Early Adopters of Energy Conservation Products in Winnipeg:

A Case Study

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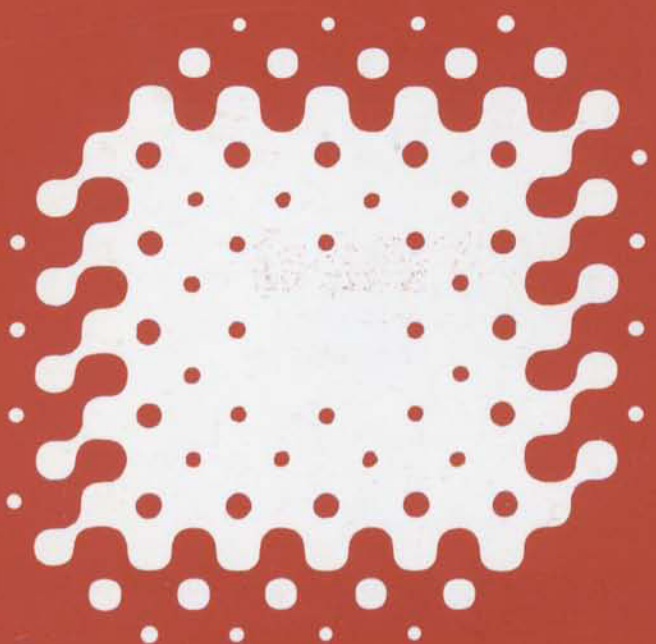

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The analysis and conclusions of this study do not necessarily reflect the views of the Department.

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FOREWORD

This project was funded by the Office of Energy Research and Development, Energy, Mines and Resources Canada, and was initiated and managed by the Strategic Policy Branch, Policy Research, Analysis and Liaison Directorate of Consumer and Corporate Affairs Canada.

It is one of a series of CCAC survey research reports, begun in 1975, entitled Energy Attitude Studies. The studies have as goals assessing and monitoring consumers' attitudes, knowledge and behaviour with respect to energy and resource use, and examining the importance that consumers have placed and continue to place on this aspect of their lifestyle.

This report, by Ian Fenwick, Roger Heeler and Patricia Simmie, examines data obtained through a questionnaire mailed to homeowners in the last week of December 1981. It identifies opinion leaders and early adopters of energy conservation products, and reveals a number of findings in the area of innovative conservation devices.

It should be understood that the findings, interpretations and recommendations of this report are those of the authors and do not necessarily imply their endorsement by Consumer and Corporate Affairs Canada. The purpose of this open publication policy is to ensure that the research environment is conducive to the production of high quality, objective scientific studies.

T. Russell Robinson
Assistant Deputy Minister
Bureau of Policy Coordination

SUMMARY

The objectives of this study are to: (1) identify early adopters of energy conservation technologies, (2) identify energy conservation opinion leaders, (3) determine consumers' perceptions and evaluations of a set of energy conservation product concepts, and (4) relate these perceptions and evaluations to consumers' innovativeness.

Following a review of the available literature on early adoption as it applies to energy conservation, this report describes the development and results of a questionnaire which was administered by mail to a random sample of homeowners in Winnipeg. The survey was designed to appeal particularly to those interested in energy conservation and those owning energy conservation products. As a result these individuals were overrepresented in the returned questionnaires.

Early adopters, defined as owners of four or more energy conservation products, tended to be upscale in demographics, to be opinion leaders, to be socially integrated, to rate themselves as innovative and to agree that they drove less. Early adopters were more discriminating in their product perceptions and more likely to be aware of new energy conservation products.

It was found that individuals' interest in buying the new energy conservation products tested could be accurately predicted using only their perceptions of each product's relative advantage, communicability and compatibility. Relative advantage was by far the most important factor. There was some evidence that payback period was the most important aspect of relative advantage, although consumers were sensitive only to large changes in payback period. Future research should investigate the individual components of relative advantage more closely.

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Chapter 1

ADOPTION AND DIFFUSION OF INNOVATION: THE TRADITIONAL APPROACH

The processes by which innovations are adopted by and diffused through a community are complex and not always well understood. The volume of literature in this area is immense. Rogers and Thomas (1975), for example, present a comprehensive bibliography of some 2 700 items, 144 of which relate to consumer marketing (Rogers 1976). As they further suggest that the literature is increasing exponentially, doubling every two years, a comprehensive review of the literature on innovation and diffusion is clearly beyond the scope of this study.

Although details frequently conflict and methodological differences do exist within the field, the key concepts are nonetheless fairly well defined. The literature review which follows concentrates on marketing applications; however, as these have tended to build on earlier research, many non-marketing sources are also reviewed. The aim of the review is to provide a solid framework for the questionnaire developed in Chapter 2. To this end, the literature is structured within the outlines of the traditional approach to adoption and diffusion research, with particular attention to those objections/modifications which are relevant to the present study.

There are four basic building blocks in the traditional approach to adoption and diffusion research:

- a consumer adoption process
- taking place within a social environment
- at different rates and at different points in time for different individuals
- all influenced by the characteristics of the innovation and its marketing methods.

Within the innovation/diffusion framework, marketing oriented researchers have focussed particularly on the characteristics of two key groups of "change agents": those adopting the innovation early (innovators or early adopters) and those playing a major role in the diffusion of the product (opinion leaders).

1.1 The Consumer Adoption Process

One of the major contributions of the classic study of Iowa corn farmers and their adoption of hybrid seed corn (Ryan and Gross 1943) was the recognition that new product adoption involves a process. The consumer moves through a series of stages culminating in adoption. The original model, implicitly used by Ryan and Gross, appears in Table 1. It is essentially a mechanistic model: all consumers eventually adopt, all go through the same stages and no stages may be skipped. It is similar to the original Awareness, Interest, Desire, Action (AIDA) model as well as the more recently propounded consumer behaviour models such as the hierarchy of effects, also shown in Table 1.

The role of such models is more conceptual than empirical. They remind the analyst that it is possible to measure diffusion prior to actual adoption of the innovation; unfortunately, the details of how such measurements should be made are debatable. Indeed, within the rural sociology field Mason (1962) found evidence that all farmers did not move through the sequence of stages suggested. The only common element in the decision process that he identified was a tendency for awareness almost always to precede adoption. Similarly, Fliegel, Kivlin and Sekhon (1968) found the same product could be adopted via different processes in different countries. In the marketing area Palda (1966) could discover no evidence for any hierarchy of effects and suggested that for consumer goods even the temporal priority of awareness could be infinitesimal. Furthermore, there is considerable evidence that the adoption process continues beyond adoption. Mason (1962) identified postadoption stages of further information search and product interest. The well-known concept of dissonance reduction can rationalize such postdecision search and also throws doubt on the position of evaluation and interest in the adoption model. Adopters may evince interest in the product and provide a favourable evaluation as a consequence rather than a cause of innovation adoption.

Campbell (1966) extended the adoption process model in two directions. First, and most relevant to this study, he recognized that consumers could be active. Thus the adoption process might begin not with awareness but with problem solving (see Table 1). The consumer could recognize a problem, becoming aware of the innovation only after active search for a solution to that problem. From an energy conservation marketing viewpoint, such a model would imply that innovators might be distinguished by their belief in an "energy problem" and a consequent search for product information.

Campbell's second contribution was to relax the strongly rational orientation of the hierarchy models. He allowed for consumers in some cases to make "impulsive" nonrational buying decisions, that is, to move directly from awareness to purchase without evaluation, preference or conviction stages. In the marketing literature Olshavsky (1980) presented evidence that innovations were diffusing with increasing rapidity, which he suggested may "preclude any type of decision process"

Table 1

Models of the Adoption Process

Ryan/Gross[a]	Hierarchy of effects[b]	AIDA[c]	Rational-problem oriented[d]
Awareness	Awareness	Awareness	Problem
↓	↓	↓	↓
Interest	Knowledge	Interest	Awareness
↓	↓	↓	↓
Evaluation	Liking	Desire	Evaluation → Rejection
↓	↓	↓	↓
Trial	Preference	Action	Trial → Rejection
↓	↓		↓
Adoption	Conviction		Adoption
	↓		
	Purchase		

Sources:

[a]Ryan and Gross (1943).
[b]Lavidge and Steiner (1961).
[c]Strong (1925).
[d]Campbell (1966).

(p. 427). This emphasis on "nonrational" decision making has been taken up by a number of consumer researchers (e.g., Robertson 1966). However, the thrust of these models is mainly directed toward frequently purchased consumer goods, and for our purposes this area of debate may be sidestepped.[1]

Rogers and Shoemaker (1971) identify three types of innovation decision: optional, collective and authority. Collective decisions (e.g., water fluoridation) are suggested to be the slowest, since several persons must pass through an adoption process and eventually reach a consensus. Optional decisions are those taken by an individual without explicit reference to other members of the system, and are considered to be faster than collective decisions. Authority decisions (e.g., automobile emission controls) are imposed on the individual by an external powerful force and are supposed to lead to the most rapid diffusion (although the authority decision itself is presumably the outcome of a possibly lengthy collective decision process).

A final problem with adoption models is the definition of adoption. Robertson (1971, p. 57) points out the distinction in the case of frequently purchased goods between a single trial purchase and the purchase/repurchase cycle implied by adoption. As our concern is solely with durable goods this particular distinction is academic. However, it is conceivable that a consumer could purchase an energy conservation product (e.g., a set-back thermostat) and not use it, or even defeat its purpose (e.g., by increasing the set-back temperature). Indeed, to the extent that some purchases of energy conservation aids may be involuntary (e.g., an appliance with a built-in energy saving feature, or an item included in a house-purchase, Quelch 1978), nonuse could be considerable. As energy conservation is contingent on use, not purchase, the true measure of adoption should be use, not ownership. Unfortunately, usage data is extremely difficult to obtain.

1.2 The Social System

Adoption and diffusion take place within a social system which affects the likelihood of any individual adopting the innovation and conditions the speed and extent of diffusion. Early diffusion work (mainly in the field of rural sociology) recognized a distinction between "traditional" and "modern" communities but otherwise tended to see diffusion as influenced by the individual and his or her personal characteristics. It was found, for example, that opinion leaders (see section 1.6) were early adopters only if the community was modern. In traditional communities opinion leaders were of no more than average innovativeness (Rogers 1962a, p. 245).

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1. Van Esch and Heeler (1981) present a lucid discussion of the possibility of integrating models of "rational" and "nonrational" decision making, but at present such work is not sufficiently developed to be applicable.

Rogers (1976) suggests that the social perspective in diffusion research -- the recognition that individual adoption decisions may be crucially conditioned by the social milieu in which they are made -- has considerable potential. The classic study in this area is Coleman, Katz and Menzel (1966), in which diffusion of the drug "gammanym" among physicians in four midwestern communities is examined.

The distinctive feature of this study relative to the pioneering rural sociology research is the concentration on networks and social relations. This led to a focus on "From whom did you obtain information?" and measures for individuals' integration into their society. Socially integrated individuals seemed to follow a different diffusion process from their nonintegrated counterparts. Specifically, socially integrated doctors adopted earlier and held more closely to an S-shaped cumulative adoption curve. Doctors who tended not to be socially integrated adopted later and followed a roughly linear cumulative adoption path. This empirical result nicely supports the theoretical rationale for S-shaped cumulative adoption curves that, as the number of adopters increases, the volume of interpersonal communication concerning the innovation rises and pressure on nonadopters grows, producing more rapid diffusion. Clearly, nonintegrated doctors are relatively immune from such interpersonal communication and are therefore not expected to follow the S-shaped curve (see also Mendez 1968).

Although social systems play an obvious role in diffusion (which is, after all, essentially an interaction concept), they also affect the individual's adoption decisions. Robertson (1968a) finds neighbourhoods whose norms stress innovativeness contain members who have adopted more than the average number of innovative products. Clearly, causality could be confused here: group norms could just as well be the result of innovativeness of group members.

The importance of the individual's immediate social sphere, as opposed to other (higher) socioeconomic levels, is reinforced by Katz and Lazarsfeld (1955) and King (1963). Katz and Lazarsfeld (1955) found that influence regarding food and household goods almost always flows in a horizontal (between equal-status levels) rather than a vertical direction. King (1963) found similar results for fashions.

These results on the importance of proximate groups ("cliques") have led to a more recent development: "the strength of weak ties" (Granovetter 1973; Liu and Duff 1972). Most interactions occur within an individual's immediate, limited environment, involving friends who are very similar (in the vernacular of this strain of research, "highly homophilous," Rogers 1973). As a result the diffusion of an innovation tends to be rapid within the immediate group but blocked from wider circulation. To jump the group's boundaries requires individuals with contacts outside the clique. These contacts are by definition links to more dissimilar ("heterophilous") individuals. It is these weak ties to individuals who are either members of more than one clique ("bridges")

or associated in a nonmember capacity with more than one clique ("liaisons") that are vital for widespread diffusion.[2] For example, Liu and Duff (1972) find that weak ties linking individuals who are not themselves friends yet have a contact in common were crucial in diffusing IUDs through the Philippines.

Essentially the research discussed above elaborates the concept of socially integrated individuals by recognizing that social integration may be measured in the context of small groups rather than society in general. An important implication is that an individual's personal characteristics may not be a good predictor of innovative behaviour. Instead, the individual's position within the groups with which he or she interacts may be of more relevance. It is quite possible that some of the currently accepted empirical findings concerning early adopters, opinion leaders, etc., may be closely conditioned by the individual's social position (so Katz [1961] reconciles apparently conflicting descriptions of innovators by reference to their group norms).

There is, however, a major methodological problem in pursuing this sociometric networks style of research in the present study. To produce valid measurements of individuals' positions within the groups of which they are members, it is necessary to concentrate data collection and perform a census within the community of interest. Each individual's interactions can then be plotted, both by their own claims to relationships and by the claims of their fellows, building a network of cross-validated relationships. This methodology is particularly appropriate where the community of interest can be narrowly defined (e.g., midwestern community doctors, Coleman, Katz and Menzel 1966). In marketing applications it is only really feasible in quasi-experimental situations (e.g., using student residences, Arndt 1967). For innovations that are generally available and have a low incidence of adoption, those approaches would be enormously costly or require an exceedingly narrow community focus. Instead, the present research must rely on self-reported measures of individuals' positions in their communities.

1.3 Differences in Innovativeness

1.3.1 Date of adoption. This is the heart of traditional diffusion research. Ryan and Gross (1943) credit popularization of the S-shaped diffusion curve, and its associated normal distribution of adoption over time, to F. Stuart Chapin, citing a 1928 source. Empirical work by Pemberton (1936) certainly applies the normal distribution, as do Ryan and Gross themselves. The basic finding that relative frequency of

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2. "Cosmopolitanism" has also long been recognized as a characteristic of innovators, for example, Tarde 1903.

individuals adopting is normally distributed over time has since been confirmed for a wide variety of innovations in agriculture and elsewhere (see Rogers and Shoemaker 1971, Table 5.1).[3]

The adoption distribution is usually divided into a number of more or less arbitrary categories. Rural sociologists, for example, have almost all used five standard categories defined by date of adoption relative to the distribution's mean and standard deviation (North Central Subcommittee 1961), that is to say:

innovators adopt before	$\bar{x} - 2\sigma$	
early adopters adopt after	$\bar{x} - 2\sigma$	but before $\bar{x} - \sigma$
early majority adopt after	$\bar{x} - \sigma$	but before $\bar{x}$
late majority adopt after	$\bar{x} + \sigma$	but before $\bar{x} + 2\sigma$
laggards adopt after	$\bar{x} + 2\sigma$	

(where $\bar{x}$ is the mean adoption time and σ the standard deviation of adoption times for the sample).

Given the approximately normal distribution of adoption times accepted by these analyses, innovators constitute 2.5% of the group, early adopters 13.5%, early and late majority 34% each and laggards 16%.

To some extent these categories have also been used in marketing studies, although researchers have not been slow to adapt or transform, or even to invent their own categorizations. For example, Bell (1963), Robertson (1968b) and Robertson and Kennedy (1968) define innovators as the first 10% to adopt; King (1963) makes them the first 35% to adopt; and Uhl, Andrus and Poulsen (1970) have 16% of buyers as innovators, 24% as laggards and 60% as "other-adopters." Baumgarten (1975), using a weighted index of product adoption, classifies 26% of his sample as early adopters. Typically, these categorizations are justified only by the need to define innovators as a sufficiently large group for analysis. There is no a priori theoretical suggestion that the first 35% of King's adopters (King 1963) are in any sense equivalent to the first 10% studied by Bell (1963) and Robertson (1968b), etc., in anything but the name "innovators" that is attached to them.

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3. There are counter-findings, particularly in the marketing literature. For example, Bass (1969) notes several nonnormalities, particularly for generic innovations (TVs, freezers) where distributions are positively skewed (see also Allvine 1968, Peterson, Rudelius and Wood 1972 and Peterson 1973). However, the normal distribution is supported in the majority of studies.

In fact a major question, apparently not addressed in the literature, is, Why categorize the adoption distribution at all? Date of adoption is a continuous variable. Data analysis techniques are certainly available to handle adoption data as a normally distributed variable. It is only really appropriate to split such a continuous variable into discrete portions if discontinuities are expected. For example, if it is believed that the characteristics of the first 2.5% to adopt are radically different from those of the next 13.5%, then definitions of innovators and early adopters make sense. However, no theoretical arguments seem to be presented to lead one to expect such discontinuities; if they were available they would presumably also define the points of discontinuity, and such a range of innovator definitions would not be observed. Indeed, as the innovator definition is frequently pragmatic, resting explicitly on the need for a reasonable sample size, it is inconceivable that a discontinuity in consumer characteristics should coincide with the categorizations used. Nor is there consistent empirical evidence for discontinuities. Profiles of innovators/early adopters/early majority, etc., tend to be related in a fairly linear fashion (Rogers and Shoemaker 1971, p. 190). The possible exceptions are leadership and use of personal communications sources (Rogers 1962a, Figure 6.2), which in some social settings are nonmonotonically related to time of adoption. In the absence of convincing discontinuity it is more appropriate to model consumer characteristics as a continuous function of, say, time of adoption rather than to use some arbitrarily defined adoption class.

The only classification scheme that looks for any sort of discontinuities is Peterson's (1973) cluster analysis, which was prompted by the nonnormal distribution of adoption dates found in some marketing studies. Peterson searches for adopter classifications by clustering on date of adoption, forming clusters until total within group sum of squares cannot be significantly reduced. This procedure in effect looks for discontinuities in the date of adoption distribution, not in the relationship between characteristics of adopters and date of adoption discussed above. However, if such discontinuities exist they may indicate a "natural" classification. Interestingly, the two empirical applications Peterson reports yield an earliest adopter category that is 14.8% of the sample in one case and 37.4% in the other. One problem with this method is its essentially ex post nature. If we make no assumption as to the form of the adoption date distribution, we can only perform the cluster analysis after all adoptions have taken place. Hence, one of Peterson's examples pertains to an "innovation" launched eight years earlier! Cluster analysis is also used in a multiproduct study by Darden and Reynolds (1974), producing six innovator groups; however, the clusters are essentially uninterpretable.

The ad hoc categorization approach is so ubiquitous that some of its other problems demand discussion. First, if the classifications are based on percentages of all adopters (e.g., innovators are the first 2.5% to adopt) it is necessary to develop an estimate of all adopters, that is, the final penetration of the innovation. Within the rural

sociology field this is not a problem, since there is a general assumption that all farmers eventually adopt the innovation. Clearly, if there are products for which the final penetration exceeds expectation, innovators will really contain early adopters; if final penetration falls short of that expected, early adopters will in fact contain innovators. Any analysis of the characteristics of different adopter groups is contingent on the accuracy of market penetration predictions.

Second, it is intuitively obvious that the definition of innovators should in some way be related to the newness of the innovation involved. Robertson (1971, p. 87) points out that being in the first 10% to adopt the third new brand of fluoride toothpaste is scarcely as innovative as being in the first 10% to adopt the first brand of fluoride toothpaste ever launched. Although the present research will not involve brands, it is reasonable to suspect that product modifications (e.g., double-glazed storm windows and doors) may be considerably less new than totally innovative products (e.g., heat pumps). As a result the characterization of innovators should be flexible enough to absorb product newness.

Third, are the categorizations to be applied to international, national, regional, community, or group time of adoption distribution? That is, to be an innovator, must an individual be in the first 2.5% to adopt in the world, or in Canada, or in Quebec, etc.? Presumably, the entire universe over which the 2.5% is defined should have access to the product (i.e., only areas within which distribution has been achieved should be considered). But the discussion of social systems in section 1.2, above, makes a strong argument for quite a local definition of innovation. However, if groups differ in terms of the innovative content of their norms (Robertson 1968a), should innovativeness be measured within or across groups? For instance, if all your friends have heat pumps, solar power units and windmills, your set-back thermostat, although innovative within the city in which you live, is scarcely innovative in a group context.

These problems can be avoided to some extent by defining innovativeness by the time of adoption irrespective of the distribution of ownership times. The lack of any theoretical structure and the quest for categories of sufficient size for analysis produces a wide range of definitions: Donnelly and Ivancevich (1974) use 90 days; Haines (1966) "several months"; Boone (1970) and Taylor (1977) three months; Peat, Gentry and Brown (1975) four months; Feldman and Armstrong (1975) the first 2 500 buyers; and Arndt (1967) 16 days. Even if categorizations were consistent, it would be difficult to define time-zero from which measurements should be made. For example, many product introductions are accompanied by predistribution promotion. Should adoption dates be measured from the start of promotion, the national product launch, or local availability? Typically, researchers seem to have used national product launch, although prepublicity may have been varied and extensive (e.g., Peterson 1973).

This method still requires estimation of the adoption date. For consumer goods, objective verification of adoption date (e.g., purchase receipts, warranty cards, etc.) may not be available, and is certainly difficult to access. Further, there is evidence that even well-educated, responsible, highly motivated individuals are not reliable sources of such dates. Coleman, Katz and Menzel (1957) find doctors consistently claiming to have adopted an innovative drug earlier than their prescription records show. As discussed in section 1.1, the definition of adoption for a consumer good is determined through self-reports. One user may report his or her first trial date, and be classified as an innovator; another user reporting the date of final commitment to continuing purchases may be classified as a late adopter, even though both tried the product at the same time.

1.3.2 Number of innovations adopted. Instead of locating adopters by date of adoption of a single innovation (a time series approach), it is possible to identify them by the number of innovations adopted (a cross-sectional approach, e.g., Summers 1971, 1972; Darden and Reynolds 1974; Green, Langeard and Favell 1973; etc.). This requires less recall -- presumably it is easier to remember ownership than date of acquisition -- and may elicit more truthful responses because of the implicit threat of ownership verification.

It is worth considering whether these two measurement methods (time series and cross-section) will identify the same individuals. Are those who adopt a single innovation soon after its launch also likely to own more new products than the average consumer? Clearly, if an early adopter of one product is also an early adopter of others, then a count of innovations adopted would allow us to identify innovators just as well as date of adoption. The evidence is that these conditions hold only if the innovations considered are within the same product category and are nonsubstitutes. Graham (1956), Robertson and Myers (1969), and Frank, Massy and Morrison (1964) all find innovativeness to be essentially monomorphic, that is, confined to a single product category. That category can be fairly widely defined, however. Whyte (1954) shows overlap of innovators between air conditioners and other household products; similarly Robertson (1966) finds overlap within appliances.

It is also possible to weight ownership data by either the innovativeness of the products concerned or by the date of product adoption. Rogers and Rogers (1961) suggest combining data sources using number and date of adoptions. However, Rossiter and Robinson (1968) indicate such weightings add little to the analysis.

Baumgarten (1975) develops an index of "aggregate popularity growth," which he claims eliminates the need for the researcher to estimate newness subjectively. However, this index is simply the ratio of intending purchasers to owners in the sample. While this ensures that "kooky" styles, as Baumgarten puts it, are down-weighted, it really is

not a measure of newness. Presumably, highly innovative individuals own styles to which others do not yet even aspire. Such innovators would not be identified by Baumgarten's approach.

Alternatively, all definitions can be thrown back onto the subjects (or a subset of respondents, "judges"). The sociometric approach calls for respondents to rate one another, allowing an overall consensus scale of innovativeness to be estimated. In the absence of a sociometric census, simple self-reports could be used, although these would lack the face validity offered by calculation of consensus (i.e., there would be no check on the accuracy of an individual's self-assessment). Indeed Summers (1968) finds little correlation between such self-ratings and innovative product ownership.

1.3.3 Comparing methods. Kohn and Jacoby (1973) make a direct comparison of innovativeness as measured by: (a) new product purchase on a simulated shopping trip, (b) self-reported innovativeness, and (c) reported ownership of innovative products. All three measures are taken on the same sample of consumers. Intermeasure correlations are very low and the authors conclude that the three methods tap essentially distinct constructs. This seems the most explicit empirical comparison of measurement methods. However, Uhl, Andrus and Poulsen (1970), in a study of laggards, find initial time of purchase and number of new grocery products purchased "give approximately the same results" (p. 51), and Rogers (1961b) reports that cross-sectional (i.e., product ownership) classifications correspond well with self-reports of innovativeness and with ratings of external judges. Midgley and Dowling (1978), in an important paper, take a theoretical perspective, pointing out that time of adoption (time series) classifications, particularly when they are innovation specific, are tautological. The first 2.5% to adopt a new strain of seed corn are innovators, and innovators of seed corn are the first 2.5% to adopt: "innovativeness is what we measure and what we measure is innovativeness" (ibid., p. 234). Without a link to an external measure (e.g., of innovativeness per se, or of another product's adoption experience), such a classification scheme is futile. At least the cross-sectional measurement (number of innovations adopted) elevates innovativeness from a single item to a product category.

Midgley and Dowling also suggest that as adoption is closely connected with group processes, in particular communication (see section 1.2), there is a strong random (probabilistic) element in date of adoption. If adoption depends on personal communication (and most research shows this to be the case for most individuals, e.g., Rogers and Shoemaker 1971), then the dates of receipt of information items will affect date of adoption. Yet for any single innovation, date of receipt of communications depends upon the path by which information reaches an individual. Midgley and Dowling suggest that although this path depends in part on the characteristics of the individual (e.g., gregariousness, social integration, product interest, etc.), for any particular product adoption it is also crucially conditioned by a host of situational and

essentially stochastic factors. Interpersonal communication on a particular topic, among a particular set of individuals, is by no means a certain event. As a result the chain of communication by which an individual receives sufficient information to lead to product adoption is highly influenced by chance. If innovativeness is conceived as a personal trait, Midgley and Dowling argue, it is inherently unsatisfactory to measure it by a single product adoption, with its largely nonpersonal (situational) influences. Date of adoption of a single product is also likely to be highly unreliable as a measure of innovativeness, the only exception being for individuals who do not use personal communications as an information source. They will, presumably, tend to adopt new products consistently early, late, or whenever.

This led Midgley in earlier papers (1976 and 1977) to develop the concept of "innate" vs. "actualized" innovativeness. Innate innovativeness is presented as a personality trait, applicable across all product classes, involving the extent to which an individual "makes innovation decisions independently of the communicated experience of others" (Midgley and Dowling 1978, p. 231). Actualized innovativeness refers to observed innovative behaviour. The measurement of innate innovativeness will involve cross-sectional measures of the adoption dates of several innovations from a variety of product classes (if innate innovativeness is to be maintained as a multiproduct concept), or yet-to-be-developed pencil and paper tests.

The Midgley and Dowling paper is of interest to this study because it presents strong support for multiple measures of innovativeness and advances theoretical arguments to support the methodology adopted here. Whether innate innovativeness is applicable across product classes need not be of concern here; pragmatically, we are concerned with identifying future adoption of energy conservation products (actualized innovativeness). Innate innovativeness with respect to energy conservation products will be the key predictor. There is no reason, a priori, to expect innate energy-conservation-product innovativeness to be any harder to measure than general innate innovativeness. In fact, from the Midgley-Dowling model, if interpersonal communication is affected by product class (e.g., via an individual's product-class interest), then our product-class version of innate innovativeness will be a better predictor of future innovation adoption in that product class than will generalized innate innovativeness.

1.4 Characteristics of the Innovation

In addition to differences in individuals' adoption speeds, differences exist in products' rates of adoption; not all products, even within a single product class, diffuse at the same rate. Clearly, the product itself plays a role in terms of how it is perceived by the consumer: "The ease or difficulty of introduction depends on the nature of the 'new' in the new product -- the new as the customer views the bundle of services he perceives in the newborn" (Wasson 1960, p. 52).

Although much innovation research, particularly in rural sociology, concentrates on explaining, ex post, reaction to a single innovation, marketing usually has a more predictive intent. If we can identify the components of the customer's perception of the "new" in one innovation we may be able to use such components in assessing the viability of future innovations.

Rogers (1962a) presents five characteristics of innovations, which are potential general dimensions of consumers' evaluation of the "new": relative advantage, compatibility, complexity, trialability and observability. However, Rogers cautions that "each of these five is somewhat interrelated with the other four, but they are conceptually distinct," and that "further research will certainly be necessary before [these] five characteristics of innovations...can be accepted as the five most important" (p. 307). Nearly ten years later, Rogers and Shoemaker (1971) are still cautious and point out that a general classification of innovations is an objective that "we have not reached" and "our postulate of 5 attributes is...empirically defenceless" (p. 137). Despite these clearly stated reservations Rogers' five attributes have gained universal acceptance, the only addition to the original 1962 list being the occasional inclusion of "perceived risk."

It is important to remember that the individual's perception is the key variable. A new product as perceived by consumers may be quite different from that intended by its producers. In all of the following, attributes of innovations should be considered as perceived by potential adopters. Unfortunately, some of the scant research on innovation attributes fails to measure consumer perceptions at all, using instead the perceptions of "experts" or "judges" (e.g., Kivlin 1960; Tucker 1961).

The only direct evaluation of Rogers' attributes seems to be provided by Ostlund (1973). Ostlund uses depth interviews in an attempt to uncover additional relevant product attributes but finds none. He suggests, however, that Rogers' attributes overlap and presents factor analysis results to support this, though he does not state how he decided on the number of factors to extract, or give any indication of the variance explained by his factor solutions. Without this knowledge his results must be treated with extreme caution. Ostlund presents separate factor structures for each of six products; sometimes extracting three, sometimes two factors. The first factor usually measures "ease of use and value of trial," with high loadings on relative advantage, trialability and perceived risk (negative). The second factor measures "complexity," with high loadings on complexity, observability (negative) and sometimes compatibility (negative). In three factor solutions the third factor is "perceived risk," with high loadings on perceived risk, compatibility (negative) and sometimes communicability (negative).

Ostlund also finds product perceptions much superior to predispositional and demographic/socioeconomic variables in explaining a "measure of innovative behaviour" -- what measures he completely omits to specify!

1.4.1 Rogers' innovation attributes

(a) Relative advantage. This is a straightforward measure of the degree to which an innovation is superior to existing products or practice and is defined as "the intensity of the reward or punishment resulting from adoption" (Rogers and Shoemaker 1971, p. 139). Suggested subdimensions of relative advantage include "economic profitability, low initial cost, lower perceived risk, decrease in discomfort, savings in time and effort and immediacy of reward" (ibid.).

For the adoption of energy conservation products the "immediacy of reward" may be particularly relevant. Rogers and Shoemaker suggest that lack of immediacy of reward explains the slow adoption of preventive innovations (disease control, seat belts, etc.). Perhaps conservation products can only expect a perceived advantage after the adverse effects of rising energy costs have been firmly felt.

Rogers and Shoemaker (1971) also cite evidence that economic profitability may be of less importance in the adoption decisions of peasants and small-scale farmers than those of large-scale farmers: "limited skill with numbers,...crude accounting schemes, and...lack of finesse with the scientific method of reaching conclusions all act to limit comparing ability" (p. 142). The same points could be made regarding adoption of energy conservation products. Recognition of conservation cost-savings demands a cost-related approach to household expenses which, in turn, may be stimulated only by rising energy costs. Energy costs could increase both the saliency and the size of relative advantages. A further point of interest is the role of grants and incentives in enhancing relative advantage and thereby speeding adoption. Rogers and Shoemaker note that careful studies are lacking, but the available data suggests that, if at all possible, use of the innovation ceases with the incentive.

For the non-cost-conscious, other subdimensions of relative advantage may be more important, or behaviour may be affected more by the other four innovation attributes.

Finally, Rogers (1962a) points out the role of crises in emphasizing relative advantage. It seems that crises may both increase the saliency of a preexisting relative advantage and create or itensify a relative advantage.

(b) Compatibility. This refers to the degree to which an innovation is "consistent with existing values, and past experiences of adopters" (Rogers 1962a, p. 126). Rogers and Shoemaker (1971, p. 145) include "consistent with consumers' needs" in their definition. This surely brings compatibility back to relative advantage: a product which is more compatible with needs is one with a relative advantage.

The most celebrated incompatibility with cultural values is probably instant coffee. Projective research showed use of this innovation to be associated with idleness and lack of caring. Interestingly, direct questions caused respondents to attribute their rejection to taste (relative advantage), although blind taste-testing found the innovation to be superior (Haire 1950).

It is particularly important that an innovation be compatible with adopters' past experience with the product which the innovation intends to supplant. The long gestation period of the electric typewriter, for example, has been attributed to its incompatibility with previous product experience.

Compatibility leads to the idea of a "complex of innovations." Once a consumer has adopted one innovative item, others associated with it may be more easily accepted. Presumably, a chain could be developed, taking the consumer by small stages away from existing practices. Though Rogers and Shoemaker report that the empirical base for this concept is small, it is intuitively plausible. For energy conservation it might be possible to press the adoption of a minor innovation compatible with existing habits as a precursor to more substantive adoptions.[4]

(c) Complexity. This is the degree to which an innovation "is perceived as relatively difficult to understand and use" (Rogers and Shoemaker 1971, p. 154), and is usually expected to retard adoption (however, see Graham 1956).

(d) Trialability. This is "the degree to which an innovation may be experimented with on a limited basis" (Rogers and Shoemaker 1971, p. 155), earlier termed "divisibility" (Rogers 1962a, p. 131). It is suggested that trialability may be particularly important for earlier adopters, who have no prior user evidence on the innovation. In a sense later adopters can make vicarious use of early adopters' trials. In that Rogers and Shoemaker link trialability to reduction of risk, this concept overlaps with "perceived risk," often added as a sixth characteristic of new products (e.g., Ostlund 1974).

(e) Observability and communicability. This is "the degree to which the results of an innovation are visible to others" (Rogers and Shoemaker 1971, p. 155), earlier, and perhaps more appropriately, termed "communicability" (Rogers 1962a, p. 132). Poor scoring on this attribute tends to retard preventive innovations. A preemergent weed-killer, for example, diffused slowly because there were no dead weeds to display

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4. This concept of a complex of innovations also supports measurement of innovativeness on a cross-sectional basis. See section 1.3.2.

(Rogers and Shoemaker 1971) -- but presumably there was an absence of weeds, equally observable, but probably less communicable. For conservation-oriented products this suggests that adoption is likely only after bills have risen: reducing energy payments is more observable and communicable than preventing their increase. Also many energy savings are not readily observable by others (except perhaps in the case of roof insulation preventing the melting of heavy snow), so that diffusion might be slow.

1.4.2 Predicting individual adoption. All the studies reported above attempt to predict aggregate adoption rates from perceived product characteristics; that is, they relate aggregate perceptions and product penetration. Rogers and Shoemaker (1971) recommend the investigation of individual differences in perceptions as an important area for further research. Ostlund (1974) presents the first attempt to follow this up by looking at product perceptions as a predictor of an individual's product adoption.

Measurement timing is a major problem for any study of perceptions and buying behaviour. If perceptions are measured prior to purchase, they may change before the innovation is adopted; if they are measured postpurchase they will reflect usage, dissonance reduction, etc. Ostlund (1974) measures perceptions by ratings obtained in a laboratory study 12 months prior to new product launch. Two months after product launch the original sample was reinterviewed (60% response rate), and aided and unaided purchase recall data collected. A discriminant analysis using only the prepurchase product perceptions data correctly identified 70% of those claiming to have purchased the product (i.e., "early adopters" in the sense of having tried the product in the first 2 months). Use of respondent psychographic and demographic data improved this hit rate by at most one percentage point.

Ostlund (1974) also reports a similar study using panel members. Perceptual data was gathered six months prior to product launch as part of an ad-testing procedure. Three months after launch this perceptual data was used to discriminate between those whose diaries showed a purchase of the product and those who had not adopted. Again hit rates were high: 79% of the sample could be correctly classified by perceptions alone. Personal characteristics added only four percentage points to this.

In both studies relative advantage (or one of its subdimensions) was the most important predictor, followed in one case by compatibility, complexity and perceived risk and in the other by perceived risk, complexity and aspects of compatibility. Both studies found observability and trialability to be of minor importance, although there are some differences in the first study for aided purchase recall.

Ostlund concludes that "the perceptions of innovations by potential adopters can be very effective predictors of innovativeness" (1974, p. 28). Unfortunately, it is not at all clear that his data supports this. Ostlund has shown that buyers (albeit in the first two to three months after launch) have different perceptions than nonbuyers do. In order to relate this to innovativeness it would be necessary to collect further data at intervals after launch and ensure that perceptions of later adopters differ from those of earlier adopters. As it stands Ostlund's evidence merely confirms that those with favourable product perceptions are more likely to purchase.

Feldman and Armstrong (1975) investigate the effect of perceived characteristics on adoption of the rotary-engined Mazda. They conduct mail interviews in California with samples of innovators and later buyers. Innovators are here defined as the first 2 500 to buy, later buyers as those buying in December, January and February, 18 months after product launch. Only two of Rogers' five innovation characteristics differ significantly between these two groups. Innovators, as Rogers would expect, perceive the innovation as less complex (i.e., express greater agreement with "I understand how this car works"). Innovators also perceive the product as more risky, contrary to Rogers' scheme (Rogers 1962a, p. 131). However, Feldman and Armstrong operationalize perceived risk (or "divisibility" as they term it) by the extent of disagreement with "When I purchased this car, I had complete faith that the dealer would stand behind the warranty." As they point out, their findings here are seriously undermined by measurement timing error. Innovators, having bought the car about 18 months earlier, have had more than sufficient time to change their perceptions. In particular, warranty perceptions are likely to change considerably with post-purchase experience of using the warranty.

The second part of the Feldman and Armstrong analysis uses mail interviews with midwestern Toyota and Mazda buyers. The first 2 500 Mazda buyers are defined as innovators, and purchasers of comparable Toyotas in the same time period are termed noninnovators. The two groups differ significantly on all five of Rogers' innovation attributes (although perceived communicability is actually lower for the innovators, that is, Mazda buyers). Unfortunately, like Ostlund (1974), Feldman and Armstrong have shown only that Mazda buyers hold generally more favourable perceptions of Mazda than nonbuyers. The perceptions held by later adopters of Mazdas in the Midwest are unknown.

Peat, Gentry and Brown (1975), in a comment on Feldman and Armstrong, do collect data on a sample of later Mazda buyers. Although they report no perceptual data, their findings on the demographic characteristics of innovators and later buyers are quite different from those of Feldman and Armstrong.

More recently, Labay and Kinnear (1981) examined the perceptions of solar energy adopters, unaware nonadopters and aware nonadopters. Overall the aware nonadopters are more like adopters than like unaware nonadopters. Product perceptions tend to be more favourable for the adopters, although few significant differences can be found between adopters' perceptions and those of aware nonadopters. Product perceptions can correctly classify 62% of the sample, and overall perceptions provide better classifications than do demographic variables. Again there is the problem of comparing earlier vs. later adopters. Part of the perceptual differences recorded by Labay and Kinnear is probably the result of solar energy owners having revised their product perceptions since making the purchase decision. Hence, product perceptions as reported by adopters may be the consequence rather than the cause of adoption. Labay and Kinnear do look at the effect on adopters' perceptions of date of adoption. Recent adopters perceived solar energy systems as being significantly more compatible and involving less social risk. There were no other significant differences.

It is strange that the influence of product attributes on innovation adoption has received so little attention in the marketing literature. Although product perceptions are recognized as a major component of purchase decisions, little attempt has been made to test or refine Rogers' original, tentative innovation attributes. Of the five marketing-based studies of product perception reviewed here -- two reported by Ostlund (1974), two by Feldman and Armstrong (1975) and one by Labay and Kinnear (1981) -- four merely show that buyers differ from nonbuyers, and the remaining study (Feldman and Armstrong 1975) confirms the significance of only one of Rogers' five attributes; Labay and Kinnear, as discussed above, also offer some support for one of Rogers' attributes.

1.5 Characteristics of Innovators and Early Adopters

Many studies have attempted to describe innovators and early adopters, collectively known as earlier adopters. Most of the relevant research originates in the classic rural sociology studies.

Innovators are distinguished by their "venturesomeness," or willingness to try new ideas (Rogers and Shoemaker 1971, p. 183), a finding typical of the tautological definition of innovators as discussed above (section 1.3.3). Early adopters are characterized as "more respectable" than innovators and more likely to serve as role models for later adopters (ibid., p. 184).

Earlier adopters (innovators and early adopters) are also reported to have higher social status and to be better educated, better connected to the social system, more upwardly mobile and wealthier than later adopters. In particular, there is evidence that earlier adopters have greater exposure to mass media and to interpersonal communications, and may be more likely to seek out information about innovations.

Studies of the personalities of earlier adopters suggest they have more favourable attitudes to change, risk, science and education than later adopters, and tend to hold higher aspirations for education, occupation, etc.[5]

Unfortunately, these findings tend to be undercut by the absence of any real discontinuities in the distribution of innovators (see section 1.3.1). As a result it is quite possible that a small change in the definition of earlier adopters (in itself quite arbitrary) could radically affect the differences discovered between this group and later adopters.

1.6 Characteristics of Opinion Leaders

Another group that has been of primary interest is opinion leaders. Rogers and Shoemaker (1971) define opinion leadership as "the degree to which an individual is able to influence informally other individuals' attitudes or overt behaviour in a desired way with relative frequency" (p. 199). This leadership can either be positive and speed diffusion of an innovation, or negative and retard diffusion.

Opinion leaders achieve their position in the communication process through their greater exposure to information sources. The two-step flow of communication model was developed following a study of the 1940 U.S. Presidential election (Lazarsfeld et al. 1944). It was found that information tended to flow first to a group of influentials in the community, who then passed on both the information and their influence or opinion to other members of their communication network. Subsequent research has suggested that the two-step flow model is too restrictive. The hypothesis that opinion leaders obtain information only from mass media sources, and that only opinion leaders obtain information from mass media, has been shown to be true only in certain situations. Rogers and Svenning (1969) found opinion leaders used interpersonal channels to gain information about an innovation if these were the most appropriate source. Furthermore, as the innovation became less "new," many later adopters received their information directly from the mass media rather than from opinion leaders. The interpersonal communication network of an individual may be a crucial factor in the study of opinion leaders. While the group of friends with whom one would discuss any particular topic tends to be highly similar, some contact or "bridge" with other groups is necessary to introduce new ideas (see section 1.2). Opinion leaders may provide that bridge between communications networks.

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5. The many findings in this area are summarized in Rogers and Shoemaker 1971, p. 184 et seq.

Several studies have attempted to relate opinion leadership to other variables. Typically, opinion leaders are found to be more cosmopolitan, to participate more socially, to be more exposed to mass media and to be of higher social status than nonleaders (see, for example, Rogers and Shoemaker 1971). In addition, there is some evidence that opinion leaders are particularly likely to participate in activities connected with the innovations studied, to have a greater knowledge of new developments and to read more specialized print media. Whether opinion leaders are also innovative has been found to depend on the norms of the social system in which they operate: innovative norms are associated with innovative opinion leaders and traditional norms with opinion leaders of no more than average innovativeness (see section 1.2). Even with innovative norms opinion leaders are more likely to be early adopters than innovators. Engel, Kegerreis and Blackwell (1969) find that innovators perceive themselves as more active in information giving and seek more information prior to product trial. Baumgarten (1975) found that 12% of his sample could be classified as both opinion leaders and early adopters.

Although these findings suggest a definite relationship between opinion leadership and innovativeness, the association is by no means one to one. As opinion leaders are a key group to influence in order to speed diffusion, it is essential to include direct measures of opinion leadership in addition to measures of innovativeness.

1.7 Measuring Opinion Leadership

Opinion leadership can be measured in three ways: by sociometrics, key informants or self-reports. As discussed above (section 1.2), the sociometrics approach, resting on individual reports from interlocking individuals, although probably the most accurate method, demands data collection by census from a small, well-defined area. Such a census is rarely possible in any but the most artificial circumstances (see, for example, Arndt 1967).

Key informants are only appropriate when there are clearly acknowledged experts whose judgements on the identity of opinion leaders will be accurate. In consumer-oriented research such acknowledged experts are rarely available. Self-reported opinion leadership is really the only possible method for large-scale survey research. The method rests on the ability and willingness of respondents to identify their own degree of opinion leadership. Strictly speaking, self-reports measure self-perceived, not actual, opinion leadership.

Self-reports have been used, with varying degrees of sophistication and success, in a wide range of innovation studies. Several researchers have used undisguised, single (or at best two) item evaluations of opinion leadership (e.g., Silk 1966; Abelson and Rugg 1959; Corey 1971; Pessemier, Burger and Tigert 1967). Indeed Pessemier,

Burger and Tigert claim that "the standard question from the literature" is, "Would you say you are more likely, about as likely or less likely than any of your friends to be asked your advice about..." (p. 351).

However, more reliable and better worded scales do exist. The most widely used is a six-item scale proposed by Rogers (1962a, p. 230), presented here as Exhibit 1. Items 1, 4 and 5 are intended to measure perceptions of past behaviour; items 2, 3 and 6 aim to measure "self-image."

Exhibit 1

Rogers' Six-Item Opinion Leadership Scale

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1. During the past 6 months have you told anyone about a new farming practice?

2. Compared with your circle of friends (a) are you more or (b) are you less likely to be asked for advice about new farming practices?

3. Thinking back to your last discussion about some new farming practices (a) were you asked for your opinion or (b) did you ask someone else?

4. When you and your friends discuss new ideas about farming practices, what part do you play? (a) mainly listen or (b) try to convince them of your ideas?

5. Which of these happens more often: (a) do you tell your neighbours about some new farming practice, or (b) do they tell you?

6. Do you have the feeling that you are generally regarded by your friends and neighbours as a good source of advice about new farm practices?

Source: Rogers (1962a), p. 230.

The major advantage of Rogers' scale is its known reliability and validity. Rogers and Cartano (1962) estimate split-half reliability as .70; Silk (1971) finds rather higher figures of .84 and .77, depending on product class. Although .80 is often recommended as the minimum reliability for applied analysis (Nunnally 1978), at least Rogers' scale approaches that level, and its reliability appears fairly consistent from one study to another.

Rogers (1962a, p. 232) also reports tests of convergent validity, finding his self-reported scale correlates .64 with opinion leadership as measured by key informants and .30 with sociometric measures. Silk (1971) points out that Rogers' scale in its original form is open to response set effects, that is, tendencies for respondents to maintain a particular response style -- "yea-saying." In particular the scale is unbalanced. In five of the six items the first response offered indicates opinion leadership. This is likely to stimulate "column-running," or unthinkingly identical responses to all items. Although such a response style would provide reliability since all scale items would be consistent, it would not reflect respondents' true feelings (the scale would lack validity). Also the dichotomous responses required by the items may exacerbate missing data problems. Respondents who do not wish to take a firm position are forced to refuse items.

Silk also tests the discriminate ability of Rogers' scale and finds it meets requirements quite well. However, there is a marked tendency for respondents to match item responses across product categories. Responses to an item when the item refers to "cooking" are highly correlated with responses to that same item when it applies to "furniture." This response effect could create an impression of generalized opinion leadership even though correlations of responses to different items (within Rogers' scale) when referred to different product categories are fairly low. The present study uses a modified version of Rogers' opinion leadership scale that is designed to remove the defects criticized by Silk.

1.8 Hypotheses from the Literature Review

The literature review and discussion suggest the following hypotheses of particular relevance for this study:

H1 Early adopter definitions should be consistent. In particular early adopters as defined cross-sectionally (by the number of energy conservation products owned) should have higher than average self-rated innovativeness scores.

H2 Early adopters will be sociodemographically distinct from other consumers. In particular early adopters will tend to be better educated, and have higher social status and higher incomes than the average consumer.

H3 Early adopters of energy conservation products are likely to be opinion leaders.

H4 Early adopters of energy conservation products are likely to be highly socially integrated.

H5 Early adopters of energy conservation products will tend to use mass media sources for information on energy conservation.

H6 Early adopters of energy conservation products will have distinctive attitudes towards energy consumption and conservation. In particular they will see the individual as playing a major role in energy conservation.

H7 The five product attributes suggested by Rogers (1962a) (relative advantage, compatibility, communicability, complexity and trialability) should explain the overall evaluation of energy conservation products for both early adopters and for other consumers.

H8 Early adopters of energy conservation products will have distinctive perceptions of energy conservation products, even those they do not own. In particular they will perceive energy conservation products more favourably, that is, as:

- having greater relative advantage,
- being more communicable,
- being more compatible with existing household behaviour,
- being more trialable, and
- being less complex.

H9 Early adopters of energy conservation products will form their evaluations of new energy conservation products in a distinctive way. In particular they will have a longer horizon in product evaluation and be prepared to adopt products with a longer payback period than would the average consumer.

The last two hypotheses (H8 and H9) are aimed at discovering the reason for early adopters being early adopters. Compared to those adopting later, early adopters should perceive conservation products as having more favourable characteristics (e.g., higher relative advantage) and/or they should translate any given set of product characteristics into a more favourable overall evaluation (e.g., any given level of relative advantage, complexity, etc., could produce a more favourable evaluation for earlier adopters).

Chapter 2

SURVEY METHODOLOGY AND RESULTS

The aim is to build a questionnaire which is solidly grounded in the large body of existing innovation literature, as reviewed above. Wherever possible we wish to use multiple measures (i.e., to have several ways of measuring the key concepts of the study -- innovativeness, opinion leadership, etc.), and scales with proven reliability. Unreliable items (i.e., items whose responses contain a considerable portion of random error) will conceal the relationships we are trying to find and weaken the predictive power of our analysis (Nunnally 1978).

2.1 Survey Media

As the literature review makes clear, innovation involves many complex concepts. It is at once apparent that telephone interviews are unlikely to allow sufficiently detailed data collection. The major choice, therefore, is between personal interviews and mail interviews. Several factors led to mail interviews being conducted.

First, personal interviews, professionally conducted, would be extremely expensive in this case because of the nature of innovators and early adopters. By definition this is a low-incidence group (see section 1.3.1). Very little is known about its demographic characteristics, and no usable sampling frame directly relevant to this group was discovered. A contact problem will exist no matter what data collection method is used: many approaches must be made to contact a few qualified respondents. Personal interviews have a high contact cost, mail interviews, a low contact cost (really only printing, stuffing and postage). Mail interviews are therefore highly cost efficient in this case.

Second, the major drawback of mail interviews -- their low response rate -- is not of crucial concern in this study, because the aim is not to produce a random sample of the population. In fact there is reason to believe that a low response rate may improve, not endanger, the study's efficiency, because the aim is to develop a picture of a specific subset of the population: innovators and early adopters of energy conservation technologies. It is known that individuals are more likely to respond to a survey if they are interested in the topic of the survey. By clearly signposting that the questionnaire has to do with energy conservation, we should be able to increase the probability of response from those interested in energy conservation, and effectively oversample the rare group with which we are concerned. Of course, the sample we obtain is unlikely to be representative of all households. And it will <u>not</u> necessarily provide good estimates of the true incidence of innovators and early adopters in the population. However, there is

every chance that the innovators and early adopters who do respond will be fairly typical of innovators and early adopters. The only bias suggested in the mail survey literature that might affect us here is a bias against low-literacy groups and members of large families. To the extent that these groups tend not to respond to mail surveys, they may be underrepresented amongst our innovators and early adopters. This bias is unlikely to be important, however, because there is nothing in the literature on innovations to suggest that such groups play a particularly major role in the adoption of innovations.

Third, many of the questions to be used in measuring innovativeness (e.g., the time of adoption measures) and in measuring household characteristics (e.g., size of heating bills) require some consideration on the part of the respondent and may involve consulting purchase records, utility bills, etc. Mail interviews provide the best conditions for considered answers.

Finally, the loose ends identified in the literature review notwithstanding, there is a wide array of well-developed, tested and standardized measures of innovativeness, opinion leadership, product characteristics, etc. Thus the power of personal interviews to collect unstructured data, or to allow measures to be adapted to respondents' conditions, is not really required. Were the area less well-developed, or were existing measures shown to be inapplicable to energy conservation products, there would be a strong argument for personal interviewing. As it is, prudence demands that existing methods be tested before expending resources on alternatives that may prove unnecessary.

Having focussed on mail interviews, there are two alternatives. Interviews can be conducted with a sample of households in the chosen city, or an existing mail panel can be used. A mail panel assures a higher response rate (typically 70%-80% of members respond) by virtue of having screened out likely refusers when the panel was originally recruited (up to 90% of those contacted refuse to join a panel) and also by motivating panel members using a variety of inducements. Unfortunately, panel members may well be atypical for our purposes. Although panels can be balanced (i.e., made representative) on any, or all, demographic characteristics, several panel organizers voiced a suspicion that their panels might underrepresent innovators -- although no hard evidence on this is available. Furthermore, as discussed above, response rate is of secondary consideration in this study. Accordingly, mail interviews were conducted with a sample of households.

2.2 The Questionnaire

Four versions of the questionnaire were employed: two rotations and two manipulations. An example of one version of the questionnaire appears in Appendix A.

From the outset the topic of the questionnaire is clear. As discussed above, those not interested in energy conservation are not part of the target population and need not be encouraged to respond. Question 1 asks for ownership and time since acquisition of each of nine energy conservation products. The products were chosen to span a range of innovativeness from "storm windows or doors" to "solar power unit." This question allows respondents' innovativeness to be measured cross-sectionally (by number of products owned), by time series (by time since adoption) and weighted cross-sectionally (by number and newness of the products). In addition, the time series measure can be tested across products (e.g., Were early buyers of heat pumps also early buyers of shower-flow restrictors?).

Question 2a identifies information sources used by the respondent. Answers to this question will help to describe innovators and, particularly, opinion leaders (see section 1.6). Questions 2b through 2g form a standard scale to measure opinion leadership. It is an adaptation of Rogers' scale (see section 1.7), having been balanced as suggested by Silk (1971) so that opinion leadership is indicated by a choice of the first response to items 2b, 2c, 2f and 2g and the second response to items 2d and 2e.

Questions 3 and 4 are basic, undisguised measures of conservation practice and motivation to conserve, respectively. Question 5 includes items designed to measure a variety of concepts. The items are randomly ordered to ensure that order effects do not pollute any particular concept. Items 5a, 5c, 5i and 5m are designed to measure social integration, which the literature suggests is an important influence on innovativeness (see section 1.2). Items 5b, 5d, 5f, 5g and 5j measure response set, or "yea-sayings." The items are drawn from the YN2 scale as summarized in Wells (1968). It has been suggested that those who rate themselves as highly influential (opinion leaders) tend to be yea-sayers (Bylund and Sanders 1967; Silk 1971).

Items 5h, 5k, 5n, 5q and 5r are designed to measure self-reported innovativeness. In particular 5h and 5k are suggested as measures of generalized innovativeness by Midgley and Dowling (1978) (see section 1.3.3).

Items 5e, 5l, 5o and 5p provide a measure of attitude to energy conservation and are based on the measures used in an earlier personal interview study conducted by Wharton et al. (1982).

Pages 4, 5, 6 and 7 of the questionnaire elicit respondents' perceptions of four product concept statements. These product concepts are rated on items measuring each of the five product attributes deemed by Rogers (1962a) to be relevant to diffusion (see section 1.4). Items g, j, l, m and n measure perceived relative advantages; items b, d and i measure observability/communicability; items a, f and o measure complexity; item c measures trialability; and items e, k and h measure compatibility. Item p measures prior awareness of the product, q and r, acceptability of the concept.

The four product concepts administered to each respondent were designed to span a range of values on Rogers' five product attributes. Each concept was administered at one of two levels, and the order of presentation of the concepts was reversed in half the questionnaires. The level of concept and the order of presentation were randomly assigned.

Exhibit 2 shows the product concepts used, while Table 2 indicates the expected score for each concept on Rogers' attributes. The manipulations focussed on two aspects of relative advantage -- price and payback period -- and on two aspects of compatibility -- compatibility with life-style and compatibility in installation. Respondents' evaluation of each concept's acceptability will allow us to relate product characteristics to product acceptance.

This product concept procedure has a number of methodological strengths. First, the product concepts are used to assess the perceptions and evaluations of early adopters and of other respondents. They are not used to define early adopters. As we saw in the literature review (section 1.4.2) previous research used the same product both to define early adopters and to compare their perceptions with those of later adopters (or, usually, nonadopters). This confounds the characteristics of being an early adopter with that of being a product owner. Previous research (in particular Ostlund 1974; Feldman and Armstrong 1975; and Labay and Kinnear 1981) cannot distinguish between perceptual differences that are the result of being early adopters and those that are the result of being product owners. For obvious reasons product owners tend to report favourable perceptions of products they own, but whether these perceptions are the cause or effect of ownership is undecided.

Our approach of defining early adoption by ownership of one set of products and product perceptions by responses to a different set of products at least mitigates the problem. Some confusion is still present in that early adopters are probably more likely to be owners of the products described in the product concepts. Indeed we deliberately allow the set of products used for early adopter definition to intersect that used for perceptions (the shower-flow restrictor is common to both groups) to provide the opportunity to assess the effect of ownership relative to that of early adoption (although this comparison is outside the scope of this report).

Second, the product concepts involve a mixture of replicated and repeated measurements. It would clearly be methodologically unsound to invite a single respondent to rate both a $10 and a $20 light bulb. Such a comparison would be unrealistic and invalid. If we are to make a realistic assessment of the effect of price in this case we use a replicated measure: one individual rates the $10 light bulb, another rates the $20 and results are analyzed across individuals (across replications). Unfortunately, replicated measures are expensive. More treatments require a larger sample. In order to maximize cost efficiency

Exhibit 2

Product Concepts Used

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1. Energy Efficient Light Bulb

Either:

The energy efficient light bulb, not available to the public until at least 1982, has an energy efficiency three times that of currently available bulbs and will last up to four times longer. The new bulb will be about the same size as conventional bulbs and will fit all regular sockets. The new bulbs will retail for $10 each. The makers state that, depending on usage, consumers will recover the price of the bulb in electricity savings within about two years of normal use.

Or:

The energy efficient light bulb, not available to the public until at least 1982, has an energy efficiency three times that of currently available bulbs and will last up to four times longer. The new bulb will be about the same size as conventional bulbs and will fit all regular sockets. The new bulbs will retail for $20 each. The makers state that, depending on usage, consumers will recover the price of the bulb in electricity savings within about two years of normal use.

2. Energy Monitor

Either:

This is an electronic device that continually monitors a household's energy usage. It allows you to set an energy budget and will flash a warning if the budget is exceeded. Its digital display can show any of 7 items of information: current $ cost of energy used, projected $ amount of next energy bill, $ amount of last energy bill, billing date, energy budget set, date and time of day. The energy monitor is expected to sell for $295 and its makers state that some users will be able to reduce energy bills by at least that amount within one year.

Or:

This is an electronic device that continually monitors a household's energy usage. It allows you to set an energy budget and will flash a warning if the budget is exceeded. Its digital display can show any of 7 items of information: current $ cost of energy used, projected $ amount of next energy bill, $ amount of last energy bill, billing date, energy budget set, date and time of day. The energy monitor is expected to sell for $295 and its makers state that some users will be able to reduce energy bills by at least that amount within two years.

Exhibit 2 (cont.)

3. Solar Economiser

Either:

The solar economiser uses the principle of solar heating. It is a solar panel attached to the outside of the home, under a window (preferably on a southern exposure). Cool air is drawn from the room into the solar panel; there it is heated by the sun and recirculated back into the room. The solar economiser can be installed by the average homeowner. The solar economiser costs $465 and its makers state that, depending on usage conditions, the unit will pay for itself within 3 years.

Or:

The solar economiser uses the principle of solar heating. It is a solar panel attached to the outside of the home, under a window (preferably on a southern exposure). Cool air is drawn from the room into the solar panel; there it is heated by the sun and recirculated back into the room. The solar economiser requires expert installation. The solar economiser costs $465 and its makers state that, depending on usage conditions, the unit will pay for itself within 3 years.

4. Shower-flow Restrictor

Either:

The shower-flow restrictor is a pipe segment added between the shower pipe and the shower head. It cuts water flow and thus reduces the amount of hot water used. The shower-flow restrictor costs about $5 and the makers state that, depending on usage habits, it may pay for itself in 3 months.

Or:

The shower-flow restrictor is a pipe segment added between the shower pipe and the shower head. It cuts water flow and thus reduces the amount of hot water used. There is some reduction in shower quality. The shower-flow restrictor costs about $5 and the makers state that, depending on usage habits, it may pay for itself in 3 months.

Table 2

Expected Product Concept Scores on Rogers' Attributes

Concept	Manipulation	Relative advantage	Compatibility	Complexity	Trialability	Observability
Light bulb	$10	Better	High	Low	High	Low
	$20	Worse	High	Low	High	Low
Energy monitor	2-yr. payback	Worse	Low	High	Low	Medium
	1-yr. payback	Better	Low	High	Low	Medium
Solar economizer	Self-installation	?	Better	High	Medium	High
	Expert installation	?	Worse	High	Medium	High
Shower-flow restrictor	Reduces quality	?	Worse	Low	High	Low
	No quality effect	?	Better	Low	High	Low

without jeopardizing methodology, we use a mixture of replication and repeated measures. Direct manipulations are only performed by replication. When two product concepts differ only on a single attribute ($10 vs. $20 light bulb; one-year vs. two-year payback for the energy monitor, etc.), each individual rates only one of the concepts. But to increase cost efficiency, indirect manipulations are made by repeated measurement, so that each individual rates four product concepts which differ on a variety of attributes (light bulb, energy monitor, solar economizer, shower-flow restrictor, etc.). This design removes the gross biases of repeated measure on highly similar concepts. The only cost is that some comparisons across product attributes are confounded with product differences. To compare large changes in price, say from $10 to $465, we have to move from a light bulb to a solar economizer. Greater price manipulation within the same product concept would be methodologically desirable but would require replicated measures and a concomitant increase in sample size and cost.

The final section of the questionnaire (pp. 8-10) gathers basic sociodemographic data on the respondent, their family and their residence (i.e., type of home, number of rooms, orientation, etc.). Item 24 asks for approximate annual heating costs and deliberately offers a "don't know" response option. The aim is to test knowledge of heating costs in addition to collecting data on cost levels.

2.3 Response Rates

A total of 2 500 questionnaires were mailed to a random sample of homeowners in Winnipeg in the last week of December 1981. By the cutoff date (February 2, 1982) 549 usable questionnaires had been received. The overall response rate was 22.0%.

It must be remembered that a high response rate was not required for this study; it was intended that response would be skewed towards "energy conservation concerned" households and towards energy conservation innovators. To the extent that the sample receiving questionnaires (homeowners) covers households not in the target population (i.e., not energy conservation concerned homeowners), a low response rate is expected.

The success of the study in skewing responses towards energy conservation innovators is shown in Table 3, which compares ownership of a range of energy conservation products in our sample with the best available national estimates (usually trade guesstimates). Sample ownership is much higher than national figures would suggest. Clearly, the low response rate per questionnaire mailed skewed the sample as desired.

It should be noted that in this study, as in any other having less than a 100% response rate, significance tests must be interpreted with caution. Significance testing rests on the assumption that questionnaires returned constitute a random sample from the target population. Although there is no reason to suspect that returns are not a random sample of energy conservation concerned households, this is an untestable assumption.

Table 3

Product Ownership

Product	Winnipeg (%)	National estimated ownership (%)
Solar power unit	0.8	--
Diesel-engined car	1.0	--
Heat pump	1.9	0.5-2.0
Water heater timer	10.0	--
Shower-flow restrictor	13.5	--
Microwave oven	21.0	9.0
Set-back thermostat	28.1	5.0-10.0
Portable electric space heater	36.7	--
Storm windows or doors	89.8	45.0-50.0

Chapter 3

DEFINING EARLY ADOPTERS

Of the three methods of defining innovators discussed in section 1.3 (cross-sectional, time series and self-report), the cross-sectional method was chosen for this study. Cross-sectional definitions have the attraction of spreading an individual's innovativeness measure over several products and so reducing the likelihood of being misled by chance early, or late, adoptions. This is particularly important to our study for three reasons.

First, some energy conservation products may be adopted for non-conservation reasons (e.g., a microwave oven, although it conserves electricity, may be adopted primarily for convenience). Second, some energy conservation products may not be adopted by an innovative household because the product is not appropriate for that household (e.g., a heat pump is difficult for a high-rise apartment owner to adopt), or because current equipment does not yet require replacement. Third, some households adopt energy conservation products on moving into a new home. If our definition of innovation were confined to a single product we could not be confident that the availability of that product in the new home was at all salient to the individual. Looking at ownership of a number of products at least improves the probability that the household recognized the energy conservation implications of the new home. Whether product adoptions on moving into a new home differ from the more active adoption of products for existing homes is a topic for further research.

Ownership data was specifically requested for the nine products listed in Table 3. Respondents were also invited to write in up to two "other energy conservation products owned." The high motivation level of the sample is reflected in the fact that 26% of respondents used these write-in facilities. The write-ins were carefully scrutinized, and irrelevant comments (less than 2% of all write-ins), and comments relating to energy conservation activities (e.g., turning off lights, setting back the thermostat), rather than products, were eliminated.

Table 4 tabulates the total number of products owned. There is a marked rise in ownership from four or more products to three or more products. Eighteen per cent of the sample reported owning four or more products, whereas 44% reported owning three or more products. As a result, owning four or more products was adopted as the criterion for being an early adopter. This definition identifies 98 respondents as early adopters.

Table 4

Number of Energy Conservation Products Owned

Own no energy conservation product	Own[a]					
	1 or more	2 or more	3 or more	4 or more	5 or more	6 or more
20	529	401	243	98	35	5
(100%)	(96.4%)	(73.0%)	(44.3%)	(17.9%)	(6.4%)	(0.9%)

[a]Out of nine products listed and up to two written in.

3.1 Characteristics of Early Adopters: Demographics

Early adopters tend to be slightly older than other sample members (average early adopter is 48, average nonearly adopter, 45) and to have higher incomes (10% of early adopters report household incomes in excess of $60 000 vs. 7% of nonearly adopters). Although these differences are not quite significant at the 5% level, they do suggest that early adopters are slightly upscale of an already very upscale sample. Compared with Winnipeg's population profiles, early adopters are clearly and significantly different. Yet being upscale is not sufficient to define early adopters, as we see many nonearly adopters are almost as upscale. Hypothesis H2 (see section 1.8), that early adopters will be sociodemographically distinct from other consumers, gets only limited support.

3.2 Characteristics of Early Adopters: Attitudinal Variables

3.2.1 Reliability. For a more distinctive description of early adopters we need to look at attitudinal variables. Before comparing early adopters on attitudinal scales it is necessary to evaluate the scales themselves. In particular we need to be confident that the scales are reliable (i.e., relatively free from random error). The basic test used here is Cronbach's alpha, which is widely accepted as one of the best tests of reliability for multi-item scales (Nunnally 1978). Cronbach's alpha basically measures the consistency of the items composing a multi-item scale by examining pairwise inter-item correlations. To the extent that a scale is free from random error, individuals' responses to items in that scale should be quite highly correlated; if inter-item correlations are very low the items are not measuring the same thing and should not be combined into a single scale. Indeed, low inter-item cor-

relations may indicate that the items are measuring nothing, and that respondents are making essentially random responses. Alpha is calculated by:

$$\text{Alpha} = N\bar{r}/(1 + \bar{r}(N - 1))$$

where N = the number of items in the scale

$\bar{r}$ = the average inter-item correlation

Cronbach's alpha is a conservative test in that it can be shown to be the lower bound of the reliability of an unweighted scale (Novick and Lewis 1967). Alpha ranges from 0 to 1, with 1 indicating perfect reliability. Clear cutoffs between acceptable and unacceptable reliabilities are not available. However, most authors find alpha values of .80 very acceptable, and scales with reliabilities of over .70 are widely used (see, for example, Carmines and Zeller 1979; Nunnally 1978).

The impact of unreliable scales is to weaken interscale relationships. A reliability coefficient (e.g., Cronbach's alpha) can be interpreted as the percentage of the true correlation between perfectly reliable scales that will be estimated using unreliable scales: if two scales are in theory perfectly correlated, yet each is measured with a reliability of only .70, the measured interscale correlation will be .70.

The items used to measure opinion leadership, social integration and self-rated innovativeness are shown in Table 5, with the reliabilities of the scales produced.

3.2.2 Opinion leadership. Opinion leadership was very well measured; its reliability (alpha = .84) compared favourably with that found by previous users of this scale: Rogers and Cartano (1962) obtain a reliability of .70; and Silk (1971), finds .84 and .77 in two applications.

Previous research suggests that early adopters will be opinion leaders only if social norms favour innovation (see section 1.2). Table 6 tabulates opinion leadership scores against early adopter classification. Early adopters are much more likely to score highly on opinion leadership. Thirty-nine per cent of early adopters have opinion leadership scores of 12 or 13 points versus only 26% of nonearly adopters, a difference significant at the 1% level. Energy conservation product early adopters are also opinion leaders. Hypothesis H3 (see section 1.8) is supported.

3.2.3 Information sources. Previous research also suggests that opinion leaders will tend to gather information from impersonal mass media sources, whereas opinion followers will use personal information sources (the two-step flow of communication theory, section 1.6).

Table 5

Scale Reliabilities

Item	Coefficient alpha
Opinion leadership	
During the past year, have you given anyone any advice or information about energy conservation?	
Compared with your circle of friends and neighbours how likely are you to be asked for your advice about energy conservation?	
Thinking back to the last discussion you had about energy conservation, did you mainly ask others for advice, or did they mainly ask you?	
When you discuss energy conservation, what part do you play? I mainly listen..... I mainly try to convince people of my ideas.....	
Which happens more often? I tell friends and neighbours about energy conservation..... My friends and neighbours tell me about energy conservation.....	
Do you have the feeling that you are generally regarded by your friends and neighbours as a good source of advice and information about energy?	.84
Social interaction	
As a rule I like to meet new people, go to social gatherings and generally get around a lot.	
I am an active member of more than one service organization.	
I like to work on community projects.	
I do volunteer work for a hospital or service organization on a fairly regular basis.	.72
Self-rated innovativeness	
I often try new products before my friends do.	
I often talk to my friends about new appliances.	
I like to try new and different things.	.69

Table 6

Early Adopters and Opinion Leadership

	Opinion leadership score			
	Low (6-7)	Medium (8-11)	High (12-13)	N
Early adopters	19%[a]	42%	39%**	77
Others	29%	45%	26%**	363

[a]Read: 19% of early adopters had low opinion leadership scores.

**Difference significant at the 1% level.

Table 7

Early Adopters and Information Sources

	Main source of information				
	Friends, relatives, neighbours	Newspapers, magazines, TV, radio	All of those	Other	N
Early adopters	6%	80%	6%	7%	97
Others	10%	79%	6%	6%	446

As indicated in Table 7, our results do not support this two-step flow of communication. Early adopters are not different from others; in both groups mass media sources are overwhelmingly important. Hypothesis H5 (see section 1.8) is supported in that early adopters do use mass media sources, but they are not distinctive in this.

3.2.4 Social integration. Social integration was also reliably measured, producing an alpha of .72. Previous research suggests that early adopters are more socially integrated than later adopters (see section 1.2) and that opinion leaders are also more socially integrated than opinion followers (section 1.6).

Table 8 tabulates social integration against early adopter classification. Overall, 36% of early adopters and 21% of nonearly adopters have high integration scores, a difference significant at the 1% level. Early adopters are significantly more likely to be highly socially integrated than other respondents. Hypothesis H4 (see section 1.8) is supported.

Table 8

Early Adopters and Social Integration

	Social integration scale			
	Low (4-10)	Medium (11-13)	High (14-20)	N
Early adopters	30%	35%	36%**	98
Others	44%	35%	21%**	427

**Difference significant at the 1% level.

3.2.5 Self-rated innovativeness. Self-rated innovativeness was measured on a five-item scale: three items from previously used self-rated innovativeness scales and two suggested by Midgley and Dowling (1978) as

measures of generalized innovativeness (see section 1.3.3). The two generalized innovativeness items had almost zero correlations with the other scale items and correlated only .19 with each other. With these two items dropped, however, the self-rated innovativeness scale has fairly good reliability. Cronbach's alpha is .69.

Table 9 tabulates self-rated innovativeness against the early adopter classification from product ownership. Overall, 45% of early adopters have high self-rated innovativeness scores, compared to 31% of nonearly adopters (a difference significant at the 1% level). Self-rated innovativeness has a significant relationship to early adoption. Hypothesis H1 (see section 1.8) is supported.

Table 9

Early Adopters and Self-rated Innovativeness

	Self-rated innovativeness			
	Low (3-7)	Medium (8-10)	High (11-15)	N
Early adopters	18%	37%	45%**	98
Others	17%	51%	31%**	442

**Difference significant at the 1% level.

3.2.6 Energy attitudes. Four energy attitude items, drawn from previous energy research studies and the relevant literature, were included in the questionnaire. Unfortunately these items are not closely related and do not constitute a reliable scale (Cronbach's alpha is only .23). Since no other reliability measures for energy attitude scales could be located -- although such scales are frequently used -- we do not know whether this unreliability is a general finding for energy attitude scales or confined to this study.

Looking at the four items individually offers some interesting comparisons (Table 10). The only energy attitude item to distinguish early adopters from others is, "I try to drive less now than in the

past." Sixty-nine per cent of early adopters agreed with this item, compared to 59% of nonearly adopters (a difference significant at the 5% level). Presumably, driving less could be interpreted as a further energy conservation action that is adopted along with the conservation products that define our early adopters. Hypothesis H6 (see section 1.8), that early adopters will have distinctive attitudes to conservation, is not well supported.

3.3 Summary

Early adopters -- defined on a cross-sectional basis as owners of four or more energy conservation products -- tend to be upscale in demographics, to be opinion leaders, to be socially integrated, to rate themselves as more innovative and to agree that they drive less.

Whereas the measures of social integration and opinion leadership are highly reliable, measures of self-rated innovativeness are slightly less reliable and energy attitude measures are not yet at all well developed. The generalized innovativeness items suggested in the literature are found here to be unrelated to other innovativeness measures.

Table 10

Early Adopters and Energy Attitudes

Attitude item	Disagree (%)	Neutral (%)	Agree (%)	N
"I try to drive less now than in the past."				
Early adopters	13	17	69*	98
Others	22	20	59*	441
"It would be hard for me to cut down on the use of energy in the home."				
Early adopters	62	13	25	98
Others	59	17	25	446
"There is not much the average citizen can do to save energy."				
Early adopters	86	3	11	97
Others	86	4	10	444
"Energy costs for most people are much higher than they were a year ago."				
Early adopters	5	3	92	97
Others	5	2	92	446

*Difference significant at the 5% level.

Chapter 4

MEASURES OF PRODUCT PERCEPTIONS

A key part of the questionnaire was the description of four energy conservation products that respondents rated on a variety of scales indicating their perceptions of each product, its usefulness and their interest in buying. The concepts were designed to span a range of values on the five attributes that Rogers postulated as affecting new product diffusion: relative advantage, compatibility, complexity, trialability and observability (see section 1.4).

Table 11 shows the items used to measure each of the five attribute scales, and the scale reliabilities. The relative advantage and compatibility scales were found to have good reliability and the complexity scale was acceptable, but only single items were found to measure observability/communicability and trialability. Given the number of studies that have used these product attributes, it is surprising that more reliable measures are not available.

4.1 Differences in Product Perceptions

Each product concept was presented in one of two versions: that is, the energy efficient light bulb was priced at $10 or $20; the solar economiser could be installed by an expert or by an average homeowner; the energy monitor promised a two-year payback or a one-year payback; and the shower-flow restrictor was said to give a slight reduction in shower quality, or shower quality was unspecified. Each respondent saw only one version of each concept.

These variations of each product concept were designed to increase the range of attributes spanned by the concepts. Two of these variations operated on the relative advantage dimension, as previous research suggests relative advantage is the key variable (see section 1.4.2). Each variation looked at a separate component of relative advantage. The light bulb variations manipulated price, and the energy monitor variations, payback period. The other two variations manipulated compatibility, also found important in previous investigations (see section 1.4.2). The solar economiser versions worked on the installation aspect of compatibility, and the shower-flow restrictor versions manipulated usage aspects of compatibility. Table 12 shows the intended direction of variations.

We can now make two sorts of comparisons: within concept and across concept. A within-concept comparison looks at the ratings given to one version of a concept compared to those given to the other version of the same concept, for example, the $10 light bulb versus the $20 light bulb. This is a severe test of the product concepts in that it

Table 11

Product Attribute Scales

Product attribute	Reliability (Alpha)
Relative advantage	
The price of this device is too high for me to consider purchasing it.	
This device would soon pay for itself.	
I doubt this device could save the amount of energy claimed.	
Compared to other ways of saving energy, this one is superior.	
It would be hard to determine how much energy this device saves.	.74
Compatibility	
The use of this device would require big changes in our daily household routine.	
Using this device would be inconvenient for our family.	
This product could be easily installed in my home.	
This device would be easy to use.	
This device appears too complicated.	.79
Complexity	
I understand how this device is supposed to work.	
It would be difficult to explain the operation of this device to my friends.	.61
Observability/communicability	
If I had this product, my friends would be interested to hear about it.	n.a.
Trialability	
This product could easily be tried out on a small scale.	n.a.

Table 12

Intended Manipulations of Product Concepts

Concept	Manipulation	Relative advantage	Compatibility	Complexity	Trialability	Observability/ communicability
Light bulb	$10	Better	High	Low	High	Low
	$20	Worse	High	Low	High	Low
Energy monitor	2-yr. payback	Worse	Low	High	Low	Medium
	1-yr. payback	Better	Low	High	Low	Medium
Solar economizer	Self-installation	?	Better	High	Medium	High
	Expert installation	?	Worse	High	Medium	High
Shower-flow restrictor	Reduces quality	?	Worse	Low	High	Low
	Quality effect unspecified	?	Better	Low	High	Low

involves comparisons of ratings by different groups of individuals. As each respondent saw only one version of each concept, any comparison across versions is also across respondent groups; that is, we compare the relative advantage rating of the $10 light bulb given by one group of respondents with the relative advantage rating of the $20 light bulb given by a different group of respondents. (Recall that product versions were used as a replicated, not repeated, measure. This is a more powerful procedure methodologically. See section 2.2.) We would expect within-concept comparisons to yield significant results, although absolute rating differences may well be small. Differences in response style, the way the respondent uses the rating scale, their underlying values, etc., will cloud within-concept comparisons.

An across-concept comparison looks at the ratings given to one concept (averaged over both versions) compared to those given to another (averaged over both versions). For example, it compares the light bulb with the energy monitor, within the same group of respondents. All respondents rated a light bulb (although its price differed) and an energy monitor (although its payback period differed). As a result, across-concept comparisons can also be analyzed on an individual basis by examining rating differences (i.e., for each individual their relative advantage rating for a light bulb could be subtracted from their rating for an energy monitor). In either case across-concept comparisons should show bigger, more significant differences than within-concept comparisons.

This combination of across-concept comparisons (involving the same individuals) and within-concept comparisons (involving different individuals) is particularly strong and allows a range of products to be tested without huge samples and without a great burden on the respondent.

4.2 Within-Concept Comparisons

As expected the $10 light bulb was given significantly higher relative advantage ratings than the $20 light bulb. The two versions of this concept did not differ significantly on any other attribute (see Table 13). The energy monitor was also rated as expected, with the one-year payback being perceived as significantly higher on relative advantage than the two-year payback. No other significant differences were perceived.

The solar economiser manipulations were not quite so clearcut. It was intended that the self-installed economiser would be perceived as more compatible than the expert-installed version. However, although the difference in overall compatibility ratings was as expected, it was not significant. The major reason for this is that the overall compatibility rating combines compatibility in use with compatibility in installations, yet only the latter element was affected by this manipulation.

Table 13

Average Product Concept Ratings
(within-concept comparisons)

	Relative advantage	Compatibility	Communicability	Complexity	Trialability
Light bulb:					
Price $10	13.1*	20.2	3.8	5.4	3.7
Price $20	12.8*	19.9	3.6	5.5	3.6
Energy monitor:					
2-yr. payback	12.6*	15.8	3.6	5.6	3.3
1-yr. payback	13.1*	15.6	3.6	5.6	3.4
Solar economiser:					
Self-installed	14.0*	17.5	3.8	4.8	3.4
Expert-installed	14.5*	17.2	3.8	4.9	3.3
Shower-flow restrictor:					
Reduces quality	15.9	19.4	3.4	4.2	3.7
Quality effect unspecified	16.2	19.5	3.5	4.4	3.8

*Difference significant at the 5% level.

An unexpected finding was a significant tendency to perceive the expert-installed solar economiser as having greater relative advantage. We can rationalize this result in several ways. As the price of the concept was the same in both versions, respondents may have felt that the price included installation for the expert-installed version, lending it an extra relative advantage. Alternatively, expert installation may lend the product additional legitimization and lead respondents to expect superior performance.

The shower-flow restrictor was rated in the direction expected. The version which reduced shower quality was rated as having lower relative advantage and being slightly less compatible than the version in which shower quality was unspecified. No significant differences were observed in the attributes of this product.

These results are reassuring. There are measurable differences in product concept ratings across concept versions despite the involvement of different groups of individuals in these comparisons. These differences are in all cases as expected, and only for one item are there any unforeseen differences between concept versions.

In examining the single-variable relative advantage, it is interesting to note that all the differences between concept versions are approximately the same. The effects on average relative advantage ratings of increasing price, increasing payback period or reducing service quality are very similar.

4.3 Across-Concept Comparisons

The predicted ordering of concepts along product attributes is shown in Table 12. The actual ordering was as predicted, with a few exceptions (see Table 14).

On the compatibility dimension, products were perceived exactly as expected. The light bulb was significantly more compatible than other concepts; next most compatible was the shower-flow restrictor, followed by the solar economiser and finally the energy monitor.

On the communicability dimension, the concepts were not very widely spread. They followed the expected order, however, with the exception of the light bulb, which was perceived as more communicable than expected. The solar economiser was seen as the most communicable concept, followed by the light bulb, energy monitor and, lastly, the shower-flow restrictor.

The ordering of the products on the complexity dimension differed over the two items measuring that attribute. On understandability the shower-flow restrictor scored highest (as expected), followed by the solar economiser (perceived as easier to understand than expected), the energy monitor and finally the light bulb (perceived as much more diffi-

Table 14

Average Product Concept Ratings
(across concepts)

	Relative advantage	Compatibility	Communicability	Complexity	Trialability
Light bulb	13.0**	20.0**	3.7	5.4**	3.7**
Rest	14.4	17.5	3.6	4.9	3.5
Energy monitor	12.9**	15.7**	3.6	5.6**	3.3**
Rest	14.4	18.9	3.7	4.9	3.6
Solar economiser	14.3	17.3**	3.8**	4.9**	3.3*
Rest	13.9	18.4	3.6	5.1	3.6
Shower-flow restrictor	16.0**	19.5**	3.5**	4.3**	3.7**
Rest	13.4	17.7	3.7	5.3	3.5

**Indicates significant difference between this concept and the rest at the 1% level.

cult to understand than expected). This ordering is probably explained by the fact that the item asks, "I understand how this device is supposed to work." Respondents may have had trouble understanding the working of the light bulb, although the concept itself was simple. Similarly the solar economiser was easy to understand in principle (respondents were familiar with the idea of solar power), although it may be technically more complex.

On the other item used to measure complexity ("It would be difficult to explain the operation of this device to my friends"), concepts followed the expected order. The energy monitor was seen as the most difficult to explain, followed by the solar economiser, the light bulb and the shower-flow restrictor. The light bulb was seen as significantly more complex than the shower-flow restrictor.

On trialability, products followed the expected order except for the energy monitor, which was not seen as less trialable than the solar economiser. The idea was that the energy monitor is not trialable at all (you have it or you do not), whereas the solar economiser can be installed on a room-by-room basis.

No prior predictions were made as to the positioning of products on the relative advantage dimension (except within concepts, as discussed in section 4.2). In fact the products were well spread, with the shower-flow restrictor seen as by far the highest relative advantage product, followed by the solar economiser, the light bulb and the energy monitor. The relative ordering of these last two depended on the particular version of the concept.

Overall, the product concepts span a range of values on all dimensions. The means shown in Table 14 reflect a wide range of values covering the entire product attribute scales.

4.4 Early Adopters vs. Others

One way in which early adopters are expected to differ from other respondents is in their perceptions of the product concept descriptions. One explanation of early adoption would be favourable product perception.

Table 15 shows the mean ratings of early adopters and the rest of the sample pooled over all product concepts, and for each concept individually. There are very few differences between early adopters and others. Over all concepts, early adopters are significantly more likely to have already heard of the product (this ties in with the status of early adopters as opinion leaders) and to rate products as significantly more useful. Both these differences, although statistically significant, are small. Otherwise there are no overall differences in perceptions. Hypothesis H8 (see section 1.8), that early adopters will have distinctive perceptions, is not well supported.

Table 15

Product Perceptions: Early Adopters vs. Nonearly Adopters

Product concept		Relative advantage	Communicability	Compatibility	Complexity	Trialability	Usefulness	Buying interest	Heard of
$10 Light bulb	Early adopters	12.1	3.6	20.3	5.1	3.5	3.2	2.6 **	2.8
	(Nonearly adopters)	(13.4)	(3.8)	(20.2)	(5.5)	(3.7)	(3.2)	(2.9)**	(2.6)
$20 Light bulb	Early adopters	13.3	3.7	20.1	5.5	3.6	3.3	2.8 **	2.7
	(Nonearly adopters)	(12.7)	(3.6)	(19.8)	(5.5)	(3.6)	(3.0)	(2.6)**	(2.5)
Energy monitor 2-yr. payback	Early adopters	12.3	3.6	15.8	5.6	3.3	2.8	2.3	2.2
	(Nonearly adopters)	(12.6)	(3.6)	(15.9)	(5.6)	(3.3)	(2.6)	(2.2)	(2.2)
Energy monitor 1-yr. payback	Early adopters	13.0	3.6	16.1	5.9	3.2	2.7	2.4	2.3
	(Nonearly adopters)	(13.2)	(3.5)	(15.5)	(5.6)	(3.4)	(2.8)	(2.3)	(2.2)
Solar economiser self-installed	Early adopters	13.4	3.7	17.6	4.7	3.4	3.2	2.7	3.3
	(Nonearly adopters)	(14.1)	(3.9)	(17.4)	(4.9)	(3.4)	(3.1)	(2.7)	(3.1)
Solar economiser expert-installed	Early adopters	15.0	3.8	17.5	5.0	3.3	3.6**	2.9	3.5**
	(Nonearly adopters)	(14.4)	(3.8)	(17.1)	(4.8)	(3.3)	(3.2)**	(2.6)	(3.1)**
Shower-flow restrictor (reduces quality)	Early adopters	16.0	3.3	19.0	4.0	3.7	3.1	3.0	3.3**
	(Nonearly adopters)	(15.8)	(3.5)	(19.5)	(4.2)	(3.7)	(3.0	(2.8)	(2.9)**
Shower-flow restrictor (quality effect unspecified)	Early adopters	16.6	3.7	20.1	4.4	3.7	3.5	3.3	3.3
	(Nonearly adopters)	(16.1)	(3.4)	(19.4)	(4.5)	(3.8)	(3.1)	(3.0)	(3.1)
All products	Early adopters	14.0	3.6	18.3	5.0	3.5	3.2**	2.8	2.9**
	(Nonearly adopters)	(14.0)	(3.6)	(18.1)	(5.1)	(3.5)	(3.0)**	(2.6)	(2.7)**

**Difference significant at the 1% level.

Looking at individual product concepts, there are some consistent effects. However, statistically significant differences are very few, partly because on an individual product basis cell size is very small, partly because there is a lot of variability within the early adopter group and perhaps partly because significance testing in these cases involves the assumption of normally distributed ratings in the population as a whole.

There is evidence that early adopters are more discriminating in assessing relative advantage. They have a wider spread of mean relative advantage ratings, giving even higher scores than the rest of the sample to the high relative advantage products (the shower-flow restrictors and the expert-installed solar economiser) and even lower scores than the rest of the sample to the low relative advantage products (the energy monitors, the $10 light bulb and the self-installed solar economiser).

Early adopters are also distinctive in their reaction to expert installation. As discussed above, the necessity to use an expert to install the solar economiser increases its relative advantage very considerably. Surprisingly this effect is particularly marked for early adopters. Presumably, expert installation provides a welcome reduction in risk for the early adopters. Early adopters also give higher than average compatibility ratings for all products, higher than average usefulness ratings for all products, and higher than average awareness ratings for all products. But early adopters are not a homogenous group as regards their product perceptions. Over all the product concepts and rating scales shown in Table 15 it is rarely possible to reject the hypothesis that variance within the early adopter group is just as great as that within the group comprised of all other respondents.

4.5 Summary

The product concepts used were very successful in generating a range of respondent perceptions along Rogers' five attributes. Looking at differences in perceptions within different versions of the same product concept is a strong test of manipulations in that it involves replicated rather than repeated measures (i.e., each respondent sees only one version of every concept). Yet within-concept comparisons showed almost all the manipulations to be perceived as intended. Across-product comparisons provided the expected spread of perceptions on compatibility and very close to the expected spread on all other dimensions.

It had been expected that early adopters would show distinctive product perceptions: they would perceive the energy conservation products more favourably. Although this was confirmed in direction, differences were small and mostly insignificant. Early adopters did

rate the new products as slightly, but significantly, more useful, were more discriminating in their relative advantage assessments (providing a wider spread of relative advantage ratings) and tended to see the products as more compatible. Early adopters were also more likely to claim to be aware of the new products already. However, there were considerable differences within the early adopter group itself on all aspects of product perception. To analyze such differences would require a much larger group of early adopters than was available here.

Chapter 5

THE EFFECT OF PRODUCT PERCEPTION ON PRODUCT EVALUATION

Two measures of product concept evaluation were taken: a rating of agreement with "This device would be very useful in my home," and a rating of agreement with "I would be interested in BUYING this device." These two measures, as expected, were highly correlated ($r = .71$). A combination of these two scales gives an overall product evaluation index with a reliability of .83. In the following we will consider the separate usefulness and buying intention scales, as differences in evaluations on the two scales may illuminate the distinction between favourable evaluation and purchase intention.

The relationship between product evaluations and product characteristics can be investigated in a number of ways. First, using bivariate analysis methods, we can examine the relationship between evaluation and product perceptions on an attribute by attribute basis. Second, using multivariate methods, we can model the overall relationship between the set of attributes describing each product and its evaluation. The multivariate methods employed are discriminant analysis and regression.

5.1 Bivariate Analysis

Table 16 shows each product's evaluation on the usefulness and buying intention scales. The shower-flow restrictor (quality effect unspecified) obtains the highest evaluation on both scales, and the energy monitor receives the lowest. All products score less well on buying intention than on usefulness; that is, respondents are likely to agree that a product is useful but not to wish to buy it. This gap between usefulness and purchase intention is smallest for the shower-flow restrictor and the $10 light bulb -- presumably a reflection of the low purchase price of these products. The greatest drop-off is for the solar economiser, expert installed, which is the highest price concept ($465) even without installation expenses. Product price clearly affects translation of usefulness into buying intent.

Within-product comparisons show that the $10 light bulb receives significantly higher buying interest than the $20 light bulb (although, sensibly, their usefulness ratings do not differ significantly). And the shower-flow restrictor with shower quality effect unspecified receives significantly higher usefulness and buying interest ratings than its shower-quality-reducing counterpart. However, the energy monitor's payback periods do not significantly affect buying interest, and the solar economiser's installation methods do not significantly affect its buying interest. So although significant differences in relative advantage were perceived for the two versions of the energy monitor and the

Table 16

Product Evaluations

	Usefulness	Buying interest	Usefulness minus buying interest
Light bulb:			
$10	3.2	2.9**	0.3
$20	3.1	2.6**	0.5
Energy monitor:			
2-yr. payback	2.6	2.2	0.4
1-yr. payback	2.7	2.3	0.4
Solar economiser:			
Self-installed	3.1	2.7	0.4
Expert-installed	3.2	2.7	0.5
Shower-flow restrictor:			
Reduces quality	3.0	2.8*	0.2
Quality effect unspecified	3.2	3.1*	0.1

**Difference significant at the 1% level.

*Difference significant at the 5% level.

solar economiser (see Table 13), they did not have a significant effect on the products' evaluations. A $10 price change in a light bulb and a shower quality reduction in a shower-flow restrictor have a significant effect on product evaluations; changes in payback periods and installation method do not.

However, across-product comparisons suggest that price is not everything. In particular the solar economiser, expert installed (the most expensive item) achieves the same buying intention rating as the $20 light bulb (a product which is $445 cheaper).

Table 17 shows pairwise correlations between product attributes, and usefulness and buying intention scores. The table shows both composite scales and the individual items, to allow for a more detailed diagnosis of the attribute-evaluation relationship.

Relative advantage is the attribute most closely related to both usefulness and buying interest. Within the relative scale the ability of the device to pay for itself is the most important item. The price of the device is an important influence on buying interest, but not on usefulness. This lends support to the validity of the ratings -- price should affect only buying interest and not usefulness -- and confirms the suggestion above that the gap between usefulness and buying interest was affected by price. The relative advantage scale also illustrates the strength of reliable scales as compared to individual items. The correlation of the overall relative advantage scale with usefulness and buying interest is higher than that of any of its component items.

Compatibility has the next highest correlation with buying interest. The most important item in the scale is the rating of convenience in use.

Observability/communicability correlates much more closely with usefulness than with buying intention. This could be a reflection of other attributes of the products (e.g., high observability products could have other characteristics that limit buying interest). This effect is examined further in the multivariate analysis section below.

Complexity and trialability are only weakly related to product evaluation.

5.2 Multivariate Analysis

The bivariate analysis above can only examine product attributes one at a time. To relate the whole set of product attributes to product evaluation requires multivariate analysis, which can show the simultaneous effect of all the product attributes making up a particular

Table 17

Product Evaluations and Product Perceptions: Correlations

	Usefulness	Buying interest
Relative advantage	.58	.64
The price of this device is too high for me to consider purchasing it.	-.26	-.43
This device would soon pay for itself.	.57	.58
I doubt this device could save the amount of energy claimed.	-.41	-.44
Compared to other ways of saving energy, this one is superior.	.49	.44
It would be hard to determine how much energy this device saves.	-.30	-.28
Compatibility	.38	.36
The use of this device would require big changes in our daily household routine.	-.20	-.19
Using this device would be inconvenient for our family.	-.32	-.30
This device could be easily installed in my home.	.28	.24
This product would be easy to use.	.32	.29
This device appears too complicated.	-.27	-.27
Observability/communicability		
If I had this product, my friends would be interested to hear about it.	.40	.33
Complexity		
I understand how this device is supposed to work.	.19	.17
It would be difficult to explain the operation of this device to my friends.	-.15	-.15
Trialability		
This product could easily be tried out on a small scale.	.27	.25

product concept. Two methods are used, discriminant analysis and regression analysis.

Discriminant analysis and regression analysis are dependence methods; that is, they relate one dependent variable to a set of predictor, or independent, variables. The object of these analyses is to discover how well the dependent variable can be predicted, and to estimate the contribution made by each predictor to the dependent variable's level. The difference between discriminant and regression analysis is in the type of scale used for the dependent variable. Discriminant analysis uses a dependent variable which has a number of discrete levels representing different categories or groups (e.g., intending buyers/non-buyers, early adopters/later adopters, etc.). Regression analysis requires that the dependent variable represent a continuous, interval-scaled score (e.g., dollar sales, temperature, etc.).

In this case the choice of method depends on our assumptions regarding the five-point usefulness and buying interest scales. The most tenable assumption is that these scales represent a grouping of respondents. Respondents who "agree" or "strongly agree" with the statement, "This device would be very useful in my home" form a favourable group, while those who "disagree" or "strongly disagree" form an unfavourable group. Viewing the product evaluation scales in this way suggests the use of discriminant analysis to attempt to predict whether a respondent will be favourable or unfavourable towards a product given information on their product attribute ratings. Discriminant analysis is attractive in that the exact extent of agreement or disagreement is probably of less interest, and less reliable, than the direction of agreement or disagreement.

A more exacting assumption about the product evaluation scales is that they represent continuous interval measurements. This is the tacit assumption of the bivariate analysis, where average evaluations were calculated. If the evaluation scale is to be considered as continuous and interval-scaled, the differences between the points on the scale ("strongly agree" "agree" "neutral" "disagree" "strongly disagree") must be determined. Standard practice is to assign the numbers 1, 2, 3, 4, 5 to the scale points. This assumes that scale points are equidistant. If this assumption is false (i.e., if the respondent's subjective use of the scale is not based on equidistant points), the predictive power of the model will be underestimated. There is some evidence that the impact of such scaling problems is usually not severe. However, regression analysis does involve more rigourous scaling assumptions for the evaluation measures than does discriminant analysis.

Both methods require that the predictor variables be continuous interval-scaled variables. It is possible to relax this assumption by using dummy variables to represent each level of each predictor. Unfortunately this approach expands the predictor set from 5 product attributes to 25 dummy variables and for technical reasons renders discriminant analysis inapplicable. In this case, therefore, we followed the

normal practice of assuming predictors to be sufficiently close to interval scales.

5.2.1 Discriminant analysis. Two sets of discriminant analyses were performed, one using respondents' evaluations of "usefulness," the other using their evaluations of "buying interest." In both cases respondents were grouped as favourable or unfavourable in their evaluations. Those giving neutral evaluations were omitted from the analysis.

Table 18 shows the discriminant coefficients for the whole sample, for early adopters and for others. To be able to interpret individual predictor coefficients it is necessary to ensure that the predictors are not themselves correlated. If predictors are correlated individual effects may be misestimated, coefficients may be unstable and standard errors unnecessarily large. Table 19 shows the pairwise correlations between the predictors used. The largest absolute correlation ($r = -.39$) is between complexity and compatibility. Although this correlation is not sufficiently high to warrant a different analysis method, the association between complexity and compatibility should be remembered when interpreting their coefficients.

Looking first at the analyses based on usefulness, discriminant coefficients are fairly similar over all subgroups of the sample. In particular, perceived relative advantage of the product is by far the most important variable in predicting whether a respondent rates the product as useful or not. (All predictors in Table 18 are standardized so that the sizes of coefficients indicate their relative importance.) Compatibility is the second most important predictor for early adopters, although it is rather less important for later adopters. Communicability is third most important. The final two predictors -- complexity and trialability -- are much less important, particularly for early adopters.

That the coefficient on complexity has the wrong sign in all the analyses may be the result of the correlation between complexity and compatibility as noted above. In any case, neither complexity nor trialability contribute greatly to explanatory power.

Goodness of fit of the discriminant analysis is measured by the number of cases that are correctly classified (i.e., the number of respondents whose product perception ratings allow us to correctly deduce whether they give favourable or unfavourable usefulness ratings). For every analysis this correct classification rate is very high, never dropping below 80%. Clearly, the major factors determining whether a respondent rates a product as useful or not useful are relative advantage, communicability and compatibility. These three variables alone allow us to correctly classify 80% of all respondents.

Hypothesis H7 (see section 1.8), that Rogers' attributes should explain evaluation, is supported.

Table 18

Product Evaluations and Product Perceptions: Discriminant Coefficients

Dependent variable	Predictors					% Correct classification
	Relative advantage	Communicability	Compatibility	Complexity	Trialability	
Usefulness:						
All	1.49	0.75	0.63	0.29	0.24	83
Early adopters	1.40	.50	.76	.13	.31	80
Others	1.54	.82	.61	.35	.22	84
Buying interest:						
All	1.95	.46	.64	.33	.16	85
Early adopters	2.75	.59	.64	.40	.20	89
Others	1.82	0.44	0.64	0.34	0.15	84

Table 19

Correlations Between Predictors

	Relative advantage	Compatibility	Observability/ communicability	Complexity	Trialability
Relative advantage	1				
Compatibility	.18	1			
Observability/ communicability	.25	.16	1		
Complexity	-.28	-.39	-.11	1	
Trialability	.17	.25	.12	-.25	1

This correct classification rate is considerably higher than which would be obtained by chance alone. The prior probabilities of group membership were set at .5, ensuring a chance correct classification rate of 50%. Classification rates were also validated by a number of jackknife analyses (see Fenwick 1979 for a discussion of the use of the jackknife in discriminant analysis). An example of the classification tables obtained appears as Table 20. These correct-classification rates are considerably better than those previously reported in the literature. Ostlund (1974) correctly identifies 70% of early adopters in one study and 79% in another. Labay and Kinnear (1981) correctly classify only 62% of solar power adopters (see section 1.4).

Table 20

Classification Table for Predicting Buying Interest Amongst Early Adopters[a]

Actual group membership / Predicted group membership	Favourable buying interest	Unfavourable buying interest	Total
Favourable buying interest	388[b] (86%)	63	451
Unfavourable buying interest	126	721 (85%)	847
Total	514	784	1 298

[a]The overall correct-classification rate is 85%.

[b]Of the 514 respondents predicted to have a favourable buying interest, 388 actually expressed a favourable buying interest, while 126 did not.

Results of buying interest analyses were even stronger. Correct-classification rates ranged from 84% to 89%. Relative advantage was by far the most relevant variable, particularly for early adopters. Again the three predictors -- relative advantage, communicability and compatibility -- were the most important, with complexity and trialability providing no additional explanatory power.

The extreme importance of relative advantage in forming early adopters' product evaluations fits with what we have already discovered about early adopters' product perceptions (see section 4.4, where early adopters were found to be more discerning with regard to relative advantage, rating high-advantage products even higher than did the rest of the sample, and rating low-advantage products even lower). Hypothesis H9 (see section 1.8), that early adopters will form their evaluations in a distinctive way, gets only minor support.

5.2.2 Regression analysis. The discriminant results show that the direction of an individual's evaluation of a product can be rather well predicted. In over 80% of all cases we can correctly predict whether an individual will favourably evaluate a product. Regression analysis goes a step further and attempts to predict an individual's level of evaluation; that is, whether an individual will "strongly agree," "agree," be "neutral," "disagree" or "strongly disagree." This is clearly a more difficult task and, given that individuals may differ in the meaning they attach to "strongly," not necessarily a meaningful one.

Separate regression analyses were performed using the usefulness rating of the product (i.e., agreement with the statement, "This device would be very useful in my home," measured on a five-point scale) and the buying interest rating (i.e., agreement with the statement, "I would be interested in BUYING this device," measured on a five-point scale).

The model fitted is a linear relationship between product evaluation (usefulness and buying interest) and Rogers' five attributes. Regression coefficients are reported in Table 21; since all variables were standardized the coefficients reported are measures of each predictor's relative importance.

For the sample as a whole we can explain 43% of the variation in usefulness ratings and 45% of the variation in buying interest ratings. These are comparatively strong results. Whenever we try to explain ratings across individuals, R^2 values tend to be low. Many factors affect an individual's ratings in addition to the five product attributes measured here (e.g., individuals' rating styles, their interpretation of scale positions, how they felt at the time, their particular situation, etc.).

Table 21

Product Evaluations and Product Perceptions: Regression Coefficients

Dependent variable	Predictors					R^2
	Relative advantage	Communic-ability	Compat-ibility	Complex-ity	Trial-ability	
Usefulness:						
All	.46	.24	.18	.08	.08	.43
Early adopters	.45	.22	.22	.06	.08	.45
Others	.46	.24	.17	.08	.08	.42
Buying interest:						
All	.55	.16	.16	.09	.06	.45
Early adopters	.60	.19	.15	.11	.11	.55
Others	.54	.16	.16	.09	.05	.43

By far, the most important predictor for usefulness is relative advantage. This variable is also crucial in predicting buying interest. The second most important variable in predicting usefulness is communicability, but in predicting buying interest this shares second place with compatibility. Complexity and trialability are much less important; as in the discriminant analysis, the coefficient on complexity has the wrong sign but is very close to zero. In fact the first three variables above -- relative advantage, communicability and compatibility -- can explain 42% of the variation in usefulness ratings and 43% of the variation in buying intent; the final variables add very little to predictive power. All coefficients shown in Table 21 are significant at the 1% level.

Regressions were also estimated for early adopters separately from the rest of the sample (Table 21). Explanatory power is a little better for early adopters (45% of the variation in usefulness and 55% of the variation in buying interest), but the relative sizes of the coefficients are very similar. For both early adopters and others relative advantage is the most important product characteristic, followed by communicability and compatibility. Early adopters do not have a distinctive product evaluation equation.

5.3 Components of Relative Advantage

Given the importance of relative advantage in predicting respondents' favourability ratings, it is useful to decompose the relative advantage scale into its component items and attempt to estimate the contribution of each component to overall favourability assessment. Five items make up this relative advantage scale (see Table 11): "The price of this device is too high for me to consider purchasing it," "This device would soon pay for itself," "I doubt this device could save the amount of energy claimed," "Compared to other ways of saving energy, this one is superior" and "It would be hard to determine how much energy this device saves." Within-product manipulations of relative advantage focussed on price ($10 vs. $20 light bulb) and payback period (one-year vs. two-year payback energy monitor). Across-product manipulations also used a range of prices (from $10 or $20 for a light bulb to $465 for a solar economiser) and payback periods (from three months for a shower-flow restrictor to three years for a solar economiser).

The immediate problems of disaggregating the relative advantage scale are reliability and multicollinearity. The whole point of forming a scale from a set of individual items is to improve the reliability of our measures and effectively allow random errors to cancel out (see section 3.2.1). Compared to the scale as a whole, disaggregation leaves the individual items with untested reliability and more random content.

Also, as the items are related (all measure relative advantage) they are by definition intercorrelated. The largest absolute correlation is -.54, between responses to "This device would soon pay for itself" and "I doubt this device could save the amount of energy claimed." Correlations of this magnitude reduce the efficiency of least squares estimates (standard errors of the coefficients will tend to be high) and affect our ability truly to discern the relative effects of individual predictors. If two predictors always vary together the data contains insufficient information to allow their individual effects to be estimated. The way we constructed several of the product concepts manipulated price and payback period separately (e.g., the light bulbs differed in price while having a constant payback period; the energy monitor changed payback period while maintaining a constant price). Nonetheless, the correlation between perceived payback period and perceived price, over all product concepts, is -.50. All comments on the individual effects of the dimensions of relative advantage must be interpreted in the light of significant intercorrelations.

Table 22 shows the coefficients obtained from regressing product evaluations on the relative advantage items. Regression was performed for each early adopter classification. All predictors were standardized, so coefficients can be interpreted as indicators of the predictor's relative importance, remembering the potentially disruptive effects of multicollinearity. As expected, price perceptions have no significant effect on product usefulness evaluations. This is reassuring both as to the validity of the survey as a whole and to the limited impact of multicollinearity. Were multicollinearity severe, price could have appeared to have a spurious effect on usefulness ratings. That price did not have such an effect provided some reassurance in interpreting the coefficients of the other regressions.

In assessing usefulness the most important predictor for both groups is payback period (agreement with the item, "This device could soon pay for itself"). The second most important predictor of usefulness is a general superiority (agreement with the item, "Compared to other ways of saving energy, this one is superior"). For early adopters, payback period is less important in predicting "buying interest," all aspects of relative advantage being of approximately equal importance. For the rest of the sample, payback period is the major determinant of buying interest.

At present we can only suggest that payback period appears to be more important than price in predicting buying interest and usefulness. This result is, however, speculative, being open to the influence of multicollinearity and specific to the range of values tested here. Further research could profitably focus on experimentation designed to manipulate the components of relative advantage according to an orthogonal design, using a wider range of replicated measurements than attempted here.

Table 22

Product Evaluations and Relative Advantage Items: Regression Coefficients

Dependent variable	"The price of this device is too high for me to consider purchasing it"	"This device would soon pay for itself"	"I doubt this device could save the amount of energy claimed"	"Compared to other ways of saving energy this one is superior"	"It would be hard to determine how much energy this device saves"	R^2
Usefulness:						
Early adopters	-.04	.27	-.11	.25	-.13	.36
Others	.03	.40	-.12	.26	-.04	.41
Buying interest:						
Early adopters	-.17	.20	-.23	.23	-.12	.48
Others	-.21	.34	-.10	.21	-.01	.43

Chapter 6

CONCLUSIONS AND POLICY IMPLICATIONS

This study was designed to gain a general understanding of early adopters of energy conservation products. It was not directed towards any specific energy conservation program or policy. Consequently, this research is intended to provide the groundwork for later policy-specific analyses. Conclusions are presented in two parts. The first part deals with methodological conclusions, which are relevant for planning and executing future projects in this area. The second looks at policy implications, by design involving overall marketing strategy rather than specific tactics for marketing any particular program.

6.1 Methodological Conclusions

First, a mail survey intentionally appealing to a self-selected, rare subgroup of the population was very effective. Ownership of energy conservation products in our sample was two to four times higher than in the Canadian population as a whole. Sampling a rare group is always difficult, particularly when group membership is not readily visible and the group is geographically dispersed. The mail questionnaire procedure appears to work well and is extremely cost-effective.

However, it is important to remember that our respondents are self-selected and may not be typical of the total population of early adopters. The only way to generate a more certainly random sample of early adopters would be to use a high response rate interviewing method (e.g., phone or personal interviews) and rely on screening to identify early adopters. The cost of the large number of contacts required to generate sufficient early adopters would be very high.

More specialized sampling frames could be useful for future studies (e.g., mailing lists of energy conservation oriented magazines, subscription lists of conservation pressure groups or recipients of government grants or information). Compared to the procedure used here, such frames should increase response rates but would probably produce samples with less claim to represent all early adopters.

Second, this study finds that measures of innovativeness do overlap. Individuals identified as early adopters in a cross-sectional sense (i.e., by the number of energy conservation products owned) also tend to score highly on self-reported innovativeness scales. Similarly, correlations between numbers of products owned at different times are high, suggesting that time of adoption is related to number of products adopted.

The cross-sectional adoption measure was used here as it spreads the early adopter definition over several products, inherently reducing the impact of chance events and of nonconservation reasons for product adoption. However, a detailed assessment of each product's adoption date has not yet been performed (though the data is available). Such an analysis could indicate specific products whose adoption is not well predicted by our cross-sectional measure. The measures of generalized innovativeness were not reliable and were not related to other early adopter definitions.

The third point concerning methodology is this study's careful concern to estimate the reliability of its measures. Measurement is only meaningful to the extent that it is systematic. If a scale contains a high proportion of random response, or error, it is unreliable, and thus unlikely to explain individuals' behaviour. The chance, or error, component in a scale will reduce its correlations with other scales and behaviour. Previous energy conservation research has found little relationship between attitudes and energy consumption. Instead, physical household characteristics have offered the best explanation of domestic energy use. These results could be explained by the unreliability of the attitude measures used, in contrast to the highly reliable, easily quantified physical household characteristics. Much of the previous research, both in energy conservation and early adoption, fails to report or even to test reliability. If research is to be programmatic, building on past successes, development of reliable measures should be given a high priority.

This study obtained highly reliable measures of opinion leadership, social integration and product relative advantage. Fairly reliable measures of product compatibility and product complexity were developed, although they did not include all the items expected to measure these constructs. Product observability/communicability and product trialability could be measured only by single items. It is surprising that more reliable measures of Rogers' product attributes are not available. The measures adopted had been used in previous research (with usually unreported reliability). The four energy conservation attitude items did not relate to one another and appeared to measure four distinct constructs.

It is hoped that future energy conservation research will estimate and report scale reliabilities. It would be useful to examine the research currently available to identify sets of reliable items, which could then constitute a test bank for use in future projects.

6.2 Energy Conservation Policy Conclusions

6.2.1 Early adopters. Early adopters (defined by the number of energy conservation products owned) are definitely upscale of the population as a whole but only slightly upscale of our sample. Although we find early adopters tend to be older, better educated and have higher incomes, these characteristics are not sufficient to define the group. Many in our sample were upscale but were not early adopters. From the marketing perspective this suggests that communications intended for early adopters should use vehicles with an upscale audience, but will need to use self-selection to target early adopters specifically. It seems to be impossible to define early adopters more tightly in demographic terms.

Early adopters and opinion leaders do overlap. Those most likely to own many energy conservation products are also likely to be involved in energy conservation discussions and to be looked to for advice, etc. This overlap is not perfect: opinion leaders as a group are not identical to early adopters -- but they are close. This means that the product experience of early adopters will be diffused throughout their communities rather quickly. This should encourage rapid diffusion of energy conservation products provided early adopters' product experience is positive. If early adopters find that energy conservation products do not live up to expectations (e.g., are faulty or provide less relative advantage or compatibility than expected), they will disseminate adverse product reports and curtail diffusion. Indeed, one of the few differences in perception between early adopters and others is a tendency for early adopters to be more discerning in their judgements of relative advantage. Early adopters may judge a product's claimed energy savings particularly critically. All this makes any early product failure extremely damaging. Early adopters are gatekeepers to wider product acceptance; if the product fails to perform for them it may not get the chance to perform for others. In this light the impact of, say, the adverse publicity concerning urea formaldehyde foam insulation can be seen as a major barrier to diffusion of the CHIP program. Early problems, even when corrected, will have major effects on diffusion.

Apart from a more critical assessment of each product's relative advantage, early adopters are not distinctive in their product perceptions. Although they tend to see all products as "more useful" and "more compatible," the major difference between early adopters and other respondents is awareness. Overall, early adopters are significantly more likely to have heard of the product concepts. This difference is particularly marked for the solar economiser and the shower-flow restrictor, both products which are on the market in one form or another and have received publicity. Unfortunately we cannot determine whether awareness is the cause or effect of early adoption. Do early adopters own energy conservation products because they are more aware of the available products? Or are they inherently more sensitive to messages about energy conservation? The latter is a possibility, although this study could not find distinctive early adopter attitudes or opinions.

Early adopters did report that they drove less. This suggests that energy conservation activities may be linked over different energy uses. Indeed, the fact that early adopters, owning a number of energy conservation products, even exist suggests the opportunity for cross-marketing of energy conservation. Individuals who buy one energy conserving product appear to be good prospects for other conserving products and for energy conservation activities. In practical terms, individuals requesting automobile gas consumption reports or applying for CHIP grants could form a useful mailing list for ENERSAVE or other conservation programs.

6.2.2 Product perceptions and evaluations. Manipulations of the product concepts showed that price, payback period and compatibility (both in the sense of ease of installation and ease of use) all affect perceived relative advantage. There is some evidence that compared to other respondents early adopters may base their relative advantage assessments on payback period rather than price.

For all respondents there is a gap between acknowledging the usefulness of a product and stating a buying interest. This gap widens as the product's price increases. The big-ticket solar economiser, expert-installed, shows the largest drop-off from usefulness to buying intention. Clearly, energy conservation products have to be more than merely useful; they must to be useful in relation to their price.

Discriminant analysis allows us to examine the effects of all aspects of product perception simultaneously. Product perceptions are found to be very good indicators of the direction of individuals' product evaluations. In the vast majority (83%) of cases we can predict whether individuals' evaluations of a product will be favourable or unfavourable based only on their perceptions of the product. In fact only three perceptual variables are important: relative advantage, communicability and compatibility. The other two of Rogers' product attributes (trialability and complexity) provide very little additional predictive power. Furthermore, relative advantage is by far the most important variable. For judgements of product usefulness, its explanatory power is greater than that of communicability and compatibility combined. In explaining buying interest, perceived relative advantage is even more important, with four times the effect of communicability and three times the effect of compatibility. For early adopters relative advantage is an even more dominant determinant of buying interest.

This means that despite the desirability of positioning energy conserving products as compatible, incompatible products can get a favourable evaluation if they are perceived to offer sufficient relative advantage. Indeed, as relative advantage is given so much weight, it is quite possible for fairly modest gains in relative advantage to outweigh considerable incompatibility, provided those relative advantage gains are perceived correctly and believed.

A key to the role of early adopters of energy conservation products is the increased weight they give to relative advantage. Early adopters are more likely to let relative advantage gains outweigh product incompatibility. As a result they buy products when relative advantage is lower (i.e., at lower levels of energy prices and higher product prices) and/or compatibility is lower (i.e., products that are not totally perfected or are more intrusive than they could be). The major role assigned to relative advantage highlights the problems of misperceived and/or artificially restrained energy prices. The relative advantage of all energy conservation is crucially tied to the market price of energy. As energy costs rise, conservation products' relative advantage automatically increases. If, for wider policy reasons, energy prices are restrained, those who market energy conservation products can manipulate perceived relative advantage by: (i) ensuring that consumers perceive current prices correctly, (ii) ensuring that consumers have realistic expectations of future energy prices, (iii) improving the operating efficiency of conservation products and ensuring that improvements are perceived, or (iv) reducing the price of energy conservation products. Alternatively, marketing must concentrate on the other important product attributes, communicability and compatibility.

Some caution is necessary in interpreting these results. In particular the individual elements of product perception are slightly correlated. The worst case is complexity and compatibility, which are correlated with $r = .39$; that is, 15% of their variation is common. The estimates of individual coefficients are not perfect. As complexity and compatibility to some extent vary together, their coefficients are intertwined. However, this level of multicollinearity is not usually considered a major problem.

In addition, this analysis involves respondents' evaluations of written concept descriptions. Such descriptions may give quantitative (usually relative advantage) data greater weight in the respondent's mind than it would have in a real buying situation. A more realistic research design would provide respondents with longer product descriptions, including artwork or promotional literature (naturally this would increase the cost of fieldwork). Nonetheless we have seen that respondents recognize differences between concepts on other grounds than relative advantage, but that those differences are only weakly related to evaluations.

Breaking relative advantage down into its components provides additional insights -- and additional problems. Multicollinearity now becomes more severe. The individual elements of relative advantage ("The price of this device is too high for me to consider purchasing it," "This device would soon pay for itself," "I doubt this device could save the energy claimed," "Compared to other ways of saving energy, this one is superior," and "It would be hard to determine how much energy this device saves") are correlated. By manipulating individual elements of relative advantage (i.e., price and payback period) we attempted to keep item intercorrelations down. Nonetheless perceptions are corre-

lated. As a result it is impossible to disentangle completely their individual effects by using this data. However, the analysis suggests that perception of "This device would soon pay for itself" is the most important individual predictor.

Interestingly, looking at the specific product for which payback period was varied (the energy monitor), moving from a two-year payback to a one-year payback did not have a significant impact on buying interest. The manipulation did change perceptions of "This device would soon pay for itself" significantly, but this change had only a small, insignificant effect on evaluations. The result obtained in the regression analysis pools data across all eight product concepts and thus measures the effects of payback period over the whole range from three months (for the shower-flow restrictor) to three years (for the solar economiser). It appears that big variations in payback period (from three months to three years) may have a major impact on evaluations, while small changes in payback (from one year to two years) leave evaluations unaffected.

Future research should systematically manipulate individual elements of relative advantage over a wider range of values than attempted here. Such manipulations should be administered across subjects, as done here (i.e., each respondent evaluates only one version of a product). Data collection could probably be accomplished by buying space on an existing omnibus survey. Certainly this research points strongly to relative advantage as the major determinant of buying interest (particularly amongst early adopters) and suggests that individual elements of relative advantage may have differing impacts on product evaluation.

Appendix A

ENGLISH QUESTIONNAIRE: VERSION ONE

INSTITUTE FOR BEHAVIOURAL RESEARCH
SURVEY RESEARCH CENTRE
667-3022 AREA CODE 416

YORK UNIVERSITY
4700 KEELE STREET,
DOWNSVIEW, ONTARIO M3J 1P3

December 30, 1981

Dear Homeowner:

The Survey Research Centre at York University in Toronto is currently conducting a survey to find out what people like you think about some new energy conservation products. This survey is sponsored by the Department of Consumer and Corporate Affairs.

Your name was randomly selected from a list of homeowners in Winnipeg and we would appreciate it if you could take about fifteen minutes to fill out the enclosed questionnaire. It is important that we hear from as many people as possible to ensure the accuracy of our findings. Any information that you give us will be kept strictly confidential and it is not necessary to put your name on the questionnaire.

It would be appreciated if you could return the completed questionnaire to us as soon as possible in the enclosed postage-paid envelope.

We thank you for your interest and cooperation in taking part in this survey. If you wish to add any comments we would be pleased to hear from you.

Yours sincerely,

F. Marsden
Project Director

SURVEY RESEARCH CENTRE
YORK UNIVERSITY

ENERGY CONSERVATION SURVEY

You have been selected to participate in our survey of energy conservation products. Most questions may be answered by circling the appropriate number. Please answer all questions.

ALL INSTRUCTIONS ARE PRINTED IN ITALICS

---

1. We are interested in knowing which of the following energy conservation products you have and when you got them. *PLEASE CIRCLE THE APPROPRIATE NUMBER FOR EACH PRODUCT.*

	DO YOU HAVE:	No	Yes: Was in home when bought	Yes: Got in last 5 months	Yes: Got in last 6-11 months	Yes: Got in last 12-24 months	Yes: Got in last 2-5 years	Yes: Got over 5 years
a)	storm windows or doors..	1	2	3	4	5	6	7
b)	microwave oven.....	1	2	3	4	5	6	7
c)	solar power unit.....	1	2	3	4	5	6	7
d)	portable electric space heater.....	1	2	3	4	5	6	7
e)	set-back thermostat.....	1	2	3	4	5	6	7
f)	heat pump.....	1	2	3	4	5	6	7
g)	shower-flow restrictor..	1	2	3	4	5	6	7
h)	electric water heater timer.....	1	2	3	4	5	6	7
i)	diesel-engined car.....	1		3	4	5	6	7
	HAVE YOU IMPROVED YOUR HOME'S:							
j)	weatherstripping.....	1		3	4	5	6	7
k)	glass-fibre or cellulose insulation....	1		3	4	5	6	7

DO YOU HAVE ANY OTHER ENERGY CONSERVING DEVICE IN YOUR HOME?

If so, write in its name below and circle when you got it.

1)	_____	1	2	3	4	5	6	7
m)	_____	1	2	3	4	5	6	7

2

2. We are interested in how people hear about energy conservation.

a) What is your main source of information about energy conservation?

Friends/Relatives/Neighbours..... 1
Newspapers/Magazines/TV/Radio..... 2
Other *(specify)*_____ 3

b) During the past year, have you given anyone any advice or information about energy conservation?

Yes..... 1
No..... 2

c) Compared with your circle of friends and neighbours how likely are you to be asked for your advice about energy conservation?

I'm more likely to be asked..... 1
I'm just as likely to be asked..... 2
I'm less likely to be asked..... 3

d) Thinking back to the last discussion you had about energy conservation, did you mainly ask others for advice, or did they mainly ask you?

I mainly asked others for advice..... 1
Others mainly asked me for advice..... 2

e) When you discuss energy conservation, what part do you play?

I mainly listen..... 1
I mainly try to convince people of my ideas... 2

f) Which happens more often?

I tell friends and neighbours about energy conservation..... 1

My friends and neighbours tell me about energy conservation..... 2

g) Do you have the feeling that you are generally regarded by your friends and neighbours as a good source of advice and information about energy conservation?

Yes..... 1
No..... 2

3. Some people change the temperature setting in their homes for day and evening...

a) At what temperature do you set your thermostat during the day?..... ___ ___ o

b) What about at night?..... ___ ___ o

4. What do you think is the most important reason that people try to conserve energy?

They want to be good citizens..... 1
They want to save money..... 2

3

5. Now we would like to find out how much you agree or disagree with the following statements. *PLEASE CIRCLE THE NUMBER THAT BEST DESCRIBES YOUR FEELINGS. IF YOU STRONGLY AGREE WITH A STATEMENT CIRCLE NUMBER 5. IF YOU STRONGLY DISAGREE, CIRCLE NUMBER 1. MANY STATEMENTS WILL FALL SOMEWHERE IN BETWEEN.*

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a) As a rule I like to meet new people, go to social gatherings and generally get around a lot	1	2	3	4	5
b) I often say the first thing that comes into my mind.	1	2	3	4	5
c) I do volunteer work for a hospital or service organization on a fairly regular basis.	1	2	3	4	5
d) There are few things more satisfying than to really splurge on something.	1	2	3	4	5
e) It would be hard for me to cut down on the use of energy in the home.	1	2	3	4	5
f) I often change my feelings about others.	1	2	3	4	5
g) I often make decisions on the spur of the moment.	1	2	3	4	5
h) I rely on friends' advice when making up my mind on new products.	1	2	3	4	5
i) I like to work on community projects.	1	2	3	4	5
j) I tend to act on impulse.	1	2	3	4	5
k) I have difficulty in deciding whether to buy new food products.	1	2	3	4	5
l) Energy costs for most people are much higher than they were a year ago.	1	2	3	4	5
m) I am an active member of more than one service organization.	1	2	3	4	5
n) I like to try new and different things.	1	2	3	4	5
o) There is not much the average citizen can do to save energy.	1	2	3	4	5
p) I try to drive less now than in the past.	1	2	3	4	5
q) I often try new products before my friends do.	1	2	3	4	5
r) I often talk to my friends about new appliances.	1	2	3	4	5

4

6. Now we would like you to read some brief outlines of new energy conservation products. When you have read each outline carefully we would like to know your opinion of the product described.

PRODUCT A: ENERGY EFFICIENT LIGHT BULB

PLEASE READ THIS OUTLINE CAREFULLY AND THEN CIRCLE THE NUMBER THAT BEST DESCRIBES YOUR FEELINGS. IF YOU STRONGLY DISAGREE WITH A STATEMENT, CIRCLE NUMBER 1; IF YOU STRONGLY AGREE, CIRCLE NUMBER 5. MANY STATEMENTS WILL FALL SOMEWHERE IN BETWEEN.

The energy efficient light bulb, not available to the public until at least 1982, has an energy efficiency three times that of currently available bulbs and will last up to four times longer. The new bulb will be about the same size as conventional bulbs and will fit all regular sockets. The new bulbs will retail for $10 each. The makers state that, depending on usage, consumers will recover the price of the bulb in electricity savings within about two years of normal use.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a) I understand how this device is supposed to work.	1	2	3	4	5
b) The results of using this product would show up clearly.	1	2	3	4	5
c) This product could easily be tried out on a small scale.	1	2	3	4	5
d) It would be difficult to explain the operation of this device to my friends.	1	2	3	4	5
e) The use of this device would require big changes in our daily household routine.	1	2	3	4	5
f) This product would be easy to use.	1	2	3	4	5
g) The price of this device is too high for me to consider purchasing it.	1	2	3	4	5
h) This device could be easily installed in my home.	1	2	3	4	5
i) If I had this product, my friends would be interested to hear about it.	1	2	3	4	5
j) This device would soon pay for itself.	1	2	3	4	5
k) Using this device would be inconvenient for our family.	1	2	3	4	5
l) I doubt this device could save the amount of energy claimed.	1	2	3	4	5
m) Compared to other ways of saving energy, this one is superior.	1	2	3	4	5
n) It would be hard to determine how much energy this device saves.	1	2	3	4	5
o) This device appears too complicated.	1	2	3	4	5
p) I have heard of this product before.	1	2	3	4	5
q) This device would be very useful in my home.	1	2	3	4	5
r) I would be interested in BUYING this device.	1	2	3	4	5

IF YOU ALREADY OWN THIS DEVICE, CHECK HERE ☐

5

7. PRODUCT B: ENERGY MONITOR

PLEASE READ THIS OUTLINE CAREFULLY AND THEN CIRCLE THE NUMBER THAT BEST DESCRIBES YOUR FEELINGS. IF YOU STRONGLY DISAGREE WITH A STATEMENT, CIRCLE NUMBER 1; IF YOU STRONGLY AGREE, CIRCLE NUMBER 5. MANY STATEMENTS WILL FALL SOMEWHERE IN BETWEEN.

This is an electronic device that continually monitors a household's energy usage. It allows you to set an energy budget and will flash a warning if the budget is exceeded. Its digital display can show any of 7 items of information: current $ cost of energy used, projected $ amount of next energy bill, $ amount of last energy bill, billing date, energy budget set, date and time of day. The Energy Monitor is expected to sell for $295 and its makers state that some users will be able to reduce energy bills by at least that amount within two years.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a) I understand how this device is supposed to work.	1	2	3	4	5
b) The results of using this product would show up clearly.	1	2	3	4	5
c) This product could easily be tried out on a small scale.	1	2	3	4	5
d) It would be difficult to explain the operation of this device to my friends.	1	2	3	4	5
e) The use of this device would require big changes in our daily household routine.	1	2	3	4	5
f) This product would be easy to use.	1	2	3	4	**5**
g) The price of this device is too high for me to consider purchasing it.	1	2	3	4	5
h) This device could be easily installed in my home.	1	2	3	4	5
i) If I had this product, my friends would be interested to hear about it.	1	2	3	4	5
j) This device would soon pay for itself.	1	2	3	4	5
k) Using this device would be inconvenient for our family.	1	2	3	4	5
l) I doubt this device could save the amount of energy claimed.	1	2	3	4	5
m) Compared to other ways of saving energy, this one is superior.	1	2	3	4	5
n) It would be hard to determine how much energy this device saves.	1	2	3	4	5
o) This device appears too complicated.	1	2	3	4	5
p) I have heard of this product before.	1	2	3	4	5
q) This device would be very useful in my home.	1	2	3	4	5
r) I would be interested in BUYING this device.	1	2	3	4	5

IF YOU ALREADY OWN THIS DEVICE, CHECK HERE ☐

6

8. PRODUCT C: SOLAR ECONOMISER

PLEASE READ THIS OUTLINE CAREFULLY, AND THEN CIRCLE THE NUMBER THAT BEST DESCRIBES YOUR FEELINGS. IF YOU STRONGLY DISAGREE WITH A STATEMENT, CIRCLE NUMBER 1; IF YOU STRONGLY AGREE, CIRCLE NUMBER 5. MANY STATEMENTS WILL FALL SOMEWHERE IN BETWEEN.

The solar economiser uses the principle of solar heating. It is a solar panel attached to the outside of the home, under a window (preferably on a southern exposure). Cool air is drawn from the room into the solar panel; there it is heated by the sun and recirculated back into the room. The solar economiser can be installed by the average homeowner. The solar economiser costs $465 and its makers state that, depending on usage conditions, the unit will pay for itself within 3 years.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a) I understand how this device is supposed to work.	1	2	3	4	5
b) The results of using this product would show up clearly.	1	2	3	4	5
c) This product could easily be tried out on a small scale.	1	2	3	4	5
d) It would be difficult to explain the operation of this device to my friends.	1	2	3	4	5
e) The use of this device would require big changes in our daily household routine.	1	2	3	4	5
f) This product would be easy to use.	1	2	3	4	5
g) The price of this device is too high for me to consider purchasing it.	1	2	3	4	5
h) This device could be easily installed in my home.	1	2	3	4	5
i) If I had this product, my friends would be interested to hear about it.	1	2	3	4	5
j) This device would soon pay for itself.	1	2	3	4	5
k) Using this device would be inconvenient for our family.	1	2	3	4	5
l) I doubt this device could save the amount of energy claimed.	1	2	3	4	5
m) Compared to other ways of saving energy, this one is superior.	1	2	3	4	5
n) It would be hard to determine how much energy this device saves.	1	2	3	4	5
o) This device appears too complicated.	1	2	3	4	5
p) I have heard of this product before.	1	2	3	4	5
q) This device would be very useful in my home.	1	2	3	4	5
r) I would be interested in BUYING this device.	1	2	3	4	5

IF YOU ALREADY OWN THIS DEVICE, CHECK HERE ☐

7

9. PRODUCT D: SHOWER-FLOW RESTRICTOR

PLEASE READ THIS OUTLINE CAREFULLY AND THEN CIRCLE THE NUMBER THAT BEST DESCRIBES YOUR FEELINGS. IF YOU STRONGLY DISAGREE WITH A STATEMENT, CIRCLE NUMBER 1; IF YOU STRONGLY AGREE, CIRCLE NUMBER 5. MANY STATEMENTS WILL FALL SOMEWHERE IN BETWEEN.

The shower-flow restrictor is a pipe segment added between the shower pipe and the shower head. It cuts water flow and thus reduces the amount of hot water used. There is some reduction in shower quality. The shower-flow restrictor costs about $5 and the makers state that, depending on usage habits, it may pay for itself in 3 months.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a) I understand how this device is supposed to work.	1	2	3	4	5
b) The results of using this product would show up clearly.	1	2	3	4	5
c) This product could easily be tried out on a small scale.	1	2	3	4	5
d) It would be difficult to explain the operation of this device to my friends.	1	2	3	4	5
e) The use of this device would require big changes in our daily household routine.	1	2	3	4	5
f) This product would be easy to use.	1	2	3	4	5
g) The price of this device is too high for me to consider purchasing it.	1	2	3	4	5
h) This device could be easily installed in my home.	1	2	3	4	5
i) If I had this product, my friends would be interested to hear about it.	1	2	3	4	5
j) This device would soon pay for itself.	1	2	3	4	5
k) Using this device would be inconvenient for our family.	1	2	3	4	5
l) I doubt this device could save the amount of energy claimed.	1	2	3	4	5
m) Compared to other ways of saving energy, this one is superior.	1	2	3	4	5
n) It would be hard to determine how much energy this device saves.	1	2	3	4	5
o) This device appears too complicated.	1	2	3	4	5
p) I have heard of this product before.	1	2	3	4	5
q) This device would be very useful in my home.	1	2	3	4	5
r) I would be interested in BUYING this device.	1	2	3	4	5

IF YOU ALREADY OWN THIS DEVICE, CHECK HERE ☐

8

Finally, we would like to get a little information about your household. *PLEASE CIRCLE THE APPROPRIATE ANSWERS.*

10. Are you:
    - Male?..... 1
    - Female?..... 2

11. How many persons live in your household?
    - # adults (18 years and over) _____
    - # children (under 18 years) _____

12. What is your age?
    - Less than 25 years..... 1
    - 25-34 years..... 2
    - 35-44 years..... 3
    - 45-65 years..... 4
    - Over 65 years..... 5

13. What is the main language spoken in your home?
    - English..... 1
    - French..... 2
    - Other *(write in)* _____ 3

14. What is the main occupation of you and your spouse? *CIRCLE A CATEGORY FOR BOTH YOU AND YOUR SPOUSE.*

		Myself	My Spouse
a)	Professional	1	1
b)	Managerial	2	2
c)	Sales	3	3
d)	Service	4	4
e)	Blue collar	5	5
f)	Clerical/Secretarial	6	6
g)	Does not work	7	7

IF YOU HAVE NO SPOUSE, CHECK HERE ☐

9

15. What is the highest level of schooling that you and your spouse have completed?

	Myself	My Spouse
Public or Elementary School	1	1
Secondary or High School	2	2
Technical or Senior College	3	3
University	4	4

Other *(please write in)* _____ _____

16. Below, we have listed a number of income ranges. Thinking about your total annual family income (that is, all the income of all the family members living in your household added together, before taxes), *please circle the number opposite the range that this would fall in:*

Less than $10,000 per year	1
$10,000 to $19,999 per year	2
$20,000 to $29,999 per year	3
$30,000 to $39,999 per year	4
$40,000 to $49,999 per year	5
$50,000 to $59,999 per year	6
Over $60,000 per year	7

17. How would you describe your home? Is it a:

House	1
Apartment or flat	2
Duplex, Triplex, 4-Plex	3
Townhouse or Rowhouse	4
Condominium Townhouse or Rowhouse	5
Condominium Apartment	6
Mobile Home	7
Other *(please write in)* _____	8

18. Do you own or rent this home?

Own outright	1
Paying off Mortgage	2
Rent	3
Other *(please write in)* _____	4

19. Which way does the front of your home face?

North	1
South	2
East	3
West	4

10

20. When did you move into your house/apartment?..... 19 __ __

21. Does your home have its own thermostat? Yes..... 1
No..... 2

22. How many finished rooms are there in your home (excluding bathrooms)? # rooms _____

23. What fuel is used for your principal home heating equipment?
Oil or other liquid fuel..... 1
Natural gas..... 2
Bottled gas..... 3
Electricity..... 4
Coal or coke..... 5
Wood..... 6

24. What are your approximate annual heating costs?
$ _____ per year
Don't know ☐

25. Do you have air conditioning?
Central Unit..... 1
Window Unit..... 2
None..... 3

26. Finally, apart from filling out this questionnaire, have you answered any other questionnaires within the last year? *(Circle as many as are applicable.)*

Yes: I have been surveyed at least once over the telephone..... 1
Yes: I have filled out at least one other mail questionnaire..... 2
Yes: I have been interviewed at least once face-to-face with the interviewer..... 3
No: I have not answered any other questionnaires within the last year..... 4

Other *(write in)* _____

Thank you for taking the time to fill out this questionnaire. *PLEASE RETURN IT IN THE POSTAGE-PAID ENVELOPE ENCLOSED.*

Remember that the information you have provided will be kept strictly confidential.

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