

Simanaviciene, Zaneta; Dirma, Virgilijus; Simanavicius, Arturas

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PSYCHOLOGICAL FACTORS INFLUENCE ON ENERGY EFFICIENCY IN HOUSEHOLDS

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Zaneta Simanaviciene, Virgilijus Dirma, Arturas Simanavicius

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Zaneta Simanaviciene, Virgilijus Dirma, Arturas Simanavicius
zasiman@mruni.eu, vdirma@yahoo.com, arturassim@yahoo.com
Mykolas Romeris University, Lithuanian Sports University

PSYCHOLOGICAL FACTORS INFLUENCE ON ENERGY EFFICIENCY IN HOUSEHOLDS

JEL Classification: *D1; C92; Q43; Q56*

Keywords: *psychological factors; efficient use of electricity; households*

Abstract

Research background: Most of the studies and their authors focus on the social and economic impacts of energy-saving behavior. But they do not focus on 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: to identify the psychological factors that influence energy efficiency in households and to identify the appropriate measures changing the individual's energy consumption behavior..

Methodology/methods: was based on analysis of scientific literature and expert evaluation, when the experts selected the most influencing psychological factors. Expert valuation also allowed to set the right conditions in which individuals are more easily assimilated by means of energy saving. The correlation and regression analysis allowed to identify a variety of factors, including the psychological impact strength.

Findings: Performed analysis of variety of factors that influence household energy consumption allowed to formulate conclusions that 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, which leads to the growth of energy consumption in households. An investigation showed that the energy consumption of households is strongly influenced by some cultural and psychological factors: the greater public openness to innovation, the households tend to use energy more efficiently. Also, a significant impact on energy consumption has some psychological indicators - 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 factor 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 he makes, what products to use or choosing a certain lifestyle, all of this create a direct and an indirect impact to the environment. Also, it influences personal and collective wellness. 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, 248 pp.; Elster, 1996, pp. 1386-1397; Gatersleben et al., 2002, pp. 335-362; Stern, 2000, pp. 1224-1232). Another area would be decreasing climate change as well as the economical and psychological areas of behaviour (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 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 with 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 ineffective 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. 1677-1689; Nair et al, 2010, pp. 2956-2963). Product innovations require costs while behavioural alterations do not require are free and save money (Reuswig, 2010, pp. 35-59; Abrahamse, Steg, 2009, pp. 265-276; Abrahame et al., 2005, pp. 273-291; Benders et al., 2006, 3612-3622).

Most studies and their authors such as W. Abrahame and L. Steg (2009, pp. 711-720) Black et al. pp. 675-697 concentrate on how social and psychological actions influence energy saving behaviour. 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 researches concentrates 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 (Balezentis, 2011, pp. 7322-7334, Simanaviciene et al., 2013, pp. 216-226, Streimikiene&Siksnyte, 2014, pp. 891-904). However, the psychological aspects influencing effective energy consumption in households are not analysed consistently in Lithuania.

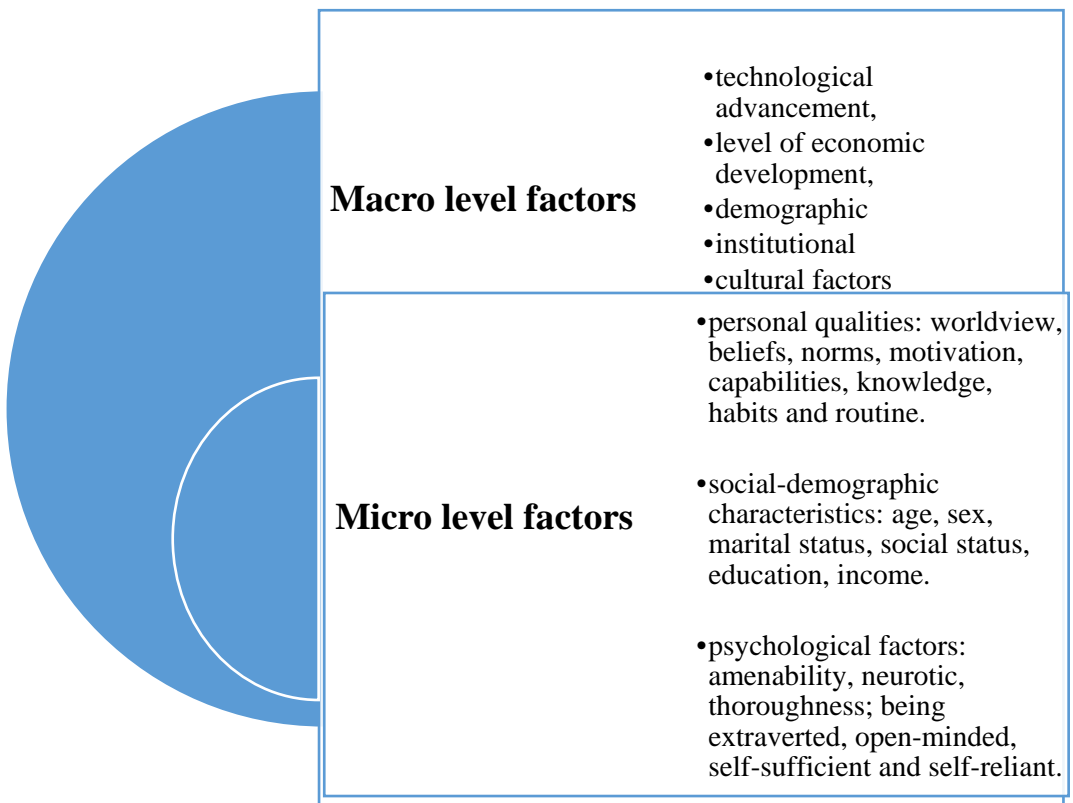
Research Methodology

As the analysis of scientific literature revealed, the behaviour of consumers is under the influence of certain situations. Behavioural models show that individual actions, related to energy consumption, are impacted by several personal and macro level processes.

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, behaviour of other people, cultural restrictions as well as economic initiatives and constraints.

In order to determine 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).

Figure 1. Factors Influencing the Tendencies of Energy Consumption



Source: authors created

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 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' competency 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 expert questionnaire was conducted from September to December in 2016. 11 experts participated in the research. 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, when n is 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 an 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 are they, 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 economic and technological aspects as well. Expert evaluation revealed that for further analysis of efficient energy consumption tendencies and factors determining them, it would be expedient to conduct a correlation-regression analysis, which would fully reveal the positive and negative effects of the factors.

Conclusions

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 when discussing household energy, transport and recycling.

Other researches 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 to start 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. Researches analyzing behavioral models 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.

The conducted expert evaluation allowed determining how various psychological factors influence the efficiency of energy consumption. The research revealed that being extravert and neurotic has a negative impact while being open-minded and amiable has a positive effect.

References

1. Books

Akerlof, Shiller, 2009; AKELOF, G. A., SHILLER, R. J. (2009). *Animal spirit*. Princeton, New Jersey: Princeton University Press.

Godwy, J. M. (2007). *Behavioral economics and climate change policy*. Rensselaer Working papers in Economics.

Homans, G. (1961). *Social Behaviour Its Elementary Forms*. London: Routledge & Kegan P.

Schiller, S. R., Prindle, B., Cowart, R., Rosenfeld, A. H. (2008). *Energy Efficiency and Climate Change Mitigation Policy*. ACEEE Summer Study on Energy

Efficiency in Buildings, American Council for an Energy Efficient Economy, Washington, DC.

2. Periodicals

Baležentis, A.; Baležentis, T.; Štreimikienė, D. The energy intensity in Lithuania during 1995-2009. *Energy Policy*, 39 (9).

Bamberg, S; Schmidt, P. (2003) Incentives, Morality, Or Habit? Predicting Students Car Use for University Routes With the Models of Ajzen, Schwartz, and Triandis. *Environment and Behavior*, 35.

Black, J. S., Stern, P. C., Elworth, J. T. (1985). Personal and contextual influences on household energy adaptations. *Journal of Applied Social Psychology*, 28.

Brekke, Johansson-Stenman (2008). *The Behavioral Economics of Climate Change*. Oxford Review of Economics 23 (2).

Brown, M. (2001). Market failures and barriers as a basis for clean energy policies. *Energy policy*, 29.

Brownstone, D., Bunch, D. S. (2000). Train, K. Joint mixed logit models of Stated and Revealed Preferences for alternative-fuel vehicles. *Transportation Research B* (34).

De Young, R. (1993). Changing behavior and making it stick. The conceptualization and management of conservation behavior. *Environment and Behavior*, 25(4).

Dietz, T., Gardner, G. T. Giligan, J. Stern, P.C. Vandenberg P.(2009). Household actions can provide a behavioural wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Science of the United States of America*, 106, (44).

Dulleck U., Kaufman S. (2004). Do customer information programs reduce household electricity demand?- the Irish programme. *Energy Policy*, 32.

Ek, K. (2005). Public and Private Attitudes Towards “Green” Electricity: The Case of Swedish Wind Power. *Energy Policy* 33(13).

Elster, 1996; ELSTER, Jon. (1996) Rationality and the Emotions. *The Economic Journal*, Blackwell Publishing, 438.

Faiers, A., C. Neame, C. (2006). Consumer Attitudes towards Domestic Solar Power Systems. *Energy Policy*, 34.

Faraqui, A.; Sergici, S. Sharif, A. (2010). The impact of informational feedback on energy consumption—A survey of the experimental evidence. *Energy*, 4.

Garmendia, E; Stagl, S. (2010). Public participation for sustainability and social learning: concepts and lessons from three case studies Europe. *Ecological Economics*, 69.

Gatersleben ir kt., 2002; GATERSLEBEN, B., STEG, L., VLEK, C. (2002). Measurement and determinants of environmentally significant consumer behavior. *Environment and Behavior*, 34.

Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, 66(4).

Iyer, M.; Kempton, W; Payne, Ch. (2006) Comparison groups on bills: Automated, personalized energy information. *Energy and Buildings* 8.

Koppl, W. (2004) Rational Choice Hermeneutics. *Journal of Economic Behaviour & Organization*, 3.

Lee, 2000). LEE, Julie. (2000) Adapting Triandis's Model of Subjective Culture and Social Behaviour Relations to Consumer Behaviour. *Journal of Consumer Psychology*, 9.

Maibach, E. W., Rose-Renouf, L. A., Leiserowitz, A.(2008). Communication and Marketing As Climate Change-Intervention Assets. *Am J Prev Med*, 35.

Marechal, K. (2007). The economics of climate change and the change of climate in economics. *Energy policy*, 35.

Martinsson, J., Lundqvist, L. J. Sundström A. (2011). Energy saving in Swedish households. The (relative) importance of environmental attitudes. *Energy Policy*, 39 (9).

Mohr, D. (2000). Promoting sustainable behavior: An introduction to community-based social marketing. *Journal of Social Issues*, 56.

Nair, G. Gustavsson, L. Mahapatra. (2010). Factors influencing energy efficiency investments in existing Swedish residential buildings. *Energy Policy*, 38 (6).

Olson, M. E. (1981). Consumer attitudes towards energy conservation. *Journal of Social Issues*, 37.

Poortiga, W.; Steg, L.; Velek, Ch.; Wiersma, G. (2003). Household preferences for energy-saving measures: a conjoint analysis. *Journal of Energy Psychology*, 24.

Steg, L. (2008). Promoting households energy conservation. *Energy Policy*, 36.

Stern, 2000; STERN Paul. (2000). What psychology knows about energy conservation. *American Psychologist*, 47.

Stern, P. (2000) Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, 56.

Streimikiene D., Volochovic, A., Simanaviciene A. (2012). Comparative assessment of policies targeting energy use efficiency in Lithuania. *Renewable and Sustainable Energy*, 16.

Štreimikienė D.; Volochovic A. (2011). The impact of household behavioral changes on GHG emission reduction in Lithuania. *Renewable and sustainable energy reviews*, 15 (8).

Štreimikienė, D.; Šikšnelytė, I. (2014). Electricity market opening impact on investments in electricity sector. *Renewable & sustainable energy reviews*, 29.

Tonglet, M.; Phillips, P; Read, A. (2004) Using the Theory of Planned Behaviour to investigate the determinants of recycling behavior: a case study from Brixworth, UK. *Resources, Conservation and Recycling*, 3.

Zarnikau, J. (2003). Consumer demand for Green Power and Energy Efficiency. *Energy Policy*, 31 (15).

3. Websites

Abrahamse, W., & Steg L. (2011). Factors Related to Household Energy Use and Intention to Reduce It: The Role of Psychological and Socio-Demographic Variables. *Human Ecology Review*, 2011. Retrieved from <https://humanecologyreview.org/pastissues/her181/abrahamse.pdf> (07.02.2017).

Abrahamse, W.; Steg, L.; Vlek, C.; Rothengatter, T. (2007) The effect of tailored information, goal setting, and tailored feedback on household energy use, energy related behaviors, and behavioral antecedents. *Journal of Environmental Psychology*, Nyderland, 7. Retrieved from www.elsevier.com/locate/yjjevp (07.02.2017).

Darby, S. (2006) The Effectiveness of Feedback on Energy Consumption - A Review for Defra of the Literature on Metering, Billing and Direct Displays Environmental Change Institute, Oxford University. Retrieved from <http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf> (07.02.2017).

Howard, S. et al. (1969). The theory of buyer behavior. New York: John Wiley. Retrieved from <http://www.jagsheth.net/docs/A%20Theory%20of%20Buyer%20Behavior2.pdf> (07.02.2017).

Jager, W. (2000) Modelling Consumer Behaviour. Universal Press, Groningen. Retrieved form <http://dissertations.ub.rug.nl/FILES/faculties/ppsw/2000/w.jager/thesis.pdf> (07.02.2017).

Lutzenhiser, L. (2009) Behavioral Assumptions Underlying California Residential sector Energy Efficiency programs. California Institute for Energy and Environment Retrieved form: http://ciee-dev.eecs.berkeley.edu/energyeff/documents/ba_ee_res_wp.pdf (07.02.2017).

Noeren, D. (2007) CO2 Emission Reduction in the German Household Sector till 2050 – Barriers and Incentives. Retrieved form http://www.lumes.lu.se/database/alumni/05.07/thesis/Dominik_Noeren.pdf (07.02.2017).

Oikonomou, V; Becchis, F; Steg, L; Russolillo, D. (2009) Energy Saving and Energy Efficiency Concepts for Policy Making. Energy Policy, 11. Retrieved form www.elsevier.com/locate/enpol (07.02.2017).

Uzzel, R.; Rathzel, N. (2009) Changing relations in global environmental change. Global Environmental Change, 19. Retrieved form http://www.elsevier.com/wps/find/journaldescription.cws_home/30425/description#description (07.02.2017).

Wilson, Ch.; Dowlatabadi, H. (2007) Models of Decision Making and Residential Energy Use. Retrieved form <http://arjournals.annualreviews.org/doi/pdf/10.1146/annurev.energy.32.053006.141137> (07.02.2017).