

A Study on the Factors Affecting Household’s Energy Consumption Behavior in Jiangsu Area of China

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ABSTRACT

Energy issues have attracted widespread attention Because of the prominent contradiction between environment constraints and economic development in Jiangsu Province. Based on the survey of household’s energy consumption in 13 cities of Jiangsu Province, We find the factors that influence energy consumption behavior include environmental literacy, family characteristics, lifestyle, energy policy and education. We analyze the micro formation mechanism and driving force behind the macro view of social energy consumption, and propose some suggestions to improve the household’s energy consumption structure and promote social energy saving work.

Keywords: Jiang Su, household, energy consumption behavior

1. INTRODUCTION

Household’s energy consumption refers to the energy consumption of electricity, gas, coal, biomass and new energy used by residents for cooking, lighting, heating or cooling, household appliances, hot water and other household life purposes. Household’s energy consumption in Jiangsu Province continues to increase because of the urbanization. Jiangsu deficient in energy resources is a large energy consumption province. It has a high population density and a small per capita environmental capacity. The challenge of energy saving is increasing[1]. Family is an individual unit of energy consumption. Through the study of household’s energy consumption behavior, we can find the way to promote social energy conservation work.

From a micro perspective, each family’s choices of energy types and energy consumption levels are unique and affected by various factors. Social psychologies believe that human behavior depends on the interaction of human internal needs and external environment[2].Combing through numerous domestic and foreign research documents, we select three internal factors of environmental quality, family characteristics and lifestyle, and two external environmental

factors of energy policy and publicity and education to explain the formation of household’s energy consumption patterns, as shown in Table 1.

Environmental quality is a concept put forward by American scholar Charles E. Roth (1968)[3], including environmental knowledge, environmental value and environmental attitudes, which constitute the psychological orientation of household’s energy consumption behavior. Family characteristics include family annual income, family population, and family living area, which determine whether the family has energy consumption and the quantity of energy consumption. Life style affects household’s energy consumption habits and preference for energy consumption. Stern (2000) believes that the subjects of environmental behaviors such as energy consumption behaviors are based on habits and conventions.For example, rural households’ choice of biomass energy mainly stems from traditional habits[4].Parker (2005) studied energy consumption behavior of Canadian residents and found that 94% of "energy-saving" residents had known or read information and materials about energy conservation[5]. Energy policy and publicity and education will regulate and guide household’s energy consumption behavior[6].

Table 1 Variable definitions of factors affecting household’s energy consumption

Explained variable	Explanatory variables		Observed variables	
Household’s energy consumption	Environmental quality	Environmental knowledge	Environmental values	Environmental attitudes
	Family characteristics	Family annual income	Family population	Family living area
	lifestyle		Recognition of energy saving habits	
	Energy policy	Energy prices	Policies and regulations	
	Publicity and education		Energy conservation promotion	

2. DATA AND METHODOLOGY

2.1. Data

We conducted a two-month questionnaire survey using stratified random sampling in 13 cities of Jiangsu Province. In Nanjing, Suzhou, Xuzhou, Nantong, Yancheng and Wuxi, six cities with a population of more than 5 million, 100 questionnaires were distributed in each city. In Changzhou, Lianyungang, Huai'an, Yangzhou, Zhenjiang, Taizhou and Suqian, 50 questionnaires were distributed in each city. The respondent included urban and rural residents. A total of 950 questionnaires were distributed in this survey, and 862 valid questionnaires were returned, with an effective rate of 90.7%. The distribution of valid questionnaires is shown in Table 2.

2.2. Method

The questionnaire is divided into five parts according to the factors that influence household's consumption. Except

family characteristics, the other parts all use a five-level scoring scale. The respondents scored according to the degree of agreement with the description of the item, as shown in Table 3.

3. RESULTS AND DISCUSSION

3.1. Results

As shown in Table 4, the most commonly used energy in the sample households is electricity, which accounts for 100% of the total; Jiangsu's pipeline natural gas has entered the cities and some rural households, accounting for 75.1% of the surveyed households; The solar energy is popular in rural areas, accounting for about 46.6%; households using liquefied gas account for 24.9%; Households in all areas do not directly use coal. A small number of households in northern Jiangsu use biogas, firewood and straw ,and they account for 3.6% of the total.

Table 2 The distribution of valid questionnaires

Region	Nanjing	Suzhou	Xuzhou	Nantong	Yancheng	Wuxi	Chaozhou
Questionnaires	98	95	86	88	90	93	47
Proportion (%)	11.4	11	10	10.2	10.4	10.8	5.5
Region	Lainyungang	Huan'an	Yangzhou	Zhenjiang	Taizhou	Suqian	
Questionnaires	43	44	46	45	44	43	
Proportion (%)	5	5.1	5.3	5.2	5.1	5	

Table 3 Variables in questionnaires

Variables		Scoring rule
Environmental quality	Environmental knowledge、 Environmental values、 Environmental attitudes	five-level, 1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree
Family characteristics	Family annual income	1:<30000 yuan; 2:30000-100000 yuan; 3:100000-200000 yuan; 4:200000-500000 yuan; 5:> 500000 yuan
	Family population、 Family living area lifestyle	The number of family population
Energy policy	Energy prices、 Policies and regulations Publicity and education	five-level, 1=Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree

Table 4 Distribution of household energy choices

Energy	Electricity	Pipeline natural gas	Solar	Liquefied gas	Others
Samples	862	647	402	215	31
Proportion (%)	100	75.1	46.6	24.9	3.6

In the energy consumption of the sample households, electric energy is mainly used for cooking, air conditioners, water heaters and other household appliances; pipeline natural gas is mainly used for cooking, water heaters and floor heating. Due to the convenience and cheapness of pipeline natural gas, most households Choose to use natural gas for plumbing; solar energy consumption is currently only used for water heaters. The survey found that some households have installed rooftop photovoltaic power generation systems as energy supply; liquefied gas is only

used for cooking; other energy sources used by a few households are mostly used for cooking and heating. Some households use multiple energy sources for the same consumption purpose, such as gas stoves and electric cookers, air conditioning and floor heating, and multiple water heaters. The survey results are shown in Table 5. Select electricity, pipeline natural gas and solar energy that account for a large proportion of household energy consumption and conduct Pearson correlation analysis. The results are shown in Table 6.

Table 5 Distribution of household energy use

Energy use (proportion)	Cooking			Heating or refrigeration	Water heaters	Other household appliances
	Cooking meals	Water heating	Cooking rice			
Electricity	109(12.6)	859(99.7)	859(99.7)	783(90.8)	198(23)	862(100)
Pipeline natural gas	647(75.1)	-	-	137(16)	365(42.3)	-
Solar	-	-	-	-	402(46.3)	-
Liquefied gas	215(24.9)	14(1.6)	-	-	-	-
Others	31(3.6)	31(3.6)	31(3.6)	26(3)	-	-

Table 6 Correlation analysis of factors affecting household's energy consumption

Independent variable		Electricity consumption	Pipeline natural gas consumption	Solar consuming willingness
Environmental quality	Environmental knowledge	-0.353**	-0.294**	0.635**
	Environmental values	-0.415**	-0.346**	0.572**
	Environmental attitudes	-0.387**	-0.223**	0.544**
Family characteristics	Family annual income	0.296**	0.187**	0.024
	Family population	0.143**	0.351**	0.031
	Family living area	0.391**	0.164**	0.074
Energy policy	lifestyle	-0.265*	-0.148*	0.053
	Energy prices	-0.082	-0.056	0.013
	Policies and regulations	-0.032	-0.058	0.043
Publicity and education		-0.137**	-0.159**	0.342**

3.2. Discussion

From the Table 6, the environmental knowledge, environmental values and environmental attitudes among environmental quality factors are all negatively related to household's energy consumption, and the households all have a positive willingness to use solar energy. Families who pay attention to energy issues, understand energy-saving products, recognize environmental protection, and are responsible for environmental protection have shown positive energy conservation behaviors.

Among the family characteristics, the annual household income is positively correlated with electricity consumption and pipeline natural gas. The number of electrical appliances in the sample households is positively correlated with income. The consumption of some household appliances has high income elasticity, which brings effect of significant correlation between electricity consumption and income. The increased demand for floor heating by high-income households has also led to the sensitivity of natural gas consumption to income performance. The number of household population is positively correlated with electricity consumption and pipeline natural gas. The marginal electric energy consumption of family members is low, and the increase of the number of households will lead to a small increase in the total household electric energy consumption while reducing the per capita electric energy consumption[7]. Pipeline natural gas is used for household cooking, water heaters and floor heating, etc. The gas consumption is obviously affected by the number of family members. Family living area is positively correlated with energy consumption. The larger living area of the family, and the larger area of lighting, heating and cooling within the family. In order to maintain the comfortable living space, energy consumption will increase accordingly. There is no significant correlation between family characteristics and the willingness to use solar water heaters.

Lifestyle is negatively related to household energy consumption. The energy consumption of these families which have acknowledge about some good energy-saving habits, such as choosing energy-saving lamps and energy-saving appliances, turning the air conditioner temperature not too low in summer and not too high in winter, turning off standby appliances, shows lower level. Lifestyle are not significantly related to Solar consuming willingness.

Among energy policy factors, the perception of energy prices is not related to energy consumption. Energy products such as electricity and gas are necessities in household consumption, and the price elasticity of demand is low. Although sample households have different perceptions of energy prices, their energy consumption levels are not significantly related to price perceptions. Policies and regulations are not related to energy consumption. Most of the sample households agree with energy-saving policies, but they have not significantly affected household's energy consumption behavior. Energy policy is not significantly related to the willingness to use solar water heaters.

Publicity and education are negatively related to energy consumption and positively related to the willingness to use alternative energy solar products. The survey found that the environmental quality and lifestyle factors of sample families who participated in the "Energy-saving and Low-carbon" series of publicity activities or read "Energy Conservation Proposal" or "Energy-saving Tips" is directly reflected in the energy consumption level and willingness to use solar water heaters.

4. CONCLUSIONS

Family environmental quality affects family energy consumption behavior. Families who care about and know about the environment pay more attention to the energy-saving standards of products in the energy consumption. Families with environmental protection values usually weigh the benefits of energy consumption from the perspective of environmental costs rather than economic costs. Families that agree with environmental protection are more self-disciplined in energy consumption behavior. The formation of family environment quality is affected by government propaganda and education. It has nothing to do with family characteristics, and will affect family lifestyle choices.

Family lifestyle affects household energy consumption behavior. Whether a family's lifestyle is simple or luxurious, closed or open, casual or rigorous, it is closely related to family characteristics, and at the same time, it is a behavioral characteristic guided by values. As a part of family life, household energy consumption activities reflect differences in lifestyles. Energy policy and publicity and education have different roles. The current government's energy policies, energy-saving measures, and control methods are basically limited to the industrial economy. There are no management measures for household's energy consumption behavior, and energy policies have not played a guidance and normative role in household's energy consumption behavior. However, various energy-saving publicity activities that went deep into the community and were seen in the media helped families cultivate environmental quality and showed their effects in household's energy consumption behavior.

The factors affecting the willingness to use solar water heaters are complex. In addition to environmental quality, other factors, including family characteristics, lifestyle, energy policy, and publicity and education are not significantly related to it. Almost all households in the sample agree that solar water heaters are economical, environmentally friendly, and energy-saving, but some factors outside the research, such as: inconvenience in the use of solar water heaters, freezing in winter, destroying the appearance of the community, have hindered the willingness to use solar water heaters.

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