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A Case Study: Energy Consumption Labelling Requirements for Refrigerators

Seventh in a Series of Studies on Government Regulatory Activity

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FOREWORD

In recent years, increasing concern has been expressed both inside and outside government about the social and economic impact of government regulatory activity. On the one hand, the regulatory process itself has been faulted for being insensitive to public needs and opinions while, on the other hand, doubts have been expressed concerning the efficiency and effectiveness of particular regulations, standards or guidelines. More specifically, with the onslaught of serious inflationary problems, it has been argued that regulations may be unnecessarily adding to costs and prices. In fact, it was in the context of the establishment of the Anti-Inflation Board and the resulting debate on controls and post-controls policies that the Cabinet directed the Department of Consumer and Corporate Affairs and the Treasury Board Secretariat to assess the feasibility of applying benefit-cost and related methods of analysis to government social regulations, and to suggest modifications to the regulatory process which might encourage greater public participation.

In response to this mandate, our predecessors, Dr. Sylvia Ostry and Dr. Maurice LeClair, arranged for the establishment of a Working Group on Social Regulations. A number of studies were initiated in this context, whose results constituted an input to the development of the main features of the Socio-Economic Impact Analysis (SEIA) policy for health, safety and fairness regulations. The SEIA policy guidelines on analytical and consultative process requirements have been incorporated into the Administrative Policy Manual (Treasury Board Canada) as Chapter 490.

The papers in this Series of Studies on Government Regulatory Activity are selected from those which were prepared by the Working Group on Social Regulations, whose major purpose was to study the feasibility and desirability of subjecting health, safety and fairness regulations to more systematic analyses. Two types of background papers were prepared in this context. The first are general studies on the

reasons for social regulations, the experience of the United States with regulatory reform, and techniques for the evaluation of regulations (evaluation methodologies for health, safety and fairness regulations are discussed in Chapter 490 of the Administrative Policy Manual). The second group of papers consist of case studies of recent representative regulations in the areas of health, safety and fairness, and provide examples of analytical frameworks likely to be used in the context of the SEIA policy.

Since a major purpose of the SEIA policy is to encourage greater public participation in the regulation-making process, we have decided that selected background papers and case studies prepared by the Working Group should continue to be published in order to increase public awareness of this very important aspect of government activity.

George Post
Deputy Minister
Consumer and Corporate Affairs

John L. Manion
Secretary
Treasury Board

SUMMARY

In 1977, when this paper was written, the federal government had just begun to initiate a number of programs to increase energy conservation. As part of these efforts, and in conjunction with its overall attempt to reduce the growth in primary energy consumption to not more than 3.5 per cent per annum, the federal government had undertaken to increase the sensitivity of consumers to the importance of appliance energy costs. The initial focus of these efforts has been on the development of an information and education program and the establishment of energy labelling requirements for refrigerators. It is expected that energy labelling will eventually be expanded to include ranges, clothes washers and dryers, dishwashers and room air-conditioners. In this study, the Energuide program is recognized as one among a number of factors (including, particularly, the trend to higher energy prices) that is likely to cause consumers to pay greater attention to energy costs when purchasing appliances. The contribution of the Energuide program is to accelerate the learning process by consumers and make the benefits of a more efficient market available sooner than otherwise. In so doing, the program has the potential to make some real resource savings available to Canadian consumers and producers.

The benefits of the refrigerator labelling program were estimated by first looking at the total gains that are likely to arise from the pressure of market forces for more energy efficient refrigerators. These gains are measured by the difference between the manufacturing costs associated with the development of more energy efficient refrigerators and the value of the associated energy savings. To identify the benefits that are attributable to Energuide, an estimate was made of the gains to the economy if the progression to more energy efficient refrigerators was to proceed somewhat more rapidly than otherwise; the specific judgement incorporated in the study was that, in the absence of Energuide, there would be an additional time lag of two to four years in the introduction of energy saving improvements. It was found that, by accelerating the development of more energy efficient refrigerators, Energuide is likely to yield very significant resource savings. The

possible savings are particularly impressive in comparison with the rather modest costs of the program. And this applies even when the most conservative assumptions are used regarding the appropriate discount rate, the future trend in energy prices, and the contributions of the labelling program towards accelerating market developments. An examination of distributional effects and some other, more general (though non-quantifiable) implications of the program did not alter the general conclusion suggested by the data on costs and benefits about the merits of the program.

1. INTRODUCTION

In recent years, there has been increasing interest in the possibilities for energy conservation both by individuals and governments. The Canadian government, for its part, has come to recognize the important contribution energy conservation can make to achieving its objective of limiting the annual growth rate in primary energy consumption to not more than 3.5 per cent. It was in the context of this objective for reducing the growth in energy use that in December 1975 the government directed the Department of Consumer and Corporate Affairs to develop an energy-consumption labelling scheme for appliances. Refrigerators, which are major users of electricity -- accounting for about eight per cent of all domestic electricity use[1] -- were chosen to inaugurate the program. It is expected that energy labelling will eventually be expanded to include ranges, clothes washers and dryers, freezers, dishwashers, and room air-conditioners.

Energy labelling has at various times been discussed in connection with the establishment of energy standards; however, energy standards constitute a different and more restrictive policy than the labelling scheme addressed in this study. The Canadian program is essentially informational and educational. It is designed, as are other information-type programs, to increase the effectiveness of consumers in the market-place and, thereby, to improve the market's efficiency and responsiveness to consumer demands. In the past, consumers have paid very little attention to energy efficiency when purchasing appliances. In fact, even if a consumer were sensitive to the importance of energy considerations, it would be very difficult to acquire the necessary information. In the case of refrigerators, for example, the only energy ratings available in Canada are those which are periodically published by the Consumers' Association of Canada. But since CAC distinguishes only between brands and not between models (brand coverage is incomplete and up-to-date ratings are often not available), it offers a modest guide at best. Given the importance of energy considerations (the fact

that the present value of energy consumed over the life of a refrigerator is likely to represent well over half the purchase price,[2] and the fact that -- as indicated by data from the United States -- there are vast disparities in the energy efficiency of various models of refrigerators) it would seem that appliance purchasers have been making their buying decisions in the absence of a rather basic piece of information.

Since the time the Cabinet issued a directive on the subject, there has been an attempt to develop a program that could fill this gap in the market. The preparatory work has included consultations with interested consumer and producer groups to get agreement on the feasibility of significant energy-efficiency improvements, and on the general features of a labelling program; the design of a label (to be known as an Energuide) that will provide the consumer with information on monthly energy use in a clear, easily understandable form at the point of sale;[3] preparation by Consumer and Corporate Affairs officials of required amendments to the Consumer Packaging and Labelling Regulations; the establishment of a compliance program with respect to both labelling and to the use of standardized test procedures; and the development of an information program to make consumers aware of the program and to increase their general sensitivity to energy costs of appliances. This preparatory work has now been completed and refrigerators manufactured after September 30, 1978 are required to have an Energuide label affixed.

One question that arises at the outset is why refrigerator manufacturers themselves have not made consumers aware of the possibilities for energy savings on particular brands. If a refrigerator is more energy efficient than its competitors, it is reasonable for the manufacturer to publicize that fact, as he publicizes the other distinctive qualities of his product. It is possible that the traditional reluctance of manufacturers to make inter-brand comparisons in their advertising has tended to discourage references to energy ratings. However, probably more significant is the fact that, up to this point in time, appliance buyers have appeared largely indifferent to the costs of

energy. This impression may be misleading; it is not at all clear that consumers would be unresponsive to energy factors if they had clear and reliable information on the facts. But this apparent indifference suggests that the manufacturer who chooses to highlight the energy efficiency aspects of this product would necessarily become involved in the considerable and costly task of consumer education. Though the benefits of educating the consumer about the significance of energy considerations may well outweigh the costs for the economy as a whole, the situation would be quite different for a manufacturer selling a brand with temporary energy-saving advantages over its competitors. The rationale for government involvement therefore arises from the possible existence of the type of positive social benefits that would not enter into the balance sheet of individual producers.

A corollary of the foregoing is that producers would probably promote the energy efficiency of their appliances if they believed that consumers would be receptive. It seems reasonable to expect that consumers will become generally much more responsive to energy costs in future years. Energy considerations are already exerting a major influence on the pattern of some consumer purchases -- most notably, automobiles. There is also some indication that consumers are becoming increasingly conscious of the energy consumed by household appliances.[4] The combination of higher relative energy prices and the increasing emphasis on energy conservation will make consumers more aware of energy factors in their future purchases of major appliances and other products with significant energy-operating costs. This suggests that conditions are probably favourable for introducing a type of energy labelling program by manufacturers themselves in the not too distant future.

These considerations have been taken into account in analysing the costs and the benefits of the Energuide program. It would seem that in coming years a group of factors are likely to sensitize consumers to the existence and importance of energy operating costs, and thereby contribute to a more efficient market for refrigerators and other

appliances. The Energuide program will contribute to this process. While the government labelling program is probably not essential to these changes, it seems reasonable to expect that the program will accelerate the learning process by consumers and make available sooner than otherwise the benefits of a more efficient market. In the analysis that follows, it is assumed that the Energuide program reduces (by some two to four years) the time lag in which consumers become aware of, and responsive to, energy considerations.

Part 2 of the paper looks at the benefits and costs of the proposed labelling program for refrigerators. It may be useful, however, to note that an information program of this type differs fundamentally from other more restrictive forms of government regulatory activity. When the government directs individuals to act in a specific way, the resulting action may or may not produce some net benefit for society. With an information program, where it is left to the individual to determine the appropriate action based on his own self-interest, we at least have the assurance that a course of action will not be pursued to the point where marginal costs exceed marginal returns. For example, a regulation or standard requiring a reduction in the energy consumption of refrigerators by, say, 80 per cent is likely to be uneconomic in that it would involve the use of more real resources in terms of refrigerator production than it would save in terms of energy consumption. By making information on energy consumption available, we need not be concerned that improvements in energy efficiency will be carried to a point of negative returns. This is not to say there would not be social or economic costs associated with an information program. And, of course, the costs of implementing and administering an information program will not necessarily be justified by the resulting benefits.

2. BENEFIT-COST ANALYSIS

Theoretical Considerations

The benefits of the labelling program can be discerned by recognizing the consumers do not demand refrigerators per se, but refrigerating services. A development that lowers the price of these services (a drop in the price of refrigerators, an improvement in their reliability, an increase in their durability, or an increase in their energy efficiency) could be expected to cause a movement along this demand curve and result in an increase in the quantity of refrigerating services demanded. A change in energy costs would also affect the price of, and demand for, refrigerating services. And an information program that causes a change in consumer perception of the price of these services would similarly influence the demand for refrigerating services. Consider, for example, an information program that makes consumers realize the lower operating cost of refrigerator A vis-à-vis its competitor refrigerator B. The immediate effect would be to cause movements along the two demand curves (for refrigerating services) as consumers realign their market demand to the newly perceived prices for the services of the two refrigerators; as a result of the perceived price changes the demand for A would increase and the demand for B would fall. Alternatively, it is possible to focus on the conventional demand curve for refrigerators (as opposed to refrigerating services) and to view the information program as influencing consumers' perception of the relative qualities of refrigerators A and B. The new information, which enhances the relative appeal of refrigerator A, would be expected to result in a shift in demand from B to A, and a corresponding adjustment in their relative market prices.

The size of these movements in demand is related to the significance of the new information that becomes available on refrigerator costs, and the price elasticity of demand for refrigerating services. With respect to the latter, a reasonable possibility is that, in the

absence of complete information, consumers use the list price of a particular brand and model of refrigerator as a substitute for the price of its services. This suggests that the demand for refrigerating services of a specific type may resemble the market demand for a corresponding type and model of refrigerator and, therefore, be fairly elastic. Certainly, it is reasonable to expect that a consumer would be fairly responsive to a change in the relative price (or perceived price) of a service for which close substitutes are available. It is also probable that an information labelling program would cause a significant revision in consumers' perception of relative prices. Energy costs are an important component of total refrigeration cost, and if they continue to increase they will become even more important. Moreover, judging by available data from the United States, it appears that there are fairly substantial differences in the energy efficiency of various designs of refrigerators. As one example, a recent issue of Consumer Reports found that for no-frost, top-freezer units with rated capacities of 17 to 18.2 cubic feet, electricity consumption ranges from 1,200 to 2,040 kwh per year.[5] All this suggests that a program capable of drawing consumers' attention to the significance of energy costs would be likely to produce a quite significant market response.[6]

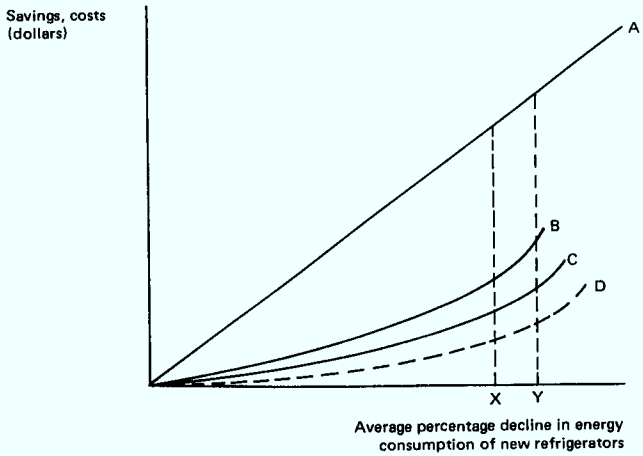
Returning to our example, the changes in demand for the services of refrigerators A and B can be regarded as the first-stage effect of the labelling program. The benefits at this point consist essentially of the saving in real resources that arises from these movements in demand, that is, the value of the energy saved by using more energy-efficient refrigerators minus the increased cost of producing these refrigerators.[7] It should be noted that we are not making any assumption about who receives the benefits of the program -- i.e. the extent to which the result is lower refrigerating cost for consumers, or higher profits for producers of the preferred brands.

Consumers' increased awareness of energy costs provides producers with the opportunity to increase sales and profits by marketing more energy efficient products. In subsequent stages,

producers will respond to this opportunity. It is indeed reasonable to expect that energy saving improvements will be introduced to the point where further changes are no longer profitable -- where the increased revenue from an appliance improvement no longer justifies the associated increase in manufacturing costs. The result is a progression to new, more energy efficient refrigerators and a trend towards greater savings in real resources for the economy.

The effects of the labelling program are summarized in Figure 1. The combined results of the growth in demand for more energy efficient models and related manufacturing improvements will be a decline in the average level of energy consumption of new refrigerators. This decline is measured on the horizontal axis. Since the production-weighted average electricity consumption of a new refrigerator is about 1,500 kwh per year, a 10-per-cent decline, for example, would represent an improvement to an annual average electricity use of about 1,350 kwh. The present discounted value of savings over the life of a refrigerator associated with a given percentage improvement in energy efficiency is indicated by line A. Curve C describes the manufacturing costs of implementing the corresponding improvement in energy efficiency. In an industry characterized by perfect competition and an absence of taxes, improvements in energy consumption would be introduced to the point where the marginal value of energy savings is equivalent to the marginal cost of the improvement -- i.e. to Y, at which point the slopes of A and C are equal. In the imperfect Canadian refrigerator industry, the more relevant curves are A and B, the latter representing the increased retail price associated with given improvements in energy efficiency after the appropriate taxes and mark-ups have been added on. The average energy consumption of new refrigerators would decline to X, after which the price increase for further improvements in efficiency exceeds the related savings in refrigerator energy costs; at point X the price of refrigerating services is thus at a minimum. The gains to the economy (resulting from the fact that new refrigerators use less energy) can therefore be calculated by determining the gap between lines A and C at point X and multiplying this by the number of refrigerators affected.

Figure 1



The foregoing analysis provides an estimate of the economic gains given the existing state of technology. Increased sensitivity to energy costs could lead to increased research and development, and ultimately to the development of a new generation of energy efficient refrigerators. Curve D shows the lower costs and increased benefits that could be available in the more distant future as a result of the development and implementation of this more advanced technology.

In the preceding description, we have emphasized the contribution of the Energuide program to the development of more energy efficient refrigerators. Clearly, however, the labelling program will be only one among a number of factors that will help make consumers aware of, and responsive to, energy costs in coming years. The increase in real energy prices is likely to continue and will certainly be an important factor in the future. The broad efforts of the federal and provincial governments to heighten energy cost awareness and to encourage conservation will also support the objectives of the labelling scheme. The establishment of appliance energy-labelling requirements in the United

States could be expected to have some influence on the Canadian market. And the general efforts in the marketplace to promote energy efficient products and energy saving devices will help to convince consumers of the need to consider energy costs in their buying decisions.

The progression to more energy efficient refrigerators will therefore reflect the influence of a range of factors that are at work in the market-place. The importance of the Energuide program stems from its ability to focus consumer awareness of energy costs specifically on refrigerators, and to make the information consumers require to bring energy factors into their purchase decisions immediately and easily available. In the absence of the energy labelling program, it is reasonable to expect that there would be an additional time lag before producers are encouraged to advertise and promote the energy consumption characteristics of their product. By eliminating this time lag, the Energuide program makes some real resource savings available to the economy.

The extent to which the Energuide program will accelerate market developments must be a matter of judgement. In the analysis that follows, we make two alternative assumptions -- both of which would appear reasonably conservative: that the Energuide program makes the benefits associated with the development of more energy-efficient refrigerators available (i) two years sooner than otherwise and (ii) four years sooner than otherwise. In the analysis, total benefits associated with the expected improvement in refrigerator efficiency are calculated, and from this total are deducted those benefits which would still be available had the process begun two years or four years later; the difference represents the gains that are attributable to the Energuide program.

It is well to be clear about the factors we have excluded from the analysis. First, no allowance has been made for the possible influence of the program on search activity. Information policies and programs are frequently analysed in terms of their impact in increasing the

efficiency of consumer search in the market-place. By increasing the benefits available from a given level of search, information programs could alter the time and resources consumers devote to search; and if so, the increased (or reduced) costs of search should be deducted from (or added to) the other benefits of the program. The time consumers spend in planning a major purchase such as that of a refrigerator is likely to be significant. However, given the little attention consumers have devoted in the past to energy factors and the rather undemanding nature of the labelling program, it is reasonable to assume that the impact of the program on search time and activity will be very minor.

Secondly, it has been assumed that improvements in energy efficiency can be introduced without reducing the quality of refrigerators in other respects. If, for example, a reduction in energy consumption were to be accompanied by a decline in aesthetic appeal or in the operating reliability of refrigerators, this would reduce or possibly eliminate the available benefits provided by lower energy costs. The evidence suggests, however, that this need not be a major concern for energy efficiency improvements. In the cost calculations that are used in this analysis, the design options that are questionable from this standpoint have been specifically excluded. For example, no consideration is given to the possibility of eliminating the automatic defrosting system that is a feature of some models. The estimated costs of improving refrigerator efficiency are therefore higher than they might be if all possible energy-saving options had been included in the analysis.

Thirdly, no allowance has been made for possible changes in patterns of refrigerator use and in consumer preference for certain types or sizes of refrigerator. Both could be influenced by the labelling program, though there are clearly more important factors underlying these aspects of consumer behaviour. As a result of the program, for example, consumers could become more sensitive to the operational characteristics affecting use -- i.e. room temperature, food

load, frequency of opening the door. However, while future government efforts will be aimed at influencing appliance care and use, this is not an immediate objective of the Energuide program; nor is it clear how much opportunity there is for energy savings in this area.

The possible influence of the labelling program on the demand for various types of refrigerators is also uncertain. It could be expected that the release of information on energy operating costs would lower the demand for larger frost-free types of refrigerators; taking into account the new information on energy operating costs would raise the perceived price of these refrigerating services. However, as energy efficiency improvements are introduced, the price of refrigerating services for these models may well decline compared with the cost of the services from smaller, less energy-intensive models. The program could thus give rise to both positive and negative influences on the relative demand for larger, frost-free refrigerators. It is assumed in this study that the net impact of these conflicting influences on the nature of the refrigerator demand would not be significant.

Lastly, it should be noted that resources have been evaluated in the study on the basis of their market prices. No allowance has been made, for example, for the possibility that the market price of electricity might not represent its true social cost. Nor has any distinction been made in evaluating resources drawn from the private and public sectors. Modifications in these respects could be introduced without significantly affecting the results of the study.

Benefits

(1) Savings from Using Less Electricity

The average price that residential customers paid for their "last block" of electricity in 1977 is estimated at 2.30 cents per kwh. To determine the value of saving one kwh of electricity in the base year

it is necessary to adjust this 2.30-cent figure to allow for the fact that electricity produces not only power but heat. Since virtually all electricity that is used ultimately appears in the form of heat, a decline in appliance electricity consumption will produce higher heating costs in the winter and lower cooling costs in the summer. The former, which is more important, can be calculated by determining the average cost to Canadian households of replacing one kwh of heat when heating is required (55 per cent of the year). The result, as calculated in Appendix A, is .86 cent. The value of the decline in cooling costs over the two peak summer months works out to .38 cent per kwh. The increase in heating expense is a cost of the labelling program, while the decline in cooling costs is an additional benefit; subtracting this cost and adding this benefit produces a value of 1.82 cents, for a saving of one kwh of electricity (see Appendix A).

(2) The Decline in Energy Consumption of Refrigerators

We have maintained that improvements in the energy efficiency of refrigerators would continue as long as the value of the energy savings exceed the associated increase in refrigerator prices; improvements in energy efficiency would be acceptable, that is, as long as they lower the price of refrigerating services. To determine point X in Figure 1, therefore, it is necessary to derive the slope of A and the configuration of curves B and C.

The slope of line A (or the present discounted value of the lifetime savings associated with a reduction of one kwh of energy consumption) can be calculated by the following:

$$\sum_{i=1}^{15} \frac{.0182}{(1+r)^i} \quad (1 + e)^i \text{ dollars}$$

where r is the real social-discount rate and e is the expected increase in real electricity prices. (It is also the expected increase for the oil and gas prices used in the calculations in Appendix A.) This cal-

culation makes use of the earlier analysis, which indicates that the value of saving one kwh of electricity amounts to 1.82 cents. And it is based on the results of a study done in the United States that suggests that the average life of a refrigerator is about 15 years.[8]

This calculation was carried out using two discount rates (five per cent and 10 per cent), and three alternative assumptions regarding the rate of increase in real energy prices, (zero, two, and four per cent). The results are given below.

Table 1

	r	e	Slope of Line A in Figure 1
	(per cent)		
Calculation A	10	0	.1523
Calculation B	5	0	.1984
Calculation C	10	2	.1700
Calculation D	5	2	.2251
Calculation E	10	4	.1895
Calculation F	5	4	.2548

Calculation D is based on the preferred set of medium-growth assumptions. Calculation A uses the most conservative set of assumptions, calculation F, the high-growth assumptions. While a five-per-cent real discount seems reasonable, judging by the opportunity cost of funds to individuals, consumers may in fact use a highly subjective discount rate in evaluating possible future monetary gains; if so, the 10-per-cent rate in calculations A and E may be more appropriate. It seems reasonable to allow for some increase in real energy prices, although four per cent may be a high estimate for the 1980s.

Table 2 below provides an estimate of the manufacturing costs and the retail-price increases associated with various increases in energy efficiency. The data were derived mainly from engineering

estimates assembled for the United States Federal Energy Administration.[9] Costs were interpolated at some intermediate points, and the American data were adjusted to reflect the higher cost of producing these efficiency improvements in Canada; it is estimated that the difference in production costs is about 10 per cent (with Canadian production costs calculated in American dollars).[10] The corresponding retail-price increase was arrived at by multiplying manufacturing costs by a factor of 2.5, as recommended by sources in the industry.[11]

Table 2

Decline in average annual energy consumption	Production cost	Retail price increase	Price increase for the last kwh of energy saving
(per cent)	(dollars)	(dollars)	(dollars)
3	.49	1.22	.0271
7	1.46	3.65	.0405
9	1.95	4.88	.0410
14	4.39	10.98	.0813
19	7.81	19.52	.1139
24	11.47	28.67	.1220
29	15.18	37.95	.1237
34	19.03	47.57	.1283
39	23.00	57.50	.1324
43	26.35	65.87	.1395
48	30.87	77.17	.1507
52	34.77	86.92	.1625
55	38.14	95.35	.1873

Note: All costs and prices are in terms of 1977 dollars.

The last column in Table 2 indicates the slope of the "price curve" (curve B in Figure 1) for various levels of improvement in energy efficiency. For calculation D it is apparent that the slope of line A (Figure 1) exceeds the slope of the "price curve" for all improvements in energy efficiency up to 55 per cent. In other words, all improvements in energy efficiency to this level would involve energy savings and decreases in operating costs that would more than offset the expected corresponding increases in the market price of refrigerators. It would appear that manufacturing costs rise very sharply after about the 55-per-cent level, making further improvements uneconomic, given the

present state of technology. A comparison of the last columns in Tables 1 and 2 shows that calculations B, E, and F all point towards a decline of about 55 per cent in average energy consumption. In calculation C, the price of refrigerating services begins to increase after a 52-per-cent decline in energy consumption, and therefore improvements would not be introduced beyond that point. Using the conservative assumptions in calculation A, further energy improvements become unacceptable after about 48-per-cent decrease in consumption has been achieved.

(3) Benefits of the Program

The benefits of the Energuide program consist of the total economic gains that are associated with the expected improvements in the energy efficiency of refrigerators, minus the economic gains that would be probable in the program's absence. The two steps that are involved in estimating the benefits will be described for calculation D.

(a) The Economic Benefits from More Efficient Refrigerators

To estimate benefits, some judgement must be made as to the time period over which changes in refrigerator performance are likely to be implemented. Since engineers have a fairly good understanding of the design changes required, improvements could be introduced fairly quickly. The specific assumption used in this analysis is that the average energy consumption of new refrigerators will decline at a rate of about 10 percentage points per year when the market has become fully responsive to consumer demands in this area. Major efficiency improvements are thus foreseen over the first half of the 1980s.

From the present time to 1988, the benefits expected from more efficient refrigerators are calculated in Table 3. All values are expressed in 1977 dollars and it is assumed that, with the exception of energy, all costs and prices will increase in pace with the Consumer Price Index. In calculation D, we are using a five-per-cent real discount

rate and are assuming a two-per-cent per annum increase in real energy prices.

L_i, the value of lifetime energy savings in year i dollars (column 4), equals:

$$D_i \times E_i \times 12.37$$

where 12.37 is the cumulative discount factor over 15 years, using the assumptions in calculation D

$$\text{(i.e. } \sum_{i=1}^{15} \frac{(1+e)i}{(1+r)^i} = 12.37 \text{ with } e = .02 \text{ and } r = .05\text{)}$$

D_i is the decline in annual energy consumption of eligible new refrigerators; and E_i is the value to consumers of a reduction of one kwh in electricity use. The resource savings in year i (column 6) are calculated by subtracting costs (C_i) from lifetime energy savings (L_i). And total benefits in each year (column 10) consist of the resource savings per refrigerator calculated in 1977 dollars (column 7), times the number of refrigerators to which such savings are likely to apply (column 9). Refrigerator sales were estimated by looking at the combination of new demand and replacement demand likely to arise in future years (see Appendix B). Column 9 is an attempt to allow for the fact that not all energy saving options can be incorporated into every model of refrigerator. It is estimated (here again it was necessary to rely on data from the United States) that the energy improvements would apply, on average, to about 70 per cent of new refrigerators -- i.e. eligible new refrigerators are equal to 70 per cent of refrigerator sales. The present value of the cumulative economic benefit over 11 years is just over $380 million. Since imports account for 15 per cent of the market, foreign manufacturers and exporters may receive some portion of these benefits. However, this share should be fairly small, amounting to only about two per cent;[12] total national benefits over the period would therefore be about $375 million.

Table 3

Economic benefits from more efficient refrigerators

Year i	Decline in average annual energy consumption of eligible new refrigerators (D_i)		Adjusted price of electricity (E_i)	Value of refrigerator lifetime energy savings in year i (L_i)	Production costs (C_i)	Value of resource savings in year i (S_i)	Present value of resource savings	Projected refrigerator sales	Eligible new refrigerators	Total value of benefits
	(per cent)	(kwh)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(thousands)	(thousands)	($000)
1977			.0182							
1978			.0186							
1979	3	45	.0189	10.52	.49	10.03	9.10	628	440	4,004
1980	14	210	.0193	50.14	4.39	45.75	39.53	655	458	18,105
1981	24	360	.0197	87.73	11.47	76.26	62.76	657	460	28,870
1982	34	510	.0201	126.80	19.03	107.77	84.49	645	451	38,105
1983	43	645	.0206	163.56	26.35	137.21	102.36	634	444	45,448
1984	52	780	.0209	201.66	34.77	166.89	118.66	622	435	51,617
1985	55	825	.0213	217.37	38.14	179.23	121.34	611	428	51,933
1986	55	825	.0217	221.45	38.14	183.31	118.23	600	420	49,657
1987	55	825	.0222	226.56	38.14	188.42	115.69	589	412	47,664
1988	55	825	.0226	230.64	38.14	192.50	112.61	590	413	46,508
Total										381,911
Column	1	2	3	4	5	6	7	8	9	10

(b) Expected Benefits without the Labelling Program

Without the Energuide program we would presumably not receive the benefits associated with the development of more efficient refrigerators until somewhat later. Two alternative situations are examined: in the first, we assume the added delay is two years and we begin to receive the benefits by 1981; in the second, we assume that without compulsory energy labelling more efficient refrigerators do not begin to come on the market until 1983. The calculations in each case are exactly as in Table 3, and again the tables pertain to calculation D.

Table 4

Benefits without Energuide (assuming a two-year lag)

Year i	Decline in average annual energy consumption of eligible new refrigerators (D_i)		Adjusted price of electricity (E_i)	Value of refrigerator lifetime energy savings in year i (L_i)	Production costs (C_i)	Value of resource savings in year i (S_i)	Present value of resource savings	Eligible new refrigerators	Total value of benefits
	(per cent)	(kwh)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(thousands)	($000)
1980			.0193						
1981	3	45	.0197	10.97	.49	10.48	8.62	460	3,965
1982	14	210	.0201	52.21	4.39	47.82	37.49	451	16,908
1983	24	360	.0205	91.29	11.47	79.82	59.54	444	26,436
1984	34	510	.0209	131.85	19.03	112.82	80.21	435	34,891
1985	43	645	.0213	169.94	26.35	143.59	97.21	428	41,606
1986	52	780	.0217	209.37	34.77	174.60	112.62	420	47,300
1987	55	825	.0222	226.56	38.14	188.42	115.69	412	47,664
1988	55	825	.0226	230.64	38.14	192.50	112.61	413	46,508
Total									265,278
Column	1	2	3	4	5	6	7	8	9

Table 5

Benefits without Energuide (assuming a four-year lag)

Year i	Decline in average annual energy consumption of eligible new refrigerators (D_i)		Adjusted price of electricity (E_i)	Value of refrigerator lifetime energy savings in year i (L_i)	Production costs (C_i)	Value of resource savings in year i (S_i)	Present value of resource savings	Eligible new refrigerators	Total value of benefits
	(per cent)	(kwh)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(thousands)	($000)
1982			.0201						
1983	3	45	.0205	11.41	.49	10.92	8.15	444	3,619
1984	14	210	.0209	54.29	4.39	49.90	35.48	435	15,434
1985	24	360	.0213	94.85	11.47	83.38	56.45	428	24,161
1986	34	510	.0217	136.90	19.03	117.87	76.03	420	31,933
1987	43	645	.0222	177.13	26.35	150.78	92.58	412	38,143
1988	52	780	.0226	218.06	34.77	132.29	107.22	413	44,282
Total									157,572
Column	1	2	3	4	5	6	7	8	9

(c) Benefits of the Energy Labelling Program

By deducting the results of Tables 4 and 5 from those of Table 3 we arrive at the benefits of the energy labelling program. Assuming Energuide is responsible for efficient refrigerators coming on the market two years sooner than otherwise, the benefits of the program are $116.6 million. Assuming Energuide reduces the lag by four years, the resulting benefit is $224.3 million. (National benefits work out to $114.0 million for two years and $219.3 million for four years.) The results using different sets of assumptions are indicated in Table 6.

Table 6

Benefits of the Energy Labelling Program

(thousands of dollars)

Calculation	With savings two years earlier	With savings four years earlier
A	45,139	81,450
B	87,416	164,743
C	62,506	115,343
D	116,633	224,339
E	84,053	158,238
F	152,528	299,428

Costs

The estimated costs of establishing and running the Energuide program are given in Table 7.

If the Energuide program did not exist but there was nonetheless a trend towards the development of more energy efficient refrigerators, many of the costs described in Table 7 would still be incurred. Manufac-

turers would still be required to build and operate energy test rooms; there would continue to be a need for labelling or for publication of energy ratings; and it would still be necessary for the government to monitor the testing done by manufacturers. In this case, however, there would be much lower government expenditures related to administration and enforcement, and there would be no public spending on information and advertising. We can also assume that the total advertising budget of manufacturers would be unaffected by developments in this area. Since what is of concern is the additional cost that is associated with the implementation of an energy labelling program, it is therefore necessary to make some adjustments to Table 7. An attempt was made to estimate the costs that would continue to be incurred in the absence of the Ener.guide program. These costs were estimated for the two alternative assumptions (two-year lag and four-year lag), using a five-per-cent and a 10-per-cent real discount rate. Subtracting these costs from the costs in Table 7 yields an estimate of the additional costs that are associated with the Energuide program. The results are given below.

Table 7

Costs of the Energuide Program

(thousands of dollars)

Year	Test rooms[1]	Operating test rooms[2]	Administration and enforcement[3]	Information and advertising[4]	Present value of costs 10-per-cent discount rate	five-per-cent discount rate
1977	900		20	50	970.0	970.0
1978		360	185	300	768.1	804.4
1979		480	330	400	999.5	1,097.5
1980		240	330	250	615.8	708.5
1981		240	330	250	560.1	674.9
1982		240	330	250	509.2	642.9
1983		240	330	100	377.9	449.8
1984		240	330	100	343.7	476.4
1985		240	330	100	312.9	453.6
1986		240	330	50	262.9	399.9
1987		240	330	50	239.3	380.7
1988		240	330	50	217.0	362.7
Total					6,176.3	7,471.2

1. This covers the capital cost of six test rooms (one for each of the major manufacturers and one for CSA) with estimated lifespans about equal to the period under study.

2. The operating cost of each test facility is estimated at $120,000 in the first year and $40,000 per year thereafter. First-year costs are divided between the last half of 1978 and the first half of 1979.

3. This covers: $20,000 in each of the first two years for research and testing; $100,000 per year for labelling; $150,000 per year for checking the compliance of Canadian manufacturers; $40,000 per year for monitoring imports; and $40,000 per year for administration of the program.

4. Information expenses include not only direct advertising costs but also the salaries of government officials and others involved in planning the information campaign and in directly promoting the Energuide program. It is expected that a large promotional effort will coincide with the launching of the labelling program and that expenditures will thereafter gradually diminish.

Table 8

Additional Costs Associated with the Energuide Program

(thousands of dollars)

	10-per-cent real discount rate	Five-per-cent real discount rate
With savings two years earlier	3,532.3	4,133.5
With savings four years earlier	4,150.6	4,811.5

Table 9

Net Benefits from the Energy Labelling Program

(thousands of dollars)

Calculation	Savings two years earlier	Savings four years earlier
A	41,606.7	77,299.4
B	83,302.4	159,631.4
C	58,973.7	111,192.4
D	112,519.4	219,527.4
E	80,520.7	154,087.4
F	148,414.4	294,616.4

Net Benefits

Using calculation D and assuming the labelling program makes the savings available from increased energy efficiency two years sooner, net benefits are $112.5 million. If the program contributes to an additional four years of energy savings, net benefits jump to $219.5 million.

Table 9 shows that with all calculations, the net benefits of this program are substantial. We can probably safely eliminate some of the extreme estimates: if energy prices do increase at four per cent annually in real terms, the relative contribution of the labelling program becomes more marginal, and so in calculations E and F the two-year estimates of net benefits are perhaps more realistic; conversely, in calculations A and B, where constant real energy prices are assumed, the four-year estimates have more appeal. But these refinements do not change the overall picture. The benefit-cost ratio is still very high (between 20 and 30 for most calculations and over 40 for calculation D, with the four-year assumption), and the clear impression that emerges is that government initiatives designed to educate and inform consumers and to promote the development of more energy efficient refrigerators are likely to yield substantial returns.

Some questions may arise because these estimates of net benefit pertain to an information program, as distinct from a program establishing performance standards. We cannot, of course, be absolutely sure that the market will respond in the manner that has been suggested and that the projected level of energy consumption will be attained. And certainly this differs from a program in which manufacturers would be required by law to reduce the energy consumption of new refrigerators by a fixed amount each year until the desired level of efficiency is attained. However, the increased certainty of the more restrictive standard-setting approach is often greatly exaggerated. If the market fails to respond to the increased information that becomes available through

energy labelling, it is quite possible that the anticipated benefits were not realized. It is conceivable, for example, that consumers could apply such a high discount rate to future savings that the benefits offered by a more energy efficient model of refrigerator would seem inconsequential. Or it is possible that a program of this type involves substantial costs of an indirect nature, which the analyst has ignored or underestimated. In situations of this type, a program of enforced standards would produce the desired behaviour by market participants, but it would not produce the expected gains for the economy.

These considerations are important not just because of what they may suggest about the credibility of a cost-impact study. Increased certainty is put forward as a main argument for adopting standards and fairly restrictive regulations as opposed to an informational-type approach for many government objectives; and in many cases such increased certainty simply does not exist. Therefore if an information program fails, the program has not necessarily been ineffective nor are more stringent measures necessarily required. It is quite possible that market participants have digested the information and concluded that their own best interests dictate a course of action contrary to that expected by the analyst.

3. SOCIO-ECONOMIC IMPACT

The energy labelling program could have some other effects that are less amenable to quantitative assessment. This part attempts to look at the implications of the program in this broader, more general context.

Price Effects

The incorporation of energy saving options will result in higher prices for refrigerators. More relevant, however, is the contribution of the program towards lower prices for refrigerator services. Price indexes are ideally constructed so as to distinguish "pure" price increases from those which are associated with changes in product quality. An appropriate price index for refrigerators would therefore reflect the contribution of the Energuide program to quality improvements, which more than offset the resulting increase in refrigerator prices.

Market Structure and Competition

The Canadian refrigerator industry is dominated by five firms -- Inglis, White, Admiral, Camco and BFG. A major benefit of the program is its contribution to the development of a new element of quasi price-competition in this relatively concentrated market. Although the program could pose some obstacles to competition and efficiency in the refrigerator industry, this is unlikely to occur. The required testing facilities and the equipment necessary for producing a more energy efficient product will increase the capital outlay required by new firms; however, in percentage terms, the increase will be minor and therefore the program should not make entry into the industry more difficult. Imports that comprise about 15 per cent of the Canadian market (by volume) should similarly remain relatively undisturbed by the program. The United States is a major exporter of refrigerators to Canada, and appliance manufacturers in the United States who must comply with their own country's

energy labelling program should not have a problem meeting Canadian import requirements. Sweden, another major exporter, also has its own appliance labelling program. Although there are important exporters in Italy and elsewhere who could initially be in a somewhat more difficult position, it is certain that major producers will undertake the energy testing and labelling necessary to comply not only with Energuide, but also with the appliance labelling programs being developed in several other countries (including France, Switzerland, Germany, Japan, and the Netherlands). All this, of course, presumes that there can be international agreement on what constitutes an acceptable procedure for testing the energy consumption of refrigerators.

Distributional Effects

The program will have implications for the relative competitive position of various refrigerator manufacturers, and of electrical and other suppliers to the refrigerator industry. The advent of labelling will provide the manufacturers who have the more energy efficient refrigerators on the market with the opportunity for some temporary gains over their competitors. Similarly, the resulting demand by manufacturers for new and higher quality components could alter the competitive position, at least in the short term, of various suppliers to the refrigerator industry. The demand for urethane foam, for example, should increase and the demand for fibreglass should fall as manufacturers seek to incorporate higher quality insulation into their products. (The growing demand for fibreglass for household insulation and other energy saving uses, however, has more important implications for producers of this product.)

It is impossible to describe with much certainty how the real gains the program offers will be distributed between producers and consumers and, within the latter group, between various classes of consumers. In the initial stage, immediately after the introduction of

labelling, it is possible that most of the gains will accrue in the form of windfall profits to manufacturers who have the more energy efficient brands on the market. In subsequent periods, as manufacturers redesign their products and seek to re-establish the relative appeal of competitive brands, there is likely to be a more equal sharing of gains between producers and consumers. As for consumers themselves, they should all benefit from the general improvement in the range of energy efficiency among refrigerators. However, the consumer who is already sensitive to energy costs and who is generally informed will benefit from the program sooner and probably more substantially. Also, the previous calculations suggest that energy improvements would result in higher percentage increases in the purchase price of the less expensive models of refrigerators. Therefore, though low-income consumers should benefit from the program, they are unlikely to achieve the greatest gains.

4. CONCLUSIONS

The analysis in this paper suggests that an energy labelling program for refrigerators is justified in terms of its net benefit to society. This study could be recast using alternative sets of assumptions regarding, for example, the trend in electricity prices, the appropriate discount rate, and probable developments in the absence of a labelling program; however, it would take quite extreme assumptions to contradict the general conclusion about the merits of the program.

This study is also an encouraging response to the more general question of the feasibility of using socio-economic evaluation techniques for assessing information programs. However, the resources required to undertake a satisfactory analysis of information programs (which would include, in some cases, market research or the construction of an econometric model to determine the response of market participants to new information) could be substantial. In addition, an impact study may be less important in an information program than in standards and other more restrictive government regulations, which may include substantial costs to the private sector as well as the public sector.

The Energuide program is an interesting example of government intervention to remedy the general type of market failure arising from insufficient information. While the energy labelling requirement is strictly speaking a regulation -- one made pursuant to the Consumer Packaging and Labelling Act -- it makes relatively modest demands on the behaviour of refrigerator producers. As such, this requirement and related information programs can be considered an alternative to regulations that require products to conform to specific design characteristics and performance standards and that, as a consequence, substantially reduce the role and influence of market forces. It is as an alternative to these more restrictive forms of government regulation that the energy labelling program is of particular interest from the broader perspective of when and how governments should intervene in the market-place.

NOTES

1. Energy, Mines and Resources Canada, 100 Ways to Save Energy and Money in the Home (Ottawa: Information Canada, 1975), pp. 96-97.

2. For a 15-cubic-foot frost-free refrigerator priced at about $600 (in 1977) and consuming slightly over 1,600 kwh of electricity annually, lifetime energy costs (using a five-per-cent real discount rate and assuming a two-per-cent annual increase in real energy prices) would amount to about $370 in present-value terms.

3. The labels that are now in use indicate the monthly energy use of a refrigerator in kwh. A seemingly preferable -- though administratively more complex -- alternative would be to indicate the energy operating costs of a model (in present dollars) over the average lifetime of a refrigerator. The latter approach would facilitate the comparison between refrigerator prices and refrigerator operating costs, and help to highlight the advantages of the more efficient models.

4. Richard Smith and Susan Cobb, "Household Energy Adjustments", National Food Situation (United States Department of Agriculture, March 1977). In this survey, one-third of the households reported that they had reduced appliance use in response to higher energy prices.

5. Consumer Union, Consumer Reports, January 1978.

6. In considering consumers' reaction to information on energy operating costs, it is important to keep in mind that these are largely expenses to be borne over a long and perhaps indefinite period of time, while the price of the refrigerator itself is an immediate expense. Based on their present position and their future expectations, certain groups of consumers are probably inclined to discount future expenses at a rather high rate. The evidence would suggest, however, that energy-operating costs would be an important consideration, even using a very high discount factor.

7. There would be another slight gain associated with the lower average perceived price, and increased consumption, of refrigerating services. This gain (which is measured by the increased consumer surplus in the market for refrigerating services) is quite small and can safely be omitted from the analysis.

8. Marilyn Doss Ruffin and Katherine Tippett, "Service-Life Expectancy of Household Appliances: New Estimates from the USDA", Home Economics Research Journal (March 1975), Vol. 3, no. 3, pp. 159-70.

9. Appliance Energy Efficiency Improvement Target for Refrigeration, Refrigerators/Freezers, National Bureau of Standards Center for Consumer Product Technology (February 25, 1977). Other studies referred to were: Study of Energy-Saving Options for Refrigerators

and Water Heaters (Cambridge, Mass.: Arthur D. Little Inc., 1977); and Hoskins and Hirst, Energy and Cost Analysis of Residential Refrigerators, Oak Ridge National Laboratory Report, ORNC/CON-G (Oak Ridge, Tenn., 1977).

The major design changes used in the calculation of costs are: increased insulation thickness, improved insulation conductivity, use of anti-sweat heater switch, improved compressor efficiency, improved door seals and cabinet throat design, increased condenser and evaporator surface areas.

10. James G. Frank, Assessing Trends in Canada's Competitive Position: The Case of Canada and the United States, Report from Compensation and Research Centre (Ottawa: The Conference Board in Canada, 1977). This study suggests that productivity in Canada's appliance industry is 65 per cent of that in the United States. Average weekly earnings in the Canadian industry are about five per cent higher after adjustment for the lower value of the Canadian dollar. Unit labour costs are therefore about 60 per cent higher in the Canadian major-appliance industry. Labour costs, however, would appear to have a relatively low weight in the production of refrigerator energy-saving options. Material costs are far more important, and -- based on the Conference Board study and discussions with manufacturers -- these would appear to be about equivalent in the two countries (again, after adjustment for the lower Canadian dollar). Allowing for the importance of material input into the production of energy-efficiency design options reduces the disparity in Canadian and American production costs to about 10 per cent. Using a Canadian dollar equal to 0.90 American dollars, Canadian manufacturing costs are thus equal to 1.22 times the American manufacturing costs.

11. A similar factor (2.6) is used in a recent study by Stevenson and Kellogg Ltd., Product Durability Study: Major Appliances and Tires, Fisheries and Environment Canada, Report EPS 3-EC-77-21 (Ottawa: Supply and Services Canada, November 1977). This "blow-up" factor covers manufacturers' overhead, taxes and profits, and a mark-up of about 40 to 50 per cent at the retail level.

12. To get a general indication of the benefits accruing to foreigners, it was assumed that the mark-up on the energy-saving options of imported refrigerators is split evenly between foreign and domestic sources (including governments). Assuming imports continue to hold about 15 per cent of the markets, the present value of the total gains to foreigners over the 10-year period to 1988 works out to $7.6 million.

APPENDIX A

THE VALUE OF REDUCING REFRIGERATOR ENERGY CONSUMPTION BY ONE KWH

The estimated average price of the "last block" of electricity to households in 1977 is estimated at 2.30 cents. It is necessary to adjust this price to allow for the fact that virtually all electricity that enters the home ultimately appears in the form of heat. Therefore reducing the energy consumption of an appliance by one kwh will produce a cost (C) in winter months in the form of higher heating costs, and an additional benefit (B) during the summer in the form of lower cooling costs.

Re: C

The fuel used by Canadian households for heating:

electricity	14.8 per cent
oil	46.4 per cent
gas	38.8 per cent

(Source: Statistics Canada, Household Facilities and Equipment, Catalogue no. 64-202, May 1977.)

The price of the oil equivalent of one kwh of heat can be calculated from the fact that one kwh = 3,412 BTUs, and that one Imperial gallon contains 168,000 BTUs. Using an oil price of 51 cents per gallon and assuming that home furnaces operate at a 65-per-cent efficiency rate, the oil equivalent price of one kwh of heat is 1.59 cents. A similar calculation can be made for gas. Using a price of $2.35 per million BTUs and assuming 65-per-cent efficiency rate, the equivalent price of one kwh of heat for gas is 1.23 cents. Given these prices, and the proportion of Canadian households using gas, oil, and electricity for heating, a weighted average price of one kwh of heat can be calculated;

this works out to 1.56 cents. The Division of Building Research at NRCC has determined that, given existing insulation levels, an average household in Canada would require heating for about 55 per cent of the year. In other words, over the year, for every kwh of electricity saved the average household must make up .55 kwh.

$$\therefore C = .55 \times 1.56 \text{ cents} = .86 \text{ cent}$$

Re: B

The value of B can be estimated from the market price of removing heat from the house in the peak summer months. This consists essentially of the cost of the electricity consumed in running an air-conditioner over an average of about two months or one-sixth of the year. (This represents a direct saving to householders with air-conditioners and an imputed valuation of the benefits of eliminating warm air for householders without air-conditioners.)

$$\therefore B = 2.30 \text{ cents} \times 1/6 = .38 \text{ cent}$$

Therefore the value of reducing refrigerator energy consumption by one kwh is equivalent to:

$$\begin{aligned} & 2.30 \text{ cents} - D + B \\ = \; & 2.30 \text{ cents} - .86 \text{ cent} + .38 \text{ cent} \\ = \; & 1.82 \text{ cents} \end{aligned}$$

APPENDIX B
PROJECTION OF REFRIGERATOR SALES

The long-term trend in refrigerator sales was estimated by looking at the general nature of both the future demand by new households and the replacement demand by existing households. Statistics Canada's projection of household formation (Catalogue no. 91-517) is the basis for determining prospective sales to new households. According to the projection used (projection 2) the number of households in Canada will increase from 7.2 million in 1977 to 9.3 million by 1988; and the annual average rate of growth in household formation will decline from 2.9 per cent in the period to 1981, to 2.5 per cent from 1981 to 1986, to 1.5 per cent in 1987 and 1988. Replacement demand was estimated from Statistics Canada data on the age of refrigerators in use (Catalogue no. 64-202). These data only indicate the number of refrigerators in various age categories, and it was necessary to assume that refrigerators are about evenly distributed within each category. Using these data and research results suggesting that the average life expectancy of a refrigerator is 15 years (see Note 8) it is possible to get an approximate indication of the number of refrigerators that are likely to be replaced over a given period.

Refrigerator sales will fluctuate above and below their long-term trend on the basis of interest rates, price trends, and general economic conditions. At present, sales are significantly below the projected long-term trend and it is reasonable to expect that some strong catch-up growth will occur over the next few years. The Canadian Appliance Manufacturers' 1977 sales projections provide a reasonable estimate of the course of this recovery, and the Canadian Appliance Manufacturers' Association estimates are used in this study for the period 1977 to 1980. After 1981 refrigerator sales are likely to decline, largely as a result of the drop in replacement demand. It is estimated that from

1981 to 1987 refrigerator sales will decline at an average rate of about 1.8 per cent per year. Total sales are thus projected to increase from 585,000 in 1977 to a peak of 657,000 in 1981 and thereafter to decline to a level of 589,000 by 1987.