USING ENERGY SAVING FUNCTIONS: PERSONAL OPINIONS

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Abstract

Conscious management of energy is a socio-technical problem. The spread of energy-saving features in technical devices contributes to cost savings and helps address climate change issues. However, such features are only useful when they are in use. Understanding personal approaches to energy savings is crucial for effective policy development, regardless of the structure of energy production systems. The pilot study results presented in the paper demonstrate an experiment designed to explore personal opinions. Based on a sample of Hungarian higher education students (n=197), this analysis aims to explore grouping options for further research.

Introduction

The rising energy consumption of humankind is a complex technical and social problem. The distribution of energy production and consumption among countries is diverse, depending on the availability of resources, population, and socio-economic development. Of course, small countries like Hungary cannot be compared to big ones like the United States or China, but similar problems can be expected at the household level. According to the data from the Hungarian Central Statistical Office for 2023 [1], the primary energy use was 4,080.8 million tonnes of oil equivalent (mtoe) in China, 2,253.4 mtoe in the United States, and 1,299.9 mtoe in the 27 countries of the European Union. Within that, Hungary's use is 24.3 mtoe, Slovakia's use was 16.4 mtoe, and Romania's use was 30.8 mtoe. The latter data are highlighted because the population of Hungary is approximately twice that of Slovakia's and half that of Romania's, which is not proportional to the energy use data. At the same time, electrical and other appliances, including smart devices, computers, air conditioners, cars, heating systems, and numerous other tools and services, contribute to overall well-being. Goal 7 of the SDGs [2] aims to ensure access to affordable, reliable, sustainable, and modern energy for all, emphasizing the big problem that 675 million people (80% of whom are in Sub-Saharan Africa) still live in the dark. That suggests structural differences and the need for local investigations: while electricity is fundamental and decisive in many countries, others are excluded from it.

Furthermore, the complexity of the problem is underlined by the SDGs. Using fossil energy sources primarily affects climate change (Goal 13). The appreciation of renewable energy [3] [4] is unable to resolve the issues by itself, partly because consumption is still growing. Energy efficiency efforts [5] [6] cover the engineering efforts in the field, but these are worthless if the users' approach does not comply. A comprehensive overview of the trends and challenges is beyond the scope of this paper; the emphasis is on presenting the results of a survey, the purpose of which is to explore personal approaches to energy savings. Without the acceptance and proper use of energy-saving features of the devices, the expansion of economic goods further increases energy demand. It seems that bothering with individual use of energy-saving features is pale in comparison to national and international-level issues, such as climate change or economic impacts through the resource prices because of recent wars [7]; and accurate measurement on an aggregated level of such features is extremely limited. Despite the above, pioneering exploration experiments can contribute to model-building for policy-making purposes and supporting energy efficiency in product development.

Experimental

A voluntary online survey was designed to collect information about personal opinions about energy-saving functions and their utilization. The pilot survey results in this paper are based on the responses of 197 higher education students of business and social programs in Hungary. The sample composition is presented in Table 1.

Table 1. Sample characteristics

Grouping factor	Option	No of respondents	%
Gender	female	128	65.0
	male	69	35.0
Age	24 years old or less	127	64.5
	more than 24 years old	70	35.5
Level of studies	bachelor	114	57.9
	master	83	42.1
Own income	no	32	16.2
	partly	73	37.1
	yes	92	46.7

The goal of the study is to provide preliminary information about personal approaches to using energy-saving features of home devices and to identify potential patterns in opinions.
To measure the opinions (see Table 2), statements were formulated, and respondents were asked to indicate their level of agreement using a 7-point scale (1: strongly disagree, 7: strongly agree). The statistical analysis included the descriptives by questions and checking the differences by gender, age, and level of study by the Kruskal-Wallis H test ($p=0.05$). Having one's own income is also included by hypothesizing that paying the bills from one's own income tends to use energy more sparingly. An additional question asked the respondents to mark which devices they use with energy-saving features.

Results and discussion

Smartphones, tablets, notebooks, and lightning are the focus of energy savings, while desktop computers as well as other household appliances are out of this scope (Figure 1). Although the use of devices deemed important is frequent or continuous, these are not typically the ones with high consumption. It is encouraging that only 1,5% of the respondents noted not using any energy-saving features of the devices.
The mean values and the distribution of the responses (Table 2) suggest that energy-saving is considered a social expectation among the students. The belief in the usefulness of energy-saving features to improve well-being, reduce costs, and strive against environmental problems is high. The respondents did not find the use of the features difficult and did not reject buying such devices, but this is not the main factor in their decision. However, it is essential to consider whether some responses reflect only social expectations and do not accurately describe the actual behavioral intentions.

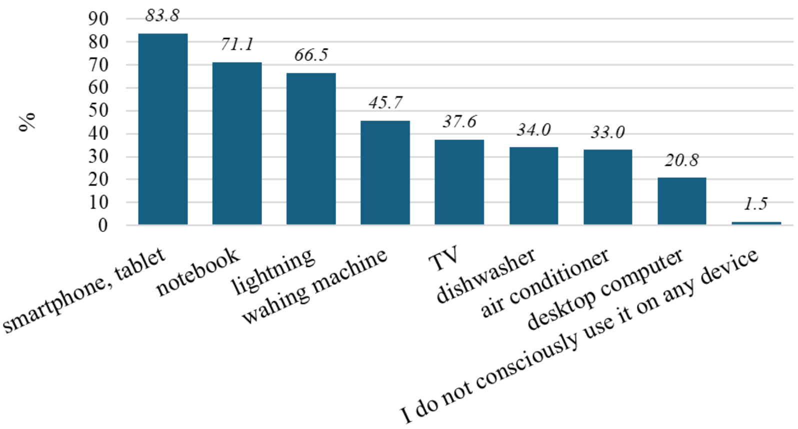

Figure 1. Using energy-saving features of the devices (% of the respondents)

Table 2. Descriptive statistics for the total sample (N=197)

	Mean	Std. Dev.	1 or 2 (%)	3, 4, or 5 (%)	6 or 7 (%)
Contribution: Energy-saving features of the devices…					
...help to reduce costs for me and my family.	5,43	1,333	2,5	47,7	49,8
...help to prevent global environmental problems.	4,85	1,463	7,1	59,4	33,5
...are worth a little discomfort.	5,13	1,397	4,5	49,2	46,2
...contribute to the well-being of society.	4,99	1,537	7,1	52,8	40,1
...help to increase the lifetime of the devices.	5,11	1,469	7,6	48,3	44,2
Personal aspects:					
Energy-saving features of the devices are easy to use.	5,68	1,219	1,5	38,5	59,9
Energy-saving options of the devices are not overcomplicated.	5,60	1,268	2,0	39,1	58,9
It will not take much time and effort to learn how to use energy-saving settings.	5,81	1,239	2,5	32,4	64,9
I have the knowledge, ability, and resources to use energy-saving options.	5,63	1,258	3,0	33,5	63,5
I intend to make efforts to save energy at home.	5,66	1,293	2,5	35,6	61,9
I measure or estimate my energy costs.	3,71	2,001	33,0	45,2	21,8
I prefer buying products with energy-saving features.	4,65	1,688	12,7	53,9	33,5
I usually buy energy-efficient household appliances.	4,63	1,696	12,7	52,3	35,0
I use energy-saving functions on many devices.	5,11	1,544	8,6	41,1	50,3
I encourage others to use energy-saving functions.	3,82	1,795	25,9	54,4	19,8
I always look for the energy-saving mode in the device settings.	4,31	1,761	19,3	50,8	29,9
I am satisfied with using the energy-saving features of the devices.	5,09	1,375	5,6	52,8	41,6

The sample shows a relatively uniform picture of the energy-saving features of devices. According to the contribution to well-being, the analysis found significant differences only by age. Elder respondents believe more that using these functions helps to reduce costs for the

family (x_{young}=5,25 x_{old}=5,74, Kruskal-Wallis H=6,989, p=0,008) and their contribution to preventing global environmental problems (x_{young}=4,68, x_{old}=5,16, Kruskal-Wallis H=4,038, p=0,044).
Among the personal aspects, females pay more attention to find the energy-saving mode in device settings (x_{female}=4,55 x_{male}=3,86, Kruskal-Wallis H=7,692, p=0,006), they are more satisfied with the features (x_{female}=5,22 x_{male}=5,86, Kruskal-Wallis H=4,055, p=0,044), and they more open to learn how to use them (x_{female}=5,91 x_{male}=5,61, Kruskal-Wallis H=4,540, p=0,033). Significant differences were found in the level of studies in the contribution of energy-saving features to well-being ($x_{bachelor}$=5,20, x_{master}=4,71, Kruskal-Wallis H=4,163, p=0,041) and increasing the lifetime of the device ($x_{bachelor}$=5,29, x_{master}=4,86, Kruskal-Wallis H=4,013, p=0,045), suggesting a more positive attitude of the bachelors compared to master students.

Table 3. Significant differences by the factor having his or her own income

Item	Mean value			Kruskal-Wallis H (d_f=2)	sig.
	No income	Partly	Having own income		
I measure or estimate my energy costs.	2.84	3.49	4.18	12.174	0.002
I prefer buying products with energy-saving features.	3.66	4.44	5.17	23.677	<.001
I usually buy energy-efficient household appliances.	3.44	4.6	5.08	25.224	<.001
I use energy-saving functions on many devices.	4.44	5.08	5.37	6.277	0.043
I always look for the energy-saving mode in the device settings.	3.44	4.32	4.61	10.594	0.005
I am satisfied with using the energy-saving features of the devices.	4.53	5.22	5.18	6.205	0.045

The results suggest, as hypothesized, that one's own income comes with greater responsibility; however, not all differences are significant (Table 3).

Conclusion

Saving energy is a social interest. New product development of corporations incorporates energy efficiency, partly due to policy and legal pressure. National and global results are measurable through energy production and consumption indicators; sustainability can be supported by increasing the share of renewable energy sources. Ultimately, technological development must be accepted and applied by households. Both measures and measurements are generating greater challenges at this level. Understanding the personal approaches and driving factors for energy-saving is essential to support future policy-making.
Considering that it is a pilot study, the generalization of the results is not possible. After validating the survey questions, a broader sample is required to test any hypothesis. Nevertheless, the survey results show that higher education students are aware of the energy-saving features of ICT tools and other household appliances; however, this awareness is not the primary driving force behind their product choices. It appears that small achievements are being made: devices with high power consumption are less in focus. At the same time, these devices

are in almost continuous use. A deep analysis is needed to build user profiles for estimating the energy use of individuals and households. Moreover, the hypothesis seems to be correct that managing one's own income has an impact on energy-conscious thinking; it is worth conducting further investigations in the field to map the influencing factors.

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