

ANALYSIS OF AWARENESS OF ELECTRICAL ENERGY CONSUMPTION IN COMPANIES AND HOUSEHOLDS

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Abstract

In this paper are shown results of the research about the awareness of the employed persons in Doboj (BiH) about the energy consumption and costs in companies and also in households. Analysis is performed based on the respondent answers and correspondent tests of questionnaires collected among employed persons. Questionnaire is organized in three main topics about other sources of energy, including fossil fuels and renewable energy as a supplementation and/or replacement for the electric energy. In the conducted research 150 fulfilled questionnaires were collected, representing the respondents opinion about the importance of source of energy related to companies' energy costs. In this paper relation between of awareness about the energy consumption costs in the company and awareness of the consumption of electricity and the possibility to make household savings in electricity costs.

Keywords: Electric energy, renewable energy, fossil fuels, costs of energy.

Introduction

Survey "Renewable energy sources" was conducted in Doboj (BiH) Municipality and 150 completed surveys were collected, which represents data sample for this analysis. Survey contains of personal data questions and questions about an opinion on efficient consumption and renewable energy sources (1st competitiveness and consumption, 2nd sources of energy). Questions are constructed in line with the possible answers with the scale of 5 possible answers: A - insignificant, B - less significant, C - intermediate, D - very significant, E - extremely significant. Respondents are the employed persons from Doboj (BiH) and they have been expressed their views on the question that they were asked.

Analysis is based on the criterion question:

Electricity consumption has a significant share in the total cost of the company.

How responded reacted to this criterion question represents their opinion about the consumption of electricity within the work they deal with. Based on the criterion question the entire sample is divided into 5 groups depending on their answers to that question.

The 5 groups are represented in the following way:

A - insignificant (0 respondents), B - less significant (4 subjects), C - intermediate (36 subjects), D - very significant (69 respondents) and E - extremely significant (41 subjects). Given distribution of the answers to the criterion question, shows that the group A is completely insignificant and because there are no respondents it won't be used it in the future, while the results of the group B is taken with the reserve because of the small number of respondents, and it cannot be considered as a relevant result. Focus will be on the difference

in attitudes between groups: C - intermediate significant (36 subjects), D - very significant (69 respondents) and E - extremely significant (41 respondents).

Methodology

Goal of this research is to determine whether there are differences between the 4 mentioned groups and on which question or a questions differences exist. Differences are important for the respondents who consider that electricity consumption has a significant share in the total costs of the company and the test hypotheses are created in the following way:

H1 – Groups defined by criteria question (CQ) have different opinion (answer) on the question “Energy consumption in the economy is high” (ENERGY IN THE ECONOMY)

H2 - Groups defined by criteria question have different opinion (answer) on the question “Households can be more economical when consuming electricity” (ELECTRICITY IN HOUSEHOLDS) ”.

Analyses used in this research are MANOVA and ANOVA analysis and data processing and calculations are done with R-project. For testing whether there was a difference on all groups the MANOVA analysis was done and if the difference is obtained as a result of MANOVA, tests between which groups differences exists is later done with ANOVA analysis.

Results

In relation to the criterion question first test was done on the first question:

1. “Energy consumption in the economy is high” (ENERGY IN THE ECONOMY).
2. “Electricity consumption has a significant share in the total cost of the company” (criterion question, CQ)

MANOVA results are shown in the table bellow

	Df	Sum Sq	Mean Sq	F value	Pr (>F)
CQ	3	23.83	7.943	14.14	0.000
Residuals	146	82.04	0.562		

There is a significant difference ($p < 0.05$), so hypothesis H1 is proven.

Next analysis, **ANOVA was done on questions:**

1. “Energy consumption in the economy is high” (ENERGY IN THE ECONOMY)
2. “Electricity consumption has a significant share in the total cost of the company” (criterion question, CQ).

Groups defined by criteria question	Diff	lower	upper	p adjusted
(B - less significant) - (E - extremely significant)	-2.08537	-3.10587	-1.06487	2.4E-06
(C - intermediate) - (E - extremely significant)	-0.80759	-1.25256	-0.36262	3.27E-05
(D - very significant) - (E - extremely significant)	-0.54189	-0.92604	-0.15773	0.001935
(C - intermediate) - (B - less significant)	1.277778	0.250999	2.304557	0.008133
(D - very significant) - (B - less significant)	1.543478	0.541553	2.545403	0.000568
(D - very significant) - (C - intermediate)	0.265701	-0.13484	0.666242	0.315015

In the cases where p value is less than 0.05 (all rows except the last one) the conclusion is that there is significant difference.

Significant differences are between following groups: (B - less significant) - (E - extremely significant) where $p=2.4E-06$, (C - intermediate) - (E - extremely significant) where $p=3.27E-05$, (D - very significant) - (E - extremely significant) where $p=0.001935$, (C - intermediate) - (B - less significant) where $p= 0.008133$, (D - very significant) - (B - less significant) where $p =0.000568$.

We can conclude that the groups for which difference is shown, have different opinion about the given question “Energy consumption in the economy is high” (ENERGY IN THE ECONOMY).

Answer frequencies for the Groups are shown in the table below:

Criteria group	A - insignificant		B – less significant		C - intermediate		D – very significant		E – extremely significant	
	n	%	n	%	n	%	n	%	n	%
B - less significant	0	0.00	3	75.00	0	0.00	1	25.00	0	0.00
C - intermediate significant	0	0.00	0	0.00	10	27.78	24	66.67	2	5.56
D - very significant	0	0.00	2	2.90	15	21.74	30	43.48	22	31.88
E - extremely significant	0	0.00	2	4.88	1	2.44	9	21.95	29	70.73

On the left side in the above table are given groups obtained by dividing the respondents on the criterion question “Electricity consumption has a significant share in the total cost of the company” (criterion question, CQ). In the head row are given answers of respondents for the question “Energy consumption in the economy is high” (ENERGY IN THE ECONOMY).

The most frequent answers per groups are:

- for the group C - intermediate significant the most frequent answer is D – very significant (24 answers)
- for the group D - very significant the most frequent answer is D - very significant (30 answers)
- for the group E - extremely significant the most frequent answer is E – extremely significant (29 answers)

Second test was done on the third question in relation to the criterion question:

3. “Households can be more economical when consuming electricity” (ELECTRICITY IN HOUSEHOLDS)
2. “Electricity consumption has a significant share in the total cost of the company” (criterion question, CQ)

MANOVA results are shown in the table below

	Df	Sum Sq	Mean Sq	F value	Pr (>F)
CQ	3	10.37	3.456	3.612	0.0148
Residuals	146	139.69	0.957		

In this case there is the statistically significant difference because $p = 0.0148$ which is less than 0.05. Hypothesis H2 is proven.

Next analysis, ANOVA was done on questions:

3. “Households can be more economical when consuming electricity” (ELECTRICITY IN HOUSEHOLDS)
2. “Electricity consumption has a significant share in the total cost of the company” (criterion question, CQ)

Groups defined by criteria question	Diff	lower	upper	p adjusted
(B - less significant) - (E - extremely significant)	-0.5	-1.83161	0.831612	0.763416
(C - intermediate) - (E - extremely significant)	-0.58333	-1.16396	-0.00271	0.048469
(D - very significant) - (E - extremely significant)	0.028986	-0.47229	0.530257	0.998785
(C - intermediate) - (B - less significant)	-0.08333	-1.42314	1.256473	0.99849
(D - very significant) - (B - less significant)	0.528986	-0.77839	1.836361	0.719384
(D - very significant) - (C - intermediate)	0.612319	0.089667	1.13497	0.014527

In the cases where p value is less than 0.05 (second and the last row in the table above) the conclusion is that there is significant difference.

Significant differences are between following groups: (C - intermediate) - (E - extremely significant) where $p=0.048469$, (D - very significant) - (C - intermediate) where $p=0.014527$. We can conclude that the groups for which difference is shown, have different opinion about the given question “Energy consumption in the economy is high” (ENERGY IN THE ECONOMY).

Answer frequencies for the Groups are shown in the table below:

Criteria group	A - insignificant		B – less significant		C - intermediate		D – very significant		E – extremely significant	
	n	%	n	%	n	%	n	%	n	%
B - less significant	0	0.00	0	0.00	3	75.00	0	0.00	1	25.00
C intermediate – significant	1	2.78	3	8.33	16	44.44	12	33.33	4	11.11
D - very significant	0	0.00	5	7.25	12	17.39	28	40.58	24	34.78
E - extremely significant	3	7.32	0	0.00	8	19.51	13	31.71	17	41.46

On the left side in the above table are given groups obtained by dividing the respondents on the criterion question “Electricity consumption has a significant share in the total cost of the company” (criterion question, CQ). In the head row are given answers of respondents for the question “Households can be more economical when consuming electricity” (ELECTRICITY IN HOUSEHOLDS).

The most frequents answers per groups are:

- for the group C - intermediate significant the most frequent answer is C – intermediate significant (16 answers),
- for the group D - very significant the most frequent answer is D - very significant (28 answers), and frequent answer is E - extremely significant (24 answers),
- for the group E - extremely significant the most frequent answer is E – extremely significant (17 answers) and D – very significant (13 answers).

Discussion

It has been shown that the respondents, who have the opinion that the price of electricity has a significant share in the costs of companies, also consider that the electricity consumption in the economy is high, and that the consumption in households can be more economical. Higher awareness of the respondents to the criterion question asked indicates greater awareness for the questions “Energy consumption in the economy is high” (ENERGY IN THE ECONOMY) and “Households can be more economical when consuming electricity” (ELECTRICITY IN HOUSEHOLDS).

Conclusion

For hypothesis H3 results indicated that there are no significant differences between criteria groups.

For hypothesis H1 and H2 results indicate statistically significant difference between criteria groups.

Respondents who have demonstrated high level of awareness about the energy consumption costs in the company (“Electricity consumption has a significant share in the total cost of the company” - criterion question), also have demonstrated high level of awareness of the consumption of electricity and the possibility to make household savings in electricity costs.

It is general conclusion that more respondents indicated very high level of awareness about electric energy consumption and also about costs that are created from the electric energy consumption at home and at their place of work.

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