

*A Research Note on:*

*HOUSEHOLD ENERGY-CONSERVATION MOTIVATORS: A FACTOR ANALYTIC APPROACH*

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*ABSTRACT*

*A factor analysis of reasons for taking household energy-conservation actions expressed by a statewide random sample of 424 Washington households resulted in the identification of four distinct energy-conservation motivators: 1) a social conformity factor, 2) a conservation ethic factor, 3) a personal benefit factor, and 4) an economic benefit factor. Regression analysis of the four factors and respondents' housing and demographic characteristics reveals that although certain variables (e.g. home ownership and single-family residence) are significantly related to two of the factors, the overall amount of variation in the factors explained is quite small.*

*INTRODUCTION*

The energy crisis of the late 1970s has abated. However, the increased energy consumption of the 1980s, combined with the burgeoning United States dependence on foreign sources of energy and the political instability in the Persian Gulf, again raises the specter of a crisis in future years. Energy conservation represents one of several defenses against societal disruptions that might be induced by future energy shortages.

By gaining an understanding of the motivating factors for energy-conservation actions taken during the previous energy crisis, we may gain insight into useful approaches to encourage energy conservation in the future. The purpose of this paper is to analyze reasons given by the general public in 1983 for reducing energy use in their homes. A factor analysis of the stated reasons is used to identify underlying motivating factors for taking action. The relationships between these factors and selected personal and housing characteristics are also explored.

*BACKGROUND*

Although much is known about savings that occur through various household energy-conservation improvements, little is known about ways to encourage or motivate households to adopt these measures. The primary thrust of research in the energy-conservation field has been to seek objective facts or information about actual conservation behavior. Attitudinal concepts have been absent in all

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United States Department of Energy (DOE) Residential Energy Consumption (REC) questionnaires dealing with a household's reasons for adding storm windows, doors, insulation, and other such energy-saving improvements (Thompson, 1984). Data collected in the five years (1978-1982) of the REC surveys, regional surveys such as the Pacific Northwest Residential Energy Survey in 1979, and the Washington Water Power Residential Survey in 1980 are also devoid of such measures (Elrick and Lavidge, Inc., 1980; Washington Water Power, 1981). Those surveys describe characteristics of housing, space and water heating equipment, conservation attributes such as amount of insulation and demographic characteristics of the house, but not personal attitudes of the respondents.

Niemeyer and Morris (1986) examine economic and psychological factors in adoption of conservation practices from an attitude behavior consistency perspective. Their study provides an extension of Morris and Winter's (1978) model of housing adjustment that portrays family behavior as an on-going process of adaptation and adjustment. The findings of the Niemeyer and Morris study show that resource constraints (household income, age, education, household size, marital status, tenure) explain most of the energy-saving conditions present in the home and are the main barriers to saving energy through structural alteration. They also find that attitudinal predispositions (responsibility, optimism, flexibility, expectations) and belief in the energy problem play almost no role in determining the propensity to make energy-conserving alterations.

The energy-adaptation model developed by Gladhart and Roosa (1983) shows that the discrepancy between the current family situation and norms (both personal and social) prompts a variety of adaptations aimed at reducing discrepancy and increasing satisfaction. Three categories of norms are related to direct energy consumption: norms for thermal comfort, energy budget, and for the level of energy usage (which includes avoidance of waste and preservation for the future).

Other studies (Dillman, Rosa, and Dillman, 1983; Tremblay, McCray, and Navin, 1984) deal with similar norm-oriented energy-conservation issues. They suggest that economics is not the sole motivator of conservation actions, but they provide little insight into motivations.

#### METHODS

The data were collected from a statewide sample of Washington households in March and April of 1983, using a mail questionnaire. The study was particularly timely inasmuch as the United States had just gone through a period in which large numbers of people had retrofitted their homes for the sake of energy conservation (Anderson et al., 1987; Makela, Chatelain, Dillman, Dillman, and Tripple, 1982).

The sample of 750 Washington households was drawn from all telephone directories of the state, using a computer-generated random selection process with selection being proportionate to the estimated number of households covered by each directory. The ten-page questionnaire was designed and administered consistent with the *Total Design Method* principles described by Dillman (1978), except that a telephone follow-up was substituted for the final certified-mail contact. Completed questionnaires were received from 424 (56.7%) of the households, or 61.9 percent of the households who actually received the questionnaire.

The respondents were asked "Thinking about the last five years, have you made any efforts to reduce energy use in your home?" Those who answered affirmatively (91.2%) were then asked to indicate the extent to which each of the

eight listed items (see Table 1) was a reason for making energy reduction efforts. As shown in the table, wide variation exists for the extent to which each item was given as a reason for trying to save energy. For example, 89 percent of the respondents gave "to reduce my monthly energy bill" as a reason, but only four percent of the respondents mentioned "To show my neighbors I am conserving energy." The personal and housing characteristics of respondents were each measured by single-item answers. The exact measurement is described by Gmelch (1984).

Principal component factor analysis with varimax rotation was used to confirm the presence of underlying commonalities among the reasons for taking conservative actions. The Statistical Analysis System (SAS) Factor sub-program was used. Factors that emerged with eigenvalues of one (1.0) or greater were considered significant. Factor scales were constructed by combining scores from the two items loading highly (0.65 or greater) on each factor. These factor scales were then used as new dependent variables in analyses with interval and dichotomous independent variables (Kim and Mueller, 1978). A correlation matrix based on Pearson's Product Moment Correlation Coefficient,  $r$ , was constructed to examine relationships among all factors (dependent variables) and independent variables.

Because there were intercorrelations among some of the independent variables, it was important to treat independent variables jointly in sets. Multiple regression analysis, using SAS General Linear Models Procedure, was used to indicate how much variation in each factor was accounted for by the joint linear influences of the independent variables (Cohen and Cohen, 1983).

#### *Motivating Factors*

Based upon an extensive review of past research, it was hypothesized that three motivating factors would emerge from a factor analysis of the data: 1) an economic motivating factor, representing money and money-related benefits, 2) an environmental motivating factor, representing concern for conservation of resources, and 3) a personal motivating factor, representing individual comfort concerns. The factor analysis confirmed the existence of three factors that fit the above descriptions. In addition, a fourth factor, which can be labeled a "social conformity" factor emerged.

*Social conformity factor.* Factor 1, the unanticipated factor, accounted for 16 percent of the common variance. Two items loaded strongly on it: 1) "feeling guilty for not conserving" (0.82) and 2) "to show neighbors and friends I am conserving energy" (0.74). This factor indicates a concern for compliance with social norms. The dissonant state that exists when one's behavior does not match perceived social expectations (guilt) may be alleviated by taking conservation actions, thus guilt may become a motivator for conservation action (Heberlein and Black, 1981). However, it is important to recognize that relatively few respondents (9% and 4%) gave these items as definite reasons for taking conservation actions.

*Conservation ethic factor.* Factor 2, accounting for 15 percent of the common variance, included two strongly loaded items: 1) "to reduce the actual amount of energy used in my home" (0.87) and 2) "to do my part to preserve future energy resources..." (0.67). This factor was accordingly labeled 'conservation ethic.' The literature frequently mentions a conservation ethic as a motivation for reducing energy consumption (Gladhart and Roosa, 1983) and studies indicate that our cultural values have shown changes in the direction of environmentalism and preservation of resources (Dunlap and Van Liere, 1984).

The proportion of respondents giving conservation ethic items as a definite

Table 1. Varimax rotated factor analysis of respondents reasons for reducing energy use (N=388)

REASONS (Organized by resultant factors)	Extent to which item is given as a reason for reducing energy use			Factor Loadings				*h <sup>2</sup>
	Not a Reason	Somewhat a Reason	Definitely a Reason	1	2	3	4	
<b>FACTOR 1: SOCIAL CONFORMITY</b>								
Otherwise I would have felt guilty	68%	23%	9%	.82	.16	-.02	.05	.703
To show neighbors and friends I am conserving energy	81%	16%	4%	.74	.14	.13	-.08	.587
<b>FACTOR 2: CONSERVATION ETHIC</b>								
To reduce the actual amount of energy used in my home	6%	33%	61%	.03	.87	.14	.12	.800
To do my part to preserve future energy resources such as coal, oil, natural gas	17%	42%	41%	.36	.76	.06	-.09	.726
<b>FACTOR 3: PERSONAL BENEFIT</b>								
To maintain or increase the value of my home	49%	26%	25%	.08	.20	.79	.00	.671
To maintain personal comfort	31%	39%	30%	.04	-.01	.85	.09	.735
<b>FACTOR 4: ECONOMIC BENEFIT</b>								
To reduce my monthly home energy bills	2%	9%	89%	-.20	.18	.01	.87	.830
To keep from having to cut back on spending for other items such as groceries and vacations	46%	28%	26%	.45	-.28	.17	.65	.733
Percent of Variance Explained				16%	15%	14%	12%	57%

\*commonality

reason for saving energy (61% and 41%) is quite high compared to the social conformity items.

*Personal benefit factor.* Factor 3, accounting for 14 percent of the common variance, included 1) "to maintain or increase the value of my home" (0.79) and 2) "to maintain personal comfort (0.85). This factor was labeled "personal benefit."

Particularly in relation to life-cycle stage, personal comfort seems likely to be a prime motivator for home-energy conservation. The thermal comfort item loaded highly on the personal benefit factor, as would be expected. The second item to load on this factor, however, was less expected. Maintaining or increasing the value of one's home might logically be an economic consideration, but respondents to this study seemed to consider it more as a personal benefit (0.79). One perspective is that one's home represents psychological comfort. Hayward (1982) explores the personal nature of "home", which includes self-identity, privacy and refuge, social network, and intimate others--all of which might be considered psychological comforts. Among home owners, energy-efficiency improvements may add to the intrinsic value of the home. The proportion of respondents citing personal benefit items as definite reasons for reducing energy use was 25 percent and 30 percent, intermediate to the social conformity and conservation ethic items.

*Economic benefit factor.* Factor 4, accounting for 12 percent of the common variance, included two items with strong loadings: 1) "to reduce my monthly home-energy bills" (0.87) and 2) "to keep from having to cut back on spending for other items..." (0.65). The first of these items was also the most frequently mentioned reason for trying to reduce energy use, being given as a "definite reason" for reduction by 89 percent of the respondents. Gladhart and Roosa (1983) consider energy budget to be a norm capable of promoting adaptive behaviors. Niemeyer and Morris (1986) find that economic constraints are a major barrier to structural energy-efficiency improvements.

#### THE FACTORS AND THE INDEPENDENT VARIABLES

Having identified four distinct factors, it is important to determine the extent to which they are related to personal and housing characteristics. The existence of strong relationships with such variables would demonstrate the usefulness of different motivation-based approaches for reaching different segments of the population in an effort to encourage conservation.

The relationships between selected personal characteristics (age, gender, marital status, education, income, and household size) and the four factors were analyzed by means of multiple regression analysis. Table 2 shows that only two of the bivariate correlations were statistically significant (marital status with personal benefit factor,  $r = 0.11$ ,  $p < 0.05$  and household size with the conservation ethic factor  $r = -0.11$ ,  $p < 0.05$ ). Married respondents tend to put higher priority on the personal benefit. As household size increases, the conservation ethic becomes less of a motivating factor. However, the most important finding is that the personal characteristics reported here have virtually no relationship with any of the four factors, with only three or four percent of the variance being explained by these six variables.

Regression of housing characteristics on each of the four motivating factors (see Table 3) results in three significant bivariate correlations: 1) tenure with personal benefit,  $r = 0.26$ ,  $p < 0.001$ ; 2) structure type with personal benefit,  $r = 0.15$ ,  $p < 0.10$ ; and 3) value of the home with conservation ethic,  $r = 0.14$ ,  $p < 0.05$ . This means that home owners and occupants of single-family dwellings are motivated by personal benefit concerns to conserve energy. Occupants of more expensive home are motivated by conservation ethic. These correlations are also of low magnitude. Considerable variation exists within independent housing variables across factors (value:  $r = 0.14$  to  $r = -0.12$ ; size:  $r = 0.06$  to  $r = -0.10$ ; and structure type:  $r = 0.15$  to  $r = -0.08$ ), which may indicate trends helpful in later research. In general, housing factors explain no more variance in the four factors than do the personal factors, with the  $R^2$  ranging from only

0.02 to 0.06.

Table 2. Bivariate correlations coefficients (r), coefficients of multiple determination (R<sup>2</sup>), and tests of significance between motivating factors and respondent characteristics

Factors	Marital				Household			R <sup>2</sup>	F
	Age	Gender	Status	Education	Income	Size			
Factor 1 Social conformity	0.08	0.07	-0.01	-0.01	-0.01	-0.09	0.03	1.76	
Factor 2 Conservation ethic	0.02	0.06	0.04	0.07	0.04	-0.11*	0.04*	2.21	
Factor 3 Personal benefit	0.07	-0.06	0.11*	-0.03	0.08	-0.10	0.04	1.98	
Factor 4 Economic benefit	-0.07	0.05	0.07	-0.04	-0.10	0.10	0.04*	2.31	

\*p < 0.05

Table 3. Bivariate correlations coefficients (r), coefficients of multiple determination (R<sup>2</sup>), and tests of significance between motivating factors and housing characteristics

Factors	Estimated values	Structure					R <sup>2</sup>	F
		Age: year built	Size: square feet	Tenure: own vs. rent	Location: urban vs. rural	Type: single vs. multifamily		
Factor 1 Social conformity	-0.09	-0.08	-0.10	-0.01	0.01	-0.08	0.04	1.42
Factor 2 Conservation ethic	0.14*	-0.03	0.04	0.04	0.06	0.02	0.02	0.75
Factor 3 Personal benefit	0.08	-0.04	0.06	0.26***	0.04	0.15**	0.02	0.71
Factor 4 Economic benefit	-0.12	-0.06	0.01	-0.02	-0.03	0.01	0.06*	2.49

\*p < 0.05

\*\*p < 0.01

\*\*\*p < 0.001

#### CONCLUSIONS

This factor analysis of reasons respondents give for reducing household-energy consumption resulted in the identification of four distinct factors: 1) social conformity, 2) conservation ethic, 3) personal benefit, and 4) economic benefit.

The extent to which the items within each of the factors was given as a "definite reason" for energy-conservation efforts varies widely. On the average, seven percent of the respondents give the social conformity items as definite reasons, 51 percent of the respondents list the conservation items, 27 percent of the sample list personal benefit items as definite reasons for energy conservation, and 57 percent of the respondents rank the economic items as definite reasons, suggesting that social conformity and personal benefit appeals are substantially less strong than conservation or economic appeals.

The most striking finding is how little variation in respondents' answers can be explained by the twelve personal and housing situation variables examined here. Thus, the strength of the motivating factors does not vary greatly across segments of the population. This study concludes that not only are the conservation and economic appeals stronger motivating factors, but that they appeal across all segments of the population. Should the United States face another energy crisis in the 1990s, as many experts predict, the study results suggest that appeals based on these two factors would have more effect than appeals based upon social conformity or personal benefit.

#### REFERENCES

- Anderson, M., Iams, D., Jones, J., Chatelain, L., Dillman, D. A., Anderson, D., Badenhop, S., Dillman, J. J., Makela, C. J., Moore, D., Peterson, C., and Tripple, P. A. (1987). *Energy Directions for the United States: A Western Perspective, 1981-1983*. (Western Region Research Publication No. 014). Laramie, WY: University of Wyoming.
- Cohen, J. and Cohen, P. (1983). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Dillman, D. A. (1978). *Mail and Telephone Surveys: The Total Design Method*. New York: Wiley-Interscience.
- Dillman, D. A., Rosa, E., and Dillman, J. (1983). Lifestyle and home energy conservation in the United States: The poor accept lifestyle cutbacks while the wealthy invest in conservation. *Journal of Economic Psychology*, 3, 299-315.
- Dunlap, R. E. and Van Liere, K. D. (1984). Commitment to the dominant social paradigm and concern for environmental quality. *Social Science Quarterly*, 65, 1013-1028.
- Erick and Lavidge, Inc. (1980). *The Pacific Northwest Residential Energy Study Report for Bonneville Power Administration and Pacific Northwest Utilities Conference Committee* (Vol. 1 Executive Summary). San Francisco, CA: Author.
- Gladhart, P. M. and Roosa, M. W. (1983). Family lifestyle and energy consumption: An energy adaptation model. In P. M. Gladhart et al. (Eds.), *Energy and Family Lifestyle* (Family Energy Project-Draft). Lansing, MI:

Michigan State University Institute for Family and Child Study.

- Gmelch, P. L. (1984). *Motivation and household energy conservation in Washington*. Master's thesis, Washington State University, Pullman, WA.
- Hayward, D. G. (1982). The meaning of home. *Human Ecology Forum*, 13 (2), 3-6.
- Heberlein, T. A. and Black, J. S. (1981). Cognitive consistency and environmental action. *Environment and Behavior*, 13, 717-733.
- Kim, J. O. and Mueller, C. W. (1978). *Introduction to Factor Analysis: What It Is and How to Do It*. Beverly Hills, CA: Sage.
- Makela, C. J., Chatelain, L., Dillman, D. A., Dillman J. J., and Tripple, P. A. (1982). *Energy Directions for the United States: A Western Perspective*. Corvallis, OR: Western Rural Development Center.
- Morris, E. W. and Winter, M. (1978). *Housing, Family and Society*. New York: John Wiley & Sons.
- Niemeyer, S. and Morris, E. W. (1986). Economic and psychological constraints in household energy conservation. *Housing and Society*, 13 (1), 44-55.
- Tremblay, K. R., Jr., McCray, J. W., and Navin, J. L. (1984). Impact of economic and energy variables on housing preferences. *AAHE Refereed Conference Papers*. Blacksburg, VA: Virginia Polytechnic Institute and State University.
- Thompson, W. (1984). The residential energy consumption survey: A look back and a look forward. In B. M. Morrison and W. Kempton, (Eds.), *Families and Energy: Coping with Uncertainty*. Lansing, MI: Michigan State University.
- Washington Water Power: Consumer Services, Research and Forecasting Section. (1981). *WWP Residential Survey*. Spokane, WA: Author.