

ANALYSIS OF EMPLOYEE'S AWARENESS OF ENERGY COSTS

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Abstract

In this document analysis of employee awareness about energy costs in companies is given through tests of questionnaire. There were three main questions observed 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 respondents (employees) were included with their opinion about the importance of source of energy related to companies' energy costs. In this paper relation between companies (employees) with higher energy costs and the level of awareness about different energy source is proven.

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

Introduction

Survey "Renewable energy sources on a test sample of 150 respondents" was conducted. It contained questions about personal data and an opinion on efficient consumption and renewable energy sources (1st competitiveness and consumption, 2nd sources of energy). Each of the questions asked consisted of answers with a scale of 5 offered responses: A - insignificant, B - less significant, C - intermediate, D - very significant, E - extremely significant.

We will consider the criterion question

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

The answer to this criterion question shows us how the respondent looks at the consumption of electricity within the work he deals with. Since this is the criterion question, it means that the entire sample is divided into 5 groups depending on their answers to it. So the sample is divided into 5 groups:

A - insignificant (0 respondents), B - less significant (5 subjects), C - intermediate (37 subjects), D - very significant (72 respondents) and E - extremely significant (36 subjects).

Based on the distribution of the answers to the criterion question, we see that the group A is minimal, we will not use it in the future because there are no respondents, while the results of group B are less significantly taken with the reserve because the group has a small number of respondents, so we can not consider the result as relevant. So our focus will be on the difference in attitudes between groups: C - medium significant (37 subjects), D - very significant (72 respondents) and E - extremely significant (36 respondents).

Methodology

Our goal is to determine whether there are differences and on which questions differences exist between the 4 groups mentioned. That is, among the respondents who consider that electricity consumption has a significant share in the total costs of the company. We will test hypotheses:

H1 – Groups defined by criteria question (CQ) have different opinion (answer) on the question “Fossil fuels (oil, gas, coal ...) will remain the basic type of energy supply until 2020.”

H2 - Groups defined by criteria question have different opinion (answer) on the question “It is feasible that by 2020, renewable energy sources represent 25% of total energy sources”.

H3 - Groups defined by criteria question have different opinion (answer) on the question “The share of renewable energy from 25% by 2020 is at a satisfactory level”.

From the analysis, we will use MANOVA and ANOVA analysis. The analysis was done with R-project. First, the MANOVA analysis was done where we tested whether there was a difference on all groups. If there is the difference as a result of MANOVA, later ANOVA analysis was conducted to test between which groups differences exists.

Results

First test was done on the first question in relation to the criterion question:

1. Fossil fuels (oil, gas, coal) will remain the basic type of energy supply until 2020.
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	5.41	1.804	1.576	0.198
Residuals	146	167.05	1.144		

There is no a significant difference, so hypothesis H1 is not proven.

Next analysis, ANOVA was done on questions:

1. Fossil fuels (oil, gas, coal ...) will remain the basic type of energy supply by 2020.
2. Electricity consumption has a significant share in the total cost of the company.
(criterion question, CQ)

Groups defined by criteria question	Diff	lwr	upr	p adj
(C - intermediate)- (B - less significant)	0.037838	-1.28671	1.362389	0.999853
(D - very significant) - (B - less significant)	0.033333	-1.25232	1.318987	0.99989
(E - extremely significant) - (B - less significant)	0.477778	-0.84896	1.804517	0.785607
(D - very significant) - (C - medium significant)	-0.0045	-0.56681	0.557806	0.999997
(E - extremely significant) - (C - intermediate)	0.43994	-0.21085	1.090727	0.298448
(E - extremely significant) - (D - very significant)	0.444444	-0.123	1.01189	0.179797

In all cases p value is grater then 0.05 so the conclusion is that there is no significant difference. In this case it means that between the groups defined by criteria question, there are no significant differences on the first question “Fossil fuels (oil, gas, coal ...) will remain the basic type of energy supply by 2020.” This means that the groups have similar opinion about the mentioned subject.

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

3. It is feasible that by 2020, renewable energy sources represent 25% of total energy sources.
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	10.48	3.492	3.026	0.0315
Residuals	146	168.48	1.154		

In this case there is the statistically significant difference because $p = 0.0315$ which is less than 0.05. Hypothesis H2 is proven.

Next analysis, ANOVA was done on questions:

3. It is feasible that by 2020, renewable energy sources represent 25% of total energy sources.
2. Electricity consumption has a significant share in the total cost of the company. (criterion question, CQ)

Groups defined by criteria question	Diff	lwr	upr	p adj
(C - intermediate)- (B - less significant)	-0.32973	-1.65995	1.000495	0.917422
(D - very significant) - (B - less significant)	-0.11389	-1.40505	1.177272	0.995738
(E - extremely significant) - (B - less significant)	0.4	-0.93242	1.732422	0.863331
(D - very significant) - (C - intermediate)	0.215841	-0.34888	0.78056	0.753466
(E - extremely significant) - (C - intermediate)	0.72973	0.076155	1.383305	0.022039
(E - extremely significant) - (D - very significant)	0.513889	-0.05599	1.083765	0.093028

There is a significant difference between groups E and C and between groups E and D.

In the group C for the third question 35.1% respondents answered with C – intermediate and in the group E 19.4% respondents answered with C – intermediate.

In the group C for the third question 8.1% respondents answered with E - extremely significant and in the group E 38.9% respondents answered with E - extremely significant

In the group D for the third question 16.7% respondents answered with B - less significant and in the group E 5.6% respondents answered with B - less significant.

In the group D for the third question 25% respondents answered with C – intermediate and in the group E 19.4% respondents answered with C – intermediate

Given result illustrate that the group of respondents who think that eelectricity consumption has significant share in the total cost of the company (answer E on the CQ), have different opinion (answer) on question “*It is feasible that by 2020, renewable energy sources represent*

25% of total energy sources” and for the group E characteristic answer on the same question

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	0.	.0	3.	60.	1.	20.0	1.	20.0
C - intermediate significant	3.	8.1	4.	10.8	13.	35.1	14.	37.8	3.	8.1
D - very significant	3.	4.2	12.	16.7	18.	25.0	25.	34.7	14.	19.4
E - extremely significant	1.	2.8	2.	5.6	7.	19.4	12.	33.3	14.	38.9

E- extremely significant

On the other side respondents who think that electricity consumption has insignificant share in the total cost of the company (answer C on the CQ), have moderate opinion (answer C – intermediate) on question “It is feasible that by 2020, renewable energy sources represent 25% of total energy sources”.

Frequency distribution of answers on the question “It is feasible that by 2020, renewable energy sources represent 25% of total energy sources” in regard to criteria groups

Third test was done on the fourth question in relation to the criterion question:

4. The share of renewable energy from 25% by 2020 is at a satisfactory level.
2. Electricity consumption has a significant share in the total cost of the company. (criteria question, CQ)

MANOVA results are shown in the table bellow

	Df	Sum Sq	Mean Sq	F value	Pr (>F)
CQ	3	1.36	0.4547	0.383	0.766
Residuals	146	173.47	1.1881		

There is no a significant difference, so hypothesis H3 is not proven.

Next analysis, ANOVA was done on questions:

- 4 The share of renewable energy from 25% by 2020 is at a satisfactory level.
- 2 Electricity consumption has a significant share in the total cost of the company. (criterion question, CQ)

Groups defined by criteria question	Diff	lwr	upr	p adj
(C - intermediate)- (B - less significant)	0.324324	-1.02544	1.674087	0.924082
(D - very significant) - (B - less significant)	0.138889	-1.17124	1.449014	0.992666
(E - extremely significant) - (B - less significant)	0.083333	-1.26866	1.435326	0.998531
(D - very significant) - (C - medium significant)	-0.18544	-0.75845	0.387578	0.834785
(E - extremely significant) - (C - mean)	-0.24099	-0.90417	0.422184	0.780945
(E - extremely significant) - (D - very significant)	-0.05556	-0.6338	0.522691	0.994512

There is no significant difference.

Discussion

Respondents who have moderate opinion (answer C – intermediate) on the criteria question, they also usually have moderate opinion (answer C – intermediate) on the tested question “*It is feasible that by 2020, renewable energy sources represent 25% of total energy sources*”.

Reason is given by the fact that they do not feel pressure with high costs of electric energy, and so their interests for the other source of energy are small.

Respondents from the companies where costs for electric energy are intermediate, has no attention on the other sources of energy beside electric energy.

Otherwise respondents from companies with high electric energy costs, have more attention on the renewable sources of energy.

Conclusion

For hypothesis H1 and H3 results indicated that there is no significant differences between criteria groups.

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

This means that the group of respondents who think that electricity consumption has significant share in the total cost of the company (answer E on the CQ), have different opinion (answer) on question “*It is feasible that by 2020, renewable energy sources represent 25% of total energy sources*” and for the group E characteristic answer on the same question is E-extremely significant.

And on the other side respondents who think that electricity consumption has insignificant share in the total cost of the company (answer C on the CQ), have moderate opinion (answer C – intermediate) on question “*It is feasible that by 2020, renewable energy sources represent 25% of total energy sources*”.

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