

ENERGY CONSUMPTION OF MOBILE HOMES IN PITTSBURG
COUNTY, OKLAHOMA AND GUIDELINES
FOR RETROFITTING

By

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1966

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
July, 1982



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ACKNOWLEDGMENTS

The author wishes to express her appreciation to her major adviser, Dr. Margaret Weber, for the continued patience in encouraging and guiding me throughout the past two years and particularly this study. The other committee members, Dr. Carl Hall, Dr. Peggy Meszaros and Sue Williams, likewise deserve much appreciation for their interest and support during that time.

The help of Oliver Johnston at Kiamichi Electric Cooperative, Dave Atteberry at Arkansas Louisians Gas Company and the staff at Public Service Company in McAlester was most appreciated for their help in securing names for my sample.

The Southeast District Cooperative Extension staff have been especially supportive during the study. Thanks go to Bill Parham, Marguerite Perry, Lavena Aldridge, Janice Curtis, Jan Montgomery and particularly my office staff who have always been there with words of encouragement and a listening ear. The thanks are extended to Betty Ogden who has helped with compiling the preliminary copy of the study and Mary Lou Wheeler who provided expertise in typing the final drafts.

Other Cooperative Extension Service active and retired staff have provided the same kind of support, including Jimmie Sallee, Sue Herndon, Lucille Clark, and Vera Taylor. Deepest gratitude is expressed to Wilda Schaefer, Max Minor and JoAnn Shroyer, for without their continued support and encouragement the study would not have taken place.

Last, but not least, my husband, Charles, and parents, A. T. and Mary Alice King have provided understanding and encouragement that has been continual moral support for my return to school and completion of this study.

TABLE OF CONTENTS

Chapter	Page
I. THE RESEARCH PROBLEM	1
Introduction	1
Statement of Problem	3
Purpose and Objectives	3
Assumptions and Limitations	4
Definitions	4
Summary	5
II. REVIEW OF LITERATURE	6
Introduction	6
Characteristics of Mobile Home Occupants	7
Cost of Housing and Financing	8
Energy Affect on Mobile Homes	14
Retrofitting Mobile Homes	18
Summary	19
III. RESEARCH PROCEDURE	20
Introduction	20
Type of Research	20
Population and Sample	21
Instrumentation	25
Data Collection	25
Summary	26
IV. FINDINGS, CONCLUSIONS, RECOMMENDATIONS, AND SUMMARY	27
Introduction	27
Information About the Mobile Homes Studied	27
Weatherization	28
Heating and Cooling	30
Family Size	32
Square Footage of Mobile Homes	34
Construction Date of Mobile Homes	38
Conclusions	40
Recommendations for Further Study	41
Summary	42
V. PROGRAM FOR EXTENSION HOME ECONOMISTS	44
Introduction	44

Chapter	Page
Background Information	44
Sealing	44
Window Treatments	47
Heating and Cooling Systems	48
Siting of the Mobile Home	50
Hot Water Insulation.	52
Insulation.	53
Enclosed Entry	53
Living Patterns	54
Summary	55
BIBLIOGRAPHY	56
APPENDIXES	62
APPENDIX A - CORRESPONDENCE	63
APPENDIX B - PILOT STUDY QUESTIONNAIRE	65
APPENDIX C - INSTRUMENT	69
APPENDIX D - GLOSSARY	73
APPENDIX E - HANDOUT	76

LIST OF TABLES

Table	Page
I. Weatherization of Mobile Homes Studied	29
II. Family Size and Utility Bills.	32
III. Square Footage and Utility Bills	35
IV. Utility Costs for Pre and Post Built 1976 Mobile Homes . .	37

LIST OF FIGURES

Figure	Page
1. Map of Pittsburg County	23
2. Directional Mobile Home Siting	51

CHAPTER I

THE RESEARCH PROBLEM

Introduction

"The mobile home is a uniquely American concept of housing" (Condon, 1976, p. 54). It is an innovative form of housing that has far-reaching impact on the housing market and industry. Mobile homes started in the 1930's as a form of temporary housing for transit and evolved into a major supplier of housing since World War II (Butler, 1974).

In the 1930's and 1940's travel trailers were utilized by families traveling west to California. The term, mobile home, is not an accurate description of today's manufactured housing (Nutt-Powell, 1980). Currently studies have shown that only a small percentage of mobile homes are moved after the initial set-up of the home. Mobile homes are defined as:

. . . a movable or portable dwelling constructed to be towed on its own chassis, connected to utilities, and designed with a permanent foundation for year-round living. It can consist of one or more units that can be folded, collapsed or telescoped when towed and expanded later for additional cubic capacity, or of two or more units, separately towable but designed to be joined into one integral unit, capable of being again separated into the components for repeated towing (U. S. Department of Housing and Urban Development, 1968, p. 73).

Mobile homes in the past have particularly appealed to low and middle-income families because of the decreased cost of housing. This

continues to be true today as building costs for conventional homes continues to skyrocket. Cost of home building materials have increased. Doubled interest rates along with increasing costs of goods and services leave home buyers with fewer dollars to spend on housing. Home building prices have also been affected by inflation. The cost of conventional homes has dimmed the prospect of ownership for many families, but the mobile home offers a reasonable alternative.

Limited income of a household affects ability to select suitable housing. Houses in poor repair and thermal condition often are more expensive to operate, especially where utility costs are concerned. Limited income families, particularly older families cannot afford to pay the marked increases in utility costs (Sarno, 1979).

Nationwide, 42 percent of all low-income households are living in rural areas or small towns and about 37 percent of all low-income families are headed by elderly persons (Office of Technology Assessment, 1979). Rural families are still larger in size, but with more males, fewer children, more old people, less education for adults, less employed women and lower incomes than urban areas (Ford, 1978). Geographically, Pittsburg County, Oklahoma, fits the description pictured as rural America. Pittsburg County is located in southeastern Oklahoma. The population of the county is 40,524 with approximately half this number living in the county seat town, McAlester. The remainder live in the small towns and rural areas. Of this population 28 percent are under 20 years of age; 56 percent are between 20 and 64 years of age; and 16 percent are 65 years of age or older (U. S. Department of Commerce, 1981). Of the total population in the county, approximately 21 percent are considered low-income or living on \$4900

or less. Those over 60 years of age are especially hard hit with 45 percent of that age living on income below this income level (Duke, 1981).

The county is faced with a large number of families living on limited incomes and in the small towns and rural areas, adequate housing is a problem. There are 17,954 housing units in the county (U. S. Department of Commerce, 1981). One problem is that 13 percent lack some or all plumbing (Wines and Powell, 1978). So mobile homes have been a housing alternative selected by some of the county families to provide lower cost housing.

Statement of Problem

Traditionally families have selected mobile homes because of limited dollars to spend on housing, but they also have limited income to spend on utilities. Energy costs continue to rise and those families living in mobile homes, especially in older models, are definitely affected. There is a need for information for mobile home residents as to kinds of things they can do to make their home more energy efficient and consequently more comfortable.

Purpose and Objectives

The purpose of this paper was to study the needs of mobile home residents in Pittsburg County, Oklahoma, concerning energy usage and make recommendations on ways energy consumption might be reduced by use of inexpensive to moderately priced retrofitting projects, thus saving on fuel bills and making their mobile home more comfortable.

The specific objectives are:

1. To assess the energy consumption of mobile homes manufactured before and after 1976.
2. To evaluate needs and make recommendations for retrofitting projects that mobile home residents could do themselves.
3. To incorporate those recommendations into a mobile housing program with emphasis on energy that can be utilized by Oklahoma State University Extension County Home Economists.

Assumptions and Limitations

It is assumed that the mobile home residents interviewed were truthful in answering questions during the personal interview. The interviews were conducted at the home of the resident so that the interviewer could study the mobile home site and added accessories. The study is limited to Pittsburg County residents who live in their mobile home year around. Single-wide mobile homes were selected for the survey and an effort was made to select an even mix of mobile homes built before and after 1976. Every effort was made to select mobile homes using natural gas and electricity as their primary heat source. Wood heat is often used as a supplement in rural homes.

Definitions

The following definitions will clarify some of the terms used in the study:

Retrofitting - Upgrading a structure to make it more energy efficient. The measures used might include weatherstripping, caulking, storm windows and any other action that would improve the structure to reduce energy usage.

1976 Legislation - Minimum standards for manufacturers of mobile homes to meet minimum energy efficiency standards.

Summary

Upon completion of the survey, conclusions were drawn. Based on information gathered, recommendations for energy conserving projects suitable for retrofitting mobile homes were made. This will be in the form of a program outline that could be used by OSU Extension County Home Economists with their clientele. Information of this nature is not presently available for County Extension Home Economist use. Programming in this area is needed to help the fixed and low-income mobile home dwellers to conserve energy and thus save dollars.

CHAPTER II

REVIEW OF LITERATURE

Introduction

With inflated costs of conventional built housing all but a very small percentage of the population are locked out of site-built housing (Lightbody, 1981). Young families, retired families, and families living on a fixed income are all seeking a place to live at a reasonable cost. This can be attained through manufactured housing which might be a reasonably priced mobile home or modular home (Plowman, 1980). Berry (1980) concurred with this idea by writing:

The American ideal of home ownership implies ownership of both the housing structure and the land to which it is attached. A growing segment of the population currently is able to satisfy its goal for home ownership only through the mobile home. Ownership of the site helps bring the 'ideal' much closer to reality. (p. 15)

Research shows low-income families aspire to the same kinds of housing enjoyed by more affluent Americans (Pippin, 1969; Concheo, 1980). To these families, living in the country gave the most satisfaction concerning their housing situations (Pike and Stubbs, 1978; Risk or Resource, 1980).

The mobile home has evolved as a type of housing that lower-income families of all ages can utilize to fulfill their housing goal and satisfy their needs (Drury, 1967; U. S. Department of Housing and Urban Development, 1968; Moore and Crocker, 1979; Berry, 1980). This

trend has definitely been affected by inflation (Davidson, 1973; Kokus, 1974) and the appeal of low-maintenance costs (Butler, 1974; Holder and Coulter, 1977). Davidson (1973) suggested that even used mobile homes were to be considered a factor in the housing market.

Characteristics of Mobile Home Occupants

In 1968, the Housing Survey conducted by the U. S. Department of Housing and Urban Development found that mobile homes were particularly important for young families in communities where housing supply did not meet their needs, as well as becoming a significant factor in providing housing for the elderly (U. S. Department of Housing and Urban Development, 1968). This evidence seems to become more apparent as authors write in later years (Butler, 1974; Holder and Coulter, 1977; Rausch, 1978; Berry, 1980; Robinson, 1980). Pike and Stubbs (1978) concluded that mobile homes are a primary source of housing for low-income families whether young or old.

More recently information seems to point out that mobile homes are reaching not only middle class, middle-income, but also middle-age. Berry (1980) attributes this to changing public attitudes, housing costs and a vastly improved product.

The size of the family living in a mobile home varies, but earlier studies suggest a family consists of three to four members per family. One of these studies was conducted in southern rural United States which makes it relevant to southeastern Oklahoma (Pike and Stubbs, 1978; Nutt-Powell, 1980).

With less cost a major factor for buying a mobile home, it would seem to follow that occupants of mobile homes have less income.

Davidson (1973) found that close to 80 percent of mobile homeowners had an income of under \$10,000. The income level had increased only a small amount in two studies made in 1978. In 1978, buyers and owners of mobile homes had an income ranging from \$11,700 to \$14,170 (U. S. Department of Commerce, 1979; Nutt-Powell, 1980).

Nationwide 42 percent of all low-income households are living in rural areas or small towns and about 37 percent of all low-income households are headed by elderly persons (Office of Technology Assessment, 1979). With less earned income, families in rural areas have difficulty in securing adequate housing. Rausch (1978, p. 28) concluded that "mobile home owners appear to be very similar to others of ownership status."

Cost of Housing and Financing

Pittsburg County, Oklahoma, is a rural county with a number of small towns and communities. Income as indicated earlier is limited with per capita income being \$6,510 in 1979 (Eddings, 1982). In Pittsburg County, there are 7,378 individuals or 21.2 percent of the population with an income at poverty level (\$4,520 or below). Another 10,585 (30.4 percent of the population) exist near low-income (\$5,650 or less) (Duke, 1982). Housing costs are a real concern with conventional home prices rising rapidly with inflation. Mobile homes have offered one valid alternative for housing in the past and will in the future. This is especially true for limited income families.

The average sale price for a mobile home in 1980 was \$18,500 which included furnishings but not the land. The average size of such a mobile home was 1,050 square feet. In 1980 the average sale

price of a site-built home including land was \$76,300 with average size being 1700 square feet (Quick Facts, 1981). These figures are not suitable for comparing construction costs since the site-built home costs include the land costs, but it does give some perspective of the difference in dollars for a modular versus conventional home.

Mobile homes offer a very real solution to housing needs in our rural areas. In 1968, conclusions drawn from the Housing Survey indicated that "mobile homes contribute significantly to housing supply outside of the central city and particularly in small communities outside of Standard Metropolitan Statistical Areas" (U. S. Department of Housing and Urban Development, 1968, p. 68).

Later studies found that during the 1970's mobile homes provided approximately one-third of the housing in areas outside Standard Metropolitan Statistical Areas (Edwards, 1977; U. S. Department of Agriculture, 1978). Studies have also tied mobile homes to lower-income families, rural families and elderly (Pike and Stubbs, 1978; Rausch, 1978). Southeastern Oklahoma is largely populated with these three segments of people. Price differential between conventional built housing and mobile homes finds mobile homes fulfilling a need at the lower end of the housing market (Kokus, 1974).

In 1968, the median price for a mobile home was \$5,585 with 69 percent of the occupied mobile homes costing between \$4,000 and \$8,000 (U. S. Department of Housing and Urban Development, 1968). In 1969, the U. S. Census Bureau reported that mobile home production accounted for 18.6 percent of new housing starts, including apartments. Tooker (1971) found that mobile homes accounted for 50 percent of all single family housing under \$15,000. "The average price of a mobile home in

1972 was \$6,950, furnished" (Mobile Homes are Coming of Age, 1973, p. 54). "Of all homes built or produced in 1972, 96 percent of those priced under \$20,000 were mobile homes" (U. S. Department of Housing and Urban Development, 1973, p. 2). A study completed in North Carolina found the median price of conventional homes in the sample was \$11,200 versus the median price of \$5,843 for mobile homes (Gray, Shelton, and Gruber, 1980).

Little information concerning mobile homes was published from 1974 to 1978. In 1973 an all-time high of 575,940 mobile homes were shipped by manufacturers to retailers. This number dropped to 212,690 shipments in 1975 before starting another upward climb. Lack of quality construction appears to have been one reason for the decline in mobile home sales in the early 1970's (Vasche, 1980; Quick Facts, 1981). More recently mobile homes represented more than 30 percent of the new single family detached housing and the percentage is expected to increase (Tietsma and Peavy, 1978). The 1979 Annual Housing Survey indicated that 3,610,000 mobile homes were occupied with 60 percent of these being in the rural areas. This compares with 53,879,000 detached single family dwellings. The median income of the owner-occupied mobile homes was \$11,700 but for renter-occupied only \$8,700. The median income of owner-occupied detached dwellings was \$18,300, while renter-occupied income level was \$10,000 (U. S. Department of Commerce, 1979). Cooper (1980) indicated that by the end of 1979, 3.9 million mobile homes were inhabited. "Presently, about 10 million people live in mobile homes. Currently it is estimated there are four and a half million mobile homes in use as primary year-round residences" (Quick Facts, 1981, p. 9).

Price is a big factor and seems to be the main attraction to mobile homes. In 1980, average prices for mobile homes were: 1) single-wides-\$11,150; 2) expandables-\$14,430; and 3) smaller double-wides-\$17,460 (Rabb and Bernard, 1975; Sumichrast and Seldin, 1977; Pickens, 1980).

While a home built on site can cost as much as \$30 a square foot, Sumichrast says, 'a manufactured house can be built for almost half that. Even with the cost of land added in, a mobile home represents a bargain many buyers may not pass up' (Mobile Homes: Respectability Ahead, 1980, p. 58).

Lightbody (1981, p. 12) further supported this by stating that the "manufactured/mobile housing industry is one of the best answers to America's urgent need for housing in the 1980's and beyond."

Discussion continues as to whether mobile homes appreciate or depreciate in value. Lack of durability and lack of land ownership are two factors often mentioned as reasons for mobile homes depreciating. Butler (1974, p. 214) says, "Mobile homes tend to depreciate at least 10 percent in value the first year and continue to depreciate to half their original value in eight years." This was written before inflation started running rampant.

Fleetwood Industries in a recent spot survey of four southern California counties found that "single-section manufactured homes appreciated in value approximately 17 percent a year, while multi-section manufactured houses rose over 24 percent per year" (Lightbody, 1981, p. 9). There is question though whether the appreciation is real or caused by the fact that inflation has increased the prices of new homes considerably. This increased price makes older mobile homes look appealing even though the asking price is more than their

original sale price. Foremost Insurance Company is the largest insurer of mobile homes. They conducted a survey of over 600,000 mobile homes in 1979 and found that degree of appreciation varied but drew the conclusion that mobile homes do appreciate (Nutt-Powell, 1980).

Appreciation of mobile homes is affected by several of the same factors that influence the appreciation of all residential real estate. Earlier an Owens Fiberglass study found that "only three percent (of mobile homes) are ever moved from their site" (Barriers to Greater Sales, 1978, p. 8). This means less wear and tear on their structure. Improvements in design of mobile homes have been another factor addressed by manufacturers to upgrade quality, improve appearance and extend durability (McLeister, 1979; Unconventional Homes Break Modular Mold, 1979).

Walush (1978, p. 603) wrote that the "mobile home industry still sees its greatest potential for sales growth in marketing of mobile homes as tract homes." These homes would then be considered real estate for financing and taxation purposes with the end result being the appreciation of the mobile home structure. As early as 1972, Gibson (1972) indicated the need for policy concerning mobile homes that would encourage rather than discourage consumers to purchase and live in mobile homes. Policies affect the siting construction, taxation and financing of mobile homes which in turn affects the appreciation.

Financing of mobile homes has changed over the years to benefit the new homeowner. HUD insured Title I Mobile Home Loans up to \$12,500 for a single unit mobile home loan with up to 12 years and down payment of only 5 percent on first \$3,000 and 10 percent of amount over \$3,000.

(U. S. Department of Housing and Urban Development, 1976). FHA and VA offer the same type programs (Walush, 1978). Savings and loan associations were given authority to extend loan periods to 20 years for new and used mobile homes and allow up to 90 percent of the buyer's total cost as a loan amount (Guidelines Established for Mobile Home Lending, 1979). All these allowances benefit the limited income and middle-income consumers whose pocketbook is affected by inflation. Inflation had moved middle-income families, especially those older families on a fixed income, to a low-income status. Many less affluent and older homebuyers have turned to mobile homes as an economically feasible housing buy for their families; availability has enhanced their popularity, as well as low-maintenance and concurrent acquisition of home furnishings (Holder and Coulter, 1977).

The majority of costs involved in purchasing, financing and operating the home are divided into monthly payments. Purchasers of mobile homes should be aware that sometimes the financing agent may include large one-time charges that in the long run make the mobile home a less attractive purchase. One such charge is a method of figuring interest charges and is called the "Rule of 78." This type interest charge has been used in figuring interest costs for a mobile home loan. The borrower pays higher interest rates at the beginning of the loan period when the amount of the loan is the largest (Land and Gillespie, 1981). When the "Rule of 78" is used to figure the interest on a loan, the borrower pays an excessive rate if the loan is paid off early. In Pittsburg County, mobile homes are usually made through a bank rather than a home loan association. The banks in this area figure these loans with simple interest and do not use the "Rule of 78" (Cranfill, 1982).

Energy Affect on Mobile Homes

The oil embargo of 1973 dramatically symbolized the end of an era of cheap and abundant supplies of energy. The United States must now enter a difficult adjustment period as it searches for ways to conserve energy (Webber, 1979, p. 255).

Energy was such an inexpensive commodity for so long that consumers had little concern about construction of homes or lifestyle. Housing uses 19 percent of the United States' total energy consumption. A single family dwelling costs approximately \$71,000 and is one of the least energy efficient forms of housing (McKown, 1980). Increased housing costs as well as increased energy costs hit hardest low-income families. Utility costs account for 15 to 30 percent of total available income for low-income families and an even higher percentage during heating season. However in Oklahoma families may be affected by equally high cooling costs. Almost one-half of all low-income families live in rural areas or small towns and over one-third of the households are headed by elderly persons who cannot reduce energy consumption (Office of Technology Assessment, 1979).

The present building stock in the United States is inherited from a period when energy consumption cost less than energy conservation measures. There is marked contrast between the poor energy characteristics of the existing housing stock and the potential performance of new construction (Webber, 1979, p. 253).

Not only is this true of conventional housing stock but mobile housing as well. Sarno (1979) pointed out that the elderly could not afford to pay the marked increases in utility costs. "Most mobile homes have higher BTU/square foot heat loss factors than do conventionally built homes" (Gorzelnik, 1978, p. 82). This is especially true of mobile homes built before June 1976.

Lifestyles affect energy usage and Americans have learned some very expensive lifestyles in terms of energy costs. Families must replace the assumption that energy is cheap with the assumption that energy will be ever more costly. They must also understand the linkage between lifestyle and energy consumption and in order to change consumption, we must change lifestyle (Gladhart, 1977; McKown, 1980).

Energy costs affect mobile home occupants more directly than conventional home occupants. A North Carolina study revealed that in comparing costs of energy usage of all electric homes, it cost 97 cents per square foot for mobile homes and only 56 cents per square foot in conventional homes. Oil heating was slightly more with \$1.18 per square foot for mobile homes and 61 cents per square foot for conventional homes (Gray, Shelton, and Gruber, 1980).

In June 1976, the Mobile Home Construction and Safety Standards became effective. In October 1980, Congress changed the name to 1980 Housing and Community Development Act. The mobile homes built after June 1976 must comply with the nationally enforced codes for mobile homes. Subpart F of the HUD standards "sets forth the requirements for condensation control, air infiltration, thermal insulation and certification for heating and cooling comfort" (U. S. Department of Housing and Urban Development, 1975, p. 58768). These are minimum standards, but are helpful for consumers lacking in knowledge of energy requirement needs. These Acts forced builders of manufactured housing to produce an improved housing product that would be a more efficient energy user.

The standards passed by Congress have not provided all the answers. Problems still occur concerning energy usage of mobile homes.

Studies conducted by the Bureau of Standards found that furnaces in mobile homes were often oversized involving added dollars spent on the heating unit as well as the heating of the mobile home (Tietsma and Peavy, 1979; U. S. Department of Housing and Urban Development, 1979a; Goldschmidt, White, and Leonard, 1980).

Infiltration was found to be a significant factor affecting mobile home energy usage. Infiltration was found to be much higher than necessary to remove contaminants, but could be controlled by caulking (Prado, Leonard, and Goldschmidt, 1976; Gorzelnik, 1978; U. S. Department of Housing and Urban Development, 1979b; Goldschmidt and Wilhelm, 1979). Duct systems were not covered by any standard but affect the energy usage of the heating and cooling systems when the system is not airtight and infiltration occurs (U. S. Department of Housing and Urban Development, 1979b). Studies have also been conducted in test laboratories and by government agencies concerning the thermal performance of mobile homes. These studies were especially concerned about mobile homes manufactured since standards were passed in 1976 (Jacobsen, 1976; Tietsma and Peavy, 1978; U. S. Department of Housing and Urban Development, 1979b).

All these inadequacies affect the energy use by mobile home occupants and this directly affects their energy costs. Increased energy costs have made mobile homeowners take a second look at operating costs which affect their budget and comfort which in turn affects their health (Griffin, 1978).

Improvements in construction can be made and are proving effective in cutting energy costs. Arkansas Power and Light Company set up standards for conventional homes and were able to cut heating and

cooling costs by 63 percent in homes built to their standards. As of 1979 the utility company started work on developing an energy saving mobile home. By using what is now called the "Arkansas home" construction builders were able to construct a mobile home that performed two and one-half times better than construction that has been traditionally used on single-wide (Levin, 1979).

Manufacturers of later model mobile homes are adding energy saving features which will reduce the operating costs, in turn reducing the dollars spent on housing. Not only are dollars saved, but comfort is greatly increased and operating costs are decreased (Ingersoll, 1978; Energy Facts, n.d.). However, this does not help owners of older model homes. "Because the mobile home market is generally very price-sensitive, the added costs are a problem" (Levin, 1979, p. 28). Some dealers are comparing monthly payments and monthly utility costs for both energy saving mobile homes and the standard mobile home. In many cases the payment for the energy saver model plus the utility bill is still less than the same payments on a standard model (Ingersoll, 1978). As energy costs increase in the future, the post-1976 mobile home may offer an even more energy efficient and economical home.

Improvement of construction of later model mobile homes is of little or no value to occupants of older model mobile homes. These occupants need help in improving existing homes for greater efficiency and comfort. Williams, Braun, and Lauener (1981) found in a study of weatherization practices in conventional homes that adoptions were made and behaviors changed primarily for reasons of comfort and cost. This same reasoning could apply to improving mobile homes. Hirst and

Carney (1978) indicated that retrofitting of existing housing units would provide the most cost effective energy and economic benefits.

Retrofitting Mobile Homes

Little consideration has been given to what can be done to improve older mobile homes so they not only better utilize dollars spent on heating and cooling, but also provide more comfortable surroundings in which to live. As in conventional homes, the measures suggested as most cost effective are not so expensive dollar wise, but may require effort on the part of the homeowner.

Landscaping can play an important part in cutting energy costs of both conventional and mobile homes. Utility bills can be decreased when orientation, shading and windbreaks are considered and utilized (McClendon, 1977; Save Money, Save Energy, 1980). Orientation, even within a mobile home part, makes a difference as to energy usage of a mobile home (Clough, Parshall, and Wolfson, 1976). Proper shading and use of windbreaks in conjunction with orientation add to the benefits a mobile homeowner can gain.

Preventive measures that help protect the mobile home, as well as cut energy usage, include caulking seams, joints and cracks; weatherstripping doors and windows; adding plastic storm windows and utilizing some type of noncombustible material for skirting. The roof can also be treated with sprayed-on insulation or reflective coating to improve the thermal qualities (Griffin, 1978; Thompson, 1980).

The solar industry has encouraged the manufactured mobile home industry to take a serious look at what benefits might be gained by using solar heating equipment on manufactured housing (Ferguson, 1980;

Nutt-Powell and Furlong, 1980). Cost of solar equipment must be considered even though potential savings energy wise look good. Since many mobile home buyers look at reduced cost of housing out of necessity, the added cost of solar heating becomes prohibitive for most.

Summary

The literature reviewed suggested that mobile homes are often selected because of lowered cost in comparison to conventional housing. Buyers of mobile homes usually have less income, consequently less dollars to spend both on housing and utility costs. Changing public attitudes along with improved construction standards brought about by Federal legislation, however, has enhanced the acceptance of mobile homes as legitimate housing.

Mobile homes have been notorious energy users in the past. Legislation has helped on homes built since 1976, but older mobile homes are still less energy efficient than desired. Little study has been done on energy usage of older mobile homes. Another area lacking research is retrofitting or upgrading of mobile homes.

CHAPTER III

RESEARCH PROCEDURE

Introduction

The purpose of this study was to look at energy consumption of mobile home residents with special interest in those living in mobile homes constructed before and after 1976. A review of current literature indicates that with legislation passed in 1976 later model mobile homes should be more energy efficient and families living in older mobile homes may have larger utility bills and be less comfortable in their homes.

Type of Research

In order to gain specific information from the mobile home residents, case studies were utilized. Gay (1976, p. 137) described a case study as the "in-depth investigation of an individual, group, or institution." Best (1977, p. 108) defined a case study as a study that "probes deeply and analyzes interaction between the factors that explain present status or that influences change or growth." The researcher felt that case studies could provide insight into trends that are being established by mobile home residents concerning energy usage and retrofitting. These case studies were completed during a personal interview to the home of the mobile home occupant. This

personal interview allowed the researcher to visually check the mobile home in the environment surrounding it. The studies were completed from August 1981 through January 1982.

Population and Sample

The population for this research was composed of all mobile home residents living in their homes year around in Oklahoma. This would be a very large number so the area was narrowed down to encompass only Pittsburg County, Oklahoma. This area is of special interest to the researcher, since it is the county where she is employed by Oklahoma State University Cooperative Extension Service.

There are 723 mobile homes in Pittsburg County whose residents have purchased a license tag, but there is no listing by name. There are other mobile homes that are situated on private property and considered a homestead. It was not possible to obtain the actual number of mobile homes that were homesteaded.

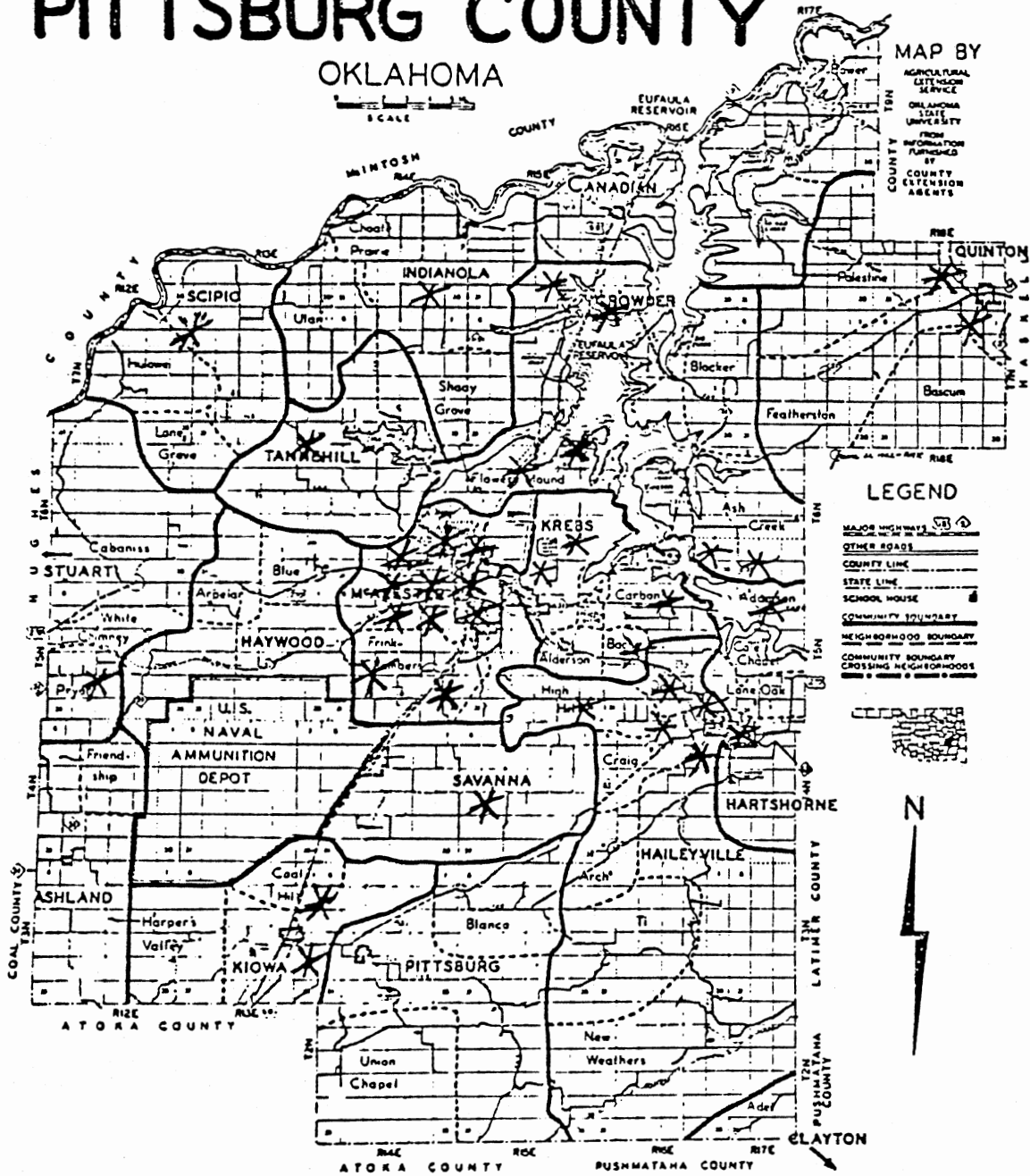
Public Service Company of Oklahoma and Kiamichi Electric Cooperative are major suppliers of electricity for Pittsburg County residents. These two utility companies had been contacted and were willing to cooperate in identifying mobile home residents throughout the county. They did not maintain a separate listing of mobile home customers but were willing to use servicemen to help make identification of a variety of mobile homes located throughout the county. In a meeting these servicemen were asked to select old and new mobile homes in order to make a comparison of mobile homes manufactured before and after 1976. Selection of single-wide mobile homes, preferably heated by gas or electricity, was requested. The servicemen provided

names of a variety of families living in their homes year around with both old and young represented as well as various size families.

Pittsburg County is considered a rural county with a population of approximately 40,000. About 20,000 of these people live in McAlester, the county seat. The remainder live in the 14 small incorporated communities throughout the outlying county (Figure 1, p. 23). Mobile home parks are located in McAlester and Savanna. In the remainder of the county, mobile homes are located on lots in small communities, on lots in the outlying areas, or on farms or ranches. Every effort was made to select mobile homes from all geographic areas of the county with the largest total being from McAlester, which accounts for half the county population. A total of 36 case studies were made or approximately five percent of the mobile homes were to be surveyed.

There were 235 names provided and of these, 76 were contacted. The names were selected by purposive sampling. Purposive sampling allows the researcher to handpick the individuals in keeping with one's needs (Compton and Hall, 1972). In this study purposive sampling allowed the researcher to select mobile home occupants from the various geographical areas of the county, as well as locating some residents living in mobile home parks, rural areas and small communities. Residents selected were sent a letter (Appendix A, p. 63) saying that if possible they would be contacted by phone for a convenient time to visit. After the first letters were sent the interviewer found it difficult to make contacts by telephone since there was no telephone directory listing for several of the families contacted by mail. It was also found that the occupants seemed to find it easy to

COMMUNITIES & NEIGHBORHOODS OF PITTSBURG COUNTY OKLAHOMA



Note: *Indicates location of mobile home respondents.

Figure 1. Map of Pittsburg County

refuse an interview by telephone, but usually were agreeable to the interview if confronted at the front door, a few days after receiving the letter. Some difficulty was experienced in locating mobile homes in the rural areas or finding occupants at home when it was not possible to contact them by telephone.

Of the 76 mobile home occupants contacted by mail, 40 were not interviewed. Some of these had moved within the past month; some refused to participate because of poor health, just too busy or did not wish to; some could not be located and others turned out to be double-wide mobile homes. Difficulty in locating the family was a particular problem for those mobile home residents without a telephone, or having a rural route address or post office box number.

Fifteen of those studied were located outside incorporated areas, 12 were located in towns of less than 2,500 and 9 were located in McAlester. Ten of the homes were located in mobile home parks, 20 were located on lots in incorporated communities or in outlying areas, while 6 were located in the rural areas on larger acreages.

Of the 36 households living in mobile homes studied, 28 were headed by males and 8 by females. The age of these household heads ranged from 21 to 82. Of these, 14 were in the 21 to 35 age bracket; 13 were in the 36 to 59 age bracket; and 9 were in the 60 to 82 age bracket. The heads of households' education level varied from six years completed to 18 years of schooling completed. Seventeen completed high school as their last formal education, which was the average for all 36. Income for the head of household ranged from six indicating under \$5,000 to four indicating about \$25,000 per year. Twenty-two of the occupants indicated they made under \$15,000 per year.

Family size ranged from seven families of one member each to four families of five members each. Twenty-five of the families had three members or less.

Instrumentation

A questionnaire was developed which includes adaptations from a previous study conducted by Sue Williams, Oklahoma State University Extension Energy Management Specialist, on weatherization practices adapted and behavior changes among low-income clientele in Choctaw County, Oklahoma. The questionnaire developed included items to obtain: (1) information about the mobile home, (2) information about occupants, and (3) information about the home energy situation. Attached to the two-page questionnaire was an additional check list that the interviewer could fill out concerning: (1) size of city or town, (2) locations of mobile home and (3) special features. Personal interviews were conducted with mobile home residents so that the interviewer could check the site orientation and special features of the mobile home.

A pilot study to test the questionnaire was made of five mobile home residents (Appendix B, p. 65). Residents were selected on the basis of: age of mobile home, age of occupants, location of home, and size of family. The questionnaire was evaluated according to the response and a few revisions were made. A copy of the revised questionnaire used for the interviews is included (Appendix C, p. 69).

Data Collection

The researcher visited the mobile homeowner/renter or spouse

in their home. This gave an opportunity to check the site orientation of the mobile home as well as check other features that would affect energy usage. The questionnaire was filled out during the visit by the interviewer. Upon completion of the interviews, utility bills were obtained from the utility companies for the time period of January 1981 through December 1981.

Summary

Using the information gathered from the 36 interviews, frequencies were used to compile data that provided a cross-sectional description of case studies completed. The case study questionnaire was developed into three categories: information about the mobile home, the mobile home occupant, and the mobile home energy situation. Home visits were made to the 36 mobile home locations, where the interviewer completed the questionnaire with answers provided by the head of household or spouse.

CHAPTER IV

FINDINGS, CONCLUSIONS, RECOMMENDATIONS, AND SUMMARY

Introduction

In this chapter the results of the 36 interviews by the researcher are compiled. The case studies provided the researcher with in-depth information which enabled the author to determine the trend being set by mobile home occupants in Pittsburg County and to better understand the needs concerning energy usage in relation to their mobile home. This in turn enabled the researcher to gather information that could be useful for a County Extension Home Economist to use in programming for mobile home occupants. Results from the individual case studies are not described since there is close similarity in the studies. The case studies have been combined to gain a perspective of the trends existing among the mobile home residents interviewed in Pittsburg County. Frequencies are used to represent the data from the case studies for analysis of the results.

Information About the Mobile Homes Studied

Of the 36 mobile homes studied, 33 of the occupants owned their home, two were renting, and one occupant was living in a mobile home provided by her son. In looking at the number paying rent or making home payments, it was found that only 17 of the 33 homeowners were

currently making house payments. The interest rate on these home loans ranged from 7 to 15 percent. However, all of the mobile home occupants studied that lived outside mobile home parks, owned their land and were not making payments on it. Those living in mobile home parks paid from \$40.00 to \$55.00 for monthly park rental.

Thirty-three of the mobile home occupants were able to identify the brand or manufacturer of their mobile home. Of these 33, 27 different brands were represented. The mobile homes varied in size from 8 by 50 feet to 13 by 84 feet. Twenty-seven of the homes were 14 feet wide.

The mobile homes varied in age from one year to 24 years old with ten being built since the 1976 legislation was passed. The occupants had lived in the mobile homes from one to 24 years with 18 having lived in their home three years or less. Five of the occupants did not know how many moves their mobile homes had made, but 15 of the mobile homes had made only one move and nine had made only two moves.

Sixteen of the mobile homes studied had only one bathroom, while the remaining 20 had two bathrooms. The number of windows varied from 6 to 19 with the average being 11.

Weatherization

Of the 36 mobile homes studied (Table I) two-thirds had caulking around the window and door frames, had weatherstripping on the windows and doors, and had at least one storm door. Sixteen had storm or double-pane windows. The majority (32) of the homes studied had been insulated originally and four of these had added insulation. Most of the occupants (30) felt their home was comfortable in the winter.

TABLE I
WEATHERIZATION OF MOBILE HOMES STUDIED

Question	Yes	No	Don't Know
Windows and doors caulked	23	8	5
Windows and doors weatherstripped	24	10	2
Storm or double windows	16	19	1
Storm doors	24	12	0
Insulated	32	2	2
Added insulation	4	32	0
Comfortable - summer	30	6	0
Comfortable - winter	29	7	0
2 x 4 Construction	33	3	0
Awnings	9	27	0
Landscaping for shading	17	19	0
Skirting	26	10	0
Enclosed entry	3	33	0
Roof built over home	3	33	0
Light color siding	29	7	0
Light color roof	28	8	0

Date of construction is not the only factor to consider when looking at the energy efficiency of the mobile home. Another factor could include how the home is oriented on the site and in conjunction with this, how much landscaping is utilized around the outside of the home. Shading and windbreaks provided by landscape plantings can affect the energy efficiency of the mobile home. Shading might also be provided by awnings or patio covers, but still are factors affecting energy consumption of the home. Color of roof, color of siding, and skirting play a part in helping the home to be more or less energy efficient. These factors are discussed in detail in Chapter V with background information provided for home economists.

The majority (33) of the mobile homes had two by four construction. Of the three exceptions, two had two by six construction and the remaining one had two by two construction. Light colored siding and roof were predominate with 29 homes having light siding and 28 homes having a light colored roof. Three homes had an extra roof built over their mobile home for added protection. Three also had added enclosed entries for protection from extreme temperatures outdoors when the front door was opened and closed. There were nine mobile homes where awnings had been utilized for shading on the windows, while 17 of the mobile homes were shaded by trees or other landscaping. For protection underneath the mobile home, 26 of the families had added skirting.

Siting of the mobile home was observed by the interviewer and 15 were found to be located longways north and south, 17 were located longways east and west and the remaining four were at an angle between the two directions.

Families were asked if they would be interested in information on upgrading the energy efficiency and comfort of their mobile home. Of the 36 interviewed, 17 said they would be interested, but when given choices of specific procedures, only seven made specific selections. The procedures listed for households to select from were: caulking, weatherstripping, storm windows, skirting, awnings, landscaping, and structural shading. Of these, caulking, awnings, and landscaping were not selected at all.

Heating and Cooling

In order to be able to measure energy consumption, the interviewer

looked for mobile homes that were heated with gas or electricity. This goal did not prove to be feasible because of the mixture of various heating methods found. Nine homes supplemented their gas or electric heat with wood heaters. Two others indicated they heated entirely with wood heat. It was found that 12 of those heating with gas used propane or were supplied by a small gas company. Monthly bill records were available only for those customers of Arkansas-Louisiana Gas Company (ARKLA).

Twenty-eight of the families knew where they set the temperature on the thermostat for winter. These temperatures ranged from 64 degrees to 80 degrees with 20 families keeping the thermostat set on 72 degrees or cooler.

None of the mobile homes used a gas cooling system, although two used no refrigerated cooling system at all. The other 34 were using electricity as a source of space cooling. Of these 34, 22 had a central cooling system, while 12 of the mobile home families relied on window units. It was also found that three families with central cooling supplemented that cooling with one window unit. Twenty of the families knew what temperature setting they kept their central cooling set on in the summer. The temperature ranged from 68 to 85 degrees with 13 keeping it at 78 degrees and above. Fourteen of the families utilized box fans to move air in their homes in the summer and stretch their cooling dollars. In 24 of the mobile homes studied, gas was used to heat water and 12 others utilized electricity.

When interviewed, occupants were asked to rate the energy efficiency of their mobile home. Thirteen replied very efficient, 17 judged their home as being average and six felt their homes were very inefficient.

Family Size

The families interviewed in the case studies ranged in size from one to five members. Table II shows that one member families' average monthly electric bill ranged from \$17.58 to \$81.50 with the average for those seven families being \$41.75. All electric bills were available. The average monthly gas bill for one member families ranged from \$4.58 to \$21.00 with the average being \$14.44. This average is representative for only the four families whose gas bill was available.

TABLE II
FAMILY SIZE AND UTILITY BILLS

Family Members	Number of Families	Range Electric Bill	Range Gas Bill	Avg. Monthly Electric Bill	Avg. Monthly Gas Bill*
1	7	17.58 - 81.50	4.58 - 21.00	41.75	(4) 14.44
2	10	26.67 - 106.16	10.75 - 25.08	48.22	(3) 16.30
3	8	27.91 - 91.75	9.25 - 21.58	48.14	(4) 16.29
4	7	21.41 - 76.83	14.00	42.10	(1) 14.00
5	4	42.33 - 136.25	21.33	80.29	(1) 21.33

Note: *Number enclosed in parenthesis represents the number of cases.

The average monthly electric bill for two member families ranged from \$26.67 to \$106.16. The average for the 10 families represented was \$48.22 for the monthly electric bill. These two member families had average monthly gas bills ranging from \$10.75 to \$25.08 with the

average for the three families whose gas bill was available being \$16.30.

The average monthly electric bill for three member families ranged from \$27.91 to \$91.75. These eight families had an average monthly electric bill of \$48.14. For three member families the average monthly gas bill ranged from \$9.25 to \$21.58. Four of these families had an average monthly gas bill of \$16.29.

There were seven families with four members each whose average monthly electric bill ranged from \$21.41 to \$76.83. The average monthly bill for these families was \$14.00. Only one of the four member families had a gas bill available and their bill averaged \$14.00 a month.

The average monthly electric bill for five member families ranged from \$42.33 to \$136.25. The average for the four families represented was \$80.29 for the monthly electric bill. Only one gas bill was available for a five member family and it was \$21.33 for a monthly average bill.

This information shows that both in gas and electric bills, those families of one member and those families composed of four members have utility bills of approximately the same amount dollar wise. One explanation for the one member family usage might be that often this is an older family that keeps thermostat settings higher in the winter and lower in the summer than other families might. Two and three member families interviewed had similar utility bills. Five member families had the highest average utility bill.

Higher bills were expected with more family members and more family members meant children were included. Children often increase

the family's utility usage with more opening and closing of doors, more laundry, more baths and showers, and more small personal appliances. In this study there were 17 families without children. Eight of those 17 families were composed of individuals over 60 years of age. The 19 remaining families that were interviewed had one to three children. Two of the families were single-parent families. Eleven of the 19 families had children under 10 years of age; two families had a combination of teen-agers and young children; and six families had only teen-agers.

Square Footage of Mobile Homes

The mobile homes studied have been grouped in Table III according to size by square footage. Also the average monthly electric bill is shown. This figure was available for all mobile homes studied. The average monthly gas bills were available for the number of homes listed in parenthesis by the average monthly gas bills. Some of the homes were total electric so in the last column the figure in parenthesis by the total monthly utility bill shows the number of homes for which all utility bills were available.

There were six mobile homes ranging in size from 400 to 696 square feet. The average monthly electric bill for these six homes was \$32.69. For two of these homes the average monthly gas bill was \$19.87. For the three mobile homes with all utility bills available, the average monthly total utility bill was \$59.19.

In the 700 to 840 square foot range, there were nine mobile homes represented whose average monthly electric bill was \$39.04. The average monthly gas bill for four of these homes was \$12.98. The

average monthly total utility bill for five of these homes was \$53.08.

TABLE III
SQUARE FOOTAGE AND UTILITY BILLS

Number of Mobile Homes	Range Square Feet	Average Month Electric Bill	Average Month Gas Bill*	Month Total Utility Bill*
6	400 - 696	\$32.69	(2) \$19.87	(3) \$59.19
9	700 - 840	\$39.04	(4) \$12.98	(5) \$53.08
11	910 - 1092	\$68.24	(4) \$14.76	(9) \$79.75
10	1120 - 1176	\$47.72	(4) \$17.77	(7) \$61.81

Note: *Number enclosed in parenthesis represents the number of cases.

There were 11 mobile homes ranging from 910 to 1,092 square feet. The average monthly electric bill for these homes was \$68.24. For four of these homes the average monthly gas bill was \$14.76. For the nine mobile homes with all utility bills available, the average monthly total utility bill was \$79.75.

The largest size mobile homes ranged in size from 1,120 to 1,176 square feet. The 10 homes represented here had an average monthly electric bill of \$47.72. The average monthly gas bill for four of these homes was \$17.77. The average monthly total utility bill was \$61.81 for seven of these homes.

The information pertaining to these last two groups of mobile homes may appear contradictory on the surface, but a closer look in

conjunction with Table IV sheds more insight. When looking closely at the 11 mobile homes in the category of 910 to 1,092 square feet we find that nine of the 11 mobile homes were constructed before 1976 legislation was enacted. With a closer look at the 10 homes in the size range of 1,120 to 1,176 square feet, we notice that seven of these mobile homes were constructed after 1976 legislation was enacted. These two pieces of information seem to strongly support the idea that later model mobile homes are more energy efficient than older mobile homes, therefore emphasizing the need for retrofitting the older homes.

A look at mobile home size and the average utility bill shows that electric bills increase as the size of the mobile home increases with the exception of the largest mobile homes. This could be explained by the fact that seven of the 10 largest homes were manufactured after 1976. A look at the gas bills shows an escalation of the bill according to size of home with the exception of the smallest size homes. The increased usage in these homes could be explained by the fact that all these homes were manufactured before 1976.

Table III specifically looks at the size of the mobile home in relation to the monthly utility bill, but size is not the only factor that affects energy consumption and in turn the utility bill. When information from Table III and Table IV was compared, it was found that all of the smallest mobile homes (400 to 696 square feet) were built before legislation was passed in June 1976 regarding construction standards. Another finding was that seven of the 10 largest mobile homes (1,120 to 1,176 square feet) were manufactured after June 1976. The largest mobile home category was composed of homes two to three times larger than the homes in the smallest mobile category.

TABLE IV
UTILITY COSTS FOR PRE AND POST BUILT
1976 MOBILE HOMES

ID Number	Square Feet	Average Monthly Electric	Electric H ₂ O Heat	Average Monthly Gas	Monthly Total Utility
<u>Pre 1976</u>					
2	840	\$ 26.67		*	
3	1,008	106.16		\$10.75	\$116.91
4	1,092	91.75	X	**	91.75
5	1,008	46.08		13.08	59.16
6	840	47.25	X	*	
7	1,120	76.83	X	**	76.83
8	1,120	57.75		**	57.75
9	1,120	42.33		*	
11	700	25.75	X	4.58	30.33
16	980	136.25	X	**	136.25
17	720	81.50	X	**	81.50
19	1,064	36.75		**	36.75
20	624	25.83		14.67	40.50
21	980	64.25		*	
22	788	27.91		*	
+24	400	17.58		*	
25	780	34.33		17.08	51.41
26	696	23.16		*	
28	576	17.58		*	
29	612	39.58		25.08	64.66
30	1,008	46.17		20.16	66.33
31	500	72.42	X	**	72.42
32	840	31.50		21.00	52.50
33	924	79.25	X	**	79.25
34	910	29.16		15.08	44.24
36	952	27.75	X	*	
Average (17) 883				Average (17)	\$ 68.15
<u>Post 1976</u>					
1	1,176	42.67		*	
++10	1,134	21.41	X	**	21.41
12	840	36.08	X	*	
13	1,120	46.50	X	14.00	60.50
14	1,120	51.58		21.58	73.16
15	1,176	52.00		14.16	66.16
++18	1,176	55.50		21.33	76.83
23	1,120	30.67		*	
27	784	40.41		9.25	49.66
35	1,050	87.08	X	**	87.08
Average (7) 1,080				Average (7)	\$ 62.11

*Don't Know

**Not Applicable

+2 x 2 Construction

++2 x 6 Construction

The monthly average utility bill for these two categories was very similar with only a \$2.62 difference for energy consumption of homes two to three times larger. This appeared to be a significant finding in relation to the first objective of this research study and is supportive of earlier research that indicated older mobile homes were less energy efficient. The findings indicate that on the whole, construction of mobile homes since 1976 has improved and made mobile homes more energy efficient dwellings for families. This finding is supported by looking at the mobile homes from 910 to 1,092 square feet in size. Again in looking at Table IV in conjunction with Table III all but one of the mobile homes in that category were built before 1976. Dollar wise the average utility bill for the largest older homes was considerably higher than the bills averaged for the largest size new mobile homes.

Construction Date of Mobile Homes

When listed by construction date, there were 26 mobile homes constructed before the June 1976 legislation and 10 constructed after that date. In the chart the homes listed by ID number of the interview with square footage, average monthly gas and electric bills, and total monthly utility bills were applicable. In Table IV an X indicated those mobile homes with electric hot water heaters. In the left hand column there is a note to show the one mobile home with two by two construction and two mobile homes with two by six construction.

The average square footage of 17 mobile homes constructed prior to 1976 was 883 square feet and their average monthly utility bill was \$68.15. This compares to seven mobile homes built after 1976 with an average square footage of 1,080 and monthly utility bills averaging

\$62.11. In one year's time the occupant of the pre-1976 mobile home would pay a total of \$72.00 more in utility bills. This represents approximately a nine percent savings in utility costs for a home with about 22 percent more square footage. When looking at the rapid escalation of utility costs in the recent past, one can only believe that the increase in utility costs will be ever increasing. This should encourage mobile home occupants to be conscious of their energy usage and how they can best apply retrofitting measures to their home. Wise use of the \$72.00 could provide a number of cost effective retrofitting projects. In the future years the savings on energy bills could be used elsewhere in the household budget.

One home that was of particular interest would be home number 10. It had two by six construction and was total electric, including water heating. The average monthly electric bill was \$21.41 for this family of four. This home was well shaded by large trees which obviously helped the energy bill. In comparison the home number 18 was also two by six construction and was not total electric, yet this average monthly electric bill was over twice that of the first with only one additional family member. The second home was located in a mobile park with no shading.

Although both homes are post-1976 construction the utility bill is considerably larger for the second home. This might indicate that the manufacturer of the mobile home should be considered as a factor in deciding on which mobile home to purchase in regard to energy efficiency. Other factors such as lifestyle, age of family, window treatments, and heating and cooling systems could affect the energy efficiency of the home. More detailed information about how they

affect energy consumption is provided in Chapter V of this study.

Average utility bills will also increase if the mobile home is total electric. Another increase in energy dollars spent by the family can be expected if the family lives in a rural area with electric service from a rural electric cooperative rather than a privately owned utility company.

Thirteen of the mobile homes used electricity to heat water. At present rates electricity is not as economical as gas for heating water. Eight of the homes using electric water heaters were total electric, but the remaining five used natural gas, propane or wood for heating the home. Six of the total electric homes were built prior to 1976 with only two built after that date. This could indicate a trend away from total electric mobile homes as rates continue to rapidly escalate.

Conclusions

The following conclusions regarding energy usage in mobile homes were drawn. Energy usage in mobile homes increased with increased size of the home with the exception of mobile homes constructed after 1976. Evidence of increased usage was noted in homes constructed before 1976. One member families, which were usually older people, used as much energy in this limited study as did four member families. This could be an indication that comfort needs to be considered and previous study has indicated that comfort can be increased by retrofitting.

When comparing mobile homes built before and after 1976 it was found that newer homes were approximately 200 square feet or 22 percent

larger but averaged a monthly utility bill of \$6.00 or about nine percent less per month than the older homes. This does not take into consideration that rates are continually increasing and the dollar amount will rise. Neither does it consider that many of the families live on fixed incomes and will drastically be affected by ever-increasing utility bills, even though they may be conserving on their energy usage. In looking at the \$6.00 savings over the period of a year, the accumulated savings of \$72.00 could easily cover the costs of a number of retrofitting projects. This would provide the occupant with the cost benefit of having the payback within one heating and cooling season. More extensive projects could also be paid back in three to five years.

The energy dollar savings found in later model mobile homes leads the researcher to believe that retrofitting of older mobile homes could be beneficial to the occupants in decreasing their utility bills and in turn increasing their living comfort. Specifically mobile home occupants could utilize the inexpensive weatherization practices of weatherstripping, caulking, and plastic storm windows. If more dollars are available in the family budget, more expensive projects could be included. These projects might be glass storm windows, awnings and landscaping, as well as skirting the mobile home. Specific information about each of these practices can be found in Chapter V.

Recommendations for Further Study

After considering the data collected, the researcher recommends the following:

1. A study be made to find out who sets the thermostat and who decides what the temperature will be.

2. A study be made of cooking sources and how they affect energy usage in the home.

3. Further study be done on water heating sources and the effect water heating has on the total utility bill.

4. Further studies be done on a larger scale to provide a broader support for the information developed for Extension Home Economists to use in programs.

5. A study made to discover safe installation procedures for a wood stove in a mobile home. In conjunction with this, information concerning safe operation of the stove could be incorporated.

6. A study made to find the savings in fuel costs when wood is used to heat the mobile home in southeast Oklahoma.

7. A study be made to compare energy usage in conventional housing and manufactured housing in homes of the same size.

8. A study be made to compare the cost of purchasing a new energy efficient mobile home to the cost of purchasing a used older model mobile home, and spending additional dollars for retrofitting.

9. A study be made to determine the types of information available to potential mobile home buyers in regard to energy efficiency and knowledge of construction features.

Summary

The purpose of this study was to study the need of mobile home residents in Pittsburg County, Oklahoma, concerning energy usage and make recommendations on ways energy consumption might be reduced by use of inexpensive to moderately priced retrofitting projects thus saving on fuel bills and making their mobile homes more comfortable.

Thirty-six families living in mobile homes in Pittsburg County were selected through purposive sampling in order to represent all the geographic areas of the county. The families lived in their single-wide homes year around. The families varied in size and age. The mobile homes also varied in size and age.

The researcher personally interviewed the families during a home visit. The findings were then analyzed by a summary of the weatherization practices of the mobile homes studied, heating and cooling information, family size and utility bill, square footage and utility bill and year manufactured and utility bill. These findings are related in the first portion of this chapter.

CHAPTER V

PROGRAM FOR EXTENSION HOME ECONOMISTS

Introduction

The third objective of this paper was to incorporate the recommendations made into a mobile housing program with emphasis on energy that can be utilized by Oklahoma State University Extension County Home Economists. In Chapter V, background technical information is cited to broaden the knowledge of the home economist. This information will enable the home economist to communicate more effectively with county clientele. A glossary (Appendix D, p. 73) and handout materials (Appendix E, p. 76) are included.

Background Information

Sealing

Infiltration causes a major loss of energy when air leaks into an environmentally controlled structure, and leaks out again (U. S. Department of Energy, 1980). Cracks around window and door frames are one of the prime sources of infiltration. In mobile homes, additional cracks may occur if windows are louvered and do not fit tightly; if plumbing into the home has not been sealed off; if weatherstripping around doors and windows has worn; or if exhaust fans do not fit tightly or are turned on and left running for long

periods of time. Siding may have worked loose, so screws need to be tightened to close up cracks. Infiltration also allows moisture to penetrate insulation or the home atmosphere. When moisture accumulates in insulation the R-value drops significantly (U. S. Department of Energy, 1980).

"Caulking and weatherstripping have direct effects on air infiltration" (ECHO, 1980, p. 10). By using caulking and weatherstripping materials, the mobile homeowner not only cuts down on energy usage, but also makes the home more comfortable. Caulking and weatherstripping provide a good starting place, since they are probably the most cost effective weatherization practices that can be made by the homeowner. The Oklahoma Cooperative Extension Service slide series, "How to Weatherize Your Home" is a good source of detailed information on caulking and weatherstripping. The information provided was designed for conventional homes, but the principles identified are applicable to use on mobile homes. Additional printed information is also available in the following Oklahoma Cooperative Extension Service publications: 1) FS 1660-"Weatherproofing the Home," George W. A. Mahoney and Sam Harp; 2) EV 201-"Home Remedies for Energy Ills," Bonnie Braun and Linda Murray; 3) EV 202-"Selecting Caulking Compounds for Home and Farm," George W. A. Mahoney and Sam Harp.

In mobile homes, skirting around the underneath sides is another weatherization practice that is used to reduce air movement into the home and increase the effective floor insulation value (McKown and Calvert, 1980). Skirting has usually been found to be more beneficial for older mobile homes that have less floor insulation and more infiltration problems (U. S. Department of Housing and Urban Development,

1979b). Temporary skirting of hay or bagged leaves can be a fire hazard and should not be used. Skirting should have adequate venting to prevent moisture build-up under the mobile home. Avoid having a vent located too close to exposed water pipes to avoid freezing problems. Be sure to provide adequate venting to gas furnaces that require underfloor air intake (Griffin, 1978). In addition to ventilation, if the mobile home is located in an area where moisture is a problem, there should be a vapor barrier of plastic placed on the ground. Lap the plastic sheets and hold in place with bricks or rocks (Save Dollars . . . Insulate! n.d.).

"Only three percent (of mobile homes) are ever moved from their original site" (Barriers to Greater Sales, 1978, p. 8). Since the majority of mobile homes are not moved from their original site, it makes sense to skirt them not only for energy efficiency but also to improve their appearance as a stable part of their community. When considering skirting materials, look not only at initial cost and ease of installation, but also consider durability and maintenance. Holder (1977) suggested five materials that could be considered for mobile home skirting. These are:

1. Plywood - use 3/8 inch A-C or B-C exterior grade; easy to install; allow 1/8 inch between joints for expansion; finish with a coat of primer and paint; requires periodical painting.
2. Masonite - similar to plywood.
3. Corrugated metal - use aluminum or galvanized; installation requires special cutting tools; excellent durability; low maintenance.
4. Corrugated fiberglass - available in colors; high initial costs; fairly difficult for do-it-yourselfer to apply; durable; low maintenance; may crack or break.

5. Vinyl - high initial cost; available in kits from mobile home dealers; easy for do-it-yourselfer to install; highly durable; low maintenance; may provide continuous ventilation (p. 2).

Window Treatments

Windows are great energy losers in the winter, and in summer they gain a great deal of heat. Single pane glass has an R-value of .88. This compares to an R-value of 11 to 19 usually found in the average wall. "One square foot of glass can lose as much heat as 10 square feet of wall" (Howard and Williams, 1980, p. A-2). This indicates that we need to effectively treat our windows in order to make them as energy efficient as possible. In the wintertime, south windows can gain wanted heat during sunny days but all windows will lose heat at night. In the summertime, east and west windows will gain a great deal of unwanted heat. South windows will also gain some unwanted heat since there is no overhang on the mobile home to provide shading. All windows may be needed for ventilation (McKown and Calvert, 1980). The materials used in the window treatment will determine whether one or a combination of materials should be used to most effectively control heat gain or loss through the windows. Utilization of the window treatment by the occupant will determine how effective the treatments will control heat gain or loss. Layering window treatments or using a combination of two or more window treatments is more effective than using just one window treatment. Layering increases the R-value of the window treatment, as well as reducing conductive heat transfer. To be most effective, window treatments must trap air between itself and the window (Howard and Williams, 1980). For some situations, even more energy efficient is a window treatment used outside so heat and

cold are never allowed to enter the home. These exterior window treatments are effective in reducing radiant heat transfer.

The publication, "Energy Efficient Window Treatment" (Howard and Williams, 1980) was developed for use by County Extension Home Economists in Oklahoma. In this book are numerous window treatments that could be effectively used by mobile homeowners. Some specific suggestions for window treatments to look at inside would be drapery liners, insulated draperies, roller shades, Roman shades, insulated shutters, inserts, thermal panels, insulation board panels, cornice boards, reflective film, and plastic storm windows. For outside use consider plastic or glass storm windows and awnings. If cost is a consideration, plastic storm windows can be used much less expensively and still provide the same effective insulation as glass storm windows (U. S. Department of Energy, 1980). The extra layer of glass or plastic over the window and the inside window treatment cut down the heat loss or gain by conduction through the window. The awnings could be for individual windows or in the form of a porch or carport that would shade a large portion of one side of the mobile home. The exterior shade reduces the heat gain by radiation. Orientation of the mobile home will have an effect on how diligent a homeowner needs to be with window treatments.

Heating and Cooling Systems

Mobile homes are normally equipped with a central forced air heating system whether gas or electric. They may or may not be equipped with central cooling. Some homeowners have added wood heaters to take the place of or to supplement their existing heating

system. Those without central cooling may have window units and/or utilize portable fans.

The least energy demanding cooling systems are simple 'air movers.' Included among these are natural ventilation through open windows, portable fans, ceiling fans. . . . Fans are effective in one of two ways, or both: circulating inside air; and replacing inside air with outside air. The cooling effect of air movers is directly related to the speed of the air, which increases the evaporative cooling of the body (U. S. Department of Energy, 1980, p. 4).

Portable fans may be used to circulate and distribute warm or cool air, so are useful year around.

Mobile homeowners need to exercise special precautions when installing wood heaters for heating in their homes. Mobile homes are especially vulnerable to fire and can be destroyed very quickly if a fire occurs. The Oklahoma Cooperative Extension Service has four publications that provide information to help those homeowners with woodburning stoves. The publications are: 1) FS 9433-"Safe Installation of Wood Burning Stoves," Joseph Gerling; 2) FS 9434-"Safe Operation of Wood Burning Stoves," Joseph Gerling; 3) FS 9436-"Preventing Chimney Fires," Joseph Gerling; and 4) FS 9438-"Wood Stove Chimney Installation," Joseph Gerling.

Home heating and cooling systems need to be serviced seasonally for most efficient operation. This cleaning, oiling, adding freon or other maintenance procedures may be done by the homeowner or if necessary contact a serviceman. Efficient operation of the heating and cooling system conserves energy. One of the very important maintenance procedures is to clean the furnace or air conditioner filter at least monthly.

Duct systems for central forced air systems require maintenance, too. Vibration from operation or moves of the mobile home can cause

the ducts to work apart at the joints. Check these periodically. For duct work located in unconditioned space, it is very important to make sure the ducts are insulated with a minimum of R-4 insulation to minimize heat loss in the wintertime and heat gain in the summertime (Save Dollars . . . Insulate!, n.d.; U. S. Department of Energy, 1980).

If it becomes necessary for the homeowner to look at replacement of the heating and/or cooling system, they need to be aware of energy labeling and that later model units are rated by energy efficiency ratios (EER's). The higher the EER the less energy will be consumed. Air conditioners, whether individual units or central systems that have an EER rating of five or six are inefficient, but those with an EER rating of 10 or above are efficient (U. S. Department of Energy, 1980).

Mobile homeowners with central heating and cooling systems need to be aware that decreased winter thermostat settings and increased summertime settings will save energy. Increased thermal efficiency of their home by weatherization can make these settings more comfortable for the family.

Siting of the Mobile Home

Location of the mobile home on the site can play an important role in saving energy for the residents as well as making the home a more comfortable place to live. Orientation of the home can give the mobile home residents advantage of shading in the summer, protection from cold winter winds, and the benefit of solar heat gain in the winter. High winds should also be considered when siting the home and

residents should always install tie downs for safety. Guidelines for siting the mobile home (Energy and Your Mobile Home, n.d.; Energy Facts, n.d.; Griffin, 1978; Mitchell, 1980; F. T. Plowman, n.d.; Pope, n.d.; and Save Money Save Energy, 1980) would be:

1. Locate the mobile home longways east and west (Figure 2).

The major amount of window areas should be on the south to allow solar heat gain in the winter. There should be limited amount of heat gain from east and west windows.

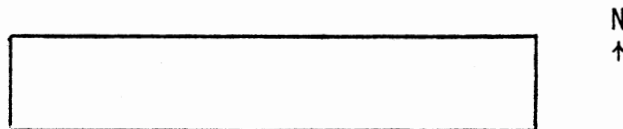


Figure 2. Directional Mobile Home Siting

2. Locate the kitchen away from the west. Solar heat gain added to heat created by cooking in the summer months adds considerable heat to the mobile home.

3. Windbreaks are needed along the north and are best located approximately 30 feet from the home and as tall as the home. Mobile homes located in areas where west winds are prevalent could benefit from windbreaks on the west side as well. Windbreaks could be in the form of a semi-enclosed carport, large evergreen shrubs, evergreen trees that hold their lower limbs, or a tall fence.

4. Further landscaping for summer energy considerations will prove beneficial for the mobile homeowner. Deciduous trees with their

heavy foliage provide good shading for summer but those trees that lose all their leaves in winter are best so there is as much solar heat gain as possible. Shading should be on the east, west, and south sides. The shading could be provided by deciduous vines on lattice work located near the mobile home. Shading of paved areas around the home can make the home more comfortable in the summer.

5. As mentioned in the window treatment section, shading of windows by awnings or porches reduces considerably solar heat gain through windows. Shading on the south in the summer is particularly beneficial.

Hot Water Insulation

Next to space heating and cooling, water heating usually is the second largest energy user in a home. "Adding insulation to the jacket of an existing water heater can reduce heat loss from the jacket wall" (ECHO, 1980, p. 10). Water heaters in mobile homes are usually located in unconditioned spaces. "Insulation for free-standing water heaters is usually most effective if the unit is located in an unconditioned space" (U. S. Department of Energy, 1980, p. 1). Even more effective in energy conservation than additional water heater insulation is the reduction of hot water consumption or temperature setting.

Safety must be considered when installing hot water heater insulation especially on gas water heaters. The insulation kits available on the market give directions that should be followed specifically.

Exposed water pipes are another item that need to be insulated. Insulation prevents freezing, as well as decreases heat loss from

exposed hot water pipes. Pipes may need to have electrical heat tapes added to assure that they do not freeze in severe weather.

Insulation

The previously mentioned low-cost energy conservation measures that can usually be made by the homeowner should be considered before looking at additional insulation in the roof or walls of the mobile home. The roof may be the easiest place to install added insulation. The temperature difference between inside and outside the home determines just how great the losses are depending on the R-value of the materials used in the roof to accomplish this task. The reflective coating can be applied by the homeowner and seals the roof as well as provides reflection of heat. This coating needs to be reapplied every year or two and is not as effective as the roof cover. Light exterior siding also helps the mobile home reflect heat.

Floor insulation is another place where work can be done by the homeowner with the results being effective to not only raise the R-value of the floor, but also cut down on drafts. Floor insulation can be added with chicken wire to hold it in place. Another method would be to remove the fiberboard subflooring, add insulation and then replace the subflooring. The insulation used in the floor should have a vapor barrier which is installed toward the inside of the home (Griffin, 1978; Save Energy . . . Insulate!, n.d.).

Enclosed Entry

A small enclosed porch or "airlock" cuts down on energy losses through the main entrance of the home. The entry should be arranged

so that the outside door is closed before the inside door is opened. For a family that comes and goes often, the enclosed entry provides protection from severe weather, whether hot or cold (Save Energy . . . Insulate!, n.d.).

Living Patterns

"Remember: the single most important factor affecting energy usage -- PEOPLE and their habits" (Energy and Your Mobile Home, n.d.). McKown (1980, p. 1) indicates "the most effective way to conserve energy is to change our energy-intensive lifestyles." Educational materials in the area of changing lifestyles in relation to energy usage have been prepared.

The Oklahoma Cooperative Extension Service has developed a slide series that deals with family lifestyles and energy usage. The series, "Solving the Energy Problem, A Family Affair" is available in the County Extension offices. There have also been a number of publications developed that discuss measures that individuals and families can adopt to decrease their energy usage. The Energy Event publications relating to lifestyle are: 1) EV 201-"Home Remedies for Energy Ills," Bonnie Braun and Linda Murray; 2) EV 204-"Conserving Energy in Home Hot Water Use," Sue Herndon; 3) EV 300-"Energy and What You Wear," Marjorie Y. Baker and Mary Lou Sadler; 4) EV 301-"Choosing Energy Efficient Kitchen Appliances," Sue Herndon; 5) EV 302-"Save Energy and Money In the Kitchen," M. Kathleen Yadrack and Sue Herndon; 6) EV 303-"Teaching Your Child Wise Energy Use," Bonnie Braun and Elaine Wilson; and 7) EV 304-"Furnish to Conserve Energy," Patricia Zipper.

Background technical information is presented in Chapter V to provide support for Extension Home Economists presenting retrofitting programs to mobile home occupants. Information is presented covering sealing, window treatments, heating and cooling systems, siting of the mobile home, hot water insulation, insulation, enclosed entry and living patterns. The information can be used for individual lesson presentations or used totally for the development of a mobile home retrofitting program.

A glossary (Appendix D, p. 73) is provided for use by the home economist and can be utilized for county clientele. The handout (Appendix E, p. 76) provides an outline of principles presented in the background information and is ready for duplication and use by the home economist.

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APPENDIXES

APPENDIX A
CORRESPONDENCE

McAlester, Oklahoma 74501

My name is Marie Howard, a graduate student in Housing, Design and Consumer Resources at Oklahoma State University. I am currently completing 35-40 case studies in Pittsburg County of mobile home occupants regarding their energy usage.

I am hopeful that the information obtained in these case studies will help me develop some useful and practical lessons for mobile home owners that will help them make their homes more energy efficient with the least cost possible. Any information obtained on the questionnaire will be for my use only and will be considered confidential.

I would appreciate 15-20 minutes of your time in helping me complete the questionnaire. If possible I will be phoning you in the next few days to set a time that would be convenient for me to make a brief visit to your home.

Thank you for your help.

Sincerely,

Marie Howard

APPENDIX B

PILOT STUDY QUESTIONNAIRE

Size of City or Town

- _____ rural (outside incorporated area)
_____ in incorporated area of less than 2500
_____ in incorporated area of 2500 or more

Location of Mobile Home

- _____ Mobile Home Park
_____ Lot
_____ Rural Area

Special Features

- _____ 2 X 4 construction
_____ awnings
_____ landscaping
_____ skirting
_____ foyer
_____ roof built over mobile home

ENERGY CONSERVATION SURVEY FOR MOBILE HOMES
PITTSBURG COUNTY, OKLAHOMA

INFORMATION ABOUT YOUR MOBILE HOME

1. Do you rent or own your mobile home?
 - a. ___rent
 - b. ___own
 - c. ___other, please specify _____
2. Who is the manufacturer of your mobile home? _____
3. Give estimates of the following:

	Not Applicable	Don't Know
a. Monthly rent or house payment \$ _____	_____	_____
b. Monthly park rental \$ _____	_____	_____
c. Average land payment \$ _____	_____	_____
d. % of interest on home loan \$ _____	_____	_____
e. Size of your mobile home _____ X _____ ft.	_____	_____
f. Age of your mobile home _____ years.	_____	_____
g. Number of years lived in _____	_____	_____
h. Number of moves the home has made _____	_____	_____
i. Number of bedrooms _____	_____	_____
j. Number of bathrooms _____	_____	_____
4. Do you live in your mobile home
 - a. _____ year around
 - b. _____ week-ends and vacation only

INFORMATION ABOUT OCCUPANTS

5. Please list all occupants as related to the head of household.

a. Occupants	b. Sex	c. Age	d. Last grade completed in school	e. Approximate Income
1. Head of Household				
2.				
3.				
4.				
5.				

INFORMATION ABOUT HOME ENERGY SITUATION

Please circle your answer. "D.K." is for Don't Know.

6. Yes D.K. No Are all windows and door frames sealed with caulk?
7. Yes D.K. No Are all windows and doors weather stripped?
8. Yes D.K. No Do you have storm windows?
9. Yes D.K. No Do you have storm doors?
10. Yes D.K. No Is your mobile home skirted or underpinned?
11. Yes D.K. No Is your mobile home insulated?
12. Yes D.K. No Have you added insulation?
13. Yes D.K. No Is your home comfortable in the summer?
14. Yes D.K. No Is your home comfortable in the winter?
15. What type heating do you have?
- a. gas b. electric
- c. other, please specify _____
16. What type cooling do you have?
- a. gas b. electric
- c. none (go on to question 18)
17. What kind of cooling system do you have?
- a. central b. window # of units
18. At what temperature do you keep the thermostat set?
- a. °summer b. °winter
19. How energy efficient do you feel your mobile home is in comparison to others of similar size? very efficient average very inefficient
20. May we contact the gas and/or electric company for the amount of your utility bills for 1980?
- a. yes b. no
- Signed: _____
21. What kind of information about energy conservation in mobile homes would be helpful to you?
- | | |
|--|--|
| <input type="checkbox"/> caulking | <input type="checkbox"/> landscaping |
| <input type="checkbox"/> weather stripping | <input type="checkbox"/> structural shading |
| <input type="checkbox"/> storm windows | <input type="checkbox"/> other, please specify |
| <input type="checkbox"/> skirting | _____ |
| <input type="checkbox"/> awnings | _____ |
22. Would you be interested in information on up-grading the energy efficiency and comfort of your mobile home? _____

APPENDIX C

INSTRUMENT

Size of City or Town

- _____ rural (outside incorporated area)
 _____ in incorporated area of less than 2500
 _____ in incorporated area of 2500 or more

Location of Mobile Home

- _____ Mobile Home Park
 _____ Lot
 _____ Rural Area

Special Features:

- _____ 2 x 4 construction
 _____ awnings
 _____ landscaping
 _____ skirting
 _____ enclosed entry
 _____ roof built over mobile home
 _____ tie down
 _____ fan
 _____ siding
 color _____
 type _____
 _____ roof
 color _____
 type _____
 _____ Siting

ENERGY CONSERVATION SURVEY FOR MOBILE HOMES
PITTSBURG COUNTY, OKLAHOMA

INFORMATION ABOUT YOUR MOBILE HOME

1. Do you rent or own your mobile home?
 - a. _____ rent
 - b. _____ own.
 - c. _____ other, please specify _____
2. Who is the manufacturer of your mobile home? _____
3. Give estimates of the following:

	Not Applicable	Don't Know
a. Monthly rent or house payment \$ _____	_____	_____
b. Monthly park rental \$ _____	_____	_____
c. Average land payment \$ _____	_____	_____
d. % of interest on home loan _____	_____	_____
e. Size of your mobile home _____ X _____ ft.	_____	_____
f. Age of your mobile home _____ years	_____	_____
g. Number of years lived in _____	_____	_____
h. Number of moves the home has made _____	_____	_____
i. Number of bathrooms _____	_____	_____

INFORMATION ABOUT OCCUPANTS

4. Please list all occupants who live in this household.

a. Occupants	b. Sex	c. Age	d. Last grade completed in school	e. Approximate Income
1. Head of Household				
2.				
3.				
4.				
5.				
6.				

¹ Under \$5,000

² \$5,000 - \$9,999

³ \$10,000 - \$14,999

⁴ \$15,000 - \$19,999

⁵ \$20,000 - \$24,999

⁶ Above \$25,000

INFORMATION ABOUT HOME ENERGY SITUATIONPlease circle your answer. "D.K." is for Don't Know.

5. Yes D.K. No Are all windows and door frames sealed with caulk?
6. Yes D.K. No Are all windows and doors weather stripped?
7. Yes D.K. No Do you have storm windows or double pane windows?
8. Yes D.K. No Do you have storm doors?
9. Yes D.K. No Is your mobile home insulated?
10. Yes D.K. No Have you added insulation?
11. Yes D.K. No Is your home comfortable in the summer?

Why _____

Areas more comfortable? _____

12. Yes D.K. No Is your home comfortable in the winter?

Why _____

Areas more comfortable? _____

13. What source of space heating do you use?

a. ___gas b. ___electric

c. ___Other, please specify _____

14. What source of space cooling do you use?

a. ___gas b. ___electric

c. ___none (go on to question 16)

15. What type of cooling system do you use?

a. ___central b. ___window, ___# of units c. ___heat pump

16. At what temperature do you keep the thermostat set?

a. ___°summer b. ___°winter

17. What source of water heating do you use?

a. ___gas b. ___electric

18. How energy efficient do you feel your mobile home is?

___very efficient ___average ___very inefficient

19. Would you be interested in information on up-grading the energy efficiency and comfort of your mobile home?

a. ___yes b. ___no

If so, what kind?

___caulking

___landscaping

___weather stripping

___structural shading

___storm windows

___other

___skirting

___awnings

APPENDIX D

GLOSSARY

Glossary

Caulking - Pliable materials used to reduce the passage of air and moisture by filling small gaps.

Ceiling Insulation - The term "Ceiling Insulation" means a material primarily designed to resist heat flow which is installed between the conditioned area of a building and an unconditioned attic. The term "Ceiling Insulation" also applies to such material as used between the underside and upperside of the roof where the conditioned area of a building extends to the roof.

Duct Insulation - The term "Duct Insulation" means a material primarily designed to resist heat flow which is installed on a heating or cooling duct located in an unconditioned area of a building.

Energy Efficiency Rating - (EER) - The ratio of usable output to input of energy; in the case of cooling units (since the input is usually electrical power-measurable power-measurable in watts and the amount of heat removed is measurable in BTU's) the EER equals the ratio of BTU's/hr to the number of watts used.

Floor Insulation - The term "Floor Insulation" means a material primarily designed to resist heat flow which is installed between the first level of a conditioned area of a building and an unconditioned basement or crawl space, or insulation installed on the inside of a crawl space wall. In the case of mobile homes, the term "Floor Insulation" also means skirting to enclose the space between the building and the ground.

Infiltration - To filter in and through. The air leakage through cracks and openings, around windows and doors and through floors and walls of a building. Save Dollars . . . Insulate!, p. 8.

Pipe Insulation - The term "Pipe Insulation" means a material primarily designed to resist heat flow which is installed on a hot or cold pipe in an unconditioned area.

R-Value - The measurement of the resistance capacity of a material. The higher the R-value of a material the more insulation value it provides.

Storm Window - The term "Storm Window" means the window or glazing material placed outside or inside an ordinary or prime window creating an air space to provide greater resistance to heat flow and to reduce air leakage of the prime window.

Water Heater Insulation - The term "Water Heater Insulation" means material primarily designed to resist heat flow which is suitable for wrapping around the exterior surface of the water heater casing.

Weatherstripping - Narrow strips of material placed over or in movable joints of windows and doors to reduce the passage of air and moisture.

APPENDIX E

HANDOUT

Conserving Energy In Your Mobile Home

A. Sealing

1. Caulk cracks around window and door frames. Secure cracks in siding and fill holes or cracks around plumbing.
2. Weather strip doors and windows. Check exhaust fans for tight fit.
3. Skirt mobile home to aid insulation and cut down drafts. Be sure to check need for vapor barrier and ventilation.

B. Window Treatments

1. Provide shade for east, south and west windows in summer.
2. Utilize south windows for solar heat gain on sunny winter days.
3. Inside look at drapery liners, insulated drapes, roller shades, Roman shades, insulated shutters, inserts, thermal panels, insulation board panels, cornice boards, reflective film and plastic storm windows.
4. Outside look at plastic or glass storm windows, awnings or other shading devices.

C. Heating and Cooling Systems

1. Utilize portable fans as "air movers."
2. Exercise safety precautions when installing and operating a wood heater.
3. Service heating and cooling system seasonally.
4. Clean filters at least monthly.
5. Check duct system for repairs needed periodically.
6. When replacement of system is necessary, shop for a new system with higher EER.

D. Siting of the Mobile Home

1. Locate long sides east to west.
2. Locate kitchen away from west.
3. Utilize windbreaks on north and possibly west.
4. Shade for summer with deciduous trees located east, west, and south.

E. Hot Water Insulation

1. Insulate hot water heater, using safety precautions.
2. Insultate exposed water pipes.

F. Insulation

1. Look at added insulation to the roof. This may be a roof cover.
2. Use reflective coating on roof for summer.
3. Add floor insulation for energy conservation and comfort.

G. Enclosed Entry

1. Enclose existing porch for reduction of energy use during severe weather.
2. Build enclosure so outside door is closed before inside door is opened.

H. Living Patterns

1. People and their habits are most important in energy conservation.
2. Utilize Oklahoma Cooperative Extension Service publications on energy and lifestyle to help change family attitudes and habits.

VITA

A. Marie King Howard

Candidate for the Degree of

Master of Science

Thesis: ENERGY CONSUMPTION OF MOBILE HOMES IN PITTSBURG COUNTY,
OKLAHOMA AND GUIDELINES FOR RETROFITTING

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