CONSUMER ATTITUDES TOWARD AN EARTH-INSULATED SOLAR HOUSE AND A SOLAR GREENHOUSE RESIDENCE

By

JACKIE LEE BELL

Bachelor of Science in Home Economics

Oklahoma State University

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SOLAR HOUSE AND A SOLAR
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Thesis Approved:

K. Kay Stewart
Thesis Adviser

Lester L. Boyer

Margaret Weber

Norman N. Durham
Dean of the Graduate College

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Throughout the history of the United States, Americans for the most part, have relied on one basic source of energy within a given period of time. The type of energy source utilized has varied, but the concentration on one main resource has remained fairly constant. In the earliest period of American history the primary energy source was wood and later coal became the major resource used. In the 1950's the use of petroleum began to increase and soon became the dominant energy resource.

In 1973 an historic event occurred that affected not only the economy of the United States, but of the world - the oil embargo. By the time of the oil embargo, 37 percent of the oil consumed in the United States was imported. Not only had imports grown prior to the embargo, but domestic oil production had begun to decline. Since 1973 energy has become a major concern to many consumers. A continuous effort evolved to develop new energy resources and techniques to supplement those currently being used.

The traditional energy sources of today can no longer be considered limitless, especially the non-renewable fossil fuels. These energy sources will continue to exist in the years to come, however, the cost of retrieving and preparing them for consumer use is unknown. Energy costs have continued to increase during the last decade and an end to this rise in prices cannot be seen at this point in time. This depletion of fossil fuel resources coupled with the rising costs of retrieving energy sources used today have forced investigation into possible alternatives.

In looking back over time man has utlized some of nature's basic components to provide heat for his shelter. One of these has been the sun. Man used the sun to see by, to grow food, and for warmth. The Greeks used a huge concave metallic mirror in 212 B.C. to reflect the sun's rays and burn the attacking Roman fleet. In 1872 Chilian officials used a solar distillery to change saltwater into fresh water for the miners. Since this time man has continued to use the sun as a source of power (Anderson, 1977, p. 4).

Utilizing energy from the sun as a residential energy resource is one of the possible alternatives to continued dependence on fossil fuels. Although technology for collecting solar energy is available, it is not always considered economical. The initial cost of a solar system is generally more expensive than a conventional heating system. However, unlike many conventional systems, future expenditures for the energy to operate the solar system is small.

Another of nature's basic energy components is that of the earth itself. The first inhabitants to live underground were the cave dwellers in pre-historic time. Since then, Indian cultures and early pioneer settlers continued to use the earth as shelter by living in dugouts.

The earth itself is not a good insulator, it is rather a temperature modifier. Ground temperatures fluctuate slowly in response to seasonal temperature changes. The heat from the summer sun is slow to penetrate into the ground. It is not until winter that the summer heat reaches deep into the ground.

Incorporating the use of solar energy with other conservation techniques can further reduce the amount of conventional fuels consumed in residential use. One such combination is that of solar energy and earth-insulation. In coupling these two conservation techniques the amount of energy used in a residence is greatly decreased. This combination is being utilized with increasing frequency. Earth-insulated solar homes are being built throughout the country as an alternative to traditional ways of heating and cooling residential and commercial structures.

Another concept being used in connection with residential solar energy is that of a greenhouse. The concept incorporates a greenhouse with a solar system, and involves two main functions. First, the basic function of a greenhouse is to facilitate growing plants during the off season. The second is that a greenhouse is designed and built with materials to absorb the sun's rays. In devising a method to trap the solar energy that is collected in the greenhouse an additional energy source can be developed.

Both the solar earth-insulated and solar greenhouse homes are possible alternatives to residences which use traditional energy resources. Research prototype houses of the two types are being carefully monitored to document energy savings and identify strengths and weaknesses in design features.

However, only within the past two years has research begun to examine acceptance of these energy-saving housing alternatives by consumers. Research has begun to examine how consumers feel about these alternative energy sources, as well as how willing the consumer is to utilize these alternatives in his/her own dwelling.

Paulus (1978) pointed out the fact that little research has been done concerning the psychological effects of living underground. If earth sheltered dwellings are to become a realistic housing alternative, consumer attitudes must be examined more carefully (pp. 65-69).

Statement of Problem

The energy shortage in the United States had increased interest in housing designs that are more energy savings. Attitudes of consumers toward such housing designs need to be examined. Continued research and development of earth-insulated and solar greenhouse homes would be in vain if consumers do not view these as viable alternatives.

Purpose and Objectives

In the fall of 1978 construction of two experimental houses was completed at Clemson University, Clemson, South Carolina. These two houses were built in connection with the Southern Regional Research Project, S-95. Both houses, one an earth-insulated solar house and the other a solar greenhouse residence, incorporated several energy-saving features in the design.

Open house for the public was held at the houses in November of that year. During the open house, consumers were given tours and information concerning both houses. A random sample of visitors to the houses was selected. Every fourth person was given a questionnaire and asked to complete and return it prior to leaving the site.

The purpose of this study was to examine attitudes of consumers toward two experimental energy saving housing designs: (1) an earth-insulated solar heated residence and (2) a solar greenhouse residence.

The following objectives guided the study:

1. To describe consumer attitudes toward the two experimental houses designed to be energy conserving.
2. To analyze the relationship between selected characteristics of the consumers and their attitudes toward each of the two experimental housing designs.
3. To examine respondent characteristics and attitudes associated with a preference for the earth-insulated solar house versus the solar greenhouse residence.

Hypotheses

Five null hypotheses were developed for this study. Objective 2 was met by testing four null hypotheses:

Ho_1: Attitudes toward selected design features of the earth-insulated solar house will not differ by the socioeconomic/demographic characteristics of the respondents.

Ho_2: Attitudes toward selected design features of the solar greenhouse will not differ by the socioeconomic/demographic characteristics of the respondents.

Ho_3: The desire to live in an earth-insulated solar house will not be related to selected socioeconomic/demographic characteristics or attitudes toward selected design features of the house.

Ho_4: The desire to live in a solar greenhouse residence will not be related to selected socioeconomic/demographic characteristics or attitudes toward selected design features of the residence.

Objective 3 was met by testing one null hypothesis:

Ho_5: Residents' desire to live in the earth-insulated solar house versus the solar greenhouse will not be related to socioeconomic/demographic characteristics of respondents nor their attitudes toward selected design features of the two residences.

Definition of Terms

The following are some of the major terms used in this study. Included are the definitions as they apply in this study.

Earth-insulated or earth bermed housing - Three sides of the structure are embanked in the earth. The fourth wall and the roof are conventional and exposed to atmospheric conditions.

Subterranean or earth covered housing - A subsurface structure or an above ground structure in which the roof is covered with earth.

Solar greenhouse - A combination of a greenhouse and a solar heated residence are used to form an energy efficient structure with the capability of food production.

Energy saving design features - Several design features have been included in the two experimental houses. In the earth-insulated solar house the features included were: a treated wood foundation, panelized construction, solar space and water heating, and earth insulation. Solar space and water heating and the greenhouse as a source of food production were included in the solar greenhouse residence.

Assumptions

The following assumptions were made in connection with this study.

1. The visitors to the open house responded honestly to the questions about the two experimental houses.

2. The exposure to the houses during the tour was sufficient for the respondents to have valid reactions to the houses.

3. All respondents were given the same information about each of the experimental houses.

Limitations

The findings of this study were based on data collected during an open house of two experimental housing designs. Therefore the findings presented were limited as follows:

1. Responses from those consumers who were interested enough in energy saving housing designs to attend the open house.

2. Only two specific energy saving housing alternatives were investigated.

3. Acknowledged differences exist in the design of the two houses: the earth-insulated solar house is a one-story structure and the solar greenhouse residence is two-story; the square footage is greater in the solar greenhouse residence than in the earth-insulated solar house.

CHAPTER II

REVIEW OF LITERATURE

Energy Supply and Demand

American demand for energy has increased dramatically in the last one hundred years. The expanding population explains a part of this growing demand, however, a large element has been the increased amount of energy used by each person (League of Women Voters, 1977, p. 5).

In the early 1800's, almost all of the energy used by Americans came from renewable resources such as wood, wind, and water. Ninety percent of the energy used in the 1850's was supplied by wood. However, as consumption increased the use of renewable energy resources decreased and nonrenewable resources became the dominant energy supply. In 1950 more than 90 percent of the energy used by Americans was supplied by nonrenewable fossil fuels (Anderson, Hofman, and Rolfe, 1975, p. 170).

Between 1950 and 1970 the population of the United States grew by 34 percent, during this same period the per capita energy consumption increased by 46 percent. As a result the amount of energy used in 1970 was almost double that used in 1950 and if consumption had continued at that rate it would have doubled again by 1990 (League of Women Voters, 1977, p. 5).

During this twenty year period, the dominant energy resource shifted from coal, which had been the major resource used since the 1880's to petroleum. The change was not due to a shortage of coal, but because of the versatility of oil and natural gas (League of Women Voters, 1977, p. 6). However, by the late 1950's a gap began to develop between the amount of energy used and the domestic energy supply. In 1957, Americans began using more energy than was domestically produced (Energy Facts and Figures, 1975, p. 3).

As demand for fossil fuels increased and the domestic production decreased, other sources outside the United States had to be located. Imported oil began to fill this gap and in 1960, 19 percent of the oil consumed in the United States was imported. By 1973, the time of the oil embargo, imports had reached 37 percent (League of Women Voters, 1977, p. 6). By 1977, American's foreign oil imports had risen to 42 percent of the total energy consumption (Economist, 1977, p. 11). Projections to the year 2000 indicate that by this time the import rate will be equal to the total amount of energy consumed in 1975 (Energy Facts and Figures, 1975, p. 4).

Dependence of the United States on foreign nations for energy has affected not only the economic conditions of the country, but the national security as well. Anderson et al. (1975, p. 171) reports that self-sufficiency of energy supplies has been a concern of national security policy makers for some time. The dependence that America has on foreign nations could be a threat in time of war, reduce national bargaining power, and cause vulnerability to political pressures or possible blackmail.

The Federal Energy Administration in 1975, sited two approaches in closing the energy gap; one, that Americans must simply reduce the amount of energy consumed and two, new domestic energy resources must be developed. Anderson et al. (1975, p. 171) echoes those two approaches and goes on to state that a combination of these options will be necessary.

Reduction in the amount of energy used will not close the energy gap, however, it will reduce the intensity of the problem. Energy conservation requires understanding of the problem on the part of all consumers and the determination to take the necessary steps to achieve a level of consumption. Once a reduction in the demand for energy begins, then concentration on developing new resources of energy must begin (Anderson, Hofman, and Rolfe, 1975, pp. 713-714).

Several alternatives have been proposed to help relieve American dependence on nonrenewable fossil fuels. The Federal Energy Administration stated that altogether new energy resources must be developed to meet the domestic energy needs in the years to come. The development of solar energy as an alternative energy source has been supported by the Federal Energy Administration (1975).

Solar Alternative

The concept of utilizing the power of the sun is not a new idea. The sun, either directly or indirectly, provides virtually all of the energy used today (Ewers, 1977, p. 1). The sun has been used as a source of energy as far back in history as 212 B.C. when the Greeks used a huge concave mirror to burn the Roman fleet (Anderson, 1977, p. 4). Solar furnaces were used during medieval times and a solar powered steam engine was used to operate newspaper printing presses in Paris, France in the early 1900's (Ewers, 1977).

Development of solar energy did not progress as quickly in the

United States as it did in other areas. Between 1920 and World War II the solar industry was beginning to get off the ground, however, once the abundance of natural gas became apparent in the 1950's the growth of solar energy ceased (Ewers, 1977). It was not until the Arab oil embargo of 1973-1974 that solar energy began to be recognized as an alternative energy source that can be implemented immediately (Anderson, 1977).

Numerous research studies have been done to determine the effectiveness of solar energy as a plausible alternative to conventional sources. As with any new area of technology, there are problems and constraints involved in utilizing solar energy, however there are also advantages to this source of energy.

A major advantage of solar energy is the amount of the resource that is available. Solar rays fall on the upper atmosphere at the rate of 1.36 kilowatts per square meter or 130 watts per square foot. Approximately 13 percent of this power arrives at the ground, depending on the season, weather conditions, latitude, etc. (Fowler, 1977). This is the energy equivalent of 10 barrels of oil per acre of land in the United States, which is approximately 4 times the amount of energy consumed in 1977 (Fowler, 1977).

In addition solar energy is available in all areas, although the amount does vary somewhat. Iker (1978, p. 40) stated, ". . . in many areas, new natural gas hookups are banned. . ." If such bannings continue consumers will be forced to consider alternative energy sources to provide the heating and cooling for their homes.

Fowler (1977, pp. 3-4) suggested that for fuel costs in the $10 per million BTU range, solar heating systems must be below $15 per square foot installed cost. Although some experimental systems have reached this cost level, most systems still cost between $20 and $50 per square foot.

A study done for AIA Research Corporation indicated the expense of solar systems are becoming equal to that of conventional heating systems. The report stated, "Solar energy is relatively expensive. Although conventional energy supply will gradually increase in cost, solar will decrease, due to the mass production of systems" (1975, p. 3).

The initial expenditure for solar energy systems is expensive, however, the energy used thereafter is free. Due to the recent increase in fossil fuel costs, solar systems are quickly becoming more competitive with conventional systems. If costs of conventional fuels continue to rise and shortages plague consumers, solar energy systems will become more economical to Americans (Leckie, Masters, Whitehouse and Young, 1975, p. 75).

In addition to the higher initial cost of solar systems it is necessary to have an auxiliary heating system in most areas of the country. The heating systems that rely 100 percent on solar energy are usually far too large to be practical, according to Anderson and Riordan (1976, p. 245). Fowler (1977, p. 3) recommended that solar collectors be used to provide 60 to 70 percent of the heat requirements to provide the most efficient system.

Another problem area in utilizing solar energy is the time that solar rays do not reach the earth. This limitation was brought out by Anderson and Riordan (1976, p. 9). There are extended periods of time that the sun does not shine - at night and in the winter. Riordan stated that the amount of solar energy falling on the roof and walls of a house is more than enough to heat it, however, consideration must be given to the periods when there is no sunshine. Until an inexpensive way of storing collected solar energy for overcast days and during the night is found, solar energy will not be considered a viable energy source (Ewers, 1977, p. 3).

A must in the utilization of a solar energy system is that the collectors face south. Oddo (1979, p. 98) reported that a few inches or a few degrees of tilt, a change in the shape, size or placement of the collectors can make a difference in the efficiency of the system.

Oddo (1979, p. 105) sited that the lengthy delay in passage of the National Energy Act hurt many manufacturers. Many small businesses make innovations, but cannot make a success in the solar market. The big manufacturers then buy the smaller companies' innovations and dominate the market. This concept is supported by Ewer (1976, p. 6) who stated that there was an increase in the number of manufacturers producing complete systems for solar heating of homes.

Another area of controversy regarding solar energy has recently developed with regard to the legal difficulties involved. In most areas a consumer who invested in a solar energy system did not have any protection. Rezoning could occur in any area which could permit higher buildings to be constructed which could reduce the amount of solar energy striking a collector. The consumer has had no right of compensation (Cunningham, 1977, p. 18).

Laws to guarantee that construction and vegetation on adjoining land did not interfere with the amount of solar energy striking a building were called for by Anderson and Riordan (1976, p. 249). Morton

(1979, p. 77) stated that only one state, New Mexico, guarantees access of light entering through another person's property. However, according to Oddo (1979, p. 105), the number of legal problems regarding solar energy systems could have been expected to be larger than they have been.

One component that will assist in balancing the initial costs of solar systems is that of steadily rising utility costs. Iker (1978, p. 40) reported studies which concluded that in the next few years, solar heating will be as cheap as electric heating in most states. Fowler (1977, p. 3) states that solar heating is already economically competitive with total-electric heating and that it is approaching a point of being competitive with other fuels.

Information presented by the American Petroleum Institute (1977) supports the concept that solar energy costs will decrease as conventional energy costs continue to increase. One way in which the costs of solar energy can be reduced is by mass production of solar components. If the energy companies of America expand their research of solar energy, costs can become more competitive for consumers.

The market of solar energy systems is an area of concern for many involved in solar energy. Estimations vary as to the actual number of companies involved in the production of solar components. The American Petroleum Institute (1977) reported approximately 70 companies were involved in manufacturing solar panels for residential and commercial heating. Anderson (1977, p. 22) sited at least 100 manufacturers "seriously" involved in production of solar equipment. In addition, there are several hundred more waiting to enter the market when it becomes more developed. Several major companies as well as numerous smaller ones are involved in solar energy, according to Ewers (1977, p. 6).

The initial investment in a solar energy system cannot be overlooked. Financing an increased initial cost can be difficult, especially when building costs are high, interest rates are high and mortgage money is tight (Anderson, 1977, p. 20). Costs involved in solar energy systems vary depending on a number of factors. Iker (1978, p. 41) sited costs of solar heating, both space and water, as ranging from $5,000 to $12,000 or more, with the average price around $8,500. According to Anderson and Riordan (1976, p. 245), one of the principle reasons that people decide not to utilize solar energy has been that they could not obtain the financing for the system.

Serious efforts are being made by the United States government to facilitate rapid and widespread use of solar energy, according to Yellot (1978, p. 171). Tax credits of $2,000 or more are available to consumers who purchase solar heating systems (Iker, 1978, p. 40). One of the first states to offer a tax incentive on solar components for new and existing buildings was Indiana, however, several states have followed in providing such tax incentives to consumers (Anderson, 1977, p. 22).

Pfister (1977, p. 21) discusses considerations to be taken into account in designing energy conserving buildings. One of the most important design elements in a solar house is that a passive solar system should be included for maximum efficiency.

Several components can be included in designing structures for passive solar collection. Some of the basic principles of passive solar design are included in a solar greenhouse. Johnson (1979, p. 28) preferred to use the term "solar-reliant" greenhouse. The solar-reliant greenhouse is oriented to the south for direct radiation and may be utilized as a heat gainer with excess energy available to be used in other spaces.

Homes are beginning to be designed and built using solar greenhouse spaces for the collection of solar energy for space heating. Johnson (1979, p. 29) stated that the concept of a solar greenhouse may encompass philosophical values such as self-sufficiency and the interdependence of life processes. However, the combination of these features is relatively new in the design of homes utilizing solar energy.

Not only does the solar-reliant greenhouse provide a source of energy for the residence, it also can provide a source of food. The off-season production of plants is the one common link to all greenhouses. Residential greenhouses have the potential to produce at least a part of the family's food needs. This possibility can be particularly important to low income families where fuel and food can consume 60 percent of the annual income (Johnson, 1979, p. 21).

Earth-Insulation Alternative

The concept of utilizing the earth as an energy conservation method is not a recently developed idea. For thousands of years man has used the earth for shelter. Studies have dated occupation of caves by mesolithic seal hunters to 11,000 years ago (Gorman, 1976, p. 17).

Throughout recorded history various cultures have been documented as utilizing different types of underground structures. Mason (1976, pp. 16-17) notes that use of underground structures varies from the Ancient Egyptian temples to the United States Pavilion at the 1970 World's Fair in Osaka, Japan. Also reported are several government, education, and corporate uses of underground structures.

An indepth study of underground human habitats in cultures around the world was conducted by Kenneth Labs. He described the habitats in terms of response to the climate, defensibility of the area, symbolic or ceremonial aspects of the people, and several locally related issues (Labs, 1976, p. 7).

In the shadow of the oil embargo of 1973-74, people in the U.S. have shown increasing interest in the advantages of underground structures. This interest was often kindered by a desire to minimize impact and reach ecological stability, rather than as energy conservation measure (Labs, 1976, p. 7). Minimal ecological impact and energy conservation are only two among several advantages of underground structures.

Underground structures have been shown to have several advantages over above ground structures. Malcom Wells and Roy Mason both sited silence as one of the biggest advantages of underground structures. Wells (1976, p. 21) states, "The best surprise was the quiet." In his report of the underground facilities of the Brunson Instrument Company in Kansas City, Mason (1976, p. 18) included silence as one of the most important advantages of the building being underground.

Wells (1976, p. 21) discovered the temperature control that the earth offers, at the time when energy was becoming a concern to many consumers. The earth surrounding his office offered heat retention in the winter and coolness in the hot summer months. Gorman (1976, p. 16) explained that the earth acts as an insulator and thus provides energy savings because of the decreased need for heating and cooling.

The Brunson Company, in Kansas City, reported a "dramatic" savings in fuel costs in its underground building. The new facility used three times less heat, 10 times less cooling, and 15 times less operating costs than an above ground structure (Mason, 1976, p. 18).

Another advantage of building underground is the space that is left open on the surface. The additional space can serve various functions, among which are parks, play areas, plants and even buildings or parking lots (Gorman, 1976, p. 16). Smay (1974, p. 88) also sited that an underground structure is an escape from "urban ugliness," blight, and overcrowding.

The list of advantages of underground structures compiled by Wells (1976, pp. 22-23) is immense. Part of those included by Wells are echoed by others, however, many are not brought out in other literature. Some of the advantages that Wells sees that others have not are: (1) proper use of rainwater, percolation and slow run off rather than erosion and flash flood, (2) an opportunity for oxygen production in place of the heat reflecting roofs of conventional structures, and (3) the creation of buildings that are in harmony with the earth, that improve with age and that change with the seasons of the year.

Although advantages of living underground are numerous, there are also some disadvantages. Various opinions have been reported concerning the construction and costs of underground structures. Gorman (1976, pp. 16-17) sited several elements of construction that must be taken into account in building underground structures that do not have to be considered in above ground structures. Excavation and moisture proofing, as well as an extra support system for the roof can all add to the initial cost of building underground.

Some reports have been made that indicate costs of building are reduced in underground structures. Smay (1974, p. 88) reported that simple building techniques can be utilized in underground structures thus minimizing building costs. John Barnard, building Ecology House, estimated saving 25 percent in building costs due to the simplicity of construction which resulted in the opportunity to use unskilled laborers (Smay, 1974, p. 132).

Another problem involved with the utilization of underground structure is obtaining financing for construction. Lending institutions have shown a reluctance to finance underground structures. The area of concern is with initial costs and resale ability rather than life-cycle costs, according to Bligh (1976, p. 30). However, as conventional energy costs continue to increase, the life-cycle costs will become more important.

The psychological impact that living underground might have on the inhabitants is another area of concern. First reactions to the concept of an underground structure, for many people, is "a clammy, dripping, stygian darkness, acrawl with bats, spiders and slimy things" (Dempewolf, 1977, p. 78). The word "underground" seems to cause this unfavorable response, however, there are several other terms for this type of structure. Earth integrated, terratecture, and geotecture are just some of the terms used to describe this concept (Gorman, 1976, p. 16). Mason (1976, p. 19) reported that experiments indicate the psychological and physical effects of living and working underground are positive. The absence of view is the only difference between above and below ground structures. There are also many above ground buildings, such as libraries, classrooms, stores, industries, etc., that do not have windows (Bligh, 1976, p. 30).

One actual study of the psychological effect of being in underground structures was done at the Abo Elementary School in Artesia, New Mexico. The study concluded that the totally underground school was not detrimental to the mental and physical health of the students. It was also reported that in some respects the learning environment was actually enhanced (Mason, 1976, p. 19; Bligh, 1976, p. 30).

Bligh (1976, p. 26) discussed his plans for a housing development of earth-sheltered residences. Included in the house plans were adjustable solar collectors located above the roof. The angle of the collectors was designed so that it could be adjusted to shade the living area during the summer when the sun is high. Then in the winter when additional heat was needed within the home, solar energy captured through the collectors could be utilized.

The use of solar collectors was also incorporated into the Plant Science Building in Millbrook, New York. This two-story building was bermed two-thirds into the earth. Solar collectors that provided all of the hot water and virtually all of the heat for the building were included in the design. Daniel Brown, Capital Projects Manager, stated that during the first year of operation the combined heating, cooling and lighting bills for the building ran 43 cents per square foot per year, while the average was about $1.50 per square foot per year (Morton, 1979, p. 126).

The combination of solar energy and earth insulation overcomes one of the major drawbacks of solar systems in above ground structures. According to the Underground Space Center at the University of Minnesota a major problem with solar systems is the large initial investment required. However, the heating requirements of an earth sheltered structure are much lower, thus the amount of solar collecting equipment needed is much less (1978, pp. 69-70).

Consumer Acceptance of Alternatives

Even with all the apparent advantages that solar energy has to offer the American public, consumers have not rallied in acceptance of the concepts. Many in the area of solar development expressed regret that the ideas involved had not become more widely used.

An air of caution and a "wait and see" type attitude seems to be hovering over the utilization of solar energy in the United States. Many developers of solar energy systems, as well as consumers, are waiting for the market to prove itself before becoming involved too deeply (Anderson, 1977, p. 23).

However, not everyone is waiting. Many consumers are utilizing these alternatives to conventional energy usage, and interest appears to be increasing. Several factors tend to support this increase in utilization of solar energy systems on the residential level.

The production of solar components has substantially increased in the last few years. A report shows that in 1977 production of solar collectors was over 5 million square feet. This production level compares to the 1974 output of 136,000 square feet (Iker, 1978, p. 40).

Sheldon Butt, former head of the Solar Industries Association stated, "By 1985 we're looking for as many as 11 million solar installations" (Iker, 1978, p. 40). The United States government also predicts increased usage of solar energy systems in the future. Approximately 2.5 million homes, one-half of them new, will be solarized by 1985, according to government estimations (Iker, 1978, p. 40).

Research shows that public interest in energy conserving homes is strong. In 1973 John Barnard opened Ecology House, a subterranean structure which he built, to the public. About 8500 visitors toured the house during July and August of that year, and some of those consumers were convinced enough to try underground living themselves (Smay, 1974, p. 132).

In 1978 an open house was held at an experimental earth-insulated solar dwelling. The house was built by researchers at Clemson University near Greenville, South Carolina. Over 3,000 people toured the house during the 2-day open house. A research study dealing with the consumer's attitudes towards the house was conducted by Stewart, McKown, and Peck (1979). Results of the study indicated a positive response to the idea of living in an earth-insulated solar home. The majority of those included in the sample responded that they would like to live in this type of house. In addition, more than 40 percent indicated that they were likely to build an underground home in the next five years. The conclusions of the study stressed the importance of consumer input during the development phases. Recommendations were made for further research in the area of consumer attitudes toward earth-insulated solar homes, especially in the area of design criteria.

Another study was done involving consumers who were seriously interested in earth-sheltered housing. The study was conducted by Gary Solomonson and Associates, with a sample identified as being primarily between 25 and 35, married, professionals, and without children. Major reasons for their interest in earth-sheltered homes were energy and environmental conservation techniques that this type of dwelling offers (Solomonson, 1979, p. 10).

Although the research is sparce, the results have been positive. It is apparent that consumers involved in these studies have favorable attitudes toward utilizing energy saving design features in residential dwellings. As Ewers (1977, p. 41) stated, "the age of solar energy is here."

CHAPTER III

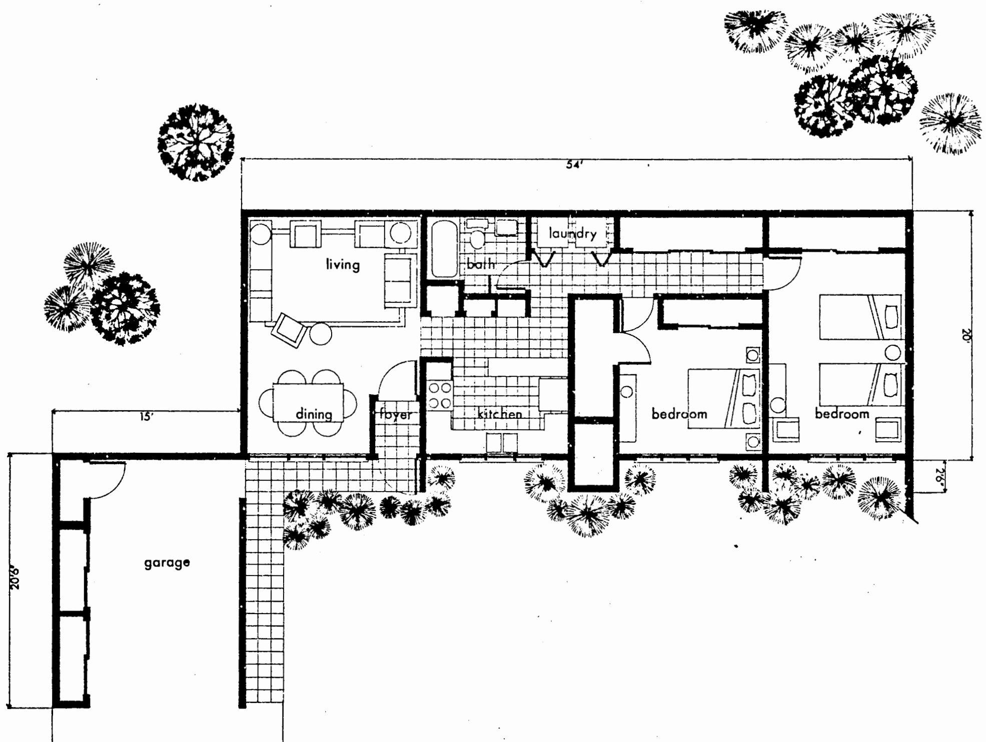
METHODOLOGY OF STUDY

This study was done in connection with the S-95 Southern Regional Research Project. Researchers at the Rural Housing Research Unit of Clemson University, Clemson, South Carolina constructed two experimental houses. In November 1978, the public was invited to visit the two experimental houses during an open house. On three consecutive Sundays consumers were given guided tours free of charge. Information was given to the consumers both prior to and during the tours as to the design features and possible energy savings of the two residences.

Description of Experimental Houses

Earth-Insulated Solar House

One of the experimental houses was that of an earth-insulated solar house. This two-bedroom residence consisted of 1080 square feet. The floorplan and perspective of the house are shown in Figure 1 as well as a perspective of the residence. Three of the walls of the structure were embanked into the earth, decreasing the fluctuation of the atmospheric temperature and increasing the constant subterranean environment. The fourth wall and the roof were conventional and exposed. A pressure treated wood foundation was utilized in the house. The hot-air solar collector was located on the roof, facing south. A scavenger system was



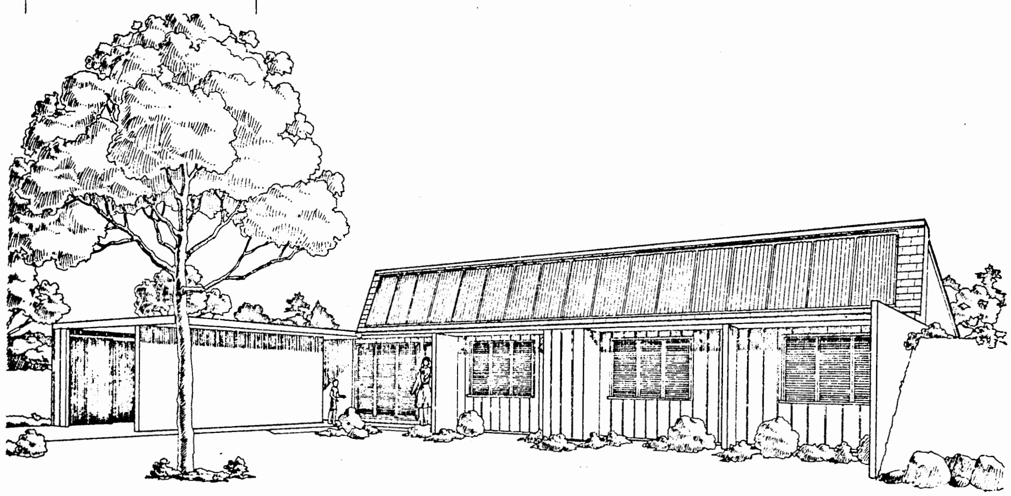


Figure 1. Floorplan and Prespective of the Earth-Insulated Solar House

installed to utilize waste heat for warming the rockfill and soil around the house. Air from the bathroom exhaust, clothes dryer and cook stove was circulated through the rock to extract a portion of energy from the air before it was expelled to the atmosphere.

Solar Greenhouse Residence

A solar greenhouse residence was the second experimental house. This two-story residence consisted of 1,472 square feet. The greenhouse attached to the house produces heat equal in quantity to that used and other than the initial costs of construction, no other cost is involved. The floorplan of the residence and a prespective drawing of the house are shown in Figure 2. Airlocks were utilized at both entrances of the house to minimize temperature change due to the opening of doors to the outside conditions.

Instrumentation

A questionnaire was developed by the author with cooperation of the designers of the houses to collect data on the socioeconomic/demographic characteristics of the respondents and their attitudes toward the houses after the open house tour. Thirty-six items were included in the questionnaire. These items were designed to obtain: (1) socioeconomic/demographic characteristics, (2) attitudes of the respondents toward the earth-insulated solar house, (3) attitudes of the respondents toward the solar greenhouse residence, and (4) respondents preference of one of the experimental houses versus the other.

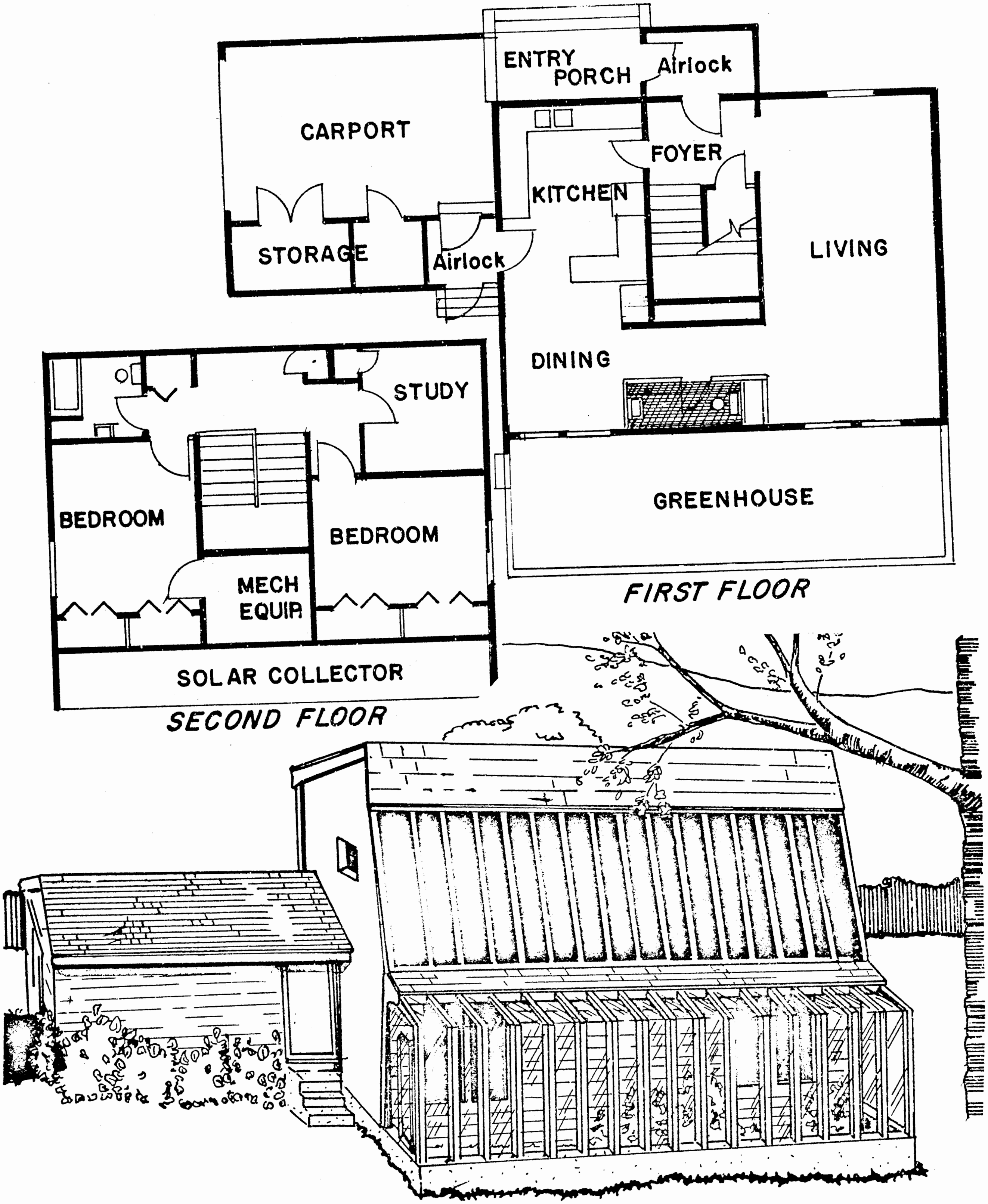


Figure 2. Floorplan and Prespective of the Solar Greenhouse Residence

Data Collection

The questionnaires were distributed to visitors during the open house by researchers from Clemson University. Every fourth person excluding minors, was given a questionnaire. Consumers were given instructions to complete the questionnaire and return it to the researchers before leaving the area. One hundred twenty-four useable questionnaires were returned.

Definitions of Major Variables

The major variables included in this study included the characteristics of the respondents and their attitudes toward the earth-insulated solar house and the solar greenhouse residence. The variables which measured the respondents attitudes were the desire to live in each of the houses, the respondents preference of the earth-insulated solar house versus the solar greenhouse residence, and the respondents' attitudes toward selected design features of the two houses. A series of social, economic and demographic variables were used to obtain the personal data from the respondents. A copy of the instrument can be found in the Appendix.

Desire to Live in Each House

The respondents desire to live in the earth-insulated solar house was measured by item 23, which asked, "Would you want to live in an earth-insulated solar house, if it were the right size for your family?" The desire of respondents to live in a solar greenhouse residence was measured by item 24 which asked, "Would you want to live in a solar greenhouse residence if it were the right size for your family?" Responses to these items were recorded on a scale of one to seven. A response of "one" indicated the respondent "definitely would not" and a response of "seven" indicated "definitely would."

Preference of Earth-Insulated Solar House Versus Solar Greenhouse

The preference of the respondent for the earth-insulated solar versus the solar greenhouse residence was measured by item 28. The item asked, "If you were to build one of these two houses, which one would you prefer?" Respondents were to indicate the house of their choice.

Attitudes Toward the Two Houses

Respondents attitudes toward selected design features included in each of the experimental houses were measured through a series of items. Corresponding items were asked for each house with regard to how the experimental house met the respondent's expectations (items 3 and 4), comparison of the overall size of each house to the respondent's expectations (items 5 and 6), and how well the size of the living area of each house met the needs of the respondent's family (items 7 and 8). Additional corresponding items measured the acceptability of each house in the respondent's community (items 13 and 14) and on the lot next to the respondent's home (items 15 and 16). Respondents attitudes toward the adequacy of access to each of the houses for bringing in groceries, moving furniture in and out, and for escape in case of fire were measured by items 21 and 22.

Specific design features of each house were listed and respondents were asked to indicate whether or not these features were good ideas. Features included in the earth-insulated solar house (item 19) were: solar space heating, solar water heating, panelized construction, pressure treated wood foundation and earth insulation. The design features included in the solar greenhouse residence (item 20) were: solar space heating, solar water heating and the greenhouse as a source of food production. Responses to all items ranged on a scale of "one" to "seven," with a response of one indicating a "questionable idea" and a seven indicating an "excellent idea."

Socioeconomic/Demographic Characteristics

Respondents were asked to respond to questions concerning the personal data of the respondents. The age, sex and marital status of the respondents were asked in items 29-31, respectively. Respondents were asked to indicate the highest level of education they had completed (item 32). The ages of the respondent's children, if any, were asked by item 33. This information was used to determine the family life cycle stage of the respondent. The size of the respondent's home town was asked in item 34. Item 35 measured the annual income of the respondent's household. The occupation of the respondent and spouse, if married, were asked in item 36.

Analysis

Frequencies and percentages were used to describe the characteristics of the sample and the general attitudes of the respondents. Chi square analysis was employed to examine the differences in attitudes related to selected socioeconomic/demographic characteristics (Ho_1 and Ho_2).

Discriminant analysis was used to identify the variables which best discriminate (1) between very positive, moderately positive, and negative responses to the desire to live in each type of house (Ho_3 and Ho_4) and (2) between those who prefer the earth-insulated solar house versus those who prefer the solar greenhouse residence (Ho_5).

Discriminant analysis is used when the objective is to statistically differentiate between at least two groups of cases. A set of discriminating variables measuring characteristics that are expected to differ between the groups is selected. "The mathematical objective of discriminant analysis is to weight and linearly combine the discriminating variables in some fashion so that the groups are forced to be statistically distinct as possible" (Nie, Hull, Jenkins, Steenbrenner and Bent, 1970, p. 435). Discriminant analysis forms one or more linear combinations of discriminating variables.

> These discriminant functions are of the form
> $$D_i = d_{i1} + di_2Z_2 + \ldots\ldots\ldots + d_{ip}Z_p$$
> where D_i is the score on discriminant function i, the d's are weighting coefficients, and the Z's are the standardized values of the p discriminating variables used in the analysis (Nie, et al. 1970, p. 435).

The standardized discriminant function coefficient reflects the relative importance of the variable to the function. Thus the standardized coefficients can be used to identify the variables which contribute most in discriminating between groups.

CHAPTER IV

ANALYSIS OF DATA

Introduction

This chapter reports the findings as related to the three objectives of the study. The first two sections describe the respondents and their attitudes toward the two experimental houses. The next five sections report the findings related to the five null hypotheses.

Description of the Sample

The characteristics of the sample of 124 persons who visited the earth-insulated solar house and the solar greenhouse residence during the open house is described in this section. The ages of those included in the sample ranged from 18 to 65 years of age (see Table I). The largest age group were those between 25 and 34 (27%). Twenty-four percent of the sample was in the 35-44 age group. It was expected that the percentage of respondents in these age categories would be higher because they are considered the most likely home buyers (Wish, 1978).

The male-female distribution was fairly even in the sample. Fifty-six percent of the respondents were male. The majority of those in the sample were married (81%).

Most stages of the family life cycle were represented by the respondents. Sixteen percent of the sample had at least one child over age 13 and no child under age six. Respondents between the ages of 18

TABLE I

CHARACTERISTICS OF THE SAMPLE

Characteristic	Frequency n	Percent (%)
Age of Respondent		
18-24	19	15.33
25-34	33	26.61
35-44	29	23.39
45-54	24	19.35
55-64	15	12.10
65 and over	3	2.42
No response	1	0.80
Sex of Respondent		
Male	69	55.65
Female	54	43.55
No response	1	0.80
Marital Status of Respondent		
Single	21	16.94
Divorced	2	1.61
Married	101	81.45
Family Life Cycle		
18-34, not married	18	14.52
18-34, married no children	17	13.71
Family, all children less than 6	13	10.48
Family, all children less than 13	14	11.29
Family, all children between 6 and 13	6	4.84
35-44, not married	0	0.00
35-44, married no children	4	3.23
Family, youngest child less than 6 and oldest between 13-18	3	2.42
Family, no children under age 6 and at least 1 over 13	20	16.13
45-64, not married	4	3.23
45-64, married no children	2	1.61
Family, all children living away from home	14	11.29
Retired couple	7	5.65
Retired single	1	0.80
No response	1	0.80

TABLE I (Continued)

Characteristic	Frequency n	Percent (%)
Size of Respondent's Home Town		
Rural	33	26.62
Village of 1,000 or less	7	5.65
Town of 1,000 to 10,000	55	44.35
City of 10,000 to 50,000	17	13.71
Suburb of city	8	6.45
City in excess of 50,000	3	2.42
No response	1	0.80
Education of Respondent		
8th grade or less	0	0.00
Some high school	2	1.61
High school graduate	13	10.48
1-3 years of college	31	25.00
College graduate	35	28.23
Master's degree	23	18.55
Doctoral degree	19	15.33
No response	1	0.80
Occupation of Household Head		
Retired	7	5.65
Unemployed	5	4.03
Student	14	11.29
Private House Worker	6	4.84
Service Worker	1	0.80
Laborer	1	0.80
Equipment Operator	1	0.80
Craftsman	4	3.23
Sales Worker, Clerical	8	6.45
Managers, Administrators	11	8.87
Professional	59	47.59
No response	7	5.65
Annual Household Income		
Under $4,999	3	2.42
$5,000-$7,999	2	1.61
$8,000-$10,999	2	1.61
$11,000-$13,999	8	6.45
$14,000-$16,999	11	8.87
$17,000-$19,999	13	10.48
$20,000-$22,999	16	12.90
$23,000-$25,999	10	8.06
$26,000-$28,999	14	11.29
$29,000-$31,999	10	8.06
$32,000-$34,999	6	4.84
Over $35,000	15	12.11
No response	14	11.29

and 34 who were not married made up 15 percent of the sample, and an additional 14 percent were in the same age group but were married and without children.

Over 40 percent of the sample indicated they were presently living in small towns of 1,000 to 10,000 inhabitants. Twenty-seven percent were living in rural areas and 14 percent were from cities with a population of 10,000 to 50,000 people.

The majority of respondents included in the sample had high education levels. One-fourth had completed one to three years of college or technical school. Twenty-eight percent were college graduates. An additional 19 percent had master's degrees and 15 percent had doctoral degrees. The high educational level may have resulted from the fact that the experimental houses were located at Clemson University and many of the visitors to the open house came from the university community.

Fifty percent of the respondents indicated their occupation as being in the professional category. Twelve percent of those in the sample were students, this was expected due to the connection of the experimental houses with Clemson University. Nine percent indicated their occupation as managers or administrators.

The annual family income of the respondents varied from less than $4,999 to more than $35,000. Fifteen percent of the sample indicated incomes between $20,000 and $22,999 a year. Fourteen percent responded their annual family income was over $35,000 and 13 percent reported incomes in the $26,000 to $28,999 category. Twelve percent of the respondents indicated the annual income of their family was between $17,000 and $19,999.

For 82 percent of the sample this was their first visit to an earth-insulated solar home. Fifteen percent of the respondents had visited a home of this type once or twice previously and only two percent knew someone that was living or had lived in an earth-insulated solar home.

Eighty-two percent of the respondents touring the experimental houses had never visited a solar greenhouse residence before. Twelve percent responded that they had made one or two previous visits to this type of house. Four percent of the sample indicated they knew someone living in or who had lived in a solar greenhouse residence, and an additional two percent of the respondents had lived in or were presently living in this type of house.

Attitudes Toward the Experimental Houses

The first objective of this study was to describe consumer attitudes toward two experimental houses designed to be energy conserving. The response of those included in the sample was quite favorable to both the earth-insulated solar home and the solar greenhouse residence. A majority of the respondents indicated a positive attitude toward living in both of the experimental houses, as long as the house was the right size for their family.

Table II shows that almost one-half of the sample responded that if an earth-insulated solar home was the right size for their family they would definitely want to live in that type of home. In addition, 29 percent indicated a favorable attitude toward living in this type of home.

TABLE II

FREQUENCIES OF RESPONDENTS' ATTITUDES TOWARD SELECTED CHARACTERISTICS OF THE TWO EXPERIMENTAL HOUSES

Question	Responses						
	Definitely Would Not			Neutral			Definitely Would
	1	2	3	4	5	6	7
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Would you want to live in earth-insulated solar home if it were right size for family?	5 (4)	6 (5)	7 (6)	13 (10)	17 (14)	20 (16)	56 (45)
Would you want to live in solar greenhouse if it were right size for family?	0 (0)	2 (2)	0 (0)	2 (2)	12 (10)	24 (20)	83 (67)
	Not as Expected						Just as Expected
How does this home compare to what you thought an earth-insulated solar home would be like?	4 (3)	8 (7)	16 (13)	17 (14)	36 (30)	28 (23)	12 (10)
How does this home compare to what you thought a solar greenhouse residence would be like?	4 (3)	3 (2)	17 (14)	15 (12)	37 (30)	27 (22)	20 (16)

TABLE II (Continued)

Question	Responses						
	Much Smaller Than Expected			Neutral			Much Larger Than Expected
	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	6 n (%)	7 n (%)
How does the overall size of the earth-insulated solar house compare to what you thought it would be like?	12 (10)	33 (27)	30 (25)	26 (21)	17 (14)	3 (2)	1 (1)
How does the overall size of the solar greenhouse residence compare to what you thought it would be like?	6 (5)	14 (11)	23 (19)	39 (32)	29 (24)	9 (7)	3 (2)

Question	Not At All Adequate 3-10	11-13	14-15	16-18	Very Adequate 19-21
Do you feel the access to this earth insulated solar home is adequate?	35 (29)	23 (19)	22 (18)	23 (19)	17 (15)
Do you feel the access to this solar greenhouse residence is adequate?	11 (10)	17 (14)	26 (22)	37 (31)	27 (23)

In comparison, two-thirds of the respondents indicated they would definitely want to live in a solar greenhouse residence if it were the right size for their family. A favorable attitude toward living in this type of home was indicated by an additional 30 percent of the sample.

The respondents were asked to indicate how each of the experimental houses compared to their expectations. A majority of the respondents reported that both houses compared favorably to their expectations. Thirty-four percent of the respondents indicated the earth-insulated solar home was just as they had expected it to be, while an additional 29 percent responded that the house was somewhat as they had expected it to be. Twenty-three percent responded that the earth-insulated solar home was not like they thought it would be.

Thirty-eight percent of the sample responded that the solar greenhouse residence was just as they had expected it to be. An additional one-third of the respondents indicated some positive comparison between the house and their expectations of it. Nineteen percent of the respondents indicated the house did not compare with their expectations of that type of home.

Responses to how the overall size of each of the experimental houses compared to the respondents expectations were quite varied. In general the earth insulated solar home was smaller than the respondents expected it to be while the solar greenhouse residence was larger than expected.

Thirty-six percent of the sample evaluated the overall size of the earth-insulated solar home as smaller than they expected it to be. An additional 25 percent indicated that the home was somewhat smaller than expected. Only 17 percent of the respondents indicated the home was larger than they had expected it to be.

The overall size of the solar greenhouse residence was evaluated as much smaller than expected by 16 percent of the respondents. Nineteen percent indicated the house was somewhat smaller than expected. However, 34 percent of the respondents indicated the overall size of the solar greenhouse residence was larger than their expectations.

The respondents were asked to consider the accessibility of each of the experimental homes. Three measures of adequacy of access were developed for the respondents to consider. The first measure dealt with the access of the house for bringing in groceries. The second measure considered adequacy to move furniture in and out of each of the houses. The third access measure dealt with the adequacy of escape from each house in case of fire. Zero order correlations revealed that measures could be summed to form a single index measuring the respondents attitudes concerning the overall adequacy of each of the houses.

Twenty-nine percent of the sample indicated the access of the earth-insulated solar home was not at all adequate and 15 percent indicated that access was very adequate. Only ten percent of the respondents indicated the access to the solar greenhouse residence was not at all adequate, while 23 percent evaluated the access as very adequate.

Respondents were given a list of possible floorplan changes for each of the experimental houses (see item , Appendix) and were asked to indicate those changes which they felt needed to be made in the floorplans. In addition the respondents had the opportunity to make additional suggestions for floorplan changes. The types of floorplan changes desired are shown in Table III. Forty percent of the

TABLE III

DESIRED CHANGES IN FLOORPLANS

Earth-Insulated Solar			Solar Greenhouse		
Type of Change	n	%		n	%
More living area and less private area	21	17	Relocate stairway	5	4
More storage throughout and smaller living area	8	6	Eliminate study for third or larger bedrooms	46	37
3 smaller bedrooms	10	8	More storage throughout	24	19
General increase in size of rooms	17	14	General increase in size of rooms	9	7
Add on rooms	10	8	Add on rooms	4	3
Change room arrangement and/or add extra features	22	18	Change room arrangement and/or add extra features	15	12
No changes desired	49	40	No changes desired	31	25

Percentages do not total 100% because respondents could indicate more than one floorplan change.

sample did not want to make any changes in the plan for the earth-insulated solar house. Eighteen percent indicated a desire to change the arrangement of the rooms and/or add extra features, such as a fireplace. Seventeen percent wanted more group living area and less private area. A general increase in the size of the rooms was desired by 14 percent of the sample.

One-fourth of the respondents reported they would not make any changes in the solar greenhouse residence. Thirty-seven percent wanted to eliminate the study and have a third or larger bedroom. More storage throughout the house was desired by 19 percent of the sample. Twelve percent of the respondents indicated wanting to make changes in the arrangement of the rooms or include additional features in the floorplan.

Summary

Both the earth-insulated solar house and the solar greenhouse residence received favorable responses from the respondents. More respondents indicated they would want to live in a solar greenhouse residence than in an earth-insulated solar house.

Both houses compared favorably to the respondents expectations. However, the overall size of the earth-insulated solar house was smaller than respondents expected while the solar greenhouse residence was larger than expected. Respondents reported the access into and out of the solar greenhouse residence was more adequate than the earth-insulated solar house. Respondents suggested that some changes be made in the floorplans of both houses and additional features to be added.

Relationship Between Respondents Characteristics and Their Attitudes

Hypothesis One

The second objective of this study was to analyze the relationship between selected characteristics of the consumers and their attitudes toward each of the two experimental houses.

Ho_1: Attitudes toward selected design features of the earth-insulated solar house will not differ by the socioeconomic/demographic characteristics of the respondents.

Chi square analysis was used to test this hypothesis. The alpha level for statistical significance was set at p .05. For the purpose of obtaining adequate cell size for the chi square analysis the categories of the variables were collapsed in the following manner (original codes are shown in parentheses):

Number of previous visits to an earth-insulated solar home
Number of previous visits to a solar greenhouse residence
1 = first visit to this type of house (1)
2 = 1 or more past visits, know someone or personally have lived or living in this type of house (2-5)

Earth-insulated solar home compared to expectations
Solar greenhouse residence compared to expectations
1 = not as expected or definitely not as expected (1-3)
2 = neutral (4)
3 = as expected (5-6)
4 = just as expected (7)

Overall size of earth-insulated solar home compared to expectations
Overall size of solar greenhouse residence compared to expectations
1 = definitely not as expected (1-2)
2 = not as expected (3)
3 = neutral (4)
4 = as expected or definitely as expected (5-7)

Acceptability of earth-insulated solar home in community
Acceptability of solar greenhouse residence in community
1 = would not be acceptable or definitely would not be acceptable (1-3)

2 = neutral (4)
3 = would be acceptable (5-6)
4 = definitely would be acceptable (7)

Acceptability of earth-insulated solar home on lot next to respondents own home
Acceptability of solar greenhouse residence on lot next to respondents own home
1 = definitely would not be acceptable (1-2)
2 = would not be acceptable (3)
3 = neutral (4)
4 = would be acceptable or definitely would be acceptable (5-7)

Impression of earth-insulation of experimental house
Impression of utilizing greenhouse as a source of food production
1 = questionable idea (1-9)
2 = good idea (10-11)
3 = excellent idea (12-14)

Is there really an energy shortage?
1 = no, there is not (1-4)
2 = yes, there is (5-6)
3 = yes, there definitely is (7)

Age of respondent
1 = 18-24 years of age (2)
2 = 25-34 years of age (3)
3 = 35-44 years of age (4)
4 = 45-54 years of age (5)
5 = 55-64 years of age (6)
6 = 65 years of age and over (7)

Marital status of respondent
1 = not married (1-3)
2 = married (4)

Family life cycle stage of respondent
1 - 18-34 years old, no children (1-2)
2 = children all less than 13 years of age (3-5)
3 = oldest child at least 13 years of age (8-9)
4 = 35 years of age and over and either no children or all children living away from home (6-7 and 10-14)

Size of home town of respondent
1 = rural or small village (1-2)
2 = town of less than 10,000 (3)
3 = city greater than 10,000 (4-6)

Annual income of respondents family
1 = less than $13,999 (1-4)
2 = $14,000-$19,999 (5-6)
3 = $20,000-$25,999 (7-8)
4 = $26,000-$31,999 (9-10)
5 = $32,000 and over (11-12)

Occupation of household head
1 = unemployed (1-2)
2 = student (3)
3 = laborers (5-8)
4 = office workers (9-10)
5 = professional (11)

Education of respondent
1 = high school graduate or less (1-3)
2 = 1-3 years of college or tech school (4)
3 = college graduate (5)
4 = master's degree (6)
5 = doctoral degree (7)

One variable that might be confusing as to the manner which the categories were collapsed was the family life cycle stage. An attempt was made to collapse the categories so that the housing needs within each category would be as similar as possible.

The degree to which the earth-insulated solar house met the expectations of the respondents differed significantly in relation to the number of previous visits the respondents had made to an earth-insulated solar home (see Table IV). Seventy-three percent of those who had visited an earth-insulated solar house before indicated that this experimental home was "just as expected," while only 25 percent of the first time visitors made the same evaluation.

Expectations of community acceptance of an earth-insulated solar home was significantly different in relation to the marital status of the respondent. Table V shows that 26 percent of the respondents who were not married indicated this type of house would not be accepted in their community, while only 13 percent of those who were married responded this way. Only 22 percent of those who were not married stated that this house would definitely be accepted in their community, but 42 percent of those who were married responded in the same manner.

TABLE IV

EARTH-INSULATED SOLAR HOUSE COMPARED TO EXPECTATIONS BY NUMBER OF PREVIOUS VISITS

Number of Previous Visits to Earth-Insulated Solar House	Comparison to What Was Expected							
	Not as Expected					Just as Expected		
	n	(%)	n	(%)	n	(%)	n	(%)
1st Visit	25	(25.3)	16	(16.2)	33	(33.3)	25	(25.3)
More than 1 Visit	3	(13.6)	1	(4.5)	2	(9.1)	16	(72.7)

$X^2 = 18.41$

$p < .0004$

TABLE V

ACCEPTABILITY OF EARTH-INSULATED SOLAR HOUSE IN THE COMMUNITY BY MARITAL STATUS

Marital Status	Acceptability in Community							
	Not At All						Definitely	
	n	(%)	n	(%)	n	(%)	n	(%)
Not Married	6	(26.1)	5	(21.7)	7	(30.4)	5	(21.7)
Married	13	(12.9)	7	(6.9)	39	(38.6)	42	(41.6)

$X^2 = 8.66$

$p < .03$

A significant difference was found between the perceived acceptability of an earth-insulated solar home being built on the lot beside the respondent's home in relation to the stage of the family life cycle. Respondents whose families were in the younger stages of the family life cycle were more likely to perceive this type of home as definitely being acceptable on the lot next ot their home (see Table VI). However, respondents who were 35 or older without children and those whose children had already left home were less likely to state that this housing alternative would be acceptable on the lot next to their home.

Evaluation of the size of the earth-insulated solar home differed significantly in relation to the size of the respondents home town. As shown in Table VII, 57 percent of the respondents who were from cities of 10,000 or more people indicated the experimental house was much smaller than they had expected, while 27 percent of those from towns of less than 10,000 people and 34 percent of the respondents from rural areas responded the house was larger than expected, compared to only 11 percent of those from cities of 10,000 or more.

Four variables measuring attitudes toward the earth-insulated solar house were found to differ significantly in relation to marital status, stage in the family life cycle, size of home town, and the number of previous visits to an earth-insulated house. Respondent-characteristics that were not related to attitudes included education, age, income, and occupation. Therefore, Ho_1 was partially accepted.

Hypothesis Two

Ho_2: Attitudes toward selected design features of the solar

TABLE VI

ACCEPTABILITY OF EARTH-INSULATED SOLAR HOUSE NEXT DOOR BY STAGE IN FAMILY LIFE CYCLE

Stage in Family Life Cycle	Acceptability Next Door							
	Not at all						Definitely Yes	
	n	(%)	n	(%)	n	(%)	n	(%)
18-34, no children	6	(17.1)	7	(20.0)	5	(14.3)	17	(48.6)
All children less than age 13	7	(21.2)	4	(12.1)	10	(30.3)	12	(36.4)
At least 1 child over age 13	4	(17.4)	2	(8.7)	5	(21.7)	12	(52.2)
35 or older, and either no children or all are living away from home	6	(18.8)	14	(43.8)	5	(15.6)	7	(21.9)

$X^2 = 17.38$

$p < .04$

TABLE VII

OVERALL SIZE OF EARTH-INSULATED SOLAR HOUSE COMPARED TO EXPECTATIONS BY SIZE OF HOME TOWN

Size of Home Town	Size Compared to Expectations			
	Much Smaller			Much Larger
	n (%)	n (%)	n (%)	n (%)
Rural or Village	13 (34.2)	6 (15.8)	11 (28.9)	8 (21.1)
1,000-10,000	15 (27.3)	20 (36.4)	11 (20.0)	9 (16.4)
10,000 or more	16 (57.1)	4 (14.3)	5 (17.9)	3 (10.7)

$X^2 = 12.26$

$p < .05$

greenhouse residence will not differ by the socioeconomic/ demographic characteristics of the respondent.

Chi square analysis was used to test this hypothesis. Categories of the variables included in this procedure were collapsed as shown on pages 43-45.

Attitudes toward the selected design features of the solar greenhouse residence were quite positive for most respondents. No significant differences in attitudes were found in relation to any of the respondent characteristics. Ho_2 was accepted.

<u>Hypothesis Three</u>

Ho_3: The desire to live in an earth-insulated solar house will not be related to selected socioeconomic/demographic characteristics or attitudes toward selected design features of the house.

Discriminant analysis was used to test Ho_3. Responses to item 23, "Would you want to live in a solar greenhouse residence, if it were the right size for your family?" were divided into three groups for the analysis. Group one was composed of those who responded with a "1" through "4" indicating that they definitely would not want to live in such a home to the point where they were neutral about it. Group 2 was those who responded with a "5" or "6" indicating that they were positively disposed to living in such a home. Group 3 was those who checked "7" indicating they definitely would want to live in an earth-insulated solar home if it were the right size for their family.

Table VIII shows the results of this analysis. Four variables were found to significantly discriminate between the three groups. These variables were adequacy of access to the house, perceived acceptability of the house in the respondents community, education of the

TABLE VIII

DISCRIMINANT ANALYSIS FOR WANTING TO LIVE IN AN EARTH-INSULATED SOLAR HOUSE

Variable	F To Remove	Wilks Lambda	Significance	Means: Would Not	Means: Would	Means: Definitely Would	Standardized Canonical Discriminant Function Coefficients
Adequacy of access	9.97	.78	0.00	10.11	12.71	15.34	0.62
Acceptability in community	8.48	.65	0.00	4.57	5.18	6.34	0.63
Education	4.25	.60	0.00	4.93	5.57	4.76	-0.25
Impression of solar system	1.63	.58	0.00	11.29	12.11	12.74	0.29

Percent of "grouped" cases correctly classified = 61%.

respondent and the respondent's impression of the solar system.

The respondent's perception of the adequacy of access to the earth-insulated solar home was the best variable for discriminating between groups. This index combined three items so the range was 3 to 21. Those respondents who indicated they would not want to live in this type of house had the lowest mean scores of adequacy of access, while those respondents who reported that they definitely would want to live in an earth-insulated solar home had the highest mean scores.

Response to the question of whether or not an earth-insulated home would be acceptable in the respondents' community was the second best variable for discriminating between respondents who would and would not want to live in a house of this type. The group that did want to live in this type of house indicated that such a house might not be acceptable in their community. The mean score on acceptability of the house increased for groups two and three which indicated that the desire to live in an earth-insulated solar home increased as the perceived acceptability of the home increased.

Education of the respondent also discriminated between groups, but to a lesser degree than did the previous two variables. The mean education level was highest for group two; those who stated that they would want to live in an earth-insulated solar home. The mean education level was between categories "5" and "6" (that is those with college degrees or master's degrees).

The fourth variable that was found to discriminate between groups was the respondent's impression of utilizing the solar system in the house. The mean of all groups indicated a favorable response to the idea. Those who definitely would want to live in an earth-insulated solar house evaluated the solar system as a good idea, while those who indicated they would not want to live in this type of house were not as favorable to the idea of utilizing the solar system.

The discriminant function scores were used to predict the group membership of each respondent. Function 1 correctly classified 68 percent of those who would and 66 percent of those who definitely would want to live in a house of this type. The overall percent of cases correctly classified was 61 percent.

Four variables were found to significantly discriminate among groups in terms of desire to live in an earth-insulated solar house. Therefore, Ho_3 was only partially accepted.

<u>Hypothesis Four</u>

Discriminant analysis was used to test Ho_4.

Ho_4: The desire to live in a solar greenhouse residence will not be related to selected socioeconomic/demographic characteristics or attitudes toward selected design features of the residence.

Item 24 asked "Would you want to live in a solar greenhouse residence, if it were the right size for your family?" Since nearly all respondents reacted favorably to the idea of living in the solar greenhouse residence, responses were divided into only two groups for this analysis. Group one consisted of those who responded with a "5" or "6" indicating they were somewhat positive toward living in this type of house. Group two was those who indicated they definitely would want to live in a house of this type. Those responding "1" through "4" were not included in the analysis because of the limited number.

Table IX shows the five variables that were found to significantly discriminate between respondents who "would somewhat" and those who

TABLE IX

DISCRIMINANT ANALYSIS FOR WANTING TO LIVE IN A SOLAR GREENHOUSE RESIDENCE

Variable	$\underline{F}$ To Remove	Wilks Lambda	Significance	Means: Somewhat Would	Means: Definitely Would	Standard Canonical Discriminant Function Coefficients
Adequacy of access	11.23	.91	0.00	14.16	16.69	.66
Acceptability in community	6.78	.82	0.00	5.81	6.53	.53
Impression of solar system	4.82	.79	0.00	11.34	12.59	.45
Age of respondent	2.98	.77	0.00	4.28	3.74	-.35

Percent of "grouped" cases correctly classified = 73%

"would definitely" want to live in a solar greenhouse residence. Perceived adequacy of access, perceived acceptability of the house by the community, impression of the solar system and the age of the respondent were the discriminating variables.

Perceived adequacy of access to the house was the most discriminating variable. Respondents who indicated they would definitely want to live in a solar greenhouse residence perceived the access to the house as more adequate than those who were only somewhat desirous of living in this type of house.

Acceptability of the house in the respondent's community was the second most discriminating variable between groups. The respondents included in group one reported the house would be accepted in the community, however, those in group two responded that a house of this type would definitely be accepted in the community.

Two additional variables were found to discriminate between groups, but to a lesser degree. The impression of the solar system was found to discriminate between the two groups. Those who definitely would want to live in a solar greenhouse residence reported more favorable attitudes toward the solar system than those in group one. The age of the respondents was also found to discriminate between groups. The means were computed on age categories rather than actual age in years. Those who definitely would want to live in a solar greenhouse residence were slightly younger than those who did not want to live in this type of home (about age 25 to 34). Since four variables were found to significantly discriminate between groups in terms of their desire to live in a solar greenhouse, Ho_4 was only partially accepted.

Accuracy of the discriminate analysis in predicting group membership was tested. Overall 73 percent of the grouped cases were correctly classified by the four variables included in the analysis.

Hypothesis Five

> Ho_5: Respondents desire to live in the earth-insulated solar house versus the solar greenhouse residence will not be related to socioeconomic/demographic characteristics of the respondents nor their attitudes toward selected design features of the two residences.

Item 28, "If you were to build one of these two houses, which one would you choose?" was used to test Ho_5. Group one was those who would prefer to live in the earth-insulated solar house and those in group two were those preferring to live in the solar greenhouse residence.

Table X shows the six variables found to significantly discriminate between the two groups. The most discriminating variable was the perceived adequacy of access to the earth-insulated solar house. Obviously, it would be expected that those who had more positive attitudes towards the accessibility of the earth-insulated solar home would prefer to live in it. The second most discriminating variable between groups was the adequacy of access of the solar greenhouse residence. As with the first variable, those who preferred the solar greenhouse residence reported a greater adequacy of access to the house than those preferring the earth-insulated solar house.

The educational level of respondents was also found to discriminate between groups, but to a lesser degree. Those who preferred the solar greenhouse residence had a higher educational level than those preferring the earth-insulated solar house. The perceived acceptability of each of the homes in the respondent's community was also found to discriminate in terms of choice of house. The perceived acceptability of the solar

TABLE X

DISCRIMINANT ANALYSIS FOR PREFERENCE OF EARTH-INSULATED SOLAR HOUSE VERSUS SOLAR GREENHOUSE RESIDENCE

Variable	F To Remove	Wilks Lambda	Significance	Means: Earth-Insulated Solar	Means: Solar Greenhouse	Standard Canonical Discriminant Function Coefficients
Adequacy of access in earth-insulated solar	11.80	.91	0.00	15.42	12.48	.85
Adequacy of access in solar greenhouse	5.63	.86	0.00	15.50	16.17	-.60
Education	3.39	.84	0.00	4.65	5.14	-.43
Acceptability of solar greenhouse in community	3.48	.82	0.00	6.15	6.32	-.51
Acceptability of earth-insulated solar in community	2.44	.80	0.00	5.77	5.32	.44
Age of respondent	2.94	.78	0.00	4.04	3.78	.79

Percent of "grouped" cases correctly classified = 68%.

greenhouse residence was greater by those who would prefer living in this type of house, while the acceptability of the earth-insulated solar home was greater by those indicating they would want to live in a house of this type.

Age of the respondent was found to discriminate between respondents preferring the earth-insulated solar home and those preferring the solar greenhouse residence. Those who were included in group one were slightly older than those in group two.

Six variables were found to significantly discriminate between respondents who wanted to live in the earth-insulated solar home and the solar greenhouse. Thus, Ho_5 was only partially accepted.

A test of accuracy in predicting the classification of respondents into the two groups according to these variables was performed. Seventy percent of those preferring the earth-insulated solar house and 67 percent of those who preferred the solar greenhouse residence were correctly classified. Overall 68 percent of the cases were grouped correctly.

Summary

The analysis presented in this chapter supported the acceptance of one of the hypothesis, but only partial acceptance of the other four hypotheses.

Ho_1 was partially accepted. The hypothesis failed to be totally accepted on the basis of four socioeconomic/demographic variables which were found to be related to the respondents' attitudes toward selected design features of the earth-insulated solar house. These socioeconomic/demographic variables were the previous visits of the respondent to a house of this type, marital status, stage in the family life cycle and the size of the respondent's home town. The design features which were significantly affected by the socioeconomic/demographic variables were the general expectations about the house, perceived community acceptance of the experimental house, perceived acceptability of the house in the respondent's community and the overall size of the house compared to expectations.

Ho_2 was accepted. The testing of this hypothesis showed that attitudes toward selected design features of the solar greenhouse residence did not differ in relation to socioeconomic/demographic characteristics of the respondents.

Ho_3 was partially accepted. Adequacy of access to the earth-insulated solar house, perceived acceptance of the house in the community, the education level of the respondent and impression of the solar system were the variables found to discriminate between groups.

Ho_4 was partially accepted. Five variables were found to discriminate between respondents who "would somewhat" and those who "would definitely" want to live in a solar greenhouse residence. These variables were perceived adequacy of access, perceived acceptability of the house by the community, impression of the solar system and the age of the respondent.

Ho_5 was partially accepted. This hypothesis failed to be totally accepted on the basis of six variables that were found to significantly discriminate between respondents who prefer one of the experimental houses versus the other. The six discriminating variables were: perceived adequacy of the solar greenhouse residence, education, perceived acceptability of the earth-insulated solar house in the community, perceived acceptance of the solar greenhouse residence in the community and the age of the respondent.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Steps must be taken by consumers in America to reduce the quantity of fossil fuels used to provide energy. Conservation methods must be utilized to reduce the amount of energy consumed, although, this will not remedy the problem situation. Alternative energy sources must be developed and used on the residential level. However, research in the area of consumer acceptance of possible alternative energy sources could aid in further utilization by consumers of these sources.

Visitors to the open house were given tours of both the earth-insulated solar house and the solar greenhouse residence. Questionnaires were distributed to the consumers at the end of the tour and instructions were given to complete and return the questionnaires before leaving the area. The questionnaire included items to obtain socioeconomic/demographic data of the respondents, attitudes of the respondents toward each of the experimental houses, and the respondents' preference of one house versus the other.

The purpose of this study was to examine attitudes of consumers toward the two experimental energy saving housing designs. This study was limited to those consumers visiting the experimental houses during an open house at Clemson University, Clemson, South Carolina.

Three objectives were used to guide this study:

1. To describe consumer attitudes toward the two experimental houses designed to be energy conserving.
2. To analyze the relationship between selected characteristics of the consumers and their attitudes toward each of the two experimental housing designs.
3. To examine respondent characteristics and attitudes associated with a preference for the earth-insulated solar house versus the solar greenhouse residence.

Three types of analysis were used in this study. Percentages were used to describe the characteristics of the sample and the general attitudes of the respondents. Chi square was used to examine the differences in attitudes related to selected socioeconomic/demographic characteristics of the respondents. Discriminant analysis was used to identify the variables which best discriminate between those who desire and do not desire to live in each type of house. Discriminant analysis was also used to discriminate between those who would prefer the earth-insulated solar house and those who would prefer the solar greenhouse residence.

Conclusions

A somewhat favorable response could have been expected from the respondents toward the experimental houses, because consumers involved in the study were interested enough in solar houses to attend the open house. Attitudes of the respondents were found to be generally favorable to both the earth-insulated solar house and the solar greenhouse residence. Over fifty percent of the respondents reported a positive attitude to living in both of the experimental houses. The study did show, however, that a greater number of respondents indicated they would want to live in the solar greenhouse residence than in the earth-insulated solar house.

Differences in the size of the two houses and in the appearance of the houses could have influenced the respondents' attitudes. The solar greenhouse residence was almost 400 square feet larger than the earth-insulated solar house. Not only was the solar greenhouse residence larger, but it was also more conventional in exterior appearance.

The study revealed that selected socioeconomic/demographic characteristics influenced the respondents' attitudes toward selected design features. Respondents' perception of the acceptability of an earth-insulated solar house in their communities was found to significantly differ according to the respondents' marital status. Those who were married indicated a house of this type would have greater acceptability in their community than did those respondents who were not married. This finding supports findings from a study by Solomonson and Associates. The Solomonson study reported that those who were the most interested in earth sheltered housing were primarily between the ages of 25 and 35, married, professional, and without children. Some of these same characteristics of respondents were found to significantly affect other attitudes toward the earth-insulated solar house.

One of these attitude variables was the perceived acceptability of the earth-insulated solar house on the lot next to the respondents' own. This attitude was found to significantly differ with respect to the respondents' stage in the family life cycle. Perceived acceptability of the earth-insulated solar house on the lot next to the respondents' own was positive for those who were under age 34 and without children. In addition, those respondents who had at least 1 child over age 13, also perceived the house as being acceptable on the lot next to their own home. Respondents in other stages of the family life cycle perceived the earth-insulated solar house as less acceptable.

Attitudes toward the solar greenhouse were quite positive for most respondents. None of the socioeconomic/demographic variables were found to be significantly related to consumer attitudes toward selected design features of the solar greenhouse.

It was concluded that for this volunteer sample, socioeconomic/demographic characteristics of the respondents did not strongly influence attitudes toward selected design features of either of the experimental houses.

Data were examined to determine if any of the socioeconomic/demographic variables and attitudes would differentiate between groups of respondents in terms of their desire to live in an earth-insulated solar house. Four variables were found to significantly discriminate between three groups: (1) those who would not, (2) those who would, and (3) those who definitely would want to live in an earth-insulated solar house.

Perceived acceptability of the house in the respondent's community was the strongest discriminating variable. Although respondents expressed favorable attitudes toward the earth-insulated design, they were hesitant about wanting to live in such a house if they felt that the house might not be acceptable in their community. Dempewolf pointed out that many people think of underground houses as being clammy dripping holes in the ground. Visitors to the experimental house may have feared that their neighbors would hold to this evaluation and thus not be accepting of the design. The size of community from which the respondents came would have influenced their feelings about acceptability of the earth-insulated design since over forty percent of the respondents were from small communities of 1,000 to 10,000 people. In these smaller communities the attitudes may well be more conservative and acceptance could be very important to the residents.

The second best discriminating variable was respondents' evaluation of the adequacy of access in and out of the earth-insulated house. Respondents who evaluated the access as adequate were more likely to want to live there. It is possible that having only one doorway to the exterior caused concern among the respondents even though most rooms had windows which opened to the outside. This finding is consistent with the general concern for fire egress provisions in earth-insulated or underground dwellings.

Education was the third discriminating variable in terms of desire to live in the earth-insulated house. Those with higher education were in the group who expressed some positive desire toward living in the house but were not <u>definitely</u> in favor of living there. It could be that the most educated group was aware of the advantages of earth-insulated dwellings in terms of energy conservation but were also aware of disadvantages related to adequacy of access and the difficulty in obtaining financing for homes of this type.

Respondents' impression of the solar system was the fourth discriminating variable. The more positive the impression of the solar system, the more likely the respondent was to express strong desire to live in the earth-insulated solar home. However, adequacy of access and acceptability of this housing alternative in the community were much stronger influences on the consumers' desire to live in an earth-insulated solar home than were evaluation of the impression of the solar system.

Data were also examined to determine if the socioeconomic/demographic and attitude variables would differentiate between groups of respondents in terms of their desire to live in a solar greenhouse. Again, four variables were found to significantly discriminate between groups. In this analysis, nearly all respondents were positive about the desire to live in the solar greenhouse; thus, the groups were (1) those who would like to live there, and (2) those who definitely would like to live there.

Adequacy of access and acceptability in the community and impression of the solar system were again important discriminating variables. Education did not differentiate between groups in their desire to live in the solar greenhouse but age of respondent did. Those definitely wanting to live in the solar greenhouse were younger (25 to 34 years of age) than those who were not so positive in their desire to live there.

It was concluded that only two of the socioeconomic/demographic characteristics were significant discriminators between groups in terms of their desire to live in either of the experimental houses - education and age of respondent. Two attitudes about design features of these homes (adequacy of access and acceptability in the community) had even stronger influences on the desire to live in the experimental homes.

Data were examined to identify variables associated with a preference for the earth-insulated solar house versus the solar greenhouse residence. Here again the respondents' evaluation of the adequacy of access and the perceived acceptability of each design in the community were the variables which best discriminated between respondents who preferred the earth-insulated solar house and those who preferred the solar greenhouse residence. The solar greenhouse was preferred over the earth-insulated solar house by respondents who evaluated the solar greenhouse as being more acceptable in their community and having more adequate access. Respondents who were younger and had higher education levels were also more likely to choose the solar greenhouse over the earth-insulated solar house. It was concluded that preference for one experimental house over the other was significantly influenced by attitudes regarding the adequacy of access in the dwellings, and respondents' perception of the community acceptance of the experimental house along with the respondents' education and age.

Attitudes about the design features were found to be more important than socioeconomic/demographic characteristics of respondents. However, it should be noted that the sample was self-selected in that they expressed interest in energy saving housing alternatives by coming to the open house. In addition, those who returned the questionnaires to the researchers may well have been more favorable toward the designs than those who threw the questionnaires away unanswered. If evaluations were obtained from a more diverse sample, the importance of the variables in relation to desire to live in the houses might be quite different.

Recommendations

The following recommendations are made with regard to further study in the area of alternatives in housing design which conserve energy consumption:

1. That studies be conducted concerning consumer attitudes toward housing designs incorporating other alternative energy sources, such as wind.
2. That studies such as this one be conducted with more heterogenous samples.
3. That studies be conducted which further investigate the psychological impact on inhabitants of living in an earth-insulated residence.
4. That a more detailed study of perceived community acceptance of alternative housing designs be conducted.
5. That studies investigating the satisfaction of residents of earth-insulated and solar housing to be continued.

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APPENDIXES

We are interested in your opinion of these two houses which you are visiting. Please take a few minutes to answer the following questions. Information obtained will be statistically treated in a large group. Your opinion will not be individually identified in any report. This study is a joint effort between Oklahoma State University, Texas Tech University and Clemson University. Your assistance in this study is greatly appreciated.

Questions in the left-hand column refer to the earth-insulated underground home. Questions in the right-hand column refer to the solar greenhouse residence. Please answer all questions for both homes.

EARTH-INSULATED, UNDERGROUND HOME

1. Have you ever visited an earth-insulated or underground home before? (Check the answer that best describes you.)

_______1 This is my first visit to such a home.
_______2 I have visited one or two such homes.
_______3 I have visited three or more such homes.
_______4 I know someone who lives or has lived in such a home.
_______5 I have lived or am living in such a home.

SOLAR GREENHOUSE RESIDENCE

2. Have you ever visited a solar greenhouse residence before? (Check the answer that best describes you.)

_______1 This is my first visit to such a home.
_______2 I have visited one or two such homes.
_______3 I have visited three or more such homes.
_______4 I know someone who lives or has lived in such a home.
_______5 I have lived or am living in such a home.

NOTE: For the following questions, please circle the number of the scale of 1 to 7 which best expresses how you feel. For example, in Question 3, if you feel that the underground house is fairly close to what you expected you could circle 5 or 6. If you feel it is not at all like you expected, circle 1.

3. In general, how does this home compare to what you thought an earth-insulated solar home would be like?

Not at all as I expected 1 2 3 4 5 6 7 Just as I expected

4. In general, how does this home compare to what you thought a solar greenhouse residence would be like?

Not at all as I expected 1 2 3 4 5 6 7 Just as I expected

5. How does the overall size of the earth-insulated home compare to what you thought it would be like?

Much smaller 1 2 3 4 5 6 7 Much larger

6. How does the overall size of the solar greenhouse residence compare to what you thought it would be like?

Much smaller 1 2 3 4 5 6 7 Much larger

7. Does the size of the living area meet your family's needs?

Not at all 1 2 3 4 5 6 7 Yes, definitely

8. Does the size of the living area meet your family's needs?

Not at all 1 2 3 4 5 6 7 Yes, definitely

9. Does the <u>size</u> of the bedrooms (<u>not</u> the number of bedrooms) meet your family's needs?

No, not at all						Yes, definitely
1	2	3	4	5	6	7

11. Would you want to live in an earth-insulated solar home if it were the right size for your family?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

13. Would an earth-insulated solar home be acceptable in appearance to be built in your community?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

15. Would a home of this type (i.e. earth-insulated solar home) be acceptable in appearance to be built on the lot beside your home?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

17. Given the same amount of floor space, what changes would you make in the floor plan of the earth-insulated solar home?

____1 None
____2 More group living area and less private area
____3 More storage throughout and smaller living area
____4 Smaller bedrooms so that three bedrooms can be incorporated
____ Other (SPECIFY) ________________________________

____

10. Does the <u>size</u> of the bedrooms (<u>not</u> the number of bedrooms) meet your family's needs?

No, not at all						Yes, definitely
1	2	3	4	5	6	7

12. Would you want to live in a solar greenhouse residence if it were the right size for your family?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

14. Would a solar greenhouse residence be acceptable in appearance to be built in your community?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

16. Would a home of this type (i.e. solar greenhouse residence) be acceptable in appearance to be built on the lot beside your home?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

18. Given the same amount of floor space, what changes would you make in the floor plan of the solar greenhouse residence?

____1 None
____2 Relocate the stairway
____3 Eliminate the study and have larger bedrooms or a third bedroom
____4 More storage throughout
____ Other (SPECIFY) ________________________________

____

19. What are your impressions of the design features included in this earth-insulated solar home?

	Questionable Idea						Excellent Idea
a. Solar space heating	1	2	3	4	5	6	7
b. Solar water heating	1	2	3	4	5	6	7
c. Panelized construction	1	2	3	4	5	6	7
d. Pressure treated wood foundation	1	2	3	4	5	6	7
e. Earth insulation	1	2	3	4	5	6	7
f. Roof shape	1	2	3	4	5	6	7

20. What are your impressions of the design features included in this solar greenhouse residence?

	Questionable Idea						Excellent Idea
a. Solar space heating	1	2	3	4	5	6	7
b. Solar water heating	1	2	3	4	5	6	7
c. Greenhouse as a source of food production	1	2	3	4	5	6	7

20 A. How likely are you to use the greenhouse for the following:

	Not at all likely						Very likely
a. To grow flowers?	1	2	3	4	5	6	7
b. To grow vegetables?	1	2	3	4	5	6	7
c. As a sun room?	1	2	3	4	5	6	7

21. Do you feel that access to this earth-insulated solar home is adequate:

	Not at all adequate						Very adequate
a. For bringing in groceries?	1	2	3	4	5	6	7
b. For moving furniture in and out?	1	2	3	4	5	6	7
c. For escape in case of fire?	1	2	3	4	5	6	7

22. Do you feel that access to this solar greenhouse residence is adequate:

	Not at all adequate						Very adequate
a. For bringing in groceries?	1	2	3	4	5	6	7
b. For moving furniture in and out?	1	2	3	4	5	6	7
c. For escape in case of fire?	1	2	3	4	5	6	7

23. Would you want to live in an earth-insulated solar home if it were the right size for your family?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

24. Would you want to live in a solar greenhouse residence if it were the right size for your family?

No, definitely would not						Yes, definitely would
1	2	3	4	5	6	7

25. Prior to seeing these homes, did you think that solar systems were economical?

_____ 1 No _____ 2 Maybe _____ 3 Yes

26. Now that you have seen these two homes and their solar systems, do you think that they can be economical?

_____ 1 No _____ 2 Maybe _____ 3 Yes

27. Some people feel the energy shortage is real, while others feel it is being exaggerated. Do you think there really is an energy shortage?

No, definitely not						Yes, definitely
1	2	3	4	5	6	7

28. If you were to build one of these two homes, which one would you prefer?

_____ 1 Earth-insulated solar home
_____ 2 Solar greenhouse residence

Why would you prefer that home?

____

____

29. Please indicate the age group to which you belong.

_____ 1 Under 18
_____ 2 18-24 years
_____ 3 25-34 years
_____ 4 35-44 years
_____ 5 45-54 years
_____ 6 55-64 years
_____ 7 65 years and over

30. What is your sex?

_____ 1 Male _____ 2 Female

31. Which of the following best describes your marital status?

_____ 1 Single--never married
_____ 2 Divorced or separated
_____ 3 Widowed
_____ 4 Married

32. What was the last year of school which you completed?

_____ 1 8th grade or less
_____ 2 Some high school
_____ 3 High School graduate
_____ 4 1-3 years of college or tech school
_____ 5 College graduate
_____ 6 Master's degree
_____ 7 Doctoral degree

33. Check the appropriate category:

_____ Never had children
_____ Have children but none are living at home
_____ Have children living at home
If have children at home please list their ages: _____ _____ _____

_____ _____ _____ _____ _____

34. Which of the following describes the area in which you are presently living?

_____ 1 Open country--rural
_____ 2 Village of 1,000 or less
_____ 3 Town of 1,000-10,000
_____ 4 City of 10,000-50,000
_____ 5 Suburb of a City
_____ 6 City in excess of 50,000

35. **Check the appropriate category that best indicates total annual income for your family:**

____ 01 Under $4,999	____ 07 $20,000-$22,999
____ 02 $5,000-$7,999	____ 08 $23,000-$25,999
____ 03 $8,000-$10,999	____ 09 $26,000-$28,999
____ 04 $11,000-$13,999	____ 10 $29,000-$31,999
____ 05 $14,000-$16,999	____ 11 $32,000-$34,999
____ 06 $17,000-$19,999	____ 12 Over $35,000

36. **Which of the following best describes your occupation and the occupation of your spouse, if married?**

OCCUPATION OF MALES	OCCUPATION OF FEMALES
____ 11 Professional, Technical	____ 11 Professional, Technical
____ 10 Managers, Administrators	____ 10 Managers, Administrators
____ 09 Sales Workers, Clerical	____ 09 Sales workers, Clerical
____ 08 Craftsmen	____ 08 Craftsmen
____ 07 Equipment Operators (e.g. heavy equip., buses, trucks, etc.)	____ 07 Equipment Operators (e.g. heavy equip., buses, trucks, etc.)
____ 06 Laborers	____ 06 Laborers
____ 05 Service Workers	____ 05 Service Workers
____ 04 Private House Workers	____ 04 Private House Workers
____ 03 Student	____ 03 Student
____ 02 Unemployed	____ 02 Unemployed
____ 01 Retired	____ 01 Retired

VITA[2]

Jackie Lee Bell

Candidate for Degree of

Master of Science

Thesis: CONSUMER ATTITUDES TOWARD AN EARTH-INSULATED SOLAR HOUSE AND A SOLAR GREENHOUSE RESIDENCE

Major Field: Housing, Design, and Consumer Resources

Biographical:

Personal Data: Born in Oklahoma City, Oklahoma, November 1, 1956, the daughter of Arlin K. and Cora Lee Andrews Bell.

Education: Graduated from Northwest Classen High School, Oklahoma City, Oklahoma, in May, 1974; received Bachelor of Science in Home Economics degree from Oklahoma State University in May, 1978; completed requirements for the Master of Science degree at Oklahoma State University in July, 1979.

Professional Experience: Graduate research assistant, Architectural Challenge Grant, Department of Housing, Design and Consumer Resources, 1979-79; Graduate Research Assistant, Agricultural Experiment Station, S-95 Project, Department of Housing, Design and Consumer Resources, 1978-79; Leasing Agent, Twin Creek Townhouses, Stillwater, Oklahoma, 1978-78; Student Internship, Oklahoma Housing Finance Agency, Oklahoma City, Oklahoma, 1977-77.

Professional Organizations: American Association of Housing Educators, American Home Economics Association, Oklahoma Home Economics Association, Phi Upsilon Omnicron.