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Examination of Turkey's Renewable Energy and Fossil energy Consumption with Analytic Hierarchy Process (AHP)

Yalçın KAPLAN[a] (ylcnkpln@mynet.com)
Umut SARAY[b,1] (umut.saray@gop.edu.tr)

[a]*Istanbul Kemerburgaz University, Department of Electrical and Computer Engineer, İstanbul*
[b]*Gaziosmanpaşa University, Turhal Vocational School, Tokat*

Abstract – In this study, examined renewable energy sources and between fossil energy sources in the Turkey. In addition, the analytical hierarchy process (AHP) to analyze values method was used. SUPER DECİSİONS program was used in this study. As an alternative, renewable energy sources and fossil energy sources was discussed. Criteria; performance, cost, price, and is causing harm to the environment. Super decisions program was used for AHP. To results of the study, compared value 69.15%, the ideal energy source renewable energy sources have been found. Renewable energy sources, performance, price, cost and environmentally preferred due to can be. For this reason, incentives should be established in this direction.

Keywords – *Analytic hierarchy process, renewable energy, fossil energy.*

1. Introduction

The needs of people, is increased in the developing world. Increasing needs, people are looking for something else to it. Used to meet the needs of fossil-based energy sources, increasingly reduced emerge as the biggest problem. Face this problem, those dealing with science, is working in this field to turn to this issue [1].

Researched and revealed that a wide variety of energy sources, efficient does not mean that the expression. In order to get the maximum efficiency from the energy source, the use of solid sources is required. For this reason, unlike from fossil energy sources renewable energy sources (solar, wind, etc.) should be used [2].

The use of renewable energy sources is increasing rapidly. The reason for the preference for renewable energy sources, environmental compatibility and efficiency is high. The incentives given to investors by increasing the number of States, the use of renewable energy sources will increase [3].

In terms of environmental pollution, greenhouse gas emissions of the year 2012 if we examine the information; Greenhouse gases found in nature 71% (301 Mton) sources of energy are released. Some 13% (56 Mton) from industry, 9% portion (36 Mton) waste and the 7% portion (29 Mton) is caused by emissions from agriculture [4].

AHP has been used in many fields such. If we look at the literature; projects in risk assessment [5], oil and gas transmission signals in the diagnosis of pests [6], teaching evaluation index weight in the decision making process [7]. Tourist accommodation facilities, environmental and energy problems determining factor in the operations [8], debt and Financial rationing decisions [9].

In the living area, people are forced to decide on several occasions. Meal, water up to the decisions taken in every area of life gives direction to life. Energy needs are met, while meeting it emerged as alternative fossil sources with renewable energy sources can be more useful. Energy producers, which will make this selection decision makers.

In this study, decision-makers as multi-criteria decision making (MCDM) and the AHP method was used. Options will be decided, after determining criteria for selecting these options are examined. Every criterion will be compared among themselves. Criteria, compared to the alternatives are compared between themselves and a weight is determined. According to the weights, the ideal alternative is selected. In our study, alternatives are renewable energy sources and fossil energy sources. Criteria were performance, price, cost and environmental damage. According to these criteria, the ideal was to determine the most appropriate energy source.

2. Method

In this study, fossil energy sources and renewable energy sources were compared. The decision-making process was used with AHP.

SUPER DECİSİONS program was used in this study [15].

2.1. Analytic Hierarchy Process

Analytic hierarchy process (AHP), is a method of decision-making. The numerical values used in this method. Every criterion will be compared among themselves. Compared to the criteria, weights are given. AHP is useful in multi-criteria decision making [10].

AHS, when used in the process are given numerical values for each criterion. This value is between 1-9.Weights, it determines the status based on criteria other criteria. AHP is a form of ranking. Alternatives, walking towards the target according to specific criteria and provides the sort.

People, emotionally decide. Emotional making decisions, the criteria can be compared in different ways. But the logic is still the same. Which two criteria discussed above and if his weight is increased. Based on criteria other than weight criteria go one step ahead and is determined as the target. Similarly, in alternative criteria are compared with each other and to the form of sorted fore excess weight. Making them consistency rate must also be

considered. Consistency ratio, 0.05 lower than it should aim to be. Otherwise, an inconsistency between weights occurs. This also affects the outcome. Alternatively, from the faulty one is selected. AHP structure shown in Figure 1 below.

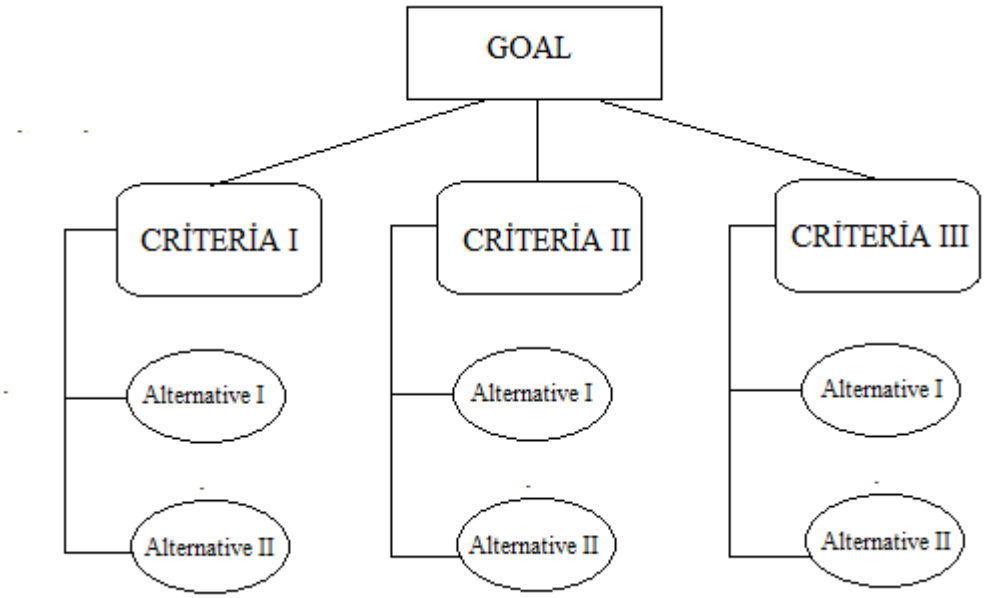

Figure 1.AHP structure

The structure seen in Figure 1, an alternative and among themselves to determine the weights of the criteria is required. For this reason, the tables are created weights.

Table 1.The weights matrix

	Criteria I	**Criteria II**	**Criteria III**	**Criteria IV**
Criteria I	**1**	D	G	K
Criteria II	A	**1**	H	R
Criteria III	B	E	**1**	M
Criteria IV	C	F	J	**1**

The weights matrix is created as in Table 1. Created matrix values, determines goals.

Table 2.Criteria, according to the target weight matrix

	Weights
Criteria I	A
Criteria II	B
Criteria III	C
Criteria IV	D

According to the goal, the criteria weights are generated. An example is shown in Table 2. According to the goal to determine the weights of the criteria, while the ordering of alternatives is very important. Because, determines the importance of the criteria. Criteria that is important to be decisive weight.

Also to the determination of these weights, the values in Table 3 are used. These values are between 1 and 9. Generally, the emphasis, the values used in the form of 1-3-5-7. The two criteria used in granting the same value 2-4-6-8 with intermediate values, while weights and reconciliation during.

Table 3. Theweightsused in the process [11]

SİGNİFİCANCE	DEFINITION	DESCRIPTION
1	Equal	In two criteria are of equal importance.
3	Definition	More important criterion
5	Strong importance	One of the criteria is more favorite.
7	Very strong importance	One proven by example is important.
9	Definite conclusions	One is a safe and accurate way.
2-4-6-8	Intermediate values	Preferred values are close to each other are used.

3. Experimental Results

In the study, renewable energy sources and fossil energy sources were compared. When compared to these four criteria are used. These criteria are performance, cost, environmentalist and price. If we take the first fossil energy resources;

3.1. Analytic Hierarchy Process

Fossil energy resources are composed of includes coal, carbon and hydrogen. A coal formation in nature, may take millions of years. If we look around the world coal reserves, first place gets 32% and Asia Pacific countries [12].

Another source of energy is fossil source. Turkey's remaining oil reserves as of 2009, 44.3 million tons. Oil production was 2.4 million tons in 2008. Removal is extremely costly [12].

One other fossil energy sources are natural gas. Natural gas is found in nature in the immediate vicinity of the oil. Removal of gas is treated the same with oil. Remaining reserves of natural gas in Turkey as of 2009 is 6.2 billion m3 [12].

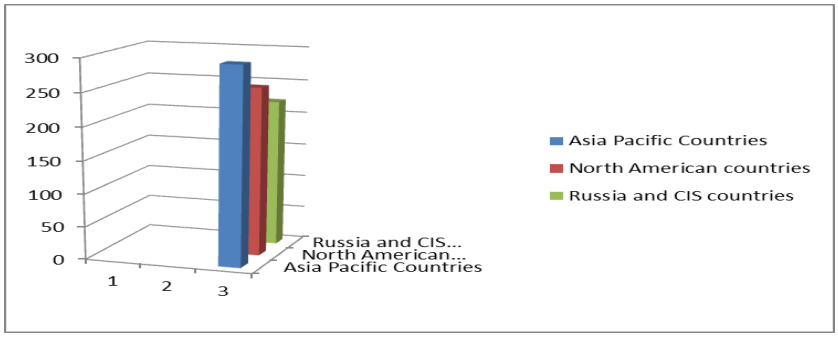

Figure 2. World coal reserves (trillion tons) [12]

As described above, the reserves of fossil energy sources are decreasing day by day. Also remove fossil resources and ensure that the transmission is extremely costly. The data used in this study, cost analysis, costs, damages to the environment and is the efficiency.

3.2. Renewable Energy Sources

Renewable energy sources are wind, solar energy, and geothermal energy sources. The use of these energy sources in our country is increasing steadily. To make maximum use of renewable energy sources, it is necessary for people's lives [13]. Renewable energy sources is one of the wind energy, the various estimation methods are applied [14]. In this study, the efficiency of renewable energy sources, cost, damages the environment and about the price of an AHP model was constructed using data.

3.3. Model

Data used in the study, bilateral comparison process is performed. This process made values 1 and 9 is number with between. The resulting matrices are decoded by the program Super Decision

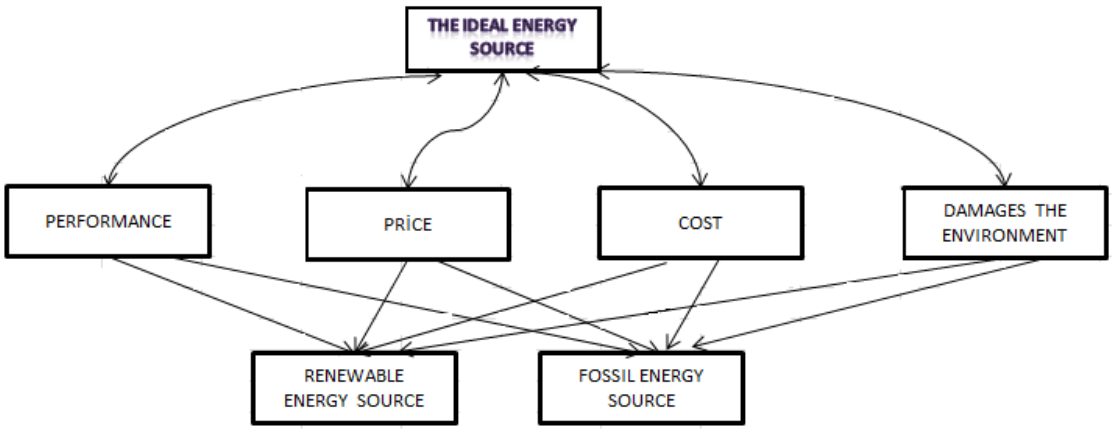

Figure 3. AHP model

Table 4. Criteria to be compared among themselves.

	Performance	**Price**	**Cost**	**Environmental importance**
Performance	**1.00**	0.50	0.50	0.50
Price	2.00	**1.00**	2.00	1.33
Cost	2.00	0.50	**1.00**	0.50
Environmental	2.00	0.33	2.00	**1.00**

Table 5. Costcomparison of alternatives according to the criteria

	Renewable energy	**Fossil energy**	**Weights**
Renewable energy	1.00	3.00	0.75
Fossil energy	0.33	1.00	0.25

Cost comparison criterions amongst alternatives are shown in Table 5. If we examine the table, in terms of cost of renewable energy compared to fossil energy has 3 times the rule.

Table 6. Performance comparison of alternatives according to the criteria

	Renewable energy	**Fossil energy**	**Weights**
Renewable energy	1.00	0.50	0.33
Fossil energy	2.00	1.00	0.66

Performance comparison criterions amongst alternatives are shown in Table 6. If we examine the table, in terms of performance of renewable energy compared to fossil energy has 2 times the rule.

Table 7. Price comparison of alternatives according to the criteria

	Renewable energy	**Fossil energy**	**Weights**
Renewable energy	1.00	3.00	0.75
Fossil energy	0.33	1.00	0.25

Price comparison criterions amongst alternatives are shown in Table 7. If we examine the table, in terms of price of renewable energy compared to fossil energy has 3 times the rule.

Table 8. The damage to the environment according to the criteria comparison of alternative

	Renewable energy	**Fossil energy**	**Weights**
Renewable energy	1.00	3.00	0.75
Fossil energy	0.33	1.00	0.25

Table 9. Ideal and normal results [15]

	İdeal	Normal
Fossil Energy Sources	0,446152	0,30851
Renewable Energy Sources	1,000000	0,69149

The damage to the environment comparison criterions amongst alternatives are shown in Table 8. If we examine the table, in terms of the damage to the environment of renewable energy compared to fossil energy has 3 times the rule

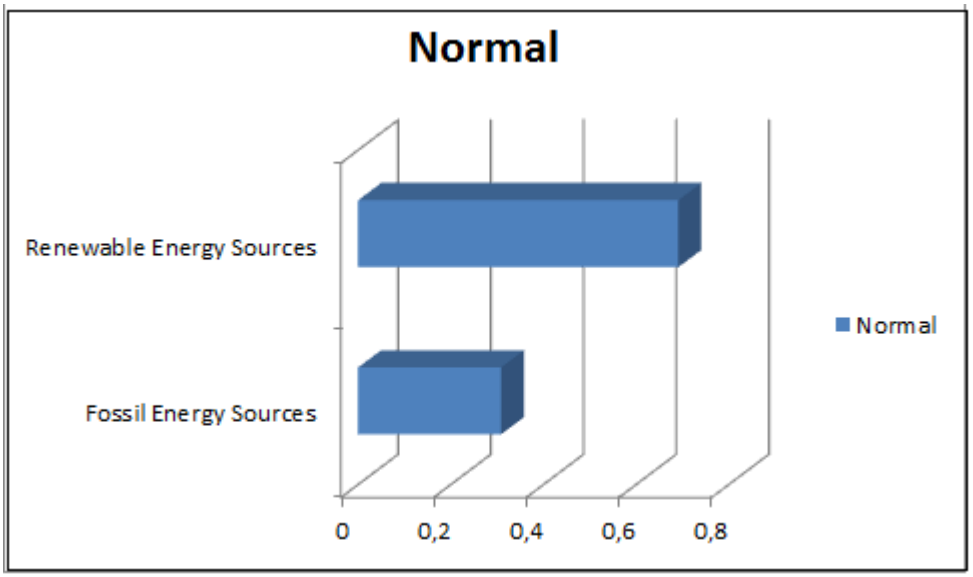

Figure 4. Created as a result of the AHP model representation of the super decisions [15]

4. Conclusions

In this study the fossil energy sources and renewable energy sources were compared. Two sources; performance, cost, damage the environment and are compared with each other in terms of price. AHP model has been created. AHP generated model is solved with Super Decision program. During the solution of the problem, compared when the operation is done according to the individual criteria. The most ideal energy source and weights were determined.

Table 10.Model results [15]

Graphic	Alternatives	Total	Normal	Ideal	Ranking
	Fossil energy sources	0.1543	0.3085	0.4462	2
	Renewable energy sources	0.3457	0.6915	1.0000	1

Determined by the ratio, with 69.15 % of renewable energy sources, 30.85 % compared to fossil energy sources with the source was found to be more preferable. Investment in

renewable energy sources have on the country in terms of development and economic recovery is extremely important. Our model further developed. This model used in other problems.

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