Factors influencing people's behavior that contribute to the formation of sustainable energy saving habits

Eleonora Vystavkina[1] and *Evgeny* Pronenko[2*]

[1]Southern Federal University, 344006 Rostov-on-Don, Russia
[2]Don State Technical University, 344002 Rostov-on-Don, Russia

Abstract. The relevance of the study is due to the growing need for rational use of natural resources and reduction of negative impact on the environment. The purpose of the study is to identify effective mechanisms for influencing people's behavior to form sustainable energy saving habits without compromising comfort. The work analyzes both internal (altruistic, biosphere values) and external motivation factors (social norms, economic incentives). The research methodology includes an analysis of modern scientific works on the psychology of energy consumption, a study of the influence of various types of motivation on energy saving behavior, as well as a study of the effectiveness of differentiated tariffs and other incentive tools. The main results show that the most effective is a combination of autonomous motivation based on internal principles with external incentives. It was revealed that the type of resource ownership and a sense of responsibility significantly affect the formation of environmentally friendly behavior. It was found that egoistic values hinder the development of energy saving habits, while altruistic and biosphere values promote their formation. The practical significance of the work lies in the possibility of using the obtained results to develop effective programs for the formation of energy-saving behavior of the population. The study emphasizes the need for a comprehensive approach to solving the problem, taking into account both legislative measures and psychological aspects of motivation.

1 Introduction

The problem of energy saving is becoming more and more important in the conditions of growing consumption of natural resources and increasing damage to the environment. Together with new technologies, the problems caused by them are introduced into our life, for example: carbon dioxide emission into the atmosphere, excessive consumption of natural resources and many others. Modern research shows that the formation of energy-saving behavior depends on both internal and external influences. With the help of such a tool as differentiated tariffs, it is possible to stimulate the formation of more environmentally friendly and energy-saving behavior.

* Corresponding author: heimag@yandex.ru

In addition, scientists distinguish two types of motivation: autonomous and controlled. As studies show, autonomous motivation is a more effective way to form energy-saving behavior [1].

Another manifestation of external motivation is social norms [2]. The pressure exerted by society encourages the development of energy-saving habits that can benefit both nature and the planet as a whole. Among the internal motivation we can distinguish, for example, altruistic and biospheric values. Also studies show that selfish values, on the contrary, will hinder the formation of energy-saving behavior [3, 4].

Thus, study focuses on finding effective mechanisms to influence people's behavior to form sustainable energy-saving habits. The main question is what incentives can motivate people to consume more responsibly without sacrificing their comfort.

2 Review of research on the psychology of energy consumption

2.1 Problems affecting the formation of energy-saving behavior

In our opinion, the problem of non-energy-saving behavior originates from irrational consumption. For example, consumption of luxury goods is motivated, pursued and encouraged not only by the division into ranks, but also by three factors: biological, social-psychological and structural.

Biological factors explain the desire for luxury through the influence of hormones. Testosterone, a hormone associated with the need for status in animals and humans, increases the desire for luxury brands.

The socio-psychological factor aims to investigate the relationship between consumers' attitudes and their interest in luxury. For example, conservatives with high socio-economic status more often choose expensive brands, as it is important for them to emphasize their position in the social hierarchy. Liberals, on the contrary, prefer unique goods that are not related to luxury. In addition, the possession of power reinforces the desire for exclusivity.So the trend observed is that the higher the inequality, the more often images of expensive brands appear in search results, confirming their role as status symbols.

An important factor in the attitude towards energy consumption is the type of ownership of this resource. Energy is not visible, it cannot be touched by hands, physically moved, etc. Unlike, for example, water, it is difficult for a person to imagine how energy is consumed and on what scale. S. Liu, C. Zheng, J. Song conclude that physical ownership increases responsibility for the resources used, while access-based ownership, i.e. renting, etc., leads to neglect of shared resources and thus over-consumption based on weak responsibility [5].

At the same time, the psychological image of consumption can be quite tangible. Regarding the difference between internal combustion engine vehicles and electric vehicles, it can be said that vehicles with internal combustion engines are associated with utilitarian use, while electric vehicles evoke social responsibility, forming a green identity among owners due to their environmental friendliness.

We can observe the relationship between ownership type and vehicle type with the intention to save energy, as well as the hypothesis about the mediating role of psychological ownership and perceived responsibility.

It has also been confirmed that, compared to ownership-based consumption, consumers are less likely to save energy when using vehicles with internal combustion engines that are accessible (e.g., rented), and it has been shown that a psychological sense of ownership and perceived responsibility underlies this effect [5].

Thus, renting a car, especially one with an internal combustion engine, will have a detrimental effect on energy saving behavior due to low ownership of the resources used.

2.2. Psychological motives for energy saving in households

Lingyun Mi et al. argue that the motivation toward energy saving in households with different levels of electricity consumption [6].

In fact, households with different UE (level of electricity consumption) also have different energy-saving potential. For example, compared to households with low EE, households with high EE have a smaller share of baseline electricity demand, a larger share of flexible consumption, and greater energy-saving potential.

Average monthly electricity consumption of high energy-using households was over 200 kWh, which was characterized by the greatest volatility. In addition, peak electricity consumption occurred in August and January. Thus, by encouraging them to save energy in certain seasons, a greater energy saving effect can be achieved. Households with average energy consumption ranged from 100 to 250 kWh and peaked in August. Consequently, these households can be motivated to save energy more efficiently. Low-energy households had average monthly energy consumption below 100 kWh and their tendency to change behavior was fairly stable

It is generally considered an effective way to achieve carbon reduction targets to encourage energy savings among households by changing their behavior, such as using savings through tariffs. However, it is known that the energy saving potential and contribution to carbon dioxide emission reduction differ among residents with different levels of energy consumption.

The results of the regression analysis of the study show that there are significant differences in the psychological motivations for energy saving of households with different levels of energy consumption. An important finding for our study is that for households with high, medium and low levels of energy consumption, psychological motivation can significantly influence their energy-saving behavior [6].

In this study, savings through tariffs, as mentioned earlier, can act as external motivation. It follows that, in addition to internal motivation in the form of environmental principles, the formation of energy-saving behavior can also be influenced through external factors.

Huiying Cynthia Hou and Ka Kiu Luo propose to influence people's behavior regarding energy consumption using political instruments [7]. In order to develop an effective policy mechanism that promotes energy conservation, the energy consumption patterns of the target population need to be studied comprehensively. And this case study focuses on energy conservation in students in dormitories.

One method to change people's energy consumption behavior might look like this: self-reported energy consumption behaviors and self-reported energy saving intentions. This integration allows for a comprehensive analysis that will help to better understand the true intentions of people seeking energy-efficient lifestyles.

This approach allows us to take into account personal perceptions of the benefits of energy conservation, environmental influences, confidence in one's ability to save energy, and a sense of moral obligation.

Using a sample of students living in dormitories, we can establish the relationship between the desire for energy conservation and psychological and social attitudes and parameters. The data obtained in the study are presented in Table 1 [7].

Table 1. Influence of socio-psychological factors on saving

Positive attitude	Subjective norm	Personal moral norm
$\beta = 0.093$, $p < 0.05$	$\beta = 0.258$, $p < 0.001$	$\beta = 0.348$, $p < 0.001$

Positive attitude towards energy saving has quite a significant influence. The stronger influence is exerted by the subjective norm, i.e. pressure from the environment, which motivates to follow energy-saving behavior. The biggest influence is exerted by personal moral norm, i.e. the sense of responsibility for environmental conservation [7].

Thus, positive attitude, supportive subjective norm and strong personal moral norm significantly enhance students' intentions to save energy. Positive attitude and moral norm can act as internal motivation, but already the pressure from society will be external motivation.

We can highlight two more interesting phenomena in the area of energy-saving behavior regulation: autonomous normative communication based on autonomy support and descriptive norms, and the "spillover effect" - the spread of behavior to other energy-saving actions.

Household energy saving behavior can be divided into two categories: rational behavior and energy saving behavior.

The self-determination theory distinguishes two levels of motivation that influence the diffusion effect in different ways. Autonomous motivation, which is generated by internal reasons, leads to sustained behavior change, while controlled motivation, which is driven by external reasons, can cause resistance.

The results of the study of management style are presented in Table 2 below [1]..

Table 2. Results of contrastive analysis

M autonomous-normative communication	**M controlling communication**	**M controlling condition**
M = 3,65	M = 3.04, t (850) = 6.6, β = 0.55, p < 0.001	M = 3.28, t (850) = 4.02, β = 0.33, p < 0.001

Autonomy-normative communication increased the perception of autonomy support compared to controlling communication and the control condition, consequently decreasing the perception of being controlled compared to the other two conditions. Controlling communication decreased perceived autonomy support and increased perceptions of being controlled compared to the control condition.

Autonomy-normative communication promoted the intention to reduce heat consumption in the home, it was more effective in promoting energy savings and related actions. Controlled communication did not affect either type of motivation. Autonomous-normative communication stimulated autonomous motivation and reduced amotivation. Trust in government directly affects willingness to reduce energy consumption within government guidelines. When trust is high, people tend to follow the prescriptions regardless of the form of communication, and when trust is low, the level of obedience drops dramatically [1].

Energy-saving behavior is closely related to environmental values. People should strive to switch from internal combustion engine cars to electric cars, to use paper and recyclable items, and not plastic.

Vikas Kumar and colleagues mention that with the growing global focus on developing sustainable energy and transitioning to a low-carbon economy, it is crucial to understand what motivates consumers to purchase eco-friendly products [3].

Altruistic values reflect an individual's desire to put the public good above personal gain. They are associated with empathy, compassion and a desire to contribute to the well-being of society, which motivates environmentally responsible behavior.

Opposite them are egoistic values. They are oriented towards personal gain, power and achievement. Research confirms that environmental consciousness is positively related to altruistic and biospheric values, but negatively related to egoistic values. Thus, biospheric, altruistic and egocentric values are positively related to environmental mindset. The results of the study support this assertion. They are presented in table 3 [3].

Table 3. Influence of values on environmental outlook

Biospheric values	Altruistic values	Egoistic values
β = 0.424, t = 9.904, p = 0.000	β = 0.302, t = 6.898, p = 0.000	β = -0.228, t = 6.355, p = 0.000

The results show a significant influence of biospheric and altruistic values on the formation of environmental worldview. The idea that egoistic values have a negative impact on environmental worldview is also supported. Egoistic values such as the pursuit of social power, wealth and authority deter people from adopting an ecological worldview because they focus more on personal gain than on environmental conservation [3]. Consequently, selfish values will hinder the formation of energy saving behavior

2.3. Willingness to adopt more energy-saving behaviors

Gap between urban and rural households under electricity price reform is poorly understood. The study by Yan Ne, Guoxing Zhang et al. established a mechanistic model of the impact of electricity price reform on urban and rural residents' electricity consumption behavior and estimated the carbon reduction effect of the policy.

At least 3 directions for research can be identified: 1) Analyzing the factors affecting the difference in energy consumption between urban and rural residents. 2) Policy- motivation-behavior model explaining the mechanisms of motives' impact on energy consumption. 3) Prediction of the dynamics of electricity demand among urban and rural population under the influence of reforms, and their contribution to energy saving and emission reduction.

When using electricity, consumers primarily focus on their basic energy needs, paying less attention to the time of use, cost and environmental aspects. In addition, the pursuit of personal comfort plays an important role: people tend to choose energy consumption patterns that provide convenience in everyday life, even if this leads to increased costs. As a result, electricity demand and comfort have a significant positive effect on electricity consumption, whereas electricity cost, environmental effects and safety have a significant negative effect on electricity use.

Psychosocial factors such as environmental influences and social norms have a weak influence on the energy consumption of rural residents. At the same time, for urban residents, they become a significant external stimulus (0.635), which is explained by their higher income, education level and professional training that increase their susceptibility to social influence. In addition, urban dwellers respond more strongly to weather conditions and temperature by adapting their energy consumption, whereas rural dwellers are less dependent on these factors.

Thus, the mechanisms of internal and external influences on the energy consumption behavior of rural and urban residents are more consistent. They are mainly driven by multiple motives, among them demand motivation and comfort motivation, which increase electricity consumption. The most important regulating factor is economic conditions [2].

Policy measures can influence the energy consumption of residents, although the motivation of urban and rural residents is different. This way of external motivation has been mentioned before, hence it will be quite effective in shaping energy saving behavior.

Based on the assumption that financial incentives can induce people to change their energy consumption behavior, it can be assumed that people are willing to sacrifice their comfort to adopt energy efficient behavior.

In this regard, two questions can be formulated: "what energy consumption patterns and usage habits are are typical for people living in the selected apartment complex?", the second

is, "to what extent can financial incentives effectively motivate people to engage in more energy efficient behaviors, and how can the monetary amounts required for successful motivation be quantified and tailored to the students' unique circumstances?

The results of a survey of a student sample showed that air conditioning unit in the dormitory consumes the most electricity in the summer (average temperature is 21-28 °C. Taking a shower (10-30 minutes) is also considered in terms of water and energy consumption. The energy consumption for lighting (1-15 hours) was deemed less significant; therefore, it was decided to combine all types of lighting into a single attribute for energy consumption. Regarding compensation for reducing energy consumption, the results show that most of the respondents would prefer a higher level of compensation. Thus,

36.14 % of respondents would prefer to receive up to HK$500 per month, while 37.3 % would prefer to receive HK$300 per month and 18.07 % would prefer to receive HK$150, etc. Only 3.61 % of the respondents are willing to reduce their energy consumption at no cost [8].

Financial incentives can motivate students in developing energy saving behavior, but comfort level remains the key factor. This underscores that a fine balance must be struck between providing adequate incentives and occupant comfort to effectively encourage environmental behavior.

3 Discussion

More and more attention is being paid to ways of influencing consumers to reduce energy consumption costs. There are gaps in past research that scientists are currently refining. The more research is conducted, the more new methods of influence emerge. For example, the discrete choice experiment identifies the most important components of energy consumption, after which the compensation for reducing their use is already calculated [8]. By identifying in what period certain groups of people are most inclined to increase energy consumption, it is possible to influence them in order to achieve a reduction in this consumption [6]. But at the same time, Huiyin Hou emphasizes in his article that it is necessary to maintain a balance between comfort and incentives [7].

Interconnection of research on this topic lies in how autonomous motivation and sense of responsibility relate to each other. Autonomous motivation is formed due to internal reasons, including any principles and other [1]. This type of motivation has a positive effect because of a sense of responsibility, as we hypothesize. As mentioned in our study, the ownership type based on ownership causes a strong sense of responsibility, which in turn affects the formation of eco-friendly behavior [5].

There are many ways to influence the formation of energy-saving behavior. It is important to choose the right ones that will be the most effective among them.

4 Conclusion

As a result, formation of energy-saving behavior requires a comprehensive approach that will take into account both internal and external factors. It is not possible to achieve the best effect by influencing only through the framework of the law or through financial incentives. The most effective way will be autonomous motivation, which is formed through the internal principles of the individual. Further research should focus on the development of personalized programs that promote the formation of sustainable energy-saving behavior in people, while not making them uncomfortable, the basis for this is modern developments in the field of psychological work with the motivation of human action [9, 10].

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