Sanja STEVANOVIĆ[1]

ENERGY EFFICIENT RESIDENTIAL BEHAVIOUR IN SERBIA

Abstract. Due to the fact that buildings use almost half of available electric energy, an important step in reducing the energy consumption is the development of energy efficient behaviour in households. We have witnessed a number of energy efficiency promotional campaigns lately, both of a global and a national nature. However, humans have been adopting simple energy inefficient habits (leaving on the lights when not necessary, leaving on TV when no one watches it, leaving air-conditioner work when no one is home, leaving infotainment appliances in stand-by mode, using energy inefficient incandescent light bulbs) over long periods of time, and it is hard to expect that short term campaigns will have lasting impact on population.

In order to measure the level of energy (in)efficient behaviour in Serbia, we have performed an online survey among 2200 Serbian residents and, with the response rate of 17,7%, we have collected 389 responses. The survey contains questions on habits related to energy efficiency, on belief in a relation between climate changes and consumption of energy and fossil fuels, as well as on socio-economic data. The statistics reveal a need for further improvement in energy efficient residential behaviour, with respect to five energy inefficient habits mentioned above. In order to achieve lasting results, it is necessary to make a transition to a lasting promotion of energy efficiency and other energy topics by making them a part of educational curriculum in high schools.

Key words: *energy efficiency, Survey, Consumer behaviour*

1. INTRODUCTION

It is generally observed that buildings use a great amount of available energy for its operation and contribute significantly to the environmental impact of the society through energy consumption and associated CO_2 emissions. A great deal of current energy research and practice is concerned with achieving more energy

[1] Sanja Stevanović, Research Associate, Faculty of Sciences and Mathematics, Višegradska 33, 18000 Niš, Serbia. Supported by Research Grant TR 36035 of Serbian Ministry of Education and Science. *E-mail:* sanja_stevanovic@yahoo.com.

efficient buildings and low carbon energy generation in terms of technology, design, finance, policy and regulation. However, buildings are used and controlled by their occupants, and it is occupants' energy-related understanding and behaviour that has an enormous impact on the final building energy consumption. This is the reason why education, training and motivation of humans in order to change behavioural patterns that address the energy use of buildings are so prominent in developed world today. Most common form of such actions present in Serbia are the awareness raising campaigns. Although we have witnessed a number of energy efficiency campaigns lately, humans have been adopting simple energy inefficient habits over long periods of time, and it is hard to expect that short term campaigns can have lasting impact. From that reason, our goal here was to estimate the level of energy (in)efficient behaviour through a survey of residents of Serbia and to test the existence of correlations with socioeconomic data. The survey and its administration are described in detail in Section 2, the descriptive statistics of its results and discussion are presented in Section 3, while conclusions are given in Section 4.

2. SURVEY

The survey consisted of four parts: energy efficient habits, climate change understanding, renewable energy support and socioeconomic data. The first part was related to simple, but frequently ocurring habits related to inefficient energy use: leaving on the lights when not necessary, leaving on TV when no one watches it, leaving air-conditioner working when no one is at home, leaving infotainment appliances in stand-by mode, using energy inefficient incandescent light bulbs. The second part was related to understanding and belief in relation between climate change and the use of fossil fuels, energy saving and renewable energy. The third part consisted of just one question, aimed at testing whether residents are informed of the existence of feed-in tariffs introduced by Serbian government in 2009 [1]. The fourth part consisted of socioeconomic questions, aimed to estimate the wealth of residents and to test possible correlations to other parts of the survey. Due to the reluctance of people to explicitly reveal wealth of their households, we have roughly estimated it using the descriptors such as the level of completed education, the age of car, taking the summer and the winter vacation during the previous year etc. The actual survey questions are given in Table 1.

Due to limited research funds, the survey was first organized as a mail survey among 200 randomly chosen household owners in Niš, which were uniformly distributed among local communities in Niš using geographical information system available at http://gis.ni.rs. Each respondent was sent an official letter from the Faculty of Sciences and Mathematics that the enclosed survey is to be used in academic research, together with a stamped return envelope. After having re-

Table 1. Survey questions.

	Energy efficiency habits	Possible replies
Q 1	Do you shut doors and windows when the air-conditioner is turned on?	Yes/No
Q 2	Do you turn off the lights when they are not necessary?	Yes/No
Q 3	Do you turn off TV when no one watches it?	Yes/No
Q 4	Do you leave the appliances in stand-by mode (by turning them off on remote control)?	Yes/No
Q 5	Do you use energy efficient (compact fluoroscent) light bulbs?	Yes/No
	Climate change	Possible replies
Q 6	Do you know which gas is responsible for climate change?	Any text
Q 7	Do you believe that climate change is related to the use of fossil fuels?	Yes/No
Q 8	Do you believe that climate change can be slowed down by saving energy?	Yes/No
Q 9	Do you believe that climate change can be slowed down or even stopped by using renewable energy sources (sun, wind, geothermal and biomass)?	Yes/No
	Renewable energy support	Possible replies
Q 10	Do you know that Republic Serbia has introduced feed-in tariff to pay to private firms and persons for generating electric energy from small hydro, biomass, wind or photovoltaic power plants?	Yes/No
	Socioeconomic data	Possible replies
Q 11	Number of household members?	Multiple choice: 1, 2, 3, 4, 5, 6, 7 or more
Q 12	Highest level of completed education among household members?	Multiple choice: Masters degree, Bachelor degree, High school diploma, Elementary school diploma
Q 13	How old is a car in your household?	Multiple choice: 0–3 years, 4–6 years, 7–10 years, 11 and more years, no car
Q 14	How do you heat your household?	Multiple choice: wood, charcoal, natural gas, electricity, district heating
Q 15	Do you have an air-conditioner in your household?	Yes/No
Q 16	Do you have a dishwashing machine?	Yes/No
Q 17	Have you been to summer vacation during the last year?	Yes/No
Q 18	Have you been to winter vacation during the last year?	Yes/No
Q 19	Have you visited one of Western European countries?	Yes/No

ceived only 33 replies (16.5% response rate), we have implemented an identical online survey at a free online system http://www.1ka.si. The second time invitations to participate in the survey were sent by e-mail to 2000 employees of schools

in Serbia (faculties, high and elementary schools). Interestingly, with 356 replies we have received, the response rate turned out to be very similar – close to 18%. From low response rates like these, we are tempted to think that responses came mostly from people having a positive attitude towards energy efficiency, climate change and renewable energy.

3. DESCRIPTIVE STATISTICS

The descriptive statistics for the first part of the survey are depicted in Figures 1 and 2. Note that the „yes" answer represents a positive energy efficiency habit in questions 1, 2, 3 and 5, while it is represented by the „no" answer in question 4. As we can see, only the first habit – shutting down doors and windows when the air-conditioner is turned on – is widely accepted. However, it is quite alarming that one third of respondents is leaving the TV working when no one watches it! Further, almost 85% of respondents leaves consumer electronics in stand-by mode, during which it still consumes electricity. Having in mind that information and communication technologies and consumer electronics now account for 15% of global residential electricity consumption [2], these two habits represent a considerable waste of electric energy in households. Relatively low presence of energy efficient light bulbs may easily be explained by their high price and unpleasantly cold light colors. Cumulative presence of positive energy efficiency habits show that most respondents have adopted three or four of these habits, but clearly there is a room for further im-

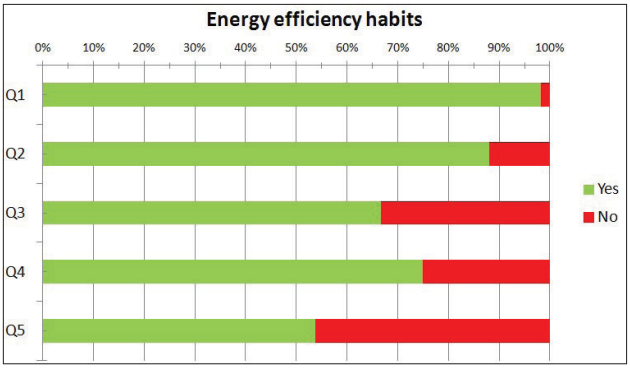

Figure 1. Proportions of positive replies to Q1–Q5.

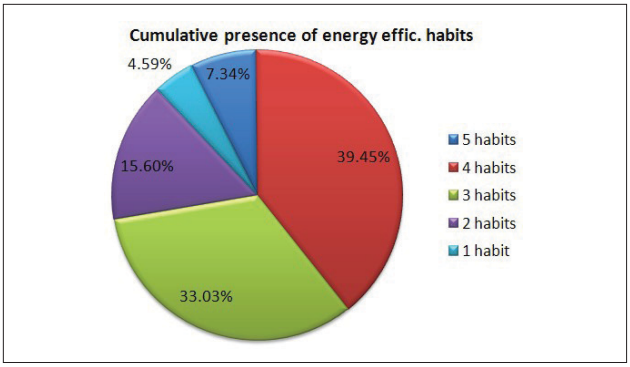

Figure 2. Cumulative replies to Q1–Q5.

provement of their understanding of energy efficiency.

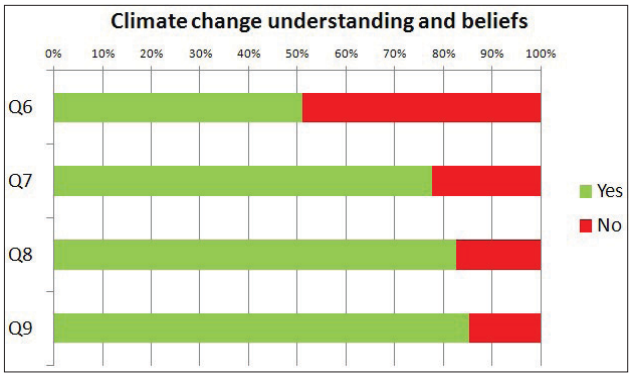

Figure 3. Proportions of positive replies to Q6–Q9.

The second part of the survey shows that, while only a half of respondents understands that CO_2 is a main cause of climate changes, most of them believe that climate changes can be successfully fought by reducing the use of fossil fuels, saving energy and introducing renewable energy sources. However, the fact that only 27.5% of respondents is *aware of the existence of feed-in tariffs for electricity generation* suggests that majority of respondents leave the care of exploitation of renewable energy to the government.

While the fourth part of the survey reveals, for example, that the average household size is 3.98, the average car age is 7.14 years, that most households are, expectably, heated either by wood or by district heating, that 62.8% had summer vacation and 20.2% had winter vacation during the last year, no statistically significant correlation has been observed between the wealth indicators and the energy efficiency habits of respondents. This is similar to conclusions reached in [3] with regards to the adoption rates of energy-efficient appliances.

4. CONCLUSIONS

The nonexistence of significant correlation between socioeconomic data and energy efficient behaviour suggests that one has to influence all levels of society equally in order to reduce residential energy use. A simple and lasting solution is to introduce energy efficiency as important part of the elementary school curriculum (e. g., within the subject of home economics), which would gradually influence whole population in a longer period. Positive benefits of such approach have been already experimentally observed in [4].

At present, educational curriculum in Serbia inadequately treats the subject of active, responsible and ecologically and economically acceptable relation to energy–a topic of energy efficiency is taught only as a small part of the theme *Environment and sustainability* in the subject *Biology* in 8 th grade of elementary school. A good step forward is a project implemented by Research station Petnica [5], which teaches and influences participants of their educational programs about

energy efficiency. Although these participants can further spread the influence to their parents and friends in schools, it should be noted that participants of Petnica programs represent a very small sample of young population. Thus, the only right step in reducing residential energy use is to increase the share of energy efficiency topics in the compulsory part of educational curriculum of elementary schools.

LITERATURE

[1] Government of the Republic of Serbia, „Decree on Measures of Incentives for the Production of Electricity using Renewable Energy Sources and Combined Electric and Thermal Power", *Official Gazette RS 72/09.*

[2] International Energy Agency, „Gadgets and Gigawatts: Policies for Energy Efficient Electronics", *available at* http://www.iea.org/textbase/nppdf/free/2009/gigawatts 2009.pdf, *last accessed October 6, 2011.*

[3] B. Mills and J. Schleich, „What's driving energy efficient appliance label awareness and purchase propensity?", *Energy Policy 38 (2010), 814–825.*

[4] N. Zografakis, A. N. Menegaki and K. P. Tsagarakis, „Effective education for energy efficiency", *Energy Policy 36 (2008), 3226–3232.*

[5] N. Božić, „Energija za budućnost", Istraživačka stanica Petnica, available at http://almanah.petnica.rs/25/25.html, last accessed Oct 6, 2011.

ENERGETSKI EFIKASNO PONAŠANJE PRI STANOVANJU U SRBIJI

Sažetak. Uzimajući u obzir činjenicu da zgrade koriste skoro polovinu raspoložive električne energije, jasno je da razvoj energetski efikasnog ponašanja građana predstavlja važan korak ka smanjenju potrošnje energije u domaćinstvima. Svjedoci smo velikog broja promotivnih kampanja o energetskoj efikasnosti u posljednje vrijeme, kako na globalnom, tako i na nacionalnom nivou. Ljudi su, međutim, jednostavne energetski neefikasne navike (ostavljanje upaljenih svijetala kada nijesu neophodna, ostavljanje uključenog TV aparata kada ga niko ne gleda, ostavljanje klima uređaja da radi kada nikog nema kod kuće, ostavljanje elektronskih uređaja u stand-by režimu rada, korišćenje energetski neefikasnih užarenih sijalica) sticali tokom dugog vremenskog perioda, tako da je teško očekivati da kratkotrajne kampanje mogu imati trajan uticaj na populaciju.

Kako bismo izmjerili nivo energetski (ne)efikasnog ponašanja građana Srbije, sproveli smo Internet anketu među 2200 građana i, sa stopom odgovora od 17,7%, prikupili smo 389 odgovora. Anketa sadrži pitanja o navikama vezanim za energetski efikasno ponašanje, o vjerovanju o povezanosti između klimatskih promjena i potrošnje energije i fosilnih goriva, kao i o socioekonomskom statusu. Statistika otkriva potrebu za daljim unapređenjem energetski efikasnog ponašanja u domaćinstvu, u odnosu na pet gorepomenutih energetski neefikasnih navika. Kako bi postigli trajne rezultate, neophodno je napraviti prelaz ka trajnoj promociji energetske efikasnosti i drugih energetskih tema čineći ih dijelom obrazovnog programa u višim razredima osnovnih škola.

Ključne riječi: *energetska efikasnost, anketa, ponašanje potrošača*