Diffusion of renewable energy innovations – innovation-acceptance behaviour of the Hungarian society[1]

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Nowadays, innovation and its diffusion represent a crucial phenomenon of economic practice and economic theories. The increase of the proportion of renewable energy consumption is an essential task of the governments worldwide; however, it has been quickly acknowledged that, in the diffusion of such innovations, social acceptance could mean a serious obstacle. The paper investigates the innovation-acceptance behaviour of the Hungarian society. It focuses on the following aspects: the moment when consumers adopt alternative energy resources, the motivations they base their decisions on and, moreover, the communicational processes and segments that characterize the acceptance procedure, especially regarding the role of information. According to research results it can be concluded that Hungarian society adopts innovations similarly to the presented theoretical background, appreciate the financial advantages of an ecologically sustainable energy source and can be influenced by a prior trial. The third result of the paper is the identification of three clusters that can provide a good basis for a communication strategy.

Keywords: renewable energy, innovation acceptance, diffusion of innovation, alternative energy consumption, social acceptance, consumer behaviour.

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Introduction

People of the 21st century meet such worldwide problems as air pollution, scarcity of water supply and effects of fossil energy sources on our everyday lives. In line with these, one can also mention renewable energy sources, their usage being able not only to help out budget but to protect the Earth for future generations as well. Increasing the share of renewable energy is high on the policy agenda of the governments worldwide. However, it was quickly acknowledged that there is one factor that can potentially be a powerful barrier to the diffusion of such innovations: their social acceptance. The paper presents one slice of a bigger research carried out in the frames of SROP-4.2.2.A-11/1/ KONV-2012-0058, Modeling the effects of the energy-production, utilization and waste management technologies to the competitiveness of the cities and regions. The aim of the research is to study the social acceptance of the ecologically sustainable technologies in Hungary, primarily the residential energy consumption. For reaching this aim, designed on literature base, a personal interviewing was carried out. The present study reveals the innovation acceptance behaviour of the Hungarians as a part of the overall research. It focuses on the diffusion of ecologically sustainable energy technology innovations in society, namely the moment when the consumers adopt the new energy sources, the motivations they base their decision on and the communication processes that characterize the social acceptance of such an innovation, especially regarding the role of information.

Literature review

Nowadays, innovation is a crucial phenomenon of economic practice and economic theories, on the turn of the 20th and 21st century. Its concept was introduced in the theory of economics by the Austrian economist Schumpeter (1980) in the 1930's as "the process born in a creative idea" and he was followed by a series of definitions. According to Vágási (2001) by synthesizing the different definitions innovation means new knowledge, ideas, methods, procedures, organizations, new

strategies, markets, new products or services and their establishment at any field supposed to be associated with some economic and societal development. When an innovation aims to win a market it is not only necessary to investigate the company side (as it is neither done in this study) but the company's innovativeness and its ability to accept as well. Several researchers and thus several fields of research deal with innovation diffusion and almost all of them are based on the theory of the "father" of innovation diffusion, Everett M. Rogers researching the topic since the early 1960's. Researchers of the diffusion defined by Rogers (2003) study the process by which the innovation is communicated through certain channels over time among the members of a social system. According to Rogers four main elements in the diffusion of innovations are: innovation, communication channels, time and the given social system. The typical process of the new product diffusion can be displayed as an S-curve that shows the cumulated percentage of the adopters of the innovation within the population concerned against time. Based on this it can be concluded that the percent of the new product adopters is low at the beginning, it gradually grows until the possible maximum where its steepness shows the proportion of acceptance and its maximum shows the market potential. Thus, while at the beginning of the diffusion relatively few people became users, the number of people joining started rising after a while and later it diminished again. Accordingly, people can be divided in groups based on the time of innovation adoption. According to Rogers' research on American consumers from 1962, five consumer types can be differentiated: innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%). This theory of Rogers is studied in our research as well.

Ecologically sustainable energy sources being different than the traditional, years-long familiar ones are also innovations. Increasing the proportion of renewable energy consumption is an essential task of the governments worldwide; however, it has been quickly acknowledged that in the diffusion of such innovations their social acceptance could mean a serious obstacle. According to Wüstenhagen et al. (2007)

Carlman was the first scholar defining the problem of social acceptance in her study on the acceptance of wind power in 1984 in which she suggested that there were several constraints for social acceptance. There are several features of renewable energy innovations that bring new aspects to the topic of social acceptance. Their implication in houses is specifically an investment decision of the individual, in which the energy conversion is carried out near to the customer ("backyard") and means short-term expenditure but long-term return at the same time. Wüstenhagen et al. (2007) intending to contribute to the clarity of the term's understanding distinguished three dimensions of social acceptance, namely socio-political acceptance, community acceptance and market acceptance that could be studied even independently in some cases. Based on the three dimensions detailed above, Sovacool and Ratan (2012) defined the conditional framework, the factors influencing acceptance. At the level of socio-political acceptance there is a need of strong institutional capacity, political commitment and favourable legal and regulatory frameworks. In case of market acceptance competitive costs, adequate information mechanisms and access to financing are needed. Furthermore, community acceptance depends on the presence of prolific use, participatory project siting and recognition of externalities. Besides, the acceptance of an innovation can also be influenced by some psychological factors. Wejnert (2002) specified characteristics of the innovation, innovators and environment, while Huijts et al. (2012) developed their model specifically regarding alternative energy consumption by defining three types of motives for the individual. Depending on whether the acceptance of energy innovation is motivated by gain, normative or hedonic goals, individuals (1) can evaluate costs, risks and benefits, (2) can perform an evaluation based on moral aspects thus weighing whether the new technology has more positive or negative effects on the environment and society, and (3) can make a decision based on their positive or negative feelings such as satisfaction, happiness, fear or anger. In addition to these knowledge and experience, trust and fairness have an essential role. The study of

McMichael and Shipworth (2013) is focusing on the diffusion of energy-efficiency innovations in households in the UK. Authors built upon Rogers' network theory and also investigate the significance of social capital. Supposing that the desired information is in connection with energy-saving innovations, the individual would ask someone, for instance, and would receive technological knowledge, experience or an argument as an answer. This practically means mobilizing the social capital, thus the authors are striving to understand the information-seeking within the communication channels regarding energy-saving opportunities through the theory of social capital. The research shown in the paper is based on the presumption that the above mechanisms are true for the Hungarian innovation acceptance behaviour as well, and the listed factors affect the willingness to apply an alternative energy source also in case of the investigated sample.

Methodology

Paper-based face-to-face interviews were carried out with a sample of 2000 people that is representative for gender, age, settlement type and highest level of education criteria, considering the Hungarian population as the base population. The questionnaire used in the face-to-face interviews is not processed entirely in the present study; we investigate only the elements regarding the basic consumer behaviour reactions on innovations and changes: acceptance of innovations and alternative energy sources in the society and behavioural elements regarding the information source. The analysis was done by using SPSS and Microsoft Excel software.

The sample consists of 52.2% of women and 47.8% of men. The majority of the respondents possesses secondary school degree (41.4%); besides, there is a higher proportion of respondents with vocational school qualification (27.5%) than those with college (14.2%) or university (4.5%) degree and primary school qualification (9.6%). 57.4% of the respondents live in a house. Regarding the age groups, 24.8% of the respondents belong to the group of 18-29, 18.6% to 30-39, 21.7% to 40-49, 16.9% to 50-59 and 18.1% to the group over 60 years.

41.6% of the respondents are married, 33.9% live with a partner and child while 21.9% only with a partner.

Results and discussion

As the overall aim of our research is to help the enhancement of using sustainable energy sources by studying current attitude of the Hungarian society regarding innovation acceptance, more fields of this topic are presented in this chapter. Based on Rogers' (2003) theory one investigates the groups included in the sample in terms of time of adoption of an energy resource, motivations of innovation acceptance and segments that can be identified in connection with the credibility and source of the information, and at the same time regarding communication target groups which can be identified for enhancement of renewable energy consumption.

Time dimension of innovation adoption

As mentioned in the previous chapter, people can be divided into five categories based on their attitude towards using an innovation. As Rogers defined (2003) these are the groups of innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%), acting along different behavioural features. Initiated by this theory, we intended to see whether there are any groups in the sample based on the time dimension of using an innovation. Using Rogers' adopter groups and their behavioural features we set five statements for each category and tried to identify these groups in the sample of our study:

- innovators: "I am really open to new things, I begin to use them as one of the firsts";
- early adopters: "I buy them when they are still new, I like getting familiar with innovations myself and then give advice about them to others";
- early majority: "I am open to new things but after others already use them";
- late majority: "I am curious about new things but I wait until their price gets lower";

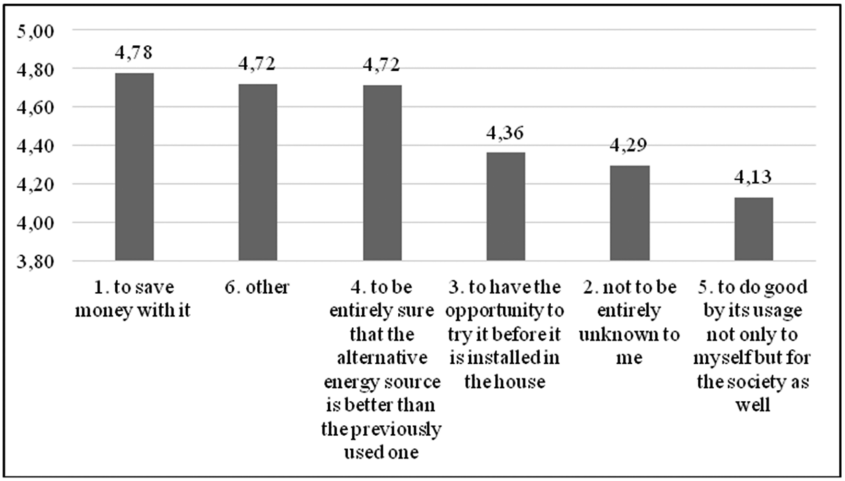
• laggards: "I do not buy innovations, I do not want to be the tester".

The respondents were asked to choose the statement most suitable for them in connection with a new product or method emerging on the market. The results were also evaluated in comparison with Rogers' results used as a reference point. According to the results, 6% of the respondents belong to the innovator category being two times larger than the basic category in Rogers' theory (2.5%). It can be concluded that the participants at the survey are more open to innovations and like to use new things more than it could be presumed based on the secondary data. The category of early adopters is theoretically 13.5%, but its size is a lot smaller in our sample as only 8% stated they buy innovations when they are still brand-new as they like getting familiar with them themselves and give advices to others. Two segments being practically the initiators of the innovations are altogether smaller than they should be according to the theory; however, compared to Rogers there is a higher proportion of those – according to their statement – who really introduce innovations to the society. The group named early adopters is larger in our research with 4% than the one presented by Rogers while late majority represents itself in almost the same proportion. However, the category called laggards is smaller with 3.5% as instead of 16% it is only 12.5%. All in all, according to the results, Rogers' adopter categories can be identified in our study on the innovation adoption of the Hungarian society as well. However, a slight shift can be realized towards the ones more open to innovations. Identifying when people start to use an innovation can be an essential base for studying further behavioural elements with the overall aim of enhancing usage of sustainable energy sources.

Motivations of innovation adoption

The respondents were asked to evaluate on a five-point Likert scale the importance of the listed aspects (1 – not important at all, 5 – very important) in case of deciding to use an alternative energy source or not: to save money with it; not to be entirely unknown to me; to have the

opportunity to try it before it is installed in the house; to be entirely sure that the alternative energy source is better than the previously used one; to do good by its usage not only to myself but for the society as well.



Source: own editing

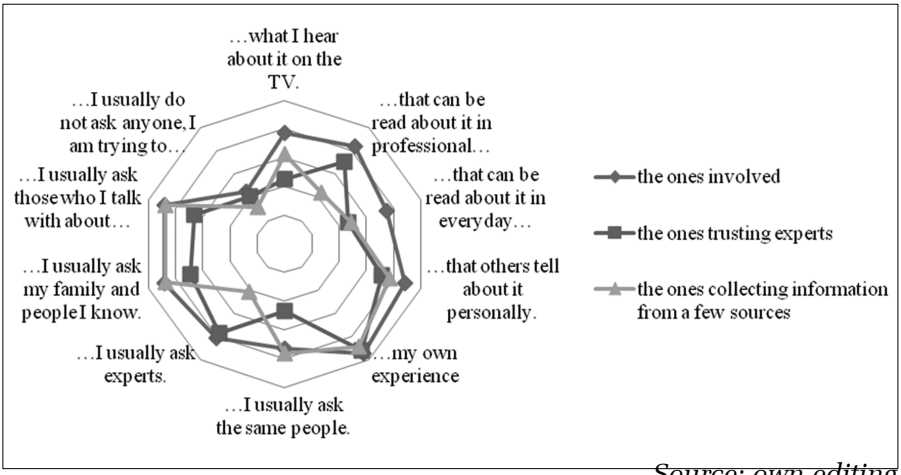
Figure 1: How important are the listed aspects to you when you decide about applying an alternative energy resource? (N=2000)

According to the respondents the most important aspect regarding the decision about applying an alternative energy source is to save money with it and it is similarly important to them to be sure that the new energy source is better than the one previously used. Still important to them is to have the opportunity to try the given technology before installing it in their house and also not to be completely unknown for them. The least important factor for the respondents is to do good not only for themselves but for the society as well by using an alternative energy source. Thus, it can be concluded that all listed aspects are important to them when making such a decision as all the average ratings are above four on the five-point scale (Figure 1). The aspect of doing something good not only for ourselves but for the whole society as well was rated at least with 3 on the five-points scale by 94% of the respondents although this is very

important only for 48% of them. In connection with this it is worth investigating the aspects and their importance included in the "others" category. 53 persons, only 2.5% of the sample, mentioned other factors to be considered in case of starting to use a new, alternative energy source. Regarding their importance, they are all important, thus they received the following rates on the scale: 4.68 is the average rating of environmental protection, 4.67 of the price and 4.5 of the "valuable and useful" category. Nearly 40% of the ones mentioning some other factor emphasized environmental protection as an important or very important aspect in decision making. It can be concluded that, taking into consideration the society, it is highly rated but at the same time it is the least important factor from the listed ones. One must add that the most frequently mentioned factors in the "other" category are associated with this. 26% of the respondents mentioning something "other" consider that the price is a crucial influencing factor as well, and some of them mentioned some important aspects such as the quick return, not to go hand in hand with destruction, to work for sure, to be long-lasting, easily used, useful, to be able to find a specialist for it, to be able to benefit entirely from its advantages, and to be implemented easily. These factors identified in our research are considered to be essential in the studies shown in the previous chapter as well (Sovacol and Ratan 2012; Wüstenhagen et al. 2007; Huijts et al. 2012). Accordingly, in case of a decision about the usage of an alternative energy source the primary aspect is whether one can save money and whether it is better than the previous one. Although the triability of the new energy source and not being completely unfamiliar with it are important factors but not unambiguously "very important" ones, opinions are divided when it comes to the importance of the factor about doing good for not only ourselves but for the society as well. It seems that by the introduction of an ecologically sustainable energy source, Hungarian residents appreciate its financial advantages (saving money) and it can also be influential if, based on a trial, the individual can make sure of it being better than the previously used one.

Groups formed by source and credibility of information

Being well-informed and the information base itself occur in the literature as quiet essential factors in enhancing the introduction or usage of an alternative energy source. The possibility of forming clusters in the sample, according to the source of information and the credibility of the received information, serving as a base for targeting in case of a communication strategy was investigated in the research. According to the results the respondents can be divided in three groups by K-means cluster analysis: "the ones involved" (44%), "the ones trusting experts" (33%) and "the ones collecting information from a few sources" (23%) (Figure 2). In what follows, the characteristics of the chapters are presented. There is a significant difference ($p<0,05$) between the clusters in case of every feature.



Source: own editing

Figure 2. Groups formed by source and credibility of information

The ones involved

The group of the ones involved is almost the most balanced segment. They consider any information possibly important thus they would like to know about everything; they mostly believe the information from their own experiences or the one they get from

someone personally about an alternative energy source. Things read in professional journals are convincing for them as well and they also pay attention to the information gathered from the TV or everyday papers.

They collect information from their family or people they know about an energy innovation as they do in case of other topics as well and they usually ask the same people with this aim. This segment is interested in the professional opinion of experts but they primarily collect information from people living close to them. Accordingly, they can be characterized by a high involvement when they want to get to know a new technology as these people try to find as much trustworthy information as they can; they thoroughly deal with the problem as they are not only interested in outside but in also direct information.

This is the most populous cluster as 880 respondents (44%) belong to the group of the involved ones out of the 2000-member sample. Although this is not the group where the largest number of women is present but there are more involved women (55%) than men (45%) – this can come from the specialty of the topic or even from the stereotypic traits characterizing the genders. Their majority belongs to the age group of 40-49 (24.7%) or to the young age group of 18-29 (23.1%); all in all more than 43% of them feels to be part of the middle-aged generation, while 42% marked the young generation for this answer. 45% possesses college or university diploma although the highest percentage of primary school qualification is also here (24.7%). They mostly consider the financial situation of their household to be moderate, 46% can buy the basic things but do not have money for others while 42% can afford some extra expenditures next to the basic ones but cannot save any money (N=1917). Compared to other groups they are the closest ones to the environment.

Equally to the ones trusting experts, 63% of the involved ones are open to modernization of their homes to reduce energy costs; 23% (two percentage points more than the ones trusting experts) have already carried out some kind of modernization, 40% have planned but have not done anything and 37% have not thought about this. The latter two categories were also asked to express their reasons. The majority of the group (56%) is restrained from modernization with the aim of reducing

energy costs because any change would lead to high expenditure, therefore they can be called to be price sensitive. 13% marked the option of not interested in the topic at all as an answer and quite a few of them answered not to have enough information or professional help in implementation. It seems that they are aware of the fact (more than 90%) that return on this investment would appear in long-term.

The ones trusting experts

The ones trusting experts are primarily convinced by their own experiences and by the information gathered from professional journals about an alternative energy source. Tools of mass media are slightly effective in their case as they do not appreciate information coming from the TV or everyday papers. When they collect information about a new technology, they rarely do this on their own and neither is typical that they would ask the same people every time. They are much more interested in expert opinions and perhaps the ones living in their close environment, family or people they know.

This is the second most populous cluster, 660 persons (33%) belong to it, out of the 2000-membered sample. This is the only segment where the proportion of men (55%) is averting the number of women (45%) that is supposed to be in connection with the fact that men are usually more familiar with the world of technology than most of the women. 27% of them are young (18-29 years old), 22% belong to the age group of 40-49, 18% to 50-59 while nearly 47% feel to be middle-aged and 43% to be young. More than 70% (71.4%) possess secondary or vocational school qualification. They evaluate their household finances to be a bit better than the category of the involved ones, 47% can buy the basic things and can also afford some extra expenditures but cannot save money, while 41% cannot spend money on things above the basic level. In this group there are more members who cannot even buy the basic things (7%) than in the previous group. After the involved ones, this group feels to be closest to the environment. 7.1% of all the answers (N=1991) belong to the group of trusting experts from those who rated this question with ten on the ten-point scale. Out of 1990 answers only 4.5% of the ones trusting experts felt to be environmental friendly and protecting the environment, which result is less than the involved ones by 3 percentage

points although still higher than the one of the third group.

63% of the ones trusting experts are open to the modernization of their home to reduce energy costs, similarly to the involved ones, but 2 percentage points less claimed to have already carried out something. 37% chose the answer "have not thought about this". The ones who have been already thinking about it but have not carried out anything or the ones who have not been thinking about this topic, also gave their reasons. The costs were the most frequently marked reason for not carrying out any modernization although this is by three percentage points less (54%) than the ones' involved. It can be observed that more members from this group do not live in their own apartment and more mentioned (10%) not to possess enough information about the opportunities. Similarly to the involved ones 13% marked that they are not interested at all in the topic. Thus, this group can also be price-sensitive besides the fact that that they can be influenced by a satisfying amount and quality information coming from experts or found in professional journals.

The ones collecting information from a few sources

The segment of the ones collecting information from a few sources is the smallest one as it consists of 460 persons (23%). They mostly do not make an effort to get information about innovations, about a new technology or about an alternative energy source. The most convincing information is coming from their own experiences or personal contacts but they consider things on TV moderately trustworthy as well. They are not persuaded by the information in professional journals or everyday papers thus they are not susceptible to print media. When collecting information they ask someone, however, not experts but those who they contact anyway, their family members and people they know (similarly to the involved ones but more than the ones trusting experts). They contact more the same people than the ones trusting experts as this latter category considers the professional opinion important thus supposedly they ask experts about the given problem.

This is the most feminine group (58%) and this group includes the lowest proportion of men (42%). This could come from a presumption that women are less interested in new technologies thus they make less

effort to gain information, however, this can be denied as in the group of involved people trying to find as much information as possible 55% are women. This is the group with the highest proportion of people above 60 years (23.7%) and at the same time 25% of the cluster ranges between 18 and 29 years. 40.6% feel to be young and 37.4% consider they belong to the middle-age generation. There are far less people with a diploma (12%) and while in the group trusting experts there is a proportion of 71% possessing at least secondary degree, in this category only 50% have secondary degree.

While the previous two clusters – although marking a moderate level regarding the financial situation of the household – chose the stronger, better financial level categories, this group of the ones collecting information from few sources rated themselves to possess a higher financial status by 14 percentage points less. 50% can buy the basic things but nothing else and 36% can afford some additional expenditures as well but cannot save money. They feel to be far away from the environment and they are the last to think to be environmental friendly or environmentalist.

Here is the highest percentage of those who are not interested in energy-cost-reducing modernization (57%) and the lowest proportion of those who have been thinking about modernization but have not done anything (30%) or have already done something (14%). The respondents of the first and second category gave a reason for that as well. The respondents from this cluster also mentioned more than the involved ones that they do not have enough information (7%); 12% do not live in their own apartment thus do not want to spend money on modernization and here is the largest group of those who are not interested in the topic at all (23%). Accordingly, they are the least inquiring group which can be in connection with their financial status or even with their qualification. Perhaps this is the segment that could be reached most difficultly, they are by all means price-sensitive as the cost of a modernization means an obstacle for them; moreover, they are the most disinterested group of all the three.

Summary of the clusters

According to the above details, three groups can be formed in the sample (being representative for the Hungarian society) regarding the information about alternative energy source. Table 1 summarizes the features of these clusters. The research tried to find whether there are some identifiable groups in the sample that can be used as target groups in case of a communication strategy.

Table 1. Summary of cluster features

	The ones involved	**The ones trusting experts**	**The ones collecting information from a few sources**
Information about an alternative energy resource	*"everything can be important"*	*"searching professional sources"*	*"no big efforts done"*
Gender	55% women	55% men	58% women
Age	40-49 (24,7%) 18-29 (23,1%)	18-29 (27%) 40-49 (22%) 50-59(18%)	above 60 (23,7%) 18-29 (25%)
Qualification	diploma (45%) primary school (24,7%)	secondary or vocational (71,4%)	at least secondary school (50%)
Financial situation	46% basic expenditures 42% some extra expenditures	41% basic expenditures 47% some extra expenditures	50% basic expenditures 36% some extra expenditures
Attitude towards the environment	more environmentalist	moderately environmentalist	farest from being environmentalist
Modernization of their homes to reduce energy cost	open and has done the most	open but more only planning	less open and the most not interested
Reason of not open to modernization of their homes to reduce energy cost	cost	cost	cost and no interest

Source: own editing

According to the results three segments can be identified from which the group of the involved ones and the ones trusting experts seem to be the most susceptible for adoption of alternative energy sources and can become available by the proper communicational tools.

Conclusion

Results shown in the study are a slice of a bigger research that aims to investigate social acceptance of ecologically sustainable

technologies, focusing on the residential energy consumption. The relevance of the research is unquestionable as, mostly, our environment falls victim to the nowadays running, consumption-centric world and it would be useful to know the basis that can be influenced for reaching the aim of enhancing renewable energy consumption.

The study investigates more fields. On the one hand, based on Rogers study (2003) we intended to identify adopter groups divided on the basis of time dimension – namely the innovators, early adopters, early majority, late majority and laggards – in the sample of our research. According to the results our sample shows similar proportions as the theoretical background although a slight shift can be observed towards the ones open to innovations. In connection with this, factors that weight in a decision about installing an alternative energy source are also shown where according to the respondents' opinion we are more open to apply a new, renewable energy source when we can save money and we are also influenced by the level of how sure we are that the new source is better than the previous one. On the other hand, the possibility of forming clusters within the sample according to the source of information and the credibility of the received information, serving as a base for targeting in case of a communication strategy was investigated. According to the results the respondents can be divided in three groups: "the ones involved" (44%), "the ones trusting experts" (33%) and "the ones collecting information from a few sources" (23%) out of which the ones involved and trusting experts could become available through the proper communication ways characterizing them. With a consciously designed communication strategy, based on the results of the research, these types of people could be convinced to use renewable energy sources thus we could get one step closer to save our environment for the following generations.

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