

FACTORS THAT INFLUENCE ENERGY-CONSERVATION ALTERATIONS IN OREGON HOUSEHOLDS

Karen J. A. Johnson-Carroll, Jeanette A. Brandt and Geraldine I. Olson

ABSTRACT

The purpose of this study is to analyze the relative contributions of factors influencing energy-conservation alterations by Oregon households. Data from the longitudinal survey conducted by the Western Regional Agricultural Experiment Station Committee (W-159) in 1981 and 1983 are analyzed by path analysis. Plans to improve the energy efficiency of the dwellings lead to both energy-efficient improvement behaviors and energy-curtailed behaviors. However, plans to curtail energy use lead only to curtailment behavior. Belief in the seriousness of the energy problem does not lead to alteration or curtailment of energy usage.

INTRODUCTION

The purpose of this study is to analyze the relative contribution of factors influencing residential energy-conservation alterations in Oregon households. This is accomplished using path analysis. Using the Morris and Winter (1981) model of housing adjustment behavior, Niemeyer (1982) develops a path analysis model in her study of the determinants of the propensity to engage in energy-conserving behavior. Niemeyer and Morris (1986) postulate that "...if the family's housing fails to meet its norms for energy efficiency, a deficit exists. If the energy deficit is salient, dissatisfaction occurs, and a propensity to engage in energy-saving adjustment behavior results" (p. 45).

Niemeyer (1982) analyzes the resource constraints and predisposition constraints that affect the occurrence of energy deficits. Morris and Winter (1978) define constraints as "...factors that restrict a family's ability to engage in housing-adjustment behavior" (p.80). "Resource constraints" in Niemeyer's model are the factors that restrict a family's ability to engage in adjustment behavior. Predisposition constraints are factors that restrict a household's skills and motivation to engage in adjustment behavior. Niemeyer (1982) and Niemeyer and Morris (1986) find that resource constraints are the key explanation to the number of energy-saving characteristics present in the dwelling. They also find that satisfaction with the energy condition of the home is dependent on the

Karen J. A. Johnson-Carroll completed this research for her doctoral dissertation. Jeanette A. Brandt is Associate Professor and Geraldine I. Olson is Associate Professor and Department Head, Department of Family Resource Management, College of Home Economics, Oregon State University, Corvallis, Oregon. Data for this study were provided by the Western Regional Agricultural Experiment Station Project (W-159): "Consequences of Energy Conservation Policies for Western Region Households", which was partly funded by a grant from the United States Department of Agriculture. This is Oregon Agricultural Experiment Station Technical Paper #7662.

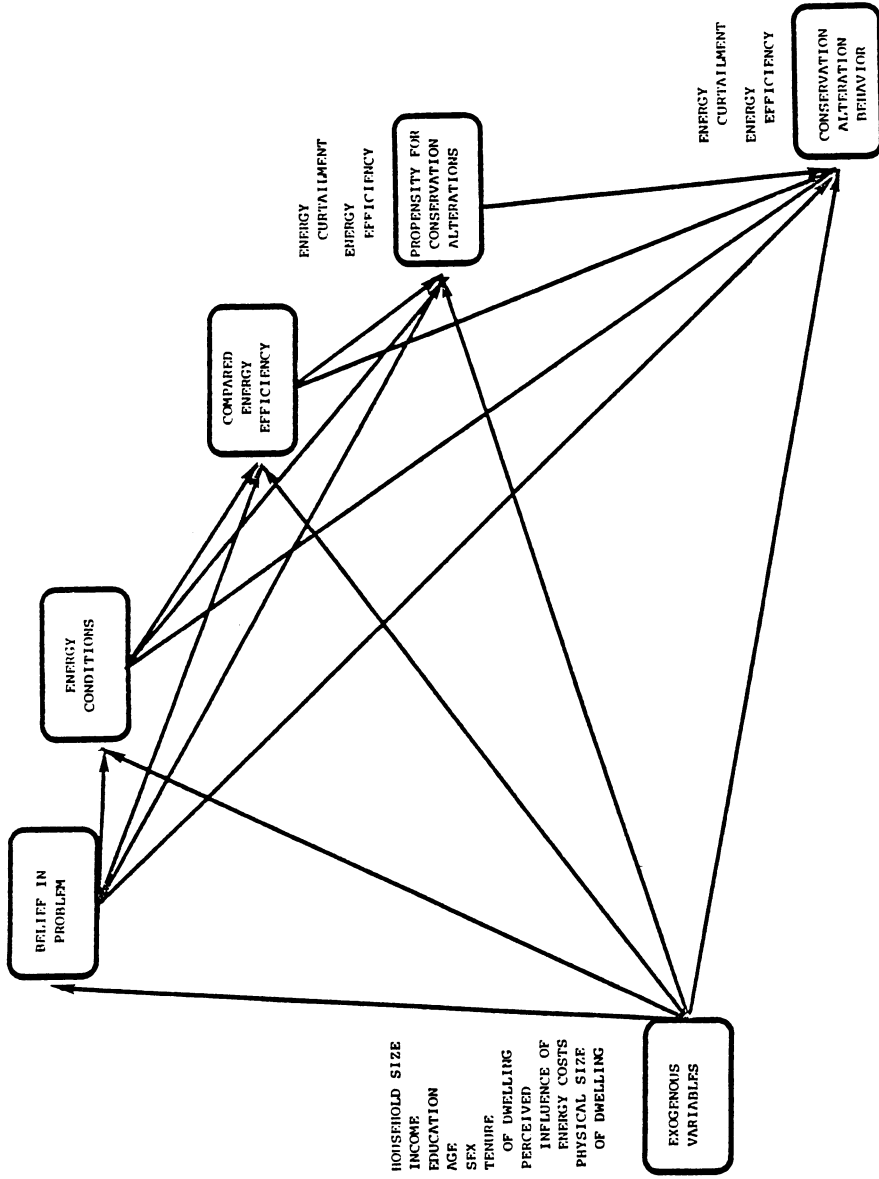


Figure 1. Proposed model of energy conservation alterations.

presence of these characteristics. In addition, Niemeyer (1982) finds that the main barriers to the propensity or intent to save energy through dwelling alterations are also the resource constraints. Households with fewer resources are less likely to have such a propensity. Niemeyer's model stops at the "intention" stage, or with the propensity for conservation behavior. She asserts that it

can be assumed that the propensity or intent to engage in energy-conserving adjustment serves as a measure of energy adjustment behavior (p. 35).

Proposed Model of Energy-Conservation Alterations

Based on Niemeyer's (1982) model of energy adjustment, the proposed model expands to include energy-conservation alteration behaviors (see Figure 1). This variable is subdivided into two conceptually different types of conservation alterations: energy curtailment and energy-efficiency improvement. In addition, the variable, propensity for conservation alterations, is divided into the propensity for the same two types of conservation alterations. Physical size of the dwelling is added as a variable under the exogenous variables---those variables originating from outside the model that Niemeyer (1982) terms "resource constraints".

Thus, the analysis is a causal model with six levels of variables: 1) energy conservation behavior (which includes energy-curtailment behavior and energy-efficiency improvement behavior), 2) propensity to conserve energy (which includes propensity to energy-curtailment behavior and propensity for energy-efficiency behavior), 3) compared energy efficiency of the dwelling, 4) energy conditions, 5) belief in the seriousness of the energy problem, and 6) the exogenous variables including household size, income, education, age, sex, tenure of dwelling, perceived influence of energy costs and dwelling size. Each of the endogenous variables (first five levels) are analyzed as dependent variables on the independent variables. Propensity to conserve energy, compared energy efficiency, energy conditions and belief in the seriousness of the energy problem act as independent variables for the endogenous variables further along the casual path. A Pearson correlation matrix is run on the exogenous variables in the current model. None of the coefficients are large enough to cause concern.

According to the model (see Figure 1), energy-efficient improvement behavior (X_{14}) and energy-curtailment behavior (X_{15}) are caused by the propensity for energy-efficiency improvement (X_{13}) and propensity for energy curtailment (X_{12}) that in turn are caused by compared energy efficiency (X_{11}). Compared energy efficiency is caused by the energy conditions of the dwelling (X_{10}), which is hypothesized to be caused by belief in the energy problem (X_9). The exogenous variables (X_8 through X_1) are related to belief in the energy problem.

The full model is written:

$$X_{15} = f(X_{13}, X_{12}, X_{11}, X_{10}, \dots, X_1)$$

$$X_{14} = f(X_{13}, X_{12}, X_{11}, X_{10}, \dots, X_1)$$

$$X_{13} = f(X_{11}, X_{10}, X_9, X_8, \dots, X_1)$$

$$X_{12} = f(X_{11}, X_{10}, X_9, X_8, \dots, X_1)$$

$$X_{11} = f(X_{10}, X_9, X_8, X_7, \dots, X_1)$$

$X_{10} = f (X_9, X_8, X_7, X_6 \dots X_1)$, and

$X_9 = f (X_8, X_7, X_6, X_5 \dots X_1)$, where

X_{15} = energy-efficiency improvement behavior

X_{14} = energy curtailment behavior

X_{13} = propensity for energy-efficiency improvement behavior

X_{12} = propensity for energy curtailment behavior

X_{11} = compared energy efficiency

X_{10} = energy conditions of the dwelling

X_9 = belief in the seriousness of the energy problem

X_8 = dwelling size

X_7 = perceived influence of energy costs

X_6 = tenure of dwelling

X_5 = sex of respondent

X_4 = age of respondent

X_3 = education of respondent

X_2 = household income, and

X_1 = household size.

DEFINITION OF THE VARIABLES

Exogenous Variables

Household size. Many researchers view the number of people in the household as an important determinant of the amount and the way energy is used, with an increase in people accounting for greater use of energy (Cramer et al., 1983; Levy, 1973; Marganus, 1984; Morrison et al., 1978). Several researchers, however, find opposite results. Gladhart (1977) finds that specific measures of the dwelling and family type eliminates the influences of family size on consumption. Herendeen and Tanaka (1976) observe that single-person dwellings are the only type of dwelling to be influenced by size. The household variable is measured by the total number of persons who lived in the household in 1981.

Income. Most researchers agree that income is one of the strongest predictors of the amount of energy consumed and the willingness to engage in energy conservation (Cunningham and Lopreato, 1977; Marganus, 1984; Newman and Day, 1975). Because low-income families cannot afford home improvements, their housing is usually not energy efficient (Katz and Morgan, 1983; Tienda and Aborampah, 1981). While low-income families tend to use less energy than high-income families, they spend a greater percentage of their disposable income on energy costs (Katz and Morgan, 1983; Newman and Day, 1975). Low-income families use less energy, not because they want to use less, but because they

cannot afford to use more. The household income variable in this study measures total family income before taxes in 1981.

Education. The effect of education on energy-conservation beliefs and behavior is mixed. Researchers report that the education level is positively related to attitudes toward the energy problem (Barnaby and Reizenstein, 1975; Bultena, 1976; Curtin, 1976; Zuiches, 1976). The education level is, however, also positively related to energy consumption (Cramer et al., 1983) and negatively related to actual energy-conservation behavior (Heberlein and Warriner, 1980). Well-educated consumers tend to have higher incomes and, thus, more energy-consumptive dwellings, while less-educated consumers tend to have lower incomes and, thus, cannot afford high energy-consumptive behavior. Education in this study measures level of education of respondent from "no formal education" through "a graduate degree" in 1981.

Age. Researchers' results are mixed regarding the effect age has on energy consumption. The elderly are shown to be both more receptive (Talazyk and Omura, 1975) and more resistant (Eichner and Morris, 1984) to energy-conservation behavior. According to previous studies, the elderly are both more conserving (Bloom, 1975; Cramer et al., 1983) and more consumptive (Marganus, 1984) than other age groups. Their homes are found to be both energy efficient (Tyler, Lovingood, Bowen and Tyler, 1982) and energy inefficient (Walden and Meeks, 1982). This diversified view of the effect of age on energy conservation is explained by Wilk and Wilhite (1983). They suggest that the house becomes a major source of security and comfort for the elderly. In their study, they find that, while elderly people view change in dwelling structure and household management as upsetting, they make their homes as energy efficient as possible in their quest for security. Age of respondent in this study measures the respondent's age in years in 1981.

Sex. While male/female attitudes toward the energy problem do not seem to be different (Niemeyer, 1982; Olsen, 1981), actual energy consumption patterns are different. Female-headed households tend to use less energy, spend a larger portion of their disposable income on energy (Brazzel and Hunter, 1979; Katz and Morgan, 1983; Newman and Day, 1975) and are less likely to fulfill plans for housing adjustments than are male-headed households (Duncan and Herman, 1976). These results may be caused by females' lower average income and their lack of taught ability to do household repairs rather than an inherent attribute of sex (Abdel-Ghany and Nickols, 1983; Glazer, 1983; Nickols and Metzen, 1978). Sex of respondent is a dichotomous variable--male and female. Females are coded "1" and males are coded "-1" in this study.

Tenure. Home owners are more likely to live in energy-efficient dwellings and make more energy-conserving adjustments than are renters (Buck, 1982; Schipper, 1983; Stern, Black and Elworth, 1982; Tyler et al., 1982). Low-income renters cannot afford to retrofit their dwellings to become more energy-efficient (Tyler et al., 1982). Even for tenants who can afford energy-conserving adjustments, there is rarely the incentive, because the cost benefits go to the landlord (Eichner and Morris, 1984). Tenure of dwelling in this study is a dichotomous variable--owners and renters. Renters are coded "1" and owners "-1".

Perceived influence of energy costs. The economic constraints perceived by a household due to energy costs influence the amount of energy consumed (Cramer et al., 1983) and the type of energy-conservation measures taken (Dillman, Rosa and Dillman, 1983; Katz and Morgan, 1983; Marganus, 1984). The households who curtail their lifestyle due to energy costs also conserve energy through measures not requiring monetary expenditures. Those households who do

not need to curtail their lifestyle invest in energy-conservation actions, such as retrofitting (Dillman et al., 1983). Marganus (1984) finds that rising energy costs have an adverse effect on how respondents feel about their quality of life. Darley and Beniger (1981) note that the rapid change in cost of energy as well as the actual cost of energy contributes to energy-related dissatisfaction. The perceived influence of energy costs in this study measures how the respondent feels the changes in energy costs affect his/her life, choosing between five levels spanning "a lot worse than it was" to "a lot better than it was".

Physical size of the dwelling. Some researchers note size of dwelling as a predictor of energy consumption in the home (Marganus, 1984; Morrison et al., 1978). As the size of dwelling increases, so does energy consumption, possibly because of increased space heating/cooling. It has also been noted that, while higher income families have larger homes, they also have more appliances (Cramer et al., 1983; Schipper, 1983). The physical size of the dwelling in this study is measured by the respondent's estimate of the square footage of the dwelling and is categorized in increments of 500 square feet.

Endogenous Variables

Belief in the energy problem. The relationship between general energy attitudes and reported conservation action is tenuous (Anderson and Lipsey, 1978; Cunningham and Lopreato, 1977; Perlman and Warren, 1977). This is consistent with general attitude-behavior theory. More recent attitude-behavior research shows that specific, strong attitudes can be predictive of behavior. Cornville, Oransky and Pestle (1979) assert that continuing high consumptive behavior in the face of an energy shortage is the first stage of reaction to a crisis. Thus, time lag is important in examining behavior. Belief in the energy problem measures how serious the respondent felt the energy problem to be in 1981 with responses ranging from "not a serious problem" to "a very serious problem".

Energy conditions of the dwelling. Energy-related conditions in a home determine energy consumption and affect concerns and beliefs related to energy (Cramer et al., 1983; Guthrie and Brandt, 1983; Morrison and Gladhart, 1976). The addition of energy-conservation modifications to a dwelling is found to be related to energy-behavior within the home (Beck, 1984; Porter, 1982). Age, education level, home ownership and sex of head-of-household are related to energy conditions of the home (Niemeyer, 1982). A composite measure is used to measure the energy conditions of the dwelling in this study. The composite measure is based on a summed scale combining the "existed" and "added" energy-saving features in 1981.

Compared energy efficiency. Satisfaction-based decisions are made based on comparative processes (Morris and Winter, 1978; Oliver, 1980). The greater the level of satisfaction with the energy efficiency of a dwelling, the less propensity there is to engage in energy-conserving behavior (Niemeyer, 1982). Larger households, households with heads having higher education and households where energy costs are seen as a problem are less likely to be satisfied with the energy conditions of the household (Niemeyer, 1982). Compared energy efficiency is measured by the respondent's rating of the dwelling compared with similar dwellings. The scale ranges from "a lot less energy efficient" through five levels to "a lot more energy efficient" in 1981.

Propensity for energy curtailment and energy-efficiency improvement. Many energy studies classifying energy conservation do so in one of two ways--either basing it on some financial aspect or on some behavioral aspect. These two methods roughly divide energy conservation into the same actions. Behavioral

divisions tend to be divided into: 1) one-time-only installation types, and 2) constant, lifestyle changes. These correspond to the financial division of: 1) financial investment, and 2) no financial investment. Stern et al. (1982) use both a financial and behavioral aspect to divide energy-conservation actions in their study, dividing energy conservation into "energy-efficiency improvements" and "energy curtailment". Behaviorally, energy-efficiency improvement usually involves one-time purchase decisions. There is an initial financial expense, with the potential of future monetary savings, but no loss of the amenities energy produces. Energy-efficiency measures include insulating walls, adding double-paned or storm windows, adding active solar heating and using glass doors on fireplaces.

The second class of behavior, energy curtailment, depends on decreasing the use of existing capital equipment. Behaviorally, energy curtailment usually involves repeated or continued responses to achieve maximum energy savings. They rarely involve financial expense, but they do involve a loss of the amenities energy produces. Energy curtailment measures included driving less, lowering room temperatures in winter and letting them rise in summer and using home appliances less.

The measure for propensity for energy curtailment is the number of energy curtailment measures the respondent planned to do within two years following 1981. The measurement of propensity for energy-efficient improvement is the number of energy-efficiency improvement measures the respondent planned to add within two years following 1981.

Actual energy-curtailment behavior and energy-efficiency improvement behavior. Morris and Winter (1978) hypothesize that the propensity to adjust housing is the cause of subsequent housing-adjustment behavior. Niemeyer (1982) states that the propensity, or intent, to engage in energy conservation serves as a measure of energy-adjustment behavior since both are specific.

Fishbein (1977) reports that near-perfect correlations between behavioral intentions and behavior result only when considering an individual's intention to perform a specific act in a specific situation. Wicker (1969) also finds that consistency is greater when the attitude object and the overt behavior are both highly specific.

Ajzen and Fishbein (1975) report that the prediction of behavioral intentions is a necessary, as well as a sufficient, condition for the prediction of overt behavior. They point out, however, that this relationship does not hold unconditionally. The more general the statement of intention and the longer the time interval between statement of intention and actual behavior, the less correlation there is.

The measurement of energy-curtailment behavior is the number of energy-curtailment measures the respondent marked "this is done now" on the 1983 questionnaire. The measurement for energy-efficiency behavior is the number of energy-efficiency measures the respondent marked "installed or added since March, 1981" on the 1983 questionnaire.

PROCEDURES

A longitudinal mail survey conducted by the Western Regional Agricultural Experiment Station Committee (W-159) provided the Oregon data for this analysis. An adequate sample size for Oregon was estimated at approximately 850 respondents. In 1981, 1503 questionnaires were mailed. Of those, 834 questionnaires were returned. In 1983, 1375 questionnaires were sent out. Of

those, 834 were sent to the original respondents. The present study analyzes the responses made by 573 respondents who completed both the 1981 and the 1983 questionnaires.

The respondents were most likely to live in households consisting of two persons who earned a total income of \$20,000-24,999. Respondents were characterized by a mean age of 47.9 years and had completed some college. Males (56.0 percent) answered the questionnaire more often than did females (40.7 percent). The median size of the dwellings was in the category of 1,001 sq. ft.-1,500 sq. ft.

Path analysis provided the method for connecting quantitative estimates to causal effects within the model. To obtain these path coefficients, multiple regressions were performed, yielding the beta weights. Beta weights indicate how much a standard unit of change in one of the independent variables would produce in the standardized dependent variable, given that the other variables are controlled. Variables with beta weights not meeting the criterion ($p < .05$) were rejected.

Two general assumptions were made using path analysis. The first was that of causal ordering where, based on previous models and/or research, the direction of the order of the variables within the hypothesized model was established. The second assumption was that the model was casually closed (i.e., seen as a small, exclusive universe with all variables working in synchronization). The path coefficient between two variables, then, was dependent on the other variables existing in the model.

In path analysis, certain endogenous variables are represented to be dependent on the others as linear functions. The exogenous variables are assumed to be given. They may be intercorrelated, but an explanation of their intercorrelation is not undertaken (Duncan, 1966), assuming their causes come from outside the model (hence, the term "exogenous") (Wolfe, 1977).

FINDINGS

The following causal paths are supported in the tested model (see Figure 2).

Exogenous Variables

Of the exogenous variables, household income and perceived influence of energy costs are not significant determinants of the endogenous variables (see Table 1). However, their effects, especially the effect of income, may be felt through tenure and dwelling size, as well as household size and education. This finding supports Schipper's (1983) research that counts home ownership as a major influence above income. He finds great variations in home ownership, lifestyle and energy intensity, even at roughly similar income levels.

Belief in the Energy Problem

Belief in the energy problem is found to be significantly related to the education and age of the respondent. The younger and better educated of the respondents are more likely to be concerned about or believe in the energy problem. Those who are less educated and are older tend to be unconcerned about or do not believe in the seriousness of the energy problem. The positive relationship between belief and education and the negative relationship between belief and age in this study is supported by previous research (Gilly and Gelb, 1978; Merfeld, 1984; Olsen, 1981; Wilk and Wilhite, 1983). The lack of

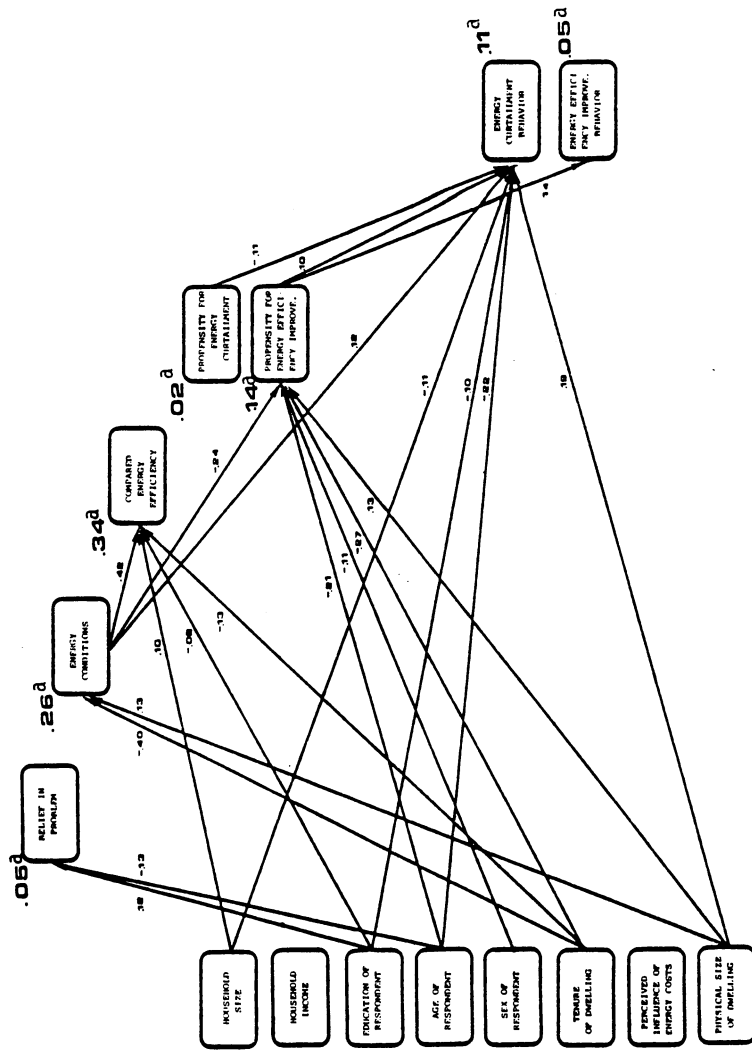


Figure 2. Tested path analysis model with betas for each significant ($p \leq .05$) path.
 $a = R^2$

relationships between the other endogenous variables and belief in the problem is also in accordance with previous studies (Anderson and Lipsey, 1978; Cunningham and Lopreato, 1977; Perlman and Warren, 1977; Sears, Tyler, Citrin and Kiner, 1978). They find no significant relationships between general energy attitudes and reported conservation action.

Energy Conditions

This study finds that owners have dwellings with more energy-saving features than do renters. This could be because renters have no incentive to install energy-saving features since the cost benefits would ultimately go to the landlord (Stern et al., 1982). This finding supports Tienda and Aborampah's (1981) and Schipper's (1983) studies where ownership status is a more important influence than socio-economic factors.

The positive relationship between energy conditions and dwelling size can be similarly explained. As Stern et al. (1982) found, rental units are often smaller in size. Smaller dwellings tend to have fewer energy-saving features than do larger dwellings.

Compared Energy Efficiency

Compared energy efficiency has a significant relationship with tenure. Owners tend to rate energy efficiency of their dwellings higher than do renters. That, like the explanation of the relationships between energy conditions and tenure and dwelling size, may be because owners tend to have more energy-saving features in their dwellings than do renters and realize this fact. Indeed, the relationship between compared energy efficiency and energy conditions is significant. The respondents living in dwellings with more energy-saving features tend to rate their dwellings as highly energy efficient.

Compared energy efficiency is positively related to household size in the path analysis model. Morris and Winter (1978) maintain that larger families give up some degree of quality, and in evaluating their housing, lower their standards. This may be a potential explanation for the higher rating larger families give the energy efficiency of their home.

Compared energy efficiency is found to be negatively related to education. This relationship supports the results of studies that show that those households with higher educations tend to have larger homes, use more electricity (Cramer et al., 1983) and do not incorporate energy-conserving aspects in home remodeling (Granite, 1978). It may be that the more education an individual has, the more information about energy-efficiency he/she also understands, leading to an awareness of a wider spectrum of potential energy-saving features for the dwelling.

Propensity for Energy Curtailment

None of the variables has a significant effect on the propensity for energy curtailment. This may be because if people need to curtail their energy use, they have already done so. If not, they do not plan on cutting back in the future.

Propensity for Energy Efficiency Improvement

Males tend to be more likely to plan energy-efficiency improvements more often than do females. This may be due to sex-typed division of labor, where

Table 1. Resultant Betas of the Regression Analyses of Endogenous Variables.

	Belief in the energy problem		Energy conditions		Compared energy efficiency		Prop. for energy curtailment	
	Sign.	Beta	Sign.	Beta	Sign.	Beta	Sign.	Beta
Household size	.277	-.06	.110	.08	.021	.10*	.164	.08
Household income	.891	-.01	.147	.07	.055	.09	.362	.05
Education	.018	.12*	.068	-.08	.050	-.08*	.411	.04
Age	.016	-.13*	.070	.09	.068	.08	.480	.04
Sex (female/male)	.222	.06	.128	.06	.602	-.02	.932	.00
Tenure (rent/own)	.452	.04	.000	-.40*	.003	-.13*	.911	.00
Perceived influence of energy costs	.097	.08	.667	-.02	.978	.00	.836	-.01
Dwelling size	.843	.01	.012	.13*	.345	.05	.679	-.02
Belief in problem			.872	-.01	.080	.07	.533	.03
Energy conditions					.000	.42*	.174	.08
Compared efficiency							.128	-.09
Propensity for energy curtailment								
Propensity for energy efficiency								

	Prop. for energy efficiency		Energy curtailment behavior		Energy efficiency behavior	
	Sign.	Beta	Sign.	Beta	Sign.	Beta
Household size	.604	-.03	.032	-.11*	.607	-.03
Household income	.621	-.03	.513	-.04	.148	.08
Education	.281	.05	.040	-.10*	.706	.01
Age	.000	-.21*	.000	-.22*	.243	-.06
Sex (female/male)	.015	-.11*	.920	.00	.537	.03
Tenure (own/rent)	.000	-.27*	.974	.00	.622	-.03
Perceived influence of energy costs	.868	.01	.688	-.02	.132	-.07
Dwelling size	.023	.13*	.001	.19*	.649	.03
Belief in problem	.280	.05	.437	.04	.938	.00
Energy conditions	.000	-.24*	.038	.12*	.458	.05
Compared efficiency	.899	.01	.694	.02	.517	-.04
Propensity for energy curtailment			.015	-.11*	.412	.04
Propensity for energy efficiency			.044	.10*	.005	.14*

* = p < .05

males assume responsibility for and perform most household repairs (Lovingood and Firebaugh, 1978; Nickols and Metzen, 1978).

The positive relationship between propensity for energy-efficiency improvement and dwelling size is reasonable in view of Marganus' (1984) study. He finds that larger homes use more energy than do smaller homes. Families who live in homes using more energy may be more interested in improving the energy efficiency of their homes. Also, families who live in larger homes tend to be owners rather than renters. Owners, rather than renters, tend to increase the energy efficiency of the home. Indeed, the positive relationship between the propensity for energy efficiency and ownership is one of the significant paths in the path analysis model.

The relationship between the propensity for energy efficiency and energy conditions of the dwelling is also a significant path. Owners and those living in homes with a low number of energy-saving features tend to plan to increase the energy-efficiency of their dwellings more than do renters and those living in homes with a larger number of energy-saving features.

The negative relationship between the propensity for energy efficiency and energy conditions supports Morris and Winter's (1978) theory of housing adjustment. The better the housing conditions, the less the household members will plan on changing or improving those conditions. When there is a large number of energy-saving features in the home, there is less tendency for household members to plan on adding energy-efficient improvements.

The last significant path, between the propensity for energy efficiency and age, supports Katz and Morgan's (1983) study. The older the respondent, the less likely he/she is to improve the energy efficiency of his/her dwelling. This could be because 1) the elderly often use energy to maintain well-being and are less likely to perform conservation actions if such actions affect their health and/or comfort, 2) the physical labor required is prohibitive, 3) the capital investment is prohibitive, and 4) benefits from expenditures on durable goods, such as housing, can be too long-term.

Energy Curtailment Behavior

The omission of the measure of crowding may account for the negative relationship between energy-curtaiment behavior and household size. The negative relationship between energy-curtaiment behavior and education supports studies by Heberlein and Warriner (1980) and Murray et al. (1974). The positive relationship between actual energy-curtaiment behavior and the propensity for energy-efficiency improvement is consistent with respondents' planning on improving the energy efficiency of their homes. Energy curtailment behavior is less expensive and less effort for the short-term. The path between actual energy-curtaiment behavior and the propensity for energy curtailment is negative. *The more a respondent plans on curtailing energy, the less he/she actually curtails energy use.* This result may be because of the lack of a variable measuring 1981 energy-curtaiment behavior. The respondents who plan on curtailing energy may already be doing so to the best of their abilities. Previous researchers find that the lifestyle change this form of energy conservation requires can be difficult to maintain (Cornille et al., 1979; Darley and Beniger, 1981).

The relationship between energy curtailment and energy conditions is also significant. The more energy-saving features a dwelling has, the more actual energy-curtaiment behaviors are performed. This result may be because of the non-differentiation between "existed" and "added" energy-saving features. If the

family has made a commitment to installing energy-saving features in the dwelling, they may have also carried their commitment over to energy-curtaiment behavior. Beck (1984) finds that certain energy-saving features added to the dwelling have the effect of increasing energy-conservation behavior.

The relationship between energy-curtaiment behavior and dwelling size is significant in the path analysis model. As the dwelling size becomes larger, so does the amount of energy-curtaiment behavior. Previous researchers find that as the dwelling size becomes larger, so does the amount of energy consumed (Marganus, 1984; Morrison et al., 1978; Tienda and Aborampah, 1981). Because more energy is consumed, those who live in larger dwellings may view energy curtaiment as both necessary and convenient.

The relationship between energy-curtaiment behavior and age is negative in the path analysis model. Older people have less of a tendency to conserve energy by energy curtaiment than do younger people. This may be because older people use energy to maintain their well-being and are reluctant to curtail their lifestyle. Age is also a constraint on energy-conservation behavior (Eichner and Morris, 1984). According to previous research, older families are less adaptive and less open to new behavior. The path analysis model supports this finding.

Energy Efficiency Improvement Behavior

One of the relationships resulting from energy-efficient improvement behavior is significant in the path analysis model. The one significant relationship is between energy-efficiency improvement and the propensity for energy-efficiency improvement. According to Fishbein (1967), only when an individual intends to perform a specific act in a specific situation are the chances better that the act will be completed. In this study, those who intend to improve the energy efficiency of their dwellings do tend to follow through on their behavior.

SUMMARY OF THE TESTED MODEL

The following causal paths are supported in the tested model (see Figure 2).

$$X_{15} = f(X_{13})$$

$$X_{14} = f(X_{13}, X_{12}, X_{10}, X_8, X_4, X_3, X_1),$$

$$X_{13} = f(X_{10}, X_8, X_6, X_5, X_4),$$

$$X_{11} = f(X_{10}, X_6, X_3, X_1),$$

$$X_{10} = f(X_8, X_6), \text{ and}$$

$$X_9 = f(X_4, X_3).$$

The tested path analysis model allows for analysis of the relative contribution of factors influencing energy-conservation alteration behaviors. In the tested model, six of the eight exogenous variables have significant ($p < .05$) direct and/or indirect effects on the endogenous variables. Two of the exogenous variables (physical size of the dwelling, age of the respondent) and one endogenous variable (energy conditions) have both direct and indirect effects on energy-conservation alterations. Of the five intervening variables between the exogenous variables and the energy-conservation alteration variables, three (energy conditions, propensity for energy curtaiment, and the propensity for energy efficiency) have

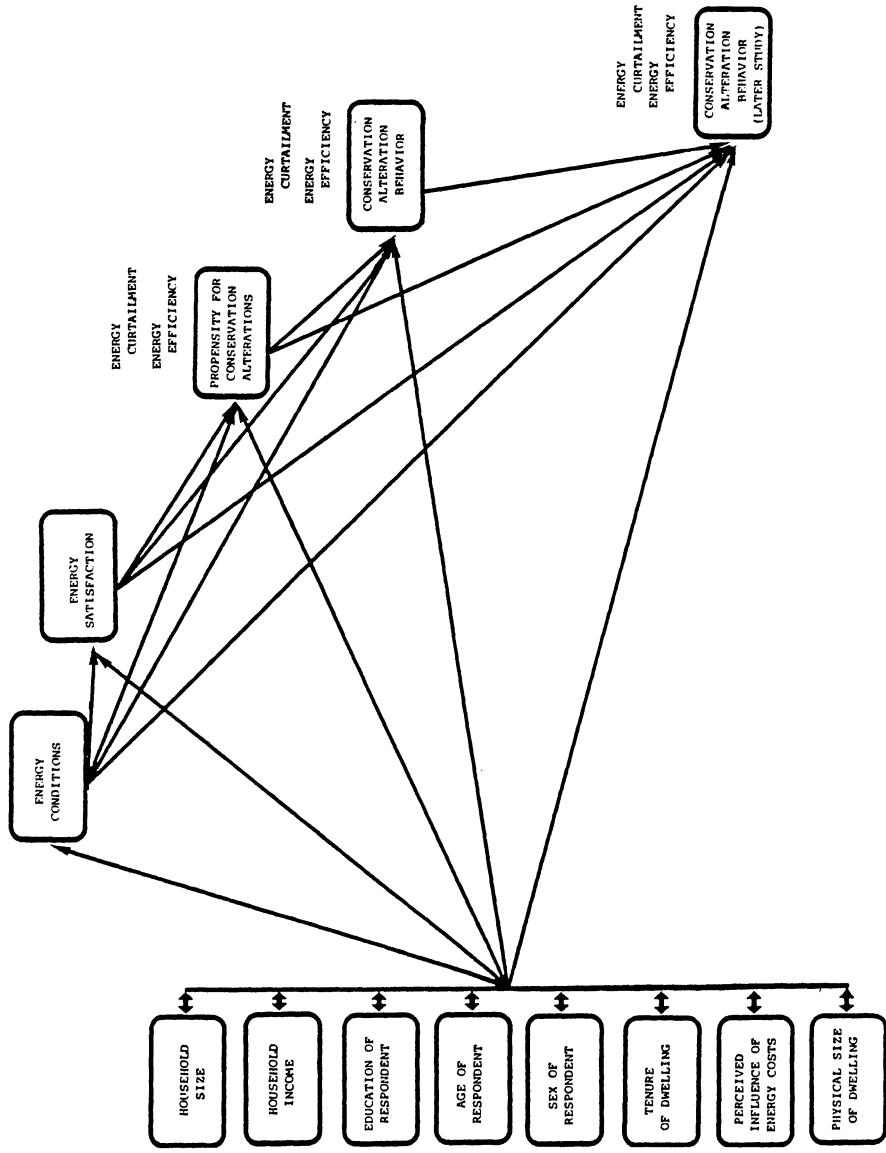


Figure 3. Proposed model for further research.

direct effects on energy-conservation alteration behaviors. Of those intervening variables, one (energy conditions) also has an indirect effect. Two intervening variables (belief in the energy problem and compared energy efficiency) are not significant predictors of other endogenous variables.

Proposed New Model

Based on the results and past research, a new model is proposed (see Figure 3). The main changes to the tested model are: 1) test for interrelationships among exogenous variables, 2) remove belief in the energy problem as a variable, 3) add a measurement of energy-curtaiment behaviors currently performed to the measurement of energy conditions, 4) change compared energy efficiency to energy satisfaction, and 5) another testing of the energy-conservation behavior of the sample.

IMPLICATIONS

Because it adds to the theoretical knowledge, this study will be of interest to those researching energy conservation. No previous study includes all the variables in the manner hypothesized and tested in this study's model. This study will also be of interest to teachers, utility company personnel, energy planners and other professionals sponsoring energy-conservation programs. If the goal of energy conservation programs is to encourage energy-conservation behavior, several implications can be drawn from this research.

First, this study highlights constraints to energy-conservation behavior. Second, this study shows that the intent to conserve energy through energy curtailment leads only to energy-curtaiment behavior, while the intent to conserve energy through energy efficiency leads to energy efficiency and energy-curtaiment behaviors. Because of this, it is recommended that energy-conservation programs specializing in the introduction and instruction of energy-efficient methods also introduce energy-curtaiment methods. Third, since belief in the seriousness of the energy problem does not lead to energy-conservation behavior, educational programs aimed at encouraging energy conservation through belief in the energy problem are not recommended. Such programs would not be effective in encouraging consumers to conserve.

Finally, this study will be of interest to local, state and federal government energy planners. These policy-makers base their energy decisions on what they feel would be most effective. Energy conservation policies directed at segments of the population that have a tendency to actuate energy plans would find an already supportive public. Policies that alleviate constraints to energy-conservation behavior would also be helpful.

REFERENCES

- Abdel-Ghany, M. and Nickols, S.Y. Husband/wife differentials in household work time: The case of dual-earner families. *Home Economics Research Journal*, 1983, 12 (2), 159-167.
- Ajzen, I. and Fishbein, M. The prediction of behavior from attitudinal and normative variables. In A. E. Liska, (Ed.), *The Consistency Controversy: Readings On The Impact Of Attitude On Behavior*. New York: John Wiley and Sons, 1975.

- Housing and Society, Vol. 14, No. 2, 1987 .
- Anderson, R. W. and Lipsey, M. W. Energy conservation and attitudes toward technology. *Public Opinion Quarterly*, 1978, 42, 17-30.
- Barnaby, D. J. and Reizenstein, R. C. Profiling the energy consumer: A discriminant analysis approach. *Survey of Business*, 1975, 11 (1), 28-31.
- Beck, B. O. *The Effect of Structural Modification on Energy-Conservation Behaviors*. (Oregon Agricultural Experiment Station Technical Paper #7204). Corvallis, OR: Oregon State University, Family Resource Management Department, 1984.
- Bloom, M. *The Effect of Rising Energy Prices on the Low- and Moderate-Income Elderly* (NTIS No. PB-244 200/2BA). Washington, D.C.: Federal Energy Administration, 1975.
- Brazzel, J. M. and Hunter, L. J. *A Distributional Analysis of Trends in Energy Expenditures by Black Households*. Washington, D.C.: U.S. Department of Energy, 1979.
- Buck, L. E. *Comparison of Oregon renter and non-renters' home energy-conservation behavior, belief about the U.S. energy problem, belief about their home energy efficiency, and belief about four energy policy directions*. Unpublished master's thesis. Oregon State University, Corvallis, Oregon, 1982.
- Bultena, G. *Public Response to the Energy Crisis: A Study of Citizens' Attitudes and Adaptive Behaviors*. (Iowa State University Sociology Report No. 130), Iowa State University, Ames, Iowa , 1976.
- Cornille, T. A., Oransky, K. S., and Pestle, R. Changing family lifestyles: Adapting to the energy crisis. *Journal of Home Economics*, 1979, Winter, 36-37.
- Cramer, J. C., Dietz, T. M., Miller, N., Craig, P.P., Hackett, B. M., Kowalczyk, D., Levine, M., and Vine, E. L. *The Determinants of Residential Energy Use: A Physical-Social Causal Model of Summer Electricity Use*. Paper presented at the Energy Crisis and Families Conference. Michigan State University, October, 1983.
- Cunningham, W. and Lopreato, S. C. *Energy Use And Conservation Incentives*. New York: Praeger Publishers, 1977.
- Curtin, R. T. Consumer adaptation to energy shortages. *Journal of Energy and Development*, 1976, 2, 38-59.
- Darley, J. M. and Beniger, J. R. Diffusion of energy-conserving innovations. *Journal of Social Issues*, 1981, 37 (2), 150-171.
- Dillman, D. A., Rosa, E.A. and Dillman, J. J. Lifestyle and home energy conservation in the United States: The poor accept lifestyle cutbacks while the wealthy invest in conservation. *Journal of Economic Psychology*, 1983, 3, 299-315.
- Duncan, G. J. and Newman, S. People as planners: The fulfillment of residential mobility expectations. In G. J. Duncan and J. N. Morgan (Eds.), *Five Thousand American Families -- Patterns of Economic Progress* (Vol. 3). Ann Arbor, MI: University of Michigan Institute for Social Research, 1976.

- Duncan, O. D. Sociological examples. *The American Journal of Sociology*, 1966, 72, 1-16.
- Eichner, M. M. and Morris, E. W. Energy conservation, air quality, health, and housing satisfaction. *Housing and Society*, 1984, 11 (1), 1-15.
- Fishbein, M. (Ed.). *Readings In Attitude Theory and Measurement*. New York: John Wiley and Sons, 1967.
- Gilly, M. C. and Gelb, B. D. Marketing energy conservation. *Journal of Home Economics*, 1978, 70, 31-33.
- Gladhart, P. M. Energy conservation and lifestyles: An integrative approach to family decision making. *Journal of Consumer Studies and Home Economics*, 1977, 1, 265-277.
- Glazer, N. Housework. In L. Richardson and V. Taylor (Eds.), *Feminist Frontiers-- Rethinking Sex, Gender, and Society*. Reading, MA: Addison-Wesley Publishing Co., 1983.
- Granite, M. L. Energy considerations in remodeling of owner-occupied detached dwellings. *Housing and Society*, 1978, 5 (4), 15-19.
- Guthrie, L. A. and Brandt, J. A. Dwelling energy efficiency and home energy-conservation policies: A western U. S. perspective. *Journal of Consumer Studies and Home Economics*, 1983, 7, 307-319.
- Heberlein, T. A. and Warriner, G. K. *Attitude, Motive, Ability and Knowledge: Factors Affecting Household Peak Load Reductions in Consumption of Electricity*. Madison, WI: University of Wisconsin, Department of Sociology, 1980.
- Herendeen, R. A. and Tanaka, J. Energy cost of living. *Energy*, 1976, 1 (2), 165-168.
- Katz, E. and Morgan, S. *The Financing of Energy-Conservation Services to Low-Income Households: Alternatives to Grants*. Paper presented at the Energy Crisis and Families Conference. Michigan State University, October, 1983.
- Levy, P. F. *The Residential Demand for Electricity in New England*. Cambridge, MA: Massachusetts Institute of Technology (MIT-EL-73-017), 1973.
- Lovinggood, R. P. and Firebaugh, F. M. Household task performance roles of husbands and wives. *Home Economics Research Journal*, 1978, 7 (1), 20-33.
- Marganus, M. *A market-oriented approach to energy conservation: Identifying disadvantaged families as target groups for energy assistance programs*. Unpublished doctoral dissertation, Oregon State University, Corvallis, Oregon, 1984.
- Merfeld, M. K. *Consumer attitudes toward potentially restrictive energy-conservation regulations*. Unpublished doctoral dissertation, Oregon State University, Corvallis, Oregon, 1984.

- Housing and Society, Vol. 14, No. 2, 1987
- Morris, E. W. and Winter, M. *Housing, Family, and Society*. New York: John Wiley and Sons, 1978.
- Morris, E. W. and Winter, M. *The current status of the theory*. (Iowa Agriculture and Home Economics Experiment Station Project No. 2341), 1981.
- Morrison, B. M. and Gladhart, P. M. Energy ad families: The crisis and the response. *Journal of Home Economics*, 1976, 68, 15-18.
- Morrison, B. M., Gladhart, P. M., Zuiches, J. J., Keith, J. G., Keefe, D. and Long, B. R. Energy and families: The crisis and the response. *Journal of Home Economics*, 1978, 70, 19-21.
- Murray, J. R., Minor, M. J., Bradburn, N. M., Cotterman, R. F., Frankel, M., and Pisarki, A. E. Evolution of public response to the energy crisis. *Science*, 1974, 184, 257-263.
- Newman, D. and Day, D. *The America Energy Consumer: A Report to the Energy Policy Project of the Ford Foundation*. Cambridge, MA: Ballinger Publishing Co., 1975.
- Nickols, S. Y. and Metzen, E. J. Housework time of husband and wife. *Home Economics Journal*, 1978, 7 (2), 85-87.
- Niemeyer, S. M. *Constraining factors in the propensity to conserve energy: The effects of predispositions and resources*. Unpublished master's thesis, Iowa State University, Ames, Iowa, 1982.
- Niemeyer, S. M. and Morris, E. W. Economic and psychological constraints in household energy conservation. *Housing and Society*, 1986, 13 (1), 44-55.
- Oliver, R. L. Conceptualizing and measurement of disconfirmation perceptions in the prediction of consumer satisfaction. In H.K. Hunt and R. L. Kay (Eds.), *Refining Concepts and Measures of Consumer Satisfaction and Complaining Behavior*. Bloomington, IN: Indiana University, Department of Marketing, School of Business, 1980.
- Olsen, M. E. Consumers' attitudes toward energy conservation. *Journal of Social Issues*, 1981, 37 (2), 108-131.
- Perlman, R. and Warren, R. *Families In The Energy Crisis: Impacts And Implications For Theory and Policy*. Cambridge, MA: Ballinger Publishing Co., 1977.
- Porter, N. L. *Behavior and structural modifications for energy conservation Nevada home owners*. Unpublished master's thesis, University of Nevada, Reno, 1982.
- Schipper, L. *Household Energy Use in Nine Countries: How Much Has Been Saved? Why?* Paper presented at the Energy Crisis and Families Conference, Michigan State University, October, 1983.
- Sears, D., Tyler, T., Citrin, J., and Kinder, D. Political system support and public response to the energy crisis. *American Journal of Political Science*, 1978, 22, 56-82.

- Stern, P. C., Black, J. S., and Elworth, J. T. *Influences on Household Energy Adaptation: Investments, Modifications, Sacrifices*. Paper presented in a symposium, Behavioral Approaches to Energy Conservation, at the meeting of the American Association for the Advancement of Science, Washington, D.C., January, 1982.
- Talazyk, W. and Omura, G. Consumer attitudes toward and perceptions of the energy crisis. In R. C. Curhan (Ed.), *The American Marketing Association: 1974 Conference*. Chicago, IL: American Marketing Association, 1975.
- Tienda, M. and Aborampah, O. Energy-related adaptations in low-income nonmetropolitan Wisconsin counties. *Journal of Consumer Research*, 1981, 8, 265-270.
- Tyler, L. L., Lovingood, R. P., Bowen, S. P., and Tyler, R. F. Energy-related characteristics of low-income urban tenants. *Housing and Society*, 1982, 9 (3), 9-15.
- Walden, M. L. and Meeks, C. B. The demand for housing capital expenditures by the elderly. *Housing and Society*, 1982, 9 (1), 31-41.
- Wicker, A. W. Attitudes versus actions: The relationship of verbal and overt behavioral responses to attitude objects. *Journal of Social Issues*, 1969, 25 (4), 41-79.
- Wilk, R. R. and Wilhite, H. L. *Household Energy Decision-Making in Santa Cruz County, California*. Paper presented at the Energy Crisis and Families Conference, Michigan State University, October, 1983.
- Wolfle, L. An introduction to path analysis. *Multiple Linear Regression Viewpoints*, 1977, 8, 36-61.
- Zuiches, J. J. *Acceptability of Energy Policies to Mid-Michigan Families*. (Research Report No. 298). East Lansing, MI: Michigan State University Agricultural Experiment Station, 1976.