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Contact to corresponding author: zasiman@mruni.eu, Mykolas Romeris University, Ateities st. 20, LT-08303 Vilnius, Lithuania

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Zaneta Simanaviciene

Mykolas Romeris University, Lithuania

Virgilijus Dirma

Lithuanian Sports University, Lithuania

Arturas Simanavicius

Lithuanian Sports University, Lithuania

Psychological factors influence on energy efficiency in households

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Abstract

Research background: Most of the studies and their authors focus on the social and economic impacts of energy-saving behavior. However, they do not focus on the psychological factors affecting the efficiency of energy consumption in households. Lithuania has a lack of a unified and justified opinion on psychological factors that affect the energy efficiency of households.

Purpose of the article: The main objective of the article is to identify the psychological factors that influence energy efficiency in households and to identify the appropriate measures to change the individual's energy consumption behavior.

Methods: The article was based on analysis of scientific literature and expert evaluation, when experts selected the most influencing psychological factors. Expert valuation allowed to set the right conditions in which individuals are more easily assimilated by means of energy saving.

Findings & Value added: In most cases, economic and technological factors significantly influence household energy consumption. Increased energy-efficient equipment production

and supply is causing an energy consumption growth in households, because they are more inclined to buy and use more efficient electrical equipment. An investigation has showed that the energy consumption is strongly influenced by some cultural and psychological factors: with greater public openness to innovation, the households tend to use energy more efficiently. Also, some psychological indicators have significant impact on energy consumption has — frequently the more pronounced neuroticism or extraversion rate. Since the research was performed only in Lithuania, in the future it will seek to carry out an investigation in several countries and to compare a various factors on the proposed measures and the efficiency of household energy consumption.

Introduction

The behaviour of individuals has a significant impact on the environment. The actions of an individual or the decisions that one makes, what products to use, which lifestyle to choose, all of this create a direct and an indirect impact to the environment. Also, it influences personal and collective welfare. Efficient consumption takes an essential part both in national and international politics. Therefore, the behaviour of individuals or consumers determines energy consumption as well as energy saving. The changes in consumer behaviour towards efficient consumption can ensure a significant decrease in energy consumption and greenhouse gas emission without extra costs and investments. Thus, the purpose of the article is to identify the psychological factors influencing energy efficiency in households and to identify the appropriate measures changing the individual's energy consumption behaviour.

A number of scientists analyse the behaviour of consumers. In this article, the behaviour will be analysed from the household position. Most scientists are concerned with the irrational behaviour of individuals in the market (Brekke *et al.*, 2008, pp. 280–297; Maibach *et al.*, 2008, pp. 488–500; Akelof & Shiller, 2009, pp. 248; Elster, 1996, pp. 1386–1397; Gatersleben *et al.*, 2002, pp. 335–362; Stern, 2000, pp. 1224–1232). In climate change assuagement economy great attention is given to economical and psychological behaviour areas (Marechal, 2007, pp. 5181–5194; Brown, 2001, pp. 1197–1207; Oikonomou *et al.*, 2009, pp. 4787–4796; Poortiga *et al.*, 2003, pp. 49–64; Uzzel & Rathzel, 2009, pp. 326–335). Researches show that saving energy and reducing greenhouse gases can be achieved in two ways: while changing the behaviour and applying product innovations (Steg, 2008, pp. 4449–4453; Gifford, 2011, pp. 290–302; Schiler *et al.*, 2008, pp. 1–15). The changes in behaviour are firstly related to realising the principles of efficient consumption (Abrahame, 2011, pp. 1–11; Portiga *et al.*, 2004, pp. 49–64; Godwy, 2007, pp. 1–38; Girod & de Haan, 2009, pp. 5650–5661). Product innovations would be substituting energetically inef-

fective devices as well as old cars into new ones, renovating heating systems, applying renewable energy sources in household, etc. (Faiers & Neame, 2006, pp. 1797–1806; Zarnikau, 2003, pp. 1661–1672; Brownstone *et al.*, 2000, pp. 315–338; Ek, 2005, pp. 167–1689; Nair *et al.*, 2010, pp. 2956–2963). Product innovations require costs while behavioural alterations do not require any expenses and save money (Reusswig, 2010, pp. 35–59; Abrahamse & Steg, 2009, pp. 265–276; Abrahamse *et al.*, 2005, pp. 273–291; Benders *et al.*, 2006, 3612–3622).

Most studies and their authors such as Abrahamse and Steg (2009, pp. 711–720) Black *et al.* (1985, pp. 675–697) concentrate on how social and psychological actions influence energy saving behaviour. The authors analyse the variables of cognition, such as values, worldview or opinion, and how they impact energy saving. Other authors concentrate on the importance of social processes (Homans, 1961, pp. 406; Garmendia & Stagl, 2010, pp. 1712–1722; Staats *et al.*, 2004, pp. 341–367; Dulleck & Kaufman, 2004 pp. 1025–1032). Moreover, a significant part of studies is aimed at revealing how information and feedback of various kinds influence energy saving behaviour (Darby, 2006, pp. 988–996; Faraqui *et al.*, 2009, pp. 1598–1608). Another important block of researchers concentrate on how the ethical, cultural, worldview and human capital aspects form environment saving behaviour (Bamberg & Schmidt, 2003, pp. 264–285; Barnut & Serletis, 2008, pp. 210–224). In Lithuania, scientists also analyse how consumer behaviour impacts effective consumption (Balezantis, 2011, pp. 7322–7334, Simanaviciene *et al.*, 2013, pp. 216–226, Simanaviciene *et al.*, 2015, Streimikiene & Siksnylyte, 2014, pp. 891–904). However, the psychological aspects influencing effective energy consumption in households have not been analysed consistently in Lithuania.

With regard to the novelty of the current contribution, the study can help to identify psychological factors affecting energy efficiency in households and identify measures that modify individual energy consumption behavior. The research results in Lithuania can be practically applied to improve the Lithuanian climate change mitigation policy, and to select new measures aimed at the energy consumption sector.

The theoretical analysis of factors influencing consumer behaviour

Energy consumption is not completely synonymous to behaviour; it should rather be explained as the results of behaviour such as turning on the light or decreasing the level of the thermostat (Becker *et al.*, 1981, p. 592). This article concentrates on the behaviour related to direct energy consumption

requirements (electricity, fuel) while evaluating such behaviour as turning on the light, using electronic devices, cooking food, washing up, etc.

According to some authors, energy consumption decreasing behaviour creates the conditions for actual changes in behaviour. Furthermore, these changes are conducted and carried out during a longer time period (Geller, 2002, p. 528), meanwhile, other authors state the opposite, namely that productive behaviour is more effective while trying to save energy (Abrahamse *et al.*, 2005, p. 274).

From the macro perspective, technological advancement, economic growth, demographical and institutional factors, as well as cultural development influence our behaviour in a long term perspective. Meanwhile, from the micro perspective and its factors such as motivation, possibilities and capabilities impact our behaviour at an individual level (Abrahamse *et al.*, 2005, p. 274). It is also worth noting that individual actions are influenced by habits and a certain routine which is carried out without thinking and spontaneously. It is worth noting that influencing factors can be divided into inner (worldview, norms, and beliefs) and external (institutions, rules, directions). Garlinger *et al.* add that when trying to change an individual's environment preserving behaviour it is important to consider both macro and micro levels, in other words, both inner and external factors (Garlinger *et al.*, 2002, p. 66–67).

It is difficult to choose the best means for such behaviour as decreased energy consumption. Nevertheless, empirical research of energy consumption present several indications and prove that correctly determined conditions influence changes in behaviour. They can also be formed by public politics (Štreimikienė & Voločovič, 2012, pp. 4118–4124).

Several main models, which will be analysed in this article, can be distinguished. One of the best known theories is the neoclassic economy model of rational choice. It is based on the fact that consumers consider the possible costs of different actions and choose the most profitable ones or the least expensive. The theory is also based on the fact that in order to understand the costs and profits from some choice and make a rational decision, a person has to have information about the chosen actions or goods (Elster, 1989, pp. 99–100). It is necessary to emphasise that the theory was widely used in energy saving research in 1970s. In those pieces of research, scientists used such means as infomercials or seminars aimed to accentuate energy saving in households.

It is thought that the process, when costs are determined and the utility of different alternatives is evaluated, has two different components. One of them is the expectations of the results of each choice and the other component is the evaluation of these results (Elster, 1996, pp. 1390).

The main feature of the rational choice theory is the analysis of the individual. According to the model, individuals base their actions on rational thinking and these actions are created from each person's subjective evaluation of expected results.

The theory of rational choice is thought to be limited, since it does not consider such factors as habits, emotions, social norms, moral behaviour (Štreimikienė *et al.*, 2012, pp. 3613–3620).

The traditional theory of economics, which is linked to consumer's preferences, is based on four basic elements: the income of the consumer, the price of the goods in the market, preference of the consumer and the behavioural assumption about maximum profit. Having limited incomes and a specific group of goods from which a lot of preferences can be distinguished, a person chooses goods in a way that one's utility is achieved and that it meets the income of the individual (Begg, 2009, p. 60).

It can be said that economists agree that there are no limits to the wishes of an individual to obtain some goods or service. The needs and desires of many people are limitless.

Selling economical goods and services is acknowledged only from one social exchange aspect. Looking from a wider perspective, individuals exchange various goods (time, gifts, work, critical appraisal) and take into consideration personal expectations that the exchanges will be profitable (Becker *et al.*, 1986, p. 37).

It is notable that the rational choice theory is useful in relation with environmentally friendly behaviour. It is just as important to determine personal costs and profit, related to the habit of not-buying, as it is essential to understand the habits of buying (for example, buying recycled goods).

According to ecology value theory, individuals who are more egoistic and self-interested tend not to act environmentally friendly unlike the people who act under social norms. Nevertheless, acting under social norms and caring about the nature are not enough to form environmentally friendly behaviour. Thus, while analysing environmentally friendly approaches and when applying behavioural theories, it is also important to consider factors such as context and situation (Steg *et al.*, 2005, p. 417).

Some key points are provided that link household behaviour and its changes with energy saving:

- Environmentally friendly behaviour is more dominant than in economical or psychological research;
- The structure can change depending on behaviour or place;
- The highest influence is most prevailing in certain situations.
- The more the behaviour is influenced by technological, infrastructural, regulation and financial costs, the less it depends on personal actions.

Laws, regulation, finances and social norms play a more significant role on changing the behaviour when compared to personal actions;

- Although a lot of behavioural models suggest that actions are chosen, the models can be applied only in certain situations;
- Choices are usually spontaneous without thinking about the consequences;
- The effect of most psychological variables to a specific action is taught to be indirect. However, some of these variables can change the behaviour in a wider sense;

Psychological variables help determine when the behaviour is not strongly influenced by habits, regulations, economical costs, etc. Due to this, it can be stated that psychological variables are useful only in certain situations. On the other hand, their importance is significant because the choice which was made in situations like changing everyday habits to be environmentally friendly determines further behaviour and affects the nature (Lutzenhiser, 2009, p. 32).

Considering how the behaviour of individuals is influenced and formed as well as how it can be changed, politicians must not forget external and inner factors, social and regulation context and how an individual is related to the political environment is just as important.

The theory of persuasion is based on these three principles: the reliability of the speaker, the reliability of the arguments or the communication and the sensitivity of the receiver, considering that the receiver will be persuaded by the communication and their actions and approach will shift. This simple theory of persuasion has restrictions, but there are other versions such as cognitive dissonance theory, which is more concentrated on individuals as active receivers in the process of persuasion. Cognitive dissonance theory is based on the principle that if a person has two-sided beliefs that conflict one another, there is a tendency to demeanour the conflicting side and change the behaviour according to it. Another branch of the theory of persuasion is the elaboration likelihood model, which shows that the shift of attitude is based on two routes and they both can influence the approach of an individual and, finally, the behaviour itself:

- Central route is when the attention of the receiver is reached through the argument of persuasion;
- Peripheral route is when the receiver is not very motivated to be interested in the message, but other recourses can be used if other individuals can consider the resources of influence of the analysed question (Gar-media & Stagl, 2010, p. 5).

Social learning theory is a different kind of behaviour theory. Based on this, individuals learn from their past experiences (ventures, failures) as

well as from other individuals (relatives, colleagues, friends, public figures). It is understood that patterns and situations change, but individuals also learn from the mistakes of other people.

It is important to stress that behaviour is influenced by several factors with different levels of complexity and some are thought to be more difficult. Human behaviour, which is mostly formed by habits, is said to be either automatic or routine. It is important that behaviour is formed and well-established, therefore, even if the person has a positive attitude towards being environmentally friendly, this does not guarantee that he or she will act in this way.

Research methodology

Efficient energy consumption in households is mostly influenced by habits and routine. Such behaviour is difficult to change as it is partially regulated by the characteristics of devices used by the individuals. However, it is much more important that behaviour is impacted by inner and external factors such as beliefs, values, worldview, and behaviour of other people, cultural restrictions as well as economic initiatives and constraints.

In order to determine the psychological aspects impacting efficient energy consumption in households, it is crucial to evaluate how it is controlled by various tendencies as well as accentuate micro and macro level factors. During the research, elements influencing energy consumption tendencies were divided into technological, economical-social, demographic, institutional, cultural, psychological and inner factors, which are related (Figure 1).

It is important to find and determine, which indicators help measure a certain factor. Demographic factors can be measured by such indexes as number of population and their age structure as well as the number of people with education. Technological, economic-social factors can be determined by GDP/per person, number of patents for advanced technologies/million per person; percentage of people working in the sector of technologies; government costs for science and development, % of GDP; actual income of residents (average wage); energy price for residents; uneven incomes; level of poverty; social costs, % of GDP.

The evaluation of experts was used in order to identify the psychological factors determining the behaviour of consumers. To confirm the validity of the results, mathematical methods were applied: Kendall's coefficient of concordance of the compatibility of experts' opinions and experts' compe-

tency coefficients were calculated. The data was described applying the average and standard deviation.

The conducted expert evaluation is based on the assumption that the expert has a lot of rationally processed information (has a lot of knowledge and experience, can rely on intuition) and, therefore, the expert can be the source of quality information.

Research

In order to identify the psychological factors influencing consumer behavior, an experimental evaluation was conducted. One of the means to lower subjectivity is choosing the right experts. In this case, only those experts could participate who have knowledge in the field of energy consumption. Methodological means formed in classic test theory were applied when deciding how many experts were needed. The theory states that the reliability of aggregated decisions and the number of people who make the decision are related by a descending indirect connection. Therefore, when conducting an expert evaluation, only seven competent experts are needed. It is said that the most accurate results are achieved when the group consists of 5–9 experts. The standard deviation grows only in the beginning, however, after 8–10 experts it stays almost the same, and does not significantly improve the reliability of the decision.

The aim of the expert evaluation was to determine what psychological factors influence the behavior of consumers. The questionnaire of expert evaluation was composed of psychological factors, which were drafted during the analysis of scientific literature. The factors included amenability, thoroughness; being extraverted, neurotic, open-minded, self-sufficient and self-reliant. Experts had to evaluate all the factors and divide 100% among them. Such evaluation was ranked, with n being the number of variation of the exploratory factor in order to conduct further calculations. Nine ranks were determined and the expert evaluation was transformed according to it.

In order to evaluate the compatibility of experts, Kendall's coefficient of concordance was calculated and hypotheses were presented that the evaluations were either controversial or similar:

H0: expert evaluations were controversial (coefficient of concordance W is 0 $W=0$);

H1: expert evaluations were similar (coefficient of concordance W is not 0 $W \neq 0$).

The chosen level of significance is $\alpha = 0,05$, the final result is lower than the chosen level of significance χ^2 – Chi-Square. The coefficient of concordance is not 0 ($W=0,787$), therefore, the 0 hypothesis is overruled and the alternative is adopted. The coefficient of concordance is statistically significant and, in this case, it shows a very good compatibility of expert opinions. A conclusion is drawn that expert evaluations are similar. In order to determine if there are experts whose opinions differ from the majority and what kind of experts they are, the competency coefficient was calculated. This coefficient is calculated by the results of evaluating alternatives, using the iteration algorithm of evaluation.

After calculating the interval of the coefficient of expert competence it was established that the average competence is 0,05 and the standard deviation is 0,005. Since expert evaluations make it to the calculated interval $0,050 \leq (K_{i^t}) \leq 0,068$, therefore, it can be stated that there is no significant difference in expert opinions. A conclusion can be drawn that there were no experts who were underqualified or appeared in the group by mistake.

The results revealed that according to the experts, the most negative influence is made by such qualities as being extravert (32%) and neurotic (29%), and the least negative influence is made by being thorough (3%). According to the experts, a positive influence on consumer behavior is made by being open-minded (41%), amenable (21%) and self-reliant (17%).

Along with psychological factors, experts had to evaluate the economic and technological aspects as well. Expert evaluation revealed that for further analysis of efficient energy consumption tendencies and factors determining them are needed.

Discussion

In order to help change behavior, it is important to change negative routine habits such as driving a car for short distances, throwing out waste which can be re-used or setting the devices on wait. Although it is difficult to change routine behavior, it is scientifically proven that this is possible. One of the ways is the effect of a community or a group. Individuals are asked to get rid of negative habits when openly speaking about them in groups of communities. These discussions should stop previous habits and change them into positive ones. Such programs were applied in the United Kingdom in previous years while discussing household energy, transport and recycling.

Other pieces of research revealed one more effect when, for example, people who recycle start saving energy at home, use ecological food, in other words, one positive behavior influences doing something else (nonetheless, this effect can have a negative side, which means that it works in a different direction as well).

Thus, as it was described before, attitude can have influence on the behavior, although, researches show that behavior can also impact attitude in certain situations. Behavior works as a predecessor for attitude. On the other hand, there are many situations when social identity determines further actions. For example, individuals who do not recycle can explain that they do not belong to the same social group as the people who recycle. Bodies of research analyzing behavioral models have revealed that these models took over some ideas of cultural theories and emphasized that different choices of environmental politics require choosing either hierarchical (traditions or institutions are most important) or individual (innovations and personal choice is most important) types. Nonetheless, behavioral changes are also impacted by social routes or so called “early conformists” who initiate social changes.

Conclusions

An analysis of theoretical assumptions for changing the behavior of the population has shown that the behavior of each individual is influenced by social and personal factors. In order to determine the psychological factors affecting energy efficiency in households, it was estimated how different trends are affecting the energy consumption in households, as well as the distinction between micro and macro level factors. Psychological factors were attributed to micro-factors. In the analysis of theoretical assumptions for changing the behavior of the population, psychological factors such as fidelity, neuroticism, thoroughness, extraversion, openness to innovations, self-confidence, and trust competence were selected.

The results of the research in Lithuania can be practically applied to improve the Lithuanian climate change mitigation policy and to select new measures aimed at the energy consumption sector.

In addition to psychological factors, experts evaluated economic and technological factors. An expert evaluation has shown that in the future, analyzing trends of energy consumption and their determinants, it is also appropriate to perform a correlation-regression analysis which more fully reveals the positive and negative effects of the factors.

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Annex

Figure 1. Factors Influencing the Tendencies of Energy Consumption

