APPLICATION OF NON-MARKET ECONOMIC VALUATION METHOD TO VALUE THE ENVIRONMENTAL BENEFITS OF GEOTHERMAL ENERGY IN MONETARY TERMS: A CASE STUDY IN YOZGAT PROVINCE

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APPLICATION OF NON-MARKET ECONOMIC VALUATION METHOD TO VALUE THE ENVIRONMENTAL BENEFITS OF GEOTHERMAL ENERGY IN MONETARY TERMS: A CASE STUDY IN YOZGAT PROVINCE

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ABSTRACT

APPLICATION OF NON-MARKET ECONOMIC VALUATION METHOD TO VALUE THE ENVIRONMENTAL BENEFITS OF GEOTHERMAL ENERGY IN MONETARY TERMS: A CASE STUDY IN YOZGAT PROVINCE

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Determining environmental economic benefits of geothermal energy is difficult since there is no market for all environmental goods and services related to it. In order to determine and measure the market price of non-market goods and services, non-market valuation methods are used. Since intangible benefits do not have monetary values, non-market valuation techniques are applied to estimate them. Non-market valuation methods are important tools for policy makers in the cost and benefit analysis and environmental impact assessment process to aid their final decision.

In this study, the Contingent Valuation Method (CVM) was used to determine the environmental benefits of using geothermal energy for house heating instead of fossil fuels and natural gas in Yozgat (center). The willingness to pay for geothermal energy of the Yozgat residents was determined and underlying motivations to use geothermal energy were assessed.

The results showed that the mean willingness to pay (WTP) for the usage of geothermal energy in house heating to increase air quality and mitigate the effects

of climate change is $50/person/month. The results also showed that respondents know the importance of the climate changes and they believe that geothermal energy usage will affect the mitigation of climate changes positively. The geothermal energy investment in the region will amortize itself in 3 years. Therefore, in the feasibility studies, geothermal energy investment seems feasible.

During the regression analyses, climate change and air pollution parameters were the most significant parameters for the calculation of mean WTP. Since, decrease in air pollution using geothermal energy, will also mitigate the effect of climate changes, during the geothermal investment in the region, training activities and campaigns should be carried to cover the issues of climate change and global warming to emphasis that geothermal energy will serve for multi-dimensional environmental problems.

Key words: Contingent valuation method (CVM), willingness to pay (WTP), environmental economics, non-market valuation, geothermal energy.

ÖZ

JEOTERMAL ENERJİNİN ÇEVRESEL FAYDALARININ PARASAL DEĞERLENDİRİLMESİ İÇİN PİYASA DIŞI EKONOMİK DEĞERLENDİRME YÖNTEMİNİN UYGULAMASI: YOZGAT İLİNDE ÖRNEK BİR ÇALIŞMA

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Jeotermal enerjinin çevresel ekonomik faydalarının belirlenmesi, çevrenin fiyatlandırılması, çevresel malların ve hizmetlerin piyasası bulunmadığından dolayı zordur. Piyasa dışı olan malların ve hizmetlerin çevresel faydalarının parasal değerlendirilmesinin yapılıp, belirlenmesi ve ölçülmesi için piyasa dışı ekonomik değerlendirme yöntemleri kullanılmaktadır. Soyut yani hâlihazırda hissedilmeyen faydalarını değerlendirilememesi ve parasal olarak ifade edilememesinden dolayı, bunların tahmin edilmesinde piyasa dışı ekonomik değerlendirme teknikleri kullanılmaktadır. Piyasa dışı değerlendirme metotları, politika üreticiler için fayda maliyet analizi ve çevresel etki değerlendirme işlemlerinde nihai karar vermede kullandıkları önemli araçtır.

Bu çalışmada, Yozgat merkezde kömür ve doğalgaz kullanımının yerine konut ısıtılmasında jeotermal enerjinin kullanımının çevresel faydaların belirlenmesi amacı ile Koşullu Değerlendirme Yöntemi (KDY) kullanılmıştır. Jeotermal enerji kullanımı için ödeme isteği tespit edilmiş ve jeotermal enerji kullanımı altında yatan motivasyonlar değerlendirilmiştir.

Sonuçlar göstermiştir ki; hane ısıtılmasında jeotermal enerji kullanımı ile hava kalitesinin artırılması ve iklim değişikliği etkilerinin azaltılması için ortalama ödeme isteği 50 ABD Doları/kişi olarak bulunmuştur. Aynı zamanda bu sonuçlar, ankete cevap verenlerin iklim değişikliğinin önemini bildiklerini ve jeotermal enerji kullanımının iklim değişikliği ektilerinin olumlu yönde azaltacağına inandıklarını göstermektedir. Jeotermal enerji yatırımı 3 yıl içerisinde kendisini amorti edecektir. Bundan dolayı fizibilite çalışmasında jeotermal yatırımının gerçekleştirilmesi mümkün gözükmektedir.

Regresyon analizinde, ortalama ödeme isteği hesaplamalarında hava kirliliği ve iklim değişikliği çok önemli parametrelerdir. Mademki jeotermal enerji kullanımı ile hava kirliliğindeki azalma aynı zamanda iklim değişikliği ve küresel ısınmayı da azaltacaktır, bölgede jeotermal yatırımları esnasında, Yozgat halkının iklim değişikliği ve küresel ısınma konularındaki hassasiyetlerinden dolayı, eğitim aktiviteleri ve kampanyalar düzenlenirken iklim değişikliği ve küresel ısınma konuları da dâhil edilmeli ve jeotermal enerjinin çok yönlü çevresel problemleri çözeceğine vurgu yapılmalıdır.

Anahtar Kelimeler: Koşullu Değerlendirme Yöntemi (KDY), ödeme isteği, çevre ekonomisi, piyasa dışı değerlendirme, jeotermal enerji

To:

My Lovely wife (Seda)
My Brave son (Ahmet Emin)
My Doctor Brother (Eyüp)
and
My triplets Daughters (Elif Nida, Ayşe Sena, Hayrunnisa)

For their endless support,
For their love

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B/F	Benefits-Costs
BFA	Benefit and Cost Analysis
CVM	Contingent Valuation Method
HRM	Hedonic Regression Method
TCM	Travel Cost method
WTP	Willingness to Pay
WTA	Willingness to Accept

CHAPTER 1

INTRODUCTION

The world is marching towards a severe energy crisis due to increasing energy demand. The energy that is used everyday is limited, and it is not granted. Oil, gas, power, even water has limited availability. Necessary precautions should be taken to deal with a possible energy crisis.

As Menegaki (2008) states the necessity for renewable energy (RE) investment is obvious due to the world's finite sources consumption. Energy resources as fossil fuels finally diminish and they are too costly or too ecologically damaging to make compensation. In order to accomplish this severe energy crisis of the world, RE sources are used to guarantee world future and clean world.

Increment the ratio of power originating from renewable energy sources (RES) is getting important issues for most of the country's strategies to accomplish decreasing in greenhouse gas (GHG) emissions. Clean air is a continuous relation in developing countries cities and CO_2 emissions caused by fossil fuels should be mitigated. Decrease in the usage of the fossil fuels causes less GHG emission to the atmosphere. RES contribute to CO_2 emissions mitigation and decrease the national dependence of imported energy.

Heating of 102,000 houses through geothermal energy (GE) in Turkey, it is saved average 1 billion CO_2 emission into the air annually. This saved amount is also equal to exhaust pollution of 596.000 vehicles in the traffic. The application of GE in Turkey has a great contribution to the mitigation of GHG. Considering the Kyoto

protocol, new geothermal project is very meaningful and crucial (State Planning Organization Development Plan, 2009).

Approximately 70% of the energy used in the country is imported. Ministry of Energy makes studies regarding new local energy resources and diversifies the energy resources. Also, research studies continue considering alternative RE and nuclear energy. Annually, there is an approximately 7% increment of energy need in Turkey. Therefore, in order to meet this energy requirement, the energy production should at least increase in this ratio. Local and RE resources should be used at full capacity. Turkey has a great potential of RE after coal resources (State Planning Organization, 2009).

Green energy is brought about renewable energy sources (RES), generally handled to be geothermal, solar, hydro, wind and bio-energy sources, having no negative effect on the environment. Additionally, renewable energy sources have extra socio-economic and environmental benefits which should be taken into account by the policy makers for optimal energy investments for Turkey in order to prevent environmental degradation and provide sustainable energy development.

RES are on the agenda and have mentioned on the literature extensively. Several valuation techniques have been conducted over near future to elicit individual preferences for RES (Koundouri et al., 2009).

Bergmann et al. (2004) pointed out that increment in the ratio of power brought about RES is getting a significant issue to accomplish decreasing in greenhouse gas (GHG) emissions. Nevertheless, renewable energy investments have extra costs and benefits. Therefore, optimal investments of the RES are to be made to prevent energy problem in the world.

During decision process, policy makers want to learn the benefits of ecological service and good of RE to use in the benefit and cost analysis and environmental impact assessment process before making optimal RE investment in the region.

Decision makers try to find out tools of valuation of environmental benefits to conclude their decision practices and determine these environmental benefits in terms of money. Costs and benefits do not have monetary values, and therefore non-market valuation techniques are used to predict them (Menegaki, 2008).

Determination of extra ecological benefits and to cost the environment is very important issue and necessary to elicit the benefits in terms of money in order to use in the cost-benefit analysis, decision making process of the policy makers during feasibility of the optimum environmental investments. The reason for that there isn't any market present for ecological goods and related services. Hence, economic valuation techniques (EVT) are improved.

Evaluating benefits combined with geothermal energy by cost/benefit analysis (CBA) should be accomplished to find out total benefits including the environmental and socio-economic benefits. As Novotny et al. (2005) argues that due to large expense associated with environmental initiatives, decision makers are thinking about proactive policies relate to RES. Decision makers generally behave considering public vote and form public meetings. Novotny et al. (2005) also mentions that without the intelligent of an unbiased and valid people interest can be wrong, because of the attendance of the motivated people to the meetings.

Since geothermal energy as a renewable energy will be utilized more for the next generations, assessment of GE is crucial issue for Turkey. Economic valuation of environmental benefits of GE has not been taken place in test of policy choices.

Most of the districts of the Yozgat Province have high geothermal energy potential. Some of the districts are Sarıkaya, Yerköy and Sorgun. In Sorgun, 1500 houses are heated by using geothermal energy with a capacity of 51% of the house central system. However the geothermal potential of Sorgun district is equivalent to 7500. In Sarıkaya district, houses are also heated by geothermal energy. However Yerköy district is completed construction works in the year of 2008 and 400 houses are heated by using GE. It is planned to increase the number of houses to 3500 houses

in near future since the potential of geothermal resources in Yerköy district is 6000 houses (Yozgat Province Special Administration, 2010). Also Sarıkaya, Sorgun, Akdağmadeni, Boğazlıyan, Saraykent, Yerköy districts has thermal baths. Most of the thermal baths are also used for health and tourism purposes.

Although it is stated that there is geothermal potential in the districts of Yozgat province, for the time being, geothermal source has not been found in the city centre of Yozgat (Yozgat Special Province Administration, 2010). GE should be transported from Sorgun district which is 34 km away from Yozgat city centre to be used in the city center. Investment in long-distance transport of geothermal economy very carefully should be examined. In the case of new energy investments, the environmental benefits of GE usage should be considered in order to use in the economical analyses in monetary terms.

Environmental benefits of GE are hard to find out due to absent of the market for ecological good and service. Also the value that people place on environmental goods is not readily measurable. To determine and measure the market price of non-market goods, EVM's are used. At present, EVM's are used to determine the ecological and socioeconomic benefits that are very helpful for decision making process.

The Contingent Valuation Method (CVM), widely used, EVM that tries to find out the market cost of non-market services and goods is utilized in this study. The CVM has been used to assess environmental benefits in monetary terms via surveys (Nomura et al., 2008). CVM is based on surveys to collect information about people's perception regarding environmental goods. Basically, people are asked to value the goods that they benefit.

1.1. Aim of the study

The aim of the study is to elicit the environmental benefits of geothermal energy usage for house heating purposes and express these intangible benefits in monetary terms by using a non market valuation method. In this study, the CVM , a non market valuation technique, was applied to drive an expression for willingness to pay for valuation environmental benefits of geothermal in Yozgat. A survey that is composed of 3 sections was designed and conducted in the Yozgat province. The valuation of the individuals in Yozgat was expressed in terms of monetary terms via willingness to pay (WTP) questions. WTP can be briefly defined as the contribution that population of Yozgat pays for the benefits of geothermal energy to improve the air quality and mitigate the effects of green house gasses. The results were analyzed and used to show what factors influence respondents' WTP for usage of geothermal energy and how much respondents' are willing to pay.

This study is the first study that attempts to determine the environmental benefits of renewable energy, geothermal energy, in monetary terms in Turkey. Furthermore, recently, as an energy policy of Turkey, since renewable energy investments are on the agenda, decision makers will want to learn the environmental benefits of geothermal energy in terms of monetary terms.

In this study, a non-market valuation technique is used to determine the environmental benefits of geothermal energy usage in monetary terms for house heating in Yozgat province to aid decision making process for optimal economical and new energy investment.

This thesis is composed of 5 chapters. In chapter 1, the purpose and the layout of the study are explained. In Chapter 2, geothermal potential in Turkey, environmental benefits of geothermal, geothermal potential of Yozgat are explained. In Chapter 3, detailed explanation of the "Non-market Valuation Techniques" namely, Revealed Preference Methods and Stated Preference Methods [1-Contingent valuation method (CVM); 2-The Travel Cost Method (TCM); 3-

Hedonic Regression Method (HRM)] are given. In Chapter 4, application of CVM to Yozgat province and the results are obtained. Also, questionnaire designs, application of the survey, survey results and WTP estimation are given in Chapter 4. Finally, in Chapter 5, conclusion of the study is mentioned.

CHAPTER 2

ENVIRONMENTAL BENEFITS OF GEOTHERMAL ENERGY AND ITS POTENTIAL

Turkey is the fifth country in the world and the first country in the Europe considering direct usage of the geothermal energy potential (MTA, 2006). As it is shown in Figure 2.1, there are about 600 hot spring water resource spots in Turkey. Turkey heat flow map (Figure 2.2) shows that, Western and Central Anatolia Region of Turkey have very high geothermal energy potential. Geothermal heating (residence and thermal facility) in Turkey regarding the current situation is 635 MWt and for 2013 projections, it is 4000 MWt. Geothermal potential for thermal tourism (baths) is 402 MWt for the current situation and for 2013 projections, it is 1100 MWt. Moreover, geothermal potential for geothermal greenhouse is 192 MWt for the current situation and for 2013 projections, it is 1700MWt (State Planning Organization, 2009).

In order to implement more investments regarding geothermal energy, the benefits and the costs of the GE projects should be considered carefully in order to evaluate the feasibility of GE investments to provide sustainable environmental development in Turkey. In the following sections, the environmental benefits and potential of GE in Turkey are explained.

2.1. Geothermal Potential in Turkey

Geothermal resource is ‘earth temperature’. Geothermal resources, briefly earth heat, consist of hot water, vapor and gases with chemicals that stored in a certain depth of earth. The temperature increases with respect to depth and reaches to the temperature of 4500 °C at the center of the earth. It is called GE that obtained with

the usage of this heat that reaches to the outer shell of the earth (State Planning Organization, 2009).

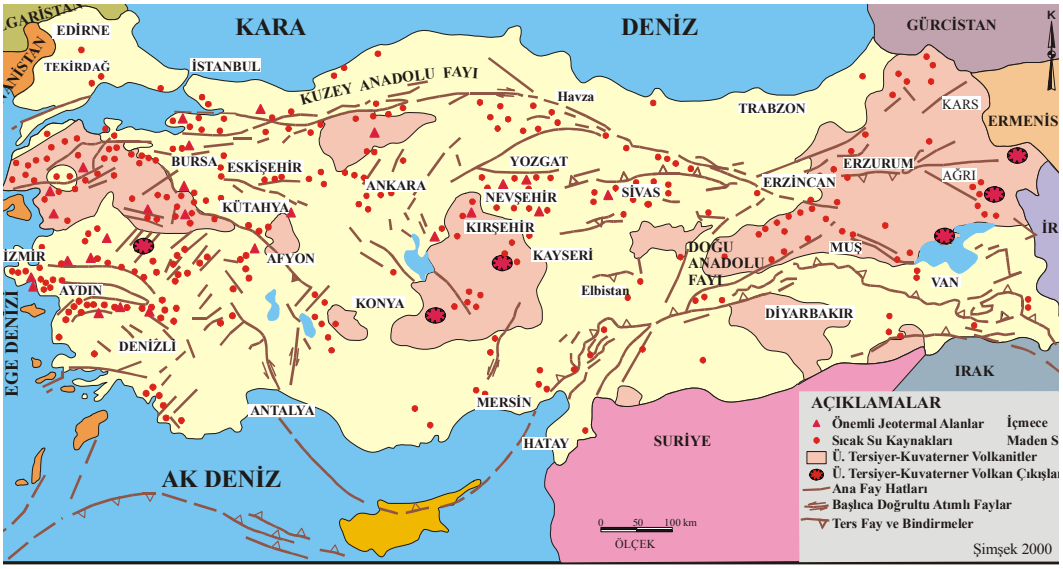

Figure 2.1. Hot spring water resource spots in Turkey (MTA, 2006)

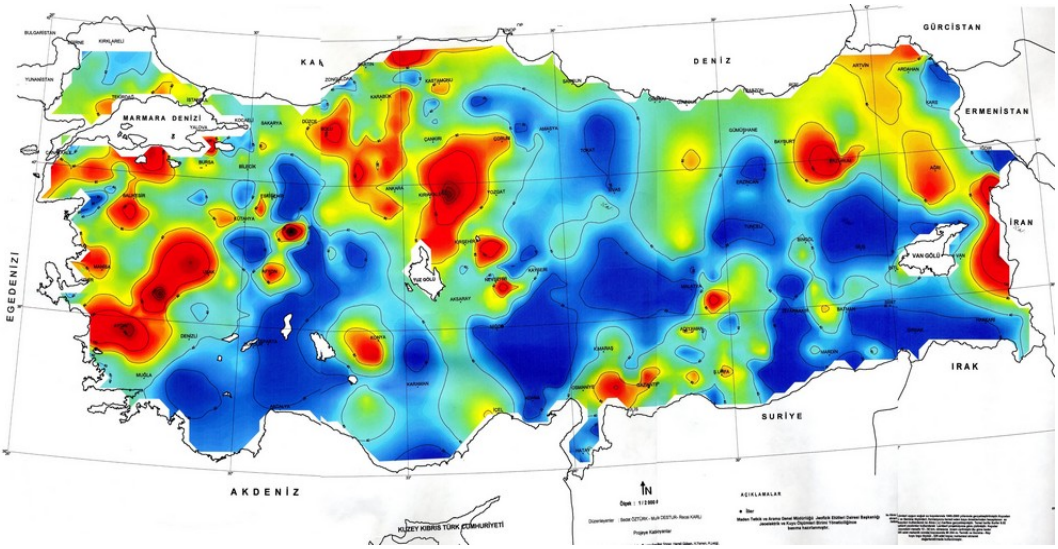

Figure 2.2. Turkey Heat Flow Map (MTA, 2006)

Turkey, as a developing and industrializing country, is in need of cheap, domestic, as well as sustainable and environmentally friendly energy sources. High potential of geothermal energy in Turkey motivates decision makers and local authorities to make new and optimal investments on geothermal energy from both environmental and socioeconomic benefits point of view.

170 geothermal fields were discovered in Turkey which has the lowest temperature limit of geothermal resources at 20 °C. Turkey is the first country in Europe regarding thermal water and mineral water potential of 1000 sources. Arslan et al. (2000) stated that Turkey's prospective geothermal heat potential is estimated as 31.500 MWt. The drilling works made by the MTA as possible according to the drilling of geothermal potential of 304 MWt 2046 confirmed as the potential for heating appears. Turkey's natural hot water outlets when the total of 600 MWt included in this figure appear in the potential of geothermal potential in 2646 MWt reached. Currently, geothermal heating capacity is 635 827 MWt in Turkey. The potential for city-dwelling, building, heating and thermal plant in heating, greenhouse heating is 192 MWt and also 402 MWt potential for thermal tourism (spa). Therefore the total direct use is 1229 MWt.

Since Turkey has high potential of geothermal resources, geothermal energy is going to gain more attention in the near future. Turkish Government initiated projects to increase the use of geothermal energy to replace fossil fuel as much as possible. However, due to the large expenses associated with province-wide central heating system by geothermal energy projects, many policymakers are hesitant to initiate proactive policies, especially those that may present a financial burden on population (State Planning Organization, 2009).

There are 94 hot spring areas for house heating appropriate within the temperature lower limit of 50^{o}C. With respect to the geothermal areas in Turkey, 55% of it is used for house heating. Geothermal central heating with a pipeline of 61 km with the longest line of geothermal water transportation is located in Iceland with the loss of temperature of 2 ° C and 27 km pipeline of geothermal water transportation

is located in the CEK Republic. In Turkey, the longest the geothermal water transports carry is 18 km in Bigadiç. Temperature loss of 10 km distance is 1 °C. Investment in long-distance transport of geothermal economy should be examined in detail. Used to be a significant problem in our country and the world skinning (arthritis) and corrosion (rot), nowadays, such as technical problems, were solved. Geothermal resources away from some of our settlements and small settlements equivalent of 5 million residential units because of the potential temperature of about 1 Million residence (home), according to today's technical and economic conditions for the purpose of heating will be evaluated (excluding greenhouse and thermal tourism) (State Planning Organization, 2009).

Direct usage of geothermal energy and estimations are explained in Table 2.2 and also observable capacity is given as per end of 2006 in Table 2.1. These figures and information show us economic value of geothermal energy in Turkey.

Table 2.1. Total Geothermal Energy Potential and Applications in Turkey (Realization in the end of 2005 and 2006 Programme) (Dagıstan, 2006)

	TYPE OF USAGE	APPLICATION CAPACITY	COMMENT
END OF 2005	House Heating + Thermal Facilities	696 MWt	103.000 equivalent house
	Greenhouse Heating	131 MWt	635.000 m2
	Thermal Bath usage	402 MWt	215 unit
	Direct usage as per 2005	1229 MWt	
	Electricity Production (Denizli Kızıldere)	12 MWe	
END OF APRIL, 2006	Electricty Production Application	Reaches to 19 Mwe	7 MWe test production started in Aydın-Salavatlı as per the beginning of 2006
	Observable Extra Heat Energy as per end of 2006	67.27 MWt	
PROGRAMME	2006 Target	200 MWt	

NOTE :
31.500 Mwt Theoretical Capacity
3000 Mwt Observable Capacity (as per end of 2006)
550 MWe Theoretical Potantial (13 field discovered)
105 MWe Observable Capacity (13 field discovered)

Table 2.2. 2013 Estimation of Geothermal Electric Production and Direct Usage (State Planning Organization, 2009)

Geothermal Assessment	February 2005	MW	2013 year Estimation	MW	Total Annually Energy
Electricity Production	20 MWe		550 MWe		4 Billion kWh/year
House Heating	103.000 house equivalent	635 MWt	500.000	4000 MWt	
Thermal Tourism(Baths)	215 baths	402 MWt	400 baths equivalent	1100 MWt	
Greenhouse	635 da	192 MWt	5000 da	1700 MWt	
Cooling	-	-	50.000 house equivalent	300 MWt	
Drying	-	-		500 MWt	
Fishing + other usage	-	-		400 MWt	
Total Direct Usage		1229 MWt		8000 MWt	35.040.000 MWth/year
2013 Estimation of Total Geothermal Direct Usage (excluding electricity) Fuel-oil Substitution					3.88 million ton/year = 4 billion USD/ year

2.2. Environmental Benefits of Geothermal Energy

There are a lot of advantages of geothermal energy. Geothermal energy is a renewable, sustainable, environmentally friendly, and green energy. Kagel et al. (2005) stated that when compared to fossil fuel energy sources such as coal and natural gas, geothermal emerges as one of the least polluting forms of energy, producing virtually zero air emissions. Geothermal offers a base load source of reliable power that compares favorably with fossil fuel power sources. But unless

legislative changes are enacted, geothermal energy will continue to be produced at only a fraction of its potential.

Furthermore, the benefits of geothermal resources are briefly listed below (SPO, 2009):

A – Production of electricity,

B – Central heating, cooling (air conditioning), green house heating and so forth

C – Usage for industrialization purposes, provision for process heat, drying and so forth,

D – Chemical substance and mineral production CO_2, fertilizer, lithium, hydrogen and so forth,

E – Thermal baths (Thermal tourism)

F – Freshwater fishery at low temperatures (30 °C)

(State Planning Organization, 2009).

Usage of geothermal energy also provides extra benefits besides environmental benefits. If we compare the geothermal with coal and fuel oil, the prices will be as follows, the price of heating with geothermal energy per month is between 12,4 – 59,4 TL, the cost of heating with coal is 408,4 TL and finally, the cost of heating with fuel oil is 591 TL (State Planning Organization, 2009).

Furthermore, the investment cost of geothermal per house (100 m^2) including building connections and drilling well is 1500 – 2000 US Dollars. However the investment cost of natural gas per house (100 m^2) is 2000-2500 US Dollars. As a conclusion, geothermal energy is cheaper than natural gas compared to initial natural gas as well as the environmental protection (State Planning Organization, 2009).

Decision and policy makers have to consider both tangible and intangible benefits of geothermal energy to provide more state-wide usage of geothermal energy. Decision makers need such an analysis. Because, they use all these analysis results in their cost and benefit analysis during the calculation of investment cost and also these results are used during the preparation of the feasibility studies of the optimal

and new geothermal energy investment. The Water Framework Directive (WFD) of the European Union (EU) (2000/60/EC) defines water resources to include surface water, groundwater, inland water, rivers, lakes, transitional waters, coastal waters and aquifers and valuation of economic valuation of environmental benefits of geothermal energy will provide policy makers with policy recommendations which might help them timely implementation of the WFD and hence sustainable management of groundwater resources.

2.3.Yozgat Geothermal Potential and Usage

Yozgat Province (Figure 2.3) which has a population of 485,000 and area of 14,123 km^2 is located in the central Turkey and shared by Kızılırmak and Yeşilırmak Watersheds. Province's economy in agriculture is based on animal husbandry and forestry. Major industrial activities are flour, beer, leather, vegetable oil, cement, prefabricated house and brick factories. There are also several mining facilities (iron, marble, rock salt, lignite, graphite, brick-tile raw material, cement raw material) in Yozgat (Yozgat Special Province Administration, 2010).

Yozgat-Central and Districts has a very high geothermal energy potential. The provinces of Yozgat, namely, Sorgun, Sarıkaya, Saraykent, Yerköy, Yenifakılı, Boğazlıyan, Akdagmadeni, Central-Çatakboğazı have the geothermal potential. As a result of geothermal drilling efforts made by Yozgat Special Province Administration and other governmental establishments the identified potential of geothermal energy in Yozgat is 1000 lt / sec, but at present, 500 lt / sec of this geothermal potential is able to use (Yozgat Special Province Administration, 2010).

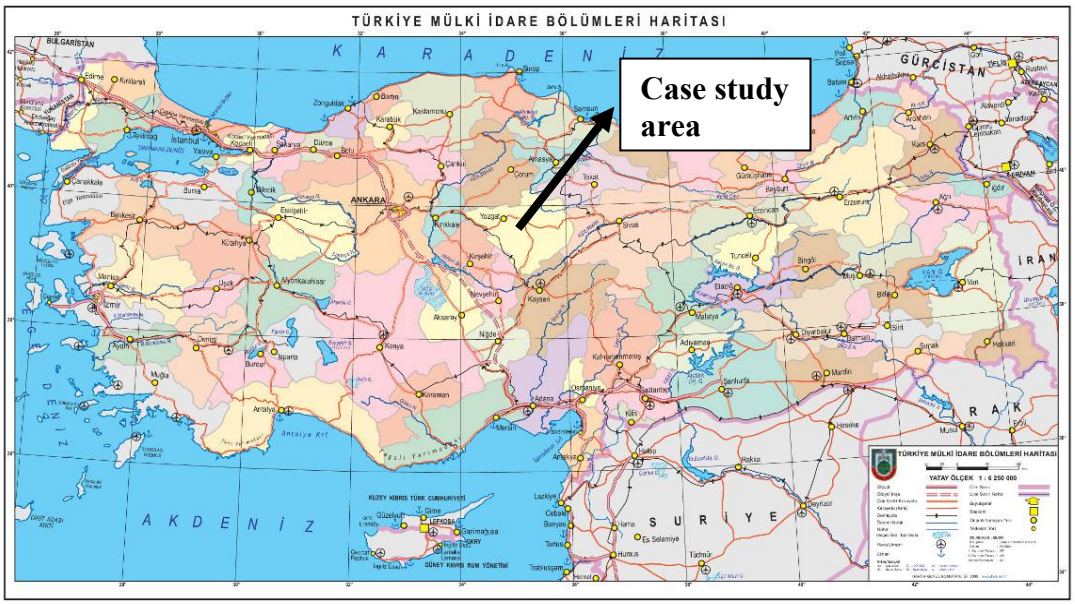

Figure 2.3. Location of Yozgat Province (HGK, 2009)

The geothermal potential of Yozgat Province which is case study area in this study as shown in Figure 2.3 is estimated to be used in 25,000 houses for the heating purposes. The major thermal springs of the province are Boğazlıyan district, Sarıkaya district, Saraykent district, Sorgun district and Yerköy district thermal springs. Yozgat's a remarkable geological feature makes groundwater potential very rich (State Planning Organization, 2009)

Geothermal fields in Yozgat province:

In Yozgat province, in Sarıkaya, Boğazlıyan Bahariye, Sorgun, Yerköy, Saraykent, Akdağmadeni, Karadikmen districts, there are thermal waters. These geothermal hot waters are used for both thermal baths purposes and house heating purposes. In the Sorgun, Sarıkaya and Saraykent districts, geothermal energy has been used for house heating purposes.

Also in Yerköy district, implementation Project of house heating with geothermal energy has been completed. After the geological, hydro geological hydro chemical researches made in Yozgat province field, positive signal are taken from the point

of view of geothermal energy production and potential (State Planning Organization, 2009). Potential fields in the Yozgat province is shown in the figure 2.4 and geothermal resources in the Yozgat province and the drilling works done by MTA General Directory listed in Table 2.2

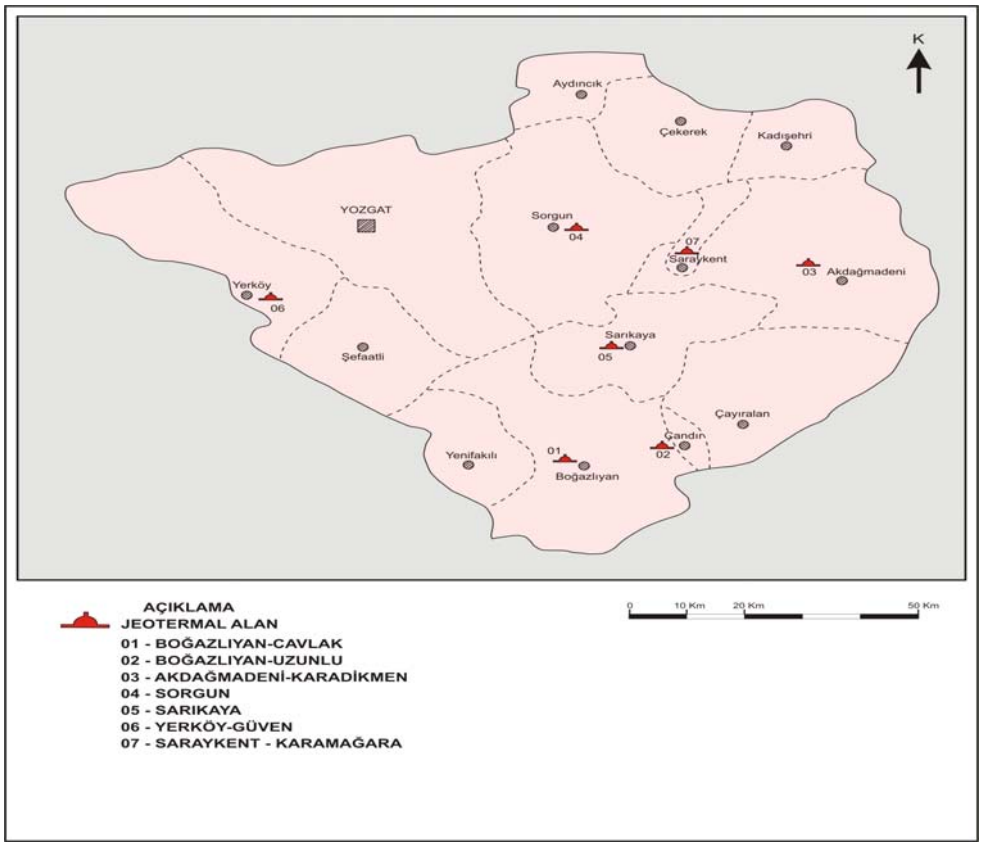

Figure 2.4. Yozgat Province Geothermal Potential (MTA, 2005)

Table 2.3. General Information of Geothermal Drilling Results in Yozgat Province (MTA, 2005)

Geothermal field	Resource name	Temperature (^{o}C)	Flowrate (l/s)
Boğazlıyan - Cavlak Geothermal field	Lake Resource	33	300
Boğazlıyan - Uzunlu Geothermal field	Resource	27	1
Akdağmadeni - Karadikmen Geothermal field	Bath Resource	38,3	0,5
	Lake Resource	34	0,1-0,2
	Uyuz Bath Resource	25	0,1-0,2
	Muşelim Bath Resource.	29,5	0,1
Sorgun Geothermal field	Bedirbaba Resource	47	3
	Yeniçeltek Resource	45	50
	Saray Resource	73	17
	Köhne Resource	61	1,5
Sarıkaya Geothermal field	Sarıkaya Resource	48,6	20
	Uyuz Bath Resource	48,5	8
Yerköy - Güven Geothermal field	Aslan Ağzı	41	0,5
	Çamur Ilıcası	45	-
Saraykent (Karamağara) Geothermal field	Saraykent	46	-

CHAPTER 3

NON MARKET VALUATION TECHNIQUES

In terms of environmental benefits, environmental protection brings both market and nonmarket benefits. Market benefits are assessed by their dollar value, and nonmarket benefits are estimated by economic means. This chapter presents a concise overview of the methods that are used to estimate monetary values and intangible benefits highlighting the broad range of possibilities and how they are related. Besides, it contains detailed information on how values and intangible benefits are assessed.

It is important to consider the definitions of tangible and intangible benefits. The former, refers monetary value. The latter, in contrast, refers non monetary value. The reason why intangible benefits cannot be expressed a monetary value can be twofold: data is not available or how to measure the value is not clear. One way of handling the intangible benefits is simply ignoring them. However, ignoring them results in biased results. It does not necessarily mean that, when benefits are intangible, they are actually unimportant. Therefore, intangible benefits should be quantified as far as possible.

Gregory et al. (1997) maintain that interests about tradeoffs several the diverse consequences of environmental policies, an significant portion of which includes the economic effects, lie at the core of this renewed controversy. While calculating the economic effects can cause serious difficulties, most challenging issues for decision makers and source organizer arise in considering the non financial effects of ecological strategies justified and acceptable terms to stakeholders.

There has been a dramatic change the environmental policy guidelines for the past years, which is evident in the newly emerging emphasis on assessing nonmonetary impacts. According to these guidelines, human health, as well as ecological, and nonmonetary social impacts, which may have economic implications, need to be explicitly evaluated as part of the environmental assessment. Such non-market impacts relate to visual and aesthetic improvements, preservation of habitats of endangered plants or animals and health benefits. Indeed, several means exist to overcome the problem of valuing non-market environmental effects. First, nonmarket values can be expressed in dollars, which is presently a common indicator of value. If this works, these values can be directly integrated with other economic impacts. For economics and cost-benefit analysis, this approach has been so far the ideal, thus commonest, model used to evaluate environmental policies (Gregory et al., 1997).

3.1. Types of Values

The total value of an environmental benefit can be grouped into three. This section provides an overview of these three types of value: use, option, and existence values.

Examples of all economic valuation methods that are appropriate to use in total economical valuation components are direct use values, indirect use values, option values and non-use values.

Economists analyze the total economic value in three main components: (1) use value, (2) option value, and (3) nonuse value. Use value refers to the direct benefit obtained from the exploitation of environmental resources. Fish the seas provide for consumption, woods exploited for timber, water obtained from steam for irrigation are some examples within this category (Menegaki, 2008).

Option value refers to the value people attach to potential benefits of the environment. It indicates a willingness to act against the probability of using the

environment in the future, even if it is not currently used. In brief, use value is derived from current use, whereas option value is the wish to preserve a possible future option (Eban, 2002).

As to nonuse value, people are commonly observed to be willing to pay for the preservation of resources, which they know exist but will never use maybe. Thus, it is also called existence value.

When these categories merge with each other, the total willingness to pay (TWP) is produced:

TWP= Use Value + Option Value + Nonuse Value

Obviously nonuse values are less tangible than use values because motivations, rather than actual use, are their origin.

For non-monetary inputs, Menegaki (2008) claims that an extensive evaluation is possible only if it includes valuation approaches. To this end, the total economic value of renewable energy (use value plus non-use value) should be particularly sought for. This is explained in Figure 3.1, which has been drawn by Bateman and Langford (2003) and then modified for renewable energy values. The use value is derived from the actual usage of renewable energies. The use value of renewable energy can be analyzed in four groups:

(i) the direct use value (e.g., using renewable energy to have homes electrified),

(ii) the indirect use value (e.g., using renewable energy as far as possible, which would save non-renewable energy and reduce the pressure on oil demand),

(iii) option use value (saving non-renewable energy for the future). The non-use value can be defined as perceived utility of a good not yet used. This can be divided into two: the bequest-value and the existence value. The bequest value is the value people enjoy from reducing emissions and

leaving a more sustainable environment to the coming generations. The existence value is the value people derive from enjoying a clearer atmosphere due to reduced air emissions.

Overall, these make up the human value of renewable energy. The intrinsic non-human value of renewable energy is the value from preserving fossil fuels. Although it is being debated whether or not it is ethical to include the passive use values in economic analysis and in the technical criteria the methods should comply with, a benefit–cost analysis which disregards this value would be unsound.

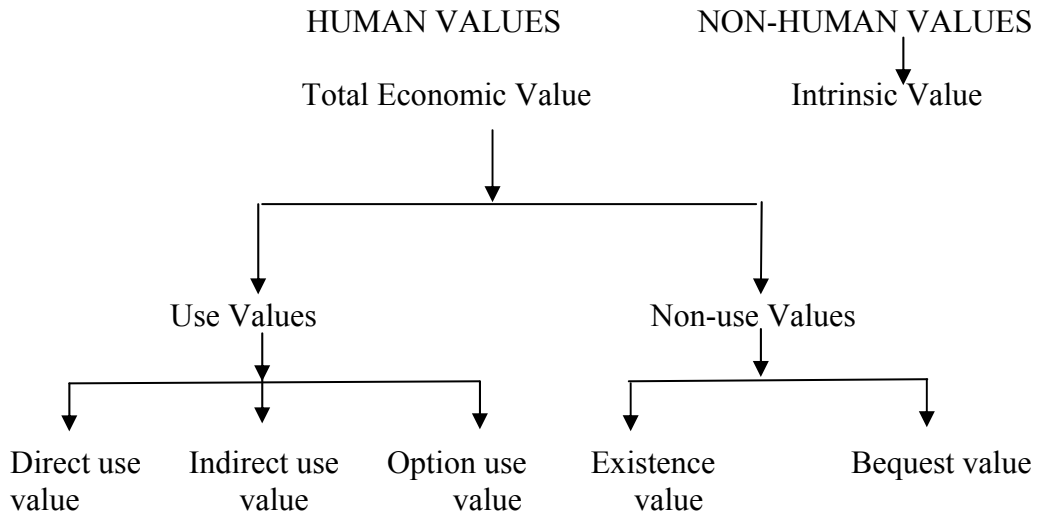

Figure 3.1. Total value disaggregation for renewable energy (Menegaki 2008)

3.2. Classifying Valuation Methods

Values are assessed by the help of different methods. This section presents an explanatory summary of all the methods and their usages (Figure 3.2). Direct revealed preference valuation methods are based on actual observable choices. These can directly reveal actual resource values. These are direct when compared with valuation methods used when the value is not directly observable. As a result,

this method attempts at obtaining values by means of survey, the items of which are geared toward eliciting the respondents' willingness to pay for the preservation of the goods.

In the past few decades, many EVM's have been improved to value the alteration in the quantity or quality of top-grade goods or services in monetary terms or to attach economic values to their intangible utilities, such as those related with recreation and landscape (Chaudhry, 2007). Such valuation is twofold; the value of the impacts of alteration in environmental amenities (e.g., scenery) on recreational actions and the impacts of environmental features on property values (e.g., pollution) can be estimated. The value of endangered species and the conservation of wetlands have also been tried to be estimated. Then comes the EVM, which are classified into direct and indirect methods. The former method utilizes such data collection tools as surveys or interviews, for these are effective in having insight into individual valuations of hypothetical alterations in environmental resources and amenities. The methods in this group assume that the respondents have thoroughly perceived the good or service they are to value, its present condition and the hypothetical alterations in quality or quantity of service/good. The latter approach is called as the market approach. This is based on the utility of market knowledge and on the prediction that market goods and environmental goods or services poorly complement each other.

The literature related to valuation methods also contains studies on renewable energy valuation. Menegaki (2008) categorizes related methods into five main streams, the departure points of which are generally the research field: stated preference techniques, revealed preference techniques, portfolio analysis, emergy analysis and other economic, but not welfare- oriented, methods

Non-market valuation techniques (Figure 3.2) have been increasingly developed and applied as discovering the price of non-market goods and services have always remained difficult. The prominent techniques so far have been contingent valuation methods and the hedonic pricing (HPM) and travel cost (TCM) approaches. The

techniques in the first group require individuals' directly expressing their willingness-to-pay through surveys and questionnaires. The techniques in the second group draw links between public and market goods, thus help assign values. Each one of them, incidentally, has its strengths and weaknesses. Therefore, it is of utmost importance to take into consideration the nature of the good or service and the available knowledge about it (Birol et al., 2006).

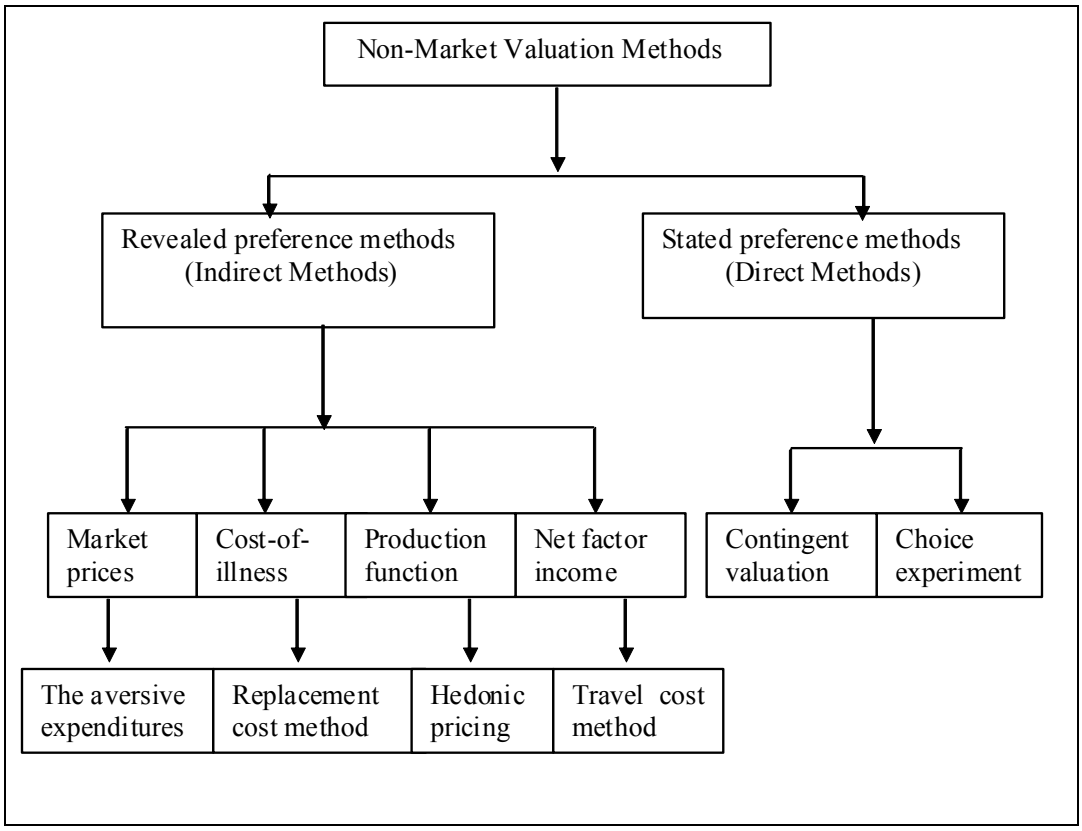

Figure 3.2. Economic Valuation Methods (Birol, 2006)

3.3. Revealed Preference Methods

Hedonic Pricing Method (HPM), Travel Cost Method (TCM) and Contingent Valuation Method (CVM) can all be traced to one use value measure of the benefits of a particular good or service. Needless to indicate, TCM and HPM cannot

estimate non-use values of environmental goods because they are the Revealed Preference Methods.

Menagaki (2008) maintains that the markets, as they reflect consumers' actual decisions, reveal WTP information. Travel cost and hedonic pricing are also revealed preference techniques. However, the literature review has pointed to the fact that few travel cost studies exist in the literature related to renewable energy and that hedonic analysis is used, though in tandem with conjoint analysis, in one study (Roe et al., 2007).Table 3.1 presents a summary of the strengths and weaknesses of the valuation methods described in following sections.

Table 3.1. Advantages and Disadvantages of Economic Valuation Methods (Commission on Geosciences, Environment and Resources (CGER), 1997).

Method	**Advantages**	**Disadvantages**
Hedonic pricing method (HPM)	Based on observable and readily available data from actual behavior and choices	Difficulty in detecting small effects of environmental quality factors on property prices
		Connection between implicit prices and value measures is technically complex and sometimes empirically unobtainable. Ex post valuation. (i.e. conducted after the change in environmental quality or quantity has occurred).
		Does not measure non-use values.
Travel cost method (TCM)	Based on observable data from actual behavior and choices	Need for easily observable behavior.
	Relatively inexpensive.	Limited to in situ resource use situations including travel.
		Limited to assessment of the current situation.
		Possible sample selection problems.
		Ex post valuation.
		Does not measure non-use values.
Replacement cost method	Based on observable data from actual behavior and choices.	Need for easily observable behavior on averting behaviors or expenditures
	Relatively inexpensive.	Estimates do not capture full losses from environmental degradation.
		Several key assumptions must be met to obtain reliable estimates.
		Limited to assessment of current situation.
		Ex post valuation.
		Does not measure non-use values.

Production function method	Based on observable data	Understates WTP.
	From firms using water as an input.	Ex post valuation.
	Firmly grounded in microeconomic theory.	Does not measure non-use values.
	Relatively inexpensive.	Omits the disutility associated with illness.
Cost-of-illness method	Relatively inexpensive.	Understates WTP because it overlooks averting costs
		Limited to assessment of the current situation.
		Ex post valuation.
Market prices	Based on observable data from actual choices in markets or other negotiated exchanges.	Does not provide total values (including non-use values).
		Limited to assessment of current situation.
		Potential for market distortions to bias values.
Contingent valuation method (CVM)	It can be used to measure the value of anything without need for observable behavior (data).	Subject to various biases (e.g., interviewing bias, starting point bias, Non-response bias, strategic bias, yea-saying bias, insensitivity to scope or embedding bias, payment vehicle bias, information. bias, hypothetical bias).
	It can measure non-use values.	Expensive due to the need for thorough survey development and pre-testing.
	Technique is not generally difficult to understand.	Controversial for non-use value applications.
	Enables ex ante and ex post valuation.	
Choice experiment method (CEM)	It can be used to measure the value of any environmental resource without need for observable behavior (data), as well as the values of their multiple attributes.	Technique can be difficult to understand.
	It can measure non-use values.	Expensive due to the need for thorough survey development and pre-testing.
	Eliminates several biases of CVM.	Controversial for non-use value applications.
	Enables ex ante and ex post valuation.	

3.3.1. Hedonic Pricing Method (HPM)

HPM is another way of measuring the nonmarket benefits of environmental protection, yet it fails to estimate non-use values of environmental goods. In this method, the benefits of an increase in environmental quality are assessed by examining the change in the price. Another technique which is based on Lancaster's characteristics theory of value (Lancaster, 1966) is commonly applied to housing prices which are strong indicators of the value of local environmental resources.

This theory is based on the assumption that any good can be described in a group of characteristics and the levels these take and that the price of the good depends on these characteristics and their respective levels.

Although Colwell and Dilmore (1999) claim that this methodology may possibly have originated in much earlier studies, Morancho (2003) asserts that Griliches (1971) and Rosen (1974) provided the theoretical foundation for the development of the hedonic models. HPM relates to the market price of a good together with the characteristics that belong to it. That is, noting the differences in the market price of a commodity which shares the same or similar characteristics, a monetary value of can be assigned to each characteristic. The conception that goods are formed by varying sets of attributes forms the rationale behind this method. In other words, behind the actual price exists an implicit price for each one of the attributes that belong to the good. The literature amply contains studies that used the hedonic approach to value environment related external conditions. It is observed that, in these studies, not only the subject matter but also the fields the HPM benefits are wildly varied. A literature review conducted by Smith and Huang (1995) highlights a total of 37 studies carried out within a period of 21 years (between 1967 and 1988) wherein HPM was used to value air quality improvement. Simons et al. (1997) adds to this list more recent works. In the studies they reviewed, housing prices are connected with such external conditions as the underground water contamination, the existence of high power electric networks and hazardous waste landfills. Still other researchers who applied HPM are Ferreiro and Sotelsek (1992), and Espey and Lopez (2000). Using this method, they valued the effects caused by acoustic contamination. The use of HPM far extends into urban planning. For example, using this method, school districts (Clark and Herrin, 2000), open spaces (Luttik, 2000), urban wetlands (Mahan et al., 2000) and air quality (Zabel and Kiel, 2000) are analyzed. Furthermore, this approach is used in studies related with urban revitalization (Ding et al., 2000) and decreases in air pollution (Bilbao, 2000).

3.3.2. Travel Cost Method (TCM)

This section describes TCM, which is another method of estimating nonmarket benefits. This method is basically used for valuing parks, lakes, and beaches and measuring how much people spend to use the resource, namely their travel cost. By nature, TCM cannot be used to predict non-use values of environmental goods.

TCM inquires how much value people assign to recreational sites. To this end, it analyzes the consumption behaviors in related markets (Fleming et. al, 2008). What is used as a gauge of price here is how much is expended on costs of travel, entrance costs, on-site expenses and the like to consume the recreational amenities. Nevertheless, this method presumes that recreational site and consumption expenditures are not so complementary. That is to say the lower the consumption expenditure, the lower the marginal utility of visitation.

In lieu with this, the recreational site cannot be valued unless the usage expenses are positive (Hanley & Spash, 1993). This is a distinctive method in the field of non-market valuation, and thus has been extensively used (Smith, 1995). Several studies (Knapman & Stanley, 1991; Stoeckl, 1995;) which focused on predicting the recreational values of Australia's National Parks have been the most popular examples of the application TCM.

Other studies have also made use of this model to estimate the effects of welfare on water quality changes in recreational sites (e.g. Smith and Desvousges, 1987; Bockstael et al., 1987) or to inquire tourists' recreational demand for saltwater (e.g. Bell and Leeworthy, 1990).

3.4. Stated preferences methods

Studies using stated preference methods inquire individuals' willingness to pay (WTP) so as to ensure a possible benefit from renewable form of energy. Some stated preference techniques are the contingent valuation and choice modelings. Contingent valuation method is used to estimate WTP for renewable energy and the factors that affect it. Choice modeling examines different alternative renewable energy choicesand the common forms of payment (e.g., whether collective or private etc…) (Menegaki, 2008).

3.4.1 Choice experiment method (CEM)

Choice experiment method (CEM) is another economic method used to measure the value of environmental resources. CEM is a method that is used to measure the value of any environmental resource without need for observable behavior (data), as well as the values of their multiple attributes. CEM measures non-use values. Technique is difficult to understand and expensive due to the need for thorough survey development and pre-testing.

The choice experiment (CE) method was originated in the literature of marketing and transport economics (Louviere, 1988, 1992; Louviere and Woodworth, 1983) and was first extended into the subject matter of environmental issues initially by Adamowicz (1994). It has been applied in a variety of ways to estimate use and non-use values in environmental economics (Adamowicz et al., 1998; Boxall et al., 1996). Recreational benefits brought by forest management policies have also been evaluated by this approach in recent times (Nielsen et al., 2007).

The choice experiment method was used in a study focusing on the Macquarie Marshes wetland in Australia (Morrison et al., 1999). The aim of the study was to assess the non-use values of environmental, social and economic features of the area. The results revealed that Australian public is willing to pay (WTP) amounts ranging from €13.3 to €60.9 per household to serve the purpose of maintaining and

increasing the wetland area, enhancing the biodiversity in the wetland and contributing to the increase of irrigation job opportunities, and resolving the conflict about the use of water resources.

Similar to Marshes wetland in Australia, Staffanstorp in Swedenis is another wetland which provided the focus of a study where CEM method was employed to estimate non-use and use values (Carlsson et al., 2003). This study supports the preservation of wetland and management programmes geared toward maximizing public benefits.

3.4.2 The Contingent Valuation Method

CVM, the main data source of which is survey responses, is employed to estimate nonmarket benefits and to measure non-use values of environmental goods. By means of CVM, a means of driving values is obtained, which can be got in other traditional ways whatsoever. Basically, this approach asks respondents to attach a degree of value to an environmental change or an attempt to protect the resource. Because respondents' preferences are sought in this way, CV is also called a "stated preference" approach (Eban, 2002).

After the risk of additional pollution has been established, actual value measures are obtained as the final step in predicting the benefits of changes in environmental quality. Although asking people their WTP, which is respondents' maximum WTP for obtaining an extra benefit of environmental good, or WTA which the minimum amount of money respondents would accept for abstaining from having extra benefit, may appear to be the most straightforward assessment of benefits, economists do use survey approaches to measure the benefits of environmental protection, which is called contingent valuation (CVs), because the survey responses are "contingent" upon the questions asked. However, interpretation of the results from CV studies is not a straightforward process (Goldstein, 2002).

According to Nomura (2004), CVM is more commonly used now to evaluate goods not physically traded and involves the statistical processing of responses to questions on how much the respondents have WTP for certain benefits. CVM is utilized to assess environmental benefits in monetary terms. It is used for both natural sources and benefits other than goods from agricultural industry.

CVM is a survey-based technique to the valuation of non-market goods and services based on a questionnaire to directly elicit information about the value of a particular good or service. There is no traditional competitive market for the type of environmental developments; CVM serves as a tool to obtain value forecasts, especially the amount that individuals or households are WTP for particular environmental goods. CVM has been used in industrialized economies to determine the value of environmental services. Yet, in the last ten years the CVM was used more widely in the valuation of environmental quality and in various public projects in developing countries (Whittington, 1996; Merrett, 2002).

According to Gregory et al. (1997), CVM survey technique is the most versatile monetary method (Mitchell and Carson, 1989). It posits a hypothetical market for an costly environmental item and elicits the maximum cost people would be willing to pay to get more of the item (if good) or to decrease or escape from the item (if bad). Based on samples consisting of several thousand people, the results are considered to be indicators of the value the society places on environmental goods. CVM's are used for many different policy issues and are granted substantial legal authority (Kopp et al., 1990). However, criticisms have been made against the use of CVM's from within as well as outside the evaluation community (Hausman, 1993). For example, critics have demonstrated experimental evidence that the wording, context and order the questions are asked may considerably affect the accuracy of CV results (Kahneman and Knetsch, 1992), referred to as problems of bias in the economics literature, because it is forecasted that people hold true values that are distorted by poor measurement techniques.

As Birol et al. (2006) mentioned, with CVM, valuation is dependent or 'contingent' upon a hypothetical condition whereby respondents are interviewed and individuals are asked to express their WTP, which is respondents' maximum WTP for obtaining an extra benefit of environmental good (or minimum willingness to accept, WTA, which the minimum amount of money respondents would accept for abstaining from having extra benefit, compensation) for an increase, or decrease, in the level of environmental quantity or quality. Special attention needs to be paid to the design and conduction of the survey needs to carry out a CVM and pilot groups, consultations with related experts, and pretesting of the survey are significant pre-requisites.

As Chaudhry (2007) stated the survey techniques in this method are expected to simulate market-like conditions for the solicitation of value knowledge. Face-to face, telephone or mail questionnaires are used to predict the public's monetary value of a resource. In developing countries, in-person interview is commonly suggested over telephonic or mail questionnaire because of socio-economic factors. Respondents are presented a hypothetical market condition which is combined with choices regarding the amount of money they feel the resource is worth. This hypothetical market includes three key elements (Loomis, 1993), which are a description of the resource being evaluated, the way of payment, and an elicitation procedure. The elicitation procedure is a key feature of CVM and refers to how the respondent would bid on the resource.

CVM is becoming more popular among ecological economists from different subject areas as a tool to elicit values for commodities that are not normally traded in markets or the non-use or existence value not reflected in costs. Then, ecological economists need to discover other ways to obtain financial values for these non-market goods. CVM approach is rooted in applied welfare economics and begins from a hypothetical market condition by asking people their maximum WTP for non-market goods and services (Cooper et al., 2004).

According to the conclusions drawn by the NOAA panel, CV methods can yield useful information (Arrow et al., 1993). To increase the reliability of the forecasts, the panel recommends the following: (1) using a probability sample; (2) face-to-face or telephone surveys rather than mail surveys; (3) measuring willingness to pay rather than WTA; (4) pilot study of the CV questionnaire; (5) interpreting CV questions in the form of hypothetical market; (6) giving a ‘‘would not vote’’ option in addition to the ‘‘no and ‘‘yes vote options; (7) breaking down WTP by a variety of respondent features such as income, interest, and attitudes; (8) telling respondents of their actual budget constraint when considering their WTP.

3.5. Stages of Contingent Valuation (CV) Method

The actual CV study can be split into a number of stages (Hanley and Spash, 1993):

A. Setting up the CV or hypothetical market
B. Getting WTP amounts
C. Forecasting mean WTP
D. Aggregating the WTP amounts
E. Evaluating the validity of the CV exercise.

3.5.1. Setting up the hypothetical market

The process of devising a convincing CV scenario consists of a number of elements. The first pace is to device a hypothetical market for the environmental good in question. For instance, Dillman and Bergstrom (1991) tried to measure WTP values for the environmental amenity of agricultural field. The environmental amenity value of agricultural field was mentioned as: (1) scenic value (like quaint barns, and rustic fences and hedges); and (2) nostalgic value (rural heritage, myths that farm life gives good and morally strong citizens).

3.5.2. Obtaining bids

As a result of CV scenario detailed, respondents must be given with a believable vehicle by which the funds will be increase, for instance, value added or sales tax, income tax, trust fund payments, entry charges, property taxes, and changes in utility bills. In a given condition, some bid vehicles are viable options for obtaining WTP bids. The selected bid vehicle should have a reasonable connection with the amenity it is been utilized to value, and also be understood to be fair and equitable in its incidence and in connection with those eliciting benefits for the suggested good. Different types of bid vehicle give different opportunities for free riders. Respondents have different opinions on the acceptability of different kind of taxes: e.g. poll, property, income, and sales taxes.

3.5.3. Forecasting mean WTP amounts

Garrod (1997) mentioned that however the median bid has much to recommend it: it is unaffected by large bids in the upper tail of the distribution; and is the amount of money which a one person one vote system would allocate to the policy or public good. Median bids are less than mean bids. Mean WTP amounts can be originated from a survey by averaging the observed bid response. A CV survey allows the researcher to calculate many different statistical values for a good.

3.5.4. Aggregating the WTP or WTA amounts

Mean WTP forecasts from the CV sample survey must be collected across the total population to obtain a total value figure. Although WTP estimates are often modest for non-use benefits, the populations over which they are aggregated can be quite large, producing enormous aggregate WTP amounts. This occurred in the Exxon Valdez case where non-use values were a whole magnitude higher than WTP to avoid loss of use-value, and two orders of magnitude higher than actual damages to fishing and recreational industries in Alaska. Such large aggregate values are of

major concern to companies being sued for environmental damages under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 1980, in the USA (Garrod, 1997).

3.5.5. Evaluating the validity of the CV exercise

The ultimate test of the accuracy of the CVM's and their utilization in determining benefits in (CBA), is whether issues will pay the amounts that they tell they would be willing to pay in a CV study. This validity of CV estimates has been judged in a number of ways following the taxonomy suggested by Mitchell and Carson (1989) in terms of:

content validity: the suitable framing of the study, and questions asked regarding the good being valued;

criterion validity: the comparison of CV forecasts with actual market or simulated market experiences;

construct validity: the correspondence or convergence between a CV measure and other determines of the value of the same good.

3.6. Biases

Mitchell and Carson (1989) mention five general sources for biases in CV studies:

(1) incentives to misrepresent responses (i.e. strategic biases);
(2) implied value cues (i.e. starting point biases, range biases and relational biases);
(3) scenario misspecification (i.e. payment vehicle biases, elicitation biases, and symbolic biases);
(4) improper sampling design or execution (i.e. population choice bias, sampling frame bias, sample non-response bias, sample selection bias); and
(5) improper benefit aggregation (i.e. temporal selection bias and sequence aggregation bias).

Tietenberg (2007) stated that the major concern with the use of the contingent valuation method is the potential for survey respondents to give biased answers. Four types of potential bias have been studied: (1) strategic bias, (2) information bias, (3) starting point bias, and (4) hypothetical bias.

Strategic bias arises when the respondent gives a biased answer to influence a particular outcome. For example, in case of a decision to preserve a river for fishing, the respondents who enjoy fishing may be tempted to provide an answer that ensures a high value instead of a lower value that reflects their true valuation. According to Goodstein (2002), strategic bias arises if people really do not have to pay their stated WTP for a certain good. Then, this may result in an inflation of one's WTP estimate, which would be a particularly good strategy if the respondent expected that larger WTP values in the survey results would result in a higher likelihood of species protection.

Information bias may arise whenever respondents are forced to value attributes they have never or rarely experienced. To illustrate, the valuation by a recreationist of a loss in water in one body of water may be based on the ease of substituting recreation on another body of water, which will be based on a false perception if the respondent has not had any experience with the second body of water (Tietenberg, 2007).

Garrod et al. (1999) mentioned that there is no exogenous criterion to specify how much information or what context needs to be provided to respondents while valuing an environmental good. For example, WTP to preserve a certain animal is tried to the individual's marginal rate of substitution between income and utility for preservation fund. WTP bids will be affected by information provided to the individual if it changes either the marginal rate of substitution or the marginal efficiency of investment.

Starting-point bias may arise when a survey instrument includes questions ask respondents to check off their answers from a predefined set of possibilities. The

way the designer of the survey defined that range may affect the resulting answers (Tietenberg, 2007).

Garrod et al. (1999) stated that starting-point bias may affect closed-ended and iterative bidding games. The starting-point that reflects the initial range of WTP amounts offered to respondents has an effect on the final WTP value given for the good because people tend to believe that the starting point suggested reflects the norm. That is, if other people pay it, they feel they are expected to do so, too. Starting-point bias has been found in many CV studies. In one study, it was possible to influence a respondent's final bid over a substantial range by the choice of the initial bid. Unfortunately, researchers themselves seldomly know what constitutes an appropriate initial bid value for most environmental commodities. Moreover, a single starting bid may not be appropriate for all respondents.

The hypothetical nature of the question may make respondents give hypothetical answers, which are not well thought out or even meaningless.

Finally, the most serious problem with CV surveys is embedding bias. The answers that respondents give are likely to be strongly affected by the amount of information provided about the issue in question, especially when valuation questions are "embedded" in a border context (Goldstein, 2002).

3.7. Examples of Contingent Valuation Techniques

The technique used for estimating nonmarket benefits is based on the survey responses and is known as Contingent Valuation (CV). CV is the only available technique for estimating benefits of environmental protection based primarily on existence value. In this section, some examples of CV approaches and studies in the world are presented in detail.

Nomura et al. (2004) reported the results of a survey using CVM to obtain information on the willingness of Japanese households to pay more for RE, through

a flat monthly surcharge. The median value of WTP for RE by Japanese households is estimated at about 2000 yen.

After the litigation surrounding the 1989 Exxon Valdez disaster the state of Alaska and Exxon started to conduct CV studies of the damaged environmental assets and to assess the accuracy and usefulness of CV studies. An expert panel that included the Nobel-Prize winning economists Kenneth Arrow and Robert Solow was appointed by the National Oceanic and Atmospheric Administration (NOAA) to study whether CVM's yield reliable knowledge about passive-use values.

According to Wiser (2007), in several studies opinion surveys or deliberative polling have been used to elicit individual preferences to support renewable power generation. There is proof that U.S. residents prefer collective, mandatory payments for RE to voluntary ones.

Yoo et al., (2009) mentioned the attempts of South Korea to use electricity originated from environmentally friendly energy sources in order to resolve the problem of energy and to reduce the effects of global warming. The CVM was used to get forecasts of the WTP values for raising the percentage of green electricity in Korea. Overall, the survey was successful in eliciting WTP values for green electricity.

Hanley et al. (1999) used CV to assess residents' preferences over the three proposed RE options, which were to be placed at specific sites within the North Assynt Estate. The aim was specifically to elicit financial values for the environmental benefits and costs for each renewable energy options as perceived by residents.

As Groothuis et al. (2008) mentioned, the CV survey was developed in order to obtain an understanding of citizen's perceptions of wind power and their influence on mountain views.

In a study by Desvousges et al. (1987) the option price bids for the developed recreation as a result of improved water quality of the Monongahela River in Pennsylvania was estimated.

According to Gregory et al. (1997), the use of constructive techniques for environmental policy problems is very recent. Within the framework of evaluating risk-management options, the health, environmental, and financial impacts of alternative understandings to keeping high-level nuclear wastes have been evaluated. A study of land-use options in Malaysia by Gregory and Keeney (1994) was based on stakeholder values to create new policy alternatives in a controversial land-use debate. Schkade and Payne (1994) analyzed respondents' WTP for a suggested environmental regulation by using a constructive preference approach as the basis for a verbal protocol. Maguire and Servheen (1992) compared wildlife-management options for endangered grizzly bear populations by using decision analysis techniques. Decision analytic techniques were also used by Keeney et al. (1990) to design public value forums for the evaluation of Germany's energy policies and by Mc- Daniels (1992) to assess policy options for old growth forest conflicts and biodiversity conservation in wilderness region in British Columbia.

According to the Wang et al. (2008), after environmental degradation and urbanization within China, more residents will an improved air quality. In this respect, they focus on the correlation between low air quality and residents' WTP for improved air quality in Ji'nan. They used a CVM to quantify individuals' WTP for improved air quality. Through the stratified sampling method 1500 residents were chosen. The respondents' WTP was elicited in face-to-face interviews which included a range of hypothetical, open-ended scenario questions. 59.7% of respondents expressed a positive WTP.

There are a comprehensive review of recent research on RE, most of which are concerned with green electricity, biomass and wind energy and were carried out via mail survey. Nevertheless, the literature seems to lack in GE related studies.

Limited researches were made related to GE usage for heating purposes in literature and researches on the valuation of RES's given in Appendix B.

When the threat of global climate change is considered, curbing the use of fossil fuels appears to be an urgent sustainability issue (Hansla et al., 2008 as cited in IPCC, 2001). Attitude towards green electricity, which offers a solution to this problem, is connected with consciousness of results of environmental issues for oneself, others, and the biosphere, concerns for these results, and self-transcendent value types. For example, the results of a mail survey which involved about 900 Swedish household consumers pointed to the fact that the more positive attitude people have towards green electricity, the more willing they are to pay for green electricity. Also, the study revealed a negative correlation between WTP and electricity costs.

In another wide-scale survey study (Hansla et al., 2008), a questionnaire was sent with a free-of-charge return envelope to a randomly selected sample of 3475 residents of Sweden. The respondents' age ranged between 19 and 78. An introductory section made it explicit it was a research affiliated with the Center of Consumption Science at Goteborg University and no commercial interests whatsoever inspired the research or no financially support was received. The instructions also required the participants were expected to complete the questionnaire in 30 min. To increase the return rate, a follow-up note to thank and remind the respondents to fill out the questionnaires was also sent after a week. Eventually, nearly 25 % of the questionnaires suitable for data analysis were returned. In the first section of the questionnaire, the respondents were asked to identify complication in the Swedish electricity market. Other question types included the items with several choices to comprise among different suppliers (Garling et al., 2007) and questions about ATT and WTP for green electricity, environment-related questions, and socio demographic questions.

Nomura et al. (2004) carried out a study; the main data collection instrument is a mail survey. The questionnaires inquired the respondents' WTP premiums for RE, especially the factors that might affect their WTP. The return rate of 1000 questionnaire sheets was 37%. The results revealed that consumers were keen to pay an average premium of 2000 yen per month, which is much higher than those recorded in other studies. Several issues, such as the preparation of the survey and the date of the interview might have influenced this result.

CHAPTER 4

APPLICATION OF CONTINGENT VALUATION METHOD(CVM) TO YOZGAT PROVINCE

In this chapter, application of the CVM to value environmental benefits of geothermal energy in monetary terms in Yozgat (center) is explained. A face to face survey was conducted in Yozgat province to learn willingness to pay to determine and find out environmental benefits of usage of the renewable energy namely, geothermal energy for the improvement of air quality and mitigates the effects of climate change in Yozgat province.

Firstly, pilot survey was conducted and 30 respondents filled in the questionnaire in December 2009. According to feedbacks of the respondents the sections and the format of some questions of the questionnaire rearranged. Finally, the questionnaire was applied to the 360 respondents in March 2010 in order to determine WTP for geothermal energy usage for house heating.

4.1. Questionnaire Design and WTP Questions

In order to use CVM, it is essential to apply interviews or surveys using questionnaires to express the willingness to pay by the individuals for quality and quantity of goods or services (benefits) via payment mechanisms.

Questionnaire was prepared to elicit individual's WTP for the usage of geothermal energy to improve air quality by reducing CO_2 emissions caused by fossil fuels as well as for mitigating the causes of climate change.

4.1.1. Survey Design

The pilot study was conducted on the Yozgat population and the focus group was composed of 30 respondents. Native of the Yozgat population attended to the face to face survey. Results obtained form the focus group help to modify the hypothetical question and the bid ranges in the WTP section in the survey.

Feedbacks from the respondents showed that some questions are not understood easily. During survey and the development of the survey scenario on pilot group and final group, the questions were defined and designed clearly so that the respondents understood the hypothetical situation and comment their views comfortably.

During the preparation of the questionnaire, firstly, the format and structure of the previously conducted questionnaires were (Alp, 1999; Koundouri, 2009; Yoo, 2009) reviewed. Moreover, during the preparation of the questionnaire, previous surveys were reviewed (Whitehead, 2007). Background data and information related to air pollution, environmental problems in the region, thermal tourism and geothermal energy potential in the Yozgat province were collected and reviewed (Yozgat Special Province Administration, 2010; MTA,2006).

In the survey, there are standard socio-economic questions aggregating information on age, educational level, family size, number of children in the household, employment condition and family income (Koundouri, 2009). The survey questionnaire is composed of: (i) demographic questions like respondents' perceptions following the provision of general background information on green electricity; (ii) questions on the WTP for the proposed policy on the use of green electricity; and (iii) family knowledge (Yoo, 2009).

Demographic questions presented in Section-I are common to all the previous studies (Alp, 1999; Whitehead, 2007; Koundouri, 2009; Yoo, 2009) . These independent variables were used to elicit the willingness to pay (WTP) for the usage of geothermal energy since all these variables are related and important in the WTP regression analysis. Also in section II, respondents were asked to elicit the mean WTP. In section III, air pollution and climate change questions and WTP question were asked. Furthermore, in section III, hypothetical market was presented in order to elicit WTP, variables effecting WTP and underlying motivations.

The questionnaire survey (Appendix A) was designed to elicit responses in three sections for each respondent, namely:

(a) Section– I Demographic questions
(b) Section II – Air pollution and climate changes questions
(c) Section III. Geothermal energy potential, socio-economic benefits and tourism benefits of geothermal energy in Yozgat.

Section– I Basic Personnel Questions

The first section of the questionnaire is composed of demographic questions like education, gender, occupation, income and marital status.

Section II – Air Pollution and Climate changes Questions

The second part of the questionnaire contained questions concerning the respondents' ideas of the significant of several environmental issues, followed by a question about the environmental issues of Yozgat. Level of air pollution and level of climate change were asked to the respondents.

Section III. Geothermal energy potential and socio-economic benefits and tourism benefits of geothermal energy in Yozgat

Hypothetical market is presented in this section in order to elicit WTP for geothermal energy benefits. This part of the questionnaire comprised contingent valuation questions, where respondents are asked first whether they are willing to

pay for improving the air quality, mitigation of effects of climate change, and possible increase in tourism revenues because of investment in geothermal energy. Then those who responds positively were asked how much were they willing to contribute as in Turkish Liras.

4.1.2. Survey Team

During the application of CVM, it is a common practice to conduct the draft survey on focus group. The reason for this common practice is composed of two concepts. First reason is the increasing of the understanding of the respondent better. Second reason is the amending the interviewing techniques.

During the implementation of survey (Appendix A), a survey team applied the questionnaire to the respondents. At first, all the technical details of the survey method were explained the survey team. Survey team consists of 5 people. The team members got familiar with the questions and the concept of the questionnaire before the survey study. These are Yaşar Duman, Yusuf Kahraman, İsmail Yar, Hasan Arun and Erol Horasanlı. Most of the team members are from Bozok University in Yozgat. The first surveys on the focus group were conducted in December 2009 and after the modification and remedy was made on the questionnaire, in March 2010, main survey study was made on focus group.

4.2 Implementation of the survey

Surveys can be conducted in many ways: face to face survey; self-fill questionnaires; mail and telephone survey; Face to face surveys are the usual technique adopted, and the procedure recommended by Arrow et al. (1993) for National Oceanic and Atmospheric Administration (NOAA). The good was defined explained more thoroughly in a face to face survey and non-response is minimized. However, face to face survey charged high to conduct. Respondent rates were higher for the face to face survey.

Face to face surveys were conducted on site around Yozgat in December 2009 for pilot group and the main survey in March 2010 for final group. Especially, the city was composed of 4 districts and a representative sample from within each region was randomly chosen. A total of 360 surveys were conducted face to face.

The selection of sample size measures the precision of the sample statistics used as forecasts of population variables like mean WTP. Generally, the larger the sample the smaller the variation in mean WTP as determined by the standard error, and defined in confidence intervals. The mean WTP amounts are readily originated from a survey by averaging the observed bid answers. 360 surveys were good enough to elicit mean WTP in this study.

4.2.1 The hypothetical scenario and the payment vehicle

Once the hypothetical scenario has been constructed and the elicitation technique selected, WTP bids were got through a questionnaire survey (appendix A).

Question can take two fundamental forms. The "WTP" question and the "WTA" compensation for alteration in the quality and the quantity of an environmental service and good. The "WTP" question was asked in the questionnaire. Closed-ended format was used from the several ways for obtaining the WTP.

4.3 Willingness to pay question

Different values are given and the respondent chooses one of the values; e.g. "If local authorities will take a decision to heat houses by new renewable domestic, cheap, green and environmental friendly energy, geothermal energy. Also they will demand and request from you monetary contribution as "geothermal hot water bill" to finance the capital and operational costs of geothermal investment."

How much would you be willing to pay monthly as your contribution as "geothermal hot water bill" for one year?

If respondent says YES to this question, he/she was presented with 8 different amounts ranging from $10 to $167.

4.4. Results

Results of the survey were analyzed by using SPSS (Statistical Package for Social Science). Calculation of mean WTP, frequencies and valid percentages are listed in this section. The set of independent variables used to explain variations in WTP is similar to what has been used in the other studies (Koundouri, 2009). In the following sections, variables are explained in detailed.

Although, recently, air pollution was gradually prevented by using natural gas, because of its high price, population of Yozgat contemplates the usage of fossil fuels that is very pollutant for ambient air of Yozgat. Also, the payment of natural gas is very high when it is compared to geothermal energy usage for heating purposes. Moreover, CO_2 emission due to usage of fossil fuels is very high. As a result, geothermal usage would provide less payment and less polluted air when it is compared to fossil fuels and natural gas. Because, during winter which last five months in the province, approximately (5 months*$202): $1010 is paid for the heating of the houses by natural gases. Average amount for coal used for house heating purpose is $690 as a result of survey.

4.4.1. Frequencies of the Demographic Questions

A total of 360 questionnaires were completed in this study. Both male and female residents were willing to participate in the survey. Of 360 respondents, 174 (48.3 %) were female and 186 (51.7%) were male. Interviewer conducted survey on streets, in governmental offices, coffee-houses, and markets etc. During the interview, interview conducted with only one respondent at that time. Since some

respondents did not answer some questions, these questions are expressed in the data sheet as the missing values. Due to the missing values, valid percent was used in order to show percentages.

Most of the respondents were native of Yozgat province and percentages were as follows: 75.8% of the respondents are native and 24.2 % of the respondents are not native of the Yozgat. Also marital status was asked to the interviewees and the results are shown as follows: 16.4 % single and widow, and 83.6 % married. Table 4.1 shows the occupational distribution of the respondents. Most of the respondents were governmental officer and dealing with commerce.

Table 4.1. Occupation distribution of the respondents

	Valid Percent
Farmer	3.1
Commerce	27.5
Governmental Officer	29.7
Student	5.6
Other	34.1

Educational levels of the respondents were shown in Table 4.2 and compared with the values of Turkish Statistical Institute (TUİK). The illiterate people of Yozgat are 10% (Turkstat, 2009) and in the survey study it is 0.3 %. This shows that most of the illiterate people live in rural areas. University in Yozgat increases the percentage of university graduated people. Also in the TÜİK data, regular or casual employee percentage is 19.8%, which is lower figure than survey study (29.7%) (Turkstat, 2009).

Table 4.2. Educational levels distribution of the respondents

	Valid Percent
Illiterate	0.3
Primary school graduate	1.4
Secondary school graduate	16.9
High school graduate	50.6
University graduate	30.8

The Gross Domestic product (GDP) of Yozgat province is $ 588 million and the average gross domestic product (GDP) per person is $ 852 in the Yozgat province. In the survey study, highest percentage is %9.4 and the correspondent amount is $1200 which is higher than Turkstat (TUİK) datas (Yozgat Employment and Vocational Education Committee Activity Report, 2010).

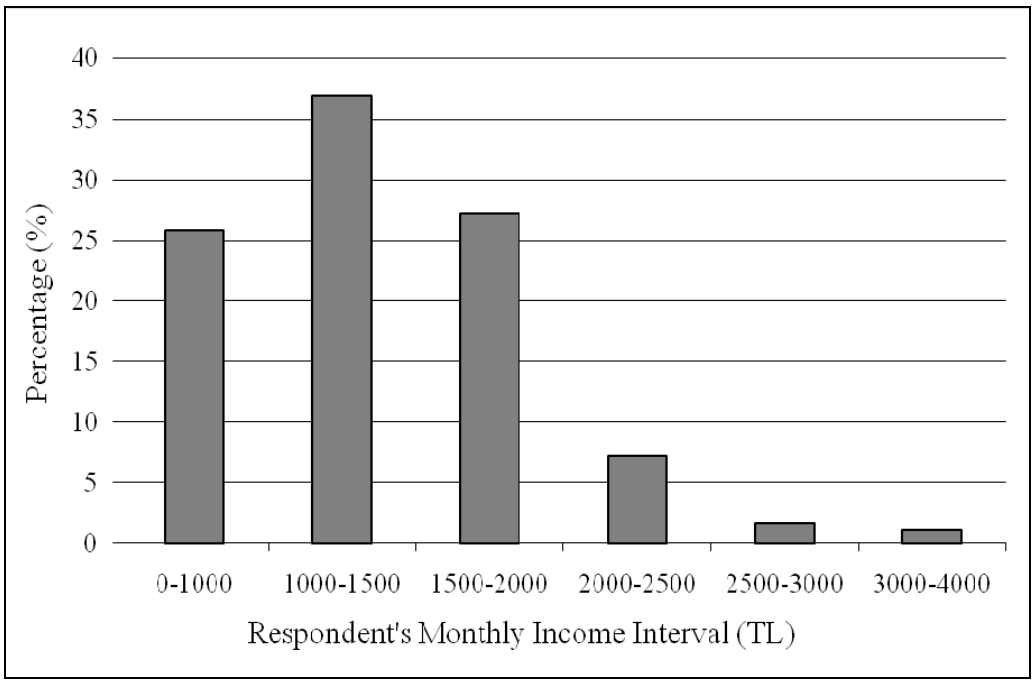

Figure 4.1. Monthly Income Distribution of the Respondents

4.4.2. Frequencies of the Air pollution and Climate Change Questions

In the Section II, respondent were asked about Environmental problems such as air pollution and climate change and global warming, and also health problems due to the low air quality. Priority of environmental problems according the respondents, are listed as, air pollution, then climate changes and finally contamination of rivers and water resources.

In question 16 in the questionnaire, the respondents were asked as "According to you, what is the first priority of the environmental problems that you observe in Yozgat?" and the percentage distribution was given in table 4.3 below.

Table 4.3. The most important environmental problems stated in the survey

	Valid Percent
Lack of green space	3.3
Air pollution	51.6
Climate change and global warming	25.4
Contamination of rivers and water resources	17.6
Extinction of flora and fauna	2.1

Respondents take the air pollution as the most important environmental problem (51.6%). As, it is stated in Environmental Assessment Report (2008), among several environmental problems, air pollution is important issue because of

geographical location of a Yozgat. Even though, natural gas has been available to be used in Yozgat, the residents tend to use coal instead of natural gas because of high natural gas bills. This issue was mentioned in the Yozgat Environment Assessment Report published by Ministry of Environment and Forestry, 2009. In this report, it was also emphasized that Yozgat is among 24 provinces with respect to air pollution being first and the most important issue. Air pollution in Yozgat leads to public health problems and increases health expenditures. Respondents stressed that increase (53.6%) in the air pollution level compared to previous year is experienced and also respondents emphasized on the degree of air pollution as serious (46.1%).

In question 19 in the questionnaire, the respondents were asked to name the factors affecting air pollution in Yozgat province. The respondents think that the usage of unqualified fuels (51.7%) and unconscious usage of fuels and burning of boiler without technical knowledge (28.8%) are the major reasons for air pollution in Yozgat.

When the respondents were asked about the best solution to use as a heating source in order to prevent air pollution due to the residential combustion from economical and environmental point of view, respondents replied as geothermal energy. There were very high proportions of the respondents (84.3%) that select geothermal energy as the best solution for the house heating considering also air pollution.

When the respondents were asked to list the measures to mitigate the effects of climate change, 81.4% of the respondents mentioned the use of geothermal energy. Also some respondents answered as the heat isolation for residence as the best strategy with 10.6% response rate. This means that population of Yozgat is aware of geothermal energy and its potential since in the most of the district; geothermal energy is already used for house heating purposes as Sorgun, Yerköy and Sarıkaya districts.

In question 20 in the questionnaire, the respondents were asked as “According to you, which one is the best solution to use as a heating source in order to prevent air pollution due to the residential combustion from economical and environmental point of view in Yozgat? ” and the percentage distribution was 84.3% for geothermal energy and 13.2% for natural gas.

In question 37 in the questionnaire, the respondents were asked as “What is the economical contribution of usage geothermal energy to Yozgat province from point of view thermal tourism income increment regarding thermal baths, health and wellness center, SPA?” and the percentage distribution for very much contribution was 73.7% and for much contribution was 23.8%.

Respondents know the effects of climate changes in the world and in the Yozgat and also think geothermal energy as an important solution for climate change mitigation and global warming. Also, respondents are aware of environmental problems of Yozgat province and want to make necessary contribution for that issue.

In question 40 in the questionnaire, the respondents were asked as “Do you think that it is worth to borrow credit or find a domestic or international finance?” and the percentage distribution for Worth was 74.7% and for Not worth was %5.3.

In question 42 in the questionnaire, the respondents were asked as “Would you explain briefly why do you not make monetary contribution?” and the percentage distribution was given in table 4.4 below. Some respondents did not offer any bids due to the some reasons that means they were not willing to pay any amount for geothermal investment in the region. Some reasons of the respondents were due to their low income that they could not afford and some reasons of the respondents were due to mistrust that funds will not be used appropriately. %44 of the respondents said that government is responsible for geothermal investment which means that government already collected taxes and has lots of revenues.

Table 4.4. The reasons not to do monetary contribution

	Valid Percent
Government is responsible	44.4
Funds will not be used appropriately	16.7
I cannot afford	38.9

In question 43 in the questionnaire, the respondents were asked as "Under the circumstances; how much would you be willing to pay monthly as your contribution by the name of "geothermal hot water bill?" and the percentage distribution was given in table 4.5 below. There were high contributions of the respondents since they were willing to pay for geothermal energy usage to improve air quality. 35.8% of the respondents contribute $50 which means that average amount of the electricity and water bills are equivalent to this affordable amount.

Table 4.5. Willingness to Pay amounts stated in the survey

Turkish Liras (TL)	Valid Percent
15	3.5
25	6.5
50	23.2
75	35.8
100	25.5
125	4.7
150	0.8

4.5 Estimation of WTP

The aim of the statistical analysis is the prediction of the coefficients, and variables that elicit the best estimates of WTP.

In this section the Ordinary Least Square (OLS) was specified. In order to obtain the most dominant variables that explain WTP, the procedures were followed as explained below. During the specification of the model the variables that are commonly used in previous studies were considered and used also in the statistical analysis. Moreover, variables that are expected to influence WTP were reviewed. During the specification of a criterion for the selection of the model F test statistics and R^2 were used.

4.5.1 Specification of the Model

As mentioned in the preceding section Ordinary Least Square statistical method (OLS) is used to predict the correlation between variables that effect WTP. The independent variables in the section I and environmental variables in the section II and section III (demographic parameters, environmental benefits and geothermal energy parameters) of the questionnaire used to express variations in WTP is the same as what has been used in the other studies. By the help of statistical analysis and OLS method, variables estimation was performed which result in the best estimation of WTP. Description of variables considered in the beginning of the regression analyses are given in Table 4.6.

As a result of survey of 360 respondents, the formulation below was used to estimate WTP:

$$WTP_n = a + \alpha_1 A_n + \alpha_2 B_n + \alpha_3 C_n + \alpha_4 D_n + \alpha_4 E_n + \alpha_5 F_n + \alpha_6 G_n \quad (4.2)$$

For individuals N,

Where	WTP_n	= WTP for individual N
	$A_n, B_n, C_n, D_n,$	= Demographic variables
	E_n, F_n, F_n	= Environmental benefits variables
	a	= Constant

Table 4.6. Variable Specification for WTP

VARIABLE	DESCRIPTION
EDU	Education level: 1=Illiterate, 5= No education Diploma, 8= Primary school graduate, 11= High school graduate, 15= University graduate
AGE	Age; continuous variable within range 18-80
GENDER	1= Male, 0= Female
MARISTAT	1= Married, 0= Single
OCCUPATION	1=Farmer, 2= Commerce, 3= Governmental officer, 4= Student, 5=Other
HOUSE	1= Owned, 2= Rental
INCOME	Income of the respondent, constant
NUMBER OF CHILDREN	Children number, constant
HOUSEHOLDSIZE	Household size, constant
TOTAL WINTER HEATING COST	Natural gas usage within 5 month in winter and coal consumption, constant
AIR POLLUTION	The first priority of the environmental problems, 1= Yes, 0= No
GLOBAL WARMING AND CLIMATE CHANGES	The first priority of the environmental problems, 1= Yes, 0= No
BOTH AIR POLLUTION AND GLOBAL WARMING AND CLIMATE CHANGES	The first priority of the environmental problems, 1= Yes, 0= No
NATIVE OF YOZGAT	Year , constant
AIR POLLUTION LEVEL	Very serious, 1= Yes, 0= No
YOZGAT CLIMATE CHANGES LEVEL	Very serious, 1= Yes, 0= No
ENVIRONMENTAL PROBLEMS OF YOZGAT	There are environmental problems, 1= Yes, 0= No
JEOTHERMAL ENERGY USAGE FOR PREVENTION OF AIR POLLUTION	Geothermal energy usage, 1=Yes, 0=No
WTP	Willingnes to pay amount, Turkish Liras, continuous variable
CONTRIBUTION OF TOURISM INCOMES	Contribution of tourism, 1= Yes, 0= No

4.5.2 Specification of a Criterion for Selection Model

The selection criterion was used in the regression analyses. In this study F, p(sig.), t and R^2 is used as the selection criteria. According to literature survey, these criteria are used generally in the previous studies (Alp, 1999; Koundouri, 2009; Yoo, 2009). Definitions of these criteria were given as follows; the mean squares are the sums of squares (SS) divided by the corresponding degrees of freedom.

R^2 is the squared multiple correlation coefficient. It is also defined the Coefficient of Determination. R^2 is the ratio of the Regression sum of squares to the total sum of squares. It is the ratio of the variability in the answer that is fitted by the model.

R^2 arises even when the new parameters have no real predictive capability. The adjusted-R^2 is an R^2-like determine that avoids this difficulty. When parameters are added to the equation, adj-R^2 doesn't arise unless the new parameters have additional predictive capability. F is the ratio of the Model Mean Square to the Error Mean Square. R^2, F and p mainly utilized as selection criteria.

4.5.3 Specification of a strategy for applying the criterion

SPSS (Statistical Package for the Social Sciences) software was used for calculation of mean WTP. All the demographic variables and also air pollution and climate changes question in section I and II included in the first round. According to selection criterion, air pollution and climate change questions in section II and some demographic questions in section I as gender, occupation, age, marital status, environmental problems, level of air pollution, effect of climate change, geothermal energy etc were removed in comparison with the value of the t statistics. All the results are listed in tables as follows. The descriptive statistics are given in Table 4.7. As a result of the linear regression process, according to the level of significance that explains WTP, variables added or removed. The independent variables (education, occupation, age, marital status, native of Yozgat, environmental problems, level of air pollution, effect of climate change, geothermal

energy etc.) is said to be useful in predicting the dependent variable (WTP) when the level of significance (P-value labeled with Sig. on the Output) is below 0.05.

This process was tried step by step applying all variables in the first round. At the end, the most important parameters were found and listed in Table 4.8. The results of linear regression process, the coefficients, R square value, sig. and F values were obtained and listed in Tables 4.9 and 4.10 below. All these values were used for the calculation of mean WTP. In the ANNOVA results, sig. is 0.0 which shows the significant level is smaller than 0.01.

Table 4.7. Descriptive Statistics for Regression Analysis for WTP estimation

	N	Minimum	Maximum	Mean	Std. Deviation
Education	360	2	15	11.62	2.61
Income	360	600.00	400.00	1459.44	541.50
Native of Yozgat	360	0	1	0.76	0.43
Air pollution Level	319	1	3	1.80	0.71
Total Winter Heating Cost (TL)	360	0.00	3250.00	1360.00	336.94
Yozgat Climate Change abd Global Warming Level	314	1.00	4.00	1.53	0.65
Contributionof Geothermal to Tourism Incomes	315	1	5	1.30	0.57
Willingness to Pay for Geothermal Water Bill	341	15.00	150.00	73.26	27.54

Table 4.8. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.307(a)	0.094	0.070	25.946

a Predictors: (Constant)

Table 4.9. ANOVA Results

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	18451.69	7	2635.956	3.915	0.000(a)
	Residual	177729.19	264	673.217		
	Total	196180.88	271			

a Predictors: (Constant),

b Dependent Variable: WTP

Also the correlations between the variables are listed using the Pearson Correlation in table 4.10. The variables were compared, whether there are correlations between the variables or not. The significant levels of the variables were checked. As it was shown in the table 4.10, there was correlation between some variables at the significant levels such as between education level and geothermal energy for tourism (0.008) and also between income and total winter heating cost (0.008). Nevertheless these variables were taken into account in the regression analyses since these variables were important parameter for WTP calculation.

Table 4.10. Pearson Correlations among the explanatory variables of the WTP

		Edu. Level	Income	Native	Air Pollutio level	Total Winter heatin Cost	Yozgat Climat Chang Level	Geo.to Touris Income	WTP for Geo. Energy
Education Level	Pearson Correlation	1	0.277 (**)	-0.048	0.014	0.065	0.086	0.008	-0.036
Income		0.27..	1	0.080	0.140 *	,008	,032	-0.12*	0.099
Native of Yozgat		-0.04	0.080	1	-0.038	-0.12*	-0.063	-0.025	0.13*
Air Pollut. Level		0.01	0.140 *	-0.038	1	0.071	0.34**	0.19**	-0.094
Heating Cost		0.06	0.008	-0.12*	0.071	1	0.047	0.029	0.080
Yozgat Climate Chan.level		0.08	0.032	-0.063	0.34**	0.047	1	0.21**	-0.13*
Contri. of Geo. to Tour. Incomes		0.008	-0.12*	-,025	0.19**	0.029	0.21**	1	-0.104
Willingne-ss to pay for geo.		-0.03	0.099	0.13*	-0.094	0.080	-0.13*	-0.104	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

For the final linear regression model (Table 4.11); the highest t value calculated for the parameter “NATIVE OF YOZGAT” showed that “NATIVE OF YOZGAT” is the most significant parameter, while the second most important one appeared to be “EDUCATION”. Then the third most important one appeared to be “TOTAL WINTER HEATING COST” Then, “INCOME”, “CLIMATE CHANGE AND GLOBAL WARMING LEVEL AND AIR POLLUTION LEVEL. Lastly, the seventh most important one appeared to be “CONTRIBUTION OF GEOTHERMAL ENERGY TO TOURISM INCOMES”. In general, the coefficient education was negative indicating low levels of educated respondents were willing to pay more than high educated levels. In final model; marital status, age, gender, occupation of the respondents are excluded since these variables are not related to WTP. Income was important parameter for mean WTP. Because high salary of the respondents resulted in high mean WTP. Also, natives of the Yozgat were very sensitive to the air pollution and climate change and mean WTP increases accordingly.

Respondents gave the first priority to the mitigation in the effect of the climate change and global warming. Respondents paid less attention to thermal tourism. However, this parameter effects mean WTP and this variable in the regression analyses and placed in the equation. Income and education level of the respondents are also important parameter for mean WTP calculation.

Table 4.11. Regression Estimates of Willingness to Pay

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	67.197	11.842		5.674	0.000
	Education	-1.526	0.651	-0.145	-2.343	0.020
	Income	0.007	0.003	0.145	2.322	0.021
	Native of Yozgat	9.503	3.823	0.149	2.486	0.014
	Total Winter Heating Cost	0.012	0.005	0.141	2.339	0.020
	Air Polution Level	-3.895	2.429	-0.102	-1.604	0.110
	Yozgat Climate Change and Global Warming Level	-5.020	2.671	-0.118	-1.880	0.061
	Conrtribution of Geothermal energy to Tourism Incomes	4.493	3.425	0.080	1.312	0.191

a Dependent Variable: Willingness to Pay

4.5.4 Calculation of the Willingness to Pay

The willingness to pay equation estimated using linear regression is shown as following equation 4.3.

WTP = 67.197-1.526(EDUCATION) + 0.007(INCOME) + 9.503(NATIVE OF YOZGAT) + 0.012(TOTAL WINTER HEATING COST) – 3.895(AIR POLUTION LEVEL) – 5.020(CLIMATE CHANGE AND GLOBAL WARMING LEVEL + 4.493(CONTRIBUTION OF GEOTHERMAL ENERGY TO TOURISM INCOMES) (4.3)

The mean WTP was calculated by placement the estimated parameters back in to the equation together with the mean values of the variables (1 $ was taken as 1.4880 TL as of December 2010) listed in Table 4.16.

WTP (mean) = 67.197–1.526(11.62) + 0.007(1459.444) + 9.503(0.76) + 0.012(1360.00) –3.895(1.80) – 5.020(1.5318) + 4.493 (1.30)

= 74.36 TL/person

= $ 50 /person

After the mean WTP was calculated, the total cost for geothermal energy investment and the public contribution per year can be calculated to find out the amortization period as follows:
The initial cost of geothermal investment is estimated between $1500-2000 per house including all network connections and heating systems.

Yozgat city center population = 73835 person

=~18458 households (estimating 4 people for a family)

18458 house * $2000/ house = $ 36 916 000

$50 * 18458 *12 month = $11,074,800 (contribution of public for a year)

In the light of figures above, it can be concluded the geothermal energy investment will be amortized in 3 years.

Also the amount that has been collected as geothermal heat bill monthly prices of the provinces that are using geothermal energy as heating purposes should be reviewed and considered carefully. Some examples of provinces are listed below to make comparison.

The monthly prices of geothermal energy usage bills of five provinces are given Table 4.12. When the mean of the five district heating costs are calculated, the result is $52.74. When the mean WTP of Yozgat province is compared with the result of the mean of the provinces given below, it can be concluded that the mean WTP calculated in this study is reasonable. Moreover, this result shows that the amount of WTP is affordable for in the case of geothermal energy usage for the geothermal hot water bills.

Table 4.12. Geothermal heat bill monthly prices of the provinces

Province/District	$ monthly price/100 m^2 house	Year
Balçova (İzmir)	51.33	2010
Sorgun (Yozgat)	46,66	2010
Afyonkarahisar	67.65	2010
Edremit (Balıkesir)	46.75	2010
Narlıdere(İzmir)	51.33	2010

The mean value of $ 50/person/month willingness to pay (WTP) for the usage of geothermal energy for house heating indicates that respondents' maximum amount of willingness to pay to improve air quality by using geothermal energy for heating purposes. Also it is emphasized that respondents know the importance of the climate changes and they believe that geothermal energy usage will affect the mitigation of climate changes positively. Moreover, there was a less attention to the contribution of geothermal energy to the tourism incomes.

The mean WTP is compared with the coal and natural gases prices. Respondents who use natural gas for heating purposes paid approximately (5 months*$270) $ 1350 during winter which last five months in the Yozgat province.. And average amount for coal used for house heating purpose is $870 as a result of survey. And the respondents are willing to pay $600 ($50/month* 12 months) if geothermal energy was available in Yozgat for the heating purposes. These figures show that from economical point of view, mean WTP, $50, is very reasonable cost. Moreover, WTP is related with the income of the public. High WTP means high contribution of the public for the geothermal energy investment.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

A. Conclusions

Extra environmental and socioeconomic benefits from renewable energy resources have attracted much the attention of academics and professionals especially after Kyoto Protocol. Improvement of air quality by geothermal energy is going to launch a bulk of forthcoming valuation studies, since capturing the economic value of the benefits from renewable energy sources, projects and investments is currently at the center of policy making.

Yozgat Province, Turkey with its significant geothermal potential is getting ready to use renewable energy sources in the near future for heating purposes in houses. Since new renewable energy investments related to the geothermal energy is going to bring extra cost to Yozgat residents it will be necessary to assess alternatives related to the geothermal energy projects which will include socio-economical considerations. In order to evaluate people's motivation and willingness to pay for the geothermal energy, contingent valuation method has been conducted in Yozgat. 360 surveys have been completed in March 2010. This study was designed to provide two objectives. i) to evaluate people's willingness to pay for geothermal energy; ii) to capture individuals' opinion about geothermal energy projects and their psychological, and social motivations for WTP. Ordinary least square (OLS) method was used to assess people's preferences for WTP. The results show that respondents in Yozgat are willing to pay 50$ for monthly geothermal heating bill.

Respondents consider air pollution and effect climate change as the most important environmental problems in Yozgat. Linear regression analysis showed that, people who consider air pollution and climate change as important environmental problems are willing to pay more for geothermal energy as the heating bill. Residents also expect that geothermal energy will increase the economic activity in Yozgat because of new investments that can be done on geothermal tourism. The geothermal energy investment in the region will amortize itself in 3 years. Therefore, geothermal energy investment seems feasible. Also when WTP amount is compared with monthly payment of the heating costs of the other cities in Turkey that used geothermal energy, mean WTP is affordable amount.

If high amount of WTP was got from the survey study, this would be interpreted as follows; Mean WTP is related with income and there is direct proportion between income and WTP as it is shown in the WTP equation 4.2. When mean WTP amount is high or low, it means that the motivations affecting mean WTP will be same or different and also the interest of respondents to their environment may not be affected accordingly. Nevertheless if the income is high in the survey area, the mean WTP would be high or vice versa.

B. Recommendation

After the completion of this master thesis that highlights economic and environmental valuation process and determination of the extra environmental benefits of geothermal energy usage for house heating by using the CVM, the survey and the statistical analysis results of thesis can be used in the cost and benefit analysis in order to prove the feasibility of new renewable energy namely geothermal energy investments in the center of Yozgat province.

Biases and uncertainties should be considered in details. These are incentives to misrepresent responses (i.e. strategic biases); implied value cues (i.e. starting point biases, range biases and relational biases); scenario misspecification (i.e. payment vehicle biases, elicitation biases, and symbolic biases); improper sampling design or

execution (i.e. population choice bias, sampling frame bias, sample non-response bias, sample selection bias); and improper benefit aggregation (i.e. temporal selection bias and sequence aggregation bias).

Moreover, different payment vehicles can be selected and different WTP results can be obtained and comparisons of the results can be made. Also, the survey study can be conducted in different times and seasons. Because in winter seasons, respondents may be more sensitive to the air pollution and house heating is an important issue especially in winter. Furthermore, different nonmarket valuation techniques can be applied to find out mean WTP.

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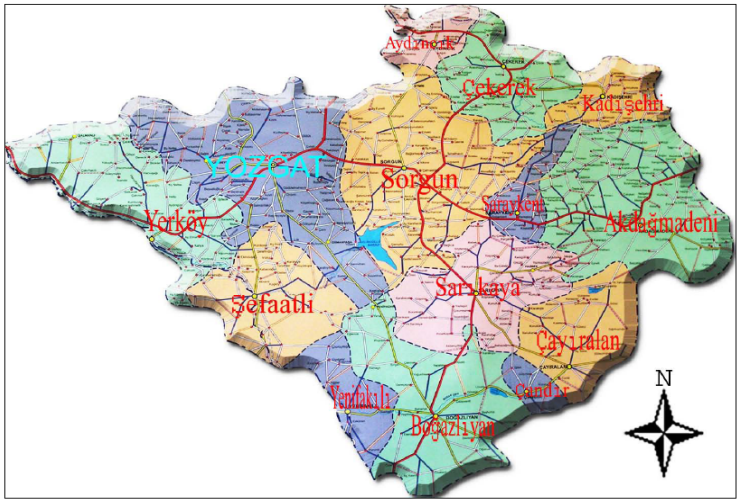
APPENDIX A

SURVEY

MIDDLE EAST TECHNICAL UNIVERSITY

FACULTY OF ENGINEERING

ENVIRONMENTAL ENGINEERING DEPARTMENT



YOZGAT

APPLICATION OF NON-MARKET ECONOMIC VALUATION METHOD TO VALUE THE ENVIRONMENTAL BENEFITS OF GEOTHERMAL ENERGY IN MONETARY TERMS: A CASE STUDY IN YOZGAT PROVINCE

QUESTIONNAIRE NO:

APPLICATION OF NON-MARKET ECONOMIC VALUATION METHOD TO VALUE THE ENVIRONMENTAL BENEFITS OF GEOTHERMAL ENERGY IN MONETARY TERMS: A CASE STUDY IN YOZGAT PROVINCE

Hi, my name is _____

I would first like to thank you for agreeing to participate in this survey and also for your contributions and sharing your opinions and recommendations with us.

In order to encourage, promote and to generalize the use of geothermal resources in house heating for the improvement of air quality in Yozgat province, I need your worthy contributions and recommendations.

There is a need for the cost-benefit analysis of socio-economic benefits of improving air quality by using geothermal energy in Yozgat province for the requirements of the degree of Master of Science in the Department of Environmental Engineering of Middle East Technical University. The study will be accomplished under the light of information obtained from this survey.

This is not a governmental and official study. The results of this survey will be used in scientific research and your answers to the questions will be kept strictly confidential.

Survey Date: _____
Survey Duration: _____ Survey Time: _____

SECTION– I Basic Personnel Questions

I would like to ask you some very basic personal questions in this section. As I stated earlier, your answers to this questionnaire, including the following questions will be strictly confidential and will be used only for scientific research purposes.

1. How old are you?

2. What is your gender?
1. Male
2. Female

3. Are you head of the household?
1. Yes
2. No

4. Are you native of Yozgat?
1. Yes
2. No

5. How long have you been in Yozgat?

6. What is your occupation?
1. Farmer
2. Commerce
3. Governmental Officer
4. Student
5. Other _____

7. What is your marital status?

1. Married
2. Single
3. Widow

8. What is your educational background?

1. Illiterate
2. No education Diploma
3. Primary school graduate
4. High school graduate
5. University graduate

District that you are living now:

9. How many people live in your household?

10. How many children live in your household?

11. Are you owner of the house?

1. Yes ( )
2. No ( )

12. Is your House is a flat in apartment or pavilion (detached house)

1. Yes ( )
2. No ( )

13. What is your monthly income?

_____TL.

14. How much do you pay for heating and hot water usage purposes monthly or annually?

-Natural Gas : (winter)----------TL ; (summer)----------TL.

-Coal : (winter)----------TL

-Fuel Oil : (winter)----------TL

-Electricity : (winter)----------TL ; (summer)----------TL.

SECTION II – AIR POLLUTION AND CLIMATE CHANGE QUESTIONS

Now, I would like to ask you some questions about your opinions concerning your environment. The word "environment" in this context refers to the general area in which you live, feel, see, hear and work, including the animals, plants and all living things together with elements such as air, water and soil that exist in the same area.

15. Do you believe that you live in a clean environment?

1. Yes ( ) **(go to question # 16)**
2. No ( ) **(go to question # 33)**
3. Don't know ( ) **(go to question # 33)**
4. No answer ( ) **(go to question # 33)**

16. According to you, what is the first priority of the environmental problems that you observe in Yozgat?

1- There is deforestation/lack of green space. ( )
2- There is air pollution and smoke due to urbanization ( ) (related questions; 17-23)
3- There is global warming and climate changes as a result of the greenhouse gasses( ) (related questions; 17-23)
4- Contamination of rivers and water resources ( )
5- Extinction of flora and fauna ( ) (related question; 32)
6- Distortion of forests ( )

17. What is degree of seriousness of air pollution in Yozgat Province?

1	2	3	4
Very serious	**Serious**	**Somewhat serious**	**No**

18. According to you, is there a sensible increment in the air pollution level compared to previous year in Yozgat?

1	2	3	4
Very sensible increment	**Sensible increment**	**Somewhat sensible increment**	**No**

Now, I would like to ask you about your opinions concerning factors affecting air pollution?

19. Would you like to mention the factors affecting air pollution in Yozgat province according to priorities?

* According to priorities, list from the most important to the least important and give figures like 1,2,3,….First mark and then list according to priorities.

1- Usage of unqualified fuels

2- Unconscious usage of fuels and burning of boiler without technical knowledge

3- Air pollution due to industry

4- Traffic and number of vehicles

20. According to you, which one is the best solution to use as a heating source in order to prevent air pollution due to the residential combustion from economical and environmental point of view in Yozgat?

* According to priorities, list from the most important to the least impotant and give figures like 1,2,3,….First mark and then list according to priorities.

1- Natural Gas ( )
2- Coal ( )
3- Fuel Oil ( )
4- Geothermal Energy ( )
5- Electricity ( )

21. Have you ever be ill or have health problemdue to air pollution in Yozgat? If yes please list.

1- Yes ( )

a-

b-

c-

d-

e- Others ……

2- No ( )

22. Have your relatives or others around you ever be ill or have health problem due to air pollution in Yozgat? If yes please list.

1- Yes ( )

a-

b-

c-

d-

e- Others ……

2- No ( )

23. How many days have you have to stay indoors due to air pollution within a year?

----

24. To what extent is the climate changes and global warming level inYozgat?

1	2	3	4
Very serious	**Serious**	**Somewhat serious**	**No**

25. What kind of climate changes and global warming observation have you have in Yozgat province, please list according to priorities?

* According to priorities, list from the most important to the least impotant and give figures like 1,2,3,….First mark and then list according to priorities.

1- Rainy days increase and flooding due to heavy rain ( )
2- Rainy days decrease and drought due to hot days ( )
3- Cold days in winter seasons ( )
4- Warm days in winter seasons ( )
5- Difference in agricultural crops ( )

6- Diminishing in drinking water resources ( )
7- Abnormal temperature changes ( )
8- Abnormal pressure changes ( )
9- Changes in foggy days ( )
10- Increase in windy days ( )
11- Increase in storm days ( )
12- Changes in soil temperature ( )

26. According to you, is there a sensible increment in the climate changes and global warming level compared to previous year in Yozgat?

1	2	3
Very sensible increment	**Somewhat sensible increment**	**No**

27- Would you like to mention the factors affecting the climate changes and global warming in Yozgat province according to priorities?

* According to priorities, list from the most important to the least impotant and give figures like 1,2,3,….First mark and then list according to priorities.

1- Chimney stack gases due to the combustion of fossil fuels for heating ( )
2- Industy Chimney gases that increase global warming ( )
3- High level usage of electricty in Industry ( )
4- Heavy traffic and car exhaust ( )
5- Distortion of forest ( )
6- Stubble burning ( )
7- Others……..... ( )

28- Have you ever have health problem or monetary problem due to the climate changes and global warming in Yozgat?

* According to priorities, list from the most important to the least important and give figures like 1,2,3,….First mark and then list according to priorities.

1- Lack of water during summer season and sell spring water
2- Flooding
3- Decreasing in flora and fauna species
4- Adverse effect of drought for agriculture
5- Tourism affected adversely and decrease in tourism incomes

29. What kind of necessary precautions should local and central government (municipalities) take in order to avert the climate changes and global warming in Yozgat?

* According to priorities, list from the most important to the least impotant and give figures like 1,2,3,….First mark and then list according to priorities.

1- Heat isolation for residence ( )
2- Training for acknowledgement and consciousness ( )
3- Increment of forests and green areas ( )
4- Promotion of geothermal energy ( )
5- car exhaust measurement controls ( )
6- Factory precautions for chimney gases ( )
7- Others……..... ( )

30. According to you, why should people protect the environment?

* According to priorities, list from the most important to the least impotant and give figures like 1,2,3,….First mark and then list according to priorities.

1- For the next generation and healty life ( )

2- For agriculture and husbandry since provide economical income ( )

3- For tourism incomes ( )

4- For protecting ourself from illness ( )

5- For other living things ( )

31. Are you believe in that climate changes and global warming are threats for Yozgat and Turkey?

1. Yes ( )

   Why:----------

2. No ( )

3. I don't know ( )

4. No answer ( )

Now I am going to ask you some questions about flora, fauna, birds and animals that is very rare in the nature around Yozgat province.

32- In comparision with previous years, what is the names of flora and founa that there is a decrease in their numbers or have extincted recently?

SECTION III. GEOTHERMAL ENERGY POTENTIAL AND WIILINGNESS TO PAY

Now, I would like to ask you some questions concerning your thoughts on air quality improvement by using geothermal energy in Yozgat province.

33. Did you have any prior knowledge about geothermal energy?

1. Yes
2. No (**go to question # 39**)
3.

34. How did you find out about the geothermal resources?

1. Village cafe
2. Media means like newspaper, tv and radio
3. At work
4. Through the gossip
5. I have already gone to thermal baths
6. Others_____

35. Do you know that Yozgat province has geothermal potential?

1. Yes ( )
2. No ( ) (**go to question # 41)**
3. I don't know ( )
4. No answer ( )

36. Knowing that there is very high geothermal potential in Yozgat province, according to you, what purposes should people use geothermal energy in Yozgat province?

* According to priorities, list from the most important to the least important and give figures like 1,2,3,….First mark and then list according to priorities.

1- Residence heating ( )

2-Greenhouse ( )

3- Thermal baths ( )

4-Health and wellness centers (SPA) ( )

5- Electric production ( )

37. What is the economical contubition of usage geothermal energy to Yozgat province from point of view thermal tourism income increment regarding thermal baths, health and wellness center, SPA?

1	2	3	4	5	6
Very much contribution	much contribution	Somewhat not much contribution	Not contribution	Don't Know	No answer

38. Mention the benefits of usage of geothermal energy in Yozgat province?

* According to priorities, list from the most important to the least impotant and give figures like 1,2,3,….First mark and then list according to priorities.

<u>Personnel benefits</u>

1- I will have a job opportunity at thermal resorts and thermal baths ( )

2- I will have better access to heat in the houses ( )

3- Less heating expenditure ( )

4- Less health expenditures. ( )

5- Decrease in climate changes and global warming problems ( )

<u>Benefits for next generations:</u>

1- Flora and fauna species in nature will be protected ( )

2- Healthy generation ( )

3- Employment in tourism sector ( )

4- Clean environment and heritage for next generations. ( )

5- Decrease in climate changes and global warming problems ( )

Benefits for the country:

1- Foreign exchange will be save up due to domestic energy ( )

2- Thermal tourism destinations will increase ( )

3- Decrease in climate changes and global warming problems ( )

4- Public health and other living things will be protected ( )

WILLINGNESS TO PAY QUESTIONS

Yozgat has a great potential regarding geothermal resources. This means that improvement of air quality and prevention of air pollution and protection of the other species other than human beings and the environment and public health is possible and also very feasible with the help of using geothermal energy which is already exist around Yozgat province.

The economic, social and environmental benefits of using geothermal energy for house heating for the improvement of the air quality are very important regarding climate change mitigation and tourism income.

Furthermore by the help of geothermal energy, e.g., thermal baths, wellness center (SPA), thermal tourism income will increase and the province would be a tourism destination in the region. Besides, the negative effects and results of air pollution on health e.g., increase in liver cancer events, chronic asthma events, asthma events, in cough events and in respiratory system events etc…would be prevented.

After all, for the capital cost and operational cost, the government and local authorities may demand for the monetary contribution from the public that live in Yozgat. In this master studies, we should determine the "likely" range of values that you would be willing to pay (WTP) for the amenity of the Yozgat province.

After mentioned above all benefits of usage geothermal energy, I would like to ask some questions as follows.

39. Do you support if the government or municipality makes policy in favor of usage of the renewable, new, green, domestic, cheap and environmental friendly geothermal energy sources to improve air quality in Yozgat?

1. Yes
2. No
3. Don't know
4. No answer

40. Do you think that it is worth to borrow credit or find a domestic or international finance?

1	2	3	4
Worth	Not Worth	Don't Know	No answer

41. Local authorities will take a decision to heat houses by new renewable domestic, cheap, green and environmental friendly energy, geothermal energy. Also they will demand and request from you monetary contribution as "geothermal hot water bill" in order to finance the capital and operational costs of geothermal investment
For instance; Sorgun and Sarıkaya districts use geothermal energy for house heating purposes. Municipality prepares another bill as "geothermal hot water bill". That is to say, they will demand monetary contribution as "geothermal hot water bill" in order to finance the capital and operational costs of geothermal investment.

In the light of information above, if the local authorities, namely municipalities, in order to finance the capital and operational costs of geothermal investment and request from you monetary contribution as "geothermal hot water bill". Do you accept monetary public contribution?

a) Yes ( ) (go to question #43)

b) No ( )

42. Would you explain briefly why do you not make monetary contribution?

1- We have already improved air quality ( )
2- The government is responsible for geothermal investment for air quality improvement ( )
3- I do not believe the funds will be used appropriately ( )
4- I cannot afford to contribute to the fund ( )
5- Others ( )

_____

43.Under the circumstances; **How much would you be willing to pay** monthly as your contribution by the name of "geothermal hot water bill"?

Payment TL/month	**15**	**25**	**50**	**75**	**100**	**125**	**150**	**250**

APPENDIX B

STUDIES ON THE VALUATION OF RENEWABLE ENERGY RESOURCES (Menegaki, 2007)

Country	**Resource type**	**Method**	**Result**	**Study**
Japan	Photovoltaic and wind energy	CVM	17US$ in the form of a flat monthly surcharge	Nomura N, Akai M., 2004
Spain	Wind energy	Conjoint analysis	Environmental costs appear higher in choice modeling that in contingent rating. Estimates of environmental costs are 3580, 6290 and 6161 pesetas for cliffs, fauna and flaura and landscape	Begon˜ a A, Hanley N., 2002
Scotland (North Assynt Estate)	Three-turbine wind farm, small-scale hydro scheme and biomass development	Local economic impact and CVM	Mean overall visitor expenditure per day = £21.50 Mean WTP for wind farm = £13,585, hydro scheme = £6642, biomass development = £14.282	Hanley N, Nevin C. 1999

Country	Resource type	Method	Result	Study
Scotland	Renewable energy investments (hydro, wind and biomass)	Choice experiments	The implicit price to maintain a neutral impact on wildlife is 75% of the price households would pay to reduce landscape impacts form high to none Rural respondents would be willing to pay an additional £1.08 per year from each household	Bergmann A, Hanley N, Wright R., 2006
USA	Renewable energy	CVM (single-bounded dichotomous choice question)	Scenario with collective payment and private provision most preferable	Wiser R., 2006
Sweden	Wind energy	CVM	WTP increased with age, income and environmental awareness	Ek K.,2005
USA	Green electricity	Choice experiment	Positive WTP for green electricity. Solar energy most preferred. Biomass and farm methane least preferred	Borchers AM, Duke JM, Parsons GR., 2007

Country	Resource type	Method	Result	Study
USA	Green electricity	Conjoint analysis and Hedonic analysis	Higher WTP when emissions reductions stem from increased reliance upon renewable resources	Roe B, Teisl MF, Levy A, Russell M., 2001
UK	Green electricity	CVM	WTP varies with social status and income	Batley SL, Colbourne D, Fleming PD, Urwin P., 2001
Wisconsin, USA	Green electricity	CVM (ordered probit model)	WTP higher when cancer cases decreased, appliance use restrictions were imposed and fish consumption bans as well sugar maple damage rates decreased	Wood LL, Kenyon AE, Desvousges WH, Morander LK.,1995
Schools in Hong-Kong	Photovoltaic electricity	CVM	Positive WTP	Close J, Pang H, Lam KH, Li T., 2006
Texas	Renewable energy	CVM (Town meetings of 200–250 citizens)	Higher WTP with age, education, income and information	Zarnikau J., 2003
USA	Photovoltaics in electricity production	Portfolio analysis	Photovoltaic-based electricity has a negative beta; its insurance value offsets its lower returns	Awerbuch S, Sauter R., 2006

Country	Resource type	Method	Result	Study
USA	Combined budget on research, development and deployment of renewables	Real options valuation, binomial lattice method	Total real options value 104 billion US$ (year base 2002)	Siddiqui A, Marnay C, Wiser R., 2007
USA	Wind power	CAPM, futures and swaps	0.50b/kWh premium over expected spot prices to lock in natural gas prices for the next 10 years	Bolinger M, Wiser R, Golove W., 2002
USA	Renewable electric technologies	Real options	The value of renewable electric technologies is $30.6 billion	Davis GA, Owens B., 2003
Spain	Switchable tariffs in wind energy	Real options	Monthly switching tariff is of more value to wind generators for its great flexibilities and accuracy of short-term forecasts	Yu W, Sheble´ GB, Pec-as Lopes JA, Matos MA., 2006
Greece	Electricity from renewable energy resources	Expanded net present value/real options Valuation	NPV = -405 smaller than option value = 755	Venetsanos K, Angelopoulou P, Tsoutsos T., 2002
USA (Mississippi river)	Natural energies (e.g., river geopotential) in river deltas	Emergy analysis	Emergy ratios 33.2 and 9.36	Martin J., 2002
Oak Openings region in USA	Environmental, cultural and economic subsystems	Emergy analysis	Emergy ratio 1.57	Higgins J., 2003

Country	Resource type	Method	Result	Study
Louisiana, USA	Wetland valuation (commercial fishing and trapping, recreation and storm protection)	CVM and emergy analysis based methods	Present value of an average acre of natural wetlands is US$2429–6400 per acre (8% discount rate) to $8977–17,000 per acre (3% discount rate). The lowest value of the wetlands is $77m and the largest value is $544 m.	Costanza R, Farber S, Maxwell J.,1989
Scotland	Hydroelectricity	Long-run average value	0.00–0.05 p/m3 compared to gas or coal with no CO2 emission charges included. 0.07–0.18 p/m3 compared to gas or coal with CO2 emission charges included	MacLeod M, Moran D, Spencer I., 2006
USA, Australia	Renewable resources	Replacement cost in the construction of indexes ISEW, GPI, SNBI/indirect valuation of renewables through the valuation of depletion of non-renewables	Equals the replacement cost of non-renewables	Lawn P., 2005

Country	Resource type	Method	Result	Study
Netherlands, Sweden, UK, USA	Renewable resources	Replacement cost of non-renewables in the construction of ISEW and GPI indexes/ indirect valuation of renewables through the valuation of depletion of non-renewables	Equals the replacement cost of non-renewables	Neumayer E., 2000
121 cities in USA	Renewable water production	Link between ecosystem service valuation with ecological footprint analyses	Mean cost associated with footprints $ 88,808km/ yr	Jenerette G, Marussich W, Joshua P, Newell J., 2006
–	Electricity externalities (metaanalysis)	Comparison of abatement cost and damage–cost approaches with ANOTA analysis	Bottom-up approaches produce the lowest external cost estimates	Sundqvist T., 2004
Canada	Metals	Cost of replacement, imposition of royalty rates on mined product revenue	-	Richards J., 2006
Ethiopia, Nepal, Ghana and India	Crop production increase, forestry, land management, cropping promotion	Short-cut techniques such as marginal user cost to add at the shadow price, multicriteria analysis, and non-market valuation	-	Knowler D., 2005
Rodriguez, Mauritius	Renewable energy	Discounted flow analysis, multi-criteria Analysis	-	Weisser D., 2004

Country	Resource type	Method	Result	Study
Qatar	Wind energy	Interest recovery factor, lifetime of the wind energy conversion system, investment rate and operation and maintenance costs	-	Marafia A-H, Ashour H., 2003
Egypt	Wind energy, photovoltaics	Life cycle cost analysis (present value)	Wind energy has the lowest cost	El-Kordy MN, Badr MA, Abed KA, Ibrahim Said MA., 2002
Bangladesh	Photovoltaics and grid electricity	Life cycle cost analysis	Life cycle cost per unit of grid energy is much higher than that of photovoltaic energy	Bhuiyan MMH, Asgar MA, Mazumder RK, Hussain M., 2000
Greece	Renewable energy	Multicriteria analysis	-	Polatidis H, Haralambopoulos DA., 2004
Greece	Biogass	Total annual cost	Biogas generated energy cheaper than conventional	Tsagarakis KP, Papadogiannis Ch., 2006
Greece	Biogass	Total annual cost	More electricity generator units will avoid the loss of renewable energy produced by biogas	Tsagarakis KP., 2007