ENERGY-EFFICIENT, INNOVATIVE HOUSING:
A COMPARISON OF PROBABLE ADOPTERS AND NONADOPTERS

by

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(ABSTRACT)

The purpose of this research, based on classical diffusion of innovations theory, was to examine factors related to the probable adoption or nonadoption of energy-efficient housing alternatives, specifically passive and active solar and earth sheltered/underground dwellings. Three types of factors were examined: demographics (geographical location by state, type of household, stage in family life cycle, race, age, and educational level); energy (belief in the energy crisis, the impact of energy on housing decisions, efforts to reduce utility costs, average monthly utility costs, and the presence of energy-conserving features in the dwelling); and, local regulatory codes for building (the presence of housing alternatives in the locality, the presence of regulatory codes, and the prior need for variances in order to construct alternative forms of housing). The study utilized data collected as part of a regional research project, S-141,

Housing for Low- and Moderate-Income Families. Data from households were collected by means of an interview schedule using a random sample of 1804 households from four counties selected in each of seven southern states after stratification on the basis of income and the number of nonfarm households. Data from local building officials in the same counties were collected using mailed questionnaires. Techniques of analysis utilized included the chi-squared test, analysis of variance, analysis of covariance, the *t*-test, and discriminant analysis. Findings indicated that probable adopters of the housing alternatives were usually younger, had more education, were in the earlier stages of the family life cycle, believed in the energy crisis, believed the energy situation had impacted housing decisions, had attempted to reduce utility costs, and lived in houses with more energy-conserving features than probable nonadopters.

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CHAPTER ONE

INTRODUCTION

The American consumer's first major experience with energy as a scarce resource was during the oil embargo of 1973 - 1974. Since that time public awareness of the limited supply of fossil fuel reserves has increased along with concern about steep and continuing rises in utility costs. Interest in energy-efficient houses and dwelling units has steadily grown.

Residential energy consumption accounts for a significant proportion (approximately 20 percent) of the total amount of energy consumed in the United States. Within the residence, 83 percent of the energy utilized is for space heating and cooling and for water heating (Hirshberg and Schoen, 1974). Consequently, any savings that could be affected in those areas would favorably impact not only the households involved but also the nation as a whole.

High costs for residential energy consumption are likely to be an especially severe burden for rural families since incomes in rural areas are usually lower than in urban and suburban localities. The average rural family spends approximately 10 to 15 percent of family income on energy (Newman and Day, 1975) while consuming less than the average urban family but paying more per unit of energy because of structured rates (Bird and Kampe, 1977). Adding to the problem is the fact that the most readily available type of housing in rural areas is the single-family detached house which, as it is usually designed and constructed, is not very energy-efficient.

Since the establishment of the goal of "a decent home and suitable living environment for every American family" in the National Housing Act of 1949, both housing conditions and standards in this country have improved significantly (Lindamood and Hanna, 1979). The high cost of energy and the large amounts of energy consumed in the average home have, however, added a new dimension to this goal according to the project outline for the S-141 Regional Research Project, Housing for Low- and Moderate-Income Families (1979). These energy related factors make the attainment of this goal more difficult for the average family and much more so for the rural family who has historically lagged behind its urban counterpart in the achievement of quality housing conditions.

Concern about the long range supply of fossil fuels has stimulated research and development of a number of innovative types of housing that are energy-efficient and/or utilize renewable sources of energy. These innovative types of housing include, but are not limited to, active solar, passive solar, and earth sheltered/underground. They offer both a reduction in energy consumption and a reduction in the consumption of fossil fuels.

Unfortunately, previous experience indicates that the diffusion of innovations throughout the housing construction industry is extremely slow. In fact, one study has estimated that it takes an average of 17 years from invention to first use in the residential construction industry for even very successful innovations (McCue and Ewald, 1970). Among the many factors which may impede the diffusion of innovations throughout the housing industry are consumer acceptance, building codes, zoning ordinances, the nature and structure of the building industry, and lenders' attitudes.

If innovative, energy-efficient types of housing such as passive and active solar and earth sheltered/underground are to have any significant impact on the nation's as well as on individual households' energy problems, it is obvious that they must become diffused both rapidly and on a large scale.

Theoretical Framework

According to Rogers and Shoemaker (1971), innovations spread throughout a social system by the process of diffusion which is a unique type of communication that deals only with messages about new ideas or new products. They further emphasize that products, ideas, or procedures should be considered innovations on the basis of the individual's perception of their newness rather than by any objective measure of the point in time of their initial use. When this criterion is applied to the analysis of various types of housing structures, it is apparent that energy-efficient dwellings such as active and passive solar and earth sheltered/underground may be classified as innovations in the field of housing construction.

The process through which individuals become aware of an innovation and decide either to adopt or to reject it is described by Rogers and Shoemaker (1971) as the innovation-decision process or the adoption process. This process, identified primarily on the basis of research findings in rural sociology, consists of five major steps which are as follows: awareness, interest, evaluation, trial, and adoption. In the awareness stage, the existence of the innovation becomes known to the individual. In the interest stage, the individual actively seeks information about the innovation. The evaluation stage is the one in which a mental determination of the suitability of the innovation to the individual's situation is made. The trial stage involves the testing of the innovation on a small scale. The final or adoption stage is full-scale and continuous utilization of the innovation. Many other researchers including Beal, Rogers and Bohlen (1957), Holmberg (1960), Lionberger (1960), and Wilkening (1953) have described the same or similar stages in the adoption process.

Rogers and Shoemaker (1971) have also suggested a series of adopter categories which classify individuals on the basis of whether they are relatively early or relatively late in the adoption of an innovation. These categories are innovators, early adopters, early majority, late majority, and laggards. In summarizing existing research on the diffusion of innovations, they noted differences (although findings were not always consistent) in the adopter categories in terms of socioeconomic characteristics, personality traits, and communication behavior.

In addition to differences among individuals, Rogers and Shoemaker (1971) also indicated that the attributes of the innovations as perceived by the individual are a determinant of the rate and likelihood of adoption. They categorized these attributes into five overall dimensions which are as follows: 1) relative advantage or the perceived advantage over the existing product; 2) compatibility or the degree of consistency with the needs, experiences, and values of the adopters; 3) complexity or the difficulty of understanding or use; 4) trialability or the extent to which the innovation can be adopted on less than a full-scale basis; and, 5) observability or the visibility of the outcome of the innovation. Ostlund (1974) found that these perceived characteristics of the innovations were better predictors of adoption than socioeconomic or personality variables. LaBay and Kinnear (1981a) in their study of the adoption of solar energy systems in Maine found attribute perceptions to be better predictors of adoption than demographics. Furthermore, research conducted in California by Leonard-Barton (1981a) indicated respondents' perceptions of solar equipment were better predictors of adoption of solar energy systems than socioeconomic variables, utility costs, attitude towards the energy crisis, and the expectation of increased energy costs in the future.

The adoption process is, in some cases, impeded by barriers or constraints to the diffusion of innovations. This is especially true in the housing and construction industries according to Hirshberg and Schoen (1974). In their discussion of barriers to the utilization of residential solar energy, Hirshberg and Schoen have observed that innovations technically feasible and competitive on an economic basis often fail to become adopted on a wide scale in the housing industry. They grouped the unique characteristics of the housing industry which have served to deter the diffusion of innovations into three categories: technological, economic, and institutional. In their discussion of technological factors, they pointed out that the housing industry is severely constrained by the prevalence of numerous local building codes and by the use of specification rather than performance types of codes. In a later report to the Energy Policy Project of the Ford Foundation, Schoen, Hirshberg, and Weingart (1975) reported that the most frequently mentioned barrier to innovation in the construction industry was building codes. The discussion of economic factors by Hirshberg and Schoen included the cyclical nature of the industry and its heavy reliance on the use of credit. They also mentioned the high sensitivity of the industry to the initial cost of a product or system. Their discussion of institutional factors included the regional structure of the industry, its fragmentary nature, its stratification on a horizontal basis, and its basis as a craft oriented industry which leads to an emphasis on procedures utilized in the past and results in a conservative social system.

Statement of the Problem

Recently developed innovative and energy-efficient types of housing such as passive solar, active solar, and earth sheltered/underground have great potential for reducing the burden of high energy costs for the individual household and for reducing the dependency of the nation on rapidly depleting supplies of fossil fuels. There has been limited research applying diffusion of innovation theory to housing innovations or consumer oriented energy innovations. Therefore, it is essential to examine and identify those demographic, energy, and regulatory code factors related to the adoption decision for these innovative, energy-efficient types of housing units.

Purpose

The purpose of this study was to examine demographic, energy and regulatory code factors in relation to the adoption of energy-efficient, innovative types of housing.

Objectives of the Study

The specific objectives of the study were:

1. to examine and compare the position of respondents in the innovation adoption process for each of the innovative types of housing in relation to: a) family demographics; b) energy attitudes and factors; c) presence of local examples of innovative housing types; d) the existence of local regulatory codes; and, e) previous requirements for code variances in the construction of innovative types of housing within the locality.

2. to examine and compare respondents and the number of types of housing alternatives in each stage of the innovation adoption process in relation to the respondent's: a) family demographics; and, b) energy attitudes and factors.

3. to examine and compare probable adopters and probable nonadopters for each of the innovative housing types in relation to: a) family demographics; and, b) energy attitudes and factors.

4. to examine and compare respondents and the number of types of housing alternatives for probable adoption in relation to: a) family demographics; and, b) energy attitudes and factors.

5. to determine whether the better predictor of probable adoption or probable nonadoption of innovative housing types is: a) demographic variables; or, b) energy attitudes and factors.

6. to compare respondents in each stage of the adoption process with both probable adopters and probable nonadopters for each of the innovative types of housing.

Definition of Terms

For the purpose of this study, the following definitions of terms were used:

Active Solar House: A house equipped with solar collectors which utilize energy from the sun for heating and cooling the house.

Adoption Stage: The stage in the adoption process represented by the full-scale acceptance and use of a new product or idea (Rogers and Shoemaker, 1971).

Awareness Stage: The stage in the adoption process where the individual learns of the new product or idea, i.e., sees, hears or reads about it (Rogers and Shoemaker, 1971).

Earth Sheltered/Underground House: A house either partially or totally surrounded by soil for the purpose of reducing heating and cooling requirements.

Evaluation Stage: The stage in the adoption process in which the individual attempts to determine the suitability of the new product or idea for his present and future condition (Rogers and Shoemaker, 1971).

Household: Any group of persons sharing a residence.

Housing Alternatives: Innovative, non-normative housing structures with energy savings potential, specifically active and passive solar, earth sheltered/underground.

Interest Stage: The stage in the adoption process in which the individual seeks additional information about the product or idea (Rogers and Shoemaker, 1971).

Nonfarm Household: A household residing in a non-SMSA county and receiving less than one-half its income from farming.

Passive Solar House: A housing unit designed to take advantage of solar heat through design, construction, materials, landscaping, and site orientation, but without the use of collectors.

Probable Adopters: Those respondents indicating they would "definitely consider" or "probably consider" living in the type of housing alternative under consideration.

Probable Nonadopters: Those respondents indicating they would "definitely not consider" or "probably not consider" living in the type of housing alternative under consideration.

Trial Stage: The stage in the adoption process in which the individual tests the utility of the product or idea by trying it on a small scale (Rogers and Shoemaker, 1971).

Hypotheses

The following null hypotheses were tested in this study:

Ho1: For each of the housing alternatives, there are no differences in means or proportions among respondents in the various stages of the innovation adoption process with respect to the following family demographic variables:

a. geographical location by state
b. type of household
c. stage in family life cycle
d. racial origins of household
e. age of respondent
f. educational level of respondent

Ho2: For each of the housing alternatives, there are no differences in means or proportions among respondents in the various stages of the innovation adoption process with respect to the following energy variables:

a. belief in the energy crisis

b. impact of the energy situation on housing decisions

c. efforts to reduce utility costs

d. average monthly utility costs

e. presence of energy-conserving features in the dwelling (energy index).

Ho3: For each of the housing alternatives, there are no differences in proportions among respondents in the various stages of the innovation adoption process with respect to:

a. the presence or absence of each of the innovative types of housing within the locality.

b. the existence of local regulatory codes for construction (building, zoning, and energy).

c. the prior need for code variances in order to construct innovative types of housing in the locality.

Ho4: For each stage of the adoption process, there are no differences in means or proportions among respondents and the number of types of housing alternatives with respect to the following family demographic variables:

a. geographical location by state

b. type of household

c. stage in family life cycle

d. racial origins of household

e. age of respondent

f. educational level of respondent.

Ho5: For each stage of the adoption process, there are no differences in means or proportions among respondents and the number of types of housing alternatives with respect to the following energy variables:

a. belief in the energy crisis

b. impact of the energy situation on housing decisions

c. efforts to reduce utility costs

d. average monthly utility costs

e. presence of energy-conserving features in the dwelling.

Ho6: For each of the housing alternatives, there are no differences in means or proportions between probable adopters and probable nonadopters with respect to the following family demographic variables:

a. geographical location by state

b. type of household

c. stage in family life cycle

d. racial origins of household

e. age of respondent

f. educational level of respondent.

Ho7: For each of the housing alternatives, there are no differences in means or proportions between probable adopters and probable nonadopters with respect to the following energy variables:

a. belief in the energy crisis

b. impact of the energy situation on housing decisions

c. efforts to reduce utility costs

d. average monthly utility costs

e. presence of energy-conserving features in the dwelling (energy index).

Ho8: There are no differences in means or proportions for probable adopters for one, two, or three types of housing alternatives with respect to the following family demographic variables:

a. geographical location by state

b. type of household

c. stage in family life cycle

d. racial origins of household

e. age of respondent

f. educational level of respondent.

Ho9: There are no differences in means or proportions for probable adopters for one, two, or three types of housing alternatives with respect to the following energy variables:

a. belief in the energy crisis

b. impact of the energy situation on housing decisions

c. efforts to reduce utility costs

d. average monthly utility costs

e. presence of energy-conserving features in the dwelling (energy index).

Ho10: There are no differences in proportions between probable adopters and probable nonadopters among the various stages of the adoption process.

Limitations

This study examined only those variables included in the instrument "Perceptions of Alternative Housing" and the two instruments utilized to gain information relative to local building codes and regulations. The lack of additional variables such as those relative to the characteristics of the social system, communication networks, change agents, perceived innovation attributes, and psychological traits of the respondent which may affect the adoption process for innovations was a limitation of this study. An additional limitation of the study was that the instruments on building codes and regulations addressed only the technological factors in the housing industry which impede the diffusion of innovations and did not address either the economic or institutional factors which may also influence this process. There may also have been undisclosed weaknesses in the design of the instruments that were limitations.

Another possible limitation of this study was the use of 1970 census data as a means of stratifying and selecting the sample counties for the regional project. It is possible that in the intervening years conditions have changed making the classification of counties on the basis of median annual income and proportion of nonfarm households out of date.

An additional limitation was posed in the selection of individual properties to be sampled in each county. Project leaders found considerable inconsistency in the methods of maintaining tax records not only from state to state but also within the same state.

Current economic conditions, particularly high interest rates on mortgage loans, may have influenced responses to the interview items creating another limitation. Responses may also have been influenced by a desire to achieve the lifestyle and level of affluence often associated in the media with certain types of innovative housing structures.

Delimitations

The sample was limited to rural, nonfarm households located in four counties in each of the seven southern states participating in the regional research project. The four counties sampled in each state were limited to those not part of a Standard Metropolitan Statistical Area.

CHAPTER TWO

REVIEW OF LITERATURE

The literature reviewed in this chapter is organized into three major sections and a summary. The first section includes an overview of theory and research on the diffusion of innovations. In the second section, the diffusion of technological innovations in the housing construction industry is discussed. The third section deals specifically with the diffusion and adoption of energy-conserving housing technologies.

Diffusion of Innovations

In their discussion of the diffusion of innovations, Rogers and Shoemaker (1971) identified (primarily on the basis of the number of studies conducted) seven major and six minor research traditions or directions. The major traditions are anthropology, early sociology, rural sociology, education, medical sociology, communication, and marketing. The minor traditions include agricultural economics, geography, general economics, speech, general sociology, and psychology. In a later review of technological innovation, Kelly and Kranzberg (1975) were able to reduce the number of traditions to three by analyzing similarities in the variables studied and in the conceptual structures utilized. The three resulting traditions which represent different, but not mutually exclusive perspectives on the diffusion of innovations are geographical, economic, and social-psychological.

The primary concern in the geographical tradition is with spatial diffusion or the relationship between adoption of an innovation and the adopter's relative position in physical space (Kelly & Kranzberg, 1975). To illustrate this approach, they described the work of Hagerstrand (1968) who found that adopters in the early stages are usually concentrated in small clusters. From these clusters, adoption spreads outward (Hagerstrand called this the "neighborhood effect") while the saturation of adoption in the clusters increases. If this process is plotted graphically, an S-shaped curve showing a slow take-off stage, a middle stage of rapid development, and a final stage of slowed growth results. Hagerstrand concluded that the major channels through which the diffusion of innovations occurs are personal communication and direct observation. Further, since the pattern of spatial diffusion occurs repeatedly, these channels imply a communication and social network that is stable over time.

Kelly and Kranzberg (1975) next discussed the work of Brown (1968) who contended that Hagerstrand's model of spatial diffusion is justified only when there are no propagators (persons who promote the rapid and complete diffusion of the innovation) involved. In a later work, Brown (1972) applied the notion of propagators to an examination of diffusion in an urban area in which he distinguished three levels of diffusion. Macro-scale diffusion includes diffusion from propagators to intermediate agencies and occurs within an entire urban system. Meso-scale diffusion occurs in a sub-area of the urban system and involves diffusion from agencies to the public. Micro-scale diffusion then is diffusion among individuals in a community. Brown believed that the study of diffusion at the macro- and meso-levels could provide an important link between previous research on propagator decisions and the work by Rogers on the adoption behavior of individuals.

The emphasis in the economic tradition of diffusion of innovations is on profitability or the expected payoff of adoption of the innovation according to Kelly and Kranzberg (1975). They cited the work of Grilich (1957) on hybrid seed corn in which he concluded that propagators' decisions to introduce innovations into certain markets and the rate of adoption are determined largely by expected payoff.

In this discussion, Kelly and Kranzberg (1975) also described the work of Mansfield (1966) who employed the concept of profitability but focused on adopters rather than propagators. Mansfield viewed the rate of diffusion as being determined by four factors: the economic advantage of the innovation over older products; the extent of uncertainty associated with the innovation; the amount of commitment required to try the innovation; and, the rate at which the initial uncertainty can be reduced. In an investigation of the adoption of 150 innovations over the period from 1919 to 1958 in four large industries that was reported in the book Industrial Research and Technological Innovation: An Econometric Analysis (1968), Mansfield noted several findings of significance. They are as follows: the time it takes a firm to adopt an innovation is inversely related to its size and its expected payoff from the innovation; it often takes as much as 20 years for an innovation to diffuse throughout an industry; the number of firms adopting an innovation is positively related to the rate of adoption; and, the characteristics of management are important in determining how soon a firm adopts an innovation.

According to Kelly and Kranzberg (1975), the social-psychological tradition in diffusion research is concerned with the social, cultural and psychological aspects of adoption including such factors as the role of change agents, resistance to change and personality traits. Kelly and Kranzberg give as an example of the type of research conducted in this tradition Spicer's (1953) investigation of 15 cross-cultural cases of both successful and unsuccessful innovative methods and ideas in the fields of agriculture, medicine, and industry. His research focused specifically on the change agent and resulted in the following conclusions: change agents should use existing channels of communication and cooperation; change agents must be sure their innovation is perceived as compatible with local customs; and, they must scrupulously avoid ethnocentrism.

Another example of research in the social-psychological tradition given by Kelly and Kranzberg is a study by Nelson and Phelps (1966) which examined the relationship of education or human capital to technological diffusion. Previous research has indicated that earlier adopters, whether in industry or agriculture, have more education than later adopters. Nelson and Phelps explain this phenomenon by relating education to the type of management skills needed today. They suggested that management requires adaptation to change and that more educated managers adopt new techniques or ideas more quickly. Therefore, education increases the speed of technological diffusion. Research by Hayami and Ruttan (1971) lends support to this view of the relation of education to the diffusion of innovations.

Research in the social-psychological tradition may also include studies of the role of social networks in the diffusion of innovations according to Kelly and Kranzberg (1975). An example would be the study by Coleman, Katz, and Menzel (1957) of the social processes which resulted in the adoption of a new drug by physicians in four cities. Their results indicated that physicians who were more in communication with colleagues (profession-oriented) adopted the drug earlier than those who were more isolated from their colleagues (patient-oriented). They also reported differences in the rate of adoption between the two groups of physicians with the profession-oriented group following the S-shaped curve and the patient-oriented group following an exponential pattern.

A major effort to bring all diffusion research together into one model was conducted by Rogers and Shoemaker (1971) with the development of the "classical diffusion model" based on their review of approximately 2400 diffusion research publications. A central component of this model is the innovation-decision process or the adoption process which consists of the following steps: awareness (knowledge of the innovation), interest (seeking information about the innovation), evaluation (a mental trial of the innovation), trial (testing the innovation on a small scale), and adoption (full scale and complete utilization of the innovation). Also included in their model was a series of adopter categories based on the relative time of adoption of an innovation. These categories were innovators, early adopters, early majority, late majority, and laggards. According to Rogers and Shoemaker, the adoption of an innovation was also a function of the attributes of the innovation as perceived by potential adopters. They identified five overall dimensions of attributes: relative advantage, compatibility, complexity, trialability, and observability.

In his most recent work on the diffusion of innovations, Rogers (1983) has modified his conceptual model of the stages in the adoption or innovation-decision process. This model proposes the following stages: knowledge, persuasion, decision, implementation, and confirmation. In the knowledge stage, a person learns of the innovation's existence and something about how it works. A positive or negative attitude about the innovation is developed in the persuasion stage. In the decision stage, the person takes actions that lead to either adoption or rejection. The innovation is actually put to use in the implementation stage. In the confirmation stage, the person seeks support and reinforcement for the decision made.

In a summary of existing diffusion of innovations studies, Rogers (1983) concluded that individuals who know of an innovation earlier have more education, have higher social status, have greater contact with mass media, have more exposure to interpersonal channels of communication, have more contact with change agents, have more social participation, and are more cosmopolite than those who know of an innovation later.

An analysis of innovative attributes by Rogers (1983) revealed that the rate of adoption of an innovation is positively related to its perceived relative advantage, compatibility, trialability, observability and the degree of communication integration in the social system. The perceived complexity of the innovation is negatively related to the rate of adoption.

In his examination of adopter categories, Rogers (1983) divided his generalizations into three sections: socioeconomic status, personality variables, and communication behavior. In terms of socioeconomic status, he concluded that earlier adopters are no different in age (although the results to date are inconclusive), have more years of education, are more likely to be literate, have higher social status, have more upward social mobility, have larger sized units (farms, houses, etc.), are more likely to have a commercial economic orientation rather than a subsistence orientation, have a more favorable attitude toward borrowing money, and have more specialized operations than later adopters.

With respect to personality variables, Rogers (1983) generalized that earlier adopters have greater empathy, are less dogmatic, have greater ability to deal with abstractions, have greater rationality, have greater intelligence, have a more favorable attitude toward change, risk, science, and education, are less fatalistic, have higher levels of achievement motivation, have higher aspirations than later adopters, and have a shorter innovation-decisions period.

In regard to communication behavior, Rogers (1983) reported that earlier adopters have more social participation, are more interconnected in the social system, are more cosmopolite, have more change agent contact, have greater exposure to mass media and interpersonal communication channels, seek information about innovations more actively, have greater knowledge of innovations, have a higher degree of opinion leadership, and are more likely to belong to well integrated systems than later adopters.

Housing Innovations

In his book Technology and Change, Schon (1967) examined technological innovations brought into commercial use in the building industry between 1930 and 1960. The innovations he considered were management and organization in building, materials and components, power tools, mechanical equipment, prefabricated and off-site preparation, and a miscellaneous category. In the management and organization of building, he observed that large building projects by the Federal government during the Depression and World War II have resulted in the consideration of building as a manufacturing process and the use of manufacturing techniques such as production schedules, cost analysis, etc.

Innovations considered in the materials and components category include plastics, high-strength concrete, prestressed concrete, plywood, hardboard and particle board, high-strength steels, and glass, insulation, and acoustic materials. Plastics are the one new major class of materials introduced during this time period. These materials, all developed by the chemical industry, have been used primarily on a replacement basis. The use of high-strength concrete has permitted the wide-scale design and construction of taller buildings while the increased use of prestressed concrete has been related to both a rise in prefabrication and the displacement of steel. Plywood was first used during World War I but could not be used for exterior purposes until the development of waterproof glues in the 1930's. Its major growth has been a replacement for lumber. The use of hardboard and particle board has also increased significantly since their development and introduction. High-strength steels have seen major use as an alternative to reinforced concrete since their development to meet war demands. Improvements in glass, insulation and acoustic materials have resulted in better building quality and greater use of prefabricated components.

The introduction and use of power tools, originally opposed by the labor unions, has combined with prefabrication and prefinishing to greatly increase productivity in building. Improvements in mechnical equipment have been made in response to needs of users, designers, and realtors and have greatly influenced the design and construction of buildings.

Improvements in structural analysis developed from the application of principles learned in the aircraft industry to building construction. Thin shell construction and sandwich panels are examples of innovations in this area.

The first massive use of prefabrication and off-site preparation occurred in the period covered by Schon's (1967) study. Government intervention during the Depression and World War II was responsible for much of this growth. Even after negative reaction to the quality of prefabricated units slowed their development, off-site manufacture of components increased.

Technological innovations included by Schon (1967) in the miscellaneous category include prefinished products, materials-handling improvements, increased use of jigs and fixtures, and the use of computers in feasibility analysis and design.

Schon (1967) concluded from his study that change in the building industry during the period he examined was more evolutionary than revolutionary. Other authors in later analyses of the building industry have reached similar conclusions (Boyd & Wilson, 1974; Kennedy, 1971; Nelkin, 1971; Schoen et al., 1975). Schon further suggested that these changes in building construction really amounted to the industrialization of building and originated with the advent of large-scale commercial and residential building contractors, the large construction projects of the Depression and World War II, and the tremendous demand for housing after the war.

Schoen et al. (1975) conducted a more recent analysis of selected technological innovations in housing. The first innovation they discussed is Habitat at Expo '67 in Montreal, an example of industrially produced housing. Although excessively expensive in comparison to traditionally constructed multi-family units and problematic in terms of on-site installation because of the irregular placement of units, it did help reduce the public's negative image of prefabrication resulting from World War II construction projects. One feature of this project that has been utilized in other situations is the concept of pedestrian skywalks.

The Disneyland Monsanto House of the Future is the second example of industrialized housing discussed by Schoen et al. (1975). This structure composed of fiberglass failed to meet building code specifications, did not conform to the American vision of a house, and was developed without regard to the fact that there was no supply of building trades labor skilled in working with fiberglass.

Despite its high visibility to the public, it generated little interest in the housing industry.

The next example of industrialized housing described by Schoen et al. (1975) is the Alside House which was a steel-frame/porcelainized aluminum wall panel house intended for production in the early 1960's. The cost of this house also proved to be prohibitive because of tooling, facility production, marketing and distribution expenses. Only a few units were completed and the impact on the housing industry was minor.

The Lustron or all steel house is probably the best known of the unsuccessful innovations according to Schoen et al. (1975). Related to this was the development of the Lustron bathtub machine which was designed to produce tubs for both Lustron homes and conventionally constructed homes. The Lustron tub was, however, one and one-half inches longer than the standard tub utilized at the time, showing a failure to integrate the innovation with existing standards and practices in the housing industry.

Producers of modular houses in the 1960's were able to handle, for the most part, problems related to codes and labor, but were still faced with the problems created by large capital investments in plant and equipment (Schoen et al., 1975). This investment is especially cumbersome during the cyclical downturns that plague the housing industry and forced many producers of modular homes to leave the business by 1972.

Schoen et al. (1975) concluded from their analysis of the housing industry that innovation at the component or subsystem level has been more successful than innovation in full building systems. In support of their conclusion, they discuss the use of the Alcoa Alumiframe aluminum framing system and PVC plastic pipe, two innovations that have achieved marginal levels of success, and plastic finish and trim products which have achieved a very high level of success. They suggested that a common factor in the diffusion of these products was their integration into an existing system of marketing, distribution, sales, installation, and service or the development of an effective parallel system to accomplish these functions.

The Alumiframe system developed by Alcoa was designed to replace the conventional wood-framed stud wall. It is lighter in weight, more dimensionally stable, and can be installed by existing skilled labor with little additional training. On the negative side, it is slightly higher in first cost than wood but competitive in installed cost because of higher productivity. In spite of its advantages, the diffusion of this framing system in the housing industry has been extremely slow and illustrates the industry's resistance to change and strong conservatism according to Schoen et al. (1975).

Plastic pipe is also advantageous in terms of material and installation costs and has been shown to equal cast-iron when used appropriately. The major problems in the diffusion of this innovation have been acceptance in building codes and resistance by union labor (Schoen et al., 1975).

The use of plastic trim and finish products has been so successful because of integration with an existing product delivery system and the selection of products likely to be little affected by codes or resisted by organized labor. Consequently, plastic substitutes for many traditional finishing and trim materials are now widely available and utilized (Schoen et al., 1975).

Schoen et al. (1975) concluded that even if an innovation is technically and economically possible it may not achieve rapid diffusion throughout the housing industry. The industry's unique characteristics and institutional forces may impede the diffusion of technological innovations. Hirshberg and Schoen (1974) identified three categories of unique characteristics in the housing industry that slow the adoption of innovations: technological, economic, and institutional. Technological barriers include local building codes and the prevalence of specification rather than performance codes. Economic factors include the extreme reliance on credit, high sensitivity to first cost of a product, and the cyclical nature of the industry. Institutional factors which may impede diffusion include the regional nature of the industry, its horizontal stratification, its fragmentary nature, and its craft orientation.

Nelkin (1971) also suggested that the organization of the housing industry affects the diffusion of innovations within it. She identified the following characteristics as impediments to the adoption of innovations: the fragmentary, compartmentalized nature of the industry; the handicraft nature of the industry based on traditional methods and existing skills; the lack of funding for research; and, the lack of entrepreneurial models within the industry. Nelkin believed, however, that building codes pose even more of a deterrent to the adoption of innovations than these factors. She concluded, as did Schon (1967) and Schoen et al. (1975), that the major progress in diffusion of innovations in the housing industry has been in the area of materials.

In his discussion of the housing industry in Australia, Kennedy (1971) contended that the building industry does not innovate by choice. He indicated that innovation occurs only when it is forced by a change in the nature of demand for buildings or by shortages in traditional materials or labor. He also pointed out the dependence of the industry on known or usual work and supervision procedures because arrangements between suppliers, contractors, financiers, etc. tend to be job specific.

Boyd and Wilson (1974) examined technology transfer in the Candian construction industry. They identified some of the same problems in the diffusion of technological innovations other authors have discussed including the nature and size of the industry, building codes and standards, and the availability of appropriately skilled labor.

In an investigation of the role of building codes as barriers to the diffusion of innovations, Oster and Quigly (1977) examined the adoption of four innovations (plastic cable, pre-assembled plumbing, 2" x 3" studs, and 24" placement of studs) in a cross section of political jurisdictions. They found that the more formal education the building official had, the greater the probability of adoption of one of these innovations. They also found that high levels of unionization of construction workers had a negative impact on the likelihood of adoption. In addition, they found support for the notions that cost reduction innovations are less likely to be adopted in higher income communities and that the more contact the building official has with organized labor the less likely innovations are to be adopted. Other findings of relevance were that the time interval between adoption by 10 percent of communities and adoption by 90 percent of communities ranged from 42 - 47 years for material innovations and was even longer for innovations that reduce labor requirements.

Energy-Conserving, Housing Technologies

Darley and Beniger (1981) have suggested that the decision to adopt energy-conserving measures and/or products is an example of a decision to adopt an innovation. They utilized the concept of innovation attributes developed by Rogers to devise a series of perceived psychological dimensions appropriate for energy-conserving measures and products. These dimensions are as follows: capital cost of the innovation; perceived savings; certainty of savings; value, attitude and style compatibility; innovation and life-pattern interaction; trialability; dissatisfaction with the existing situation; and, effort and skill required to install the innovation. Darley and Beniger also hypothesized that the interpersonal channel of communication is the most important in influencing the adoption of energy-conserving innovations. Furthermore, they proposed a government sponsored program similar to the county agricultural extension agents to speed the adoption of this type of innovation.

In a discussion of solar energy innovations and diffusion theory, Shama (1981) described product, price, promotion, and distribution decisions that would make solar energy attractive to consumers. Under product considerations, he noted that the adoption rate could be accelerated by the selective emphasis of the innovation's attributes depending upon the group of adopters targeted. For example, innovativeness should be emphasized to innovators and early adopters whereas product differentiation and market segmentation become more important for the early majority. He also pointed out that policy measures related to the product such as demonstrations, standards, labeling requirements and consumer protection may also accelerate adoption. Under price considerations, Shama discussed the problems associated with the high first cost of solar systems. He pointed out that even with federal and state tax credit incentives there is a time lag between the initial expenditure and receipt of the tax credit which may reduce the overall effect of the tax credit incentive. He cautioned, however, that economic incentives should be combined with policies that emphasize information, product quality, and consumer protection for the greatest impact. Under promotional concerns, Shama noted that informational messages are most effective in the early stages of diffusion whereas persuasion messages are more appropriate in the later stages. He further contended that specialized media are more effective in the early stages but that the mass media may be more effective as early adopters enter the picture. Other aspects of promotion include the use of demonstration projects and mandates. Under distribution considerations, Shama reported that the lack of integrated, accessible delivery systems may impede adoption of solar systems. He further pointed out that since solar systems are not consumed directly by the consumer but are designed as part of a system, their delivery poses an even greater challenge to rapid diffusion. Factors which contribute to this situation include the following: adoption units consisting of more than one person; the involvement of facilitators before adoption can take place including quality installers, willing builders and architects, and cooperative bankers; and, the availability of the innovation in the right time and at the right place.

LaBay and Kinnear (1981a) utilized a mail questionnaire to compare adopters of solar heating or hot water heating systems with knowledgeable nonadopters and the general population. The sample consisted of 631 residents in Maine. The results indicated that adopters were younger, had more education, had higher incomes, were in earlier stages of the family life cycle, and were higher in occupational status than the general population. Few differences were found between adopters and knowledgeable nonadopters but adopters did seem to be clustered around the age of 35. In terms of perceived attributes of innovations, adopters found solar systems to be more advantageous, less risky both socially and financially, less complex, more compatible, and less observable than the general population. Similar trends were found when adopters and knowledgeable nonadopters were compared but the only statistically significant findings related to complexity and observability. The authors noted that the concept of trialability is not appropriate in the adoption of solar systems since even small-scale applications (when they are possible) involve the expenditure of significant amounts of money. No major differences were found in adopters on the basis of time of adoption lending credence to the classification of all solar adopters to date as true innovators. Results of both the multivariate nominal scale analysis and the multiple discriminant function analysis indicated that attribute perceptions are better predictors of adoption of solar systems than demographics.

Leonard-Barton (1981a) reported the results of three studies on the diffusion of energy conservation and technologies. The first study consisted of interviews with 215 homeowners in Palo Alto in 1978 to determine acceptance of energy conservation. The second study of acceptance of residential solar systems was conducted in 1979 and consisted of interviews with 215 homeowners in San Francisco, 111 who were solar adopters and 104 who lived adjacent to the adopter. The third study of residential solar adoption consisted of interviews with a representative statewide sample of 812 homeowners in 1979.

Since this sample contained only 21 adopters, the major variable of interest was the intention to adopt solar. The results of the first study indicated that information about energy conservation can be transmitted through neighborhood networks and that residents identified by neighbors as conservers are considered reliable sources of information in their network. In the second study, both adopters and nonadopters were found to rely heavily on interpersonal sources of information useful in the purchase of residential solar systems. Nonadopters were found to be more dependent on friends as informational sources whereas adopters were found to be more dependent on sales personnel for information. In the third study, the strongest predictor of intention to purchase a residential solar system was found to be the number of solar owners known. Other predictors were the perceived payback period, perceptions of solar equipment, and voluntary simplicity behaviors. Variables that were not good predictors of intention to purchase a residential solar system were awareness of the energy tax credit, socioeconomic status, age, probability of moving, perceived effect on resale of dwelling, mechanical ability of the homeowner, expectation of future energy costs, utility costs, and attitude towards the energy crisis. The author concluded that the role of interpersonal communication in the diffusion of residential solar is likely to increase in the future. She also suggested that since solar owners are viewed as more credible sources of information than professionals in this area, "weak links" between different socioeconomic classes of homeowners need to be established to facilitate the diffusion of residential solar systems.

In another report based on the research studies described above (all of which were conducted at the Institute for Communication Research at Stanford University), Leonard-Barton (1981b) reported that although few California homeowners had had experience with solar equipment, most were aware of some of its uses in residential situations. She found higher levels of awareness among younger, more educated professional people. She also found that interpersonal sources of information were very important in the diffusion of solar systems. Another finding was that belief in the energy crisis did correlate with the intention to purchase solar equipment but that the relationship was relatively weak. Her research indicated that attitudes about solar equipment were better predictors of intention to purchase such equipment. Other findings indicated that consumers attach more risk to the purchase of solar equipment than they do to other similarly priced items and that financial considerations are among the top factors important in the solar purchase decision. Using a multiple regression of 13 variables on the dependent variable of purchase intention, Leonard-Barton found only four to be statistically significant predictors. These were belief about the payback period, attitudes about the personal feasibility of solar equipment, the score on an index of voluntary simplicity behaviors (behaviors consistent with the values of material simplicity, ecological awareness, and self-sufficiency), and the number of solar owners known by the respondent (the strongest of the four predictors). Her research also revealed that adopters of solar equipment had high income and educational levels and had slightly larger families, higher utility bills, and larger houses. She also found that adopters made more investments (particularly real estate) and invested more in home improvements than nonadopters. Adopters also perceived solar equipment to be less of a risk than nonadopters and were more likely to view solar as a fully developed technology. Finally, she reported that adopters of solar equipment are satisfied with their systems and are communicating that satisfaction to other potential adopters.

Rogers (1981) drew upon the results of studies conducted in association with Leonard-Barton reported above to develop eight general conclusions regarding the diffusion of solar innovations from researchers and manufacturers to consumers. The first conclusion, based on a projected one percent adoption by the end of 1981, was that the diffusion of residential solar equipment is beginning.

The second conclusion was that the high degree of social and physical visibility of solar equipment will be an important factor in its continued diffusion. The third conclusion stated that most messages about residential solar are positive and, as such, seem to be influencing other consumers to view residential solar in a positive manner. The fourth conclusion was that messages indicating that residential solar is not completely satisfactory are also spreading through interpersonal networks. The fifth conclusion stated that current adopters of residential solar have higher status, more education, and more income and that these characteristics will have a positive impact on the diffusion of solar innovations through interpersonal networks. The sixth conclusion pointed out that current patterns of solar diffusion may favorably impact the nationwide energy situation since higher status consumers who are also the largest users of energy are those who are adopting solar but that the continuation of this trend will inevitably increase the gap between various socioeconomic groups in our society. The seventh conclusion suggested that because of different motivations and influences it will be useful to subdivide the market for solar equipment into these categories: pool heating, domestic hot water heating, and space heating. For example, Rogers' research indicated that pool owners were motivated by economic reasons whereas domestic hot water heater owners were motivated by ideological and altruistic concerns. The eighth and final conclusion stated that community factors which include both the influence of neighbors and mandates by the local government are very important in the adoption of residential solar equipment.

A two year (1977 - 1979) study of both adopters and nonadopters in the HUD Solar Hot Water Program in Connecticut was conducted by Warkow (1981). Data were obtained by means of telephone interviews with 182 persons who completed the grant application forms for the program. Both those who participated in the program (adopters) and those who dropped out during the application process (nonadopters) were interviewed. The best predictors of solar adoption were found to be a supportive social environment, perceived noneconomic or secondary economic benefits, proper siting of the residence and acceptable roof design, and belief in declining world fossil fuel supplies. Residential energy conservation practices were not found to be good predictors of adoption. Nonadopters cited problems with costs, the length of the payback period, and the size of the grant in addition to the belief that similar benefits could be obtained by spending the same money on other conservation measures. In a follow up interview six months later, only this last reason was found to be correlated with a willingness to consider solar adoption. It is important to note that it is the perception of these alternative benefits, not actual behavior, that acted as a barrier to solar adoption in this particular population. Respondents were also asked to evaluate the reliability of various sources of energy conservation information. The results of these ratings were found to be insignificant in understanding residential behavior related to energy conservation. Therefore, the author concluded that emphasis should be placed on the social context of the household decision making, particularly the social networks involved.

Through summarizing 15 empirical studies of solar homeowners conducted between 1976 and 1978, Unseld and Crews (1981) were able to derive a number of general conclusions. In terms of demographics, the majority of studies found solar users to have relatively high incomes and all studies found users to have unusually high educational levels. Most users also reported high levels of satisfaction with their solar systems, in spite of the fact that a significant number had experienced problems related to the design, installation, or operation of these systems. Unseld and Crews also concluded that there is a need for consumer protection measures for purchasers of solar systems the lack of which could hinder their widespread adoption. Their final conclusion indicated the need for additional research in the area of residential solar energy.

Wisenblit (1981) discussed factors likely to influence perceptions of solar heating (economic feasibility; reliability, maintenance, and safety; legal and regulatory issues; and, regional aspects) in terms of the perceived innovation attributes identified by Rogers (relative advantage, perceived risks, compatibility, complexity, tri[al]-ability and observability. Under relative advantage, he identified the following factors: perceptions of future financial savings and recovery of initial costs, maintenance and repair compared to conventional systems, and noneconomic concerns such as maintaining comfort levels. Under the category of perceived risk, Wisenblit pointed out four types of risks: functional risk (workability of the system); physical risk (safety and health concerns); financial risk (cost of the system related to worth); and, social and psychological risks (ego and status concerns). Concerns listed under compatibility included the following: perceptions of compatibility in relation to the resale of the house; concerns of compatibility in relation to a retrofitted installation; perceptions of compatibility with public utilities; and, perceptions of compatibility in terms of climate, regional energy supplies, regional building codes and laws, regional pollution standards, and regional property taxes and house financing laws. Under the category of complexity, Wisenblit listed the following factors to be considered: perceptions of the difficulty in understanding and calculating payback and perceptions of the functioning and maintenance of the system. In terms of tri[al]ability, he indicated concern with perceptions of the reliability of demonstration programs. Concerns indicated under observability included perceptions of the aesthetic aspect of solar systems and perceptions of visits to solar homes. In an empirical study, Wisenblit found support for the notion that homeowners' perceptions of solar heating systems correspond with the perceived innovation attributes utilized in diffusion research. From a review of other empirical studies in this area, he concluded that, in general, the relative advantages of solar are an incentive for adoption and the risks associated with solar heating systems (both financial and functional) pose barriers to adoption. He further concluded that there is a need for more research on the attributes of compatibility, complexity, observability, and tri[al]ability.

Combs, Tremblay, and Madden (1982) studied the perceived complexity and trialability of solar home heating systems using a statewide survey with responses from 912 representative Nebraska households, 105 solar homeowners, and 97 solar experts. Solar homeowners and solar experts were found to perceive solar systems as less complex and more easily trialable than the general population. It was also found that many in the general population had an overall lack of knowledge about solar systems and that the elderly, families of two or fewer persons, and those with lower educational and income levels tended to perceive solar systems as more complex.

Shoemaker (1981) identified a lack of knowledge among potential adopters as one of the major barriers to the diffusion of solar technologies. He supported this assertion by contrasting the low rate of solar adoption with the favorable attitudes toward solar revealed by a Gallup survey of 2,000 homeowners (homeowners prefer solar over other energy alternatives; 77 percent favor solar energy for use in homes; 58 percent favor solar energy for use in their homes; and, 45 percent believe solar is currently economically and technically feasible). Shoemaker further suggested that most consumers are presently in an ignorance or early awareness stage in terms of solar technologies and that a knowledge threshold of approximately 30 percent of all homeowners must be reached before the adoption rate begins to increase substantially. In addition, Shoemaker pointed out that it is the early adopters, not the innovators, who are more integrated in the local community and, therefore, serve as role models for other consumers. Furthermore, it is the interpersonal communication sources that are most important in the adoption decision for both adopters and nonadopters. He concluded that a carefully designed informational campaign could significantly enhance the diffusion of solar technologies.

In a paper suggesting that designers (primarily architects) are the key leverage point in the acceptance of passive solar innovations, Hart and Kurtz (1979) identified some of the barriers to the diffusion of passive solar. First, it is hard to establish the relative advantage of passive solar since it is difficult to distinguish the features of passive solar from energy-conserving design or conservation features. Second, there are communicability problems particularly in defining passive solar. Third, compatibility is a problem since passive solar does not conform to current norms, values or structures. Fourth, passive solar requires a change in lifestyle and thus creates problems of pervasiveness. Fifth, reversibility is a problem since passive solar cannot be tested on a small scale basis. The authors concluded that unless designers are utilized as a leverage point, these barriers will cause the diffusion of passive solar to take a much longer than expected time to occur.

McCray and Weber (1981) interviewed 52 housing intermediaries (10 builders, 16 appraisers, 22 lenders, and 4 inspectors) in eight counties in Arkansas and Oklahoma for the purpose of identifying constraints to the adoption of passive solar and earth sheltered housing systems. In this study, housing intermediaries were viewed as the adopting unit. All intermediaries interviewed identified constraints to the adoption of these types of housing systems. The constraints identified pose economic, social and political risks for the adopting unit suggesting that these housing systems should be considered entrepreneurial innovations. These risks, according to the housing intermediaries, are not reduced by energy savings potential or life cycle cost considerations. Two important constraints identified were lack of consumer knowledge and the resale potential of the house. All intermediaries were found to be beyond the awareness stage of the adoption process with most in the interest stage and only a few in the evaluation or adoption stage. McCray and Weber concluded that if these types of energy-efficient, innovative housing systems are to become widely diffused, the risks associated with their adoption by housing intermediaries must be reduced.

In a paper presented at the National Passive Solar Conference, Talbot and Johnson (1979) discussed barriers to the adoption of passive solar by builders. They suggested that the additional barriers added to the building process by passive solar may have a multiplier effect by recomplicating a process that builders have learned to handle successfully. The major barriers they identified were technical and economic problems, lack of initial acceptance, problems in developing marketable designs, lack of marketable systems, problems in establishing creditable performance, and problems with building codes and zoning ordinances. The specific problems found with building codes and zoning have to do with window egress, safety glazing, lot size restrictions, set back and side yard requirements, and building height. They suggested that passive solar overcome these barriers by use of some of the techniques that have been successful with other innovations in housing: trial installations, technical assistance, national and local code approval, and cooperative advertising.

In another paper presented at that conference, Shillington (1979) examined the institutional barriers to the use of passive solar in a subdivision in an urban area. The potential barriers identified were as follows: zoning bylaws and subdivision planning regulations, administrative inflexibility to the special requirements of passive solar housing, a generally conservative attitude toward housing innovations, conservative attitudes among lenders, building codes which impede innovation, tradespeople unfamiliar with solar housing, union jurisdictional disputes, a negative attitude among the public toward solar heating, and the lack of legal guarantees of solar rights.

O'Riordan and Migani (1979) examined barriers to the implementation of energy-conserving design in housing by conducting telephone interviews with eight large developers and other industry and government personnel in the Northeast. Their findings may be summarized as follows: lack of knowledge and uncertainty hampers the use of energy-conserving design; higher first costs associated with energy-conserving design impedes acceptance; indirect costs currently associated with passive solar are higher than is acceptable in the industry; industrialized components introduced since World War II are insensitive to regional climatic variations; the lack of precedence in regulatory decisions creates high levels of uncertainty; current land use, zoning and regulatory requirements are not conducive to energy-conserving design; and, since there is a lack of awareness by consumers of their dependence on fossil fuels, there is little consumer demand for passive solar heating and cooling.

Miller and Thompson (1977) also discussed the barriers created by building codes to the adoption of solar heating and cooling. They pointed out that since solar heating and cooling are not specifically included in most building codes, they are subject to testing and approval requirements which create uncertainty, delays and added expense. They proposed nationally recognized standards and tests conducted by a national accrediting agency to overcome this problem. They also suggested that, because of problems in administering performance codes, the standards developed by this agency should be incorporated into existing specification codes.

Dalton's (1979) analysis of the barriers to passive solar also focused on codes and regulations, particularly those related to building, mechanical systems and energy. He noted that most passive designs are unique and thus require a variance from the local building department. Problems also exist in the definition of passive solar and with the requirement by some state codes of the calculation of energy savings.

Summary

The diffusion of innovations has been studied in many disciplines with the major research traditions being geographical, economic, and social-psychological (Kelly & Kranzberg, 1975). Rogers and Shoemaker (1971) summarized these traditions into a comprehensive theory called the "classical diffusion model" which included these elements: stages in the adoption process, categorization of individuals on the basis of time of adoption (adopter categories), and a classification scheme for the attributes of innovations. Generalized relationships to the elements of the theory were developed for demographic, personality, and communication variables.

Within the housing or building industry, change resulting from the diffusion of innovations has been more evolutionary in nature than revolutionary (Boyd & Wilson, 1974; Kennedy, 1971; Nelkin, 1971; Schoen et al., 1975;

Schon, 1967) and has occurred more often at the materials or component level than at the level of full building systems (Nelkin, 1971; Schoen et al., 1975; Schon, 1967).

There exist a number of factors or barriers which impede the diffusion of innovations within the housing industry. Among those most frequently mentioned are the nature and structure of the industry itself (Boyd & Wilson, 1974; Kennedy, 1971; Nelkin, 1971; Schoen et al., 1975) and building codes and regulations (Boyd & Wilson, 1974; Nelkin, 1971; Oster and Quigly, 1977; Schoen et al., 1975).

Research reported to date on the adoption of energy-conserving housing innovations indicates that innovation attribute perceptions are generally better predictors of adoption than demographic variables (LaBay & Kinnear, 1981a; Leonard-Barton, 1981a) and that there are differences in the way adopters and nonadopters perceive innovations (Combs et al., 1982; LaBay & Kinnear, 1981a; Leonard-Barton, 1981a). The results reported on the relationship of demographics to adoption, however, have not been consistent. Most research indicates that adopters have more education and higher incomes (LaBay and Kinnear, 1981a; Leonard-Barton, 1981b; Unseld and Crews, 1981) while LaBay and Kinnear (1981a) also found adopters to be higher in occupational status and in earlier stages of the family life cycle. On the other hand, Leonard-Barton (1981a) indicated in one report that socioeconomic status and age were poor predictors of intention to adopt. Leonard-Barton (1981a) also found energy variables to be unrelated to adoption whereas Warkov (1981) found belief in the declining world supply of fossil fuels to be positively related to adoption.

Building codes are viewed as a major constraint to the adoption of energy-conserving housing innovations (Dalton, 1979; Miller & Thompson, 1977; Shillington, 1979; Talbot & Johnson, 1979). Other similar types of barriers include zoning ordinances and subdivision planning regulations (O'Riordan & Migani, 1979; Shillington, 1979; Talbot & Johnson, 1979). Lack of consumer demand for this type of innovation and negative public attitudes toward some of these innovations are other types of constraints to the adoption of energy-conserving innovations in housing construction (O'Riordan & Migani, 1979; Shillington, 1979).

CHAPTER THREE

METHODOLOGY

The purpose of this study was to examine demographic, energy, and regulatory code factors in relation to the adoption of energy-efficient, innovative types of housing. Therefore, the six major objectives of this study were as follows:

1. to examine and compare the position of respondents in the innovation adoption process.

2. to examine and compare respondents among the number of types of housing alternatives in each stage of the adoption process.

3. to examine and compare probable adopters and probable nonadopters of innovative, energy-efficient types of housing.

4. to examine and compare respondents among the number of types of housing alternatives for probable adoption.

5. to determine whether the better predictor of probable adoption or probable nonadoption of innovative types of housing is demographic variables or energy attitudes and factors.

6. to compare respondents in each stage of the adoption process with both probable adopters and probable nonadopters for each of the innovative types of housing.

The methodology that was utilized to conduct this study is described in the following sections: source of data; selection of sample; description of the instruments; collection of data; treatment of data; and, analysis of data.

Source of Data

This study utilized data from the Southern Regional Research Project, S-141, Housing for Low- and Moderate-Income Families. The S-141 project began October 1, 1979 and is scheduled to be completed by September 30, 1984. The project is a cooperative effort of the Agricultural Experiment Stations and/or the Research Divisions of the land-grant universities of Alabama, Arkansas, Florida, Georgia, North Carolina, Oklahoma, and Virginia; and the Tennessee Valley Authority; the Rural Housing Research Unit at Clemson; the Appalachian Regional Commission; and the United States Department of Agriculture. S-141 has five major objectives which are listed in Appendix A. This study contributed to Objective C which is to determine constraints that exist within the family to the adoption of housing alternatives and to Objective B/D which is to determine the impact of building codes and regulations on the distribution of innovative housing designs.

Selection of Sample

A sample of 1800 households selected from the seven southern states participating in the regional project was planned for Objective C. The allocation of the sample among the states was based on the proportion of the region's nonfarm households located in each state. Four non-SMSA (Standard Metropolitan Statistical Area) counties in each state were selected for sampling using a two phase stratification process based on median annual income and the number of nonfarm households in each county. The first phase of this process categorized all the non-SMSA counties into two equal groups using median annual income (MAI) as the criterion. The resulting categories were identified as low MAI and high MAI. The second phase of this process subdivided these categories into equal components on the basis of the number of nonfarm households (NFH) in each county resulting in the following four strata of counties:

1. LL - low MAI, low NFH
2. LH - low MAI, high NFH
3. HL - high MAI, low NFH
4. HH - high MAI, high NFH

In each of the participating states, one county was selected at random in each of these four strata. The number of surveys to be conducted in each county was determined by multiplying the allocation for that state by the following fraction:

$$\frac{\text{number of NFH in county stratum}}{\text{number of NFH in state}}$$

The counties selected in each state and the county sampling allocations by strata are indicated in Table A, Appendix G.

The process of selecting individual households within each county involved the identification of each tract of land using the county tax records. Using the identification number available in each county, a random sample of properties was drawn by means of a computer generated list of random numbers aproximately four times the sample size required. Alternate properties were also selected in the event that the original selection did not meet the criteria of the research or the household on the property could not be interviewed. All properties of an industrial or commercial nature or lacking a dwelling unit were eliminated from the sample.

The sample for Objective B/D was drawn from the four states participating in that objective. These states were Arkansas, North Carolina, Oklahoma, and Virginia. The sample consisted of the four counties in these states also participating in the survey for Objective C.

Description of the Instruments

The instrument utilized to survey households for Objective C, "Perceptions of Alternative Housing," was developed, evaluated, and revised by the S-141 technical committee. The instrument was subjected to a pretest evaluation (on a total of 70 subjects, 10 in each of the participating states) and was revised for clarity of meaning and procedure on the basis of this evaluation. The revised instrument, "Perceptions of Alternative Housing," contained four major parts as follows:

1. Present Housing Situation (Questions 1 through 25). Responses obtained in this section provided information relative to housing structure and condition, housing costs, tenure status, and energy-saving features.

2. Decision-Making Practices (Questions 26 through 55). Responses obtained in this section provided information relative to how families make decisions about housing including the influence of factors related to tenure, satisfaction, aspirations, and the energy crisis.

3. Consumer Acceptance of Housing Alternatives (Questions 56 through 63). Responses obtained in this section provided information relative to consumer acceptance of selected housing alternatives such as passive solar, active solar, earth sheltered, energy retrofitted, multi-family, and manufactured or mobile homes. A visual workbook (containing definitions and four pictures or

diagrams of each alternative and a similarly configured conventional dwelling unit) was used to introduce and/or clarify the concepts of the alternative housing structures to the respondent.

4. Demographics (Questions 64 and 65). Responses obtained in this section provided information relative to household composition and race, sex, age, education, income, employment status, and the disability of each household member.

This study utilized information obtained from these four major sections of the S-141 instrument "Perceptions of Alternative Housing." A copy of the instrument may be found in Appendix B. Questions used in this study are identified by an asterisk.

Two questionnaires were utilized to obtain information relative to building codes and regulations for Objective B/D. The first questionnaire (Appendix C) provided information on the number and types of energy-efficient, innovative housing units in the locality and on the types of construction codes in the locality. In addition, the name and address of the person responsible for administering each code was obtained. Items used in this study are indicated by an asterisk.

The second instrument on building codes and regulations (Appendix D) obtained information on the types of codes and regulations, structures covered, jurisdiction, enforcement, and variances. Information was also obtained on the requirement for variances in the construction of energy-efficient, innovative housing units previously built in the locality. The last section of the questionnaire requested information on the relative strengths and weaknesses of code enforcement. The questions used in this study are indicated with an asterisk.

Collection of Data

Data were collected using the household survey schedule "Perceptions of Alternative Housing" by interviewers secured and trained by the project leader in each of the seven participating states. All interviewers participated in an intensive training program and were given detailed instructions that had been incorporated into a training manual used throughout the region. All data were collected between June, 1981 and February, 1982.

Interviewers were instructed to make three attempts to contact the household located on the sample property. After three unsuccessful attempts to conduct the interview, they were instructed to substitute a household from the list of alternates. Interviewers were also instructed to interview a household from the list of alternates if the household on the original sampling list received more than one-half its income from farming and was, therefore, classified as a farm household. In most cases, the actual interview was conducted with the female homemaker as the respondent. Male heads of household were interviewed in situations of one-person households or unusual family compositions. In group living situations, the interview was conducted with any adult member of the household. The responses of the individual were recorded by the interviewer on the survey form. This information was then coded according to a plan utilized consistently by all states and prepared for statistical analysis.

Data on building codes and regulations were collected by mailed questionnaires. The first questionnaire was sent to public officials in all counties and incorporated municipalities in the sample. The names of these officials were obtained from sources such as the state Municipal League Directory and the Directory of County Officials. A cover letter explaining the nature of the research project accompanied the questionnaire. After approximately three weeks, nonrespondents were sent a follow-up letter stressing the importance of the information requested and including another copy of the questionnaire. Ten days later, telephone contacts were made with those who still had not responded. A copy of the two letters sent to respondents may be found in Appendix E.

The second questionnaire pertaining to building codes and regulations was mailed to the public officials whose names had been obtained from the first questionnaire. An explanation of the research study was included at the beginning of the instrument. Nonrespondents received a follow-up postcard after ten days and a letter including a replacement copy of the questionnaire after another ten days. A copy of this postcard and letter may be found in Appendix F.

This study utilized data obtained from the building codes and regulations questionnaires only for the four counties in each state that were also sampled for Objective C.

Treatment of Data

For the purposes of this study, it was necessary to create some of the variables using raw data available from the S-141 questionnaires. These variables and the methods that were used in their determination are described in this section.

The actual ages of the respondent and other household members were recorded. The recorded age of respondent was used in the statistical analyses. For descriptive purposes, the following categories were used: less than 24; 25 - 34; 35 - 44; 45 - 54; 55 - 64; 65 - 74; and 75 and over.

The variable stage in family life cycle utilized categories derived from those developed by Aldous (1978). Stages where there were no children present in the household were defined by the wife's age. The ages used to define these categories were drawn from the work of Glick (1977). The family life cycle stages studied were as follows:

1. Newly established couple families with no children and the wife less than 31 years of age.

2. Childbearing families with the oldest child less than five years of age.

3. Families with school age children (the oldest child is between the ages of five and 12).

4. Families with secondary school children (the oldest child is between the ages of 13 and 18).

5. Families with young adult children (the oldest child is between the ages of 19 and 23).

6. Couple families with no children and the wife between the ages of 31 and 52.

7. Couple families with no children or no children living at home and the wife age 53 or older.

The variable educational level was determined by recording the actual number of years of education. The actual recorded number was used for statistical purposes. For descriptive purposes, the categories used for educational level were as follows: grade school; some high school; high school graduate; some college or technical school; college graduate; and postgraduate work.

The categories that were utilized for the variable race were black and white.

The variable type of household was created by first dividing the total number of households into the two broad categories of family households and nonfamily households. The family household category was subdivided into the following groups: married (couple family); male householder, no wife present; and, female householder, no husband present. The nonfamily household category was subdivided into these groups: male householder living alone; female householder living alone, and other.

Average monthly utility cost was computed by adding the average monthly costs for electricity, gas (natural), gas (bottled), oil, wood, and other fuels. These expenditures were recorded as actual dollar amounts in parts 1c, 2c, 3c, 4c, 6c, and 7c of Question 14 on the instrument "Perceptions of Alternative Housing." The actual dollar figure was used in the statistical analyses. The categories of utility costs used for descriptive purposes were as follows: $0 - $49, $50 - $79, $80 - $119, and $120 and over.

The presence of energy-conserving features in the dwelling was measured using an index developed from the information provided in Question 24 of the instrument "Perceptions of Alternative Housing." This item listed ten energy-conserving features (including insulation, storm windows and doors, caulking, and exterior hot water heater insulation) for which the respondent was to indicate the presence in the current housing unit as none (0), partial (1), or complete (2). By summing the responses to these ten items, a scale with a minimum score of 0 and a maximum score of 20 was created with the higher scores representing the presence of a greater number and more complete energy-conserving features. The actual score on the energy index was used in the statistical procedures. For descriptive purposes, the following categories were used: 0 - 5, 6 - 10, and 11 - 20.

Belief in the energy crisis was determined on the basis of Question 42 of the instrument "Perceptions of Alternative Housing." This item consisted of the question "Do you believe there is an energy crisis?" Possible responses were "yes," "no," and "not sure." Only the "yes" and "no" responses were used in the study.

The impact of the energy situation on housing decisions was determined on the basis of Question 44 of the instrument "Perceptions of Alternative Housing." In this item, the respondent was asked the following question: "Do you believe that the energy situation has had any impact upon your present dwelling or upon how you make decisions about your housing?" Of the possible responses ("yes," "no," or "don't know"), only "yes" and "no" were analyzed in the research.

Efforts to lower utility costs was determined on the basis of Question 45 of the instrument "Perceptions of Alternative Housing." In this question, respondents were asked "Have you or other members of your household made changes that would reduce your utility costs?" Possible responses to this item consisted of "yes" and "no."

Respondents were categorized into four of the stages in the adoption process (awareness, interest, evaluation, adoption) for each of the innovative types of housing on the basis of answers to Questions 53, 54, and 55 of the instrument "Perceptions of Alternative Housing." The fourth stage in the adoption process, trial, could not be determined from the data obtained in the S-141 project, and, as defined by Rogers and Shoemaker (1971), cannot easily occur with the types of innovative housing units that were considered in this study.

The respondent was classified as in the awareness stage for each of the innovative types of housing if part a, b, or c of Question 53 was checked and part d of Question 53 and Questions 54 and 55 were not checked. A response pattern of this nature indicated that the respondent had seen, heard about or read about the innovative housing type, but had not tried to obtain additional information about it, to determine its advantages and disadvantages, or lived in a unit of its type.

The respondent was classified as in the interest stage of the adoption process for each of the innovative housing types if Question 54 were checked in addition to part a, b, or c of Question 53 and part d of Question 53 and Question 55 were not checked. This response pattern indicated that the respondent was not only aware of the innovation but also had tried to obtain additional information about the innovation. The respondent, however, had not lived in the innovative housing type or tried to determine its advantages or disadvantages.

The respondent was classified as in the evaluation stage of the adoption process for each of the innovative types of housing if Question 55 was checked in addition to Question 54 and part a, b, or c of Question 53 and part d of Question 53 was not checked. This pattern of responses indicated that the respondent had not only seen, heard about or read about the innovative housing type but also had tried to obtain information about it and determine its advantages and disadvantages.

The respondent was classified as in the final or adoption stage of this process if part d of Question 53 was checked in addition to Questions 55 and 54 and part a, b, or c of Question 53. This pattern of responses indicated that the respondent had been through the awareness, interest, and evaluation stages and had adopted the innovation. The frequency of respondents in the adoption stage was so small that this category had to be eliminated from the statistical analyses for all the housing alternatives.

Probable adopters of each of the innovative, energy-efficient types of housing were determined on the basis of the response to part a of Questions 60 - 62 on the instrument "Perceptions of Alternative Housing." These questions indicated whether the respondent would consider living in one of the innovative housing types if making a change in dwelling unit. The possible responses were "definitely would consider," "probably would consider," "undecided," "probably would not consider," and "definitely would not consider." The variable probable adopters was created by combining the two categories of "definitely would consider" and "probably would consider."

Probable nonadopters of each of the innovative types of housing were also determined on the basis of part a of Questions 60 - 62 of the instrument "Perceptions of Alternative Housing." This variable was created by combining the two categories of "probably would not consider" and "definitely would not consider."

The variables awareness, interest, and evaluation were created on the basis of the number of housing alternatives for which the respondent was in that stage of the adoption process. For example, a respondent aware of passive solar and earth sheltered/underground housing but in the evaluation stage for active solar would be categorized as in awareness for two types of housing alternatives and as in evaluation for one type of housing alternative.

The presence of innovative housing units within the locality was determined on the basis of the response to Question 1 on the codes and regulations survey B/D-1.

The types of codes and regulations used as variables were building codes, zoning ordinances, and energy codes. The existence of these codes and regulations was determined by examining, for each locality, the types of codes present. This information was obtained from questionnaire B/D-1.

The variable related to previous need for variances in the construction of housing alternatives was created using data from questionnaire B/D-2 on codes and regulations. Respondents were asked to indicate if variances were required, and the type of variance needed. The codes and regulations that were considered in this study are building, zoning, and energy.

Analysis of Data

Responses to the items in these questionnaires were coded, transferred to computer cards and verified for accuracy. The data were subjected to various methods of statistical analysis, dependent upon the level of measurement of the variables being investigated.

Hypothesis 1. Three statistical procedures were used to examine Hypothesis 1. Parts a through d of this hypothesis were examined using the chi-squared test to determine if there were differences in proportions among respondents in the various stages of the adoption process for each of the housing alternatives with respect to geographical location, type of household, stage in the family life cycle, and race. For part 3, analysis of variance was used to determine if there were differences in the means among respondents in the various stages of the adoption process for each of the housing alternatives with respect to age. The analysis of covariance procedure was utilized to determine if there were differences in the mean educational level, part f, among respondents in the different stages of the adoption process for each housing alternative since it allowed for statistical control of the effect of age on educational level.

Hypothesis 2. Two statistical procedures were used to examine Hypothesis 2. For parts a through c of this hypothesis, the chi-squared test was used to determine if there were differences in proportions among respondents in the various stages of the adoption process for each of the housing alternatives with respect to belief in the energy crisis, impact of the energy situation on housing decisions, and household efforts to lower utility costs. Parts d and e utilized analysis of covariance to determine if there were differences in means among respondents in the various stages of the adoption process for each of the housing alternatives with respect to average monthly utility costs (with energy index as a covariate) and the presence of energy-conserving features in the dwelling (with utility costs as a covariate).

Hypothesis 3. The chi-squared test was used to determine if there were differences in proportions among respondents in the various stages of the adoption process for each of the housing alternatives and the presence or absence of each housing alternatives within the locality, the existence of local regulatory codes for construction (building, zoning, and energy), and the prior need for code variances in order to construct housing alternatives within the locality.

Hypothesis 4. Three statistical procedures were used to examine Hypothesis 4. Parts a through d of this hypothesis were examined using the chi-squared test to determine if there were differences in proportions among respondents and the number of types of housing alternatives in each stage of the adoption process with respect to geographical location by state, type of household, stage in family life cycle, and race. For part e, analysis of variance was used to determine if there were differences in the means among respondents and the number of types of housing alternatives in each stage of the adoption process with respect to age. Differences in mean educational levels, part f of this hypothesis, among respondents and the number of types of housing alternatives in each stage of the adoption process were tested using the analysis of covariance procedure with age as a covariate.

Hypothesis 5. Two statistical procedures were used to examine Hypothesis 5. Parts a through c of this hypothesis were examined using the chi-squared test to determine if there were differences in proportions among respondents and the number of types of housing alternatives in each stage of the adoption process with respect to belief in the energy crisis, impact of the energy situation on housing decisions, and household efforts to lower utility costs. For parts d and e, analysis of covariance was used to determine if there were differences in means among respondents and the number of types of housing alternatives in each stage of the adoption process or with respect to average monthly utility costs (with energy index as a covariate) and the presence of energy-conserving features in the dwelling (with utility costs as a covariate).

Hypothesis 6. Two statistical procedures were used to examine Hypothesis 6. The first four parts of this hypothesis (a through d) were examined using the chi-squared test to determine if there were differences in proportions between probable adopters and probable nonadopters for each of the housing alternatives with respect to geographical location by state, type of household, stage in family life cycle, and racial origins of the household. For parts e and f, a t-test was used to determine if there were differences in the means between probable adopters and probable nonadopters for each of the housing alternatives with respect to age and educational level.

Hypothesis 7. Two statistical procedures were used to examine Hypothesis 7. Parts a through c of this hypothesis were examined using the chi-squared test to determine if there were differences in proportions between probable adopters and probable nonadopters for each of the housing alternatives with respect to belief in the energy crisis, impact of the energy situation on housing decisions, and household efforts to lower utility costs. For parts d and e, a t-test was used to determine if there were differences in means between probable adopters and probable nonadopters for each of the housing alternatives with respect to average monthly utility costs and the presence of energy-conserving features in the dwelling.

Hypothesis 8. Three statistical procedures were used to examine Hypothesis 8. Parts a through d of this hypothesis were examined using the chi-squared test to determine if there were differences in proportions among respondents and the number of types of housing alternatives for probable adoption with respect to geographical location by state, type of household, stage in family life cycle, and racial origins of the household. For part e, analysis of variance was used to determine if there were differences in the means among respondents and the number of types of housing alternatives for probable adoption with respect to age. Part f of this hypothesis was examined using analysis of covariance to determine whether there were differences in the mean educational levels (controlling for the effect of age) for respondents and the number of types of housing alternatives for probable adoption.

Hypothesis 9. Two statistical procedures were used to examine Hypothesis 9. Parts a through c of this hypothesis were examined using the chi-squared test to determine if there were differences in proportions among respondents and the number of types of housing alternatives for probable adoption, with respect to belief in the energy crisis, impact of the energy situation on housing decisions, and household efforts to lower utility costs. For parts d and e, analysis of covariance was used to determine if there were differences in means among respondents and the number of types of housing alternatives for probable adoption with respect to average monthly utility costs (controlling for the effect of energy index) and the presence of energy-conserving features in the dwelling (controlling for the effect of utility costs).

Hypothesis 10. The chi-squared test was used to determine if there were differences in proportions between probable adopters and probable nonadopters for each of the housing alternatives with respect to the initial position of the respondent in the stages of the adoption process.

Additional Analysis of Data. In addition, discriminant analysis was used to classify respondents as probable adopters or probable nonadopters using demographic and energy variables.

Where analysis of variance revealed a significant difference in the means among respondent groups, the Tukey-Kramer procedure for comparison of means was used to detect which groups were different (SAS Institute Inc., 1982).

The alpha level for all hypotheses tested was set at the .05 level of significance.

CHAPTER FOUR

BACKGROUND INFORMATION

The instruments utilized in the study provided information on the respondents, households, energy factors, probable adopters and nonadopters of the housing alternatives, and regulatory code factors. A descriptive analysis of these factors is presented in this chapter. The total number of cases changed from variable to variable due to missing data combined with the treatment of the data utilized in creating the variables.

Description of Respondents

The sample for the research consisted of 1804 households in seven southern states. As shown in Table 1, the proportion of respondents in the 55 through 64 age group (19.7%) was slightly larger than the proportion of respondents in the other age categories. The proportions of respondents aged 24 or less (3.7%) and aged 75 and over (7.5%) were much smaller than those of the other age categories.

The highest educational level achieved by the largest share of respondents was the completion of high school (33.1%), while 14.4% had at least a college education.

Table 1

Description of Respondents

Characteristic	Number	Percent
Age of respondent		
24 years and less	63	3.7
25 through 34 years	263	15.5
35 through 44 years	314	18.5
45 through 54 years	293	17.3
55 through 64 years	335	19.7
65 through 74 years	302	17.8
75 years and over	127	7.5
Total	1697	100.0
Educational level of respondent		
Grade school	334	19.1
Some high school	300	17.2
Graduate high school	577	33.1
Some college/technical school	282	16.2
Graduate college	175	10.0
Postgraduate work	78	4.4
Total	1746	100.0
Race of respondent		
White	1384	79.5
Black	357	20.5
Total	1741	100.0

Respondents who achieved only a grade school education comprised 19.1% of the sample whereas 17.2% of the respondents had some high school education.

The sample consisted of a majority of white respondents (79.5%) with the remainder composed of black respondents.

Description of Households

The geographical distribution of the sample of households was planned using a stratification system based on income and the proportion of nonfarm families in each of the participating states. It was planned that data would be collected from 1800 households according to the design shown in Table A, Appendix G. The actual number of households interviewed was 1804 and the distribution of those households among the seven states involved is reported in Table 2.

Most of the households interviewed for the study (71.8%) were family households comprised of couple families with or without children (see Table 3). Only 6.7% of the households were families headed by females with no spouse present. The proportion of households composed of single female, nonfamily households was 14.4%.

With respect to family life cycle stages, the largest proportion of households (30.9%) was in the category of couple families with the wife aged 53 or older. This

Table 2

Location of Households

State	No.	%
Alabama	216	12.0
Arkansas	215	11.9
Florida	157	8.7
Georgia	320	17.7
North Carolina	415	23.0
Oklahoma	169	9.4
Virginia	312	17.3
Total	1804	100.0

Table 3

Description of Households

Characteristic	Number	Percent
Type of household		
Family households		
Couple families	1278	71.8
Males, no spouse present	29	1.6
Females, no spouse present	119	6.7
Nonfamily households		
Single males	77	4.3
Single females	256	14.4
Other	21	1.2
Total	1780	100.0
Stage in family life cycle		
Young couple	72	5.4
Oldest child < 5 years	68	5.2
Oldest child 5 to 12	184	13.9
Oldest child 13 to 18	251	19.0
Oldest child 19 to 23	177	13.4
Couple families (wife between 31 and 52)	162	12.2
Couple families (wife 53 or older)	409	30.9
Total	1323	100.0
Annual Household Income		
$7499 or less	232	22.5
$7500 - $9,999	103	9.9
$10,000 - $14,999	208	20.2
$15,000 - $24,999	280	27.1
$25,000 or more	209	20.2
Total	1032	100.0

category included not only empty nesters but also couples who never had children. Couple families with the wife between 31 and 52 years of age comprised 12.1% of the sample. The largest proportion of households with children present (19.0%) was in the family life cycle stage with the oldest child aged 13 to 18. The proportions of households in the early stages of the family life cycle, specifically the young couple and families with the oldest child less than 5 years of age, were relatively small (5.4% and 5.2%, respectively).

The largest proportion of households who responded to the income question (27.1%) had annual incomes in the range of \$15,000 - \$24,999. There was also a relatively large proportion of the sample of households (22.5%) with incomes below \$7499. Statistical tests using income were not conducted because of the large percentage of respondents (43%) who did not provide this information.

Description of Energy Factors

For average monthly utility costs (see Table 4), the distribution of households among the four categories was fairly even with a slightly larger proportion of respondents (28.6%) reporting average monthly utility costs in the range of \$50 - \$79.

The household index of energy conserving features in the dwelling measured not only the presence of such fea-

Table 4

Description of Energy Factors

Characteristic	Number	Percent
Average monthly utility costs		
$0 - $49	341	21.1
$50 - $79	461	28.6
$80 - $119	433	26.9
$120 and over	377	23.4
Total	1612	100.0
Household index (type and extent) of energy-conserving features		
0 - 5 (low)	562	31.3
6 - 10 (moderate)	685	38.1
11 - 20 (high)	548	30.6
Total	1795	100.0
Believe in energy crisis		
Yes	839	59.9
No	559	40.1
Total	1398	100.0
Energy situation had impact on housing decisions		
Yes	1268	73.6
No	455	26.4
Total	1723	100.0
Made efforts to lower utility costs		
Yes	1417	78.6
No	385	21.4
Total	1802	100.0

tures but also the extent to which such features were complete. The largest proportion of households (38.2%) reported information that placed them in the moderate range for this measure. The remaining households were divided in nearly equal proportions between low and high scores on the index of energy-conserving features (31.3% and 30.6%, respectively).

The largest proportion of respondents in the study (59.9%) reported that they did believe in the energy crisis. A large proportion of respondents (73.6%) also indicated that they believed the energy situation had influenced their housing decisions. In addition, most of the respondents (78.6%) had more efforts to reduce their utility costs.

Description of Probable Adopters and Probable Nonadopters

With respect to the adoption process for passive solar dwellings, the largest proportion of respondents (88.0%) was in the awareness stage of the adoption process (see Table 5). The next largest proportion of respondents (7.9%) was in the evaluation stage with only 2.9% in the interest stage and only 1.2% in the final or adoption stage.

For the adoption process for active solar dwellings, the largest proportion of respondents (86.2%) was also

Table 5

Description of Probable Adopters
and Probable Nonadopters

Characteristic	Number	Percent
Adoption stages for passive solar		
Awareness	1062	88.0
Interest	35	2.9
Evaluation	96	7.9
Adoption	15	1.2
Total	1208	100.0
Adoption stages for active solar		
Awareness	1071	86.2
Interest	49	3.9
Evaluation	121	9.7
Adoption	2	0.2
Total	1243	100.0
Adoption stages for earth sheltered/ underground		
Awareness	1302	91.0
Interest	40	2.8
Evaluation	88	6.1
Adoption	1	0.1
Total	1431	100.0
Passive solar		
Probable adopters	973	66.6
Probable nonadopters	489	33.4
Total	1462	100.0
Active solar		
Probable adopters	891	61.9
Probable nonadopters	548	38.1
Total	1439	100.0
Earth sheltered/underground		
Probable adopters	575	35.6
Probable nonadopters	1041	64.4
Total	1616	100.0

found to be in the awareness stage. The proportion of respondents in the evaluation stage was 9.7% with only 3.9% in the interest stage and 0.2% in the adoption stage.

The categorization of respondents in the adoption process for earth sheltered/underground dwellings revealed the largest proportion of respondents (91.0%) to be in the awareness stage. The proportion of respondents in the evaluation stage was 6.1%. Only 2.8% of the respondents were in the interest stage and only 0.1% were in the adoption stage.

The largest proportion of respondents (66.6%) reported information that classified them as probable adopters of passive solar dwellings in future housing decisions. This was also true for active solar dwellings with 61.9% of respondents in the probable adopters category. In contrast, for earth sheltered/underground dwellings, 64.4% of the respondents reported information that classified them as probable nonadopters of this type of housing alternative.

Description of Regulatory Code Factors

The analysis using regulatory code factors was conducted for a subsample consisting of four states. For each of the housing alternatives, very high percentages (94.5% to 99.7%) of the respondents lived in localities where no examples of that housing alternative were present (see Table 6). Most of the respondents lived in communities that did have building codes (69.5%) and zoning ordinances (62.7%). Only a small portion of respondents lived in localities with energy codes (3.2%). None of the communities studied reported a prior need for code or regulatory variances in order to build the types of housing alternatives examined.

Summary

The majority of respondents in the study were white, had at least a high school education, and were over the age of 45. Most of the households in the research were family households (nearly half were couple families with no children and a large proportion of those had wives aged 53 or older), were low- or moderate-income, and were distributed among the participating states based on income and the percentage of nonfarm households in each state.

Most of the participants in this study had monthly utility bills between $50 and $119, reported information indicating energy-conserving features present in the dwelling to a moderate degree, believed in the energy crisis, indicated the energy situation had had an impact on their housing decisions, and had made an effort to reduce their utility costs.

Table 6

Description of Regulatory Code Factors

Factor	Number	Percent
Passive Solar		
Present	61	5.5
Not Present	1050	94.5
Total	1111	100.0
Active Solar		
Present	3	0.3
Not Present	1108	99.7
Total	1111	100.0
Earth Sheltered/Underground		
Present	4	0.4
Not Present	1107	99.6
Total	1111	100.0
Building Code		
Present	772	69.5
Not Present	339	30.5
Total	1111	100.0
Zoning		
Present	697	62.7
Not Present	414	37.3
Total	1111	100.0
Energy Code		
Present	36	3.2
Not Present	1075	96.8
Total	1111	100.0

In terms of the innovation adoption process, the greatest share of respondents in the study were in the awareness stage of the adoption process for all the housing alternatives, would be considered as probable adopters of passive and active solar dwellings, and would be classified as probable nonadopters of earth sheltered/ underground dwellings.

Few of the participants in the research involving regulatory code factors lived in communities with examples of the housing alternatives present. Most did live in localities with building codes and zoning ordinances, but very few lived in communities with energy codes.

CHAPTER FIVE

RESULTS

Demographic, energy and regulatory factors were examined in relation to the probable adoption and probable nonadoption of energy-efficient housing alternatives, specifically passive solar, active solar, and earth sheltered/underground. Ten hypotheses were utilized in the examination of these relationships. The results and discussion are presented for each hypothesis organized according to the type of housing alternative or stage in the adoption process under consideration. Although the alpha level was set at the .05 level of significance for all hypotheses, exact probabilities are reported in the tables under the heading "*p*."

Test of Hypothesis 1

Hypothesis 1. For each of the housing alternatives, there are no differences in means or proportions among respondents in the various stages of the innovation adoption process with respect to the following family demographic variables:

a. geographical location by state
b. type of household
c. stage in family life cycle
d. race
e. age of respondent
f. educational level of respondent

Passive Solar

The results of the chi-squared test for passive solar and parts a through d of Hypothesis 1 are presented in Table 7. No statistically significant relationship was observed for the respondent's position in the innovation adoption process and stage in the family life cycle or race. Significant relationships were found for stage in the adoption process and geographical location by state and type of household.

Geographical location. A larger proportion of respondents in Arkansas and in Florida were in the evaluation stage of the adoption process for passive solar than in the other states (15.0% and 15.8%, respectively). The percentage of respondents from Alabama in the interest stage was 6.3%, the largest of all the states studied. For all states, the greatest number of respondents were found in the awareness stage of the adoption process.

Type of household. As originally created, this variable had six categories. In order to eliminate the problem of low expected cell frequencies in the chi-squared analysis, these categories were collapsed into the two broad classifications, family households and nonfamily households. For the passive solar alternative, the percentage of nonfamily households found in the awareness stage (95.9%) was larger than it was for family households.

Table 7

Passive Solar:
Demographic Factors by Stage in the Adoption Process

Factor	Stages in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Geographical location[a]						
Alabama	128	90.1	9	6.3	5	3.5
Arkansas	103	81.1	5	3.9	19	15.0
Florida	61	80.3	3	4.0	12	15.8
Georgia	151	89.6	8	4.0	13	6.4
North Carolina	277	91.4	6	2.0	20	6.6
Oklahoma	99	94.3	0	0.0	6	5.7
Virginia	213	89.5	4	1.7	21	8.8
Type of household[b]						
Family	840	87.4	33	3.4	88	9.2
Nonfamily	212	95.9	2	0.9	7	3.2
Stage in family life cycle[c]						
Young couple	43	76.8	3	5.4	10	17.9
Oldest child <5	35	83.3	3	7.1	4	9.5
Oldest child 5-12	110	87.3	3	2.4	13	10.3
Oldest child 13-18	140	85.4	7	4.3	17	10.4
Oldest child 19-23	94	85.5	6	5.5	10	9.1
Couple families (wife 31 to 52)	107	87.7	1	0.8	14	11.5
Couple families (wife 53 or older)	260	90.9	6	2.1	20	7.0
Race[d]						
White	861	88.2	33	3.4	82	8.4
Black	167	93.8	2	1.1	9	5.1

[a] X^2=33.584; *df* = 12; *p* = .0008
[b] X^2=13.366; *df* = 2; *p* = .0013
[c] X^2=16.577; *df* = 12; *p* = .1662
[d] X^2= 5.197; *df* = 2; *p* = .0744

Larger portions of family households than nonfamily households were found in the interest (3.4%) and evaluation stages (9.2%).

Age. Analysis of variance revealed no significant differences in the mean age of respondents among the three stages of the adoption process for passive solar (see Table B, Appendix G).

Educational level. A significant difference in the mean educational level for respondents in the various stages of the adoption process for passive solar was revealed through analysis of covariance which controlled for the effect of age on educational level (Table C, Appendix G). The adjusted mean educational level was higher for the interest (14.35 years) and evaluation stages (13.54 years) and lowest for the awareness stage (11.80 years).

Active Solar

Table 8 presents the results of the chi-squared analysis for active solar and the first four variables in Hypothesis 1. The relationships for the respondent's position in the adoption process and geographical location, type of household, stage in family life cycle, and race were found to be statistically significant.

Geographical location. For active solar, the largest portions of respondents in all states were in the awareness

Table 8

Active Solar:
Demographic Factors by Stage in the Adoption Process

Factor	Awareness No.	Awareness %	Interest No.	Interest %	Evaluation No.	Evaluation %
Geographical location[a]						
Alabama	124	90.5	8	5.8	5	3.7
Arkansas	109	81.3	7	5.2	18	13.4
Florida	79	79.8	6	6.1	14	14.1
Georgia	167	81.1	11	5.3	28	13.6
North Carolina	276	89.6	11	3.6	21	6.8
Oklahoma	110	90.9	0	0.0	11	9.1
Virginia	206	87.3	6	2.5	24	10.2
Type of household[b]						
Family	854	84.9	44	4.4	108	10.7
Nonfamily	206	92.4	5	2.2	12	5.4
Stage in family life cycle[c]						
Young couple	46	75.4	1	1.6	14	23.0
Oldest child < 5	37	78.7	2	4.3	8	17.0
Oldest child 5-12	124	87.9	3	2.1	14	9.9
Oldest child 13-18	137	79.7	11	6.4	24	14.0
Oldest child 19-23	95	84.8	8	7.1	9	8.0
Couple families (wife 31 to 52)	99	82.5	3	2.5	18	15.0
Couple families (wife 53 or older)	258	89.6	9	3.1	21	7.3
Race[d]						
White	876	85.1	39	3.8	115	11.2
Black	165	94.1	7	4.1	3	1.8

Stages in the Adoption Process

[a] X^2=27.490; *df* = 12; *p* = .0066
[b] X^2= 8.626; *df* = 2; *p* = .0134
[c] X^2=27.401; *df* = 12; *p* = .0068
[d] X^2=14.524; *df* = 2; *p* = .0007

stage. A greater percentage of respondents from Arkansas and Florida were in the evaluation stage (a range of 13.4% to 14.1%) while the percentage of respondents in the interest stage was relatively larger in Alabama, Arkansas, Florida, and Georgia, ranging from 5.2% to 6.1%.

Type of household. Although the largest portion of respondents in both family and nonfamily households were in the awareness stage for active solar, the percentage of family households found in the interest and evaluation stages was approximately twice that of nonfamily households.

Stage in family life cycle. For active solar housing, the majority of respondents in all stages of the family life cycle were in the awareness stage of the adoption process. Stages of the family life cycle with greater portions of respondents in the evaluation stage were the young couple (23.0%), families with the oldest child less than five (17.0%), families with the oldest child 13 - 18 (14.0%), and couple families with the wife age 31 to 52 (15.0%). The larger percentages of respondents in the interest stage were found in the family life cycle stage with the oldest child 13 - 18 (6.4%) and with the oldest child 19 - 23 (7.1%). In the awareness stage, families with the oldest child 5 - 12 and couple families with the wife age 53 or older reported higher frequencies (87.9% and 89.6%, respectively).

Race. More blacks (94.1%) were found in the awareness stage for active solar than whites (85.1%). The portion of respondents from both racial groups in the interest stage was approximately equal but the percentage of white respondents in the evaluation stage, 11.2%, was significantly larger than that for blacks (1.8%).

Age. A statistically significant difference was found in the mean age of respondents among the three stages of the adoption process for active solar. The summary table for the analysis of variance is presented in Appendix G, Table D. A comparison of means using the Tukey-Kramer method which controls the Type I experimentwise error rate revealed a significant difference in the mean age between the awareness and evaluation stages. The mean age for the evaluation stage was 4.13 years less than the mean for the awareness stage.

Educational level. Respondents in the various adoption stages were found to have significantly different mean educational levels when the effect of age on educational level was removed. Table E, Appendix G reports the results of the analysis of covariance utilized to test part e of this hypothesis. The adjusted mean educational level was lowest for the awareness stage (11.89 years) and was higher for the interest (13.77 years) and evaluation stages (13.48 years).

Earth Sheltered/Underground

Table 9 presents the results of the chi-squared test for earth sheltered/underground and parts a through d of Hypothesis 1. No significant relationship was observed between location in the adoption process and stage in family life cycle. The relationships for stage in the adoption process and geographical location, type of household, and race were statistically significant.

Geographical location. The majority of respondents in all states examined were in the awareness stage for earth sheltered/underground. The percentage of respondents from Alabama in the interest stage (6.9%) was larger than in the other states. In Arkansas and Oklahoma, a greater number of respondents were in the evaluation stage (9.3% and 10.1%, respectively) than in the other states.

Type of household. The greatest portion of respondents from both family and nonfamily households were in the awareness stage for earth sheltered/underground, but the percentage of respondents from family households in the evaluation stage was almost triple that from nonfamily households (7.0% compared to 2.4%).

Race. For earth sheltered/underground housing, a larger portion of black respondents were in the awareness stage (97.0% compared to 89.8%) with greater numbers of

Table 9

Earth Sheltered/Underground:
Demographic Factors by Stage in the Adoption Process

Factor	Stages in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Geographical location[a]						
Alabama	166	88.3	13	6.9	9	4.8
Arkansas	158	86.3	8	4.4	17	9.3
Florida	113	91.1	3	2.4	8	6.5
Georgia	232	91.0	8	3.1	15	5.9
North Carolina	260	93.9	4	1.4	13	4.7
Oklahoma	132	85.6	2	1.3	15	10.1
Virginia	241	94.9	2	0.8	11	4.3
Type of household[b]						
Family	1040	90.0	35	3.0	81	7.0
Nonfamily	244	95.7	5	2.0	6	2.4
Stage in family life cycle[c]						
Young couple	45	81.8	3	5.5	7	12.7
Oldest child < 5	51	87.9	2	3.5	5	8.6
Oldest child 5-12	143	87.7	6	3.7	14	8.6
Oldest child 13-18	179	87.3	7	3.4	19	9.3
Oldest child 19-23	130	91.6	2	1.4	10	7.0
Couple families (wife 31 to 52)	115	87.1	5	3.8	12	9.1
Couple families (wife 53 or older)	309	93.9	7	2.1	13	4.0
Race[d]						
White	1036	89.8	39	3.4	79	6.9
Black	224	97.0	0	0.0	7	3.0

[a] X^2=30.730; df = 12; p = .0022
[b] X^2= 8.929; df = 2; p = .0115
[c] X^2=14.632; df = 12; p = .2622
[d] X^2=13.414; df = 2; p = .0012

white respondents found in the interest (3.4% compared to 0.0%) and evaluation stages (6.9% compared to 3.0%).

Age. The one-way analysis of variance detected a significant difference in the mean age of respondents among the stages in the adoption process as reported in Table F, Appendix G. Utilization of the Tukey-Kramer procedure indicated that the mean age of respondents in the evaluation stage was 5.72 years younger than the mean age in the awareness stage for earth sheltered/underground housing.

Educational level. The analysis of covariance summary for earth sheltered/underground and part f of Hypothesis 1 is presented in Appendix G, Table G. A significant difference in the mean educational level was observed among the stages in the adoption. When adjusted for the effect of age on educational level, the mean number of years of education was lowest for the awareness stage (11.73), and higher for the interest (13.89) and evaluation stages (13.19).

Summary for Hypothesis 1

The results of the test of null Hypothesis 1 of no relationship between family demographics and the respondent's position in the adoption process can be summarized as follows:

1. reject for all housing alternatives: geographical location, type of household, and educational level of respondent.

2. reject for active solar: stage in family life cycle, race and age of respondent.

3. reject for earth sheltered/underground: race and age of respondent.

4. retain for passive solar: stage in family life cycle, race, and age of respondent.

5. retain for earth sheltered/underground: stage in family life cycle.

Test of Hypothesis 2

Hypothesis 2. For each of the housing alternatives, there are no differences in means or proportions among respondents in the various stages of the innovation adoption process with respect to the following energy variables:

a. belief in the energy crisis
b. impact of the energy situation on housing decisions
c. household efforts to lower utility costs
d. average monthly utility costs
e. presence of energy-conserving features in the house (energy index).

Passive Solar

Information pertaining to the chi-squared analysis for passive solar and parts a, b, and c of Hypothesis 2 is presented in Table 10. Statistically significant relationships were observed for stage in the adoption process and belief in the energy crisis, impact of the

Table 10

Passive Solar:
Energy Factors by Stage in the Adoption Process

Factor	Stages in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Believe in energy crisis[a]						
Yes	476	85.3	21	3.8	61	10.9
No	339	91.6	9	2.4	22	6.0
Energy situation had impact on housing decisions[b]						
Yes	762	86.9	31	3.5	84	9.6
No	256	94.5	4	1.5	11	4.1
Made effort to lower utility costs[c]						
Yes	870	88.0	34	3.4	85	8.6
No	190	94.1	1	0.5	11	5.5

[a] $X^2 = 8.414$; $\underline{df} = 2$; $\underline{p} = .0149$
[b] $X^2 = 11.839$; $\underline{df} = 2$; $\underline{p} = .0027$
[c] $X^2 = 7.706$; $\underline{df} = 2$; $\underline{p} = .0212$

energy situation on housing decisions, and efforts to reduce utility costs.

Belief in the energy crisis. For both believers in the energy crisis and nonbelievers, most of the respondents were in the awareness stage of the adoption process for passive solar. The proportions of respondents who believed in the energy crisis were larger in the interest (3.8%) and evaluation stages (10.9%) than they were for nonbelievers.

Impact of the energy situation on housing decisions. For the passive solar housing alternative, the percentage of respondents reporting the energy situation had not influenced housing decisions was larger in the awareness stage than it was for those reporting an energy impact (94.5% compared to 86.9%). The proportions of respondents indicating the energy situation had affected housing decisions in the interest and evaluation stages was twice that of those reporting no effect on housing decisions.

Efforts to reduce utility costs. When compared to respondents who had attempted to reduce utility costs, more respondents who had not tried to lower utility costs were found in the awareness stage of the adoption process for passive solar (94.1% and 88.0%, respectively). Higher percentages reporting they had attempted to reduce utility costs were found in the interest (3.4%) and evaluation stages (8.6%) than those reporting no efforts to reduce utility costs.

Utility costs. No significant difference in the mean utility costs among respondents in the various stages of the adoption process for passive solar was observed (see Table H, Appendix G for part d of Hypothesis 2).

Energy index. For passive solar, the analysis of covariance procedure revealed a significant difference in the mean score on the energy index among the three stages of the adoption process when the effect of utility costs on the energy index was controlled (Appendix G, Table I). The means on the energy index, adjusted for the covariate, ranged from a low of 8.54 for the awareness stage to a high of 10.45 for the evaluation stage.

Active Solar

The results of the chi-squared test for active solar and parts a, b and c of Hypothesis 2 are presented in Table 11. The relationships for stage in the adoption process and belief in the energy crisis, impact of the energy situation on housing decisions, and efforts to reduce utility costs were statistically significant.

Belief in the energy crisis. For the active solar housing alternative, the portion of nonbelievers in the energy crisis was larger in the awareness stage than it was for those who did believe in the energy crisis (90.4%

Table 11

Active Solar:
Energy Factors by Stage in the Adoption Process

Factor	Stages in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Believe in energy crisis[a]						
Yes	491	81.3	34	5.6	79	13.1
No	339	90.4	10	2.7	26	6.9
Energy situation had impact on housing decisions[b]						
Yes	768	83.8	42	4.6	106	11.6
No	265	93.0	6	2.1	14	4.9
Made effort to lower utility costs[c]						
Yes	877	85.0	45	4.4	110	10.7
No	192	92.8	4	1.9	11	5.3

[a]X^2=14.930; *df* = 2; *p* = .0006
[b]X^2=15.105; *df* = 2; *p* = .0005
[c]X^2= 8.821; *df* = 2; *p* = .0121

compared to 81.3%). The interest and evaluation stages contained larger percentages of respondents who believed in the energy crisis (5.6% and 13.1%) than nonbelievers.

Impact of the energy situation on housing decisions. The largest percentages of respondents were found in the awareness stage for active solar. However, at the more advanced stages of the adoption process, the proportions of respondents reporting that housing decisions were affected by the energy situation were larger than those reporting no effect, 4.6% for the interest stage and 11.6% for the evaluation stage.

Efforts to reduce utility costs. The proportion of respondents who had not made an effort to lower their utility costs was higher in the awareness stage for active solar than it was for those who had (92.8% compared to 85.0%). The percentages of respondents who had tried to lower their utility costs were higher in the interest (4.4%) and evaluation (10.7%) stages than they were for respondents reporting no effort to reduce utility costs.

Utility costs. After adjusting for the effect of the energy index on utility costs, no significant difference was found in the mean utility costs among the various stages for the test of active solar and part d of Hypothesis 2 (Appendix G, Table J).

Energy index. A significant difference in the mean score on the energy index was found to exist among the three stages in the adoption process. The mean scores, adjusted for the influence of utility costs, ranged from a low of 8.72 for the awareness stage to a high of 10.71 for the evaluation stage (Appendix G, Table K).

Earth Sheltered/Underground

The chi-squared results for earth sheltered/underground and parts a, b, and c of Hypothesis 2 are presented in Table 12. Statistically significant relationships were found for stage in the adoption process and belief in the energy crisis, impact of the energy situation on housing decisions, and efforts to reduce utility costs.

Belief in the energy crisis. For earth sheltered/underground housing, the percentage of nonbelievers was larger in the awareness stage (93.1%) than it was for believers in the energy crisis (88.2%). On the other hand, the proportions who believed in the energy crisis were larger than the proportions of nonbelievers in the interest (4.4%) and evaluation (7.5%) stages.

Impact of the energy situation on housing decisions. Most of the respondents were in the awareness stage for earth sheltered/underground, but the proportions of respondents who believed the energy situation had some impact on housing decisions were higher in the interest and evaluation stages (3.3%, and 7.0%, respectively) than

Table 12

Earth Sheltered/Underground:
Energy Factors by Stage in the Adoption Process

Factor	Stages in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Believe in energy crisis[a]						
Yes	604	88.2	30	4.4	51	7.5
No	406	93.1	7	1.6	23	5.3
Energy situation had impact on housing decisions[b]						
Yes	930	89.7	34	3.3	73	7.0
No	323	94.2	5	1.5	15	4.4
Made effort to lower utility costs[c]						
Yes	1052	90.3	38	3.3	75	6.4
No	249	94.3	2	0.8	13	4.9

[a] $X^2=8.835$; df = 2; p = .0121
[b] $X^2=6.469$; df = 2; p = .0394
[c] $X^2=6.004$; df = 2; p = .0497

they were for those reporting no energy influence on housing decisions.

Efforts to reduce utility costs. For the earth sheltered/underground housing alternative, the portions of respondents who had tried to lower their utility costs were larger in the interest and evaluation stages (3.3% and 6.4%) than they were for those indicating no efforts to reduce utility costs. The percentage of respondents who had not attempted to reduce utility costs was somewhat higher in the awareness stage than it was for those who had tried to lower utility costs (94.3% compared to 90.3%).

Utility costs. Using analysis of covariance, no significant difference was found in the mean utility costs for respondents in the various stages of the adoption process for the earth sheltered/underground housing alternative, part d of Hypothesis 2, as reported in Table L, Appendix G.

Energy index. Among the stages in the adoption process for earth sheltered/underground, a significant difference in the mean score on the energy index was observed when controlling for the effect of utility costs on the energy index (see Appendix G, Table M). Using analysis of covariance, the adjusted mean on the energy index was found to be lowest for the awareness stage (8.24) and highest for the evaluation stage (10.61).

Summary for Hypothesis 2

The results of the test of null Hypothesis 2 of no relationship between energy factors and the respondent's position in the adoption process are summarized as follows:

1. reject for all housing alternatives: belief in the energy crisis, impact of the energy situation on housing decisions, efforts to reduce utility costs, and energy index.

2. retain for all housing alternatives: average monthly utility costs.

Test of Hypothesis 3

Hypothesis 3. For each of the housing alternatives, there are no differences in proportions among respondents in the various stages of the innovation adoption process with respect to:

a. the presence or absence of innovative types of housing within the locality
b. the existence of local regulatory codes for construction (building, zoning, and energy)
c. the prior need for code variances in order to construct innovative types of housing in the locality.

Passive Solar

Table 13 presents the results of the chi-squared test for passive solar and parts a and b of Hypothesis 3. No significant relationships were found for stage in the adoption process and the presence of passive solar housing units, building codes, or energy codes. The relationship of the adoption process to the prior need for

Table 13

Passive Solar:
Regulatory Code Factors by Stage
in the Adoption Process

Factor	Stage in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Passive Solar[a]						
Present	28	87.5	0	0.0	4	12.5
Not Present	664	89.6	15	2.0	62	8.4
Building Codes[b]						
Present	504	90.8	7	1.3	44	7.9
Not Present	188	86.2	8	3.7	22	10.1
Zoning[c]						
Present	472	92.0	7	1.4	34	6.6
Not Present	220	84.6	8	3.1	32	12.3
Energy Code[d]						
Present	22	95.7	0	0.0	1	4.4
Not Present	670	89.3	15	2.0	65	8.7

[a]$X^2 = 1.277$; $df = 2$; $p = .5282$
[b]$X^2 = 5.903$; $df = 2$; $p = .0523$
[c]$X^2 = 10.181$; $df = 2$; $p = .0062$
[d]$X^2 = 1.047$; $df = 2$; $p = .5924$

code variances could not be tested due to lack of data. A statistically significant relationship was observed between respondent's position in the adoption process and the presence of zoning ordinances.

Zoning ordinances. For passive solar housing, the percentages of respondents in localities without zoning were higher in the interest and evaluation stages than they were for respondents in communities with zoning ordinances.

Active Solar

The chi-squared results for active solar and parts a and b of Hypothesis 3 are reported in Table 14. There were no significant relationships for stage in the adoption process and the presence of active solar housing units, building codes, zoning ordinances, or energy codes. No statistical tests were performed using the prior need for code variances because no data were available for this variable.

Earth Sheltered/Underground

The results of the chi-squared analysis for earth sheltered/underground and parts a and b of Hypothesis 3 are shown in Table 15. No significant relationships were found for stage in the adoption process and the presence of earth sheltered/underground housing, building codes, or energy codes. The variable prior need for variances

Table 14

Active Solar:
Regulatory Code Factors by Stage
in the Adoption Process

Factor	Stage in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Active Solar[a]						
Present	1	50.0	0	0.0	1	50.0
Not Present	700	87.8	24	3.0	73	9.2
Building Codes[b]						
Present	505	88.4	15	2.6	51	8.9
Not Present	196	86.0	9	4.0	23	10.1
Zoning[c]						
Present	470	89.4	13	2.5	43	8.2
Not Present	231	84.6	11	4.0	31	11.4
Energy Code[d]						
Present	21	87.5	0	0.0	3	12.5
Not Present	680	87.7	24	3.1	71	9.2

[a] $X^2=3.979$; df = 2; $p = .1368$
[b] $X^2=1.295$; df = 2; $p = .5234$
[c] $X^2=3.875$; df = 2; $p = .1441$
[d] $X^2=1.024$; df = 2; $p = .5994$

Table 15

Earth Sheltered/Underground:
Regulatory Code Factors by Stage
in the Adoption Process

Factor	Stage in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Earth Sheltered/ underground[a]						
Present	3	75.0	0	0.0	1	25.0
Not Present	788	91.7	16	1.9	55	6.4
Building Codes[b]						
Present	543	92.4	7	1.2	38	6.5
Not Present	248	90.2	9	3.3	18	6.6
Zoning[c]						
Present	496	93.6	5	0.9	29	5.5
Not Present	295	88.6	11	3.3	27	8.1
Energy Code[d]						
Present	22	84.6	0	0.0	4	15.4
Not Present	769	91.9	16	1.9	52	6.2

[a] X^2=2.318; df = 2; p = .3138
[b] X^2=4.480; df = 2; p = .1065
[c] X^2=8.891; df = 2; p = .0117
[d] X^2=3.911; df = 2; p = .1415

was not subjected to statistical tests because of lack of data. A significant relationship was found between stage in the adoption process and the presence of zoning ordinances.

Zoning ordinances. The proportions of respondents living in localities without zoning in the interest and evaluation stages were greater than they were for those living in localities with zoning.

Summary for Hypothesis 3

The results of testing null Hypothesis 3 which stated no relationship for stage in the adoption process and regulatory code variables are summarized below:

1. reject for passive solar and earth sheltered/underground: zoning ordinances.

2. retain for all housing alternatives: presence of each housing alternative, building codes, and energy codes.

3. retain for active solar: zoning.

Test of Hypothesis 4

Hypothesis 4. For each stage of the adoption process, there are no differences in means or proportions among respondents and the number of types of housing alternatives with respect to the following family demographic variables:

a. geographical location by state
b. type of household
c. stage in family life cycle
d. race

e. age of respondent
f. educational level of respondent

Awareness Stage

The results of the chi-squared examination of the awareness stage and parts a through d of Hypothesis 4 are presented in Table 16. The relationships for the number of types of housing alternatives in the awareness stage and geographic location, type of household, stage in family life cycle, and race were statistically significant.

Geographical location. With the exception of Florida, the majority of respondents in all states were aware of three types of housing alternatives (a range of 30.7% to 68.8%). The proportion of respondents aware of two of the housing alternatives was largest in Florida (37.8%). Arkansas had the largest share of respondents aware of only one of the housing alternatives (35.0%).

Type of household. With the exception of the family household headed by females, the largest segment of each group was aware of three types of housing alternatives. Family households headed by females with no spouse present and nonfamily households composed of single males had a greater portion of respondents in the awareness stage for one type of housing alternative (44.9% and 35.9%, respectively).

Stage in family life cycle. The greatest shares of respondents for each stage in the family life cycle were

Table 16

Demographic Factors by Awareness of Number of Types of Housing Alternatives

Factor	One		Two		Three	
	No.	%	No.	%	No.	%
Geographical location[a]						
Alabama	46	25.0	42	22.8	96	52.2
Arkansas	63	35.0	44	24.4	73	40.6
Florida	40	31.5	48	37.8	39	30.7
Georgia	72	27.3	68	25.8	124	47.0
North Carolina	72	20.4	103	29.2	178	50.4
Oklahoma	32	22.1	30	20.7	83	57.2
Virginia	47	17.9	35	13.3	181	68.8
Type of household[b]						
Family households						
Couple Families	254	23.2	279	25.5	562	51.3
Male, no spouse	3	12.5	7	29.2	14	58.3
Female, no spouse	40	44.9	10	11.2	39	43.8
Nonfamily households						
Single males	23	35.9	8	12.5	33	51.6
Single females	41	19.8	60	29.0	106	51.2
Others	4	22.2	1	5.6	13	72.2
Stage in family life cycle[c]						
Young couple	16	25.4	23	36.5	24	38.1
Oldest child < 5	13	23.2	19	33.9	24	42.9
Oldest child 5-12	42	25.2	40	24.0	85	50.9
Oldest child 13-18	50	24.3	62	30.1	94	45.6
Oldest child 19-23	49	36.1	27	18.2	72	48.7
Couple families (wife 31 to 52)	28	20.6	31	22.8	77	56.6
Couple families (wife 53 or older)	76	21.5	80	22.7	197	55.8
Race[d]						
White	261	21.7	317	25.8	631	52.5
Black	96	36.4	49	18.6	119	45.1

[a]X^2=79.239; df = 12; p = .0001
[b]X^2=40.708; df = 10; p = .0001
[c]X^2=24.382; df = 12; p = .0180
[d]X^2=26.026; df = 2; p = .0001

aware of three types of housing alternatives. Awareness of only one housing alternative was greater for families whose oldest child was age 19 to 23 (36.1%). The larger percentages of respondents aware of two housing alternatives were young couples (36.5%), families with the oldest child less than five (33.9%), and families with the oldest child 13 - 18 (30.1%). Couple families, both those with the wife age 31 to 52 and those with the wife age 53 and older, had more respondents in the awareness stage for three of the housing alternatives (56.6% and 55.8%, respectively).

Race. The proportions of white respondents aware of two and three of the housing alternatives were larger than those for blacks (25.8% and 52.5% compared to 18.6% and 45.1%).

Age. Analysis of variance for part e of Hypothesis 4 revealed no significant differences in the mean age of respondents aware of one, two, or three types of housing alternatives (Table N, Appendix G).

Educational level. For Hypothesis 4, part f, a statistically significant difference in the mean educational level of respondents aware of one, two, or three types of housing alternatives was observed (see Appendix G, Table O). The mean educational levels, adjusted for the effect of age, ranged from a low of 11.21 years for awareness of one housing alternative to a high of 11.91 years for awareness of all housing alternatives.

Interest Stage

Table 17 presents the findings from the chi-squared examination of parts a through d of Hypothesis 4 for the interest stage of the innovation adoption process. No statistically significant relationships were found to exist for the number of housing alternatives in the interest stage and geographical location by state, type of household, stage in the family life cycle, or race.

Age. For part e of Hypothesis 4, no significant differences were detected in the mean ages for respondents in the interest stage for one, two, or three housing alternatives (see Table P, Appendix G).

Educational level. A significant difference in the mean educational level of respondents interested in one, two, or three types of housing alternatives was found to exist. The mean educational levels adjusted for the covariate age were 13.12 years for one type, 14.37 years for two types, and 15.51 for three types of housing alternatives, indicating higher levels of education for persons interested in more types of housing alternatives. These results for part f of Hypothesis 4 are presented in Appendix G, Table Q.

Table 17

Demographic Factors by Interest in Number of Types of Housing Alternatives

Factor	One		Two or More	
	No.	%	No.	%
Geographical location[a]				
Alabama	8	47.1	9	52.9
Arkansas	11	73.3	4	26.7
Florida	4	57.1	3	42.9
Georgia	15	71.4	6	28.6
North Carolina	10	66.7	5	33.3
Oklahoma	2	100.0	0	0.0
Virginia	2	28.6	5	71.4
Type of household[b]				
Family	44	59.5	30	40.5
Nonfamily	8	80.0	2	20.0
Stage in family life cycle[c]				
Young couple	1	25.0	3	75.0
Oldest child < 5	3	60.0	2	40.0
Oldest child 5-12	7	77.8	2	22.2
Oldest child 13-18	15	79.0	4	21.1
Oldest child 19-23	4	40.0	6	60.0
Couple families (wife 31 to 52)	5	71.4	2	28.6
Couple families (wife 53 or older)	5	41.7	7	58.3
Race[d]				
White	45	60.8	29	39.2
Black	5	71.4	2	28.6

[a] X^2=7.968; df = 6; p = .2405

[b] X^2=1.576; df = 1; p = .2093

[c] X^2=9.838; df = 6; p = .1316

[d] X^2=0.305; df = 1; p = .5807

Evaluation Stage

The chi-squared results for parts a through d of Hypothesis 4 for the evaluation stage of the innovation adoption process are reported in Table 18. The relationships for the number of housing alternatives in the evaluation stage and geographical location by state, type of household, and stage in family life cycle were not statistically significant. The relationship between the number of housing alternatives in the evaluation stage and race was statistically significant.

Race. Although the relationship between race and the number of housing alternatives in the evaluation stage was significant, it must be interpreted with caution since approximately one-half the chi-squared value was contributed by one cell. The results indicate a trend for a greater proportion of white respondents to be in the evaluation stage for two or more of the housing alternatives and for a greater share of black respondents to be in the evaluation stage for only one of the housing alternatives.

Age. For part e of Hypothesis 4, no significant difference in the mean ages of respondents in the evaluation stage for one, two, or three types of housing alternatives was observed (see Table R, Appendix G).

Table 18

Demographic Factors by Evaluation of Number of Types of Housing Alternatives

Factor	One		Two or More	
	No.	%	No.	%
Geographical location[a]				
Alabama	14	87.5	2	12.5
Arkansas	21	60.0	14	40.0
Florida	7	36.8	12	63.2
Georgia	23	62.2	14	37.8
North Carolina	16	50.0	16	50.0
Oklahoma	13	61.9	8	38.1
Virginia	19	55.9	15	44.1
Type of household[b]				
Family households				
Couple families	100	58.1	72	41.7
Male, no spouse	0	0.0	0	0.0
Female, no spouse	3	75.0	1	25.0
Nonfamily households				
Single males	3	60.0	2	40.0
Single females	6	60.0	4	40.0
Others	1	50.0	1	50.0
Stage in family life cycle[c]				
Young couples	8	44.4	10	55.6
Oldest child < 5	7	63.6	4	36.4
Oldest child 5-12	16	61.5	10	38.5
Oldest child 13-18	28	68.3	13	31.7
Oldest child 19-23	14	66.7	7	33.3
Couple families (wife 31 to 52)	10	41.7	14	58.3
Couple families (wife 53 or older)	16	50.0	16	50.0
Race[d]				
White	99	56.9	75	43.1
Black	13	86.7	2	13.3

[a] X^2=10.575; $\underline{df}$ = 6; $\underline{p}$ = .1024

[b] X^2= 0.531; $\underline{df}$ = 4; $\underline{p}$ = .9704

[c] X^2= 7.456; $\underline{df}$ = 6; $\underline{p}$ = .2807

[d] X^2= 5.069; $\underline{df}$ = 1; $\underline{p}$ = .0244

Educational level. The difference in the mean educational level of respondents in the evaluation stage for one, two, or three types of housing alternatives was not significant for Hypothesis 4, part f, as reported in Appendix G, Table S.

Summary for Hypothesis 4

The findings from the test of null Hypothesis 4 which stated no relationships for family demographic factors and the respondent's number of types of housing alternatives in each stage of the adoption process are summarized as follows:

1. reject for the awareness stage: geographical location by state, type of household, stage in family life cycle, race, and educational level of respondent.

2. reject for the interest stage: educational level of respondent.

3. reject for the evaluation stage: race.

4. retain for the awareness stage: age of respondent.

5. retain for the interest stage: geographical location, type of household, stage in family life cycle, and age of respondent.

6. retain for the evaluation stage: geographical location, type of household, stage in family life cycle, and educational level of respondent.

Test of Hypothesis 5

Hypothesis 5. For each stage of the adoption process, there are no differences in means or proportions among respondents and the number of types of housing alternatives with respect to the following energy factors:

a. belief in the energy crisis
b. impact of the energy situation on housing decisions
c. efforts to reduce utility costs
d. average monthly utility costs
e. presence of energy-conserving features in the dwelling (energy index).

Awareness Stage

The results of the chi-squared test of parts a, b, and c of Hypothesis 5 for the awareness stage are presented in Table 19. No statistically significant relationships were found for the number of housing alternatives in the awareness stage and belief in the energy crisis or impact of the energy situation on housing decisions. The relationship between the number of housing alternatives in the awareness stage and efforts to reduce utility costs was significant.

Efforts to reduce utility costs. When comparing respondents who had and had not attempted to reduce utility costs, a larger proportion of respondents who had tried to reduce their utility costs were aware of two or three of the housing alternatives (25.6% and 51.8%); whereas, a larger proportion of respondents who had not

Table 19

Energy Factors by Awareness of Number of Types of Housing Alternatives

Factor	One		Two		Three	
	No.	%	No.	%	No.	%
Believe in energy crisis[a]						
Yes	178	25.7	152	21.9	363	52.4
No	121	24.9	132	27.2	236	47.9
Energy situation had impact on housing decisions[b]						
Yes	258	23.9	264	24.4	558	51.7
No	95	25.3	91	24.3	189	50.4
Made effort to lower utility costs[c]						
Yes	276	22.6	312	25.6	633	51.8
No	95	32.4	58	19.8	140	47.8

[a] $X^2 = 4.423$; $df = 2$; $p = .1095$
[b] $X^2 = 0.330$; $df = 2$; $p = .8479$
[c] $X^2 = 13.265$; $df = 2$; $p = .0013$

attempted to reduce utility costs were aware of only one type of housing alternative (32.4%).

Utility costs. Analysis of covariance revealed no significant difference in the mean utility costs for respondents in the awareness stage for one, two, or three types of housing alternatives for part d of Hypothesis 5 (see Table T, Appendix G).

Energy index. A significant difference in the mean score on the energy index was observed among respondents in awareness for one, two, or three types of housing alternatives in the test of Hypothesis 5, part e as shown by the analysis of covariance summary in Table U, Appendix G. The mean scores, adjusted for the influence of utility costs, were 7.31 for one type, 8.29 for two types, and 8.78 for three types, indicating greater numbers and more complete energy-conserving features in the dwellings of respondents aware of more housing alternatives.

Interest Stage

For the interest stage in the adoption process, the chi-squared results of part a, b, and c of Hypothesis 5 are presented in Table 20. No statistically significant relationships were found to exist for the number of housing alternatives in the interest stage and belief in the energy crisis, impact of the energy situation on housing decisions, or efforts to reduce utility costs.

Table 20

Energy Factors by Interest in Number of Types of Housing Alternatives

Factor	One No.	One %	Two No.	Two %	Three No.	Three %
Believe in energy crisis[a]						
Yes	33	58.9	17	30.4	6	10.7
No	15	75.0	4	20.0	1	5.0
	One No.	**One %**	**Two or More No.**	**Two or More %**		
Energy situation had impact on housing decisions[b]						
Yes	46	63.0	27	37.0		
No	4	44.4	5	55.6		
Made effort to lower utility costs[c]						
Yes	47	60.3	31	39.7		
No	5	83.3	1	16.7		

[a] X^2=1.697; *df* = 2; *p* = .4280
[b] X^2=1.161; *df* = 1; *p* = .2812
[c] X^2=1.258; *df* = 1; *p* = .2620

Utility costs and Energy index. In the test of parts d and e of Hypothesis 5, there were no significant differences in the mean utility costs or mean scores on the energy index for respondents in the interest stage for one, two, or three housing alternatives (see Tables V and W, Appendix G).

Evaluation Stage

The results of the chi-squared tests for parts a, b, and c of Hypothesis 5 for the evaluation stage of the adoption process are shown in Table 21. No statistically significant relationships were observed for the number of housing alternatives for which the respondent was in the evaluation stage and belief in the energy crisis, the impact of the energy situation on housing decisions, or the respondent's efforts to reduce utility costs.

Utility costs and Energy index. For Hypothesis 5, parts d and e, no significant differences were found in mean utility costs or mean scores on the energy index for respondents in the evaluation stage for one, two, or three types of housing alternatives as reported in Tables X and Y, Appendix G.

Summary of Hypothesis 5

The result of testing null Hypothesis 5 which stated, for each stage of the adoption process, the relationship

Table 21

Energy Factors by Evaluation of Number of Types of Housing Alternatives

Factor	One No.	One %	Two No.	Two %	Three No.	Three %
Believe in energy crisis[a]						
Yes	75	60.5	31	25.0	18	14.5
No	28	60.9	11	23.9	7	15.2
Energy situation had impact on housing decisions[b]						
Yes	93	56.7	43	26.2	28	17.1
No	18	64.3	8	28.6	2	7.1
Made effort to lower utility costs[c]						
Yes	102	58.6	48	27.6	24	13.8
No	11	55.0	3	15.0	6	30.0

[a]X^2=0.028; *df* = 2; *p* = .9861
[b]X^2=1.797; *df* = 2; *p* = .4072
[c]X^2=4.168; *df* = 2; *p* = .1244

of energy factors and the respondents for one, two, or three types of housing alternatives can be summarized as follows:

1. reject for the awareness stage: efforts to reduce utility costs, and energy index.

2. retain for all stages: belief in the energy crisis, impact of the energy situation on housing decisions, and average monthly utility costs.

3. retain for the interest and evaluation stages: efforts to reduce utility costs and energy index.

Test of Hypothesis 6

Hypothesis 6. For each of the housing alternatives, there are no differences in means or proportions between probable adopters and probable nonadopters with respect to the following family demographic variables:

a. geographical location by state
b. type of household
c. stage in family life cycle
d. race
e. age of respondent
f. educational level of respondent.

Passive Solar

The chi-squared results of the examination of passive solar and parts a through d of Hypothesis 6 are presented in Table 22. Statistically significant relationships were found for probable adoption and probable nonadoption and geographical location, type of household, stage in the family life cycle, and race.

Table 22

Passive Solar:
Demographic Factors by Probable Adopters and Nonadopters

Factor	Probable Adopters No.	Probable Adopters %	Probable Nonadopters No.	Probable Nonadopters %
Geographical location[a]				
Alabama	109	65.7	57	34.3
Arkansas	129	66.8	64	33.2
Florida	102	76.7	31	23.3
Georgia	195	70.9	80	29.1
North Carolina	222	67.3	108	32.7
Oklahoma	110	74.3	38	25.7
Virginia	106	48.9	111	51.2
Type of household[b]				
Family households				
Couple families	738	69.9	318	30.1
Male, no spouse	14	66.7	7	33.3
Female, no spouse	54	57.5	40	42.6
Nonfamily households				
Single males	36	64.3	20	35.7
Single females	107	53.8	92	46.2
Others	12	85.7	2	14.3
Stage in family life cycle[c]				
Young couple	52	85.3	9	14.8
Oldest child < 5	45	79.0	12	21.1
Oldest child 5-12	126	78.0	34	21.3
Oldest child 13-18	169	79.3	44	20.7
Oldest child 19-23	93	64.1	52	35.9
Couple families (wife 31 to 52)	85	66.9	42	33.1
Couple families (wife 53 or older)	191	57.9	139	41.9
Race[d]				
White	799	69.9	34	30.1
Black	142	52.6	128	47.4

[a] X^2=43.203; df = 6; p = .0001

[b] X^2=25.871; df = 5; p = .0001

[c] X^2=49.221; df = 6; p = .0001

[d] X^2=29.422; df = 1; p = .0001

Geographical location. Larger portions of respondents were probable adopters of passive solar in Florida and Oklahoma (76.7% and 74.3%, respectively) than in the other states. The percentage of probable nonadopters in Virginia was significantly greater (51.2%) than it was elsewhere.

Type of household. The majority of respondents in all types of households were probable adopters of passive solar. Two groups, family households headed by females with no spouse present and nonfamily households composed of single females, had smaller segments of respondents as probable adopters (57.5% and 53.8%, respectively) whereas the percentage of nonfamily household (exclusive of single males and single females) probable adopters was very high (85.7%).

Stage in family life cycle. The largest number of respondents in all stages of the family life cycle were probable adopters of passive solar. A larger portion of families in the young couple stage (85.3%) were probable adopters while couple families with the wife age 53 or older were represented in large numbers in the probable nonadopters category (57.9%).

Race. The share of white probable adopters was significantly larger than the number of black probable adopters (69.9% compared to 52.6%).

Age and Educational level. The *t*-test for parts e and f of Hypothesis 6 indicated statistically significant differences in the mean ages and educational levels for probable adopters and nonadopters of passive solar (see Table 23). Probable adopters were younger (9.2 years) and had more years of education, 12.1 compared to 10.7 for the probable nonadopters.

Active Solar

The results of the chi-squared test for active solar and parts a through d of Hypothesis 6 are presented in Table 24. The relationships for probable adoption and probable nonadoption and geographical location, type of household, stage in family life cycle, and race were statistically significant.

Geographical location. The majority of respondents in all states were probable adopters of active solar. Greater shares of respondents in Alabama and North Carolina (72.7% and 70.3%, respectively) were probable adopters and the largest percentage of probable nonadopters was in Virginia (49.3%).

Type of household. Large segments of probable adopters of active solar were found in family households composed of couples while the lower portions of probable adopters were found in family households headed by a

Table 23

Passive Solar:
Comparison of Probable Adopters and Probable Nonadopters on Age and Education

Variable	Probable Adopters Mean	Probable Adopters S.D.	Probable Nonadopters Mean	Probable Nonadopters S.D.	df	t	p
Age	46.6	17.1	55.8	16.6	1408	-9.55	.0001*
Education	12.1	3.2	10.7	3.2	1414	7.65	.0001*

*Significant at the alpha = .05 level.

Table 24

Active Solar:
Demographic Factors by Probable Adopters and Nonadopters

Factor	Probable Adopters No.	Probable Adopters %	Probable Nonadopters No.	Probable Nonadopters %
Geographical location[a]				
Alabama	117	72.7	44	27.3
Arkansas	103	55.1	84	44.9
Florida	78	58.7	55	41.4
Georgia	164	59.0	114	41.0
North Carolina	229	70.3	97	29.8
Oklahoma	94	64.8	51	35.2
Virginia	106	50.7	103	49.3
Type of household[b]				
Family households				
Couple families	688	66.0	354	34.0
Male, no spouse	13	61.9	8	38.1
Female, no spouse	48	52.8	43	47.3
Nonfamily households				
Single males	34	56.7	26	43.3
Single females	87	46.3	101	53.7
Others	11	68.8	5	31.3
Stage in family life cycle[c]				
Young couple	50	84.8	9	15.3
Oldest child < 5	37	67.3	18	32.7
Oldest child 5-12	123	74.1	43	25.9
Oldest child 13-18	162	75.4	53	24.7
Oldest child 19-23	92	63.9	52	36.1
Couple families (wife 31 to 52)	87	69.6	38	30.4
Couple families (wife 53 or older)	159	50.3	157	49.7
Race[d]				
White	729	65.0	393	35.0
Black	135	50.4	133	49.6

[a] X^2=34.442; *df* = 6; *p* = .0001

[b] X^2=31.272; *df* = 5; *p* = .0001

[c] X^2=57.903; *df* = 6; *p* = .0001

[d] X^2=19.605; *df* = 1; *p* = .0001

female with no spouse present (52.8%) and nonfamily households composed of single females (46.3%).

Stage in family life cycle. The majority of respondents in all stages of the family life cycle were probable adopters of active solar. A greater share of respondents in the young couple stage were probable adopters (84.8%) while the lowest portion of probable adopters was in the family life cycle stage of couple families with the wife age 53 or older (50.3%).

Race. There were more white probable adopters of active solar than there were black (65.0% compared to 50.4%).

Age and Educational level. The results of the *t*-tests for active solar and parts d and e of Hypothesis 6 are presented in Table 25. The mean age of probable adopters (45.5) was significantly lower than the mean age of probable nonadopters (55.3). There was also a significant difference in the mean educational levels indicating higher levels of education for probable adopters (12.1 years compared to 10.9).

Earth Sheltered/Underground

The results of the chi-squared test of Hypothesis 6, parts a through d, for earth sheltered/underground are shown in Table 26. Statistically significant relationships were found for probable adoption and probable

Table 25

Active Solar:
Comparison of Probable Adopters and Probable Nonadopters on Age and Education

Variable	Probable Adopters Mean	Probable Adopters S.D.	Probable Nonadopters Mean	Probable Nonadopters S.D.	df	t	p
Age	45.5	16.7	55.3	17.0	1387	-10.53	.0001*
Education	12.1	3.1	10.9	3.4	1025.9	6.32	.0001*

*Significant at the alpha = .05 level.

Table 26

Earth Sheltered/Underground:
Demographic Factors by Probable Adopters and Nonadopters

Factor	Probable Adopters No.	Probable Adopters %	Probable Nonadopters No.	Probable Nonadopters %
Geographical location[a]				
Alabama	77	38.9	121	61.1
Arkansas	84	41.0	121	59.0
Florida	40	27.6	105	72.4
Georgia	83	28.0	214	72.1
North Carolina	120	33.8	235	66.2
Oklahoma	85	58.2	61	41.8
Virginia	86	31.9	184	68.2
Type of household[b]				
Family households				
Couple families	454	39.6	693	60.4
Male, no spouse	5	19.2	21	80.8
Female, no spouse	33	29.2	80	70.8
Nonfamily households				
Single males	29	43.3	38	56.7
Single females	43	19.1	182	80.9
Others	9	47.4	10	52.6
Stage in family life cycle[c]				
Young couple	26	42.6	35	57.4
Oldest child < 5	24	38.7	38	61.3
Oldest child 5-12	76	46.1	89	53.9
Oldest child 13-18	88	37.8	145	62.2
Oldest child 19-23	58	36.3	102	63.7
Couple families (wife 31 to 52)	68	49.3	70	50.7
Couple families (wife 53 or older)	125	33.8	245	66.2
Race[d]				
White	478	38.4	768	61.6
Black	85	26.7	234	73.4

[a] X^2=49.916; df = 6; p = .0001
[b] X^2=42.340; df = 5; p = .0001
[c] X^2=14.789; df = 6; p = .0220
[d] X^2=15.138; df = 1; p = .0001

nonadoption and geographical location, type of household, stage in family life cycle, and race.

Geographical location. The majority of respondents (58.2%) in only one state, Oklahoma, were probable adopters of earth sheltered/underground housing. Probable nonadopters ranged from 59% in Arkansas to 72% in Florida and Georgia.

Type of household. The largest segment of respondents in all types of households were probable nonadopters of earth sheltered/underground housing. However, types of households with larger shares of probable adopters were nonfamily households composed of single males (43.3%), and nonfamily households composed of other than single males or single females (47.4%). Types of households reporting lower percentages of probable adopters were family households headed by males with no spouse present and nonfamily households composed of single females (19.2% and 19.1%, respectively).

Stage in family life cycle. Most of the respondents in all stages of the family life cycle were classified as probable nonadopters of earth sheltered/underground housing. The highest proportions of probable adopters were found in families with the oldest child ages 5 to 12 (46.1%) and in couple families with the wife age 31 to 52 (49.3%). The largest percentage of probable nonadopters was found in couple families with the wife age 53 or older (66.2%).

Race. A greater proportion of white respondents were probable adopters of this housing alternative than were blacks (38.4% compared to 26.7%).

Age and Educational level. The *t*-test results for parts d and e of Hypothesis 6 are presented in Table 27. Probable adopters of earth sheltered/underground housing were found to be significantly younger (a mean of 47.3 years compared to 52.3) and to have significantly more education (a mean of 12.0 years compared to 11.3) than probable nonadopters.

Summary of Hypothesis 6

The results of the test of null Hypothesis 6 which stated no relationship for demographic factors and the probable adoption and nonadoption of the housing alternatives indicated that the null hypothesis for all housing alternatives and all demographic variables (geographical location, type of household, stage in family life cycle, race, age of respondent, and educational level of respondent) could be rejected.

Table 27

Earth Sheltered/Underground:
Comparison of Probable Adopters and Probable
Nonadopters on Age and Education

Variable	Probable Adopters Mean	Probable Adopters S.D.	Probable Nonadopters Mean	Probable Nonadopters S.D.	df	t	p
Age	47.3	16.3	52.3	17.6	1559	-5.53	.0001*
Education	12.0	3.0	11.3	3.4	1305.7	4.23	.0001*

*Significant at the alpha = .05 level.

Test of Hypothesis 7

Hypothesis 7. For each of the housing alternatives, there are no differences in means or proportions between probable adopters and probable nonadopters with respect to the following energy variables:

a. belief in the energy crisis
b. impact of the energy situation on housing decisions
c. efforts to reduce utility costs
d. average monthly utility costs
e. presence of energy-conserving features in the dwelling (energy index).

Passive Solar

The chi-squared results of Hypothesis 7, parts a, b, and c, for passive solar are presented in Table 28. The relationship between belief in the energy crisis and probable adoption and probable nonadoption was not significant. Statistically significant relationships were found for probable adoption and probable nonadoption and impact of the energy situation on housing decisions and efforts to reduce utility costs.

Impact of the energy situation on housing decisions. For both those reporting an energy impact on housing decisions and those reporting none, the largest percentages of respondents were probable adopters of passive solar. However, the share of respondents indicating no energy impact on housing decisions who were probable nonadopters was greater than it was for those reporting energy had impacted their housing decisions, 46.3% compared to 28.6%.

Table 28

Passive Solar:
Energy Factors by Probable Adopters and Nonadopters

Factor	Probable Adopters No.	Probable Adopters %	Probable Nonadopters No.	Probable Nonadopters %
Believe in energy crisis[a]				
Yes	487	70.8	201	29.2
No	315	66.7	157	33.3
Energy situation had impact on housing decisions[b]				
Yes	736	71.4	295	28.6
No	201	53.7	173	46.3
Made effort to lower utility costs[c]				
Yes	817	69.7	355	30.3
No	154	53.5	134	46.5

[a] $X^2 = 2.149$; *df* = 2; *p* = .1426
[b] $X^2 = 38.459$; *df* = 2; *p* = .0001
[c] $X^2 = 27.365$; *df* = 2; *p* = .0001

Efforts to reduce utility costs. The majority of respondents who had tried to lower their utility costs were probable adopters of passive solar (69.7%). The percentage of respondents reporting no efforts to reduce utility costs was greater in the probable nonadopters category than it was for those who had tried to reduce utility costs (46.5% compared to 30.3%).

Utility costs and Energy index. The results of the *t*-test for passive solar and parts d and e of Hypothesis 7 are reported in Table 29. No significant difference was found between the mean monthly utility costs for probable adopters and probable nonadopters. Probable adopters were found to have a significantly higher mean score on the energy index than probable nonadopters (8.3 compared to 7.1).

Active Solar

The results of the chi-squared analysis for active solar and parts a, b, and c of Hypothesis 7 are reported in Table 30. The relationships for probable adoption and probable nonadoption and belief in the energy crisis, impact of the energy situation on housing decisions, and effort to reduce utility costs were statistically significant.

Belief in the energy crisis. A higher percentage of respondents who believed in the energy crisis were

Table 29

Passive Solar:
Comparison of Probable Adopters and Probable Nonadopters on Utility Costs and Energy Index

Variable	Probable Adopters Mean	Probable Adopters S.D.	Probable Nonadopters Mean	Probable Nonadopters S.D.	df	t	p
Utility Costs	$92.3	66.7	$94.0	78.0	745	-0.38	.7050
Energy Index	8.3	4.7	7.1	4.7	1452	4.82	.0001*

*Significant at the alpha = .05 level.

Table 30

Active Solar:
Energy Factors by Probable Adopters and Nonadopters

Factor	Probable Adopters No.	Probable Adopters %	Probable Nonadopters No.	Probable Nonadopters %
Believe in energy crisis[a]				
Yes	456	67.4	221	32.6
No	287	61.2	182	38.8
Energy situation had impact on housing decisions[b]				
Yes	690	67.2	337	32.8
No	168	47.1	189	52.9
Made effort to lower utility costs[c]				
Yes	763	65.7	398	34.3
No	127	46.0	149	54.0

[a] X^2 = 4.614; <u>df</u> = 2; <u>p</u> = .0317
[b] X^2 =45.548; <u>df</u> = 2; <u>p</u> = .0001
[c] X^2 =36.725; <u>df</u> = 2; <u>p</u> = .0001

classified as probable adopters of active solar (67.4%) than were nonbelievers. The share of nonbelievers was somewhat larger in the probable nonadopters group than it was for those who believed in the energy crisis (38.8% and 32.6%, respectively).

Impact of the energy situation on housing decisions. More probable adopters of active solar indicated the energy situation had influenced their housing decisions (67.2%) whereas more probable nonadopters reported no influence of the energy situation on housing decisions (52.9%).

Efforts to reduce utility costs. Respondents who had tried to lower utility costs were more likely to be probable adopters of active solar than those who had not attempted to reduce utility costs (65.7% compared to 46.0%).

Utility costs and Energy index. The results of examination of active solar and parts d and e of Hypothesis 7 are presented in Table 31. No significant difference was found in the mean utility costs for probable adopters and probable nonadopters. Using the *t*-test procedure, probable adopters were found to have a significantly higher mean score on the energy index (8.5) than probable nonadopters (6.9).

Table 31

Active Solar:
Comparison of Probable Adopters and Probable Nonadopters on Utility Costs and Energy Index

Variable	Probable Adopters Mean	Probable Adopters S.D.	Probable Nonadopters Mean	Probable Nonadopters S.D.	df	t	p
Utility Costs	$94.1	68.2	$91.8	75.2	970.3	0.55	.5815
Energy Index	8.5	4.7	6.9	4.7	1429	5.96	.0001*

*Significant at the alpha = .05 level.

Earth Sheltered/Underground

The chi-squared analysis for earth sheltered/underground and parts a, b, and c of Hypothesis 7 is reported in Table 32. No significant relationship was observed between probable adoption and probable nonadoption and belief in the energy crisis. Statistically significant relationships were found for probable adoption and probable nonadoption and impact of the energy situation on housing decisions and efforts to reduce utility costs.

Impact of the energy situation on housing decisions. The portion of respondents indicating that energy had affected their housing decisions was larger in the probable adopters group for earth sheltered/underground housing than it was for respondents reporting no influence of the energy situation on housing decisions (38.9% compared to 28.4%).

Efforts to reduce utility costs. The majority of respondents in both groups were probable nonadopters for earth sheltered/underground housing. However, the proportion of nonadopters was higher for those reporting no attempts to reduce utilities than it was for those who had tried to lower utility costs, 75.7% related to 61.4%.

Utility costs and Energy index. The results of the *t*-test for earth sheltered/underground and parts d and e of Hypothesis 7 are reported in Table 33. Probable non-

Table 32

Earth Sheltered/Underground:
Energy Factors by Probable Adopters and Nonadopters

Factor	Probable Adopters No.	Probable Adopters %	Probable Nonadopters No.	Probable Nonadopters %
Believe in energy crisis[a]				
Yes	293	38.1	477	62.0
No	189	38.1	307	61.9
Energy situation had impact on housing decisions[b]				
Yes	440	38.9	691	61.1
No	119	28.4	300	71.6
Made effort to lower utility costs[c]				
Yes	492	38.7	781	61.4
No	83	24.3	259	75.7

[a] X^2 = 0.000; df = 1; p = .9849
[b] X^2 =14.626; df = 1; p = .0001
[c] X^2 =24.313; df = 1; p = .0001

Table 33

Earth Sheltered/Underground:
Comparison of Probable Adopters and Probable Nonadopters on Utility Costs and Energy Index

Variable	Probable Adopters		Probable Nonadopters		df	t	p
	Mean	S.D.	Mean	S.D.			
Utility Costs	$86.3	62.9	$93.7	71.9	1210.1	-2.03	.0422*
Energy Index	8.4	4.9	7.5	4.7	1606	3.71	.0002*

*Significant at the alpha = .05 level.

adopters were found to have significantly higher mean utility costs ($93.7 compared to $86.3) while probable adopters had significantly higher mean scores on the energy index (8.4 compared to 7.5).

Summary of Hypothesis 7

The findings of the test of null Hypothesis 7 which stated no relationship for energy factors and the probable adoption and nonadoption of the housing alternatives can be summarized as follows:

1. reject for all housing alternatives: impact of the energy situation on housing decisions, efforts to reduce utility costs, and energy index.

2. reject for earth sheltered/underground: average monthly utility costs.

3. retain for all housing alternatives: belief in the energy crisis.

4. retain for passive and active solar: average monthly utility costs.

Test of Hypothesis 8

Hypothesis 8. There are no differences in means or proportions among respondents who are probable adopters for one, two, or three types of housing alternatives with respect to the following family demographic variables:

a. geographical location by state
b. type of household
c. stage in family life cycle

d. race
e. age of respondent
f. educational level of respondent.

Probable Adopters

The results of the chi-squared analysis for Hypothesis 8, parts a through d, are reported in Table 34. No significant relationship was found between probable adoption of one, two, or three types of housing alternatives and stage in the family life cycle. The relationships for the number of housing alternatives for probable adoption and geographical location by state, type of household, and race were statistically significant.

Geographical location. In most states, the majority of respondents were classified as probable adopters of two of the housing alternatives. The exceptions were Oklahoma where the largest proportion of respondents was classified as probable adopters for all of the housing alternatives (41.8%) and Virginia where the largest percentage of respondents was classified as probable adopters for only one type of housing alternative (40.4%).

Type of household. For most types of households, the largest share of respondents were probable adopters of two housing alternatives. The category of family households headed by males with no spouse present reported the highest frequency (76.5%) in this group. Nonfamily households composed of single males had the largest

Table 34

Demographic Factors by Probable Adoption of Number of Types of Housing Alternatives

Factor	One No.	One %	Two No.	Two %	Three No.	Three %
Geographical location[a]						
Alabama	44	29.0	65	42.8	43	28.3
Arkansas	46	28.9	69	43.4	44	27.7
Florida	37	32.7	45	39.8	31	27.4
Georgia	72	31.7	95	41.9	60	26.4
North Carolina	66	42.1	119	43.3	89	32.5
Oklahoma	35	26.1	43	32.1	56	41.8
Virginia	67	40.4	66	39.8	33	19.9
Type of household[b]						
Family households						
Couple families	275	29.4	372	39.8	287	30.7
Male, no spouse	3	17.7	13	76.5	1	5.9
Female, no spouse	28	38.4	28	38.4	17	23.3
Nonfamily households						
Single males	9	20.0	18	40.0	18	40.0
Single females	45	35.2	57	44.5	26	20.3
Others	5	31.3	6	37.5	5	31.3
Stage in family life cycle[c]						
Young couple	11	18.3	30	50.0	19	31.7
Oldest child < 5	15	28.9	20	38.5	17	32.7
Oldest child 5-12	41	26.5	58	37.4	56	36.1
Oldest child 13-18	52	25.6	86	42.4	65	32.0
Oldest child 19-23	37	30.1	52	42.3	34	27.6
Couple families (wife 31 to 52)	35	29.2	50	41.7	35	29.2
Couple families (wife 53 or older)	97	38.2	93	36.6	64	25.1
Race[d]						
White	268	27.2	410	41.7	306	31.1
Black	86	42.4	75	37.0	42	20.7

[a] X^2=28.083; df = 12; p = .0054

[b] X^2=21.479; df = 10; p = .0180

[c] X^2=18.085; df = 12; p = .1131

[d] X^2=20.051; df = 2; p = .0001

percentage of probable adopters for three of the housing alternatives (40.0%). Types of households with large proportions of respondents classified as probable adopters of one housing alternative were family households headed by females with no spouse present (38.4%) and nonfamily households composed of single females (35.2%).

Race. More whites than blacks were probable adopters of two (41.7% compared to 37.0%) or three (31.1% compared to 20.7%) of the housing alternatives.

Age. The analysis of variance procedure revealed significant differences in the mean ages for probable adopters of one, two, and three types of housing alternatives for the test of part e of Hypothesis 8 as reported in Table Z, Appendix G. The Tukey-Kramer method of comparison of means indicated the mean age of probable adopters of one type of housing alternative was significantly higher than the mean ages of probable adopters of two types (3.91 years higher) and probable adopters of three types of housing alternatives (6.02 years higher).

Educational level. In the test of Hypothesis 8, part f, no significant differences in the mean educational levels of respondents who were probable adopters of one, two, or three types of housing alternatives were found to exist when the effect of age on educational level was removed (Appendix G, Table AA).

Summary of Hypothesis 8

Null Hypothesis 8 stated no relationship between family demographic factors and the probable adoption for one, two, and three types of housing alternatives. The findings from the test of this hypothesis are summarized below:

1. reject for probable adoption: geographical location by state, type of household, race, and age of respondent.

2. retain for probable adoption: stage in family life cycle and educational level.

Test of Hypothesis 9

> Hypothesis 9. There are no differences in means or proportions among respondents who are probable adopters for one, two, or three types of housing alternatives with respect to the following energy variables:
>
> a. belief in the energy crisis
> b. impact of the energy situation on housing decisions
> c. efforts to reduce utility costs
> d. average monthly utility costs
> e. presence of energy-conserving features in the dwelling (energy index).

Probable Adopters

The chi-squared results for parts a, b, and c of Hypothesis 9 are presented in Table 35. No significant relationship was found between belief in the energy crisis and probable adoption of one, two, or three types

Table 35

Energy Factors by Probable Adoption of Number of Types of Housing Alternatives

Factor	One		Two		Three	
	No.	%	No.	%	No.	%
Believe in energy crisis[a]						
Yes	171	28.1	246	40.5	191	31.4
No	112	28.6	161	41.1	119	30.4
Energy situation had impact on housing decisions[b]						
Yes	256	27.9	376	41.0	286	31.2
No	99	37.6	103	39.2	61	23.2
Made effort to lower utility costs[c]						
Yes	298	29.0	416	40.5	314	30.5
No	68	34.9	85	43.6	42	21.5

[a]$X^2 = 0.125$; df = 2; p = .9396
[b]$X^2 = 11.045$; df = 2; p = .0001
[c]$X^2 = 6.853$; df = 2; p = .0325

of housing alternatives. Significant relationships were found for probable adoption of one, two, or three types of housing alternatives and impact of the energy situation on housing decisions and efforts to reduce utility costs.

Impact of the energy situation on housing decisions. Larger shares of respondents, both those reporting an impact of energy on housing decisions and those who did not, were probable adopters of two housing alternatives. The proportion of respondents reporting an energy impact on housing decisions was larger for probable adopters of three of the housing alternatives (31.2%) than it was for those reporting no impact of energy on housing decisions.

Efforts to reduce utility costs. For respondents who had attempted to lower their utility costs, the larger numbers were probable adopters for two or three housing alternatives (40.5% and 30.5%, respectively). The greater percentages of respondents reporting no attempt to reduce utility costs were probable adopters for one (34.9%) or two (43.6%) of the housing alternatives.

Utility costs. For part d of Hypothesis 9, no significant differences were observed in the mean utility costs for probable adopters of one, two, or three types of housing alternatives using the energy index as a co-variate (see Table BB, Appendix G).

Energy index. The analysis of covariance test (Appendix G, Table CC) for part e of Hypothesis 9 indicated a significant difference in the mean scores on the energy index for probable adopters of one, two, or three types of housing alternatives. The adjusted mean score on the energy index ranged from a low of 8.21 for probable adopters of one type to a high of 9.03 for probable adopters of three types of housing alternatives.

Summary of Hypothesis 9

The findings from the test of null Hypothesis 9 which stated no relationship for energy factors and the probable adoption of one, two, or three types of housing alternatives are summarized as follows:

1. reject for probable adoption: impact of the energy situation on housing decisions, efforts to reduce utility costs, and presence of energy-conserving features in the dwelling.

2. retain for probable adoption: belief in the energy crisis and average monthly utility costs.

Test of Hypothesis 10

Hypothesis 10. For each of the housing alternatives, there are no differences in proportions between probable adopters and probable nonadopters among the various stages of the adoption process.

Passive Solar

The chi-squared results for Hypothesis 10 are reported in Table 36. A statistically significant relationship was found between the probable adoption or nonadoption of passive solar and the respondent's position in the innovation adoption process. The proportions of probable adopters were higher in the interest and evaluation stages (4.4% and 12.1%) than they were for probable nonadopters.

Active Solar

The relationship between probable adoption and nonadoption of the active solar housing alternative and the respondent's position in the adoption process was significant. The percentages of probable adopters in the interest and evaluation stages (5.3% and 14.8%) were larger than they were for probable nonadopters.

Earth Sheltered/Underground

The relationship between probable adoption and nonadoption and the respondent's position in the adoption process was statistically significant. Of the probable adopters, 4.0% were in the interest stage and 15.2% were in the evaluation stage. For the probable nonadopters, only 2.0% were in the interest stage and only 0.9% were in the evaluation stage of the innovation adoption process.

Table 36

Probable Adoption of Housing Alternatives by Stage in the Adoption Process

Housing Alternative	Stages in the Adoption Process					
	Awareness		Interest		Evaluation	
	No.	%	No.	%	No.	%
Passive Solar[a]						
Probable Adopters	576	83.6	30	4.4	83	12.1
Probable Non-adopters	276	97.2	3	1.1	5	1.8
Active Solar[b]						
Probable Adopters	539	79.9	36	5.3	100	14.8
Probable Non-adopters	300	92.9	9	2.8	14	4.3
Earth Sheltered/Underground[c]						
Probable Adopters	409	80.8	20	4.0	77	15.2
Probable Non-adopters	762	97.1	16	2.0	7	0.9

[a] $X^2=34.212$; *df* = 2; *p* = .0001
[b] $X^2=25.965$; *df* = 2; *p* = .0001
[c] $X^2=104.706$; *df* = 2; *p* = .0001

Summary of Hypothesis 10

The results of testing null Hypothesis 10 which stated no relationship of probable adoption and nonadoption to the respondent's position in the innovation adoption process indicated that the hypothesis can be rejected for all housing alternatives.

Prediction of Probable Adoption and Nonadoption

In addition to the hypotheses tested in the study, discriminant analysis was utilized to determine whether demographic or energy factors were the better predictors of probable adoption and probable nonadoption for each of the housing alternatives studied. With the discriminant analysis using both demographic and energy factors, the proportion of respondents misclassified as probable adopters and nonadopters was relatively high. The results of the discriminant function with the highest rate of successful classifications using both demographic and energy factors as predictors are presented as representative examples of the results obtained with this analysis.

Demographic Variables. Using the demographic variables studied throughout the research (geographical location by state, type of household, stage in family life cycle, race, age of respondent, and educational level of respondent), a discriminant function was developed to classify respondents as probable adopters and nonadopters of each type of housing alternative. The results presented here are for the discriminant function for passive solar which classified a larger proportion of respondents correctly than the functions for active solar or earth sheltered/underground. The classification criterion was based on the within-group covariance matrices rather than the pooled covariance matrix since the test for homogeneity of the within-group covariance matrices failed. This resulted in a quadratic rather than linear discriminant function. Using the function derived to classify respondents in the research resulted in the categorization of respondents shown in Table 37. These results indicated that the demographic variables studied in the research were better predictors of probable adoption for passive solar than they were of probable nonadoption.

Energy Variables. Using the discriminant analysis based on energy variables (belief in the energy crisis, impact of the energy situation on housing decisions, efforts to reduce utility costs, average monthly utility costs, and the energy index) more respondents were correctly classified as probable adopters and nonadopters for the active solar housing alternative than for the other housing alternatives. This function was also quadratic rather than linear with the criterion based on the

Table 37

Passive Solar:
Prediction of Probable Adoption and Nonadoption
Based on Demographic Variables

	Predicted Classification Based on Demographics			
	Probable Adopters		Probable Nonadopters	
Observed No.	No.	%	No.	%
Probable Adopters (n = 729)	546	74.9	183	25.1
Probable Nonadopters (n = 314)	152	64.2	162	35.8

within-group covariance matrices rather than the pooled covariance matrix. The results of the application of the developed discriminant function to the respondents in this research are indicated in Table 38. For the participants in the study, these results indicated that energy factors were better overall predictors of probable adoption and probable nonadoption than demographic factors.

A discussion of the findings presented in this chapter for the test of Hypothesis 1 through 10 and the prediction of probable adoption and nonadoption of the housing alternatives follows in Chapter 6.

Table 38

Active Solar:
Prediction of Probable Adoption and Nonadoption
Based on Energy Variables

	Predicted Classification Based on Energy Factors			
	Probable Adopters		Probable Nonadopters	
Observed No.	No.	%	No.	%
Probable Adopters (n = 657)	456	69.4	201	30.6
Probable Nonadopters (n = 361)	173	47.9	188	52.1

CHAPTER SIX

DISCUSSION OF FINDINGS

A summary and discussion of the findings are presented in this chapter along with a comparison of the results to other research. Chapter Six is organized into three major sections, one each on demographic, energy, and regulatory code variables.

Demographic Variables

The demographic variables analyzed in the study included geographical location by state, type of household, stage in the family life cycle, race, age, and educational level of respondent.

Geographical location by state

Statistically significant relationships were found for geographical location and: the respondent's position in the adoption process for each housing alternative; awareness of number of types of housing alternatives; probable adoption and probable nonadoption for each housing alternative; and, the number of types of housing alternatives for probable adoption.

In general, respondents in the southernmost states were further along in the adoption process and were more likely to be probable adopters of the housing alternatives studied. Virginia reported lower rates of probable adoption than the other states and had more probable adopters of only one housing alternative. This may have been due to the fact that Virginia was the northernmost state in the study and respondents may have held the misconception that passive and active solar were suitable only in more southern and warmer climates. Lower rates of probable adoption in Virginia may also be reflective of a more conservative taste in terms of architectural images for housing.

The highest proportion of probable adopters of earth sheltered/underground housing was in Oklahoma. Arkansas also reported a higher frequency of probable adopters for earth sheltered/underground than the other states. The findings suggest that respondents in Oklahoma and Arkansas may have considered the safety advantages of earth sheltered/underground dwellings for tornado prone areas in addition to their energy-conserving advantages.

Wisenblit (1981) recognized the importance of regional and climatic factors in relation to the adoption of solar heating. He discussed these concerns within the perceived innovation attributes framework devised by Rogers and Shoemaker (1971) as part of the classical diffusion of innovations theory. Wisenblit proposed that regional factors be considered under the attribute of compatibility. Empirical investigations reported to date have been limited to one location or several locations within the same state.

Type of household

The relationships for type of household and the following variables were found to be statistically significant: respondent's position in the adoption process for each housing alternative; awareness of number of types of housing alternatives; probable adoption and nonadoption of each housing alternative; and the number of types of housing alternatives for probable adoption. In general, family households were more prevalent than other types of households in the interest and evaluation stages of the adoption process. Female headed family households and single female households tended to be probable adopters for only one type of housing alternative and were represented in lower frequencies as probable adopters for all the housing alternatives. Single male households were more likely to be probable adopters of three types of housing alternatives and other types of nonfamily households were also more likely to be probable adopters of the earth sheltered/underground housing alternative. The findings suggest that households headed by males are more likely to adopt innovative, energy-efficient housing alternatives. A factor contributing to this result could be the relatively high number of low-income female headed households, who may have believed that the housing alternatives would be expensive to adopt. It may also be that the females in the study perceived these housing innovations as too complex and not compatible with their current housing situation.

Type of household was not utilized as a variable in the literature reviewed for the study. Other researchers have, however, utilized the variable stage in family life cycle which is the next variable to be discussed.

Stage in family life cycle

Significant relationships were observed for stage in the family life cycle and the following variables: respondent's position in the adoption process for the active solar housing alternative; awareness of number of types of housing alternatives; and, probable adoption and probable nonadoption of each housing alternative. For the active solar housing alternative, more couples (both young marrieds and couple families with the wife age 31 - 52) and more families with children under 5 or between 13 and 18 were in the evaluation stage. Larger numbers of families with children between 5 and 12 and couple families with the wife age 53 or over were in the awareness stage.

Awareness of three housing alternatives was greatest among couple families, for both those with the wife between 31 and 52 and those with the wife age 53 or older.

The results suggest that although families in the later stages of the family life cycle possess knowledge of the housing alternatives, they are not likely to become probable adopters. Families in the later stages of the family life cycle are especially likely to be living in houses with mortgages at low interest rates and, therefore, are likely to feel that their housing options are very restricted. The increase in monthly mortgage payments would more than offset any reduction in utility costs achieved by adoption of the energy-efficient housing alternatives. The fact that approximately half the sample reported average monthly utility costs of less than $80 helps explain the apparent reluctance of families in the later stages of the family life cycle to exchange the possibility of reduced utility bills for the certainty of higher mortgage payments. These families may also have sentimental attachments to their current residence or a lack of confidence in the innovation to provide the level of comfort and savings they desire. The findings also indicate that there are several stages in the family life cycle where other factors may take precedence over concern with energy-efficient housing. For example, larger numbers of families with the oldest child between 19 and 23, the typical period of heavy financial demands for educational purposes, were aware of only one housing alternative.

These results support the findings of LaBay and Kinnear (1981a) from a study of the adoption of solar heating and hot water heating systems which indicated that adopters were usually in the earlier stages of the family life cycle. In addition, Combs, Tremblay, and Madden (1982) found that the elderly and families with two or fewer persons tended to perceive solar systems as more complex. Wisenblit (1981) also discussed the problems of perceived complexity in understanding and computing payback periods and in the functioning and maintenance of systems, both of which may have been influential in the results obtained with the analysis of the family life cycle variable.

Race

The relationships for race and the following variables were statistically significant: respondent's position in the adoption process for active solar and earth sheltered/underground; awareness and evaluation of number of types of housing alternatives; probable adoption and probable nonadoption of each of the housing alternatives; and, the number of types of housing alternatives for probable adoption. In all cases, white respondents were more likely than black respondents to be in the interest and evaluation stages for each of the housing alternatives, to be in awareness and evaluation for more housing alternatives, and to be probable adopters of a greater number of housing alternatives. Differences in educational level and income between whites and blacks may have contributed to these results. It is also possible that differences in educational level may cause more blacks to perceive these housing innovations as too complex. In addition, the observability of the housing innovations may be a negative factor for many blacks who are just beginning to achieve the traditional image of normative housing in our society.

The variable race was not analyzed in other research reviewed for this study.

Age of respondent

Statistically significant relations were found for age of respondent and the following variables: respondent's position in the adoption process for the active solar and earth sheltered/underground housing alternative; probable adoption and nonadoption for each housing alternative; and, the number of types of housing alternatives for probable adoption. Younger respondents were more likely than older ones to be in the evaluation stage for each housing alternative and to be probable adopters of two or three types of housing alternatives. Younger persons may perceive fewer risks associated with these innovations and because of higher educational levels they may view them as less complex. Because of their age, they may also be willing to accept longer payback periods than older persons. Furthermore, it is possible that a number of younger persons are interested in this type of innovation from a moral and ethical perspective arising from concern with environmental issues.

The results of existing research on age indicate no clearly defined trend in terms of its relation to the adoption of energy-conserving housing innovations. LaBay and Kinnear (1981a) found adopters to be younger whereas Leonard-Barton (1981a) reported that age was not a good predictor of intention to purchase a residential solar system. In another study (1981b), she did, however, find higher levels of awareness among younger persons. Rogers (1983) noted in his most recent summary of diffusion research that the overall results on the relationship of age to the adoption of innovations are still inconclusive.

Educational level of respondent

The relationships for educational level and the following variables were statistically significant: respondent's position in the adoption process for each housing alternative; awareness of and interest in number of types of housing alternatives; and, probable adoption and probable nonadoption of each housing alternative. Respondents with more education were generally found in the interest and evaluation stages for each housing alternative, were aware of all three types of housing alternatives, were interested in two or more of the housing alternatives, and were probable adopters of each of the housing alternatives. More education may enable persons to better understand the functioning and payback computation of these innovations (and thereby reduce their perceived complexity). In addition, persons with higher levels of education usually earn higher incomes, so any perceived risk of adopting the housing alternatives may be of less importance. An enhanced awareness of environmental and energy issues developed from more education could make these housing alternatives more compatible with the philosophies and lifestyles of this segment of the population.

The results of the research in terms of educational level are consistent with the other literature surveyed. LaBay and Kinnear (1981a), Leonard-Barton (1981b), Rogers (1981), and Unseld and Crews (1981) reported higher levels of education among adopters of such housing alternatives as passive and active solar. In many cases, the educational levels observed were unusually high. These results are also consistent with the generalization related to educational level derived by Rogers (1983) in his review of diffusion research, namely that early adopters have higher levels of education than later adopters.

Prediction of probable adoption and nonadoption

The discriminant analysis using demographic variables as the basis for predicting probable adoption and nonadoption of the housing alternatives was most successful for the passive solar alternative. There was, however, still a large number of incorrect predictions, particularly for probable nonadopters. The most likely explanation for this is that other variables not included in the study were influencing responses to the interview items. The cost, or more precisely, the perceived cost of adopting these housing alternatives may have caused some respondents who would otherwise have been probable adopters to respond negatively to their adoption. Other factors, such as impossibility or lack of desire to more or the perceived risk of adoption may also have influenced the findings.

Leonard-Barton (1981b) reported that financial considerations were among the top factors important in the decision to purchase solar equipment. Warkov (1981) also noted that nonadopters in the HUD solar hot water heater program frequently cited problems with the costs of adopting the innovation. In their study of adopters of solar heating and hot water heating, LaBay and Kinnear (1981a) reported that a multiple discriminant function based on the perceived attributes of the innovation was a better predictor of solar adoption than one based on demographic factors.

Energy Variables

The energy variables examined in the study included belief in the energy crisis, impact of the energy situation on housing decisions, efforts to reduce utility costs, average monthly utility costs, and the presence of energy-conserving features in the dwelling (energy index).

Belief in the energy crisis

The only significant relationships were for belief in the energy crisis and the respondent's position in the innovation adoption process for the housing alternatives. For each of the housing alternatives, persons who believed in the energy crisis were represented in larger numbers than nonbelievers in the interest and evaluation stages, indicating that belief in and concern about the energy crisis can be a motivating factor in seeking more information and determining the advantages and disadvantages of energy-efficient housing alternatives. The fact that other significant relationships were not observed may be a function of the amount of time that has passed since the two peak periods of energy shortages in the U.S. (1973 - 1974 and 1979), indicating a change in perception about energy from that of a crisis situation to that of a long term problem.

Other researchers have reported some support for the relation of attitude toward the energy crisis and the adoption of energy innovations. In one study, Leonard-Barton (1981a) reported attitude toward the energy crisis was not a good predictor of intention to purchase a residential solar system. In another study, however, Leonard-Barton (1981b) reported a positive, but weak relationship between these variables. In Warkov's study of the adoption of solar hot water heaters (1981), belief in declining world fossil fuel supplies was found to be a good predictor of solar adoption.

Impact of the energy situation on housing decisions

Statistically significant relations were observed for impact of the energy situation and: the respondent's position in the adoption process for each housing alternative; awareness of number of types of housing alternatives; probable adoption and nonadoption of each housing alternative; and, the number of types of housing alternatives for probable adoption. Respondents indicating the energy situation had impacted housing decisions were more likely than those reporting no influence of energy on housing decisions to be in the interest and evaluation stages and to be probable adopters of three types of housing alternatives. These results suggest a strong relationship between the respondent's perception of the energy situation in terms of previous and current housing decisions and the future adoption of energy-efficient housing alternatives.

Although other researchers have not used precisely the same variable, some related evidence exists as support for these findings. Leonard-Barton (1981b) found that attitude about the personal feasibility of solar equipment was one of only four significant predictors of intention to purchase and that solar adopters invested more in real estate and home improvements. She also reported (1981a) that the probability of moving, the perceived effect on resale potential, and the expectation of future energy costs were not good predictors of intention to purchase solar equipment.

Efforts to reduce utility costs

The relationships for efforts to reduce utility costs and the following variables were statistically significant: stage in the adoption process for each housing alternative; awareness of number of types of housing alternatives; probable adoption and nonadoption of each housing alternative; and, the number of types of housing alternatives for probable adoption. In general, persons reporting efforts to reduce utility costs were represented in larger numbers than those who had not tried to reduce utility costs in the interest and evaluation stages. They were also more likely to be aware of two or three of the housing alternatives and to be probable adopters for two or three of the housing alternatives. These findings provide support for a relationship between past and future behaviors since they indicate that persons attempting to reduce utility costs in the past are likely to continue that concern about utility costs in the future as probable adopters of energy-efficient housing alternatives.

Differences in phrasing of survey questions make direct comparisons of these results with other research questionable. Related findings reported by Warkov (1981) indicated that energy conservation practices were not good predictors of adoption of solar water heaters and that many nonadopters felt similar benefits could be obtained with other conservation measures. In addition, Leonard-Barton (1981a) found expectations of future energy costs to be a poor predictor of intention to purchase residential solar equipment.

Utility costs

The only significant relationship found using average monthly utility costs as a variable was with the probable adoption and nonadoption of the earth sheltered/underground housing alternative. Probable nonadopters of earth sheltered/underground housing had higher mean utility costs than probable adopters. This may indicate that although utility costs were higher, incomes were also higher making the role of utility costs in housing decisions less important. These results may also be an indication of the overwhelming negative response to the earth sheltered/ underground housing alternative shown throughout the study (with nearly every category of all variables analyzed, the majority of respondents were probable nonadopters). The fact that no other significant relationships were found using utility costs may indicate a belief on the part of respondents that regardless of their individual actions, utility costs will continue to increase.

No clear trend is evident in the research to date on the relation of utility costs to the adoption of energy-conserving innovations. Leonard-Barton (1981a) reported that utility costs and expectations of future energy costs were not good predictors of intention to purchase solar equipment. On the other hand, another study by Leonard-Barton (1981b) found that adopters of solar equipment had higher utility bills than nonadopters.

Energy index

Statistically significant relationships were found for energy index (presence of energy-conserving features in the dwelling) and the following variables: respondent's position in the adoption process for each housing alternative;

awareness of number of types of housing alternatives; probable adoption and nonadoption of each housing alternative; and, the number of types of housing alternatives for probable adoption. Respondents reporting higher scores on the energy index were generally in the more advanced stages of the adoption process for each housing alternative than respondents with lower scores. They also tended to be probable adopters for all the housing alternatives. The results suggest that past behaviors to purchase or retrofit houses with energy-conserving features are indicative of future consideration and probable adoption of energy-efficient housing innovations. It may also be true that a continuum of energy-conserving measures exists and that once an initial action is instituted, others follow more easily.

These findings contradict those of Warkov (1981) in his study of the adoption of solar hot water heaters where he found energy conservation practices to be poor predictors of adoption. This discrepancy may be related to the fact that Warkov's study involved retrofitting for solar hot water heaters which meant that proper siting and acceptable roof design became dominant factors in the decision to adopt. His research was also limited in terms of location to the state of Connecticut.

Prediction of probable adoption and nonadoption

The discriminant function based on energy factors was most successful in predicting probable adoption and nonadoption of the active solar housing alternative. In this instance, the majority of respondents for both probable adoption and probable nonadoption were classified correctly. The greater success of this discriminant function may be attributed to the fact that actual behaviors in terms of energy conservation were measured in some of the variables entered into the function, indicating a relationship between past and future behaviors.

The role of energy variables in predicting adoption of energy-efficient, housing innovations is not yet clear. Leonard-Barton (1981a) found that energy factors were not good predictors of the intention to purchase residential solar systems. On the other hand, Warkov (1981) reported that belief in declining world fossil fuel supplies was a good predictor of solar adoption.

Regulatory Code Variables

The regulatory code variables studied in the research were: presence of each housing alternative in the locality; presence or absence of construction codes (specifically building, zoning, and energy); and, prior need for variances in codes in order to construct housing alternatives.

Presence of alternative housing

No significant relationships were observed for the presence of alternative housing and the respondent's position in the innovation adoption process for any of the housing alternatives. This finding could be a function of the relatively low numbers of respondents living in areas where the housing alternatives were present. Or, particularly in the case of passive solar, it may have been that the housing alternative was present but not recognized as such by the general public, an explanation consistent with the generalizations developed by Rogers (1983) related to the innovation attribute of observability. It is also possible that the presence of existing forms of housing alternatives were known to a relatively small number of persons living in the locality.

Leonard-Barton's research (1981a) indicated that it may not be just the presence of energy-efficient housing alternatives which influences others to adopt them, but the actual number of owners known on a personal basis. She concluded that this finding provided support for the strong role that interpersonal communication plays in the diffusion of residential energy-conserving technologies. In another study, Leonard-Barton (1981b) reported that the number of solar owners known by the respondent was the strongest predictor of intention to purchase residential solar.

Building codes

There were no significant relationships found for the respondent's position in the innovation adoption process and the presence of building codes in the locality for any of the housing alternatives. It seems likely that the small number of localities in which any of the housing alternatives had been constructed is a major contributing factor to this finding. It may simply be that so few of these units have been constructed in the localities examined that the majority of respondents were unaware of whether or not the code would enhance or impede their construction. This finding may also reflect a general lack of knowledge among the public about the functions, purposes, and practices of building codes, particularly in the area of adoption of new products, materials, and technologies.

The negative impact of building codes and regulations on the adoption of innovations in the building industry has been discussed by a number of writers (Boyd and Wilson, 1974; Nelkin, 1971; Oster and Quigley, 1977; Schoen et al., 1975). Others have focused more specifically on the impact of building codes and regulations on the adoption of energy-conserving innovations in housing (Dalton, 1979; Miller & Thompson, 1977; Shillington, 1979; Talbot & Johnson, 1979). Problems mentioned include difficulties in defining passive solar, the lack of nationally recognized standards and tests, and the fact that since these types of systems are not specifically included in most codes they are subject to testing and appproval requirements which increase uncertainty and expenses.

Zoning ordinances

Statistically significant relationships were found for the respondent's position in the innovation adoption process and the presence of zoning ordinances for passive solar and earth sheltered/underground but not for active solar. In general, respondents who lived where there were no zoning ordinances were more likely than those in localities with zoning to be in the interest and evaluation stages of the adoption process. This may indicate that persons in localities without zoning feel freer to build whatever type of housing meets their specific needs or lifestyle while those who live where there is zoning feel confined to a more traditional style and appearance for housing. No relationship for passive solar and zoning may also be an aspect of the lack of observability of the innovation.

The negative impact of zoning ordinances on the adoption of energy-efficient housing innovations has been described by a number of authors (O'Riordan & Migani, 1979; Shillington, 1979; Talbot & Johnson, 1979). Particular problems mentioned in connection with zoning ordinances and subdivision regulations include lot size restrictions, set back and side yard requirements, and building height requirements.

Energy codes

No statistically significant relationships were found for stage in the adoption process and the presence of energy codes for any of the housing alternatives. This may be due to the fact that many localities incorporate energy requirements directly into the building code rather than having a separate set of regulations. It may also reflect a lack of awareness about or understanding of such codes by the general public.

In his discussion of the barriers to the adoption of passive solar, Dalton (1979) pointed out that even energy codes can impede the adoption of energy-efficient housing systems. This is especially true where codes require advance calculation of energy savings which can be very difficult for passive solar dwellings. He also indicated problems exist in developing a precise definition of a passive solar system.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of the study was to examine the relationships between the adoption of energy-efficient, housing alternatives and demographic, energy, and regulatory code factors. The study, conducted within the framework of classical diffusion of innovations theory as explained by Rogers and Shoemaker (1971), utilized three stages of the adoption process (awareness, interest, and evaluation) and also analyzed the probable adoption and nonadoption of each of the housing alternatives examined.

The source of data for the study was the Southern Regional Research Project, S-141, Housing for Low- and and Moderate-Income Families. A sample of 1804 households was interviewed to obtain household demographic and energy information. The households interviewed were located in four counties from each of the seven participating states (Alabama, Arkansas, Florida, Georgia, North Carolina, Oklahoma, and Virginia). The counties were selected using a stratification system based on annual income and the percentage of nonfarm households in the county. Data from the households were obtained by means of an interview schedule, "Perceptions of Alternative Housing," that had been developed, pretested, and revised by the S-141 technical committee. The revised instrument contained sections on present housing conditions, decision-making practices, consumer acceptance of housing alternatives, and demographics.

Data pertaining to regulatory codes were collected for a subset consisting of four of the states involved in the overall project (Arkansas, North Carolina, Oklahoma, and Virginia) in the same counties as household demographic and energy data. Two mailed questionnaires were sent to local officials to obtain this information. Follow-up letters and telephone contacts were employed to increase the response rate.

The demographic variables analyzed were: geographical location by state, type of household, stage in the family life cycle, race, age of respondent, and educational level of respondent. The energy factors studied included: belief in the energy crisis, impact of the energy situation on housing decisions, efforts to reduce utility costs, average monthly utility costs, and the presence of energy-conserving features in the dwelling (energy index). The regulatory code variables examined were: presence of housing alternatives in the locality, presence or absence of construction codes, and the prior need for variances to construct housing alternatives in the locality. It was necessary to create some of these variables using raw data available from the S-141 instruments.

Stages in the adoption process and the probable adoption and nonadoption of three types of energy-efficient, innovative housing alternatives were considered in the study: passive solar, active solar, and earth sheltered/underground. Respondents were categorized into the various stages of the adoption process (awareness, interest, and evaluation) and as probable adopters and nonadopters based on their responses to a series of questions on the instrument "Perceptions of Alternative Housing."

Various techniques of statistical analysis were utilized depending upon the nature and level of measurement of the variable being studied. The following statistical methods were used in the study: chi-squared test, *t*-test, analysis of variance, analysis of covariance, and discriminant analysis.

Description of Respondents and Households

Approximately 80% of the respondents participating in the study were white and almost two-thirds had at least a high school education. More than 60% of the respondents were over the age of 45. Over three-quarters of the households were composed of families although nearly half of these were couple families with no children. Slightly more than half of the households had incomes below $15,000.

The households were distributed among the seven participating states based on median annual income and the percentage of nonfarm households in each state.

More than half of the respondents in the study reported monthly utility bills between $50 and $119 while about two-thirds reported conservation measures resulting in low or moderate scores on the energy index. The proportions indicating they believed in the energy crisis, felt the energy situation had influenced housing decisions, and had made efforts to reduce utility costs ranged from about 60% to nearly 80%.

The largest proportions of respondents were in the awareness stage for all the housing alternatives. About two-thirds were classified as probable adopters of passive and active solar whereas only one-third were probable adopters for earth sheltered/underground.

Most of the respondents lived in communities with no examples of the housing alternatives present. Building codes and zoning ordinances were present in the majority of localities, but very few had energy codes.

Results and Conclusions

The overall results of the statistical analysis (i.e., significant relationships/differences in means) are presented in Chart 1. A summary of the findings and conclusions based on those findings will be presented in

Chart 1

Summary of Significant Relationships/Differences

	Adoption Process			Number of Alternatives In			Probable Adoption/Nonadoption			Number for
	Passive Solar	Active Solar	Earth Sheltered	Aware	Interest	Evaluation	Passive Solar	Active Solar	Earth Sheltered	Probable Adoption
Demographic Variables										
Geographic location	X	X	X	X			X	X	X	X
Type of household	X	X	X	X			X	X	X	X
Stage in family life cycle		X		X			X	X	X	
Race		X	X	X		X	X	X	X	X
Age		X	X				X	X	X	X
Educational level	X	X	X	X	X		X	X	X	
Energy Variables										
Belief in energy crisis	X	X	X							
Impact on housing decisions	X	X	X				X	X	X	X
Efforts to reduce utility costs	X	X	X	X			X	X	X	[illegible]
Average utility costs									X	
Energy index	X	X	X	X			X	X	X	X
Regulatory Code Variables										
Presence of alternative housing				-	-	-	-	-	-	-
Building code				-	-	-	-	-	-	-
Zoning	X		X	-	-	-	-	-	-	-
Energy code				-	-	-	-	-	-	-
Prior need for variances				-	-	-	-	-	-	-
Stages in Adoption Process										
Passive solar	-	-	-	-	-	-	X	-	-	-
Active solar	-	-	-	-	-	-	-	X	-	-
Earth sheltered/underground	-	-	-	-	-	-	-	-	X	

three sections, one each on demographic, energy, and regulatory code variables.

Demographic Variables

Geographical location by state. In general, the findings indicated that greater numbers of respondents in the states of the deep south were found in the more advanced stages of the adoption process. In particular, respondents in Virginia were more likely to be probable adopters of only one of the housing alternatives than respondents in the other states. The share of probable nonadopters for each of the housing alternatives was also larger in Virginia than in the other states. Oklahoma and Arkansas had higher percentages of probable adopters of the earth sheltered/underground housing alternative than the other states.

Type of household. Family households especially those headed by males tended to be in the more advanced stages of the adoption process and were more likely to be probable adopters while single female and female headed households tended to be probable nonadopters in greater proportions. Single male and other types of nonfamily households were represented in higher numbers as probable adopters of all three of the housing alternatives.

Stage in the family life cycle. As a general rule, probable adopters tended to be in the earlier stages of the family life cycle whereas nonadopters were more often couple families with the wife age 53 or older. More couple families, both those with the wife between 31 and 52 and those with the wife age 53 or older, were aware of all three housing alternatives while families with children between 19 and 23 tended to be aware of only one housing alternative. For the active solar housing alternative, more couple families (both young marrieds and those with the wife between 31 and 52) and more families with children under 5 or between 13 and 18 were in the evaluation stage. Greater proportions of families with children between 5 and 12 and of couple families with the wife age 53 or older were found in the awareness stage.

Race. White respondents in the study were more likely than black respondents to be in the interest and evaluation stages, were more likely to be probable adopters, were in awareness and evaluation for more of the housing alternatives, were more likely to be probable adopters for each of the housing alternatives, and were probable adopters of more than one type of the housing alternatives.

Age of respondent. Younger respondents were represented in greater proportions than older respondents in the evaluation stage of the adoption process for active solar and earth sheltered/underground housing. Probable adopters of each of the housing alternatives also tended to be younger as did those who were probable adopters of two or three types of the housing alternatives.

Educational level of respondent. Respondents in the interest and evaluation stages usually had higher levels of education. Probable adopters of the housing alternatives as well as those aware of all the housing alternatives and interested in two or more of the housing alternatives were also likely to have more education.

Prediction of probable adoption and nonadoption. The highest rate of correct classifications using the discriminant function developed to predict probable adoption and nonadoption on the basis of demographic variables was obtained for the passive solar housing alternative. However, the number of respondents misclassified, particularly probable nonadopters, was relatively large.

Conclusions. The following conclusions are derived from the results obtained by analyzing demographic variables:

1. Geographical location was a factor in the adoption process for energy-efficient housing alternatives. Respondents in Virginia, the northernmost state in the study, were less likely to be probable adopters and were more likely to be in the earlier stages of the adoption process. This result combined with the higher levels of probable adoption for the earth sheltered/underground housing alternative found in Oklahoma and Arkansas indicate

that other regional and geographical factors (conservative taste in architecture and susceptibility to tornadoes, for example) may influence probable adoption of innovative types of housing.

2. Family households particularly those headed by males were more likely to be in the interest and evaluation stages of the adoption process while households headed by females or composed of single females were more likely to be aware of only one housing alternative and were less likely to be probable adopters of the housing alternatives than other types of household. Single male and other types of nonfamily households tended to be probable adopters of all three housing alternatives.

3. Probable adopters of the housing alternatives tended to be in the earlier stages of the family life cycle. Although couple families with the wife over age 53 reported high levels of awareness for all three of the housing alternatives, they tended to be probable non-adopters.

4. More white than black respondents were found in the advanced stages of the adoption process, in awareness and evaluation for more types of housing alternatives, as probable adopters for each housing alternative, and as probable adopters for more types of housing alternatives.

5. In most cases, respondents in the interest and evaluation stages were younger. Probable adopters of the housing alternatives were also found to be younger.

6. Higher educational levels were reported by respondents in the interest and evaluation stages of the adoption process. Respondents with higher levels of education were generally aware of all the housing alternatives and interested in two or more of the housing alternatives. They were also more likely to be probable adopters of each of the housing alternatives.

7. The prediction of probable adoption and non-adoption using the discriminant function based on demographic variables resulted in a relatively high proportion of misclassification although the rate of successful prediction was better for probable adopters than it was for probable nonadopters. The influence of other variables on the decision to adopt (particularly perceived cost) may explain the predictive problems with this analysis.

Energy Variables

Belief in the energy crisis. Respondents who believed in the energy crisis were found in greater numbers than nonbelievers in the interest and evaluation stages of the adoption process for each of the housing alternatives.

Impact of the energy situation on housing decisions. Larger proportions of respondents reporting the energy situation had influenced housing decisions than those indicating no energy impact on housing decisions were in the interest and evaluation stages of the adoption process, were probable adopters for each housing alternative, and were aware of and probable adopters of more types of housing alternatives.

Efforts to reduce utility costs. In comparing respondents who had and those who had not attempted to reduce utility costs, more respondents who had attempted to reduce their utility costs were found in the interest and evaluation stages, were aware of two or three of the housing alternatives, were probable adopters for each of the housing alternatives, and were probable adopters of more types of housing alternatives.

Utility costs. Probable nonadopters of the earth sheltered/underground housing alternative reported higher monthly utility costs than probable adopters.

Energy index. In general, higher scores on the energy index (indicating a greater number of and more complete energy-conserving features in the dwelling) were reported by respondents who were in the interest and evaluation stages of the adoption process, were aware of two or three of the housing alternatives, were probable adopters for each of the housing alternatives, and were probable adopters of two or more types of housing alternatives.

Prediction of probable adoption and nonadoption. Using energy variables as a basis, the discriminant function for probable adopters and nonadopters of the active solar housing alternative classified the majority of the respondents correctly. However, the percentage of probable nonadopters correctly classified was only slightly about 50%.

Conclusions. From those results, it can be concluded that:

1. The relationships between belief in the energy crisis and factors relative to the adoption of energy-efficient housing alternatives was not strong for this sample since the only significant relationships observed were for the respondent's position in the adoption process.

2. The respondent's indication that the energy situation had impacted housing decisions was related not only to the adoption process but also to the probable adoption of each housing alternative and the number of types of housing alternatives in awareness and for probable adoption.

3. Respondents who had tried to reduce their utility costs were usually in the interest and evaluation stages of the adoption process, were probable adopters, and were in awareness and probable adoption for more types of housing alternatives.

4. For the respondents in the study, the role of utility costs in the adoption of energy-efficient housing alternatives was negligible.

5. Respondents with higher scores on the energy index were usually in the more advanced stages of the adoption process, were probable adopters for each of the housing alternatives, and were aware of and probable adopters of more types of housing alternatives.

6. The rate of successful prediction of probable adopters was higher using the discriminant function based on energy variables than it was for probable nonadopters. The overall rate of correct prediction was higher using the function based on energy variables than it was for the one based on demographics.

7. For respondents in this study, energy factors relative to actual behaviors appear to be more closely related to the adoption of energy-efficient housing alternatives than attitudinal energy factors.

Regulatory Code Variables

Presence of housing alternatives. No relationships were observed for the presence of housing alternatives in the community and stage in the adoption process.

Presence of building codes. The presence of building codes in the locality was not related to the respondent's position in the innovation adoption process.

Presence of zoning ordinances. The presence of zoning ordinances in the community was negatively related to the adoption process for the passive solar and earth sheltered/ underground housing alternative.

Presence of energy codes. No relationship between the presence of energy codes and stage in the adoption process was found.

Prior need for variances. Because none of the localities reported a prior need for variances to construct these types of housing alternatives, the data on this variable could not be subjected to statistical analysis.

Conclusions. The following conclusions are drawn from the results of analyzing the regulatory code variables:

1. For this sample, no relationships for stage in the adoption process and presence of housing alternatives, building codes, energy codes, and the prior need for variances to construct innovative housing were found.

2. The presence of zoning ordinances in the community was negatively related to the respondent's position in the innovation adoption process for passive solar and earth sheltered/underground housing.

3. The impact of prior need for variances in order to construct innovative types of housing could not be assessed because of low frequencies.

4. For this sample and these localities, building codes do not appear to impede the adoption of energy-efficient housing alternatives.

Implications

In order to facilitate more widespread adoption of these energy-efficient housing alternatives, promotional materials, whether educational or sales oriented, need to be targeted to those segments of the population in the more advanced stages of the adoption process and to those categorized as probable adopters. Consequently, promotional programs aimed at family households in the early stages of the family life cycle and to younger, more highly educated persons would be likely to increase the rate of adoption of these innovations. Furthermore, the results indicate that, in some instances, informational efforts may need to be made to correct apparent misconceptions about these housing alternatives (i.e., the relatively high rate of probable nonadoption in Virginia suggests that respondents perceive the housing alternatives as unsuitable or impractical for their climate).

On the basis of this research, the rate of adoption of these housing alternatives might be enhanced by informational programs implemented in conjunction with delivery systems for retrofit energy conservation materials and techniques since past behaviors in those areas seem to be related to future probable adoption of energy-efficient housing systems.

Since the adoption of the kind of innovations studied here involves more than one participant, there is a need for the dissemination of revelant information to all potential actors in the innovation adoption process (lenders, designers and architects, builders and developers, local building officials and inspectors as well as consumers). The development of prototypes, model installations and plans, labeling standards, the availability of technical assistance, national or regional code approval, consumer protection measures, and cooperative advertising are examples of measures which could be helpful in this process.

Informational or promotional programs based on market segmentation may also speed the adoption of energy-conserving housing innovations. For example, Rogers (1981) noted that adopters of solar pool heating tend to be motivated by economic concerns while adopters of solar hot water heaters are more likely to be motivated by idealistic concerns. As adoption progresses, educational and promotional strategies will need to be adjusted to appeal to the particular group of adopters targeted. Shama (1981) suggested that in the early stages of diffusion when purchasers are innovators or early adopters, informational messages through the specialized media should be more successful. However, for the early and late majorities, persuasive messages through the mass media should be more effective.

As the diffusion of energy-efficient housing alternatives increases, the role of regulatory code factors in the process will also become greater. Measures need to be taken now to prevent severe impediments to the adoption of housing alternatives as the rate of diffusion increases. Such things as definitions of passive solar, calculation of payback periods, and national or state code approval which will remove some of the uncertainty and risk of adoption for builders and developers need to be instituted now.

Recommendations for Further Study

This research studied only three of the stages in the innovation adoption process (awareness, interest, and evaluation) proposed by Rogers and Shoemaker (1971). The fourth stage in the process, trialability, was not possible with the kind of innovations examined here. There is a need for research that incorporates the fifth stage, adoption, which could not be analyzed in this study because of very low frequencies.

The revised innovation-decision process suggested by Rogers (1983) which consists of the five stages of knowledge, persuasion, decision, implementation, and confirmation also warrants study. A comparative examination of these two conceptualizations of the adoption process would be useful in determining the direction of future research on the diffusion of innovations.

The prediction of probable adoption and nonadoption using the discriminant functions based on demographic and energy variables resulted in an unacceptably high rate of misclassifications. Investigations of other variables, particularly that of cost or perceived costs, which may contribute to better prediction of probable adoption and nonadoption are needed. There is some indication from previous research that perceived innovation attributes (relative advantage, complexity, compatibility, trialability, and observability) are better predictors of adoption than demographics, but additional study is needed to determine if that is true for the specific type of innovation examined in this study. The role of personality variables (dogmatism, attitude toward change and risk, empathy, and motivation, for example) in the decision to adopt energy-efficient housing innovations warrants further study. Other elements of the classical diffusion of innovations theory which need to be examined as predictors of adoption of the innovations studied here are the role of change agents, types of communication behaviors, and communication networks.

Of the respondents reporting information on income, slightly more than half could be classified as low- or moderate-income. Income could not be analyzed statistically, however, because of the large percentage of missing data (43%). There is a need for similar research with other socioeconomic groups as well as a need for this type of research where accurate and reliable income information is available.

There is a need for research on the adoption process for energy-efficient housing alternatives for persons in urban areas or in Standard Metropolitan Statistical Areas in order to determine whether or not the factors which influence the decision to adopt are the same as they are for rural, nonfarm families. Additional research is needed to confirm and to investigate further the role of geographical location along with regional and climatic variations (mountains vs. plains, coastal vs. inland, sunbelt vs. snowbelt, etc.) in the adoption decision process for energy-efficient housing alternatives.

There is still no conclusive evidence on the role of age in the adoption of innovations. Additional study is needed to determine whether this relationship is a general one, is specific to the kind of innovation examined, or is a result of the interaction of age with some other factor such as education.

There is evidence from the study which suggests that once people initiate some measures and methods of conserving energy that they are more likely to become probable adopters of the energy-efficient housing alternatives. This gives rise to the concept of a continuum of energy-conserving, housing innovations, an area which warrants further research.

Additional studies are needed to examine the role of regulatory codes in the adoption of innovative types of housing. Much of the literature on this topic to date has been theoretical rather than empirical in nature. Studies of this type are also needed in communities of other sizes and of different socioeconomic groups. The influence of variances required on the adoption of housing alternatives warrants further investigation with a sample selected through a procedure that will insure appropriate numbers for statistical tests. In addition to research on consumer perceptions on the role of building codes in the adoption of energy-efficient housing alternatives, research into the attitudes and perceptions of builders and developers relative to codes and regulations as they impact the adoption of new technologies would be useful.

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APPENDIX A

S-141 PROJECT OBJECTIVES

The five major objectives of the S-141 cooperative regional research project, Housing for Low- and Moderate-Income Families, are described in the project outline as follows:

A. Provide innovative designs and research assistance for the construction of prototype housing systems and subsystems and for rehabilitation of existing housing and evaluate them by interdisciplinary teams.

B. Determine societal constraints to the adoption of housing alternatives, including those of finance, cost, regulations, land use and energy use.

C. Determine constraints within the family to the adoption of housing alternatives including demographic characteristics, family resources, family decision-making processes and consumer acceptance.

D. Analyze existing and innovative delivery systems for producing, marketing, and financial housing to maximize accessibility of quality housing.

E. Develop effective methods of disseminating housing research to consumers and key decision-makers in the area of housing.

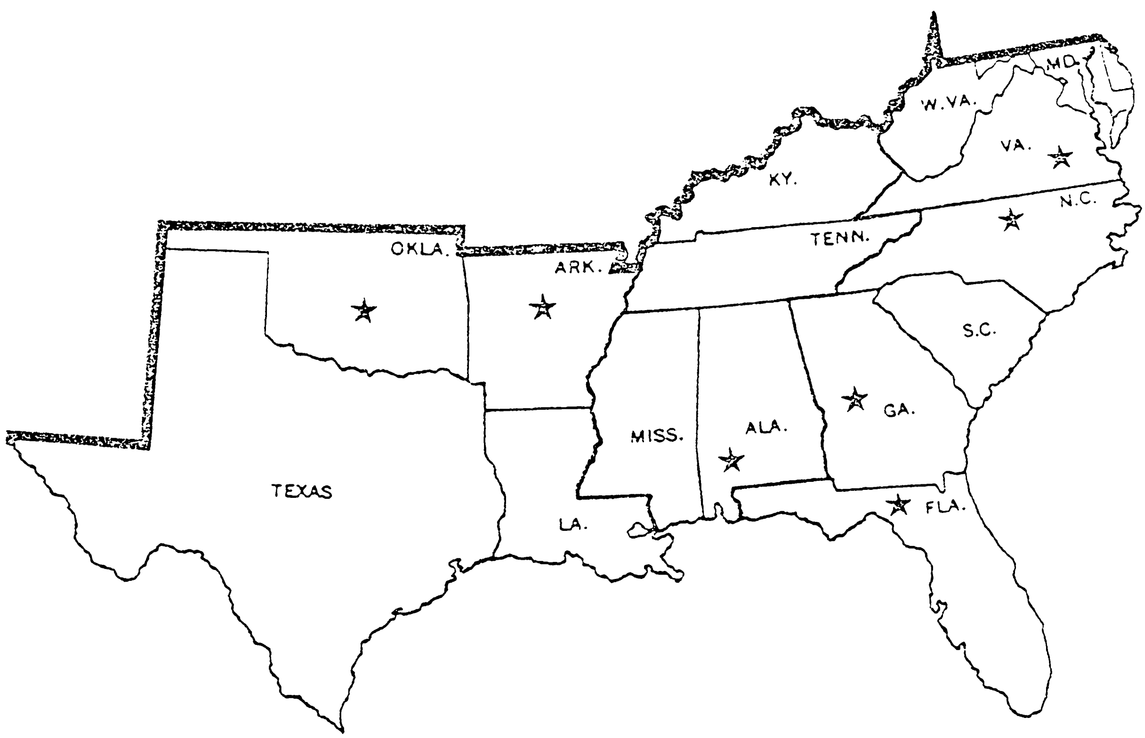
APPENDIX B

INTERVIEW SCHEDULE:

"PERCEPTIONS OF ALTERNATIVE HOUSING"

PERCEPTIONS OF ALTERNATIVE HOUSING

Southern Regional Project No. 141



★ In cooperation with Agricultural Experiment Stations.

PERCEPTIONS OF ALTERNATIVE HOUSING

Southern Regional Project No. 141

COLUMN

1. STATE________________ 2. COUNTY________________ __ 1
3. RESPONDENT NO.________________ 4. INTERVIEWER________________ __ 2
5. DATE________________ TIME________________ a.m./p.m. __ __ __ 3-5

Interviewer Statement:

Hello, my name is________________. I am working for the ____________ University Agricultural Experiment Station on a regional research project concerned with housing. By housing, we mean your house or home or any type of place your family could live now or in the future.

The information that we are gathering will be used to make decisions about improving present and future housing quality. You will be helping us determine what the present housing situation is, what people feel their needs and preferences are, and what might be done about them.

All of the information will be combined to get an overall picture of housing and what should be done to help people have better housing. None of the information will identify a person or his/her home. Your help will assist us in finding what can be done to assure good housing for all people.

NOTE TO THE INTERVIEWER: The following is to be filled in by you AFTER THE INTERVIEW or ATTEMPT TO INTERVIEW is COMPLETED.

Secured Interview: Date___/___/___ Time am/pm________________Start
am/pm________________Finish

Made Appointment
to Return: Date___/___/___ Time am/pm ________________

6. COULD NOT COMPLETE INTERVIEW: Reason 1. Refused ______ 2. Sick ______ 3. Not at home ______ 4. Could not locate dwelling ______ 5. Not a house ______ 6. Farm household ______ __ 6

7. PERSON INTERVIEWED: 1. Male head ______ 2. Female head ______ 3. Male co-head ______ 4. Female co-head ______ 5. Spouse ______ 6. Adult son or daughter ______ 7. Other (specify) ______ __ 7

8a. TYPE OF STRUCTURE: 1. Single Family ______ 2. Multi-family ______ __ 8
8b. HOUSING TYPE: 1. Mobile home ______ 2. Modular ______ 3. Conventional ______ 4. Apartment ______ 5. Other (Specify) ______ 9. Don't know ______ __ 9
9. LOCATION OF HOUSING/DWELLING UNIT: __ 10
   1. Open country ______
   2. Suburban area ______
   3. Incorporated area (population 5,000) ______
   4. Town (population 5,001 - 10,000) ______
   5. Town (population 10,001-25,000) ______
   6. Town (population over 25,000) ______

I. Present Housing Situation:

First, I want to ask you some questions about your present housing unit or dwelling.

10. HOW OLD IS YOUR HOUSING/DWELLING UNIT? __ __ __ 11-13
    1. ______years
    9. DK______
11. GIVE ME AN ESTIMATE OF THE NUMBER OF SQUARE FEET IN HOUSING/DWELLING UNIT:
    1. ______sq. ft. __ __ __ __ 14-17
    9. DK______
12. DO YOU: __ 18
    1. Own (paid for)______ (skip to question 14)
    2. Own (are buying)______
    3. Rent (or lease)______
    4. Receive for services______ (skip to question 14)
    5. Other (Specify ________________
13. HOW MUCH IS YOUR MONTHLY HOUSE PAYMENT OR RENT?
    1. $________________ __ __ __ __ 19-22

*14. PLEASE GIVE ME AN ESTIMATE OF THE FOLLOWING UTILITY COSTS FOR 1980.

	Highest Monthly	Lowest Monthly	Average Monthly	NA (888)	DK (999)
1. Electricity	______	______	______	__	__
2. Gas (natural)	______	______	______	__	__
3. Gas (bottled)	______	______	______	__	__
4. Oil	______	______	______	__	__
5. Water	______	______	______	__	__
6. Wood	______	______	______	__	__
7. Combined	______	______	______	__	__
Other (Specify)					

___ ___ ___ 23-25
___ ___ ___ 26-28
___ ___ ___ 29-31
___ ___ ___ 32-34
___ ___ ___ 35-37
___ ___ ___ 38-40
___ ___ ___ 41-43
___ ___ ___ 44-46
___ ___ ___ 47-49
___ ___ ___ 50-52
___ ___ ___ 53-55
___ ___ ___ 56-58
___ ___ ___ 59-61
___ ___ ___ 62-64
___ ___ ___ 65-67
___ ___ ___ 68-70
___ ___ ___ 71-73
___ ___ ___ 74-76
REPEAT COLUMNS 1-5
___ 6
___ ___ ___ 7-9
___ ___ ___ 10-12
___ ___ ___ 13-15

15. DOES YOUR HOME HAVE ANY OF THE FOLLOWING ENERGY CHARACTERISTICS? (Check as many as apply)
   1. Active solar collectors______ ___ 16
   2. Passive use of solar______ ___ 17
   3. Earth sheltered______ ___ 18
   4. None______ ___ 19
   9. DK______ ___ 20

16. HOW MANY ROOMS ARE IN YOUR DWELLING (excluding bathrooms and closets)? ___ ___ 21-22
   1. ______(Record actual number)

17. HOW MANY BEDROOMS ARE IN YOUR DWELLING? ___ 23
   1. ______(Record actual number)

18. HOW MANY BATHROOMS ARE IN YOUR DWELLING? ___ 24
   1. 1______
   2. 1½______
   3. 2______
   4. 2½______
   5. 3______
   6. More than 3______
   7. None______

19. DO YOU HAVE RUNNING WATER IN THE KITCHEN? ___ 25
   1. Cold only______
   2. Hot and cold______
   3. None______

20. DO YOU HAVE RUNNING WATER IN THE BATHROOM? ___ 26
   1. Cold only______
   2. Hot and cold______
   3. None______

21. HOW IS YOUR DWELLING COOLED? (Check as many as apply)
   1. Window or attic fan______ ___ 27
   2. Free standing fans______ ___ 28
   3. Window air conditioners______ ___ 29
   4. Central air conditioning______ ___ 30
   5. Other (specify) ______________________ ___ 31
   6. NA______ ___ 32

22. HOW IS YOUR DWELLING HEATED? (Check as many as apply)
   1. Floor furnace______ ___ 33
   2. Wood stove______ ___ 34
   3. Space heaters______ ___ 35
   4. Radiators______ ___ 36
   5. Central heating______ ___ 37
   6. Solar heater______ ___ 38
   7. Baseboard or periphery heating______ ___ 39
   8. Other (specify) ______________________________ ___ 40

23. WHAT FUEL IS USED FOR HEATING WATER? (check as many as apply)
   1. Gas (natural)______ ___ 41
   2. Gas (bottled)______ ___ 42
   3. Electricity______ ___ 43
   4. Solar assisted______ ___ 44
   5. Other (specify) ______________________________ ___ 45
   8. NA______ ___ 46

* 24. WHICH OF THE FOLLOWING DOES YOUR DWELLING HAVE? (Is it partial or complete?):

	NONE (0)	PARTIAL (1)	COMPLETE (2)	NA (8)	DK (9)	
1. Ceiling insulation	___	___	___	___	___	___ 47
2. Wall insulation	___	___	___	___	___	___ 48
3. Floor insulation	___	___	___	___	___	___ 49
4. Storm windows	___	___	___	___	___	___ 50
5. Double pane windows	___	___	___	___	___	___ 51
6. Plastic covering on windows	___	___	___	___	___	___ 52
7. Storm doors	___	___	___	___	___	___ 53
8. Weather stripping	___	___	___	___	___	___ 54
9. Caulking	___	___	___	___	___	___ 55
10. Exterior insulation around hot water heater	___	___	___	___	___	___ 56

25. DO ANY OF THE FOLLOWING CONDITIONS CAUSE YOU OR YOUR HOUSEHOLD PROBLEMS IN YOUR HOME? (Is it to a major or minor extent?)

	CONDITION	NO PROBLEM (0)	MINOR PROBLEM (1)	MAJOR PROBLEM (2)	NA (8)	
1.	Leak(s) in the roof					___ 57
2.	Crack(s) in walls or ceiling					___ 58
3.	Sag(s) or bulge(s) in walls or ceilings					___ 59
4.	Peeling paint on inside walls					___ 60
5.	Peeling paint on outside walls					___ 61
6.	Decay of porch and outside steps					___ 62
7.	Decay of door and window frames					___ 63
8.	Uneven floors					___ 64
9.	Holes or badly worn places in floor					___ 65
10.	Broken or missing window panes					___ 66

11.	Broken or missing materials on exterior walls or foundation						___ 67
12.	Missing or torn screens						___ 68
13.	Quality of water						___ 69
14.	Condition of heating system						___ 70
15.	Condition of cooling system						___ 71
16.	Condition of plumbing system						___ 72
17.	Condition of electrical system						___ 73

II. Decision-Making Practices:

26. HOW LONG HAVE YOU LIVED IN THIS HOUSE? (Record actual number) ___ ___ ___ 74-76
    1. Years ______
    9. DK ______

(If respondent lived in this house less than 10 years, ask) REPEAT COLUMNS 1-5

27. WHY DID YOU MOVE FROM YOUR FORMER HOME? (Check as many as apply)
    1. Changes in employment ______ ___ 6
    2. Changes in spatial needs ______ ___ 7
    3. Wanted to build or buy ______ ___ 8
    4. Decrease in income ______ ___ 9
    5. Increase in income ______ ___ 10
    6. Family reasons ______ ___ 11
    7. Dissatisfied with location ______ ___ 12
    8. Dissatisfied with home ______ ___ 13
    9. Displaced ______ ___ 14
    10. Economic reasons ______ ___ 15
    11. Other (specify) ______ ___ 16
    88. NA ______ ___ 17
    ___ 18

28. IN WHAT TYPE OF HOME DID YOU LAST LIVE? ___ 19
    1. Single family ______
    2. Apartment ______
    3. Townhouse ______
    4. Mobile home ______
    5. Other (specify) ______
    8. NA ______

29. WHY DID YOU/YOUR HOUSEHOLD SELECT THE DWELLING/HOUSE YOU ARE NOW LIVING IN? (Check as many as apply)
    1. Affordable ______ ___ 20
    2. Location; neighborhood ______ ___ 21
    3. House design; plan and layout ______ ___ 22
    4. Built new house ______ ___ 23
    5. Provide more space ______ ___ 24
    6. Limited choice; needed immediately ______ ___ 25
    7. Other (specify) ______ ___ 26
    8. NA ______ ___ 27
    9. DK ______ ___ 28

30. WHAT DO YOU/YOUR HOUSEHOLD LIKE BEST ABOUT WHERE YOU LIVE? (Check only one)
    1. Neighborhood and neighbors ______ ___ 29
    2. Location ______
    3. Privacy ______
    4. House design: size, plan and layout ______
    5. Ease of maintenance and convenience ______
    6. Site and yard ______
    7. Rent includes utilities ______
    8. Other (specify) ______

31. WHAT THING DO YOU LIKE LEAST ABOUT WHERE YOU LIVE? (Check only one) ___ 30
   1. Neighborhood and neighbors ______
   2. Location ______
   3. Lack of privacy ______
   4. House design: size, plan, and layout ______
   5. Amount of maintenance and inconvenience ______
   6. Site and yard ______
   7. Cost of unit ______
   8. Other (specify) ______
32. HOW SATISFIED ARE YOU WITH YOUR PRESENT DWELLING? ___ 31
   1. Very satisfied ______
   2. Satisfied ______
   3. Neither satisfied or dissatisfied ______
   4. Dissatisfied ______
   5. Very dissatisfied ______
33. WOULD YOU *LIKE* TO MOVE INTO ANOTHER DWELLING WITHIN THE NEXT COUPLE OF YEARS? ___ 32
   1. Yes ______
   2. No ______ (skip to question 35)
   3. Maybe ______
34. WHY WOULD YOU LIKE TO MOVE? (Check as many as apply)
   1. Present house is wrong size ______ ___ 33
   2. Plan to build or buy ______ ___ 34
   3. Improve location ______ ___ 35
   4. Dissatisfied with conditions of present dwelling ______ ___ 36
   5. Change in family structure ______ ___ 37
   6. Plan to change jobs ______ ___ 38
   7. Other (specify) ______ ___ 39
   8. NA ______ ___ 40

(If YES or MAYBE in question 33, skip to question 36)

35. WHY WOULD YOU NOT LIKE TO MOVE? (Check as many as apply)
   1. House meets family needs ______ ___ 41
   2. Economic reasons ______ ___ 42
   3. Close to relatives ______ ___ 43
   4. Privacy ______ ___ 44
   5. Location ______ ___ 45
   6. Convenience ______ ___ 46
   7. Other (specify) ______ ___ 47
   8. NA ______ ___ 48
36. DO YOU HAVE DEFINITE PLANS TO MOVE INTO A NEW OR DIFFERENT HOUSE WITHIN THE NEXT COUPLE OF YEARS? ___ 49
   1. Yes ______
   2. No ______

(If NO in 33 and YES in 36, answer question 37)

37. WHY DO YOU PLAN TO MOVE WITHIN THE NEXT FEW YEARS? (Check as many as apply)
   1. Present house is wrong size ___ ___ 50
   2. Plan to build or buy ___ ___ 51
   3. Improve location ___ ___ 52
   4. Dissatisfied with conditions of present dwelling ___ ___ 53
   5. Change in family structure _____ ___ 54
   6. Plan to change jobs _____ ___ 55
   7. Other (specify) ______ ___ 56
   8. NA _____ ___ 57

(If YES or MAYBE in question 33 and NO in question 36, answer question 38.)

38. WHY DO YOU NOT PLAN TO MOVE WITHIN THE NEXT FEW YEARS? (Check as many as apply)
   1. House meets family needs ______ ___ 58
   2. Economic reasons ______ ___ 59
   3. Close to relatives ______ ___ 60
   4. Privacy ______ ___ 61
   5. Location ______ ___ 62
   6. Convenience ______ ___ 63
   7. Other (specify) ______ ___ 64
   8. NA ______ ___ 65

39. HOW MUCH DO THESE PEOPLE HELP IN MAKING DECISIONS ABOUT YOUR HOUSING?

	NOT AT ALL (0)	SOME (1)	VERY MUCH (2)	NA (8)	
1. Male Head/Co-head					___ 66
2. Female Head/Co-head					___ 67
3. Children					___ 68
4. Other household members					___ 69
5. Other relatives					___ 70
6. Housing professional (real estate agents, engineers, etc.)					___ 71
7. Friends					___ 72
8. Others (specify) ______________					___ 73

40. SOME LOCAL AREAS ARE NOW PROVIDING FREE HOUSING INFORMATION SERVICE. IF IT WERE AVAILABLE IN YOUR COMMUNITY, WOULD YOU USE IT? ___ 74
   1. Yes, definitely ______
   2. Yes, maybe ______
   3. No ______
   9. DK ______

REPEAT COLUMNS 1-5

41. IF YOU WANTED TO MODIFY OR CHANGE YOUR DWELLING, WHAT KINDS OF INFORMATION WOULD BE MOST HELPFUL TO YOU? (Check as many as apply)
   1. Financing ______ ___ 6
   2. Energy Conservation ______ ___ 7
   3. Building methods ______ ___ 8
   4. Buying a house ______ ___ 9
   5. Housing maintenance ______ ___ 10
   6. Remodeling ______ ___ 11
   7. Insurance and taxes ______ ___ 12
   8. Other (specify) ______________________________ ___ 13
   9. NA—do not want to change dwelling ______ ___ 14

___ 15

MANY PROFESSIONALS FEEL THAT A VERY IMPORTANT FACTOR IN HOW PEOPLE MAKE DECISIONS ABOUT THEIR HOUSING IS THE COST OF ENERGY. FOR THE PAST SEVERAL YEARS WE HAVE HEARD A GREAT DEAL ABOUT A SHORTAGE OF ENERGY.

* 42. DO YOU BELIEVE THERE IS AN ENERGY CRISIS? ___ 16
   1. Yes ______
   2. No ______ (skip to question 44)
   3. Not sure ______ (skip to question 44)

43. HOW SEVERE DO YOU BELIEVE THE ENERGY CRISIS IS? ___ 17
   1. Not at all severe ______
   2. Somewhat severe ______
   3. Severe ______
   4. Very severe ______

* 44. DO YOU BELIEVE THAT THE ENERGY SITUATION HAS HAD ANY IMPACT UPON YOUR PRESENT DWELLING OR UPON HOW YOU MAKE DECISIONS ABOUT YOUR HOUSING? ___ 18
   1. Yes ______
   2. No ______
   9. DK ______

* 45. ASSOCIATED WITH THE ENERGY CRISIS IS THE INCREASING COST OF UTILITIES, PARTICULARLY HEATING AND COOLING EXPENSES. HAVE YOU OR OTHER MEMBERS OF YOUR HOUSEHOLD MADE CHANGES THAT WOULD REDUCE YOUR UTILITY COSTS? ___ 19
   1. Yes ______
   2. No ______ (skip to question 47)

46. WHAT ARE SOME OF THESE CHANGES? (Check as many as apply)
   1. Lowered thermostat in winter ______ ___ 20
   2. Raised thermostat in summer ______ ___ 21
   3. Added or increased insulation ______ ___ 22
   4. Added storm or double-pane windows ______ ___ 23

5. Used wood stove or energy efficient heater ______ ___ 24
6. Used appliances more efficiently ______ ___ 25
7. Lowered water heater thermostat ______ ___ 26
8. Reduced wattage or lighting use ______ ___ 27
9. Weatherstripped and caulked ______ ___ 28
10. Closed off rooms ______ ___ 29
11. Covered windows with plastic ______ ___ 30
12. Used fans instead of air conditioner ______ ___ 31
13. Added insulation to water heater ______ ___ 32
14. Other (specify) ______________________________ ___ 33
88. NA ______ ___ 34

47. HAVE YOU MADE ANY CHANGES THAT WOULD REDUCE OTHER HOUSING COSTS? ___ 35
1. Yes ______
2. No ______ (skip to question 49)

48. WHAT ARE SOME OF THESE CHANGES? (Check as many as apply)
1. Moved to less expensive dwelling ______ ___ 36
2. Deferred maintenance and repairs ______ ___ 37
3. Did own maintenance and repairs ______ ___ 38
4. Changed to low maintenance materials ______ ___ 39
5. Doubled-up with another household ______ ___ 40
6. Other (specify) ______________________________ ___ 41
8. NA ______ ___ 42

49. HAVE YOU MADE ANY CHANGES THAT WOULD REDUCE TRANSPORTATION COSTS? ___ 43
1. Yes ______
2. No ______ (skip to question 51)

50. WHAT ARE SOME OF THE CHANGES? (Check as many as apply)
1. Made fewer trips ______ ___ 44
2. Used carpool ______ ___ 45
3. Used more efficient car ______ ___ 46
4. Rode bus or public transportation ______ ___ 47
5. Moved closer to job ______ ___ 48
6. Other (specify) ______________________________ ___ 49
8. NA ______ ___ 50

51. DO YOU PLAN TO MAKE ANY CHANGES, REPAIRS, OR IMPROVEMENTS IN YOUR DWELLING/HOUSING UNIT IN THE NEXT COUPLE OF YEARS? ___ 51
1. Yes ______
2. No ______ (skip to question 53)
8. NA ______ (skip to question 53)
9. DK ______ (skip to question 53)

52. WHAT TYPE OF IMPROVEMENT OR REPAIRS DO YOU PLAN TO MAKE? (Check as many as apply)
1. Repairing roof ______ ___ 52
2. Adding rooms ______ ___ 53
3. Adding storm windows or doors ______ ___ 54
4. Adding flooring ______ ___ 55
5. Painting - exterior ______ ___ 56
6. Painting - interior ______ ___ 57
7. Remodeling kitchen/bath ______ ___ 58
8. Making cosmetic changes (building cabinets, book shelves, paneling, etc.) ______ ___ 59
9. Adding siding ______ ___ 60
10. Repairing or improving plumbing ______ ___ 61
11. Repairing or improving electrical system ______ ___ 62
12. Improving landscape ______ ___ 63
13. Adding sunporch ______ ___ 64
14. Enclosing patio with glass ______ ___ 65
15. Adding greenhouse ______ ___ 66
16. Adding insulation ______ ___ 67
17. Caulking and weatherstripping ______ ___ 68
18. Adding solar panels ______ ___ 69
19. Adding solar water heater ______ ___ 70
20. Other (specify) ______________________________ ___ 71
88. NA ______ ___ 72

IN RECENT YEARS, ARCHITECTS, ENGINEERS AND OTHER HOUSING PROFESSIONALS HAVE BEEN DESIGNING NEW TYPES OF HOUSING THAT MAY REDUCE THE AMOUNT OF ENERGY USED IN BUILDING AND IN HEATING AND COOLING HOUSES. WE'RE GOING TO CALL THESE ENERGY EFFICIENT HOMES INNOVATIVE HOUSING TYPES.

* 53. WHICH OF THE FOLLOWING TYPES HAVE YOU HEARD ABOUT, READ ABOUT, SEEN, LIVED IN? (Check as many as apply)

	HEARD ABOUT (a)	READ ABOUT (b)	SEEN (c)	LIVED IN (d)	NEVER HEARD OF/DK (e)	
						73 74 75 76 77 REPEAT COLUMNS 1-5 6
1. Passive solar						7 8 9 10 11
2. Active solar						12 13 14 15 16
3. Manufactured home/mobile home						17 18 19 20 21
4. Apartment/multifamily						22 23 24 25 26
5. Earth-sheltered/underground						27 28 29 30 31
6. Retrofitted (energy saving improved) home						

* 54. HAVE YOU EVER LOOKED FOR ADDITIONAL INFORMATION ABOUT THESE HOUSING TYPES? (Check as many as apply)

1. Passive solar ______ ___ 32
2. Active solar ______ ___ 33
3. Manufactured/mobile home ______ ___ 34
4. Apartment/multifamily ______ ___ 35
5. Earth sheltered/underground ______ ___ 36
6. Retrofitted (energy saving improved) home ______ ___ 37
7. None ______ (skip to question 56) ___ 38

* 55. AFTER GATHERING INFORMATION, HAVE YOU TRIED TO DETERMINE THE ADVANTAGES AND DISADVANTAGES OF ANY OF THE HOUSING TYPES FOR YOUR OWN PARTICULAR USE? (Check as many as apply)

1. Passive solar ______ ___ 39
2. Active solar ______ ___ 40
3. Manufactured/mobile home ______ ___ 41
5. Apartment/multifamily ______ ___ 42
5. Earth sheltered/underground ______ ___ 43
6. Retrofitted (energy saving improved) home ______ ___ 44
7. None ______ ___ 45

III. Consumer Acceptance:

Now, I am going to show you pictures and/or sketches of different innovative housing types. All of these housing types can reduce cost and increase energy efficiency if they are well constructed. (Show pictures and read definitions)

56a. IF YOU WERE MOVING TO A NEW AREA OR INTO A DIFFERENT DWELLING UNIT IN THIS AREA, WOULD YOU BUY OR CONSIDER LIVING IN A CONVENTIONALLY BUILT HOUSE? ___ 46

1. Definitely would consider ______
2. Probably would consider ______
3. Undecided ______
4. Probably would not consider ______
5. Definitely would not consider ______

56b. WHAT WOULD YOU LIKE ABOUT LIVING IN A CONVENTIONALLY BUILT HOUSE?

___ 47
___ 48
___ 49
___ 50
___ 51
___ 52

56c. WHAT WOULD YOU DISLIKE ABOUT LIVING IN A CONVENTIONALLY BUILT HOUSE?

___ 53
___ 54
___ 55
___ 56
___ 57
___ 58

57a. IF YOU WERE MOVING TO A NEW AREA OR INTO A DIFFERENT DWELLING UNIT, WOULD YOU BUY OR CONSIDER LIVING IN A MANUFACTURED HOME/MOBILE HOME?

1. Definitely would consider ___
2. Probably would consider___
3. Undecided ___
4. Probably would not consider___
5. Definitely would not consider___

___ 59

57b. WHAT WOULD YOU LIKE ABOUT LIVING IN A MANUFACTURED HOME/MOBILE HOME?

___ 60
___ 61
___ 62
___ 63
___ 64
___ 65

57c. WHAT WOULD YOU DISLIKE ABOUT LIVING IN A MANUFACTURED HOME/MOBILE HOME?

___ 66
___ 67
___ 68
___ 69
___ 70
___ 71

58a. IF YOU WERE MOVING TO A NEW AREA OR INTO A DIFFERENT DWELLING UNIT WOULD YOU BUY OR CONSIDER LIVING IN AN APARTMENT/MULTIFAMILY UNIT? ___ 72

1. Definitely would consider ______
2. Probably would consider ______
3. Undecided ______
4. Probably would not consider ______
5. Definitely would not consider ______

58b. WHAT WOULD YOU LIKE ABOUT LIVING IN AN APARTMENT/MULTIFAMILY UNIT? ___ 73

___ 74

___ 75

___ 76

___ 77

___ 78

REPEAT COL. 1-5

58c. WHAT WOULD YOU DISLIKE ABOUT LIVING IN AN APARTMENT/MULTIFAMILY UNIT?

___ 6

___ 7

___ 8

___ 9

___ 10

___ 11

___ 12

59a. IF YOU WERE MOVING TO A NEW AREA OR INTO A DIFFERENT DWELLING UNIT, WOULD YOU BUY OR CONSIDER LIVING IN A RETROFITTED (ENERGY SAVING IMPROVED) HOME? ___ 13

1. Definitely would consider ______
2. Probably would consider ______
3. Undecided ______
4. Probably would not consider ______
5. Definitely would not consider ______

59b. WHAT WOULD YOU LIKE ABOUT LIVING IN A RETROFITTED (ENERGY SAVING IMPROVED) HOME? ___ 14

___ 15

___ 16

___ 17

___ 18

___ 19

59c. WHAT WOULD YOU DISLIKE ABOUT LIVING IN A RETROFITTED (ENERGY SAVING IMPROVED) HOME? ___ 20

___ 21

___ 22

___ 23

___ 24

___ 25

* 60a. IF YOU WERE MOVING TO A NEW AREA OR INTO A DIFFERENT DWELLING UNIT, WOULD YOU BUY OR CONSIDER LIVING IN A PASSIVE SOLAR HOME? ___ 26

1. Definitely would consider______
2. Probably would consider______
3. Undecided______
4. Probably would not consider______
5. Definitely would not consider______

60b. WHAT WOULD YOU LIKE ABOUT LIVING IN A PASSIVE SOLAR HOME? ___ 27

___ 28

___ 29

___ 30

___ 31

___ 32

60c. WHAT WOULD YOU DISLIKE ABOUT LIVING IN A PASSIVE SOLAR HOME? ___ 33

___ 34

___ 35

___ 36

___ 37

___ 38

* 61a. IF YOU WERE MOVING TO A NEW AREA OR INTO A DIFFERENT DWELLING UNIT, WOULD YOU BUY OR CONSIDER LIVING IN AN ACTIVE SOLAR HOME? ___ 39

1. Definitely would consider______
2. Probably would consider______
3. Undecided______
4. Probably would not consider______
5. Definitely would not consider______

61b. WHAT WOULD YOU LIKE ABOUT LIVING IN AN ACTIVE SOLAR HOME? ___ 40

___ 41

___ 42

___ 43

___ 44

___ 45

61c. WHAT WOULD YOU DISLIKE ABOUT LIVING IN AN ACTIVE SOLAR HOME? ___ 46

___ 47

___ 48

___ 49

___ 50

___ 51

* 62a. IF YOU WERE MOVING TO A NEW AREA OR INTO A DIFFERENT DWELLING UNIT, WOULD YOU BUY OR CONSIDER LIVING IN AN EARTH SHELTERED/UNDERGROUND HOME? ___ 52

1. Definitely would consider______
2. Probably would consider______
3. Undecided______
4. Probably would not consider______
5. Definitely would not consider______

62b. WHAT WOULD YOU LIKE ABOUT LIVING IN AN EARTH SHELTERED/UNDERGROUND HOME? ___ 53

___ 54

___ 55

___ 56

___ 57

___ 58

62c. WHAT WOULD YOU DISLIKE ABOUT LIVING IN AN EARTH SHELTERED/UNDERGROUND HOME? ___ 59

___ 60

___ 61

___ 62

___ 63

___ 64

63. I WOULD LIKE YOU TO LOOK AT THESE DWELLING UNITS AGAIN AND TELL ME WHICH HOME YOU LIKE BEST (1), WHICH YOU LIKE SECOND BEST (2), WHICH HOME YOU LIKE LEAST (7), WHICH HOME YOU LIKE NEXT TO LEAST (6). NOW OF THE ONES LEFT, WHICH DO YOU LIKE BEST (3)? WHICH DO YOU LIKE LEAST (5)? THEN THE ONE LEFT IS (4).

1. Conventionally built home ______ ___ 65
2. Manufactured home/mobile home______ ___ 66
3. Apartment/multifamily unit______ ___ 67
4. Retrofitted (energy saving improved) home______ ___ 68
5. Passive solar home______ ___ 69
6. Active solar home______ ___ 70
7. Earth sheltered/underground home ______ ___ 71

* 64. *Demographic Data* - WE NEED SOME INFORMATION ABOUT EACH PERSON IN THE HOUSEHOLD:

HOUSEHOLD MEMBER	RELATION TO HEAD	SEX	AGE	RACE	DEGREE OF DISABILITY	MARITAL STATUS	EDUCATION	EMPLOYMENT	OCCUPATION
Place an asterisk or circle respondent	1-head 2-co-head 3-spouse 4-offspring 5-parent 6-sibling 7-other -relative 8-none	1-male 2 female	Code actual years	1-Afro-American 2-White 3-Hispanic 4-American Indian 5-Other	1-none 2-mild 3-moderate 4-extreme	1-single 2-married 3-widowed 4-divorced 5-separated 6-other	Code actual years 1-12; 13-vocational; 14, 15, 16-college graduate; 17-post graduate	01-full-time 02-part-time 03-retired 04-unemployed 05-student 06-homemaker 07-full & student 08-part & student 09-part & retired 10-part & home-maker 11-NA 12-other-specify	01-Professional/technical 02-Semi-professional 03-Farmers & Farm mgrs. 04-Mgrs., officials & proprietors 05-Clerical 06-Sales 07-Craftsmen, foremen 08 Operators 09 Farm laborers 10-Laborers 11-Domestic service workers 12-Other service workers 13-Retired 14-Other (specify)
M HD									
F HD									

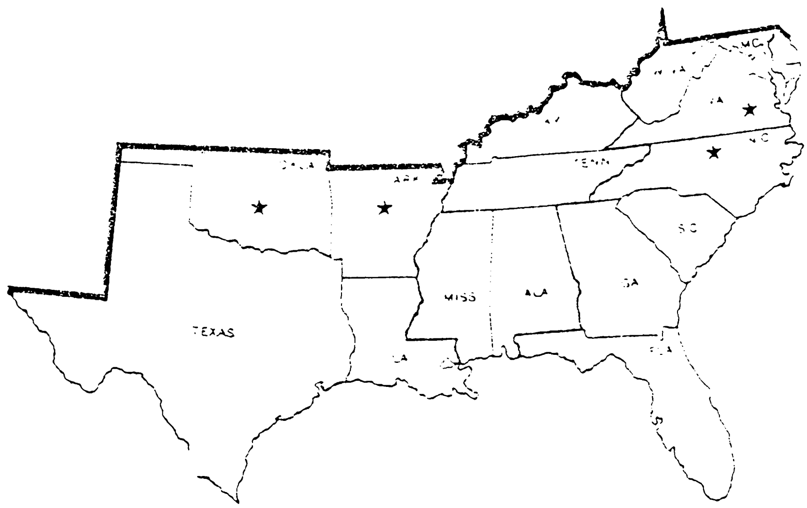
* 65. Now we need to know something about your family income for 1980. This information is anonymous and will not have your name associated with it in any way. It will be used only for classification purposes to group people together who have similar incomes.

HOUSEHOLD MEMBER	HOW IS HOUSEHOLD MEMBER PAID? 1. Weekly 2. Bi-weekly 3. Monthly 4. Annually 5. Other-Specify	HOW MUCH TIME DID HOUSEHOLD MEMBER WORK DURING 1980? Record actual number of months. (01-12)	AMOUNT OF INCOME FOR 1980 TAKE HOME PAY (Hand Income Card to respondent that corresponds to pay period.) From these cards, please give me the number that corresponds to the amount of take home pay received by each household member. (Record number)	SUPPLEMENTAL INCOME Did any household member receive supplemental income during the year? 1. Yes 2. No	What type of supplemental income? (Check as many as apply) 1. Investment (stock, bonds, etc.) 2. Pension or retirement 3. Government funding (welfare, AFDC, Section 8, etc.) 4. Second job 5. Social Security (handicapped, elderly, dependent children) 6. Alimony 7. Other	(Give respondent Annual Income Card.) Please give me the number that corresponds to the amount of supplemental income received by each household member. (Record number)
MH						
FH						
OTHER HOUSEHOLD MEMBER						
OTHER HOUSEHOLD MEMBER						
OTHER HOUSEHOLD MEMBER						
OTHER HOUSEHOLD MEMBER						
OTHER HOUSEHOLD MEMBER						
OTHER HOUSEHOLD MEMBER						

Reports of Oklahoma Agricultural Experiment Station serve people of all ages, socio-economic levels, race, color, sex, religion and national origin. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agriculture and has been prepared and distributed at a cost of $1,115.00 for 4,000 copies. 0781

APPENDIX C

CODES AND REGULATIONS QUESTIONNAIRE ONE



Housing researchers at land grant universities in the Southrern Region are conducting a study of codes and regulations which may help or hinder families in obtaining alternative types of housing. Please take a few minutes of your time to complete the information requested on this form and return within a week so that a follow-up questionnaire may be sent to the appropriate person in your locality for further data collection. Thank you for your cooperation.

* 1. Are any of the following types of housing units located in your locality?

Type	Not present	Present	Approximate number
Earth sheltered	________	________	________________
Passive solar	________	________	________________
Active solar	________	________	________________
Solar retrofit	________	________	________________

* 2. Are there any construction codes on residential structures in your locality (county or municipality)? Please check those codes which are applicable and give the name(s) and address(es) of person(s) responsible.

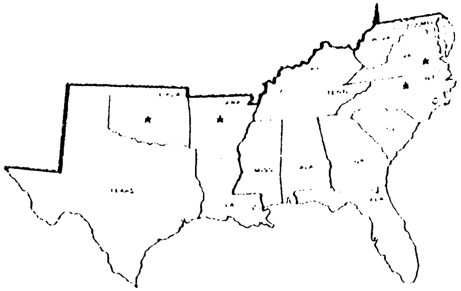
Types of codes present	Name and address of person responsible
____ Building Code	________________________________
____ Zoning ordinance	________________________________
____ Electrical code	________________________________
____ Plumbing code	________________________________
____ Sanitation code	________________________________
____ Energy code	________________________________
____ Mobile home ordinance	________________________________
____ Fire code	________________________________
____ Other (specify) ____________	________________________________

____ No codes—if none, are any under consideration? Yes ____ No ____

If yes, what types of codes? ________________________________

APPENDIX D

CODES AND REGULATIONS QUESTIONNAIRE TWO



In early February a questionnaire was sent to your municipality requesting the names of persons responsible for various code enforcement programs. You were identified as one of those code enforcement officials; so this follow-up questionnaire is being sent to you for completion.

Agricultural Experiment Stations in eleven southern states are cooperating on a Regional Housing Research Project designed to improve the quality and availability of energy efficient housing alternatives in the southern region of the United States. One component of the research project concerns the impact of codes and regulations on the availability of energy efficient housing alternatives.

This questionnaire is being sent to persons identified as code enforcement officials in all counties and incorporated areas of Arkansas, Oklahoma, North Carolina, and Virginia. Your patience and time will greatly aid us in getting the required information in our state.

We have developed a survey instrument that should not take much of your time to complete. *Please give information only for those codes/regulations for which you are responsible (those checked in red). If you are responsible for codes not checked in red, please do complete the requested information for those codes.*

When completed, fold the questionnaire so that the stamped return address shows, staple, and mail back. If you are interested in learning the results of the survey, please indicate by placing a check here ______ If you have questions or comments about the survey, you may telephone the project leader in your state at the telephone number listed below.

Thank you for your cooperation.

ARKANSAS
Jacquelyn W. McCray
Professor-Housing
501-541-6839

OKLAHOMA
Margaret Weber
Associate Professor Housing
405-624-5048

NORTH CAROLINA
Nancy Baird
Research Instructor in Housing
919-379-5472

VIRGINIA
Savannah S. Day
Professor Housing
703-961-5448

Name and title of person completing questionnaire

Telephone number:

		Building	Zoning	Electrical	Plumbing	Sanitation	Energy	Mobile Home	Fire	Other (Specify)
	Year Adopted									
	Last Year Revised									
Jurisdiction	City/Town									
	County									
	City/Town & County									
Structures Covered	Single Family									
	1-2 Family									
	3-4 Family									
	Multi Family (5 Or More Units)									
Model Code Used	Basic Code - BOCA									
	Uniform Code - ICBO									
	Southern Standard Code - SBCCII									
	National Code - AIA									
	Other Code - Specify									
Method of Enforcement	Systematic									
	Selected Area									
	Mandatory/Certification/License									
	Complaint Based									
Variances	Number of Variances Requested During Past 12 Months		Map / Text							
	Number of Variances Granted									
	Official/Agency Approving/Denying Request For Variance-Specify									

Type of Code/Regulation

(Please complete other side.)

APPENDIX E

CORRESPONDENCE RELATED TO CODES QUESTIONNAIRE ONE

COLLEGE OF HOME ECONOMICS

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DEPARTMENT OF MANAGEMENT, HOUSING AND FAMILY DEVELOPMENT

February 5, 1982

Dear Public Official:

The Virginia Agricultural Experiment Station is cooperating with agricultural experiment stations in ten other southern states in a Regional Housing Research Project designed to improve the quality and availability of energy efficient housing alternatives in the southern region of the United States.

One component of the research project deals with codes and regulations which may facilitate or constrain families in obtaining newer types of housing units. Please take a few minutes of your time to complete the enclosed questionnaire. This questionnaire is being sent to all counties and incorporated areas of Arkansas, Oklahoma, North Carolina and Virginia. Your patience and time will greatly aid us in getting the required information in our state.

Thank you for your assistance.

Sincerely,

Professor of Housing

cls

Enc.

COLLEGE OF HOME ECONOMICS

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DEPARTMENT OF MANAGEMENT, HOUSING AND FAMILY DEVELOPMENT

February 26, 1982

Dear Public Official:

Approximately three weeks ago a questionnaire was sent to your municipality requesting the names of persons responsible for various code enforcement programs. As of today, I have not received your completed questionnaire.

Agricultural Experiment Stations in eleven southern states are cooperating on a Regional Housing Research Project (S-141) designed to improve the quality and availability of energy efficient housing alternatives in the southern region of the United States. One component of the study concerns the impact of codes and regulations on the availability of energy efficient housing alternatives.

I am writing to you again because of the significance each questionnaire has to the usefulness of the study. If you have already completed and returned the questionnaire, please accept my sincere thanks. If you have not completed and returned it, please do so today.

In the event that the questionnaire has been misplaced or you never received it, a replacement is enclosed.

Sincerely,

Professor of Housing

cls

Enc.

APPENDIX F

CORRESPONDENCE RELATED TO CODES QUESTIONNAIRE TWO

Non-Profit Org.
U. S. POSTAGE
PAID
Blacksburg, Va.
Permit No. 28

SOUTHERN REGIONAL HOUSING TECHNICAL COMMITTEE

Code Official:

A questionnaire was recently sent to your office regarding building and other codes that exist in your locale. If you have returned the questionnaire, your time and effort are greatly appreciated. If you did not complete the questionnaire, would you take a few minutes to do so and drop it in the mail today.

It is very important that we hear from you via the questionnaire if our state is to be accurately represented. Thank you very much for your cooperation.

APPENDIX G

TABLES

Table A

S-141 Sample Counties and Sample Size

State	LL	LH	HL	HH	Total	%
AL	Crenshaw	Dallas	Clay	Lee		
	34	58	42	82	216	12.0
AR	Stone	Baxter	Sevier	Ouachita		
	36	58	38	80	212	11.8
FL	Washington	Walton	Okeechof	Putnam		
	17	47	18	75	157	8.8
GA	Randolph	McIntosh	Lumpkin	Spalding		
	42	93	47	138	320	17.8
NC	Bertie	Moore	Davie	Stanley		
	58	144	58	153	413	22.9
OK	Love	Caddo	Craig	Pawnee		
	27	57	27	59	170	9.4
VA	Madison	Southampton	Culpeper	Rockingham		
	38	110	44	120	312	17.3

Note.

This table was compiled from information provided by Dr. Marvin Lentner, Statistical Consultant for the S-141 project.

Table B

Passive Solar:
Analysis of Variance for Age of Respondent and Stage in the Adoption Process

Source of Variation	SS	df	F	p
Between	1120.05	2	1.81	.1634
Within	355893.76	1153		
Total	357013.82	1155		

Table C

Passive Solar:
Analysis of Covariance for Education and Stage in the Adoption Process with Age as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	438.92	2	26.26	.0001*
Covariate Age	345.60	1	41.36	.0001*
Error	9592.09	1148		
Total	10416.98	1151		

*Statistically significant at alpha = .05

Table D

Active Solar:
Analysis of Variance for Age of Respondent and Stage in the Adoption Process

Source of Variation	SS	df	F	p
Between	1946.29	2	3.12	.0444*
Within	372930.37	1197		
Total	374876.67	1199		

*Statistically significant at alpha = .05

Table E

Active Solar:
Analysis of Covariance for Education and Stage in the Adoption Process with Age as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	388.36	2	22.83	.0001*
Covariate Age	389.15	1	45.76	.0001*
Error	10128.73	1191		
Total	10954.52	1194		

*Statistically significant at alpha = .05

Table F

Earth Sheltered/Underground:
Analysis of Variance for Age of Respondent and Stage in the Adoption Process

Source of Variation	SS	df	F	p
Between	2817.85	2	4.80	.0084*
Within	390278.44	1378		
Total	392997.29	1380		

*Statistically significant at alpha = .05

Table G

Earth Sheltered/Underground:
Analysis of Covariance for Education and Stage in the Adoption Process with Age as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	322.86	2	17.86	.0001*
Covariate Age	706.60	1	78.16	.0001*
Error	12394.54	1371		
Total	13500.98	1374		

*Statistically significant at alpha = .05

Table H

Passive Solar:
Analysis of Covariance for Utility Costs and Stage in the Adoption Process with Energy Index as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	390.05	2	0.07	.9344
Covariate: Energy Index	32307.46	1	11.24	.0008*
Error	3082383.24	1072		
Total	3116292.97	1075		

*Statistically significant at alpha = .05

Table I

Passive Solar:
Analysis of Covariance for Energy Index and Stage in the Adoption Process with Utility Costs as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	308.88	2	7.21	.0008*
Covariate: Utility Costs	240.64	1	11.24	.0008*
Error	22958.66	1072		
Total	23520.54	1075		

*Statistically significant at alpha = .05

Table J

Active Solar:
Analysis of Covariance for Utility Costs and Stage in the Adoption Process with Energy Index as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	173.74	2	0.02	.9770
Covariate: Energy Index	13550.28	1	3.52	.0609
Error	4283905.63	1113		
Total	4297459.16	1116		

Table K

Active Solar:
Analysis of Covariance for Energy Index and Stage in the Adoption Process with Utility Costs as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	398.51	2	9.32	.0001*
Covariate: Utility Costs	75.26	1	3.52	.0609
Error	23793.92	1113		
Total	24267.98	1116		

*Statistically significant at alpha = .05

Table L

Earth Sheltered/Underground:
Analysis of Covariance for Utility Costs and Stage in the Adoption Process with Energy Index as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	2026.54	2	0.30	.7417
Covariate: Energy Index	27624.91	1	8.15	.0044*
Error	4306240.13	1270		
Total	4334617.93	1273		

*Statistically significant at alpha = .05

Table M

Earth Sheltered/Underground:
Analysis of Covariance for Stage in the Adoption Process and Energy Index with Utility Costs as a Covariate

Source of Variation	SS	df	F	p
Adoption Stages	576.56	2	13.28	.0001*
Covariate: Utility Costs	176.91	1	8.15	.0044*
Error	27577.19	1270		
Total	28325.95	1273		

*Statistically significant at alpha = .05

Table N

Analysis of Variance for Age of Respondent and the Number of Types of Housing Alternatives in the Awareness Stage

Source of Variation	*SS*	*df*	*F*	*p*
Between	851.48	2	1.36	.2574
Within	458231.29	1462		
Total	459082.77	1464		

Table O

Analysis of Covariance for Education and the Number of Types of Housing Alternatives in the Awareness Stage with Age as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Awareness	118.11	2	6.42	.0017*
Covariate Age	888.17	1	96.6	.0001*
Error	13349.81	1452		
Total	14352.44	1455		

*Statistically significant at alpha = .05

Table P

Analysis of Variance for Age of Respondent and the Number of Types of Housing Alternatives in the Interest Stage

Source of Variance	*SS*	*df*	*F*	*p*
Between	1005.29	2	2.56	.0840
Within	14923.69	76		
Total	15928.99	78		

Table Q

Analysis of Covariance for Education and the Number of Types of Housing Alternatives in the Interest Stage with Age as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Interest	49.97	2	4.08	.0208*
Covariate Age	35.96	1	5.87	.0178*
Error	459.09	75		
Total	530.30	78		

*Statistically significant at alpha = .05

Table R

Analysis of Variance for Age of Respondent and the Number of Types of Housing Alternatives in the Evaluation Stage

Source of Variation	SS	df	F	p
Between	195.10	2	0.45	.6380
Within	39189.76	181		
Total	39384.86	183		

Table S

Analysis of Covariance for Education and the Number of Types of Housing Alternatives in the Evaluation Stage with Age as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Interest	11.48	2	0.81	.4446
Covariate Age	14.72	2	2.09	.1502
Error	1262.27	179		
Total	1289.15	182		

Table T

Analysis of Covariance for Utility Costs and the Number of Types of Housing Alternatives in the Awareness Stage with Energy Index as a Covariate

Source of Variation	*SS*	*df*	*F*	*p*
Adoption Stage: Awareness	1.92	2	0.86	.4227
Covariate: Energy Index	24.42	1	21.90	.0001*
Error	1505.18	1350		
Total	1532.46	1353		

*Statistically significant at alpha = .05

Table U

Analysis of Covariance for Energy Index and the Number of Types of Housing Alternatives in the Awareness Stage with Utility Costs as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Awareness	483.76	2	11.23	.0001*
Covariate: Utility Costs	224.88	1	10.44	.0013*
Error	29087.29	1350		
Total	29786.24	1353		

*Statistically significant at alpha = .05

Table V

Analysis of Covariance for Utility Costs and the Number of Types of Housing Alternatives in the Interest Stage with Energy Index as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Interest	101.78	2	0.02	.9814
Covariate: Energy Index	292.52	1	0.11	.7433
Error	203119.63	75		
Total	203483.72	78		

Table W

Analysis of Covariance for Energy Index and the Number of Types of Housing Alternatives in the Interest Stage with Utility Costs as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Interest	22.66	2	0.77	.4646
Covariate: Utility Costs	1.58	1	0.11	.7433
Error	1097.26	75		
Total	1121.37	78		

Table X

Analysis of Covariance for Utility Costs and the Number of Types of Housing Alternatives in the Evaluation Stage with Energy Index as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Evaluation	407.52	2	0.08	.9190
Covariate: Energy Index	863.60	1	0.36	.5503
Error	426894.49	177		
Total	428035.67	180		

Table Y

Analysis of Covariance for Energy Index and the Number of Types of Housing Alternatives in the Evaluation Stage with Utility Costs as a Covariate

Source of Variation	SS	df	F	p
Adoption Stage: Evaluation	53.64	2	1.43	.2413
Covariate: Utility Costs	6.70	1	0.36	.5503
Error	3312.14	177		
Total	3371.56	180		

Table Z

Analysis of Variance for Age and Number of Types of Housing Alternatives for Probable Adoption

Source of Variation	SS	df	F	p
Between	6585.84	2	11.62	.0001*
Within	335946.79	1185		
Total	342532.63	1187		

*Statistically significant at alpha = .05

Table AA

Analysis of Covariance for Education and Number of Types of Housing Alternatives for Probable Adoption with Age as a Covariate

Source of Variation	SS	df	F	p
Probable Adoption	50.07	2	2.70	.0680
Covariate: Age	688.53	1	74.13	.0001*
Error	10941.81	1178		
Total	11730.05	1181		

*Statistically significant at alpha = .05

Table BB

Analysis of Covariance for Utility Costs and Number of Types of Housing Alternatives for Probable Adoption with Energy Index as a Covariate

Source of Variation	SS	df	F	p
Probable Adoption	4310.84	2	0.52	.5967
Covariate: Energy Index	21259.13	1	5.10	.0242*
Error	4618379.12	1107		
Total	4643226.24	1110		

*Statistically significant at alpha = .05

Table CC

Analysis of Covariance for Energy Index and Number of Types of Housing Alternatives for Probable Adoption with Utility Costs as a Covariate

Source of Variation	SS	df	F	p
Probable Adoption	138.01	2	3.09	.0459*
Covariate: Utility Costs	113.80	1	5.10	.0242*
Error	24721.20	1107		
Total	24969.65	1110		

*Statistically significant at alpha = .05

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