings knowledge 43.5667 (n = 30), builders with poor knowledge 15.7971 (n = 69), T test significant at 0.005 level.

7. Builders with good energy savings knowledge 13.8667 (n = 30), builders with poor knowledge 38.6232 (n = 69), T test significant at 0.001 level.

8. Large builders 10.0602 (n = 83), small builders 3.0435 (n = 23), T test significant at 0.05 level.

9. Large builders 23.5301 (n = 83), small builders 7.1739 (n = 23), T test significant at 0.1 level.

10. Builders with good energy savings knowledge 32.7667 (n = 30), builders with poor knowledge 15.0000 (n = 69) T test significant at 0.05 level.

11. X^2 = 7.44461, d.f. = 3, significance = 0.05.

12. X^2 = 6.71714, d.f. = 1, significance = 0.01.

13. X^2 = 6.82991, d.f. = 1, significance = 0.01.

14. X^2 = 4.30664, d.f. = 1, significance = 0.05.

15. X^2 = 2.99690, d.f. = 1, significance = 0.1.

16. Large builders 44.1163 (n = 129), small builders 61.3905 (n = 169), T test significant at 0.001 level.

17. Large builders 51.7132 (n = 129), small builders 26.8639 (n = 169), T test significant at 0.001 level.

18. X^2 = 9.38171, d.f. = 3, significance = 0.05.

19. X^2 = 8.94149, d.f. = 3, significance = 0.05.

20. X^2 = 13.22558, d.f. = 3, significance = 0.01.

21. X^2 = 8.37168, d.f. = 3, significance = 0.05.

22. X^2 = 7.19845, d.f. = 3, significance = 0.06.

Chapter VII: EVALUATION OF POLICY OPTIONS

A framework for analysis and policy formulation in the area of energy conservation has been advanced by Evans, Ritchie, and McDougall (1978).[1] Policy types may be defined along two major dimensions - the financial - non-financial spectrum and the persuasive-mandatory spectrum. Table VII-1 attempts to classify nine policy options into four categories based upon an integration of these two dimensions. These nine options were ranked by survey respondents according to the energy savings which each was likely to promote if implemented (see Table VI-42).

In this chapter, each of the four types of policy option is qualitatively evaluated in terms of its ability to stimulate the purchase by builders of more energy efficient equipment. Problems of implementation and other impacts in addition to incremental energy savings are also considered. A quantified cost benefit analysis for each policy option has not been attempted, but could usefully provide the focus for further research in the area of imposed choice purchases.

While the policy options addressed in this chapter are considered in terms of their ability to promote the purchase of more energy efficient equipment by builders, it is clear that the builder and retail segments of the market for each of the three equipment categories discussed in this study are closely linked. Policies designed to motivate the builder segment should be designed and implemented in tandem with policies designed to motivate the retail segment.

A. Persuasive and Financial Policies

Policy options which are persuasive and financial in nature depend for their effectiveness upon the impact of financial incentives in shaping consumer behavior. They are non-mandatory in the sense that the consumer decides whether or not to behave in the manner suggested by the incentive. Table VI-42 indicated that builder respondents to the survey in aggregate ranked a persuasive, financial policy option as second in terms of its likely effectiveness in reducing the consumption of energy using equipment in the residential sector. The policy of providing tax credits for any additional cost involved in installing energy efficient equipment is evaluated in this section as an example of a persuasive, financial intervention.

Tax credit programs have been introduced as incentives to consumers to purchase insulation. The analogy between insulation and energy using equipment is however, by no means perfect. There are several differences to note:

1. Tax credit programs for insulation have been directed at consumers, not builders. Their objective has not been to influence the equipment installed in new housing but rather to persuade homeowners to retrofit and upgrade their existing levels of insulation.

2. In the case of insulation, the purpose of a tax credit program is to motivate purchase of the product category. In the case of energy using equipment, the objective would be to motivate purchase of the most energy efficient brand within a product category. It is arguable that this latter task requires a more complex information base and decision making process.

3. Once installed, the effectiveness of insulation in terms of energy conservation does not depend on consumer usage and maintenance to the extent that these factors determine the actual efficiency of energy using equipment.

The apparent success of tax credit programs in motivating purchases of insulation does not, therefore, imply that similar programs for residential energy using equipment would be equally easy to implement or equally successful.

The appeal of tax credit programs to the builder respondents to the survey stems from their price sensitivity and their unwillingness to install more expensive energy efficient models if there is less than complete assurance that the incremental costs can be passed on to the purchaser of the dwelling. However, the appeal of different tax credit programs can vary widely depending upon the magnitude of the incentive. A tax credit program designed to reimburse to the builder the incremental cost of purchasing an energy efficient model does not compensate the builder directly for the time spent on acquiring comparative energy usage information for different brands or for the time spent on completing the necessary paperwork involved in securing the credit. In addition, the builder has to bear the carrying cost on the incremental purchase price of the more energy efficient equipment from time of purchase to time of sale. Despite these costs, however, two indirect financial benefits may accrue to the builder:

1. A reduction in utility bills if the builder remains as landlord following completion of a housing unit, assuming utility costs are included in rental charges.

2. A builder may be able to raise the price or rental of a housing unit on the basis of preinstalled energy efficient equipment beyond what he could charge if only standard

equipment were preinstalled, plus secure the tax credit for the incremental costs associated with installing the energy efficient equipment.

Since the costs of energy using equipment preinstalled in new housing represent about five percent of total construction costs, tax credits equivalent to the incremental cost of the energy using equipment are likely to be insufficient to motivate many builders to devote additional time to the decision making process with respect to these equipment purchases. To supply a more appealing incentive, one of two options might be considered:

1. Apply a tax credit to the total cost of models certified, presumably by the C.S.A., as energy efficient, rather than to the incremental cost of these models over and above the cost of standard models. Such an approach would mean that the builder could expect to be financially better off (rather than no worse off) if he purchased an energy efficient model rather than a standard model, although the program costs to the Federal Government would increase proportionately.

2. Set the tax credit at a level in excess of the discounted value of the stream of energy savings achieved through the specification of energy efficient rather than standard equipment. This approach might be particularly attractive to builder-landlords who have a greater financial interest in the energy usage ratings of the equipment which they install in new housing.

In addition to the difficulty of setting the optimal incentive structure in a tax credit program to maximize energy savings, other problems are associated with the implementation of this policy option:

1. There is no clear relationship at present between the energy efficiencies of equipment options within a particular product category and their prices. The efficiency ratings of refrigerators conducted for the Energuide program have shown this to be the case. While the absence of any correlation between energy efficiencies and prices may simply be a reflection of the current low salience of energy efficiency as a purchase criterion, it does suggest that a tax credit might have to be related to an energy efficiency rating rather than to the retail price. The builder, used to buying equipment strictly on a price basis, might find a tax credit program based upon energy efficiencies rather than prices more complex to understand, and therefore, less appealing.

2. Any tax credit program must be carefully designed to minimize complexity (so as not to deter builders from using it) but also to minimize undesired responses. For example, a tax credit based upon incremental costs might prompt builders to purchase the most expensive model even though it might not be the most energy efficient. In addition, the availability of a tax credit might cause builders to order larger sized, more energy consuming models (for example, of refrigerators) than would otherwise be the case.

3. In order to implement a tax credit program based upon the comparative energy efficiencies of equipment options, it is necessary to first generate the type of information required for an energy performance labelling program.

4. A tax credit might encourage manufacturers to price their energy efficient models higher than would otherwise be the case because, if adopted, the tax break would reduce the builder's price sensitivity. If these energy efficient models simultaneously increased in price in the retail market, their attractiveness to end consumers would be reduced, assuming that the tax credit program was applicable to builders alone.

5. If the availability of a tax credit program increased the penetration of energy efficient models in the builder segment of the market, the financial viability of smaller manufacturers would be strained. This is due to the capital investment costs required for retooling in order to manufacture the more energy efficient models, costs which larger manufacturers can bear more easily.

A further issue is whether a similar tax credit program would be made available to both builders and consumers. If tax credits were available only to builders and not to consumers, the percentage of new housing units sold with discretionary equipment (major kitchen and laundry appliances) and energy efficient models preinstalled would probably increase. In addition, some builders might attempt to establish themselves as unofficial intermediaries between manufacturers and end consumers interested in buying energy efficient equipment. The consequences would include a reduction in the percentage of units sold through the retail segment forcing retail prices to rise, and a reduction in manufacturer income since, on a unit basis, builder segment sales are often less profitable than retail segment sales. Since there is no evidence to suggest that consumers would be less enthusiastic or responsive to a tax credit program than builders, the Federal Government would doubtless be pressured to make the program generally available. Administrative costs would increase

substantially if this were the case; whereas many builders buy energy using equipment in bulk orders, individual consumers commonly purchase only one model at a time. For this same reason, the costs of informing the target market of the existence of a tax credit program may be expected to be higher, per unit of energy saved, if consumers at large rather than builders alone constitute the program target.

Due to the problems associated with the design and implementation of an easily understandable tax credit program, this policy option is not recommended, either for the builder segment alone, or for both builders and consumers. This recommendation is made despite the level of support for this policy option demonstrated by survey respondents. Whatever the incentive structure, it is believed that the builder's willingness to install energy efficient equipment in new housing depends largely upon his perception of the consumer's willingness to pay a higher price for the sake of having such equipment preinstalled. Thus, the demand for energy efficient models among builders is likely to continue to be a derived demand based upon the level of consumer interest in such equipment. This conclusion supports the argument that policymakers can expect to impact the builder segment by motivating the consumer segment to purchase more energy efficient equipment. When the salience of energy efficiency among consumers increases, builders can be expected to respond in their own purchasing behavior.

B. Persuasive and Non-Financial Policies

Policy options which are both persuasive and non-financial in nature usually involve information delivery programs. As reported in Table VI-42, the policy options presented to survey respondents included a government sponsored information program in cooperation with trade associations to encourage the purchase of more energy efficient equipment by builders; an information program to educate consumers how to use and maintain equipment to maximize energy efficiency; energy usage labelling of equipment; and energy usage disclosures in manufacturer catalogues, price lists and promotional material. There were no statistically significant differences among the mean rankings of these four options. Among the nine policy options presented to survey respondents, the four information delivery programs ranked in the middle range in terms of likely level of energy savings.

A distinction must be drawn between programs designed to convey general information and programs designed to convey brand specific information. With respect to energy using equipment in the residential sector, general information programs (such as the first two mentioned above) may attempt to:

- Persuade the consumer that his/her contribution to energy conservation can be significant.

- Raise the salience of energy usage as a purchase criterion for energy using equipment.

- Indicate how different equipment options can be compared in terms of their energy usage.

- Suggest how energy may be conserved through proper use and maintenance.

Whereas general information programs are often overtly persuasive in nature, brand specific information programs are intended to provide consumers with objective information regarding the performance of specific brands on specific attribute dimensions of interest to the policymaker. Manufacturers of energy using equipment could be required to generate energy performance data for each of their models, and disclose this information on labels attached to each unit. Government agencies might provide summary lists of comparative performance data as is currently done in the case of automobile mileage ratings. The principal purposes of brand specific information programs are to:

- Raise the salience of energy usage as a purchase criterion for energy using equipment.

- Enable potential purchasers to readily compare brand alternatives on the energy usage criterion with a view to choosing more energy efficient models. Note that there is a risk that some consumers will perceive the label as legitimizing the product in question, and will not compare the data on the label from one brand to another.

The value of a labelling or disclosure program depends upon the existence of variations in energy efficiency among the brands within a particular product category. If such differences do not exist or are not perceived to exist, the label information will not be used by consumers. One additional objective of an information disclosure program is, therefore, to motivate manufacturers to develop more energy efficient products whose superior performance can be highlighted on the product label or in supporting manufacturer advertising.

It may be noted that the type of brand specific information required for a product labelling program is also a necessary prerequisite for other policy interventions discussed in this chapter. Any tax credit or sales tax program based upon the comparative energy performance of different brands within a product category requires that brand specific performance data be generated either by manufacturers, independent laboratories, or

government agencies. Similarly, the existence of product standards for energy using equipment requires that brands be tested to insure compliance with the standards. To the extent that energy performance criteria are now or in the future included in product standards, energy performance data must be collected for each brand. Thus, the incremental cost of implementing a labelling or other disclosure program in conjunction with one or more of these other policy interventions is not likely to be as great as if such a program is implemented in isolation.

General information programs and brand specific information programs are mutually reinforcing rather than mutually exclusive. Without general precepts and understanding, consumers are unlikely to be either able or motivated to use brand specific information. And general information is of little economic value to consumers if brand specific information is not available to permit it to be applied to purchase decision making. The introduction of any brand specific labelling program should, therefore, be accompanied by a general campaign to make consumers aware of the labelling program and of how to use the information (if, for example, the label information is presented in terms of annual operating costs or life cycle costs).

The stages involved in the design of any information delivery program, whether general or brand specific, are outlined in Figure VII-1. Three stages in this process - selection of target markets, messages, and media - are next addressed with specific reference to the objective of encouraging builders to purchase energy efficient equipment when available. Distinctions are drawn between general and brand specific information programs where appropriate.

Target market selection is designed to maximize the efficiency with which program objectives are achieved. Three target market options are available for a general information program to encourage builders to purchase more energy efficient equipment:

1. Builders: To convince one builder to emphasize energy performance in the many equipment selection decisions for which he is responsible each year can potentially result in much greater energy savings than can be achieved by convincing one consumer to do the same thing. The critical issue is how receptive the builder can be expected to be to an information campaign with this objective. It could be argued that his current emphasis on price rather than energy performance in purchase decision making is partly a function of such information not being readily available. However, given the number of decisions facing the builder in the construction of a new dwelling, and given the simplicity of

purchasing on a price basis, it seems unlikely that the time sensitive builder will change his purchasing pattern in response to an information campaign alone. There is less risk involved in specifying tried and tested equipment, and even less time to consider deviating from a straight rebuy purchasing formula when the residential construction industry is in an expansionary mode. Although some larger builders with sizeable staffs may be inclined to pay some attention to an information campaign directed at home builders, the building industry is so fragmented that the majority of new homes are constructed by small builders who would be less likely to have the time to pay attention to such a campaign. A recent information program sponsored by a major gas utility and directed at builders to persuade them to install higher levels of insulation in new housing units received little response. In the final analysis, if the builder cannot expect incremental profit from investing more time in the purchase decision making process for energy using equipment, no information campaign can be expected to have an impact.

2. Consumers: Given the percentages of annual purchases of water heaters, furnaces, and major kitchen and laundry appliances, made by consumers, it is possible to envisage an information delivery program targeted primarily at consumers which might also influence indirectly the imposed choice purchases of builders in two ways. First, builders are likely to be exposed to the information in their capacity as consumers. Second, to the extent that the salience of energy performance as a purchase criterion is increased among consumers as a result of an information campaign, builders may see an increasing opportunity to differentiate their new homes on the basis of preinstallation of energy efficient equipment.

3. Other Parties: The ability of other parties such as plumbing and heating wholesalers and contractors to influence builders to consider energy efficiency as a purchase criterion is limited because of the price basis for competition which permeates the entire channel of distribution. Manufacturer salesmen may be expected to highlight to the builder those of their products with an energy performance advantage, but competition at the manufacturer level is such that salesmen generally have neither the time nor the inclination to change a

manufacturer's purchasing criteria. One party, the consulting engineer, is not selling the builder equipment, but rather advice. As such, he is in a position to influence the builder to select a more energy efficient water heating or space heating system. However, consulting engineers are only hired by builders in the case of major apartment buildings. In conclusion, it would appear that any information campaign targeted at other parties in the purchase decision making process with a view to influencing builders to specify more energy efficient equipment could not be expected to be effective.

Following selection of a target market, it is necessary to next consider the appropriate source and content of the information message. Source credibility can influence the impact of a particular message on the target market. It is recommended that any government sponsored general information campaigns targeted at builders should be conducted under the auspices of appropriate trade associations whose source credibility might be higher. Cooperation of this nature between government agencies and trade associations would also help to insure a consistency in the information delivered to builders by the two groups. Unlike other policy interventions discussed in this chapter, information programs can be introduced by other parties besides government agencies. To minimize the possibility of conflicting messages confusing consumers and discouraging them from responding to the information, coordination among the various sponsors of information delivery programs is essential.

The detailed contents of any information programs designed to persuade builders to buy more energy efficient equipment are not discussed in this report. It should be emphasized, however, that information of this nature should be part of a complete information program covering all aspects of home design and construction which bear upon energy consumption. Such an approach may increase program effectiveness by minimizing the number of diverse communications directed at builders and by insuring a balance of emphasis among the many actions builders might take to improve the energy efficiency of their new dwellings.

Message content is as important a component of a brand specific information program as of a general information program. In the case of a labelling program, for example, the degree of complexity of the information to be provided must be determined along with the label size and presentation format. The Energuide labels on refrigerators sold in Canada show Kwh of electricity used per month on a sticker adhered to the inside door (thereby reducing the labels' attention-getting power). The United States

Department of Energy proposed appliance labels showing annual operating costs. Although this latter approach does not take into account inter-regional variations in utility rates, the information presented may be more immediately useful to the consumer. Consumer research with members of the target market is necessary to determine the manner in which energy performance information can most appropriately be presented.

The information content of the label may be constrained by the space available on the product. In contrast to food products, however, there is ample space available for energy performance information on the energy using products discussed in this study. Indeed, the space availability is such that policymakers may be tempted to overload the label to the extent that the consumer's willingness to pay attention to the label information is reduced.

The information conveyed on energy performance labels may differ among product categories but cannot be adjusted according to the target group. With general information campaigns, different messages essentially conveying the same information may be targeted at different groups. The energy performance label, however, is attached by the manufacturer at the factory, and must remain standardized across all units of a particular model. It cannot be tailored to the information needs of each of several target grops. An exploratory study into energy labelling of water heaters indicated that plumbers, builders, and consumers differed widely in their degrees of understanding of a particular label format.[2] Thus, it is essential that policymakers have a clear notion of their principal target audience when designing an energy performance label for a particular product.

In the case of brand specific information disclosure programs, the media vehicles used for dissemination of the information are largely determined by the nature of the disclosures. A labeling program necessarily implies using the product package as an information delivery vehicle. By way of contrast, general information can be conveyed through a wide variety of vehicles including print and electronic media. The media consumption habits of the target market, the complexity of the messages to be conveyed, and relative media costs are the principal determinants of the media selected.

Once an information program is implemented, results must be measured against program objectives in terms of changes in awareness, knowledge, attitudes, and behaviors of target consumers. On the evidence of studies regarding the effectiveness of labelling programs, a period of five years may elapse before widespread usage of label information is evident. Policymakers interested in achieving energy savings in the residential sector

should be cognizant of the need for sustaining information programs over several years before effectiveness can be maximized. One further constraint upon the rapidity of diffusion of label usage is the frequency with which a particular product is purchased. A consumer who purchases a food product once a week may be exposed to the nutrition label information quite frequently, in contrast to a consumer who purchases a water heater once every ten years. On the other hand, since the water heater is a substantially more expensive item, the consumer may at the time of purchase pay more attention to comparative label information despite the low frequency of purchase and exposure. The rapidity of diffusion of label usage is probably likely to vary among product categories and will be partly influenced by the level of awareness generated by a supporting general information campaign and, in the case of retail purchases, by the degree of interest and support generated among retail salespersons.

An energy performance labeling program is likely to have greater direct impact on the purchase selection processes of consumers in the retail segment of the market than on those of builders. Consumers are likely to pay considerable attention to a major appliance purchase and are likely to compare brands. Builders, with many precurement decisions to make and accustomed to purchasing on a price basis, are unlikely to closely evaluate the energy performance of alternative brands. Indeed, with the exception of a small builder buying equipment for preinstallation personally at the retail level, builders are unlikely to inspect alternative models and, therefore, see any labels which may be attached prior to making their purchase decisions.

But, whether or not energy performance labels have a direct effect on imposed choice purchases, they may be valuable for their indirect effects. In particular, the advent of energy performance labelling is likely to prompt some equipment manufacturers to attempt to upgrade their products. In this way, a labelling program may lead to more product differentiation on the basis of energy performance and this, in turn, may encourage further usage of labelling. Manufacturers may, at first, be cautious in their promotion of energy efficient models, despite the legitimation provided by the label, for the following reasons:

- Manufacturers of the three types of equipment addressed in this study are not used to engaging in aggressive advertising.

- Manufacturers do not want to be accused of exploiting through advertising the ignorance of consumers regarding the basis for energy performance computations.

- Most manufacturers are likely to have some "winners" and some "losers" in their current portfolios of products.

- Manufacturers may wish to avoid the possible energy performance "horsepower race" which could stem from the advertising of new energy efficient models.

At the same time, it is likely that energy performance labelling may prompt manufacturers of energy efficient models which, hitherto, may have been priced on an equivalent basis to less efficient models, to increase their prices accordingly.

In addition to its effect on product development and differentiation, energy performance labeling may indirectly impact builder decision making processes for energy using equipment through influencing consumers. If consumers can be sensitized to the fact that the energy consumption of different brands of a product may vary, a conservation conscious segment of consumers may begin to evaluate prospective homes, in part, on the energy efficiency of the installed equipment. Builders might respond by upgrading their preinstalled equipment in terms of its energy efficiency. In the case of discretionary equipment purchases including major kitchen and laundry appliances, they might respond to the broadening range of consumer preferences regarding energy efficiency by ceasing to preinstall such equipment.

The impact which changes in consumer decision making criteria may exert on builder purchasing patterns are likely to be greatest in the case of kitchen and laundry appliances. Consumers are familiar with these equipment categories and purchase them regularly in retail stores. However, only a minority of consumers are currently familiar with or purchase for themselves water heaters or furnaces and space heating equipment. Consumers are, therefore, more likely to be exposed to label information on kitchen and laundry appliances than on water and space heating equipment. However, it should be noted that the percentages of purchases of these two equipment categories being made by consumers at the retail level are increasing.

An energy performance labelling program is recommended, not so much for its direct impact on builder purchase decision making, but rather for its indirect effects including improvements in the energy efficiency of products on the market and its impact on consumer decision making to which builders must ultimately be sensitive. A cost benefit analysis of an energy performance labelling program in isolation might not prove favorable.[3] However, the brand specific information required for labelling and disclosure programs is also required for the effective

implementation of other policy interventions considered in this chapter. Therefore, it is recommended that the effects of an energy performance labelling program for each of the three equipment categories addressed in this study should be investigated in greater detail.

C. Mandatory and Financial Policies

A graduated sales tax was among the nine policy options presented to survey respondents. The effect would be that progressively less energy efficient models would carry a progressively higher tax. Thus, a financial disincentive would be created to discourage purchase of less energy efficient models.

As reported in Table VI-42, builders ranked this option low in terms of the level of energy savings it would generate if implemented. The low ranking of this proposal appears surprising, given the relatively high ranking accorded to the other financially based proposal included in the set of policy options - the tax credit program. The difference in reaction may be explained, in part, by the fact that a tax credit program is persuasive in nature whereas a sales tax is mandatory. A builder may choose whether or not he participates in a tax credit program, and such a program may be perceived by the builder as offering an incremental financial advantage if he adopts the suggested behavior pattern. On the other hand, a graduated sales tax program promises no incremental financial advantage. The builder must simply search for the least worst product option, given that all models within a particular product category will be subject to a greater or lesser tax. In order to effectively implement a graduated sales tax program for a particular product category, energy performance information similar to that which might appear on a product label would be required for all brands on the market. Apart from the time and other costs incurred by manufacturers or government financed testing laboratories in generating this information and subsequently testing for product quality, other difficulties may be noted:

- The establishment of the optimal sales tax schedule is likely to require considerable research and will vary from one product category to another. The sales tax schedule should serve as an incentive to manufacturers to concentrate their production on energy efficient models and as an incentive to builders, other intermediaries, and consumers to purchase these models. To avoid market distortions, it would probably be necessary to apply the same schedule to both the builder and consumer segments of a particular market, even though selling prices and price elasticities of demand may vary between these two segments.

- If the effect of a graduated sales tax is to raise the prices of less energy efficient models to a level equivalent to or greater than the prices of the more efficient models, the overall average price of the product will probably rise. The cost of new housing will correspondingly increase. Since water and space heating equipment are preinstalled and may, in any event, be treated as necessities, the sales tax would affect consumers on lower incomes to a proportionately greater extent.

- As the Energuide labelling program for refrigerators has suggested, there is unlikely to be a clear relationship within a particular product category between the energy efficiency of equipment options and their current prices. The manufacturer response to a sales tax program must be thoroughly assessed prior to its implementation. For example, if the program resulted in an increase in the average price of a product, consumers might be more inclined to substitute repairs of existing equipment for purchases of new equipment as replacements. Overall primary demand for the product would fall, causing manufacturers to increase prices in order to cover fixed costs on a lower unit sales volume.

- A graduated sales tax might be set either as an absolute sum or as a percentage of selling price related in either case to the energy performance of each model. If a percentage approach were to be used, it might be easier for manufacturers to adjust the prices and margins on their models in order to preserve existing price differentials, irrespective of the sales tax program. Without the cooperation of manufacturers, there is no assurance that a graduated sales tax would produce the desired changes in consumer behavior.

The principal argument in favor of the graduated sales tax as a policy option is that it focuses on the price variable to which builders are particularly sensitive. Unlike a tax credit program, a graduated sales tax does not depend for its effectiveness upon the willingness of builders to commit time and effort to information acquisition. However, the comparatively negative reaction of the builders towards the sales tax proposal, together with the implementation problems outlined above, suggest that it should not be considered further by policymakers.

D. Mandatory and Non-Financial Policies

The goal of making builders specify more energy efficient equipment in their imposed choice purchases can be achieved

through amending and upgrading the minimum energy usage performance standards for particular equipment categories, or through the creation of such standards where none exist. The feasibility of implementing such upgraded standards is a function of the ability of manufacturers to mass produce equipment which meets these standards and the willingness of other parties to incorporate these standards in national, provincial, and municipal building codes.

A summary outline of the standards setting process for residential energy using equipment is present in Figure VII-2. The initial stage involves Government funded agencies and trade association research institutes working with equipment manufacturers on the development of new energy efficient models. Since all three categories of energy using equipment discussed in this study are at the maturity stage of the product life cycle, competition between companies is principally on a price basis. Hence, only the largest Canadian companies have funds available for basic research. Those which are subsidiaries of U.S. manufacturers may obtain access to the results of their parent companies' research and development.

A manufacturer commonly constructs prototypes of a potential new product, installs them at selected sites, and tests performance over a period of time. If results are satisfactory, the manufacturer sets in motion the procedure which leads to a product certification indicating that the product complies with Canadian Standards Association performance and safety standards. If the new product incorporates technological innovations which require amendments to existing standards, the commercialization of the product is likely to be correspondingly delayed. Several manufacturers interviewed for this study indicated that the duration of the product certification and standards setting processes act as disincentives to new product development.

To some extent, the duration of the process is under the manufacturer's control. The manufacturer is responsible for the speed with which field testing and tooling for commercial production take place. In addition, there appears to be an unwritten custom in some industries that a new product standard will not be approved without the agreement of all manufacturers. While this approach protects the smaller manufacturer from the investment burdens of new product introductions, it does delay the pace of new product introductions within an industry.

However, the detailed nature of the evidence required before standards are set and products certified also bears heavily on the time needed before the process is completed. It is

essential that the opinions of all relevant parties be sought before standards are set and products certified, and this takes time. Sometimes, the criteria used by these parties do not take account of the growing importance of energy conservation and, as such, may deter the introduction of more energy efficient equipment. For example, approval of modifications to gas furnaces depends largely on the opinions of the Chief Gas Inspectors of the provinces who together form the Inter-provincial Gas Advisory Council. Their principal focus is on product safety and durability, not energy efficiency. It is likely that the product certification and standards setting processes will have to increasingly consider tradeoffs between safety and durability on the one hand and energy efficiency on the other.

While C.S.A. standards are increasingly addressing issues of energy performance, they are sometimes insufficiently comprehensive. Several standards have been promulgated for furnaces, but they have not indicated how furnaces should be sized for particular dwellings except to state that the sizing should be undertaken in accordance with good engineering practice. While there is always a tradeoff to be made between accuracy and simplicity in the formulation of standards and codes, omissions of this nature can create uncertainties which serve to deter manufacturers from product innovation.

Manufacturers are not only deterred from product innovation by apparent delays in the product certification and standards setting processes, but also by uncertainties as to whether new product standards will be incorporated in the national and provincial building codes. Because builders traditionally select equipment on a price basis, a manufacturer may see little promise of selling a higher priced more energy efficient model to the builder segment until the features of that model are presented in building codes.

Responsibility in this area rests with the National Research Council's Associate Committee on the National Building Code, representing manufacturers, builders, and government agencies, and its Standing Committee on Energy Conservation in Buildings. While the national code traditionally leads the provincial and municipal codes, inclusion of a new product standard in the national code is no guarantee of its adoption by the provinces and municipalities. On the basis of regional and local variations in fuel rates, climate, and other factors, it is likely that considerable local automony will continue in the area of building codes. Such autonomy presents a degree of uncertainty to the manufacturer considering the introduction of an energy efficient product, particularly when many provincial and municipal codes treat the energy efficiency of installed

equipment to a lesser extent than does the national code. Given the economic infeasibility of producing different models for different provinces, manufacturers pay special attention to the Ontario building code when formulating their product development strategies.

The gap between the national and provincial codes has recently been highlighted in the response to a set of guidelines on energy conservation in new buildings published by the Associate Committee on the National Building Code.[4] In cooperation with the Ontario Ministry of Energy, the Housing and Urban Development Association developed its own Builders Guide to Energy Efficiency in Housing in response to the Associate Committee's document on the grounds that its recommendations implied significant increases in house prices without appropriate cost benefit analyses having been conducted, and that it was too complex for builders to understand. As a result, the Associate Committee's recommendations have not yet been adopted in the Ontario building code.

Any amendment or addition to the National Building Code is usually followed by publication of a simplified Builders Bulletin by the Central Mortgage and Housing Corporation. Enforceable by the C.M.H.C. inspectorate, these Bulletins must be adhered to in the construction of all new houses financed under the National Housing Act. A declining percentage of new homes are N.H.A. financed since the ceiling on house prices to qualify for N.H.A. financing has not risen in line with inflation. However, many banks require that the houses which they finance meet C.M.H.C. standards. Thus, it would seem that, even if energy performance standards included in the National Building Code are not adopted in provincial and municipal codes, they could influence the construction of a large percentage of new housing units through C.M.H.C. Builders Bulletins. However, even the C.M.H.C. has not yet implemented the recommended measures for energy conservation in new buildings advocated by the Associate Committee on the National Building Code.

Standards for energy using products and for new housing design and construction have historically evolved out of a process of mutual cooperation and negotiation on the part of manufacturers, builders, and government agencies. To accelerate the process in response to the urgency of the energy situation will doubtless create strain. However, one advantage of standards as a policy intervention in comparison to other approaches is that the process is already understood and accepted by manufacturers and builders alike.

The existence of standards protects legitimate manufacturers from poorer quality imports or domestically made products, and insures

the safety of equipment sold in the marketplace. While the delays and uncertainties associated with the standards setting process may serve to deter product innovation, another deterrent is probably the ease with which a competitor can imitate any one manufacturer's attempt at product differentiation due to the mature state of the technology associated with each of the three equfpment categories addressed in this study. An energy efficiency "horsepower" power race among the major manufacturers within each equipment category, which could force smaller manufacturers out of business and prompt an overall increase in the price of equipment to consumers, appears unlikely. As it stands, the standards setting process enables new energy performance criteria to be gradually incorporated in product standards, without disrupting the price basis of competition among manufacturers.

Builders on occasion complain about particular building codes just as manufacturers on occasion complain about particular product standards. For example, the implementation of higher insulation requirements in new housing has resulted in roof shingles lifting and dry wall sagging. When standards and codes are being amended to address the energy issue, the total energy system of the home must be considered. Despite occasional errors of judgment in the specification of standards and codes, they offer several advantages to the builder. First, the builder who constructs a new dwelling in accordance with building codes is protecting himself as much as the prospective purchaser or tenant. Second, construction according to the codes minimizes the number of decisions the builder has to make. If the builder can be assured that his competitors are being forced to comply with the codes, his willingness to adhere to them is enhanced.

Builders are unwilling to specify more energy efficient equipment in the construction of new housing units built on speculation because of their uncertainty that the incremental cost of such equipment will be readily assumed by prospective purchasers. If, however, building codes are rewritten to specify the preinstallation of such equipment, builder opposition is likely to be minimal. Since all builders would have to comply with the revised code, no one builder would be placed at a competitive disadvantage. Within the parameters stipulated in the revised code, builders could continue to purchase their equipment for preinstallation on the simple price basis which they currently use. And they would not be obliged to spend time obtaining information on how to compare the energy efficiencies of different models within an equipment category in order to make a contribution towards energy conservation. The only cost to the builder involved in an upgrading of standards is any additional

carrying cost involved between purchase and sale of the higher priced more energy efficient equipment.

As reported in Table VI-42, builder respondents to the questionnaire ranked raising the energy efficiency performance standards for equipment as the intervention likely to result in the most energy savings. Such standards would be applicable to models sold through both the builder segment and the retail segment of the market. Any attempt to apply standards to equipment preinstalled in new housing which did not also apply to equipment sold to the retail segment might result in distortions in the current patterns of marketing, at least in the cases of kitchen and laundry appliances where preinstallation is discretionary. For example, to mandate that refrigerators installed in new housing be of the manual defrost rather than frost free variety in the interest of energy conservation would probably prompt a substantial reduction in the number of new housing units sold with refrigerators preinstalled.

Product standards apply equally to the builder and retail segments. Whereas it is expected that the builder segment will lag the retail segment in its adoption of more energy efficient equipment if the market is permitted to operate freely, the gradual upgrading of product standards in the area of energy usage will necessarily result in simultaneous adoption by both segments.

Since product standards and building codes are familiar to both manufacturers and builders, it is recommended that the Federal Government thoroughly evaluate the processes by which products are certified and standards and codes are set to minimize delays and uncertainties which may discourage manufacturers from developing more energy efficient products, and to maximize the speed with which energy efficient equipment is adopted by the builder segment. An intensive analysis should be undertaken of how current product standards and building codes could best be revised to both reflect recent technological improvements in the efficiency of energy using equipment and to maximize the cooperation of builders, manufacturers, and government agencies.

In addition to evaluating current product standards, government agencies should consider the possibility of establishing or assisting in the establishment and publicizing of an Energy Efficient Home Certification Program. Such a Program is currently being developed by the Canadian Electrical Association and sponsoring utilities. Applicable to both new and existing homes, the Program delineates the specifics of a merit points system against the criteria of which the features of any dwelling unit can be evaluated. Included in the criteria are product performance standards for water heaters, space heating

equipment and furnaces, and major kitchen and laundry appliances. To the extent that preinstallation of energy efficient equipment can add to a home's total points score and increase the chances of the home receiving the certification, a builder may be encouraged to adopt more energy efficient models even if they are higher priced than standard models.

E. Summary of Recommendations

This report has indicated that the annual energy consumption of equipment purchased in 1978 on an imposed choice basis represents 48 percent of the energy consumption attributable to all 1978 purchases of equipment within the three specified product categories. In addition, the annual energy consumption of 1978 imposed choice purchases represents a significant 3.1 percent of total secondary energy consumption within the residential sector. Substantial energy savings could result from the application of known design modifications to commercial models of all three categories of equipment. The issue for policymakers is what, if any, action they should take to promote the development and commercial production of such upgraded models and to encourage their adoption by builders and consumers. Both segments of the market must be considered in the setting of policy, and it should be recognized that the retail segment (where consumers are principally responsible for decision making) is likely to lead the builder segment in the adoption of energy efficient models.

Builder respondents to the survey indicated that the upgrading of energy performance standards would be the policy option likely to produce the greatest energy savings. Thus, it is recommended that the Federal Government thoroughly review the product standards for the equipment categories addressed in this study to determine whether the energy performance components should be upgraded. In addition, the process whereby product standards are established should be reviewed to minimize the delays and uncertainties which may deter manufacturers from developing and marketing energy efficient models. Finally, the Federal Government should investigate whether upgraded product standards can be incorporated more rapidly into the National and Provincial building codes as a result of process or organizational improvements.

Upgraded performance standards would apply to equipment destined for both the retail and builder segments of the market. Procedures for setting standards are already in place. Manufacturers are familiar with and responsive to the concept of upgrading standards for energy efficiency. Builders have few objections to the principle of setting standards for energy using equipment or of incorporating such standards in building codes;

since compliance is mandatory no builder is placed at a competitive disadvantage in terms of his construction and equipment costs.

In two areas, the Federal Government may attempt to directly influence imposed choice purchases through the use of product standards. First, Federal Government procurement contracts for energy using equipment to be installed in new public housing could include energy performance specifications. All residential construction financed under the National Housing Act could also be required by the C.M.H.C. to have equipment installed which meets these specifications. Second, the Federal Government can use moral suasion and other forms of leverage, to attempt to persuade the utilities to become early adopters of the more energy efficient models which appear on the market.

With respect to standards for housing as opposed to for products, it is recommended that the Federal Government support the development of a Certification Program for Energy Efficient Homes which would incorporate certain standards for the efficiency of preinstalled energy using equipment and which could, if implemented, sensitize consumers to acquiring a home with this Certification. Through consequent market pressures, builders might be encouraged to specify energy using equipment with a view to insuring that their new homes received the Certification.

Such interaction between the builder and consumer segments of the market may also occur in the area of information programs General information programs directed at consumers should raise the salience of energy conservation; educate them towards a greater understanding of the percentages of residential sector consumption accounted for by space heating, water heating, and major appliances; and indicate the energy savings which can accrue from regular equipment maintenance, thereby reducing some of the "mystery" associated with furnaces and water heaters. If such information programs raise the salience of energy efficiency as a decision making criterion for consumers, when purchasing new homes they may increasingly question builders on the energy efficiencies of preinstalled equipment and treat the quality of this equipment as an indicator of the overall quality of the dwelling. As a result, builders may increasingly be encouraged to install more energy efficient equipment in their new housing.

In the area of general information programs directed specifically at builders, it is recommended that any Federal Government initiatives be taken in cooperation with the Housing and Urban Development Association of Canada (and, in Quebec, with the Provincial Home Builders Association) to maximize source credibility, to insure effective information delivery, and to

insure consistency of the information communicated with that supplied to builders through other trade association information programs. Further, it should be noted that there may be actions other than the purchase of energy efficient equipment which builders can take when designing and constructing new residential housing offering potentially greater energy savings. Information regarding the energy performance of equipment options should, therefore, be incorporated into a broader information program dealing with all aspects of housing design and construction related to energy conservation.

Energy performance labelling, similar to the Energuide labels now applied to new refrigerators, should be considered for all categories of energy using equipment. Although such labels may not directly impact the decision making processes of builders in imposed choice purchases, they could influence purchases by consumers. To the extent that the salience of energy efficiency as a purchase criterion is increased among consumers as a result of energy labelling, market pressures may cause builders to consider comparative energy efficiencies along with prices in their purchase decision making. Furthermore, a labelling program would prompt equipment manufacturers to closely scrutinize the energy performance of their existing models. Labelling would probably accelerate the introduction and facilitate the marketing of more energy efficient models. Finally, it should be noted that the brand specific energy performance information which must be generated for a product label is also a necessary prerequisite for the effective implementation of most other possible policy interventions. Any cost benefit analysis of energy performance labelling should take this fact into account.

Despite builder interest in a tax credit program, the use of financial incentives and disincentives to influence imposed choice purchases is not recommended. Any incentives are likely to be too small to persuade the builder to devote additional time to the decision making process with respect to these equipment purchases. The effectiveness of an incentive such as a tax credit program depends upon whether the builder believes that he can pass on to home buyers any incremental costs associated with the purchase of more energy efficient equipment as well as gain the tax credit. Other problems associated with the implementation of (dis)incentive programs include the absence of a clear relationship within a particular product category between the energy efficiency of equipment options and their prices. In addition, any incentive program might encourage manufacturers to price their energy efficient models higher than would otherwise be the case because, if adopted, the incentive could reduce the builder's price sensitivity.

In order to adequately consider these and other policy options, it is essential that policymakers thoroughly understand the complexities of the distribution channels for each of the three categories of energy using equipment addressed in this study. Prior to implementation, the implications of any policy option for all parties in the distribution channel and their likely responses should be ascertained through consultation.

Notes to Chapter VII

1. John L. Evans, J.R. Brent Richie, and Gordon H.G. McDougall, "Energy Use and Consumer Behavior: A Framework for Analysis and Policy Formulation," unpublished working paper, November, 1978.

2. Brown, Gary L., Robert L. Hiett, and M. Dean Havron, A Study to Evaluate NBS Developed Labels for Water Heaters, Prepared by Human Sciences Research Inc. for the National Bureau of Standards, Washington, D.C., June, 1975.

3. For an application of cost-benefit analysis to an energy performance labelling program, see Ron Hirschhorn, "A Case Study of the Proposals for Energy Consumption Labelling of Refrigerators," Working Paper No. 1, Economic Council of Canada, October, 1978.

4. National Research Council of Canada, Measures for Energy Conservation in New Buildings 1978, issued by the Associate Committee on the National Building Code, NRCC No. 16574, 1978.

TABLES

Table IV-1

Comparative Gas Water Heater Performance

	Standard Model	Commercial Energy Saving Model	CGRI Torpedo Model	CGRI Special Model
Capacity (imp. Gal.)	33.3	33.3	33.3	33.3
Input (M BTU/HR	40.0	32.5	36.0	33.5
Insulation (inches)	1	2	2	2
Thermal Efficiency	70%	77%	82%	85%
Standby loss	6.8%	5.1%	4.4%	3.5%
Degree Gallon Capacity	82%	72%	79%	83%

Source: CGRI

Table IV-2

Design Features of the New CGRI Water Heater

1. Shield to deflect heat away from top circular weld.
2. Plastic-lined anode/hot water outlet combination fitting.
3. Wide centre flue with special baffles for highest extraction of heat from flue gases.
4. Patented CGRI polarized magnesium anode for maximum protection of tank surfaces.
5. Double thickness insulation to minimize heat losses.
6. Special position of thermostat to reduce stacking.
7. Easily accessible primary air adjustment for combustion tuning.
8. Mini-pilot of stable design and low input to minimize gas consumption on standby.
9. Placement of secondary air entry to maximize preheating of secondary air.
10. Radiation shield to permit installation on combustible floors.
11. Drain combined with zinc probe for verification of corrosion protection.
12. Cold water inlet diffuser for best reliable temperature distribution.
13. Corrosion resistant plass enamel lining.
14. Plastic coated T & P valve for superior safety performance.
15. New draft diverter design to minimize loss of heated room air.

Source: CGRI

Table IV-3

Energy Saving Options for Gas-Fired Water Heaters

	Approximate Energy Savings	
	F.E.A.	Wilson
Increased flue baffling (natural draft).		6%
Forced draft with increased flue baffling.		10%
Continuous pilot modifications:		
a) Reduced energy input from pilot	2%	2%
b) Automatic ignition		5%
c) Automatic ignition with flue closure		14%
Improved insulation of the storage tank (e.g. two inches added fiberglass)	8%	8%
Reduced factory setting of the thermostat (20^{o}F) and a detent on the controls at this setting	6%	6%
Preheat tank using waste heat		11%
Instantaneous heater with forced draft and automatic ignition		40%
Automatic off periods with automatic ignition		13%
Indirect heater with forced draft and automatic pilot		27%
Sealed combustion system		--
Reduced scaling/degradation		50%
Condensation of flue gases		9%
Heat traps in the cold water inlet and hot water outlet piping	1%	
Improved heat transfer	6%	

Sources: Federal Energy Administration, "Energy Conservation Program for Appliances", Federal Register, 42:136 (July 15, 1977), Part III, 36671-2 and R.P Wilson Jr., "Energy Conservation Options for Residential Water Heaters", Energy, 3 (1978), 156-157.

Table IV-4

Projected Evolution of Gas-Fired Water Heaters

Time Frame for Market Introduction	Stage	Daily Energy Consumption	Recovery Efficiency E_r	Standby Loss S	Available Options Employed to Achieve E_r and S
1972	Baseline	102,000 Btu	72%	6%/hr	--
1976	First Generation Energy Conserving	85,000 Btu (17% Energy Savings)	77%	3.5%/hr	• Combination of the following: - reduce pilot - thermostat setback to 140°F. - increased flue bafflir to reduce stack temperature and reduce excess air. - Eliminate leaks - increase insulation
1980	Second Generation Energy Conserving	66,000 Btu (35% Energy Savings)	84%	1%/hr	• Electric pilot, increased flue baffle, forced draft, flue damper, 3" insulation. or;
		61,000 Btu	84%	0%/hr	• Instantaneous heater, probably for combined water/space heating.

Source: R.P. Wilson, Jr., "Energy Conservation Options for Residential Water Heaters," Energy, (1978), 156-157.

Table IV-5

Energy Saving Options for Electric Water Heaters

	Approximate Energy Savings	
	F.E.A.	Wilson
Improved insulation of the storage tank (e.g. two inches added fiberglass).	8%	8%
Reduced factory setting of the thermostat (20°F) and a detent on the controls at this setting.	5%	5%
Heat traps in the cold water inlet and hot water outlet piping.	2%	
Preheat tank using waste heat		13%
Solar preheat		40%
Heat pump		50%

Sources: Federal Energy Administration, "Energy Conservation Program for Appliances", Federal Register, 42:136 (July 15, 1977), Part III, 36671-2 and R.P. Wilson Jr., "Energy Conservation Options for Residential Water Heaters," Energy, 3 (1978), 156-157.

Table IV-6

Projected Evolution of Electric Water Heaters

Time Frame for Market Introduction	Stage	Daily Energy Consumption	Options Employed
1972	Baseline	18.0	--
1976	First Generation Energy Conserving	16.2 kwh (10% Energy Red.)	• Insulation increased. • Thermostat to 140°F.
1980	Second Generation Energy Conserving	10.8 kwh (40% Energy Red.)	• heat pump • solar preheat tank.

Source: R. P. Wilson, Jr., "Energy Conservation Options for Residential Water Heaters," Energy, (1978), 156-157.

Table IV-7

Energy Saving Options For Oil-Fired Water Heaters

	Approximate Energy Savings F. E. A.
Improved insulation of the storage tank (e.g. two inches added fiberglass)	8%
Reduced factory setting of the thermostat (20^{0}F) and a detent on the controls at this setting.	5%
Ignition system improvements	2%
Combustion and burner efficiency improvements	2.6%
Improved heat transfer	1.3%
Heat traps in the cold water inlet and hot water outlet piping	1%

Source: Federal Energy Administration, "Energy Conservation Program for Appliances," Federal Register, 42:136 (July 15, 1977), Part III, 36671-2 and R.P. Wilson Jr., "Energy Conservation Options for Residential Water Heaters," Energy, (1978), 156-157.

Table IV-8

Potential Energy Savings By Type of Water Heater

	Percentage of Total Canadian Stock (1)	Percentage of 1978 Unit Sales (2)	Potential Energy Savings (1972 base) (3)
Electric Water Heaters	52%	65%	15%
Gas-Fired Water Heaters	34%	33%	20%
Oil-Fired Water Heaters	12%	2%	19%

Sources: (1) Statistics Canada, Household Facilities and Equipment, May 1978, p.23.

(2) Manufacturer interviews.

(3) Federal Energy Administration,"Energy Conservation Program for Appliances," Federal Register, 42:136 (July 15, 1977), Part III, 36651-2.

Note: Although a more viable proposition for water heating than for space heating, solar water heating is not yet a factor in the marketplace.

Table IV-9

Principal Heating Equipment, By Fuel, Canada, May 1978

(Estimates in thousands of households)

FUEL	TOTAL HOUSEHOLDS	STEAM OR HOT WATER FURNACES	HOT AIR FURNACES		HEATING STOVES	ELECTRICITY	COOK STOVES OR RANGES	OTHER
			FORCED	OTHER				
TOTALS:	7,320	1,654	3,781	230	431	1,142	68	13
Oil or other liquid fuel	3,189	1,000	1,770	119	268	---	29	---
Piped Gas	2,721	644	1,901	86	78	---	---	---
Bottled Gas	55	---	36	5	10	---	---	---
Electricity	1,188	---	44	---	---	1,142	---	---
Coal or Coke	32	---	5	---	18	---	---	---
Wood	133	---	25	19	55	---	26	---
Other	---	---	---	---	---	---	---	---

Source: Statistics Canada, Household Facilities and Equipment, December, 1978, p. 20.

Table IV-10

Housing Units Completed in 1978 Classified by Type of Space Heating Equipment

HOUSING CATEGORY	COMPLETIONS IN 1978	TYPE OF SPACE HEATING EQUIPMENT			
		BASEBOARD ELECTRIC	HOT WATER FURNACE	FORCED AIR FURNACE	BOILER SYSTEM
SINGLE DETACHED	106,195	5,310 (5%)	29,260 (28%)	71,625 (67%)	-
SEMI-DETACHED/ DUPLEX	19,155	960 (5%)	5,360 (28%)	12,835 (67%)	-
ROW	26,644	1,332 (5%)	6,930 (26%)	17,050 (64%)	1,332 (5%)
APARTMENT	94,539	61,450 (65%)	1,130 (1%)	2,700 (3%)	29,259 (31%)
TOTAL	246,533	69,052 (28%)	42,680 (17%)	104,210 (42%)	29,391 (12%)

Table IV-11

CGRI Furnace Features

1. Electric Ignition - Eliminates off-time pilot consumption.
   - Reduces corrosion problems, and so extends economic life.

2. Burner - Uses a conventional atmospheric oil power burner for low cost operation.
   - Can be adapted to incorporate a sealed combustion system.

3. Heat Transfer - A drum type heat exchanger maximizes heat transfer with minimum corrosion.
   - A secondary heat exchanger condenses the water in the combustion products and recovers the low temperature heat.

4. Extraction System - Eliminates off-time heat losses and the need for a chimney.
   - Improves the performance of the heat exchanger.

Source: CGRI

Table IV-12

Energy Saving Options for Oil-Fired Furnaces

	Approximate Energy Savings
Improved burner performance (including high speed flame retention burners and smaller burner heads)	14-20%
Thermostat cut-back (moderate/severe)	7-15%
Reduced firing rate	9%
Positive chimney damper to reduce "off" cycle losses from furnace and ventilation losses in venting system	3- 9%
Increased thermostat anticipator	0- 2%

SOURCE: A.C.S. Hayden, R.W. Braaten, and T.D. Brown "Emissions and Energy Conservation in Residential Oil Heating," Journal of the Air Pollution Control Association, 28:7 (July 1978), 669-672.

Table IV-13

Energy Consumption of Major Kitchen and Laundry Appliances Sold in 1978

Appliance	Total Unit Sales[1]	Builder Segment Unit Sales[2]	Annual Kwh Energy Usage[3]	Annual Energy Consumption[4] (million Btu)	
				Total Sales	Builder Sales
REFRIGERATORS[5]					
Frost free	473,100	78,740	1,200[6]	1,937,514.8	322,468.6
Manual defrost	142,900	48,260	850	414,535.8	139,996.5
RANGES[7]					
Electric:					
Self-cleaning	109,200	14,400	1,250	465,847.2	61,430.4
Not Self-cleaning	397,800	105,600	1,200	1,629,134.2	432,470.0
Gas:	25,000	5,900[8]	3,080[9]	262,785.6	62,017.4
DISHWASHERS	291,000	30,000[10]	300	297,937.4	30,715.2
AUTO WASHERS[11]	(454,550 (18,450 (coin)	(18,920 (4,725 (coin)	90 90	145,282.9	7,227.3
CLOTHES DRYERS					
Electric	(376,160 (12,840	(19,840 (3,210 (coin)	900 900	1,194,821.3	70,798.5
Gas	(8,770 (4,230	(660 (110 (coin)	2,800[12] 2,800	124,225.9	7,358.0
TOTALS:	2,314,000	330,250 (14.3%)		6,472,085.1	1,134,481.9 (17.5%)

Notes:

1. Source: Canadian Appliance Manufacturers Association, Major Appliances: Industry Forecast 1979.

2. Source: Canadian Appliance Manufacturers Association, Major Appliances: Industry Forecast 1979, unless otherwise noted.

(cont'd)

Notes to Table IV-13 (cont'd)

3. Unless otherwise noted, the source for these energy consumption estimates was the 100 Ways to Save Energy publication of the Office of Energy Conservation, Energy Mines and Resources Canada.

4. Expressed in million B.T.U.'s.

5. In terms of total unit sales, C.A.M.A. estimates that 23.2 percent of refrigerators sold in 1978 were manual defrost. However, one industry representative estimates that 38 percent of refrigerators sold in 1978 to the builder segment were manual defrost.

6. Energy consumption estimates are for twelve cubic feet frost free and manual defrost refrigerators.

7. C.A.M.A states that 21.5 percent of the 508,000 electric ranges sold in 1978 were self-cleaning. One industry representative estimates that 12 percent of electric ranges sold into the builder segment were self-cleaning.

8. The ratio of builder segment sales to total sales is assumed to be the same for gas and electric ranges.

9. Based upon consumption of 10.2 MCF of natural gas per range. Source: Union Gas Ltd., Energy Costs and Efficiencies, p.2.

10. Industry source estimate. No estimate is provided in the C.A.M.A. forecast.

11. The C.A.M.A. forecast estimates that 4 percent of total industry sales of 473,000 units were to the builder segment, and that 3.9 percent of unit sales were coin-operated units. It is assumed that 25 percent of the coin operated units were installed in the laundry rooms of apartment buildings and other residential housing either by the builder or by a laundry room operator contracted by the builder or landlord. This same assumption is applied to sales of electric and gas clothes dryers. In this case, C.A.M.A. estimates the builder segment at 5.1 percent and the coin-operated segment at 3.3 percent of unit sales.

12. Based upon annual consumption of 9.3 MCF of natural gas per clothes dryer. Source: Union Gas Ltd., Energy Costs and Efficiencies, p. 2.

Table IV-14

Energy Saving Design Options For Refrigerators

	Approximate Energy Savings		
	F.E.A.	Hoskins	Dewees
Improved compressor motor efficiency (1,2,3)	9%	13%	12%
Eliminate condensor fan motor (1)	1%		
Improved insulation (1,2,3)	12%	22%	22-33%
Improved door seals and cabinet throat design (1,3)	4%		2%
On-off control switch for the antisweat heater when used as a condensation control device (1,2,3)	6%	19%	12%
Increase the evaporator surface to reduce temperature drop and increase condenser surface to reduce the mean temperature rise (2,3)		10%	8%
Relocate the evaporator fan outside the cold space (2)		2%	
Better refrigerant (3)			4%
Eliminate the butter compartment (4)		1%	

Sources: (1) Federal Energy Administration, "Energy Conservation Program for Appliances", Federal Register, 42:136 (July 15, 1977), Part III, 36650.

(2) Robert A. Hoskins, Eric Hirst, and W.S. Johnson, "Residential Refrigerators", Energy, 3 (1978), p. 43-49.

(3) D.N. Dewees, "Energy Conservation in Home Refrigerators," January, 1977

(4) Manufacturer interviews

Table IV-15

Energy Saving Design Options For Ranges

	Approximate Energy Savings
A. ELECTRIC	
Increase insulation in oven walls (1)	3%
Improve oven door seals (1)	1%
Lower wattage, recess elements (2)	N/A
Shallower drip pans (2)	N/A
Eliminate preheat oven (2)	N/A
B. GAS	
Elimination of continuous burning pilot (1)	47%
Reduction of flue gas losses from oven (1)	4%

Sources:

(1) Federal Energy Administration, "Energy Conservation Program for Appliances", Federal Register, 42:136 (July 15, 1977), Part III, 36654,

(2) Manufacturer interviews.

Table IV-16

Energy Saving Design Options for Dishwashers

	Approximate Energy Savings
A switch to deactivate optional hot drying after last rinse and before drying heater is activated. (1)	3%
Elimination of one rinse cycle from normal wash cycle (1)	5.6%
Changing the water chamber geometry to lower water usage (1)	7.1%
Improvement in accuracy of water fill controls to prevent overfilling (1)	3.9%
Reduce hot water from 150^{o} to 135^{o} and change detergent (2)	N/A
Discontinue booster element (2)	N/A

Sources:

1. Federal Energy Administration, "Energy Conservation Program for Appliances", Federal Register, 42:136 (July 15, 1977), Part III, 36650.

2. Manufacturer interviews

Table IV-17

Energy Saving Design Options For Clothes Washers

	Approximate Energy Savings
Elimination of warm rinse by closing off hot water part and only supplying cold water during a rinse cycle (1)	23.6%
Reduction of water temperature at the warm temperature setting of the wash cycle (1)	8%
Lengthen the presoak cycle (2)	N/A
Suds-saver feature (2)	N/A

Sources:

1. Federal Energy Administration, "Energy Conservation Program for Appliances", Federal Register, 42:136 (July 15, 1977), Part III, 36655
2. Manufacturer interviews

Table IV-18

Energy Saving Design Options For Clothes Dryers

	Approximate Energy Savings
A. ELECTRIC	
Insulation of inside surfaces (1)	5%
Improvement of electric heating element efficiency through design changes which improve the heat transfer characteristics between the heating surface and dryer drum (1)	2%
Reduction in element rating (2)	N/A
Larger drums (2)	N/A
Increase drum speed (2)	N/A
Reclaim heat and recirculate (2)	N/A
B. GAS	
Eliminate gas pilot and use automatic ignition (1)	15%

Sources:

1. Federal Energy Administration, "Energy Conservation Program for Appliances", Federal Register, 42:136, (July 15, 1978), Part III, 36650.

2. Manufacturer interviews.

Table IV-19

Energy Consumption Estimates for 1978

(million Btu)

	Installations in the Total Housing Stock	Installed Equipment sold in 1978	Imposed Choice Installations in 1978
Space Heating	857,584,440.870[1]	48,138,368.950[2]	28,882,904.220[3]
Water Heating	220,521,705.100[4]	23,291,882.080[5]	7,427,032.449[6]
Major Kitchen and Laundry Appliances	98,009,646.670[7]	6,472,085.100[8]	1,134,481.900[9]
TOTAL	1,176,115,792.640 (96.0%)[10]	77,902,336.130 (6.4%)[11]	37,444,418.560 (3.1%)[12]

Notes to Table IV-19

1. An assumption has been made that 70 percent of annual Canadian secondary residential sector energy consumption is accounted for by space heating. This figure represents 70 percent of a total 1,225,120,617 million Btu estimated for 1978 residential sector consumption. Alternatively, the figure reflects an estimated annual household energy consumption for space heating of 117,156,341 Btu for 7,320,000 Canadian households.

2. Industry estimates suggest that 60 percent of the space heating equipment sold in 1978 was installed in new housing, the remaining 40 percent sold to replace equipment in existing housing. Since 246,533 dwelling units completed in 1978 had space heating installed, it is estimated that an additional 164,191 dwelling units were installed with replacement equipment. Assuming annual household energy consumption for space heating of 117,156,341 Btu, the equipment sold in 1978 and installed in a total of 410,724 dwelling units would account for 48,138,368.950 million Btu on an annual basis.

Notes to Table IV-19 (cont'd)

3. Based on an estimated annual household energy consumption for space heating of 117,156,341 Btu for 246,533 dwelling units completed in 1978.

4. Based on an estimated annual household energy consumption for water heating of 30,125,916 Btu for 7,320,000 Canadian households.

5. In 1978, 169,000 tank type water heaters sold for installation in new housing served a total of 246,533 dwelling units. Applying this same ratio, the total of 530,000 tank type water heaters sold in 1978 are assumed to have served a total of 773,151 dwelling units, each consuming 30,125,916 Btu annually for water heating purposes.

6. Based on an estimated annual household energy consumption for water heating of 30,125,916 Btu for 246,533 dwelling units completed in 1978.

7. An assumption has been made that 8 percent of annual Canadian secondary residential sector energy consumption is accounted for by major kitchen and laundry appliances. This figure represents 8 percent of a total 1,225,120,617 million Btu estimate for 1978 residential sector consumption.

8. From Table IV-13.

9. From Table IV-13.

10. The percentage of total secondary residential sector energy consumption in 1978 accounted for by the three equipment categories under study.

11. The percentage of total secondary residential sector energy consumption in 1978 accounted for by 1978 sales of the three equipment categories (on an annual basis).

12. The percentage of total secondary residential sector energy consumption in 1978 accounted for by 1978 imposed choice purchases of the three equipment categories (on an annual basis).

Table V-1

Percentages of Intermediaries Making Final Purchase Decisions For Major Kitchen and Laundry Appliances Installed in New Housing

	Single Family Dwellings	Multiple Family Dwellings
Vendor/Landlord	56	61
Developer	5	37
Architect	0	2
General Contractor	22	7
Contractor	9	0
Not Stated	14	7

Note: The sum of the percentages in each column exceeds 100 due to multiple responses.

Source: Maclean-Hunter Research Bureau, Survey of Buying Influences in Canada's Building Construction Industry - 1975

Table VI-1

Number of Housing Units Constructed by Respondents' Firms During 1978

(Question 6: N = 475)

	Percentages of Respondents				
	0 to 5 Units	6 to 20 Units	21 to 50 Units	51 to 100 Units	Over 100 Units
Single Detached	36.8	35.2	12.6	6.5	8.8
Duplex (Units)	83.1	6.9	4.2	3.6	2.1
Row Housing (Units)	86.5	3.4	2.5	3.6	4.0
Apartment (Units)	82.5	2.5	3.4	4.8	6.7

Note: To be read (for example): 36.8% of respondents reported that their firms built 0 - 5 single detached units during 1978.

Table VI-2

Crosstabulation of "Building Firm Also Acts as Landlord"

with Builder Size

(N = 366)

Building Firm Also Acts As Landlord	Builder Size	
	SMALL	LARGE
YES	65	103
NO	195	103

X^2 = 30.08386, d.f. = 1, significance = 0.001

Note: A small builder is defined as a respondent who, in answer to Question 6, checked no more than one housing category in the 6-20 units range, and checked the 0-5 units range for the three remaining housing categories. Respondents meeting this definition constitute 55.5 percent of the sample, the remaining 45.5 percent being defined as large builders. The bases for this classification of respondents' firms into large and small categories hold constant for all subsequent uses of the Builder Size variable.

Table VI-3

Profile of Respondents

A. ROLE WITHIN FIRM (Question 4: N = 470)

	%
General Management	91.2
Engineering	1.1
Marketing/Sales	3.6
Purchasing	3.4
Other	0.8

B. LOCATION OF HEAD OFFICE (Question 5: N = 475)

	%
British Columbia	11.6
Maritimes	2.9
Ontario	44.0
Prairies	21.7
Quebec	19.8

Table VI-4

Personal and Household Behavior Related to Energy Consumption: Frequency Distribution of Responses

(Question 1)

PERSONAL AND HOUSEHOLD BEHAVIOR	Percentages of Respondents				
	YES	NO	NOT APPLICABLE	DON'T KNOW	N
a. It's probably not that difficult to reduce the amount of energy I use.	74.8	22.8	0.2	2.2	464
b. I have read a Government publication on Energy Conservation.	75.0	23.5	0.6	0.9	468
c. In the last year, we have spent more than $100 on insulation for our home.	39.6	52.6	7.7	0.2	470
d. The present car I own is smaller than the last car I owned.	38.9	57.1	3.4	0.6	471
e. In the last twelve months, I have had my car tuned up at least twice.	61.8	36.9	1.3	0.0	471
f. I keep a record of the amount I spend on gasoline for my car.	62.7	35.8	1.3	0.2	472
g. In the last year, I have kept the thermostat lower than the year before.	60.4	39.0	0.4	0.2	472
h. Every year we add up our heating bills to find out how much it cost to heat our home.	63.7	34.0	2.1	0.2	471
i. In the last year, the furnace in our home has been modified to increase its efficiency.	12.8	66.8	19.8	0.6	475
j. In the last year, the filters in our furnace have been changed or cleaned at least twice.	65.5	9.8	24.7	0.0	475

Table VI-5

Percentages of Subjects Responding Affirmatively to Attitude Statements by Location of Respondents' Firms

	Atlantic Provinces	British Columbia	Ontario	Prairie Provinces	Quebec	N
a. It's probably not that difficult to reduce the amount of energy I use.	61.5	80.8	76.5	82.8	69.7	453
b. I have read a Government publication on Energy Conservation.	84.6	79.2	81.2	71.0	67.7	461
c. In the last year, we have spent more than $100 on insulation for our home.[1]	53.8	31.5	43.0	36.9	38.0	469
d. The present car I own is smaller than the last car I owned.	61.5	45.5	42.3	38.4	32.6	452
e. In the last twelve months, I have had my car tuned up at least twice.	38.5	61.8	63.7	57.4	69.6	465
f. I keep a record of the amount I spend on gasoline for my car.[1]	53.8	67.9	71.4	60.4	48.9	465
g. In the last year, I have kept the thermostat lower than the year before.[2]	84.6	61.8	69.7	44.6	54.3	469
h. Every year we add up our heating bills to find out how much it cost to heat our home.[3]	69.2	61.8	80.6	35.0	65.9	460
i. In the last year, the furnace in our home has been modified to increase its efficiency.	15.4	11.1	13.2	14.6	10.9	467
j. In the last year, the filters in our furnace have been changed or cleaned at least twice.[4]	53.8	63.6	72.0	82.5	34.8	470

Note: To be read (for example): 61.5 percent of respondents whose firms were headquartered in the Atlantic Provinces agreed with statement (a).

(cont'd)

Table VI-5

Percentages of Subjects Responding Affirmatively to Attitude Statements by Location of Respondents' Firms

(cont'd)

[1]A crosstabulation of positive and negative responses to this statement by location of respondents' firms yielded $X^2 = 15.34922$, d.f. = 4, significance = 0.005.

[2]A crosstabulation of positive and negative responses to this statement by location of respondents' firms yielded $X^2 = 22.83245$, d.f. = 4, significance = 0.001.

[3]A crosstabulation of positive and negative responses to this statement by location of respondents' firms yielded $X^2 = 61.60373$, d.f. = 4, significance = 0.001.

[4]A crosstabulation of positive and negative responses to this statement by location of respondents' firms yielded $X^2 = 73.02596$, d.f. = 8, significance = 0.001.

Table VI-6

Crosstabulation of Consumers/Conservers by Reading of Government Publication on Energy Conservation

	I have read a Government publication on Energy Conservation.	
	YES	NO
CONSUMERS	216	87
CONSERVERS	135	23

$X^2 = 10.68857$, d.f. = 1, significance = 0.001

Note: A "consumer" is defined as a subject who responded affirmatively to five or fewer of the eight statements, (c) through (j) on Table VI-4. A "conserver" responded affirmatively to six or more of these statements.

Table VI-7

DCAA/CREB Consumer Survey

Personal and Household Behavior Related to Energy Consumption:

Frequency Distribution of Responses

(N = 4,732)

	Percentages of Respondents	
	YES	NO
It's probably not that difficult to reduce the amount of energy I use.	66.9	21.6
I have read a Government publication on Energy Conservation.	52.1	34.5
In the last year, we have spent more than $100 on insulation for our home.	26.3	52.0
The present car I own is smaller than the last car I owned.	30.3	44.1
In the last twelve months, I have had my car tuned up at least twice.	50.3	24.0
I keep a record of the amount I spend on gasoline for my car.	31.7	43.8
In the last year, I have kept the thermostat lower than the year before.	45.7	36.8
Every year we add up our heating bills to find out how much it cost to heat our home.	45.7	36.8
In the last year, the furnace in our home has been modified to increase its efficiency.	58.1	22.9
In the last year, the filters in our furnace have been changed or cleaned at least twice.	54.3	8.7

Note (1): Thus survey was conducted in 1978 with 2,366 males and 2,366 females by G.H.G. McDougall, J.R. Brent Ritchie, and John D. Claxton. The aggregate results reported above omit respondents falling into the Not Applicable, Don't know, and No Answer categories.

Note (2): The first statement was presented on a six point agree-disagree scale. All "agree" responses have been summed and classified as "yes", all disagree responses have been similarly summed and classified as "no" for purposes of presentation of the results.

Table VI-8

Knowledge of Potential Energy Savings:
Frequency Distribution of Responses

(Question 17)

	"Correct" Response Range	Percentage of Respondents			
		Correct	Over	Under	N
(a) For each Fahrenheit degree below 68° you set your thermostat at, your fuel saving is about what percent?	0 - 5%	66.7	32.3	N/A	366
(b) If cold rather than warm water is used during the rinse cycle of a clothes washer, your electricity saving is about what percent?	20-30%	15.9	8.4	75.7	358
(c) A frost-free refrigerator, rather than a manual defrost refrigerator, increases electricity usage by about what percent?	45-50%	3.6	N/A	96.4	334
(d) Getting your furnace checked and cleaned twice a year can save you up to what percent of fuel?	15-25%	42.8	8.1	49.1	402
(e) Adding storm windows and doors, weatherstripping and caulking can result in a fuel saving of up to what percent?	25-35%	22.1	11.3	66.6	430
(f) A major furnace modification (retrofiting) can result in a fuel saving of up to what percent?	25-35%	15.1	8.1	76.8	285
(g) Increasing the thickness of the insulation on a gas or electric water heater from 2" to 4" can save you up to what percent of fuel?	5 -15%	64.9	22.5	2.6	342

Note: The "correct" response ranges for items (a) through (g) are derived from Carman Cullen, The Potential for Energy Conservation in the Residential Sector, CREB/DCCA, December, 1978.

Table VI-9

DCAA/CREB Consumer Survey

Knowledge of Potential Energy Savings: Frequency Distribution of Responses

(N = 4,732)

	"Correct" Response Range	Percentages of Respondents			
		Correct	Over	Under	N
(a) For each Fahrenheit degree below 68° you set your thermostat at, your fuel saving is about what percent?	0-5%	55.8	44.2	n/a	1,902
(b) A frost-free refrigerator, rather than a manual defrost refrigerator, increases electricity usage by about what percent?	45-50%	0.5	n/a	95.5	2,242
(c) Getting your furnace checked and cleaned twice a year can save you up to what percent of fuel?	15-25%	42.0	16.3	41.7	2,321
(d) Adding storm windows and doors, weatherstripping and caulking can result in a fuel saving of up to what percent?	25-35%	32.3	19.9	47.8	3,127
(e) A major furnace modification (retrofiting) can result in a fuel saving of up to what percent?	25-35%	27.1	11.8	60.1	1,277

Table VI-10

Crosstabulation of Builder Size with Energy Savings Knowledge

(N = 433)

Builder Size	Energy Savings Knowledge	
	Good	Poor
Small	56	188
Large	61	128

$X^2 = 4.23476$, d.f. = 1, significance = 0.05

Table VI-11

Knowledge of Residential Sector Consumption: Frequency Distribution of Responses

(Questions 15 and 16: N = 432)

	"Correct" Response Range	Mean Response	Percentages of Respondents		
			Correct	Over	Under
Residential sector energy consumption as a percentage of total energy consumption in dollar terms.	15-25%	40.293%	22.9	73.3	3.8
Furnaces and heating equipment as a percentage of total residential sector energy consumption.	65-75%	45.255%	5.8	4.9	89.3
Water heaters as a percentage of total residential sector energy consumption.	15-20%	16.199%	40.9	17.5	41.6
Kitchen and laundry appliances as a percentage of total residential sector energy consumption.	5 -10%	16.517%	36.5	60.9	2.6
Other appliances as a percentage of total residential sector energy consumption.	0 - 5%	7.099%	22.9	77.1	N/A
Lighting as a percentage of total residential sector energy consumption.	0 - 5%	11.440%	29.3	70.7	N/A
All other as a percentage of total residential sector energy consumption.	0 - 5%	3.490%	83.1	16.9	N/A

Note: In each of the six cases, the "correct" response range is based upon information contained in Energy, Mines and Resources Canada, Energy Conservation in Canada: Programs and Perspectives, Report, EP77-7, 1977.

Table VI-12

Percentages of Respondents Displaying Good and Poor

Energy Knowledge on Two Measures by Location of Respondents' Firms

	Atlantic Provinces	British Columbia	Ontario	Prairie Provinces	Quebec
Energy Savings Knowledge[1]					
Poor (N = 322)	76.9	78.8	68.1	70.1	83.0
Good (N = 119)	23.1	21.2	31.9	29.9	17.0
Residential Energy Use Knowledge[2]					
Poor (N = 310)	69.2	55.8	66.5	72.7	82.4
Good (N = 133)	30.8	44.2	33.5	27.3	17.6

[1] $X^2 = 8.20556$, d.f. = 4, significance = 0.08

[2] $X^2 = 13.14839$, d.f. = 4, significance = 0.01

Table VI-13

Crosstabulation of Builder Size with Residential Energy Use Knowledge

Builder Size	Residential Energy Use Knowledge	
	Good	Poor
Small	63	182
Large	69	121

$X^2 = 5.19968$, d.f. = 1, significance = 0.05

Table VI-14

Crosstabulation of Knowledge of Potential Energy Savings with Personal Rating of Energy Usage Knowledge

(N = 391)

Knowledge of Potential Energy Savings	"I would rate myself higher in knowledge than most people about how much energy I use."	
	YES	NO
GOOD	76	31
POOR	161	123

Note: The "Knowledge of Potential Energy Savings" variable is derived from responses to the seven items, (a) through (g), listed on Table VI-8. A subject who provided two or fewer estimates in the correct response range was assigned to the "poor" knowedge category. A subject who provided three or more estimates in the correct response range was assigned to the "good" knowledge category.

Table VI-15

Mean Percentages of Water Heaters Selected by Different Groups

(Questions 12 and 13)

A. New Single Family Dwellings (N = 412)

	Mean Percentage
My Firm	34.004
Architects	1.502
Heating Contractors	8.735
Plumbing Contractors	38.238
Utilities	13.340
Other (Specify)	4.146

B. New Apartment Dwellings (N = 106)

	Mean Percentage
My Firm	31.226
Consulting Engineers	23.651
Heating Contractors	8.274
Plumbing Contractors	30.104
Utilities	4.858
Other (Specify)	1.887

Table VI-16

Mean Percentages of Water Heaters Selected by Different Groups by Location of Respondents' Firms: New Single Family Dwellings

	Atlantic Provinces (N = 12)	British Columbia (48)	Ontario (184)	Prairie Provinces (93)	Quebec (75)
My firm[1]	37.5000	35.5417	29.1576	30.1613	49.3333
Architects	0.0000	2.1875	0.8696	0.4731	4.1333
Heating Contractors[2]	10.4167	24.0417	4.2935	12.3118	5.1333
Plumbing contractors[3]	20.8333	36.4583	33.2283	56.7742	31.4667
Utilities[4]	16.6667	0.0000	27.5272	0.2796	2.7333
Other[5]	14.5873	1.7708	4.9239	0.0215	7.2000

[1] $F = 3.4590$, significant at 0.01 level

[2] $F = 6.7653$, significant at 0.0001 level

[3] $F = 5.8651$, significant at 0.001 level

[4] $F = 18.9906$, significant at 0.001 level

[5] $F = 3.5481$, significant at 0.01 level

Table VI-17

Mean Percentages of Water Heaters Selected by Different Groups by Location of Respondents' Firms: New Apartment Dwellings

	Atlantic Provinces (N = 3)	British Columbia (11)	Ontario (34)	Prairie Provinces (33)	Quebec (25)
My firm	33.3333	34.0909	28.5294	28.7879	36.6000
Consulting engineers	33.3333	20.4545	28.8235	21.7273	19.4000
Heating contractors	0.0000	11.3636	3.5294	14.9091	5.6000
Plumbing contractors	0.0000	34.0909	24.4118	33.6667	35.0000
Utilities[1]	0.0000	0.0000	14.7059	0.3030	0.2000
Other	33.3333	0.0000	0.0000	0.6061	3.2000

[1] F = 2.8663, significant at 0.05 level

Table VI-18

Mean Importance Rankings of Factors Influencing Purchases of Water Heaters[1]

(Question 10: N = 327)

	Mean Ranking[2]
(a) Purchase Price	2.758
(b) Reliability	3.083
(c) Availability	4.131
(d) Warranty	4.229
(e) After Sales Service	4.410
(f) Energy Efficiency	4.807
(g) Brand Name	5.269

[1]T tests for significant differences between means indicated that the following pairs of mean rankings were not significantly different at the 0.05 level: (c) and (d); (d) and (e).

[2]The lower the mean ranking, the more important the factor.

Table VI-19

Mean Importance Rankings of Factors Influencing Purchases of Water Heaters by Location of Respondents' Firms

	Atlantic Provinces (N = 5)	British Columbia (47)	Ontario (126)	Prairie Provinces (88)	Quebec (61)
Brand Name[1]	5.8000	5.5532	5.4127	4.6818	5.5574
Availability	3.8000	4.0000	4.2302	3.8182	4.5082
After sales service	4.6000	4.5957	4.2460	4.5568	4.3770
Energy efficiency[2]	4.8000	5.0213	4.4762	5.2227	4.2951
Purchase price[3]	1.0000	2.4468	2.6190	2.8364	3.2459
Reliability[4]	4.4000	2.8511	3.1587	2.6364	3.6393
Warranty[5]	3.6000	4.7447	4.3810	4.0682	3.8033

[1] $F = 2.6457$, significant at 0.05 level

[2] $F = 5.2279$, significant at 0.001 level

[3] $F = 2.4548$, significant at 0.05 level

[4] $F = 3.9069$, significant at 0.005 level

[5] $F = 2.6672$, significant at 0.05 level

Table VI-20

Mean Importance Rankings of Factors Influencing Purchases of Water Heaters by Builder Size

	SMALL BUILDER N = 178	LARGE BUILDER N = 147
Brand Name	5.3315	5.1837
Availability	4.2865	3.9184
After Sales Service	4.2865	4.5782
Energy Efficiency	4.6742	4.9592
Purchase Price	3.0899	2.3469*
Reliability	2.9775	3.2381
Warranty	4.2472	4.2245

*Significant at 0.001 level (T test)

Table VI-21

(Dis)similarity Perceptions of Seven Equipment Types in Terms of Energy Efficiency: Frequency Distribution of Responses

(Question 14)

	Percentages of Respondents				
	Very Dissimilar	Moderately Dissimilar	Moderately Similar	Very Similar	N
Furnaces and Heating Equipment	9.3	14.8	39.3	36.6	453
Water Heaters	5.5	9.4	37.9	47.1	456
Stoves	6.7	11.8	46.1	35.5	434
Refrigerators	6.7	14.6	44.1	34.6	430
Washing Machines	6.1	17.3	44.5	32.1	427
Clothes Dryers	7.3	18.8	42.5	31.5	426
Window Air Conditioners	11.3	25.5	36.1	27.0	415

Table VI-22

Respondents Perceptions of (Dis)similarity of Water Heaters by Rank Order of Energy Efficiency as a Purchase Criterion for Water Heaters[1]

(N = 321)

LEVEL OF (DIS)-SIMILARITY OF WATER HEATERS	RANK ORDER OF ENERGY EFFICIENCY - WATER HEATERS	
	1 - 4	5 - 7
VERY DISSIMILAR	55.6	44.4
MODERATELY DISSIMILAR	56.0	44.0
MODERATELY SIMILAR	45.0	55.0
VERY SIMILAR	30.9	69.1

Note: To be read (for example): 55.6 percent of subjects who rated water heaters as "very dissimilar" in terms of energy efficiency rated energy efficiency between "1" and "4" in importance as a factor influencing selections of furnaces and heating equipment.

[1] $\chi^2 = 10.98614$, d.f. = 3, significance = 0.05

Table VI-23

Mean Percentages of Furnaces and Heating Equipment Selected by Different Groups

(Questions 12 and 13)

A. New Single Family Dwellings (N = 417)

	Mean Percentage
My Firm	35.307
Architects	1.494
Electricial Contractors	9.484
Heating Contractors	45.712
Mechanical Contractors	3.638
Other (Specify)	4.367

B. New Apartment Dwellings (N = 106)

	Mean Percentage
My Firm	29.811
Architects	8.538
Electrical Contractors	15.208
Heating Contractors	17.009
Mechanical Contractors	7.708
Consulting Engineers	19.981
Other (Specify)	1.745

Table VI-24

Mean Percentages of Furnaces and Heating Equipment Selected by Different Groups by Location of Respondents' Firms:

New Single Family Dwellings

	Atlantic Provinces (N = 13)	British Columbia (49)	Ontario (186)	Prairie Provinces (94)	Quebec (75)
My firm	25.1538	35.5306	32.5000	35.2128	44.0000
Architects	0.9231	2.1429	1.3548	0.4149	2.8667
Electrical contractors[1]	23.6154	7.3469	4.6667	1.9149	29.8667
Heating contractors[2]	27.8462	51.1224	53.5860	57.9787	10.3733
Mechanical contractors	8.6154	1.1020	4.4892	4.4255	1.3333
Other[3]	13.8462	2.7551	3.4194	0.0532	11.5333

[1] F = 19.9378, significant at 0.001 level

[2] F = 19.6703, significant at 0.001 level

[3] F = 7.0830, significant at 0.001 level

Table VI-25

Mean Percentages of Furnaces and Heating Equipment Selected by Different Groups by Location of Respondents' Firms: New Apartment Dwellings

	Atlantic Provinces (N = 3)	British Columbia (11)	Ontario (34)	Prairie Provinces (33)	Quebec (25)
My firm	33.3333	26.2626	35.1471	26.2121	28.4000
Architects	0.0000	9.0909	13.2353	8.3333	3.2000
Electrical contractors[1]	0.000	20.4545	8.3824	4.7576	37.8000
Heating Contractors[2]	0.000	16.8182	12.0588	32.6667	5.2000
Mechanical Contractors	0.0000	9.0909	11.3235	9.7576	0.4000
Consulting engineers	33.3333	18.1818	19.8529	16.7576	23.6000
Other[3]	33.3333	0.0000	0.0000	1.5152	1.4000

[1] F = 6.1363, significant at 0.001 level

[2] F = 3.4176, significant at 0.05 level

[3] F = 8.1053, significant at 0.001 level

Table VI-26

Mean Importance Rankings of Factors Influencing Purchases of Furnaces and Heating Equipment[1]

(Question 9: N = 371)

	Mean Ranking[2]
(a) Purchase Price	2.960
(b) Reliability	3.032
(c) After Sales Service	4.596
(d) Availability	4.596
(e) Warranty	4.763
(f) Energy Efficiency	4.906
(g) Brand Name	5.480
(h) Adaptability to Air Conditioning	6.625

[1]T tests for significant differences between means indicated that the following pairs of mean rankings were not significantly different at the 0.05 level: (a) and (b); all relationships involving (c), (d), (e), and (f).

[2]The lower the mean ranking, the more important the factor.

Table VI-27

Mean Importance Rankings of Factors Influencing Purchases of Furnaces and Heating Equipment by Location of Respondents' Firms

	Atlantic Provinces (N = 8)	British Columbia (47)	Ontario (172)	Prairie Provinces (88)	Quebec (56)
Brand Name[1]	5.6250	5.6383	5.5174	4.7159	6.4107
Availability[2]	3.7500	4.2553	4.8430	4.1364	4.9643
After sales service	5.2500	4.8936	4.4826	4.5341	4.6964
Adaptability to air conditioning[3]	7.6250	7.0638	6.2326	7.0455	6.6607
Energy efficiency[4]	3.7500	4.9787	4.7558	5.8409	4.0000
Purchase price	2.3750	2.9787	2.8895	2.9773	3.2143
Reliability[5]	3.3750	3.1277	3.0174	2.5795	3.6607
Warranty[6]	4.2500	5.0426	5.0407	4.4205	4.2857

[1] F = 4.4529, significant at 0.005 level

[2] F = 2.5322, significant at 0.05 level

[3] F = 3.9757, significant at 0.005 level

[4] F = 7.4555, significant at 0.001 level

[5] F = 3.2723, significant at 0.05 level

[6] F = 3.3546, significant at 0.05 level

Table VI-28

Mean Importance Rankings of Factors Influencing Purchases of Furnaces and Space Heating Equipment by Builder Size

	SMALL BUILDER N = 200	LARGE BUILDER N = 168
Brand Name	5.5500	5.3631
Availability	4.8050	4.3095*
After Sales Service	4.5200	4.7083
Adaptability to Air-conditioning	6.3650	6.9286**
Energy Efficiency	4.5850	5.3095**
Purchase Price	3.3050	2.5298***
Reliability	3.0600	3.0357
Warranty	4.9450	4.5774*

*Significant at 0.05 level (T test)

**Significant at 0.005 level (T test)

***Significant at 0.001 level (T test)

Table VI-29

Respondent Perceptions of (Dis)similarity of Furnaces and Heating Equipment by Rank Order of Energy Efficiency as a Purchase Criterion for Furnaces and Heating Equipment[1]

(N = 360)

Level of (Dis)similarity of Furnaces	Rank Order of Energy Efficiency - Furnaces	
	1 - 4	5 - 6
Very Dissimilar	60.6	39.4
Moderately Dissimilar	57.1	42.9
Moderately Similar	44.4	55.6
Very Similar	27.1	72.9

Note:

To be read (for example): 60.6 percent of subjects who rated furnaces and heating equipment as "very dissimilar" in terms of energy efficiency ranked energy efficiency between "1" and "4" in importance as a factor influencing selections of furnaces and heating equipment.

[1] $\chi^2 = 22.02688$, d.f. = 3, significance = 0.001

Table VI-30

Equipment Preinstallations in Single Family Dwellings Built in 1978 For Sale

(Question 8)

	(A) Percentage of Respondents Who Preinstalled Equipment	(B) Mean Percentage of Housing Units Built by Respondents Included in Column (A) with Equipment Preinstalled
Stoves	20.8	68.7
Refrigerators	15.5	54.9
Washing Machines	8.4	59.8
Clothes Dryers	8.0	60.7
Dishwashers	29.0	54.9
Window Air Conditioners	1.8	42.8
Heat Pumps	8.0	25.9
Automatic Night-off Thermostats	6.5	49.9

Note: To be read (for example): 20.8 percent of the 475 survey respondents preinstalled stoves in at least one single family dwelling built in 1978. The respondents included in this 20.8 percent preinstalled stoves in an average of 68.7 percent of the single family dwellings which they constructed.

Table VI-31

Equipment Preinstallations in Single Family Dwellings Built in 1978 For Sale by Location of Respondents' Firms

Percentages of Builders Who Presintalled Equipment

	Atlantic Provinces	British Columbia	Ontario	Prairie Provinces	Quebec
Stoves[1]	22.2	36.6	14.9	51.1	18.8
Refrigerators[2]	22.2	31.7	12.4	31.1	17.2
Washing Machines	0.0	7.3	8.7	13.3	17.2
Clothes Dryers	0.0	7.3	8.7	12.2	15.6
Dishwashers	22.2	41.5	28.1	70.0	17.2

Note: (To be read) for example: 22.2 percent of respondents whose building firms were located in the Atlantic Provinces preinstalled stoves in at least one single family dwelling built in 1978.

[1] $\chi^2 = 16.39399$, d.f. = 4, significance = 0.005

[2] $\chi^2 = 42.59186$, d.f. = 4, significance = 0.001

Table VI-32

Mean Percentages of Kitchen and Laundry Appliances Selected by Different Groups

(Questions 12 and 13)

A. New Single Family Dwellings (N = 300)

	Mean Percentage
Homeowners	54.220
My Firm	37.370
Plumbing Contractors	2.390
Electrical Contractors	0.843
Other (Specify)	5.200

B. New Apartment Dwellings (N = 95)

	Mean Percentage
Landlords	25.316
My Firm	65.684
Plumbing Contractors	0.947
Electrical Contractors	1.421
Other (Specify)	6.632

Table VI-33

Mean Percentages of Kitchen and Laundry Appliances Selected by Different Groups by Location of Respondents' Firms: New Single Family Dwellings

	Atlantic Provinces (N = 8)	British Columbia (37)	Ontario (136)	Prairie Provinces (77)	Quebec (42)
Homeowners[1]	56.2500	40.6757	60.8971	35.8961	77.7381
My firm[2]	31.2500	52.5676	30.9044	59.0649	6.3095
Plumbing contractors	12.5000	1.0811	2.2426	2.1039	2.6190
Electrical contractors	0.000	0.2703	0.4779	0.8831	2.6190
Other	0.000	5.4054	5.5147	2.0779	10.7143

[1] $F = 8.3625$, significant at 0.001 level

[2] $F = 14.1828$, significant at 0.001 level

Table VI-34

Mean Percentages of Kitchen and Laundry Appliances Selected by Different Groups by Location of Respondents' Firms: New Apartment Dwellings

	Atlantic Provinces (N = 3)	British Columbia (8)	Ontario (33)	Prairie Provinces (33)	Quebec (18)
Landlords	0.000	25.0000	18.6364	24.0909	44.1667
My firm[1]	66.6667	50.0000	78.3333	71.8182	38.0556
Plumbing contractors[2]	0.0000	0.0000	0.3030	0.3030	3.8889
Electrical contractors	0.0000	0.0000	0.3030	2.2727	2.7778
Other[3]	33.3333	25.0000	2.4242	1.5152	11.1111

[1] F = 3.0512, significant at 0.05 level

[2] F = 2.3840, significant at 0.06 level

[3] F = 3.1604, significant at 0.05 level

Table VI-35

Mean Importance Rankings of Factors Influencing Purchases of Kitchen and Laundry Appliances[1]

(Question 11: N = 182)

		Mean Ranking[2]
(a)	Purchase Price	2.511
(b)	Reliability	3.308
(c)	Availability	4.390
(d)	Warranty	4.484
(e)	Brand Name	4.918
(f)	After Sales Service	5.038
(g)	Energy Efficiency	6.071
(h)	Appearance/Colour	6.082

[1]T tests for significant differences between means indicated that the following pairs of mean rankings were not significantly different at the 0.05 level: (c) and (d); (d) and (e), (e) and (f); (g) and (h).

[2]The lower the mean ranking, the more important the factor.

Table VI-36

Mean Importance Rankings of Factors Influencing Purchases of Kitchen and Laundry Appliances by Location of Respondents' Firms

	Atlantic Provinces (N = 4)	British Columbia (26)	Ontario (70)	Prairie Provinces (66)	Quebec (16)
Brand Name	4.5000	5.8077	4.5571	4.9091	5.1875
Availability	4.7500	4.4231	4.8143	3.8939	4.4375
After sales service	6.5000	4.8846	4.9143	5.1818	4.8750
Appearance/color[1]	4.5000	5.9615	6.5000	5.6061	6.8125
Energy efficiency[2]	7.2500	5.3846	5.9280	6.6667	5.0625
Purchase price	1.2500	2.3462	2.4714	2.6515	2.6875
Reliability	4.7500	3.6154	3.1429	3.1212	3.9375
Warranty	4.0000	4.7692	4.60000	4.3485	4.1875

[1] $F = 3.1118$, significant at 0.05 level

[2] $F = 4.1840$, significant at 0.005 level

Table VI-37

Mean Importance Rankings of Factors Influencing Purchases of Major Kitchen and Laundry Appliances by Builder Size

	SMALL BUILDER N = 74	LARGE BUILDER N = 107
Brand Name	4.8378	4.9533
Availability	4.6892	4.1682
After Sales Service	5.0135	5.0561
Appearance/color	6.0541	6.0841
Energy Efficiency	5.5135	6.4953**
Purchase Price	2.9865	2.1776*
Reliability	3.4324	3.2420
Warranty	4.7568	4.2991

*Significant at 0.05 level (T test)

**Significant at 0.001 level (T test)

Table VI-38

Attitudes Towards Government and Business Action on the Energy Issue: Frequency Distribution of Responses

(Question 1)

	Percentages of Respondents				
	YES	NO	NOT APPLICABLE	DON'T KNOW	N
The Government is spending too much money on Energy Conservation.	17.3	67.9	0.6	14.1	468
Most Businesses are not doing anything about Energy Conservation.	40.3	43.9	0.2	15.5	471
The Government can best address the "Energy Issue" by refraining from any intervention in the marketplace.	24.3	64.2	0.9	10.6	461

Table VI-39

Percentages of Subjects Responding Affirmatively to Attitude Statements by Location of Respondents' Firms

	Atlantic Provinces	British Columbia	Ontario	Prairie Provinces	Quebec	N
a. The Government is spending too much on Energy Conservation[1].	15.4	17.0	17.6	21.8	12.9	465
b. Most Businesses are not doing anything about Energy Conservation.	30.8	47.3	37.2	42.7	42.4	470
c. The Government can best address the "Energy Issue" by refraining from any intervention in the marketplace.[2]	8.3	30.2	25.3	31.1	14.3	457

Note: To be read (for example): 15.4 percent of respondents whose firms were headquarted in the Atlantic Provinces agreed with statement (a).

[1] A crosstabulation of positive and negative responses to this statement by location of firms yielded $X^2 = 16.01906$, d.f. = 8, significance = 0.05.

[2] A crosstabulation of positive and negative responses to this statement by location of respondents' firms yielded $X^2 = 20.34752$, d.f. = 8, significance = 0.01.

Table VI-40

Mean Percentages of Responsibility for Reducing Residential Energy Using Equipment Consumption Allocated to Different Groups

(Question 3: N = 461)

	%
Building Contractors (Including Builder-Landlords)	9.852
Mechanical Contractors	3.709
Heating Contractors	7.013
Plumbing Contractors	3.479
Electrical Contractors	4.163
Architects	6.603
Consulting Engineers	7.111
Manufacturers of Equipment	26.505
Distributors and Retailers	2.781
Government Agencies (Federal and Provincial)	10.991
Landlords (who are not Builders)	3.584
Consumers	13.922
Other	0.282

Table VI-41

Mean Percentage of Responsibility Allocated to Different Groups by Location of Respondents' Firms

	Atlantic Provinces (N = 13)	British Columbia (54)	Ontario (204)	Prairie Provinces (96)	Quebec (94)
Building contractors	6.3077	10.1111	10.3578	8.4792	10.5000
Mechanical contractors	3.6923	3.1667	3.5784	4.8125	3.1809
Heating contractors	7.3077	6.7778	6.5539	7.2083	7.9043
Plumbing contractors	4.1538	3.2407	3.3284	3.8854	3.4362
Electrical contractors[1]	3.3846	3.9630	3.6029	3.8438	5.9255
Architects	7.1538	6.3148	5.6765	7.0729	8.2234
Consulting Engineers[2]	5.3077	7.3148	5.6961	7.2083	10.2128
Manufacturers[3]	25.7692	27.6481	27.9608	29.7188	19.5106
Distributors and retailers[4]	4.3846	2.8148	1.8627	4.0313	3.2553
Government agencies	13.0769	9.2963	11.3480	9.4375	12.4894
Landlords	2.6923	2.5926	3.6471	3.0729	4.8596
Consumers[5]	16.6154	16.6481	16.2794	11.0208	9.8298
Other[6]	0.1538	0.1111	0.0980	0.2083	0.8723

[1] $F = 3.6134$, significant at 0.01 level

[2] $F = 3.4677$, significant at 0.01 level

[3] $F = 2.6860$, significant at 0.05 level

[4] $F = 4.5521$, significant at 0.005 level

[5] $F = 3.1803$, significant at 0.05 level

[6] $F = 2.9082$, significant at 0.05 level

Table VI-42

Mean Rankings of Government Actions to Reduce Residential Energy Using Equipment Consumption[1]

(Question 2: N = 403)

		Mean Ranking[2]
(a)	Raise the energy efficiency performance standards for new furnaces, water heaters, and major kitchen/laundry appliances.	3.968
(b)	Provide tax credits to builders and consumers for any additional cost involved in installing energy-efficient furnaces, water heaters, and major kitchen/laundry appliances.	4.419
(c)	An information campaign to educate consumers how to use and maintain furnaces, water heaters, and major kitchen/laundry appliances to maximize energy efficiency.	4.675
(d)	Energy usage disclosures in all manufacturers' catalogues, price lists, and promotional material for furnaces, water heaters, and major kitchen/laundry appliances.	4.824
(e)	Develop with builder trade associations an information campaign to encourage the purchase of more energy efficient furnaces, water heaters, and major kitchen/laundry appliances by builders and contractors.	4.834
(f)	Energy usage labelling of furnaces, water heaters, and major kitchen/laundry appliances.	4.901
(g)	Increase government funding of manufacturers' research and development efforts to accelerate introduction of more energy efficient furnaces, water heaters and major kitchen/laundry appliances.	5.494
(h)	A graduated sales tax such that progressively less energy efficient models of furnaces, water heaters, and major kitchen/laundry appliances carry a progressively higher tax.	6.184
(i)	Require all home furnaces to have an annual inspection and maintenance by an authorized service person.	6.831

[1]T tests for significant differences between means indicated that the following pairs of mean rankings were not significantly different at the 0.05 level: (b) and (c); all relationships involving (c), (d), (e) and (f).

[2]The lower the mean ranking, the more preferred the government action.

Table VI-43

Mean Rankings of Government Actions by Location of Respondents' Firms

Public Policy Intervention	Atlantic Provinces (N = 12)	British Columbia (47)	Ontario (177)	Prairie Provinces (97)	Quebec (70)
Graduated sales tax	6.3333	6.1915	6.0395	5.8351	7.0000
Consumer information campaign	5.1667	4.8923	4.8531	4.5670	4.1571
Builder information campaign[1]	4.7500	4.3830	5.2768	4.2887	4.7857
Energy usage disclosures	5.0833	4.5319	4.6780	4.8660	5.2857
Energy usage labelling	5.3333	5.0213	4.7797	5.1237	4.7429
Tax credits	4.6667	4.4043	4.3164	4.3093	4.8000
Energy efficiency standards	4.1667	3.4468	3.9492	4.1546	4.0714
Government funding of R & D[2]	5.7500	5.8085	5.8136	5.5876	4.3000
Annual furnace inspection	5.7500	7.4468	6.7910	7.0412	6.4143

[1] F = 3.5775, significant at 0.01 level

[2] F = 3.9945, significant at 0.005 level

Table VI-44

Mean Rankings of Government Actions by Builder Size

	SMALL BUILDERS (N = 217)	LARGE BUILDERS (N = 180)
Graduated sales tax	6.3502	5.9889
Consumer information campaign	4.7281	4.6611
Builder information campaign	4.8756	4.7889
Energy usage disclosures	4.5806	5.1333*
Energy usage labelling	4.6037	5.2778*
Tax credits	4.6406	4.0944*
Energy efficiency standards	3.7788	4.1889
Government funding of R & D	5.7604	5.1722
Annual furnace inspection	6.6498	7.0556

*Significant at 0.05 level (T test)

Table VII-1

Classification of Policy Options Designed to Promote Energy Conservation With Respect to Three Categories of Equipment Within the Residential Sector

	FINANCIAL	NON-FINANCIAL
PERSUASIVE	Provide tax credits to builders and consumers for any additional cost involved in installing energy efficient furnaces, water heaters, and major kitchen and laundry appliances.	An information campaign to educate consumers how to use and maintain furnaces, water heaters, and major kitchen/laundry appliances to maximize energy efficiency.
	Increase government funding of manufacturers' research and development efforts to accelerate introduction of more energy efficient furnaces, water heaters and major kitchen and laundry appliances.	Energy usage disclosures in all manufacturers' catalogues, price lists, and promotional material for furnaces, water heaters, and major kitchen and laundry appliances. Develop with builder trade associations an information campaign to encourage the purchase of more energy efficient furnaces, water heaters, and major kitchen/laundry appliances by builders and contractors. Energy usage labelling of furnaces, water heaters, and major kitchen and laundry appliances.
MANDATORY	A graduated sales tax such that progressively less energy efficient models of furnaces, water heaters, and major kitchen/laundry appliances carry a progressively higher tax.	Raise the energy efficiency performance standards for new furnaces, water heaters and major kitchen and laundry appliances. Require all home furnaces to have an annual inspection and maintenance by an authorized service person.

Note: These policy options are initially presented in Table VI-42.

FIGURES

Figure III-1

Diagrammatic Summary of Research Methodology

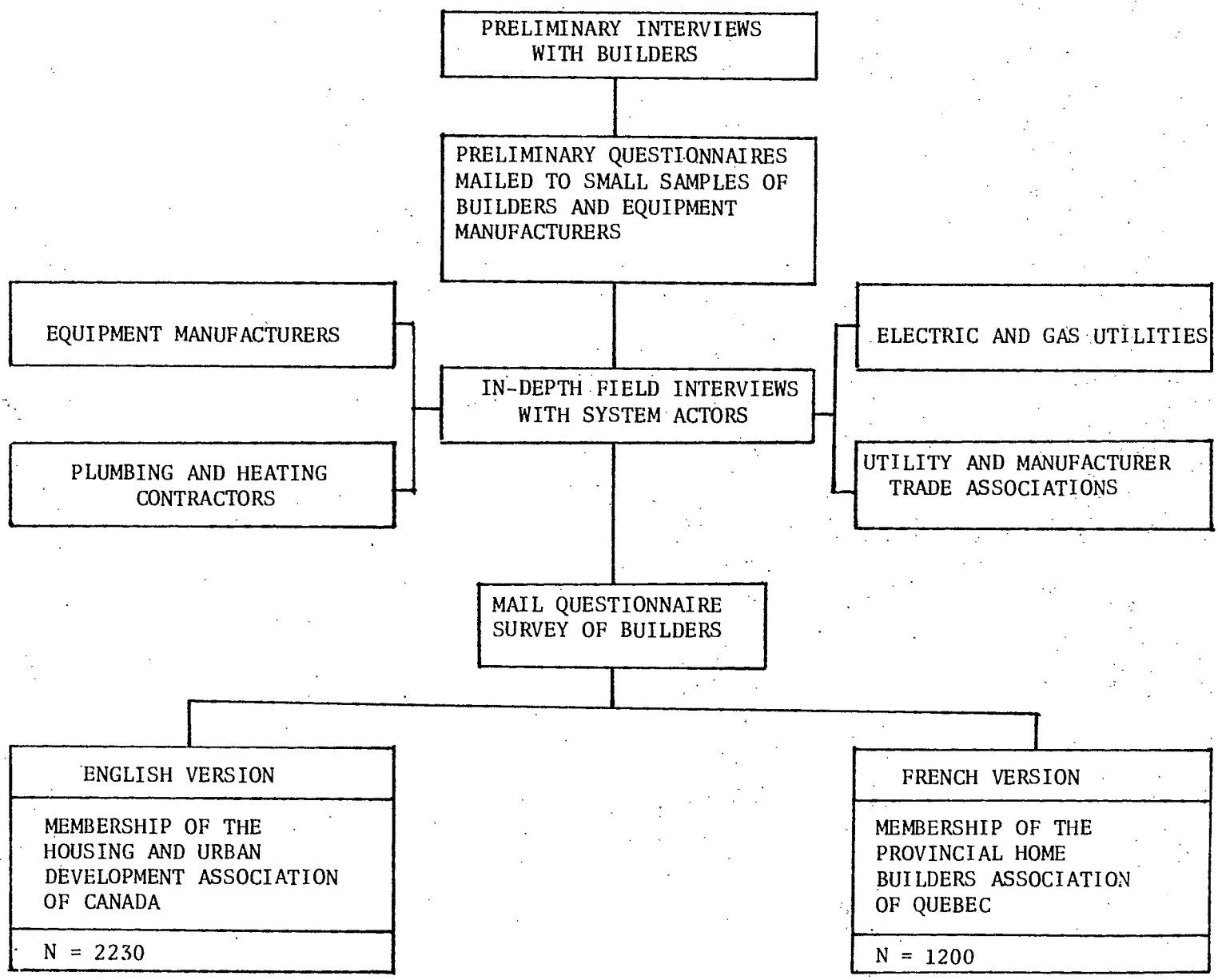


Figure IV-1

Distribution Channels for Water Heaters Manufactured in Canada for Installation in New Housing

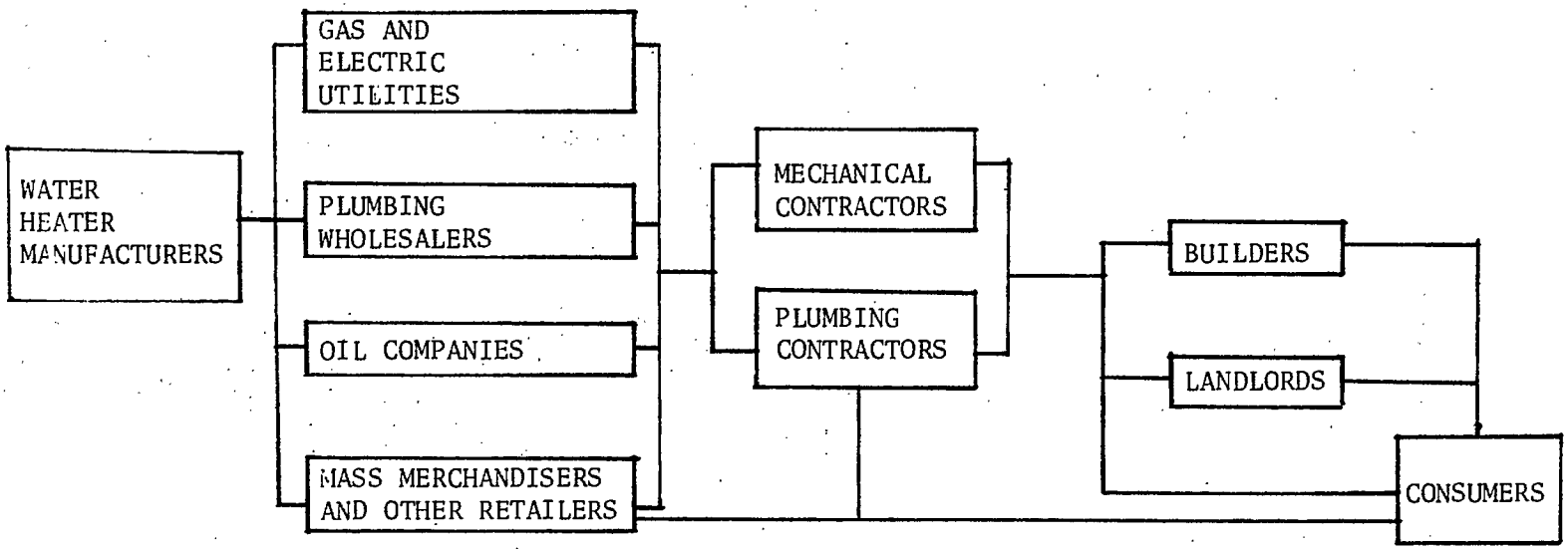


Figure IV-2

Distribution Channels for Forced Air and Hot Water Furnaces

Manufactured in Canada for Installation in New Housing

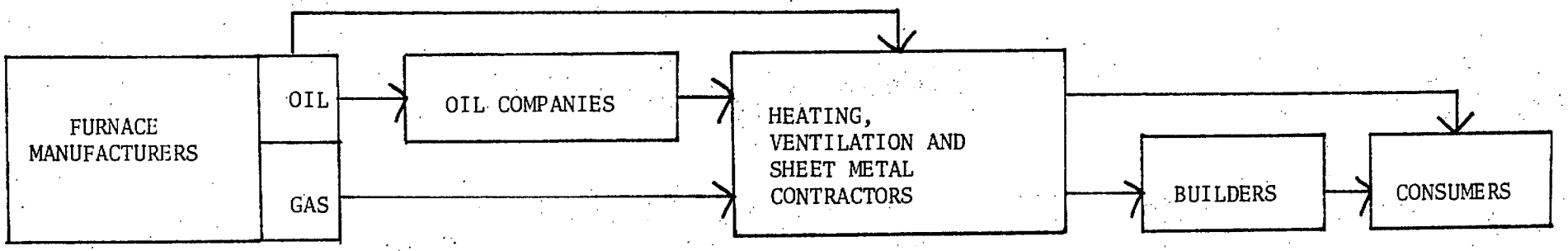


Figure IV-3

Distribution Channels for Baseboard Electric Space Heating Equipment

Manufactured in Canada for Installation in New Housing

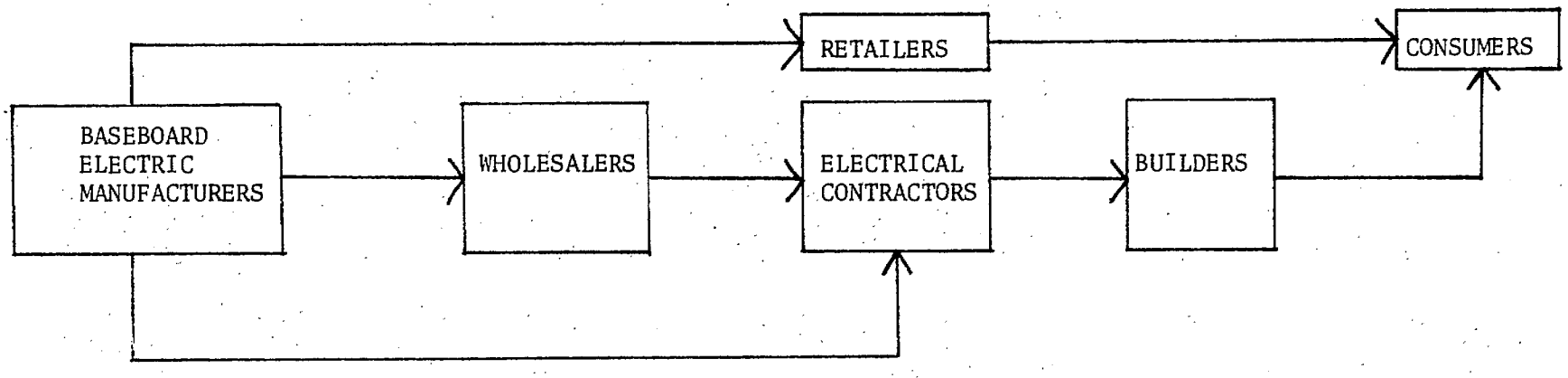


Figure IV-4

Distribution Channels for Major Kitchen and Laundry Appliances

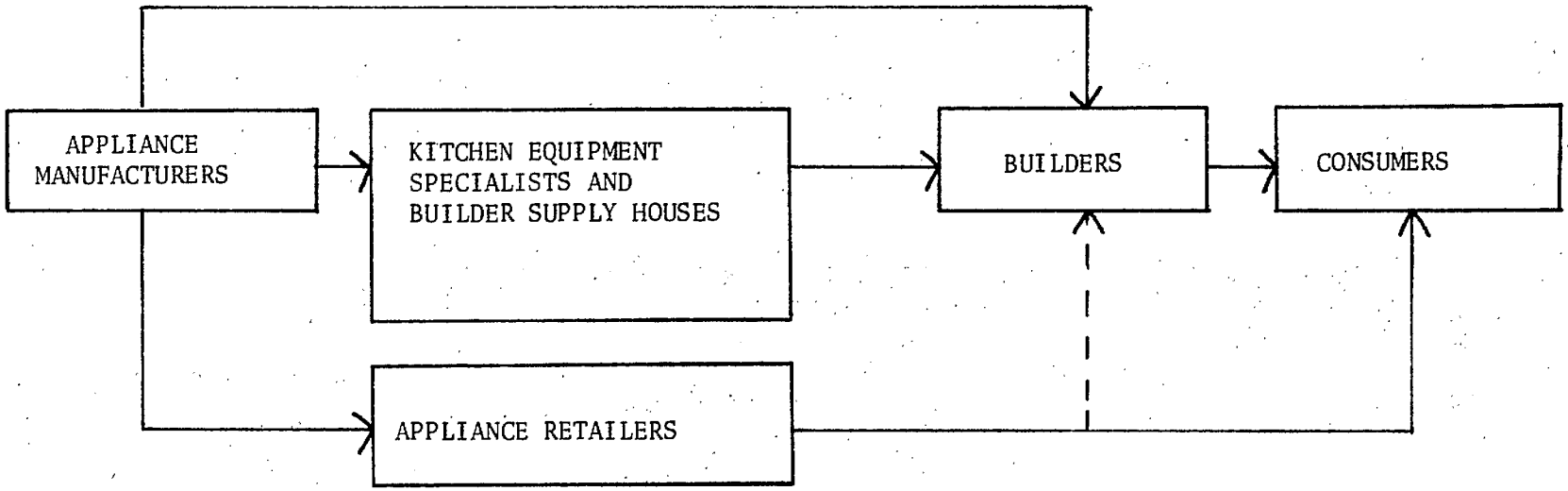


Figure IV-1

Placement and Purchases of Residential Refrigerators

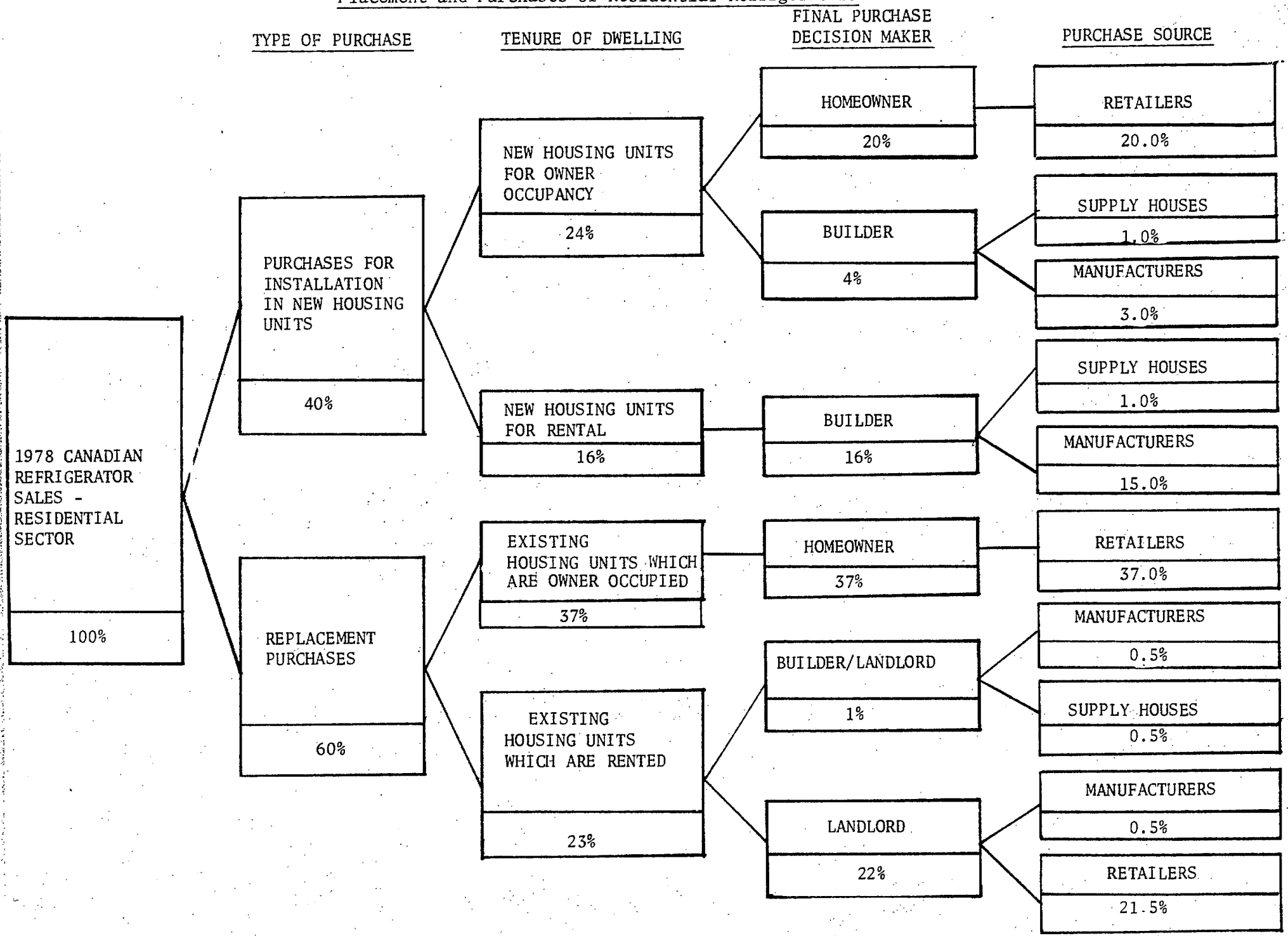


Figure V-1

Decision Making Process For Purchase of Water Heating Equipment by Builders For New Housing Completions Supplied Through the Traditional Distribution Channel

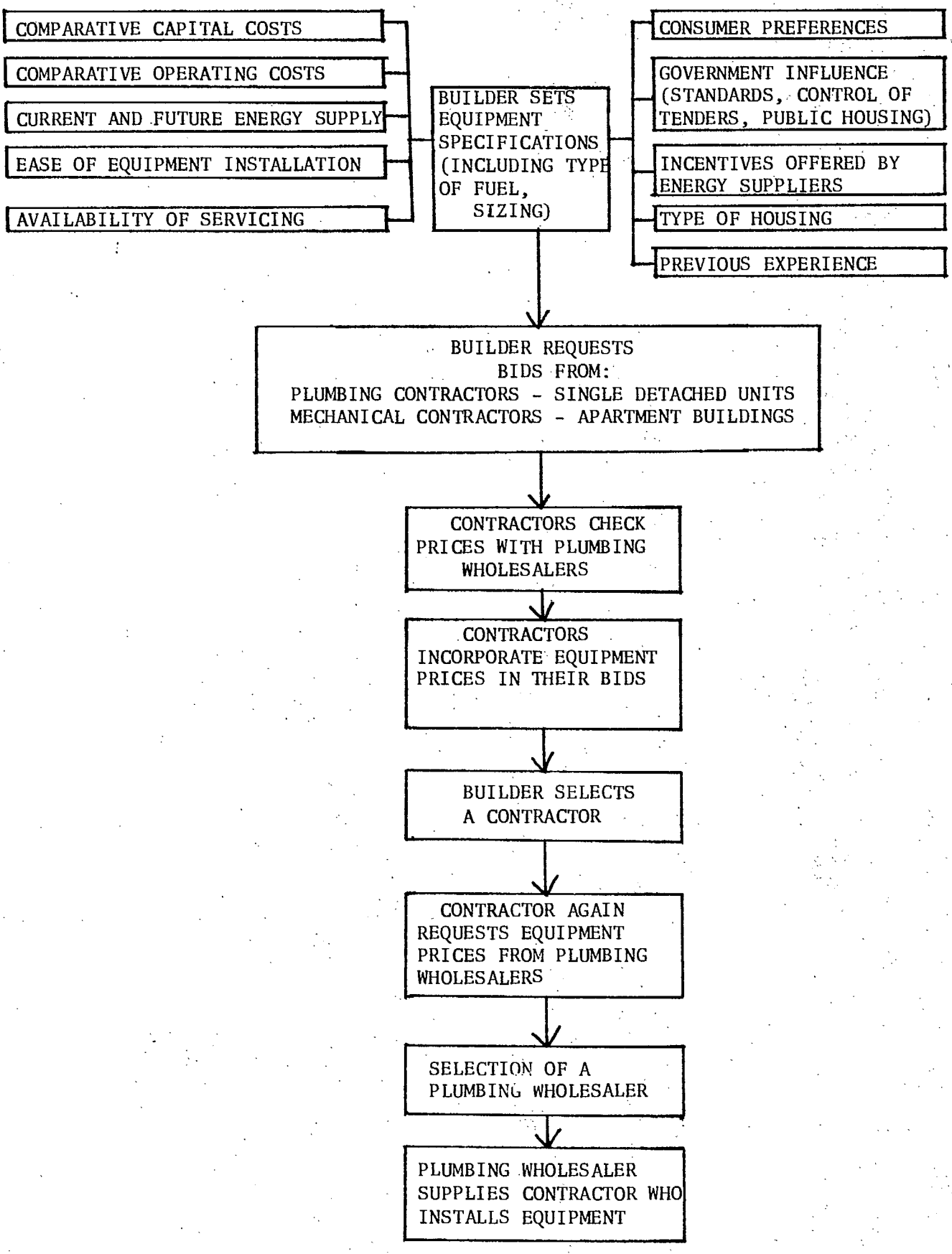


Figure V-2

Decision Making Process For Purchase of Space Heating Equipment By Builders For New Housing

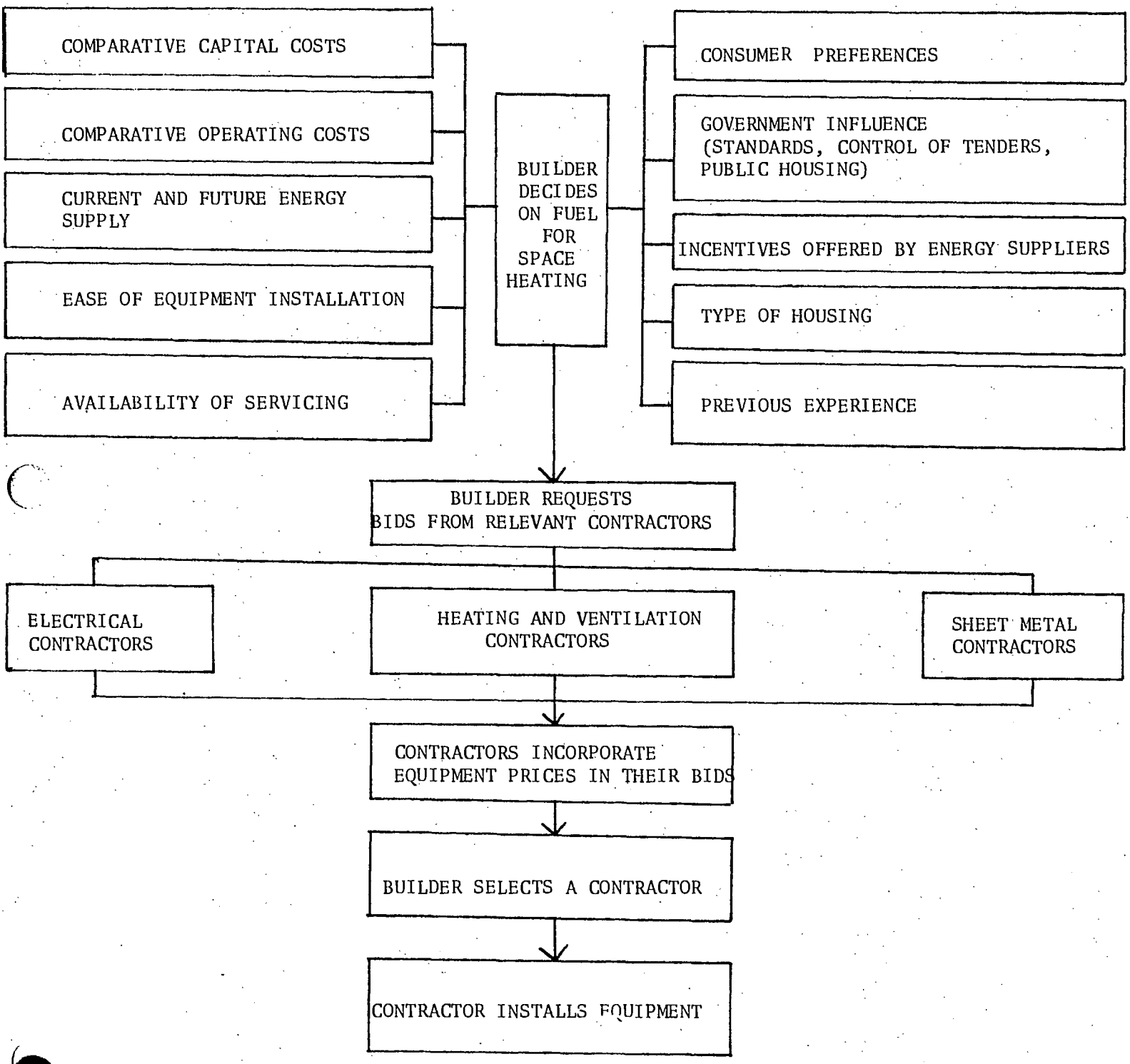


Figure V-3

Builder Decision Making Process For Major

Kitchen and Laundry Appliances

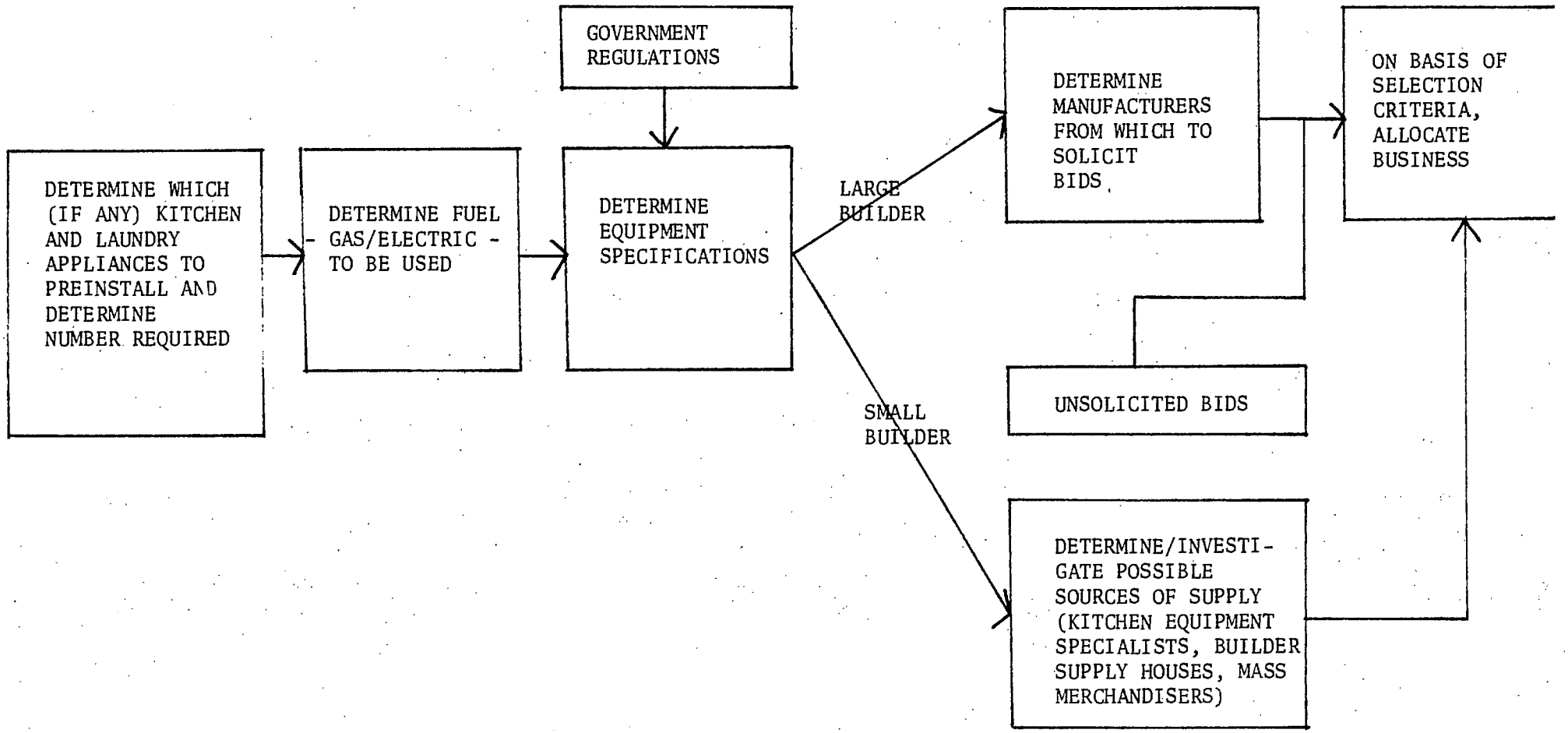


Figure VII-1

Stages in the Design and Implementation of Information Delivery Programs

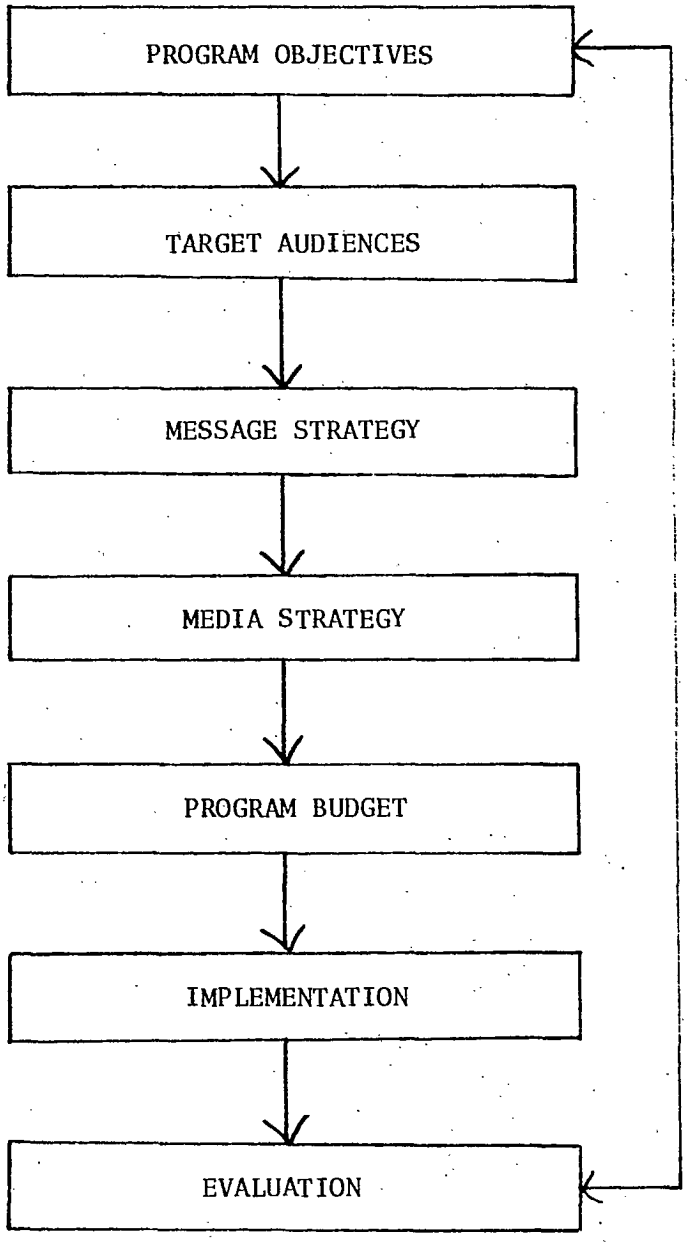
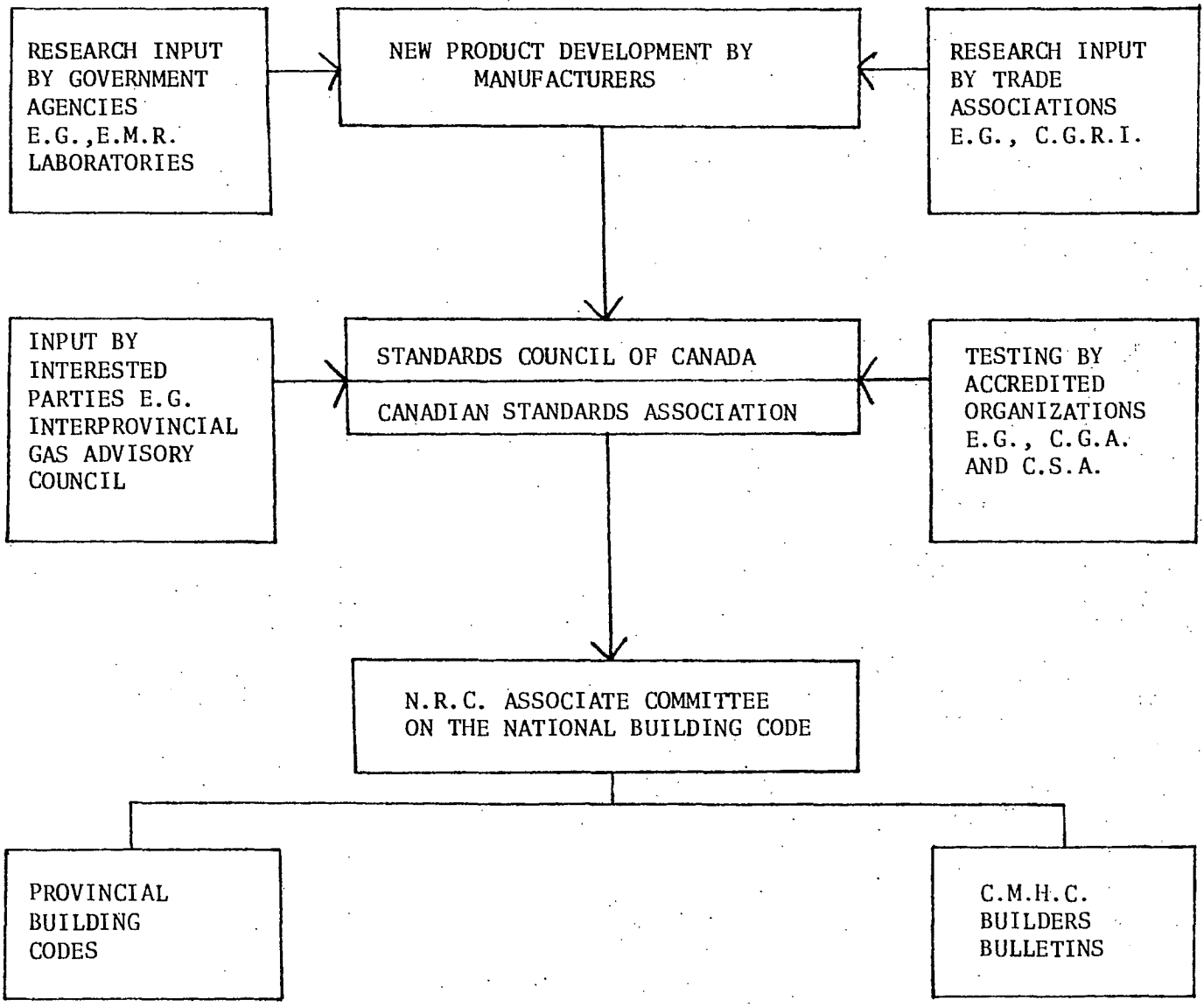


Figure VII-2

Simplification of the Standards Setting Process for Residential Energy Using Equipment



APPENDIX A!

ENGLISH AND FRENCH QUESTIONNAIRES!

STUDY DB761

BUILDERS' STUDY QUESTIONNAIRE

CANADIAN FACTS
160 BLOOR STREET EAST
TORONTO, ONTARIO
M4W 9Z9

First, some questions about your personal opinions and actions.

1. For the following questions we would like you to simply circle a number under "YES" or "NO". If the question is not applicable (if, for example, you do not have a car) please circle under the "Not Applicable" category. If you don't know the answer (if, for example, you don't know what has been done to your furnace) circle the number under the "Don't Know" category.

	YES	NO	NOT APPLICABLE	DON'T KNOW	FOR OFFICE USE ONLY
The Government Is Spending Too Much Money On Energy Conservation.	1	2	3	4	(7)
Most Businesses Are Not Doing Anything About Energy Conservation.	1	2	3	4	(8)
The Government Can Best Address The "Energy Issue" By Refraining From Any Intervention In The Marketplace.	1	2	3	4	(9)
I Have Read A Government Publication On Energy Conservation.	1	2	3	4	(10)
I Would Rate Myself Higher In Knowledge Than Most People About How Much Energy I Use.	1	2	3	4	(11)
It's Probably Not That Difficult To Reduce The Amount Of Energy I Use. ..	1	2	3	4	(12)
In The Last Year, We Have Spent More Than $100 On Insulation For Our Home.	1	2	3	4	(13)
The Present Car I Own Is Smaller Than The Last Car I Owned.	1	2	3	4	(14)
In The Last Twelve Months, I Have Had My Car Tuned Up At Least Twice.	1	2	3	4	(15)
I Keep A Record Of The Amount I Spend On Gasoline For My Car.	1	2	3	4	(16)
In The Last Year, I Have Kept The Thermostat Lower Than The Year Before.	1	2	3	4	(17)
Every Year We Add Up Our Heating Bills To Find Out How Much It Cost To Heat Our Home.	1	2	3	4	(18)
In The Last Year, The Furnace In Our Home Has Been Modified To Increase Its Efficiency.	1	2	3	4	(19)
In The Last Year, The Filters In Our Furnace Have Been Changed Or Cleaned At Least Twice.	1	2	3	4	(20)

2. Please read through the following list of actions which government might take to promote energy conservation with respect to Furnaces and Heating Equipment, Water Heaters, and Major Kitchen/Laundry Appliances within the residential sector.

Place a "1" next to the action which you consider likely to promote the most energy savings, a "2" next to the action likely to produce the second most energy savings, and so on for all nine actions. Be sure to place a number next to each action and do not use the same number more than once.

	RANK ORDER	FOR OFFICE USE ONLY
a. A Graduated Sales Tax Such That Progressively Less Energy Efficient Models Of Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances Carry A Progressively Higher Tax.	____	(21)
b. An Information Campaign To Educate Consumers How To Use And Maintain Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances To Maximize Energy Efficiency.	____	(22)
c. Develop With Builder Trade Associations An Information Campaign To Encourage The Purchase Of More Energy Efficient Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances By Builders And Contractors.	____	(23)
d. Energy Usage Disclosures In All Manufacturers' Catalogues, Price Lists, And Promotional Material For Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances.	____	(24)
e. Energy Usage Labelling Of Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances.	____	(25)
f. Provide Tax Credits To Builders And Consumers For Any Additional Cost Involved In Installing Energy-Efficient Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances.	____	(26)
g. Raise The Energy Efficiency Performance Standards For New Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances.	____	(27)
h. Increase Government Funding Of Manufacturers' Research And Development Efforts To Accelerate Introduction Of More Energy Efficient Furnaces, Water Heaters, And Major Kitchen/Laundry Appliances.	____	(28)
i. Require All Home Furnaces To Have An Annual Inspection And Maintenance By An Authorized Service Person.	____	(29)

3. In your opinion, what percentage of responsibility should be assumed by each of the following groups for the task of reducing the energy consumption of Furnaces and Heating Equipment, Water Heaters, and Major Kitchen/Laundry Appliances within the residential sector?

Your answer in each case may range from 0 to 100 percent, but all numbers in the column must total 100.

		FOR OFFICE USE ONLY
Building Contractors (Including Builder-Landlords)	_____ %	(30/31)
Mechanical Contractors	_____ %	(32/33)
Heating Contractors	_____ %	(34/35)
Plumbing Contractors	_____ %	(36/37)
Electrical Contractors	_____ %	(38/39)
Architects	_____ %	(40/41)
Consulting Engineers	_____ %	(42/43)
Manufacturers Of Equipment	_____ %	(44/45)
Distributors And Retailers	_____ %	(46/47)
Government Agencies (Federal And Provincial)	_____ %	(48/49)
Landlords (Who Are Not Builders)	_____ %	(50/51)
Consumers	_____ %	(52/53)
Other (Specify) _____	_____ %	(54/55)
	100%	

Now for a few questions about your firm.

4. Which of the following best describes your role within your firm: (Circle One Code Number)

		FOR OFFICE USE ONLY
Engineering	1	(56)
Marketing/Sales	2	
Purchasing	3	
General Management	4	
Other (Specify) _____		

5. In which province is the head office of your firm located? (Circle One Code Number)

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Newfoundland	1	(57)
Prince Edward Island	2	
Nova Scotia	3	
New Brunswick	4	
Quebec	5	
Ontario	6	
Manitoba	7	
Saskatchewan	8	
Alberta	9	
British Columbia	0	

6. For each of the four categories of housing listed below on the left, please circle the code number under the column of "Units" which indicates the total number of housing units constructed by your firm during 1978. (Circle One Code In Each Row)

	0 To 5 Units	6 To 20 Units	21 To 50 Units	51 To 100 Units	Over 100 Units	
Single Detached	1	2	3	4	5	(58)
Duplex (Units)	1	2	3	4	5	(59)
Row Housing (Units)	1	2	3	4	5	(60)
Apartment (Units)	1	2	3	4	5	(61)

7-a) Does your building firm also act as a landlord? (Circle One Code)

Yes 1 (62)

No ..... 2 GO TO QUESTION 8

-b) (IF "YES" IN Q. 7-a)) For what percentage of units in each of the following four categories constructed by your firm in 1978 does your firm also act as a landlord?

Single Detached	_____%	(63/64)
Duplex (Units)	_____%	(65/66)
Row Housing (Units)	_____%	(67/68)
Apartment (Units)	_____%	(69/70)

(71/75)

8. In what percentage of

-a) the SINGLE FAMILY DWELLINGS (including duplexes and row housing) built by your firm in 1978 FOR SALE and

-b) the SINGLE FAMILY DWELLINGS (including duplexes and row housing) built by your firm in 1978 FOR ULTIMATE RENTAL,

was each of the following types of equipment PRE-INSTALLED by either your firm or a sub-contractor?

	-a) For Sale	-b) For Rental By A Landlord	
Stoves	____%	____%	(7/10)
Refrigerators	____%	____%	(11/14)
Washing Machines	____%	____%	(15/18)
Clothes Dryers	____%	____%	(19/22)
Dishwashers	____%	____%	(23/26)
Window Air Conditioners	____%	____%	(27/30)
Heat Pumps	____%	____%	(31/34)
Automatic Night-Off Thermostats	____%	____%	(35/38)

FOR OFFICE USE ONLY

6-2

9. Please read through the following list of factors which may have influenced the selection of FURNACES AND HEATING EQUIPMENT (including baseboard electric) purchased by your firm directly or through a sub-contractor during 1978.

Place a "1" next to the factor which was most important in influencing purchase decisions, a "2" next to the factor which you consider second in importance, and so on for all eight factors. Be sure to place a number next to each factor and do not use the same number more than once.

If your firm purchased NO furnaces or heating equipment either directly or through a sub-contractor during 1978 check this box ☐ and go to question 10.

	RANK ORDER	
Brand Name	____	(39)
Availability	____	(40)
After Sales Service	____	(41)
Adaptability To Air-Conditioning	____	(42)
Energy Efficiency	____	(43)
Purchase Price	____	(44)
Reliability	____	(45)
Warranty	____	(46)

10. Please read through the following list of factors which may have influenced the selection of WATER HEATERS purchased by your firm directly or through a sub-contractor during 1978.

Follow the same procedure as in question 9, i.e., most important = 1 etc. In this question we have seven factors.

If your firm purchased NO water heaters either directly or through a subcontractor during 1978, check this box ☐ and go to question 11.

	RANK ORDER	FOR OFFICE USE ONLY
Brand Name	_____	(47)
Availability	_____	(48)
After Sales Service	_____	(49)
Energy Efficiency	_____	(50)
Purchase Price	_____	(51)
Reliability	_____	(52)
Warranty	_____	(53)

11. Please read through the following list of factors which may have influenced the selection of KITCHEN AND LAUNDRY APPLIANCES purchased by your firm either directly or through a sub-contractor during 1978.

Again follow the same procedure of ranking as for question 9 and 10. In this question we want you to rank eight factors.

If your firm purchased NO such appliances either directly or through a subcontractor during 1978, check this box ☐ and go to question 12.

	RANK ORDER	
Brand Name	_____	(54)
Availability	_____	(55)
After Sales Service	_____	(56)
Appearance/Colour	_____	(57)
Energy Efficiency	_____	(58)
Purchase Price	_____	(59)
Reliability	_____	(60)
Warranty	_____	(61)

12. This question refers only to equipment installed in the NEW SINGLE FAMILY dwellings built by your firm during 1978. Include duplexes and row housing but exclude apartment dwellings.

If your firm did not construct any new single family dwellings during 1978, check this box ☐ and go to question 13.

-a) What percentages of FURNACES AND HEATING EQUIPMENT installed in new single family dwellings were selected by each of the following groups?

Your answer in each case may range from 0 to 100, but all numbers in the column must total 100%.

FOR OFFICE USE ONLY

FURNACES AND HEATING EQUIPMENT

My Firm	_____ %	(62/63)
Architects	_____ %	(64/65)
Electrical Contractors	_____ %	(66/67)
Heating Contractors	_____ %	(68/69)
Mechanical Contractors	_____ %	(70/71)
Other (Specify) _____ .	_____ %	(72/73)
	100%	(74/75)

-b) What percentages of WATER HEATERS installed in new single family dwellings were selected by each of the following groups?

6-3

WATER HEATERS

My Firm	_____ %	(7/8)
Architects	_____ %	(9/10)
Heating Contractors	_____ %	(11/12)
Plumbing Contractors	_____ %	(13/14)
Utilities	_____ %	(15/16)
Other (Specify) _____ .	_____ %	(17/18)
	100%	

-c) What percentages of KITCHEN AND LAUNDRY APPLIANCES installed in new single family dwellings were selected by each of the following groups?

KITCHEN AND LAUNDRY APPLIANCES

Homeowners	_____ %	(19/20)
My Firm	_____ %	(21/22)
Plumbing Contractors	_____ %	(23/24)
Electrical Contractors	_____ %	(25/26)
Other (Specify) _____ .	_____ %	(27/28)

13. This question specifically refers to equipment installed in new apartment dwellings built by your firm during 1978.

If your firm did not construct any new apartment dwellings, check this box ☐ and go to question 14.

-a) What percentages of FURNACES AND HEATING EQUIPMENT installed in new apartments were selected by each of the following groups?

FURNACES AND HEATING EQUIPMENT		FOR OFFICE USE ONLY
My Firm	____ %	(29/30)
Architects	____ %	(31/32)
Electrical Contractors	____ %	(33/34)
Heating Contractors	____ %	(35/36)
Mechanical Contractors	____ %	(37/38)
Consulting Engineers	____ %	(39/40)
Other (Specify) _____	____ %	(41/42)
	100%	

-b) What percentages of WATER HEATERS installed in new apartments were selected by each of the following groups?

WATER HEATERS		
My Firm	____ %	(43/44)
Consulting Engineers	____ %	(45/46)
Heating Contractors	____ %	(47/48)
Plumbing Contractors	____ %	(49/50)
Utilities	____ %	(51/52)
Other (Specify) _____	____ %	(53/54)
	100%	

-c) What percentages of KITCHEN AND LAUNDRY APPLIANCES installed in new apartments were selected by each of the following groups?

KITCHEN AND LAUNDRY APPLIANCES		
Landlords	____ %	(55/56)
My Firm	____ %	(57/58)
Plumbing Contractors	____ %	(59/60)
Electrical Contractors	____ %	(61/62)
Other (Specify) _____	____ %	(63/64)
	100%	

14. Now for some questions about the information you have about energy in the residential sector. In your opinion how SIMILAR or DISSIMILAR are the brand alternatives for each of the following equipment categories in terms of their ENERGY EFFICIENCY.

For example, if you believe that the different brands of furnaces and heating equipment on the market are very similar in terms of their energy efficiency, circle the number "4" next to that equipment category. Circle one number in each row.

	VERY DISSIMILAR	MODERATELY DISSIMILAR	MODERATELY SIMILAR	VERY SIMILAR	FOR OFFICE USE ONLY
Furnaces And Heating Equipment	1	2	3	4	(65)
Water Heaters	1	2	3	4	(66)
Stoves	1	2	3	4	(67)
Refrigerators	1	2	3	4	(68)
Washing Machines	1	2	3	4	(69)
Clothes Dryers	1	2	3	4	(70)
Window Air Conditioners	1	2	3	4	(71)

15. In dollar terms, what percentage of Canada's annual energy consumption do you estimate is used in the RESIDENTIAL sector? (Circle one number)

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

% % (72/73)

(74/75)

16. In dollar terms, what percentages of the above total residential energy usage do you estimate are consumed by each of the following categories of equipment?

6-4

Your answer in each case may range from 0 to 100 percent, but all numbers in the column must total 100%.

Furnaces And Heating Equipment	_____ %	(7/8)
Water Heaters	_____ %	(9/10)
Kitchen And Laundry Appliances	_____ %	(11/12)
Other Appliances	_____ %	(13/14)
Lighting	_____ %	(15/16)
All Other	_____ %	(17/18)
	100%	

17. There are a number of ways in which people can save energy. We would like to find out how much you think could be saved in each of the following situations. Please circle the point on the scale which you think is closest to the expected savings. For example, if you thought that in one situation, you could save 35%, you would circle (35). If you have no idea at all, please check the "DON'T KNOW" box.

EXAMPLE: % 0 5 10 15 20 25 30 (35) 40 45 50 50+ % Don't Know .. ☐

			FOR OFFICE USE ONLY
1.	For each Fahrenheit degree below 68° F you set your thermostat at, your fuel saving is about what percent?	% 0 5 10 15 20 25 30 35 40 45 50 50+ Don't Know .. ☐	(19/20)
2.	If cold rather than warm water is used during the rinse cycle of a clothes washer, your electricity saving is about what percent?	% 0 5 10 15 20 25 30 35 40 45 50 50+ Don't Know .. ☐	(21/22)
3.	A frost-free refrigerator, rather than a manual defrost refrigerator, increases electricity usage by about what percent?	% 0 5 10 15 20 25 30 35 40 45 50 50+ Don't Know .. ☐	(23/24)
4.	Getting your furnace checked and cleaned twice a year can save you up to what percent of fuel?	% 0 5 10 15 20 25 30 35 40 45 50 50+ Don't Know .. ☐	(25/26)
5.	Adding storm windows and doors, weatherstripping and caulking can result in a fuel saving of up to what percent?	% 0 5 10 15 20 25 30 35 40 45 50 50+ Don't Know .. ☐	(27/28)
6.	A major furnace modification (retrofiting) can result in a fuel saving of up to what percent?	% 0 5 10 15 20 25 30 35 40 45 50 50+ Don't Know .. ☐	(29/30)
7.	Increasing the thickness of the insulation on a gas or electric water heater from 2" to 4" can save you up to what percent of fuel?	% 0 5 10 15 20 25 30 35 40 45 50 50+ Don't Know .. ☐	(31/32)

WOULD YOU PLEASE CHECK TO SEE THAT YOU HAVE ANSWERED ALL THE QUESTIONS.

PLEASE MAIL BACK THIS QUESTIONNAIRE IN THE STAMPED SELF-ADDRESSED ENVELOPE. (33/75)

THANK YOU VERY MUCH FOR YOUR CO-OPERATION.

ETUDE DB761

ETUDE AUPRES DES ENTREPRENEURS DE CONSTRUCTION

REALITES CANADIENNES
1390 rue SHERBROOKE, OUEST,
MONTREAL, QUEBEC

En premier lieu, quelques questions sur vos opinions et vos actions personnelles.

1. Nous aimerions que vous encercliez un chiffre sous "OUI" ou "NON" pour les questions suivantes. Si la question ne s'applique pas à vous (si, par exemple, vous n'avez pas d'automobile), veuillez encercler le chiffre sous la catégorie "Pas applicable". Si vous ne savez pas la réponse, (si, par exemple, vous ne savez pas ce qu'on a fait à votre fournaise), encerclez le chiffre sous la catégorie "Ne sais pas".

	OUI	NON	PAS APPLICABLE	NE SAIS PAS	A L'USAGE DU BUREAU SEULEMENT
Le gouvernement dépense trop d'argent sur la conservation de l'énergie	1	2	3	4	(7)
La plupart des entreprises ne font rien en ce qui concerne la conservation de l'énergie.	1	2	3	4	(8)
La meilleure façon pour le gouvernement d'attaquer le "Problème de l'Energie", serait de s'abstenir de toute intervention dans le bon fonctionnement du marché	1	2	3	4	(9)
J'ai lu une publication gouvernementale sur la conservation de l'énergie	1	2	3	4	(10)
J'estime en savoir plus que la plupart des gens sur la quantité d'énergie que j'utilise	1	2	3	4	(11)
Diminuer la quantité d'énergie que j'utilise n'est probablement pas si difficile	1	2	3	4	(12)
Au cours de la dernière année, nous avons dépensé plus de $100 sur l'isolation de notre maison	1	2	3	4	(13)
L'automobile que je possède en ce moment est plus petite que celle que j'avais avant	1	2	3	4	(14)
Au cours des douze derniers mois, j'ai fait faire au moins deux mises au point à ma voiture	1	2	3	4	(15)
Je note le montant que je dépense pour l'essence de ma voiture	1	2	3	4	(16)
Au cours de la dernière année, j'ai baissé mon thermostat par rapport à l'année précédente	1	2	3	4	(17)
Chaque année, nous additionnons nos factures pour le chauffage afin de savoir combien ça nous a coûté pour chauffer notre maison	1	2	3	4	(18)
Au cours de la dernière année, la fournaise de notre maison a été modifiée afin d'augmenter son rendement	1	2	3	4	(19)
Au cours de la dernière année, les filtres de notre fournaise ont été changés ou nettoyés au moins deux fois	1	2	3	4	(20)

2. Veuillez lire la liste suivante d'actions que le gouvernement pourrait entreprendre afin d'augmenter la conservation de l'énergie en ce qui concerne les fournaises et l'équipement de chauffage, les chauffe-eau et les gros appareils électroménagers qu'on retrouve dans le secteur résidentiel.

Inscrivez "1" à côté de l'action qui, d'après vous, contribuerait le plus à conserver de l'énergie; vous mettrez ensuite un "2" à côté de l'action qui conservera la deuxième plus grande quantité d'énergie, et ainsi de suite pour les neuf actions. Soyez certain d'inscrire un numéro à côté de chaque facteur et n'utilisez pas deux fois le même numéro.

	CLASSEMENT	A L'USAGE DU BUREAU SEULEMENT
a. Une taxe de vente qui serait progressive de manière à ce que les modèles de fournaises, chauffe-eau et gros appareils électroménagers utilisant progressivement plus d'énergie payeraient une taxe progressivement plus élevée	_____	(21)
b. Une campagne d'information pour renseigner les consommateurs sur la façon d'utiliser et d'entretenir les fournaises, les chauffe-eau et les gros appareils électroménagers afin de maximiser leur rendement par rapport à l'énergie utilisée	_____	(22)
c. Développer, avec l'aide des associations d'entrepreneurs de construction, une campagne d'information pour encourager l'achat, par les entrepreneurs, de fournaises, chauffe-eau et gros appareils électroménagers qui utilisent l'énergie d'une façon plus efficace	_____	(23)
d. Publication de la consommation énergétique des fournaises, chauffe-eau et gros appareils électroménagers, dans les catalogues, listes des prix et matériel publicitaire de tous les fabricants	_____	(24)
e. Des étiquettes indiquant la consommation énergétique des fournaises, chauffe-eau et gros appareils électroménagers	_____	(25)
f. Accorder des dégrèvements d'impôt aux entrepreneurs de construction et aux consommateurs pour tout coût supplémentaire ayant trait à l'installation des fournaises, chauffe-eau et gros appareils électroménagers qui utilisent l'énergie d'une façon plus efficace	_____	(26)
g. Hausser les normes d'efficacité énergétique auxquelles doivent se conformer les fournaises, chauffe-eau et gros appareils électroménagers neufs	_____	(27)
h. Augmenter les subventions gouvernementales pour les travaux de recherche et de développement des fabricants afin d'accélérer la mise en vente de fournaises, de chauffe-eau et de gros appareils électroménagers ayant une plus grande efficacité énergétique	_____	(28)
i. Exiger l'inspection et l'entretien annuels, par un technicien autorisé, de toutes les fournaises résidentielles .	_____	(29)

3. D'après vous, quel degré de responsabilité devrait être assumé par chacun des groupes suivants afin de réduire la consommation d'énergie des fournaises et de l'équipement de chauffage, des chauffe-eau et des gros appareils électroménagers dans le secteur résidentiel?

Pour chacun des cas, votre réponse peut aller de 0 à 100%, mais tous les chiffres dans la colonne doivent totaliser 100%.

		A L'USAGE DU BUREAU SEULEMENT
Entrepreneurs de construction (y compris les entrepreneurs/ propriétaires)	_____%	(30/31)
Entrepreneurs en mécanique	_____%	(32/33)
Entrepreneurs de chauffage	_____%	(34/35)
Entrepreneurs de plomberie	_____%	(36/37)
Entrepreneurs électriciens	_____%	(38/39)
Architectes	_____%	(40/41)
Ingénieurs conseil	_____%	(42/43)
Fabricants d'équipement	_____%	(44/45)
Distributeurs et détaillants	_____%	(46/47)
Services gouvernementaux (Fédéraux et provinciaux)	_____%	(48/49)
Propriétaires d'immeubles (qui ne sont pas entrepreneurs de construction)	_____%	(50/51)
Consommateurs	_____%	(52/53)
Autre (Précisez) _____ .	_____%	(54/55)
	100%	

Maintenant, quelques questions sur votre entreprise.

4. Parmi les possibilités suivantes, laquelle décrit le mieux votre rôle dans votre entreprise: (Encerclez un numéro code)

Ingénieur	1	(56)
Marketing/Ventes	2	
Acheteur	3	
Administration générale	4	
Autre (Précisez) _____		

5. Dans quelle province est situé le bureau-chef de votre compagnie? (Encerclez un numéro code)

A L'USAGE DU BUREAU SEULEMENT

Terre-Neuve	1	(57)
Ile-du-Prince-Edouard	2	
Nouvelle-Ecosse	3	
Nouveau-Brunswick	4	
Québec	5	
Ontario	6	
Manitoba	7	
Saskatchewan	8	
Alberta	9	
Colombie-Britannique	0	

6. Pour chacune des quatre catégories d'habitation inscrites ci-dessous à gauche, veuillez encercler le numéro code, sous la colonne d'"Unités" qui indique le nombre total d'unités d'habitation construites par votre compagnie en 1978. (Encerclez un code à chaque ligne)

	0 à 5 Unités	6 à 20 Unités	21 à 50 Unités	51 à 100 Unités	Plus de 100 Unités	
Unifamiliale	1	2	3	4	5	(58)
Duplex (Unités)	1	2	3	4	5	(59)
Maisons en rangée (Unités)	1	2	3	4	5	(60)
Appartement (Unités)	1	2	3	4	5	(61)

7-a) Votre compagnie s'occupe-t-elle de louer des habitations dont elle est le propriétaire? (Encerclez un code)

Oui 1 (62)

Non .... 2 PASSEZ A LA QUESTION 8

-b) (SI "OUI" A LA Q.7-a)) Pour chacune des quatre catégories suivantes, quel pourcentage d'unités construites par votre compagnie en 1978 sont louées par votre entreprise à des locataires?

Unifamiliale	_____%	(63/64)
Duplex (Unités)	_____%	(65/66)
Maisons en rangée (Unités)	_____%	(67/68)
Appartement (Unités)	_____%	(69/70)

(71/75)

8. Quel pourcentage

-a) des HABITATIONS UNIFAMILIALES (y compris les duplexes et les maisons en rangée) construites par votre compagnie en 1978 A DES FINS DE VENTE et

-b) des HABITATIONS UNIFAMILIALES (y compris les duplexes et les maisons en rangée) construites par votre compagnie en 1978 A DES FINS DE LOCATION,

avait chacun des genres suivants d'équipement de chauffage PRÉINSTALLÉ par votre compagnie ou par un sous-entrepreneur?

	-a) Fins de Vente	-b) Fins de Location	A L'USAGE DU BUREAU SEULEMENT 6-2
Cuisinières	____ %	____ %	(7/10)
Réfrigérateurs	____ %	____ %	(11/14)
Laveuses	____ %	____ %	(15/18)
Sécheuses	____ %	____ %	(19/22)
Lave-vaisselle	____ %	____ %	(23/26)
Climatiseurs installés dans des fenêtres	____ %	____ %	(27/30)
Echangeurs de chaleur (Heat pumps)	____ %	____ %	(31/34)
Thermostats réduisant automatiquement la température pendant la nuit	____ %	____ %	(35/38)

9. Veuillez lire ci-dessous la liste de facteurs qui auraient pu influer sur la sélection de FOURNAISES ET D'EQUIPEMENT DE CHAUFFAGE (y compris le chauffage électrique installé dans les plinthes) achetés en 1978, directement par votre compagnie ou par l'entremise d'un sous-entrepreneur.

Inscrivez "1" à côté du facteur qui a eu le plus d'influence sur la décision d'acheter; un "2" à côté du facteur qui, selon vous, était le deuxième en degré d'importance, et ainsi de suite, pour les huit facteurs. Soyez certain d'inscrire un numéro à côté de chaque facteur et n'utilisez pas deux fois le même numéro.

Si votre compagnie n'a PAS acheté de fournaises ou d'équipement de chauffage directement ou par l'entremise d'un sous-entrepreneur en 1978, cochez cette case ☐ et passez à la Question 10.

	CLASSEMENT	
Marque de commerce	____	(39)
Disponibilité	____	(40)
Service après-vente	____	(41)
Facilité d'adaptation à un système de climatisation	____	(42)
Efficacité énergétique	____	(43)
Prix d'achat	____	(44)
Fiabilité	____	(45)
Garantie	____	(46)

10. Veuillez lire ci-dessous la liste de facteurs qui auraient pu influer sur la sélection de CHAUFFE-EAU achetés en 1978, directement par votre compagnie ou par l'entremise d'un sous-entrepreneur.

Procédez de la même façon qu'à la Question 9, c'est-à-dire, le plus d'influence = 1, etc. Cette question comprend sept facteurs.

Si votre compagnie n'a PAS acheté de chauffe-eau directement ou par l'entremise d'un sous-entrepreneur en 1978, cochez cette case ☐ et passez à la Question 11.

	CLASSEMENT	A L'USAGE DU BUREAU SEULEMENT
Marque de commerce	_____	(47)
Disponibilité	_____	(48)
Service après-vente	_____	(49)
Efficacité énergétique	_____	(50)
Prix d'achat	_____	(51)
Fiabilité	_____	(52)
Garantie	_____	(53)

11. Veuillez lire ci-dessous la liste de facteurs qui auraient pu influer sur la sélection d'APPAREILS ELECTROMENAGERS POUR LA CUISINE ET DE LAVEUSES/SECHEUSES achetés en 1978, directement par votre compagnie ou par l'entremise d'un sous-entrepreneur.

Encore une fois, procédez de la même façon qu'à la Q.9 et la Q.10. Pour cette question, nous vous demandons de classer huit facteurs.

Si votre compagnie n'a acheté AUCUN de ces appareils en 1978, soit directement, soit par l'entremise d'un sous-entrepreneur, cochez cette case ☐ et passez à la Question 12.

	CLASSEMENT	
Marque de commerce	_____	(54)
Disponibilité	_____	(55)
Service après-vente	_____	(56)
Apparence/Couleur	_____	(57)
Efficacité énergétique	_____	(58)
Prix d'achat	_____	(59)
Fiabilité	_____	(60)
Garantie	_____	(61)

12. Cette question se rapporte uniquement à l'équipement installé dans les habitations UNIFAMILIALES NEUVES construites par votre compagnie en 1978. Ceci comprend les duplexes et les maisons en rangée mais pas les immeubles avec des appartements.

Si votre compagnie n'a pas construit de maisons unifamiliales neuves en 1978, cochez cette case ☐ et passez à la Question 13.

-a) Quel pourcentage de FOURNAISES ET D'EQUIPEMENT DE CHAUFFAGE, installés dans les maisons unifamiliales neuves, fut choisi par chacun des groupes suivants?

Pour chacun des cas, votre réponse peut aller de 0 à 100, mais tous les chiffres dans la colonne doivent totaliser 100%.

FOURNAISES ET EQUIPEMENT DE CHAUFFAGE		A L'USAGE DU BUREAU SEULEMENT
Ma compagnie	_____ %	(62/63)
Les architectes	_____ %	(64/65)
Les entrepreneurs électriciens	_____ %	(66/67)
Les entrepreneurs de chauffage	_____ %	(68/69)
Les entrepreneurs en mécanique	_____ %	(70/71)
Autre (Précisez) _____ .	_____ %	(72/73)
	100%	(74/75)

-b) Quel pourcentage de CHAUFFE-EAU, installés dans les maisons unifamiliales neuves, fut choisi par chacun des groupes suivants? 6-3

CHAUFFE-EAU		
Ma compagnie	_____ %	(7/8)
Les architectes	_____ %	(9/10)
Les entrepreneurs de chauffage	_____ %	(11/12)
Les entrepreneurs de plomberie	_____ %	(13/14)
Les services publics	_____ %	(15/16)
Autre (Précisez) _____ .	_____ %	(17/18)
	100%	

-c) Quel pourcentage d'APPAREILS ELECTROMENAGERS POUR LA CUISINE ET DE LAVEUSES/SECHEUSES, installés dans les maisons unifamiliales neuves, fut choisi par chacun des groupes suivants?

APPAREILS ELECTROMENAGERS POUR LA CUISINE ET LAVEUSES/SECHEUSES		
Les propriétaires	_____ %	(19/20)
Ma compagnie	_____ %	(21/22)
Les entrepreneurs de plomberie	_____ %	(23/24)
Les entrepreneurs électriciens	_____ %	(25/26)
Autre (Précisez) _____ .	_____ %	(27/28)
	100%	

13. Cette question se rapporte uniquement à l'équipement installé dans les immeubles neufs avec appartements construits par votre compagnie en 1978.

Si votre compagnie n'a pas construit d'immeubles neufs avec appartements en 1978, cochez cette case ☐ et passez à la Question 14.

-a) Quel pourcentage de FOURNAISES ET D'EQUIPEMENT DE CHAUFFAGE, installés dans les appartements neufs, fut choisi par chacun des groupes suivants?

FOURNAISES ET EQUIPEMENT DE CHAUFFAGE		A L'USAGE DU BUREAU SEULEMENT
Ma compagnie	_____ %	(29/30)
Les architectes	_____ %	(31/32)
Les entrepreneurs électriciens	_____ %	(33/34)
Les entrepreneurs de chauffage	_____ %	(35/36)
Les entrepreneurs en mécanique	_____ %	(37/38)
Les ingénieurs conseil	_____ %	(39/40)
Autre (Précisez) _____ .	_____ %	(41/42)
	100%	

-b) Quel pourcentage de CHAUFFE-EAU, installés dans les appartements neufs, fut choisi par chacun des groupes suivants?

CHAUFFE-EAU		
Ma compagnie	_____ %	(43/44)
Les ingénieurs conseil	_____ %	(45/46)
Les entrepreneurs de chauffage	_____ %	(47/48)
Les entrepreneurs de plomberie	_____ %	(49/50)
Les services publics	_____ %	(51/52)
Autre (Précisez) _____ .	_____ %	(53/54)
	100%	

-c) Quel pourcentage d'APPAREILS ELECTROMENAGERS POUR LA CUISINE ET DE LAVEUSES/SECHEUSES, installés dans les appartements neufs, fut choisi par chacun des groupes suivants?

APPAREILS ELECTROMENAGERS POUR LA CUISINE ET LAVEUSES/SECHEUSES		
Les propriétaires	_____ %	(55/56)
Ma compagnie	_____ %	(57/58)
Les entrepreneurs de plomberie	_____ %	(59/60)
Les entrepreneurs électriciens	_____ %	(61/62)
Autre (Précisez) _____ .	_____ %	(63/64)
	100%	

14. Maintenant, quelques questions concernant l'information que vous avez sur l'énergie pour le secteur résidentiel. Pour chacune des catégories d'équipement suivantes, dites-moi jusqu'à quel point, selon vous, les différentes marques SE RESSEMBLENT ou NE SE RESSEMBLENT PAS, en ce qui concerne leur EFFICACITE ENERGETIQUE.

Par exemple, si vous croyez que les différentes marques de fournaises et d'équipement de chauffage qu'on trouve sur le marché se ressemblent beaucoup, en ce qui concerne leur efficacité énergétique, encerclez le chiffre "4" pour cette catégorie d'équipement. Encerclez un numéro à chaque ligne.

	NE SE RESSEMBLENT PAS DU TOUT	NE SE RESSEMBLENT PAS BEAUCOUP	SE RESSEMBLENT PASSABLEMENT	SE RESSEMBLENT BEAUCOUP	A L'USAGE DU BUREAU SEULEMENT
Fournaises et équipement de chauffage	1	2	3	4	(65)
Chauffe-eau	1	2	3	4	(66)
Cuisinières	1	2	3	4	(67)
Réfrigérateurs	1	2	3	4	(68)
Laveuses	1	2	3	4	(69)
Sécheuses	1	2	3	4	(70)
Climatiseurs installés dans des fenêtres	1	2	3	4	(71)

15. Pensant en fonction des dollars dépensés, selon votre estimation, quel pourcentage de la consommation annuelle d'énergie au Canada est consommée par le secteur RESIDENTIEL? (Encerclez un numéro)

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

% |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_| %

(72/73)

(74/75)

16. En fonction des dollars dépensés, selon votre estimation, quel pourcentage du total de la consommation résidentielle ci-dessus est utilisé par chacune des catégories d'équipement suivantes?

6-4

Pour chacun des cas, votre réponse peut aller de 0 à 100%, mais tous les chiffres dans la colonne doivent totaliser 100%.

Fournaises et équipement de chauffage ...	_____%	(7/8)
Chauffe-eau	_____%	(9/10)
Appareils électroménagers pour la cuisine et laveuses/sécheuses	_____%	(11/12)
Autres appareils	_____%	(13/14)
L'éclairage	_____%	(15/16)
Tout autre équipement	_____%	(17/18)
	100%	

17. Il y a différentes façons d'économiser l'énergie. Nous aimerions savoir le pourcentage d'énergie que <u>vous pensez</u> pourrait être économisé dans <u>chacune</u> des situations suivantes. Veuillez encercler sur l'échelle, le chiffre qui correspond le plus à votre opinion de ce que vous pourriez économiser. Par exemple, si dans une situation, vous pensez pouvoir économiser 35%, vous encerclez (35). Si vous ne savez pas du tout, cochez la case "NE SAIS PAS".

EXEMPLE: 0 5 10 15 20 25 30 (35) 40 45 50+ Ne sais pas.. ☐
%

		A L'USAGE DU BUREAU SEULEMENT
1.	Lorsque vous réglez le thermostat, quel pourcentage de combustible économiserez-vous pour chaque degré Fahrenheit au-dessous de 68 F.? 0 5 10 15 20 25 30 35 40 45 50+ Ne sais % pas.. ☐	(19/20)
2.	Quel pourcentage d'électricité sera économisé si vous utilisez de l'eau froide plutôt que de l'eau tiède dans la laveuse pendant le cycle du rinçage? 0 5 10 15 20 25 30 35 40 45 50+ Ne sais % pas.. ☐	(21/22)
3.	Quel est le pourcentage d'augmentation dans la consommation d'électricité quand vous employez un réfrigérateur sans givre plutôt qu'un réfrigérateur à dégivreur manuel? 0 5 10 15 20 25 30 35 40 45 50+ Ne sais % pas.. ☐	(23/24)
4.	Quel pourcentage de combustible sera économisé si vous faites vérifier et nettoyer votre fournaise deux fois par année? 0 5 10 15 20 25 30 35 40 45 50+ Ne sais % pas.. ☐	(25/26)
5.	Quel pourcentage de combustible sera économisé en utilisant des portes et des fenêtres doubles, du calfeutrage et des matériaux isolants? 0 5 10 15 20 25 30 35 40 45 50+ Ne sais % pas.. ☐	(27/28)
6.	Quel pourcentage de combustible sera économisé si vous faites faire une modification importante à votre fournaise (retrofiting)? 0 5 10 15 20 25 30 35 40 45 50+ Ne sais % pas.. ☐	(29/30)
7.	Quel pourcentage de combustible sera économisé si l'épaisseur du matériel isolant sur votre chauffe-eau électrique ou au gaz, est augmenté de 2" à 4"? 0 5 10 15 20 25 30 35 40 45 50+ Ne sais % pas.. ☐	(31/32)

(33/75)

VEUILLEZ VERIFIER LE QUESTIONNAIRE AFIN D'ETRE CERTAIN QUE VOUS AVEZ REPONDU A TOUTES LES QUESTIONS ET RENVOYEZ-LE PAR LA POSTE DANS L'ENVELOPPE AFFRANCHIE, PREADRESSEE.

MERCI BEAUCOUP DE VOTRE COOPERATION.

APPENDIX B!

ENGLISH AND FRENCH COVER LETTERS!

CANADIAN FACTS
Vancouver Toronto Ottawa Montreal
A division of SK/CF Inc.

Canadian Facts
160 Bloor Street East, Toronto
Ontario M4W 1C2. (416) 924-5751

March, 1979

Dear Builder,

Each year builders across Canada purchase thousands of furnaces, water heaters, and kitchen and laundry appliances, all of which consume energy. As part of a university research study, we are interested in learning how your firm makes these purchase decisions. In addition, your personal opinions as a builder regarding the energy issue and what should be done about it are of vital interest to us, to builder trade associations, and to governments.

You and your firm are one of a limited number of builders who are being asked to give their opinions on these matters. In order that the results will truly represent the thinking of builders across Canada, it is important that each questionnaire be completed and returned.

For every completed questionnaire received, a twenty-five cent donation will be made to the research fund of the national Housing and Urban Development Corporation as a token of our appreciation for your time.

You may be assured of complete confidentiality. The questionnaire has no identification number on it.

The results of this research will be made available to builder trade associations and government departments across Canada, and to all interested citizens. You may receive a summary of results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on the questionnaire itself.

We would be most happy to answer any questions you might have. Please write or call Professor John Quelch, the Project Researcher at the University of Western Ontario, School of Business Administration, London, Ontario N6A 3K7, (519) 679-6659.

Thank you for your assistance.

Sincerely,

John Quelch
Professor John Quelch,
Project Researcher.

Mary Auvinen
Mary Auvinen, Senior Project
Director, Canadian Facts.

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mars, 1979

Cher Entrepreneur de construction,

Chaque année les entrepreneurs de construction à travers le Canada achètent des milliers de fournaises, de chauffe-eau, et de gros appareils électroménagers consommant tous de l'énergie. Dans le cadre d'une recherche universitaire nous aimerions savoir comment votre entreprise décide de les acheter. De plus, en tant qu'entrepreneur de construction vos opinions personnelles sur la question de l'énergie et ce qu'on devrait faire, sont d'importance capitale pour nous, pour les associations de constructeurs d'habitations et pour les gouvernements.

Vous faites partie ainsi que votre entreprise d'un nombre limité d'entrepreneurs de construction à qui on demande d'exprimer leurs opinions à ce sujet. Afin que les résultats soient vraiment représentatifs de l'opinion des entrepreneurs de construction à travers le Canada, il est très important que chaque questionnaire soit complété et renvoyé.

Pour chaque questionnaire complété qu'on reçoit, on fera un don de 25 cents au fonds de recherche de l'Association provinciale des constructeurs d'habitations au Québec en guise de remerciement pour le temps que vous y consacrez.

Nous pouvons vous assurer que vos réponses seront strictement confidentielles. Le questionnaire ne porte aucun numéro qui pourrait servir à l'identifier.

Les résultats de cette recherche seront accessibles aux associations de constructeurs d'habitations et aux départements gouvernementaux à travers le Canada, et aussi à toutes les personnes qui pourraient s'y intéresser. Vous pouvez recevoir un résumé des résultats en écrivant "voudrais copie des résultats" sur le dos de l'enveloppe et en dessous inscrivez en lettres moulées vos nom et adresse. Veuillez ne pas inscrire ces renseignements sur le questionnaire lui-même.

Si vous avez des questions, il nous ferait plaisir d'y répondre. Veuillez écrire ou téléphonner au Professeur John Quelch, Project Researcher, School of Business Administration, University of Western Ontario, London, Ontario, N6A 3K7, (519) 679-6659.

Nous vous remercions de votre aide.

Sincèrement,

John Quelch
Professeur John Quelch,
Project Researcher.

Mary Auvinen
Mary Auvinen, Chargé d'étude,
Réalités Canadiennes.

APPENDIX C!

ENGLISH FOLLOW-UP POSTCARD!

FOLLOW-UP POSTCARD

Last week, a questionnaire seeking your opinions about energy consumption and the purchase of energy-using equipment for installation in houses was mailed to you.

If you have already completed and returned it to us, please accept our sincere thanks. If not, please do so today. Because it has been sent to only a limited sample of builders, it is extremely important that yours also be included in the study if the results are to accurately represent the opinion of builders across Canada.

If my some chance you did not receive the questionnaire, or it was misplaced, please call me collect, and I will mail you another one today.

Sincerely,

Mary Auvinen
Project Director

DATE DUE
DATE DE RETOUR
