THE REPUBLIC OF TURKEY
BAHÇEŞEHİR UNIVERSITY

ENERGY SOURCES AND INVESTMENT PROJECT ASSESSMENT: A CASE STUDY ABOUT WIND ENERGY IN TURKEY

Master's Thesis

AYÇA AY

İSTANBUL, 2010

THE REPUBLIC OF TURKEY
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CAPITAL MARKETS AND FINANCE

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İSTANBUL, 2010 Ayça AY

ABSTRACT

ENERGY SOURCES AND INVESTMENT PROJECT ASSESSMENT: A CASE STUDY ABOUT WIND ENERGY IN TURKEY

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All over the world, energy resources have always been a subject of interest. Some countries have become a monopoly in energy production and export. These resources are required in many different areas. It is well known that the production and consumption of energy is an indication of civilization. With this understanding, the importance of energy resources and investments made toward their acquisition is undeniable.

The purpose of this thesis is to analyze the proper distribution methods of limited funds, especially in the installation stage of projects that require major investments. The objective of investment in energy costs with their components correctly identified, as well as deviations which may arise in the future, and the ensuing results contribute to findings.

As companies cannot embark upon new projects with exact figures at hand, those that will make the most accurate estimates are the ones that will succeed. Investment decisions for financing projects are vital for a company's future. In this regard, the state or private sector alone will lack the necessary funds and therefore must act together. As an alternative to fossil resources, renewable energy resources need the backing of governments and international organizations. Feasibility research for investment in fossil energy resources has over time come to yield predictable results. However, as yet, this is not the case with renewable energy sources.

Renewable energy sources are environmentally-friendly, are low cost and sustainable, and therefore the most obvious choice for the future. Developed countries, especially, have begun to acknowledge this fact and act accordingly in terms of investment. Investing in renewable energy will contribute to a country's economic development, supply its energy demands, and create a cleaner environment.

Keywords: Energy Resources, Investment Decisions and Projects, Renewable Energy, Fossil Based Energy, Wind Energy

ÖZET

ENERGY SOURCES AND INVESTMENT PROJECT ASSESSMENT: A CASE STUDY ABOUT WIND ENERGY IN TURKEY

Ay, Ayça

Sermaye Piyasaları ve Finans

Tez Danışmanı: Prof. Dr. Niyazi Berk

Haziran, 2010, 142 Sayfa

Enerji kaynakları her zaman bütün dünyayı ilgilendiren bir konu olmuştur. Bazı ülkeler bu kaynakları ithal ederek elde ederken, bazı ülkelerde bu kaynakları üretme konusunda tekel konumuna gelmiştir.Bu kaynakların hepsi farklı alanlarda talep edilmektedir. Ama şu bilinmektedir ki enerji kaynakları medeniyetleşmenin bir göstergesi olmuştur.Bu kaynakların öneminin kavranması ile birlikte bu alana yatırımlar yapılmaya başlanmıştır.

Bu tezin amacı bu kaynakların özellikle projenin kurulum aşamasında büyük yatırımlara ihtiyaç duymasından ve sağlanacak fon kaynaklarının kısıtlı olmasından dolayı nasıl bir dağılım yapılabileceğini gösterebilmektir.Buradaki amaç enerji yatırımlarının maliyet ayaklarının doğru belirlenmesi ile birlikte gelecekte ortaya çıkacak sapmalardan bu kalemlerin ne şekilde etkilenip etkilenmeyeceği bilinmesidir.

Yatırımlar yapılırken her zaman tahmini rakamlardan yola çıkılır. Firmaların elinde kesin rakamlar yoktur ancak ne kadar tahmine yakın olunursa firma o kadar başarılı olacaktır.Yatırıma karar verirken firmalar için finansman ihtiyacı tesbitide en önemli kararlardan biridir. Bu durumda devlet veya özel sektörün tek başına sağladığı kaynaklar eksik kalmaktadır. Devlet ve özel sektörün birlikte hareket etmesi gerekmektedir.Özellikle fosil kaynaklara alternatif olarak çıkan yenilenebilir enerji kaynaklarının devlet ve uluslararası kuruluşlar tarafından daha çok desteğe ihtiyacı olduğu anlaşılmıştır. Çünkü fosil enerji kaynaklarına yapılan yatırımlar çok eskiden beri yapıldığı için fizibilite aşaması daha tahmin edilebirdir. Ancak bu yenilenebilir enerji kaynakların fizibilite aşaması için geçerli olamamaktır.

Yenilenebilir enerji kaynaklarının çevreci olması ve dış maliyetlerinin çok düşük olması ve sürdürülebilir kalkınma açısından etkin olması, bu kaynakları geleceğin enerji kaynakları yapmaktadır. Bu doğrultuda özellikle gelişmiş ülkelerde yenilenebilir kaynak yatırımlarına ciddi yönelmeler vardır. Yenilenebilir kaynaklara yatırım yapmak hem ülke ekonomisine, hem ülke enerji ihtiyacına hemde dünyamızda daha temiz bir çevre yaratma isteğine katkıda bulunacaktır.

Anahtar Kelimeler: Enerji Kaynakları, Yatırım Kararları ve Projeleri, Yenilenebilir Enerji, Fosil Kaynaklar, Rüzgar Enerjisi

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LIST OF ABBREVIATIONS

Build Operate Transfer	:BOT
Build Own Operate	:BOO
Commonwealth of Independent States	:CIS
Concentrating Solar Power	:CSP
Development Bank of Turkey	:TKB
Electricity Generation Company	:EUAS
Energy Information Administration	:EIA
Energy Market Law	:EML
Energy Market Regulatory Authority	:EMRA
European Union	:EU
European Wind Energy Association	:EWEA
General Directorate of Electric Power Resources	:EIE
General Directorate of State Hydraulic Works	:DSI
Industrial Development Bank of Turkey	:TSKB
Internal Rate of Return	:IRR
International Bank for Reconstruction and Development	:IBRD
Kilowatt	:KW
Megawatt	:MW
Ministry Of Energy And Natural Resources	:MENR
Net Present Value	:NPV
Organization for Economic Co-operation And Development	:OECD
Organization of Petroleum Exporting Countries	:OPEC
Prototype Carbon Fund	:PCF
Rate of Return	:ROR
Special Purpose Debt Facility	:SPDF
Tons Equivalent of Petroleum	:TEP
Turkish Electricity Distribution Company	:TEDAS
Turkish Electricity Trading And Contracting Company	:TETTAS

Turkish Electricity Transmission Company	:TEIAS
United Kingdom	:UK
United States of America	:USA

1. INTRODUCTION

Energy is a subject that has preserved its popularity for several centuries and about which many books have been written, a lot of research has been conducted. It is crucial for all countries and it caused many conflicts and wars between nations in the past. The turning point for energy came with the increasing need of the world for new resources, especially renewable energy. The reason why this resource is so sought after is, firstly, the considerable decrease in fossil based reserves around the world. Secondly, there is an increasing awareness of protecting the environment, particularly against global warming, calving of glaciers, and ozone layer depletion. Human beings have always been consumers but this outlook needs to change in current era and precautions need to be taken by each country. In this regard, the Kyoto Protocol's being accepted by almost every country in the world is a sign of change.

Focusing on Turkey's geopolitical position, it can be seen that Turkey is surrounded by energy reserves on three sides. Despite political and economical limitations and the limitations on efficient use of those reserves, Turkey has the potential to be an energy bridge between countries.

The importance of balanced consumption of energy sources should not be underestimated, especially considering that these sources are in a decline globally. Finding new sources of energy is crucial in solving this problem and this can only be possible by changing traditional understanding. Most countries' policy about energy is that it should be affordable and reliable. Developed countries implement such policies; on the other hand, the policies of developing countries are generally composed of weak and short-term solutions.

Energy can be divided into two categories: renewable and non-renewable energy resources. This is the focus of this study, as well as how these resources are perceived by certain countries' governments (presented in graphs.) Investing in renewable energy resources, with the help of international firms, is considered in a favorable light.

This study is also an examination of which resources attract investors and which are promising for investment. In this regard, the second section defines both renewable and fossil resources by giving detailed information with graphics; this section also examines the annual global usage of energy resources.

In the third section, economical research and the decision making process for investment projects are analyzed; the five methods of project assessment that can be used during this phase are also analyzed in this section.

The fourth section deals with how investment projects are supported financially. Projects can be financed by equity, loans and other project financing methods. These applications are important to construction and project maintenance.

In the final section, Turkey's position in terms of the aforementioned resources and funds is examined. An investment project on wind energy in Turkey is focused on as a case study. The study includes actions taken by the government, the regulations passed by the parliament of the Turkish Republic, and international agreements on energy resources.

2. SOURCES AND USES OF ENERGY RESOURCES

Energy is categorized in different ways: primary and secondary sources; commercial and non-commercial sources; but the focus of this study is what the United Nations (UN) defines as renewable and non-renewable (fossil based) energy sources.

Fossil based energy resources contain coal, oil, gas and nuclear power. Renewable energy resources consist of solar, wind, tidal, hydroelectric, biomass, geothermal and wave power. These energy resources are among the following topics that will be discussed below.

Before mentioning these categories of energy, it will be useful to focus on the role of energy in the life of human beings. Energy plays a crucial role in all areas of our life, especially on sustainable development. It influences all social, economical, and political activities; the state of the environment and the climate are influenced by it, and often it determines whether nations will live in peace or conflict. According to Steinhagen and Nitsch (2005, p.290), when renewable energy resources are combined with technological advances and conventional energy, sustainable and socially acceptable development is possible. With technological advances, the use of renewable energies has created a variety of resources and has increased levels of energy from Watts to Megawatts. These technologies can be adapted to any kind of energy service and are compatible with modern energy supply systems.

As Steinhagen and Nitsch puts it (2005, p. 288) 'With extended networks of centralized and decentralized power plants and heat supply systems, security of supply can be ensured. Because of the foreseeable increase in conventional energy prices, a forceful strategy for accelerated introduction of renewable energy sources is not only a requirement for sustainable growth, but also an economically sound policy.'

Renewable energy should also be sustainable, clean and should not cause environmental damage. With the increase of the negative impacts of fuel (coal, oil and gas) on the climate and with the depletion of major fossil fuel reserves, talks on renewable energy are more prevalent than ever before and are becoming crucial for political stability and reliability (Thomas 2010).

As Tony Hayward states, with the help of governments, renewable energy resources have become widespread when they are used to provide the total of the energy required. However, when renewable and non-renewable sources are combined to provide energy, renewable sources comprise a small portion of the mix. Some countries, especially developed ones, have been calling attention to wind, solar and geothermal power capacity as sources for energy (Bp Statistical Review 2008, p.5).

Energy is on demand everywhere and we always need it. The most important question is how we can obtain the sources we need and how we can consume them in the most balanced way. If we are really conscious about how we use our resources, energy consumption in the future will be less than today. But if we are insistent on being careless and indulgent, depletion of reserves will be a significant problem in the future. It is obvious that solar power can not be the source for all energy production. So, the question is how to supply the energy demand (Uyar 2007, pp.6-9).

Rather than focusing on the supply of energy, concentrating on the consumption of it is very important here because if energy consumption is reduced and prices decrease accordingly, demand will enter a falling trend. The Energy Information Administration (EIA) (2010) estimates that, world energy consumption will increase by 59 percent by 2010. As a result, since resources will be limited in supply, prices will rise relatively. However, renewable energy resources have the potential to meet this demand and are therefore favorable for government investment, providing a solution to the problem. When we consider all this in the long term, this should be kept in mind (http://www.eia.doe.gov/ 2010).

According to the World Energy Council, the energy sector will be affected the most in the 21st century by the economic crisis. Globally, total investment on energy sources was estimated to be 22 trillion dollars; 25% for oil, 25% for natural gas, 50% for electricity.

(http://www.worldenergy.org/documents/energy_efficiency_es_final_online.pdf 2008, p.3).

The energy sector is not only responsible for energy production but also for conversion of energy into other forms of energy, for storage, consumption, and assessment of the resulting waste (National Renewable Energy Laboratory 2000, p.18).

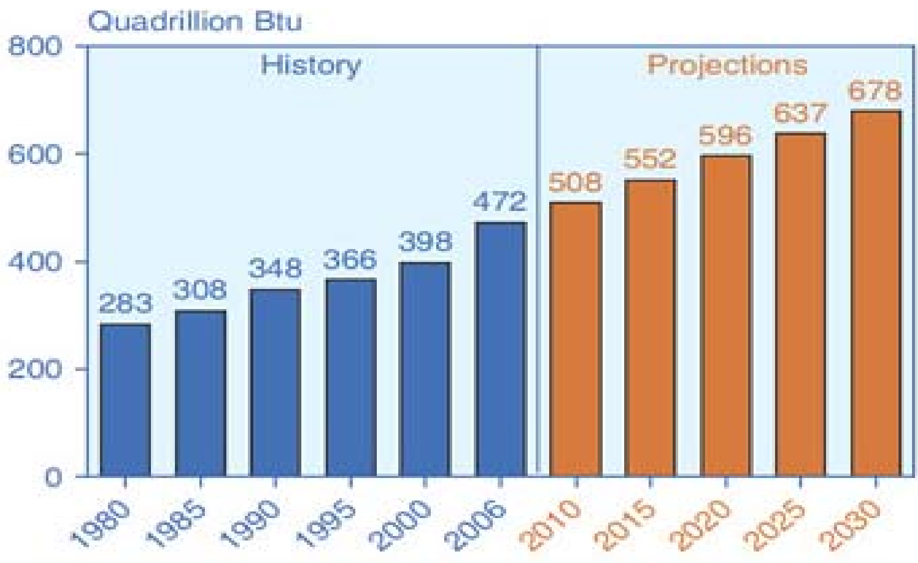

Figure 2.1: World energy consumption
Source: History: Energy Information Administration (EIA), international annual 2006(June-December 2008). Projections: EIA World energy projection plus (2009)

According to the EIA (2009, p.8) reports (see figure 2.1), world energy consumption is expected to increase by 44 percent by 2030 when compared to 2006 (forecasted figures). From 1980 to 2006, world energy consumption increased 66 percent (final figures). There is a decrease in estimated future energy consumption when compared to previous years thanks to the quest for new sources. Apart from this, awareness and sensitivity pertaining to energy consumption are also factors affecting future consumption. In the past, energy consumption increased sharply; but in the future, countries will take measures with new policies to prevent this. When we examine levels of consumption between the years 1980 and 2030, there is a 140 percent increase. If we look on the bright side, this indicates a developing civilization and growth. However, when we look at the rate of consumption, we see that we have to take certain measures to maintain sustainable energy. The most effective of these measures will be to give up old methods and replace non-renewable sources with renewable ones.

Figure 2.2: World energy consumption; OECD and Non- OECD, 1980-2030
Source: History: Energy Information Administration (EIA), international annual 2006 (June-December 2008). Projections: EIA World energy projections plus (2009)

When we look at figure 2.2 of OECD and non- OECD countries, we see a discrepancy in annual consumption rates. Until 2006, energy consumption in OECD countries was greater than non-OECD countries; but after 2006, projections change and non-OECD countries' consumption becomes greater. I think the most significant reason for this is the development of technology and industry, and the increase in energy demands of non-OECD countries such as China and India. Besides this, new environment related carbon emissions agreements which are signed by OECD countries, such as the Kyoto agreement, to adopt more careful practices while consuming energy resources, is a consideration (International Energy Outlook data 2009, p.9).

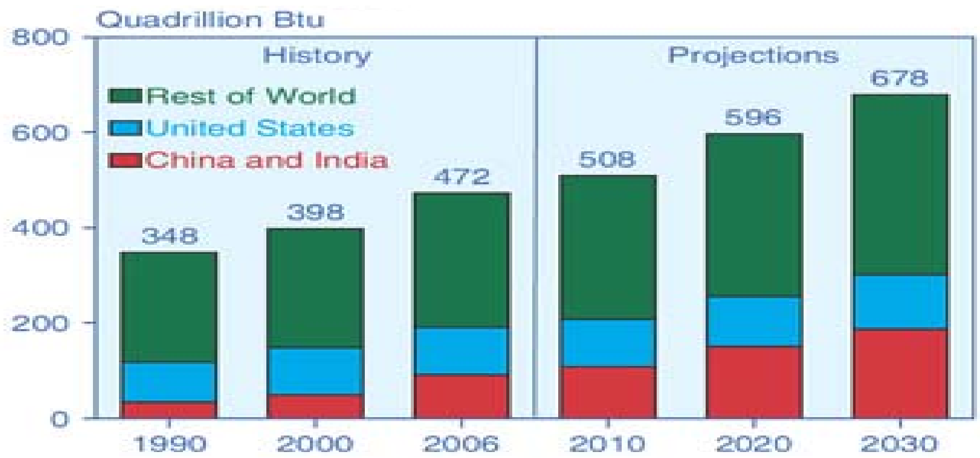

Figure 2.3: Marketed energy use by region (1990-2030)
Source: History: Energy Information Administration (EIA), international annual 2006 (June-December 2008). Projections: EIA World energy projections plus (2009)

It is important to examine figures 2.3 and figure 2.4 together. In these figures, we can see the use of energy resources in different regions and countries differ in intensity and distribution is not balanced. Upon general examination, China and India in particular are leaders in energy consumption and use. These two countries, after 2010 year, will take up a considerable share (International Energy Outlook data 2009, p.9).

According to Energy Information Administration data (2009):

> *China and India are the fastest-growing non-OECD economies, and they will be key world energy consumers in the future. Since 1990, energy consumption as a share of total world energy use has increased significantly in both countries. China and India together accounted for about 10 percent of the world's total energy consumption in 1990, but in 2006 their combined share was 19 percent. Strong economic growth in both countries continues over the projection period, with their combined energy use increasing nearly two fold and making up 28 percent of world energy consumption in 2030 in the reference case. In contrast, the U.S. share of total world energy consumption falls from 21 percent in 2006 to about 17 percent in 2030.*

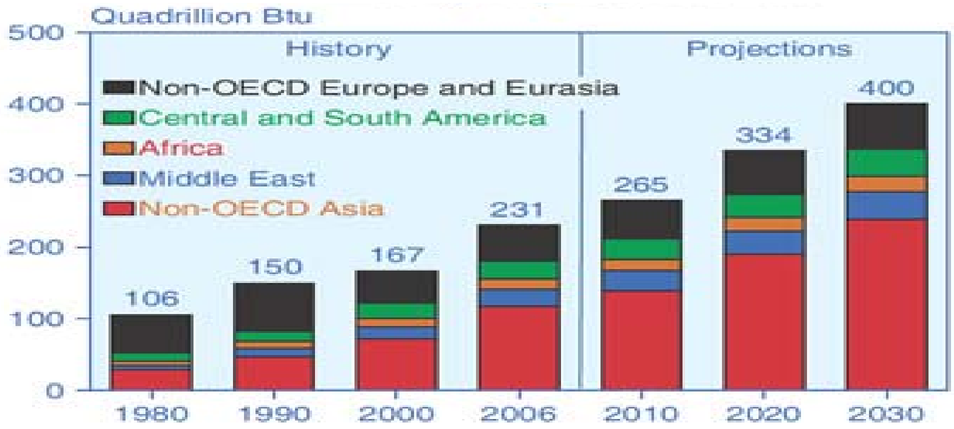

Figure 2.4: Marketed energy use in the Non-OECD economies by region (1980-2030)
Source: History: Energy Information Administration (EIA), international annual 2006(June-December 2008). Projections: EIA World energy projections plus (2009)

When we examine figure 2.4, we get an idea of non-OECD countries' share of energy sources. Non-OECD countries such as Russia, China, and India comprise a serious factor in global energy consumption so it is important to take into consideration regions of these non–OECD countries. Non-OECD Asian countries like China and India have had significant increases in their energy consumption over the years. Non-OECD Eurasian countries such as Russia and the countries that made up the former Soviet Union (CIS) are not massive consumers. Energy consumption continues to be stable among these countries. Non-OECD Middle Eastern countries such as Iran, Iraq etc. also do not have a very large share. Also, in African countries, energy consumption is minimal because industry is not very developed in this region. As is generally known, Russia, Iran and Iraq are leaders in energy production and export but are not great consumers. In China and India, fast growing industry has had a direct effect on energy consumption and takes up a large portion of the energy consumed in those countries (International Energy Outlook data 2009, p.11).

In addition, in reference to non-OECD countries' energy uses as demonstrated in figure 2.4, I would like to outline in detail the Energy Information Administration's explanation of the effects of global crises on financial systems as related to energy costs. Recent problems within the global financial system have made taking out loans from banks and other institutions difficult in non-OECD European and Eurasian countries such as Russia, Kazakhstan, and the Ukraine. The impact was softened somewhat by higher world market prices for commodity exports but not in the short term because of the collapse of commodity prices and worsening global economic situation. High global oil prices affect the energy sector, especially the Caspian region, influencing their investment prospects. With the changes in energy market prices, it is not likely that the economies of non-OECD European and Eurasian countries will be able to sustain the growth rates recently achieved until they achieve more broad-based diversification from energy production and exports. The Former Soviet Republic countries' economies are supported economically in a variety of ways and will make further improvements domestically in their financial markets in the long-term (International energy outlook 2009, p.12).

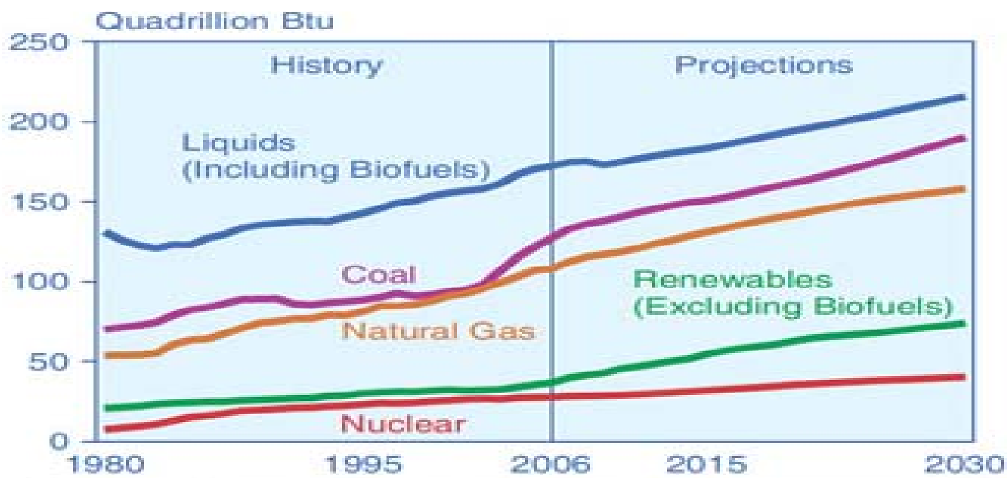

Figure 2.5: World marketed energy use by fuel type (1980-2030)
Source: History: Energy Information Administration (EIA), international annual 2006 (June-December 2008). Projections: EIA World energy projections plus (2009)

Figure 2.5 above demonstrates approximately how much and which energy resources are being used yearly. Figure 2.5 provides a visual representation of the facts and presents new energy sources and determines the course of the trend. It is a complicated and long process which requires extensive feasibility studies to leave behind old methods, develop new models, pursue different courses of action; and one that necessitates a lot of cash flow (International Energy Outlook data 2009, p.15).

This is a part of my dissertation that is still in progress, and I will provide more detailed information presently. If we examine the above statements, there are many indications that make it appear that nuclear can not be much in demand. It is does not constitute a large share of the global market. Fossil based energy resources, such as coal and liquid fuels, make up a significant share of these total sources. Attempts have been made to make room for renewable energy sources and usage over the years is expected to increase. But if we look at the data provided by the EIA (2009, p.18) presented in figure 2.5, in detail, we can see that there is not room allocated to renewable energy, as expected. Although these sources are on the agenda worldwide, it would appear actual implementation is intangible. Perhaps leaving history behind and abandoning retrospective views is not favored and therefore, currently, it is difficult to find the place for renewable energy that it deserves. Because the usage of renewable energy sources is a new concept, making the necessary investments and getting things running efficiently will take approximately 7-8 years. In the production of electricity, all resources are used efficiently. Liquid fuels are not the preferred resource for electricity production. On the contrary, coal is. The demand for natural gas and renewable sources are parallel. The most important point here is that nuclear power is more in demand than liquid fuels. As a result, fossil based sources still remain popular; and the addition of new sources and the usage of renewable sources are starting to be seen in a favorable light.

In analyzing the data on the table provided by the Energy Information Administration (EIA) in detail, we can see that it is important to determine which areas demand the most energy and is their average growing demand from year to year. Energy sources are most commonly used in the commercial sector, the industrial sector and the transportation sector.

According to the Energy Information Administration web-site, the commercial sector is sometimes referred to as the services sector or the services and institutional sector, and contains businesses, institutions and organizations that provide services. The commercial sector contains many different types of buildings and a wide range of activities related to energy services. Facilities in this sector include: schools, hotels, stores, restaurants, museums, etc. but the most energy is used in buildings or structures that supplying services such as heating, lighting, water heating and cooling. In addition, besides buildings, energy is also needed for traffic lights and city water; these types of usage also fall into the commercial energy use category. Also, economic growth determines the degree to which additional facilities and activities are offered and utilized in the commercial sector. If there are high levels of sustainable economic growth, this means that the demand for energy in hotels and restaurants, cultural canters, theatres, galleries and sporting venues will influence the business cycle. According to EIA, "In the commercial sector, as in the residential sector, energy use per capita in the non-OECD countries is much lower than in the OECD countries. Non-OECD commercial energy consumption per capita averaged only 1.3 million Btu in 2006, compared with the OECD average of 16.3 million Btu." These statistics are in reference to countries sustaining economic growth (http://www.eia.doe.gov/oiaf/ieo/ 2009, p.86).

Another important sector in terms of energy consumption which needs to be covered intensively is the industrial sector. The industrial sector encompasses a diverse number of areas such as: manufacturing, agriculture, mining and construction; and it also includes a wide range of activities such as: processing and assembly, space conditioning, and lighting; in addition, the diversity of the demand in this sector changes from region to region; it changes based on the level and mix of technological and economic development, among other factors. Other factors in the industrial sector include using natural gas and petroleum for feed stocks to produce non-energy products. For aggregates, the industrial sector uses more energy than any other end-use sector, consuming about one-half of the world's total delivered energy (http://www.eia.doe.gov/oiaf/ieo/ 2009, p.97).

According to EIA, in the transportation sector energy is used to move people and goods by road, rail, air, water, and pipeline. Transportation components are light duty vehicles such as automobiles, sport utility vehicles, minivans, small trucks, and motorbikes, as well as heavy-duty vehicles, such as large trucks used for moving freights and buses for passenger travel. The demand for energy in the transportation sector is directly linked to the rate of economic growth and population size. As it is mentioned on the EIA website, economic growth spurs industrial output, which requires the movement of raw materials to manufacturing sites, as well as the movement of manufactured goods to end users. Energy demand in the transportation sector is increasing steadily in both non-OECD and OECD countries. Personal travel is a primary factor underlying projected increases in energy demand for transportation (http://www.eia.doe.gov/oiaf/ieo/ 2009, p.113).

2.1. FOSSIL BASED ENERGIES (NON-RENEWABLE ENERGY)

Fossil fuels such as oil, coal and gas, which are used widely today, are not renewable sources because they burn and run out. They are made up of dead plants and animals. Fossil fuels supply a huge portion of the world's demand for energy including heating, transport, electricity generation and other uses. At first glance, non-renewable resources are a gift for us from our environment. But they are not renewable. Of course fossil fuels have advantages. Because of this, they have been preferred a long time. With fossil fuels, very large amounts of electricity can be generated in one place using coal and for fairly cheap. Transporting oil and gas to the power stations is easy. Gas-fired power stations are very efficient. A fossil-fuelled power station can be built almost anywhere, so long as you can get large quantities of fuel to it. Basically, the main drawback of fossil fuels is pollution. Burning any fossil fuel produces carbon dioxide, which contributes to the "greenhouse effect", warming the earth. Burning coal produces more carbon dioxide than burning oil or gas.

It also produces sulfur dioxide, a gas that contributes to acid rain. Mining coal can be difficult and dangerous. Strip mining destroys large areas of landscape. Coal-fired power stations need huge amounts of fuel, which means train-loads of coal almost constantly coming and going. In order to deal with differences in demand for power, there needs to be more stations that are have easy access to reserves. As a result, the reserves must be near cities (http://home.clara.net/darvill/altenerg/fossil.htm 2010).

The price of fossil based resources is important; it affects the preference for them and substitution options. In general, with the beginning of industrialization, fossil based sources have been increasingly on demand. With this perspective in mind, resources have become important in the political outlook.

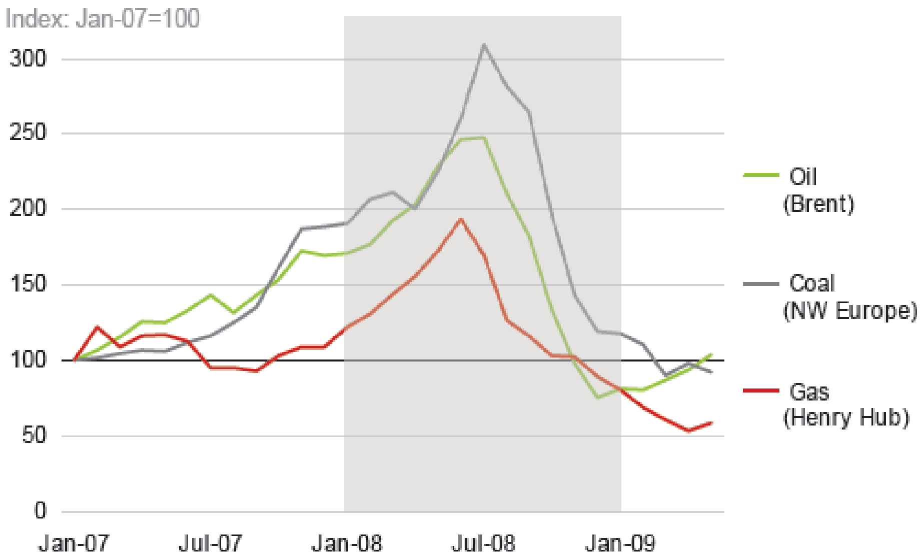

Figure 2.6: Energy prices (2007-2009)
Source: Includes data from Platts and McCloskey, BP statistical review of world energy, June 2009

When we review the data on energy prices in the last two years around the world in figure 2.6, we see a decrease in the price of oil, coal and gas in January 2009. The most important point here is that the drop in price is consistent with all three resources. The price of coal is the most expensive which is an indication that it the most in demand. The price of gas is the lowest since intensive privatization has brought about competition which led to a drop in prices. In addition, the 2007 global crisis also affected prices. With the start of the crisis prices fell slightly. The fact that the prices of all three resources dropped is remarkable. In 2007, coal prices remained below that of oil and gas. However after 2007, this situation was reversed. There is an issue here that should be considered; the increase in coal prices attracted attention in that one of the reasons for the lesser popularity of renewable sources is the high prices associated with them. What was the reasoning behind the price of coal increasing while it is one of the highest producers of carbon emissions? Environmental policies may be the reason for inflated coal prices during this period (Finley 2009, p.5).

As Bp group Chief Tony Hayward states, in 2008, the amount of global energy consumption slowed with the halt in the economy and higher than average prices breaking a string of five consecutive years of above-average growth. Production growth exceeded that of consumption for all fossil fuels. For the year as a whole, prices for all forms of traded energy rose substantially despite sharp declines late in the year. Oil prices reached inflation-adjusted record highs, rising for the seventh consecutive year. Internationally traded coal prices rose more steeply than other fuels (Finley 2009, p.7).

Although when it comes to non-renewable energy sources the output of coal is the leader, oil is more commonly used, especially in the transport and industrial sectors. Also, the popularity of gas is increasing in these sectors. The progress of technology and improving standards of living within progressing civilizations have brought down the level of coal usage when compared to natural gas, which has increased in popularity as it is a cleaner burning resource. Natural gas is now the preferred source in homes instead of having pipelines from quarries into houses (BP statistical review 2008, p.8).

According to Bp group Chief Tony Hayward, fossil fuel consumption growth slowed because primary energy consumption growth slowed. Rapidly industrializing non-OECD countries, especially China, are responsible for all the net growth in energy consumption, accounting for nearly three quarters of global growth. “For the first time, non-OECD energy consumption surpassed OECD consumption. For a sixth consecutive year, coal was the fastest-growing fuel – with obvious implications for global CO_2 emissions. Their data confirms that the world has enough proved reserves of oil, natural gas and coal to meet the world’s needs for decades to come. The challenges the world faces in growing supplies to meet future demand are not below ground, they are above ground. They are human, not geological" (BP statistical review 2008, p.8).

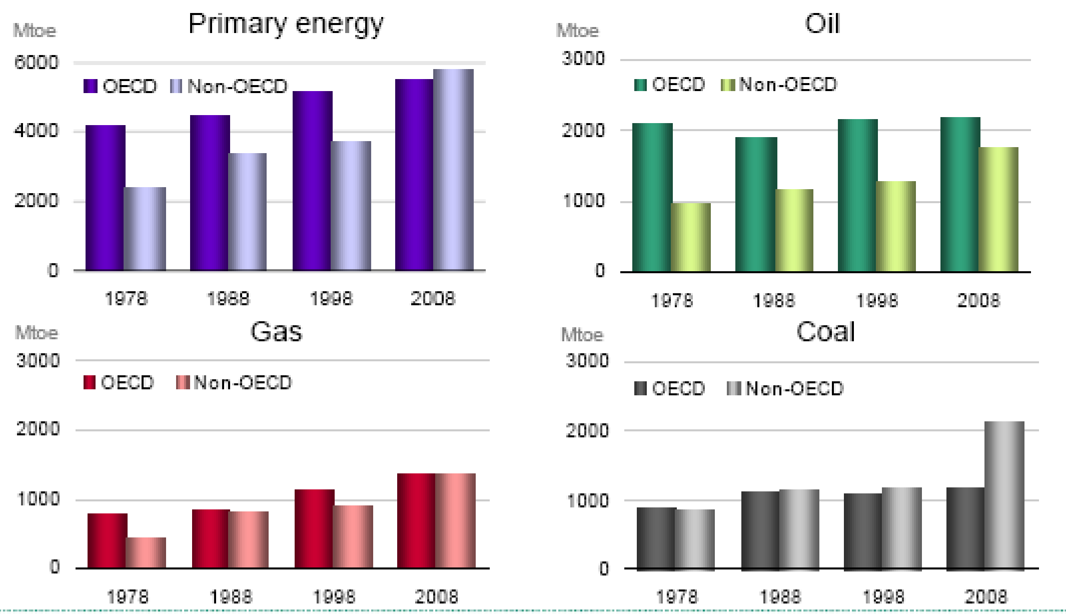

Figure 2.7: Energy consumption at OECD and Non-OECD countries
Source: BP Statistical Review of world energy, June 2009

In figure 2.7 above, the consumption of fossil based sources over the years of OECD and non-OECD countries is outlined clearly. It is important to examine this table as it provides an opportunity to examine the consumption of these resources. As expected, the tables show a clear change in 2008. It is a priority to mention that the consumption of all fossil energy tended to increase between 1978 and 2008. If we accept this as a trend and compare OECD to non-OECD countries, non-OECD countries have experienced big jumps. When we look at the table, except for oil, non-OECD countries' fossil energy consumption is more than OECD countries' fossil energy consumption. Non-OECD countries such as Iran, Iraq, and Arabian countries, which have high volumes of oil reserves, maintain control over petrol reserves; as a result, OECD countries' dependence on these countries still remains. In non-OECD countries, with the growth of industry, the demand for gas and coal, for primary energy sources increases. This demand for primary energy sources is a serious signal for non-OECD countries about their yearly dependence on fossil resources. In 2008, coal consumption in OECD countries was half of the consumption in non-OECD countries. The reason for this is renewable energy, which has become more in demand in OECD countries that may be trying to minimize carbon emissions (Finley 2009, p.7).

2.1.1. Coal

Coal is first crushed into fine dust and then burnt. Coal provides around 28% of our energy and it receives its energy from the sun; dead plants contain solar energy in them and when they die and drop onto the soil, in time they became coal. And when we use them, the energy gives off light. Burning coal produces sulfur dioxide, an acidic gas that contributes to the formation of acid rain. This can be largely avoided using "flue gas desulphurization" to clean up the gases before they are released into the atmosphere. This method uses limestone, and produces gypsum for the building industry as a by-product. However, it uses a lot of limestone (http://home.clara.net/darvill/altenerg/fossil.htm 2010).

The use of coal is centuries old. The China Cheng mines have been running thousands of years. Around the world, coal energy has been a leading resource up to the 20th century. United Kingdom (U.K.) is known to have an important place as a producer and exporter of coal. (Oluklulu, 2003, p.12).

The largest and oldest coal fires in the world have occurred in China, the United States and India. These three countries have a big impact on coal mining. Removing coal from the underground is difficult. It requires technical support and human labor. Techniques used to fight coal fires include slurry and ash injection, surface and tunnel sealing, aqueous foam technology, remote sensing, and computer software. Elusive, unpredictable, or cost prohibitive coal fires may burn indefinitely, choking the life out of a community and its environs while consuming a valuable natural resource (Stracher and Taylor 2004, p.13).

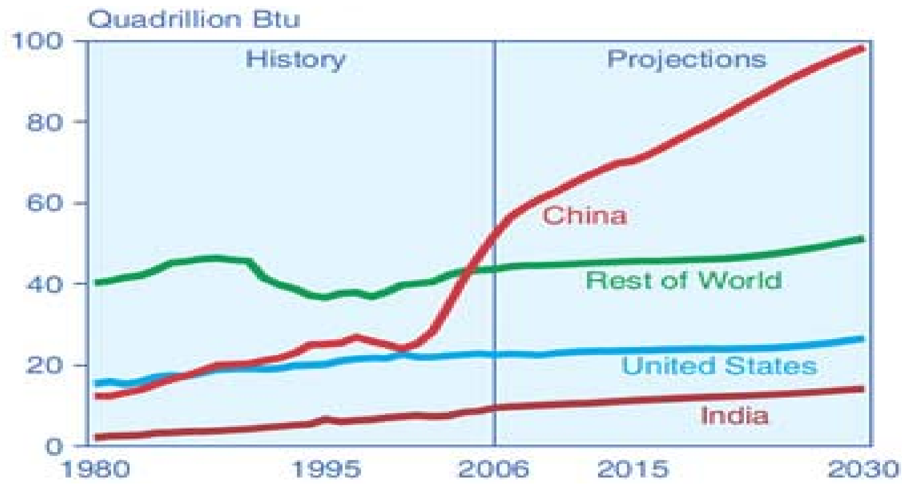

Figure 2.8: Coal consumption in selected world regions (1980-2030)
Source: History: Energy Information Administration (EIA), international annual 2006(June-December 2008). Projections: EIA World energy projections plus (2009)

In figure 2.8 above, we can review coal consumption in selected world regions from1980 to 2030. Especially in China, coal consumption is expected to increase. From 1980 until 2030 there was not and nor is there expected to be big jumps in the consumption of other major countries. China and India are the most striking in figure 2.8. With the economic growth in these countries, increases in the consumption of coal have occurred. Coal is used extensively in the industry sector, and the future prospects of these two countries in terms of production and consumption is bound to be substantial. With the exception of the United States, coal consumption around the world decreased (International Energy Outlook data 2009, p.43).

Global coal consumption slowed in 2008, yet coal remained the fastest-growing fuel in the world for a sixth consecutive year. In China (the world's largest consumer, with a 43 percent share), consumption grew by 6.8 percent, below the 10-year average but still sufficient to account for 85 percent of global growth. In liberalized energy markets, coal prices in 2008 increased more rapidly than other fossil fuels; consumption growth outside

China was a weak 0.6 percent. Growth was below the 10-year average for every region but South and Central America and Africa (Finley 2009, p.11).

According to MENR, in 2007, total primary energy consumption of our country was 106 million tons equivalent of petroleum (TEP). In energy consumption, coal has a significant share of 28 percent. Lignite is a type of coal which is usually placed at the bottom of the coal list since it has low heating value, and high ash and humidity content, and is typically used as fuel for thermal power plants. However, it is an energy raw material that is used frequently due to its abundance in the earth's crust. Hard coal is classified as a high-calorie coal. Of our domestic resource potential, 10, 4 billion tons is lignite, and 1, 33 billion tons is hard coal. On the global scale, we are a middle-level country in terms of lignite reserves and production amounts, and lower-level in hard coal. Having about 1, 6 percent of the world's total lignite reserves; Turkey's total lignite reserve is at 8, 3 billion tons. Yet exploitable reserves are at 3, 9 billion tons. Furthermore, having a low heating value, the majority of our lignite is typically used at thermal power plants. Of the 33 million tons of coal sold in 2008, 82 percent went to thermal power plants, and 12 percent went to heating and industry. As of the end of 2008, installed power of lignite-based thermal power plants in our country is 8.110 MW, which corresponds to 19, 4 percent of our total installed power. Contribution of coal to total installed power is 10.097 MW, which corresponds to 24, 1 percent of our total installed power. Installed power of our hard coal based thermal power plants is 335 MW, which corresponds to 0, 8 percent of our total installed power (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=enerji_EN&bn=215&hn=&nm=40717&id=40717 2009).

2.1.2. Oil

Oil provides 40 percent of our energy and can be burnt directly. Crude oil, termed petroleum, is easier to get out of the ground than coal as it can flow along pipes. This also makes it cheaper to transport. This also makes it cheaper to transport. Some scientists are claiming that oil is not a 'fossil' fuel because it is not the remains of prehistoric organisms. They claim it was made by some other, non-biological process. Currently this is not accepted by the majority of scientists (http://home.clara.net/darvill/altenerg/fossil.htm 2010).

Oil was first used 3000 years ago with the formation of tar. The Mesopotamian nation made use of tar to compensate for water deficiencies in nature. In ancient times, oil was used for cleaning wounds, relieving rheumatism, etc. and other ailments. It was also used for fighting tools during wars. What we understand from this is that oil was used for other purposes besides as a source of energy (Oluklulu 2003, p.21).

According to the Ministry of Energy, petroleum consists of a complex formula of hydrogen and carbon, and contains a little bit nitrogen, oxygen and sulfur. Gas, in liquid and solid states, may also be present. Liquid petroleum, which is refined, as opposed to raw petroleum, is commercially the most important one. Petroleum in gas state is typically referred to as natural gas in order to distinguish it from synthetic gas. Semi-solid and solid petroleum consists of heavy hydrocarbon and tar. This type of petroleum is called asphalt, bitumen, tar and other names depending on their properties and local use. Since main components of raw petroleum and natural gas are hydrogen and carbon, they are also referred to as "Hydrocarbons." Taking the world's existing energy sources from proven reserves and annual production amounts into consideration, the reserve life of petroleum is estimated at 42 years. Being the primary source of energy across the globe, petroleum meets 35, 6 percent of the global energy demands as of 2007. Of petroleum reserves, 100 billion tons (62 percent) are in Middle Eastern countries, 16,7 billion tons (10 percent) in Russia and the CIS, and 14,9 billion tons (9 percent) in Africa (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=enerji_EN&bn=215&hn=&nm=40717&id=40717 2009).

Initially, because it was found in limited amounts, petroleum use was not common until the 18th century. Petroleum was first used in lighting and as technology progressed, it started to be used in the transportation sector. Petroleum is a very important source of energy because of its economic and political role. The Organization of Petroleum Exporting Countries (OPEC) was established in order to prevent any one country from monopolizing the oil export industry. This organization aims to control and reduce the volatility of fluctuations in oil prices. During the 1973-74 oil crisis, however, OPEC was powerless to prevent Eastern countries from putting an embargo on Western countries and thereby causing oil prices to go up almost four times what they were before the embargo. The second crisis took place in 1978-79, prices increased sharply again, and OPEC was once again ineffective. It would appear that those countries that have oil in their control tend to swing a power bat and it is no easy task to prevent this (Oluklulu 2003, p.23).

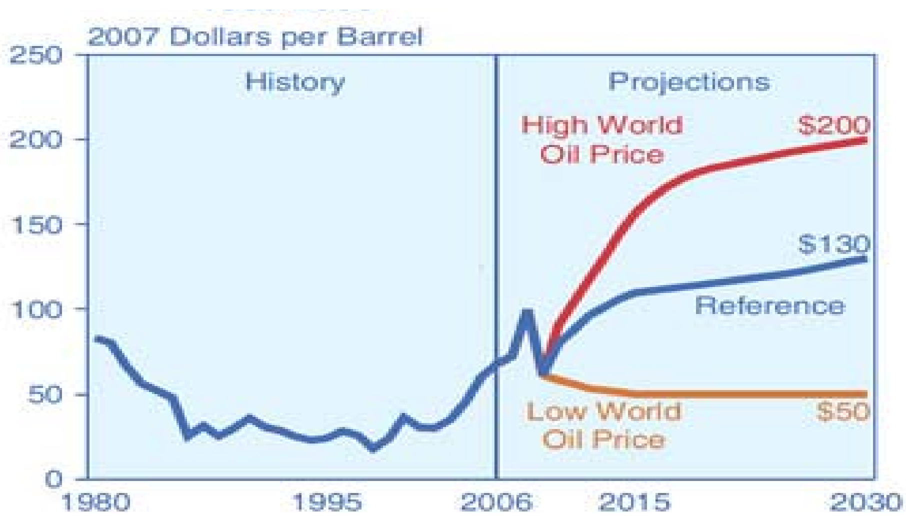

Figure 2.9: World oil prices in three prices cases (1980-2030)
Source: EIA, Annual energy Outlook 2009, DOE/EIA-0383(2009) (Washington, DC, June, 2009) www.eia.doe.gov/oiaf/aeo

Figure 2.9 above presents a price fluctuation forecast from 1980 to 2030. In this table, we need to take note of the high prices during the oil crisis in 1980. However, prices remained low until 2007. In the years between 2007 and 2030 the prices are expected to rise. I believe the reason behind this the strategic and political implications of oil. It is difficult to account for the gap between the highest and the lowest prices as the fluctuations are difficult to estimate because of: political changes; the orientation of new investments in Arab countries; and the war in Iraq (International Energy Outlook data 2009, p.48).

Figure 2.10: World liquids consumption in three price cases (2030)
Source: EIA, world energy projections plus 2009

Consumption by sector on figure 2.10 above references high, low and reference prices for liquid distribution. All three columns refer to liquid consumption. The transportation sector leads while the industrial sector is second. Ignoring the unbalanced distribution between the former two sectors and the latter electricity, commercial and residential sectors would almost be negligible. Perhaps we can conclude that, given the relatively little use of the electricity, commercial and residential sectors of non-renewable liquid resources when compared to the other two, it will be easier for them to transition to renewable sources of liquid. In this regard, continued investments in renewable sources are foreseeable (International Energy Outlook data 2009, p.45).

As the Ministry of Energy states (2009):

About 72 percent of world's producible petroleum and natural gas reserves are located in the vicinity of our country. Due to its geopolitical position, Turkey is neighbors with countries that own three fourth of world's proven petroleum and natural gas reserves, and takes part and supports numerous important projects acting as an "Energy Corridor" between the energy-rich Caspian, Central Asian and Middle Eastern countries and consumer markets in Europe. Projections suggest that a substantial part of world's energy consumption, which is expected to increase by 50 percent by 2030, will be met by resources from our region.

2.1.3. Gas

Gas is similar to oil in that it can be burnt directly. Natural gas comprises around 20 percent of the world's consumption of energy. After the 1970 crisis, the price of petrol went up and, as a result, gas became more on demand. Natural gas is lighter than air; it is mostly made up of a gas called methane. Methane is a simple chemical compound that is made up of carbon and hydrogen atoms. Natural gas is usually found near petroleum underground. It is pumped from below ground and travels in pipelines to storage areas. It is extracted in the same way as petroleum, and later transmitted via large pipelines. Natural gas usually has no odor and you cannot see it.

Between 6,000 and 2,000 BCE (Before the Common Era), the first discovery of natural gas was made in Iran. Many early writers described the natural petroleum sources in the Middle East, especially in the Baku region of what is now Azerbaijan. The gas resource, probably first ignited by lightning, provided the fuel for the "eternal fires" of the fire-worshiping religion of the ancient Persians.

On the public website of the Ministry of Energy, there is detail information about natural gas reserves. Excepting Turkey, 73 trillion cubic meters (41 percent) of global natural gas reserves are in Middle Eastern countries; 59 trillion cubic meters (33 percent) in Russia and CIS; and 28 trillion cubic meters (16 percent) in Africa/Asia Pacific countries. Turkey’s domestic potential in natural gas is about 27 billion m^3. By the end of 2008, natural gas consumption was expected to increase by 5, 5 percent compared to the previous year, reaching 33, 6 million TEP. Turkey’s installed power in natural gas is about 13.337 MW, which is 31, 8 percent of our total installed power. As it is mentioned in natural gas studies, problems in meeting the annual gas demand are not expected until 2011. In this context, commissioning in 2007 of the Silivri natural gas depot, which has a capacity of 1, 6 billion m^3, has been very beneficial for ensuring availability of seasonal supply. Nowadays, research will be conducted and measures will be taken for improving the capacity of existing natural gas depots and for building additional underground depots, particularly in Salt Lake; and, also, natural gas has been discovered in Akçakoca city (www.enerji.gov.tr 2010).

As mentioned by the Ministry of Energy, The Baku-Tbilisi-Erzurum (BTE) Natural Gas Pipeline (Shah Sea Project), which aims to carry Caspian gas resources to Turkey and European markets, has been commissioned. Gas transmission started on November 26, 2006, and the first production of the Shah Sea Project started on December 15, 2006. Also, the process of creating the trans-Caspian petroleum and gas pipelines, in the context of Turkmen and Kazak resources, was planned in a way that was related to other projects. In 2007, the Greek connection of the South European Gas Ring (Turkey-Greece-Italy Pipeline), which aims at transmitting Caspian and Middle Eastern gas resources to EU markets, was completed an commissioned. The Italian connection is due for completion in 2012. With an annual capacity of 12 billion m^3, this project will have a significant share in Greek and Italian gas markets, and constitutes the first step in the integration of the Turkish gas system with the EU. Work is still in progress with regard to the NABUCCO Project which, within the scope of activities to bring natural gas to Europe, will connect Turkey to Austria via Bulgaria, Romania and Hungary, and will carry Caspian and Middle Eastern gas resources to the Central European Natural Gas Distribution Center. Listed as one of the top-priority projects in EU official documents, the aim of the NABUCCO project is to carry, in its first stage, 25 to 30 billion m^3 of gas annually over a line of 3.400 km. This figure is expected to increase in the years to come. Work is in progress with the Arabic Natural Gas Pipeline Project for transmitting Egyptian natural gas resources to our country (www.enerji.gov.tr 2010).

According to the Ministry of Energy, the Baku-Tbilisi pipeline, the NABUCCO project, the Turkey-Greece-Italy projects and other project agreements were established in order to supply all of the global natural gas demand. Heating energy, especially natural gas, has a significant share. Sources other than coal are preferable because of they are cleaner.

2.1.4. Nuclear Power

According to Energy Ministry of Turkey, breaking up atomic nuclei yields to a huge amount of energy. Obtained through fission and fusion reactions, this energy is called nuclear energy. Nuclear reactors are systems that transform nuclear energy to electricity. Fundamentally speaking, nuclear energy released as a result of fission is transformed to thermal energy within nuclear fuel and other materials, which is in turn converted into kinetic energy and then into electricity within the generator system. They are stored in shielded concrete underground galleries to be built 1.000m under surface in geologically stable areas. A 1.000 MW nuclear reactor produces about 27 tons of used fuel in a year.

In 1965, the first commercial nuclear power plant was constructed. In contrast to other sectors, the nuclear power sector got started on the premise of a national independence strategy. This sector's investment projects are financed by the government (Oluklulu 2003, p.23).

Until 1979, there was a rapid expansion of nuclear power plants. After 1979 however, expansion came to a halt because: electricity yields greater capital in developed countries; the issues in the past relating to the consumption of oil energy have decreased; central costs constantly increasing; and the uncertainty about the reliability of nuclear energy (Yücel 1994, p.117)

The White Paper discussed the positive aspect of nuclear energy. This source has low carbon emissions; it is affordable and dependable; and it is safe. In further detail, low carbon means minimizing the negative effects of climate change. It is affordable because it is currently one of the cheapest low carbon electricity generation technologies, so it could help us achieve our goals in a cost efficient manner. It is dependable because it is a proven technology with modern reactors capable of producing electricity reliably. It is safe because it is backed up by a highly effective regulatory framework. It is also capable of increasing diversity and reducing our dependence on any one technology or country for our energy or fuel supplies. Companies that build nuclear power plants need immense technical and financial strength. This is hard to square with the need. If competition is to be effective, there need to be large numbers of competing companies (Thomas 2010).

As stressed by the Ministry of Energy, for the generation of electricity, nuclear power plants are safer and more available compared to other sources such as thermal and hydraulic power plants. With global developments, renewable energy sources have become more common, widespread and more in demand. Nuclear energy investment projects are also gaining impetus worldwide. Based on electricity energy supply and demand projections, 5.000 MW nuclear power plant capacity is planned to be commissioned as of 2015. To that end, Law No. 5710 on Construction and Operation of Nuclear Power Plants and Law on Sale of Energy (2007) were enacted. Construction of nuclear power plants is in progress. A license has been obtained for the first nuclear power plant in Turkey, which is planned to be in Mersin-Akkuyu, and licensing work for Sinop is underway (www.enerji.gov.tr 2010).

The perspective of the Ministry of Energy is as stated above. But the people's perspective is not positive as the government's. Until 1960, Turkey's point of view on nuclear energy was positive, although not very well understood. The explosion of the Chernobyl nuclear plant in 1984 changed perspectives.

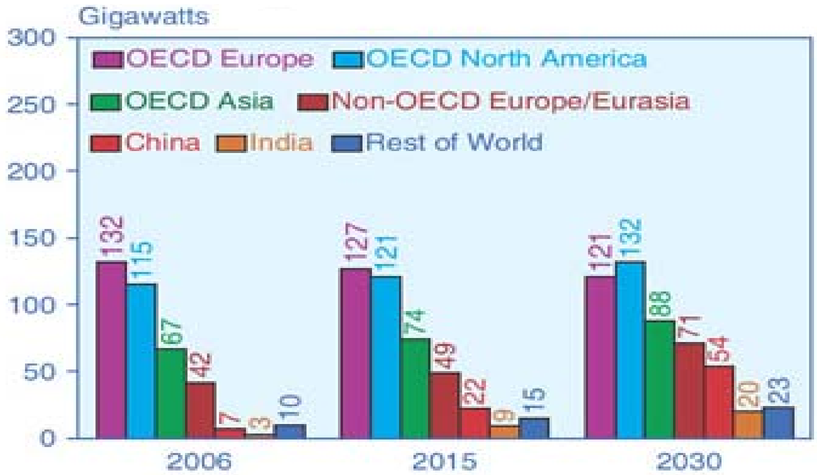

Figure 2.11: World nuclear generating capacity by region, 2006, 2015 and 2030
Source: History: Energy Information Administration (EIA), international annual 2006(June-December 2008). 2015 and 2030: EIA World energy projections plus (2009)

In figure 2.11 above, a detailed breakdown of data about the regions in the world with the capacity to generate nuclear energy according to the EIA annual report can be reviewed. OECD countries in Europe generate 2006, 2015, 2030 Gigawatts of nuclear energy according to annual estimates. So which of these countries in nuclear energy is the front blade? Germany and France are leaders in nuclear energy production. The United States also has an impact on nuclear energy production. South Korea is the leading OECD country in Asia and has opened a series nuclear power plants. Also, Russia, the non-OECD Eurasian country, has an important role in nuclear power plants. China and India have 2 percent of the world's nuclear energy capacity. The total capacity of OECD Europe in the year 2006 was 35 percent; OECD North America was 31 percent; OECD Asia was 18 percent; non-OECD Europe and Asia share 11 percent; and the rest of the world has 2 percent share. In fact, the reliability of this data may be questioned since there are countries that may have used nuclear energy for unethical reasons. However, the use of nuclear energy within the industry is legitimate and the data here can be trusted here. The source of nuclear energy can be dangerous and very risky. It can also be used as a weapon for war. Countries that have a particularly large share can impact the economy of the world. For countries like the U.S.A, South Korea, Russia, and Germany especially, this nuclear power has a strategic importance (International energy Outlook 2009 pp.51-52).

Most recently, a new nuclear plant was built in South Korea, Russia and the Ukraine. In total, approximately 17 percent of electricity production is provided by nuclear power plants (Ültanır 1998, p.152).

According to Steve Thomas (2002, p.3):

> *In part, the removal of the nuclear subsidy was possible because of efficiency improvements in the nuclear industry and this was welcome. However, it was possible partly because the burden of paying for long-term costs such as radioactive waste disposal and decommissioning was shifted from today's electricity consumers to future generations of taxpayer. This runs counter to the 'polluter pays' principle and cannot be regarded as equitable.*

According to Tanay Sıdkı Uyar, as of 2050 , only 10 percent of nations will use nuclear energy, though about 1,000 of them will need new nuclear power plants to be established (currently there is approximately 440 worldwide). Perhaps it is possible to establish a thousand new plants but it will take a decade. These plants were established with much of the uranium reserves in a very short period. The International Atomic Energy Agency (IAEA) admits that the rapid spread of nuclear energy is altering the climate. To stop climate change and its negative effects is only possible with renewable energy sources and related energy saving developments (Uyar 2008, p.15).

According to Stephen Thomas (2010, p.23):

> *If nuclear power really was an essential element to combating climate change then there might be no alternative but to acknowledge that there are economic and other problems and devise ways of reducing their impact. However, electricity accounts for less than 20 percent of the energy we use and we currently get less than 20 percent of our electricity from nuclear sources, so even if we replaced all the existing plants (which would need about 6 new reactors) and built enough additional plants to bring the share of nuclear electricity up to 60 percent (a total of 20 reactors), nuclear power would only be providing about 10 percent of our energy needs.*

Correct use of nuclear energy is very important. In most cases, nuclear energy is not synonymous with nuclear weapons. While have been writing this thesis, two of the larger and more powerful countries around the world (U.S.A and Russia) have signed the Start-II treaty to reduce nuclear weapons. The purpose of this agreement is to minimize large losses in the future as nuclear weapons are difficult to control. Besides these two countries, North Korea and Iran have acquired a significant amount of nuclear power, especially in the last 10 years. These countries should act in accordance as soon as possible.

2.2. RENEWABLE ENERGY RESOURCES

Renewable energy is defined as 'nature's own evolution in an energy source that can be available in the same way the next day. It is not true that renewable energy sources provide less energy than fossil based and nuclear sources. We are living in an atmosphere that is generously provided for by the sun. We did not have the technology to make use of the sources for electricity and heat that we have come to depend on for energy in the1850s. We have only had the technology to fully benefit from fossil and nuclear sources for the last 30 years. With renewable energy, it is possible to fulfill all our needs. Nations are capable of using renewable energy sources to supply the country's transportation, industrial, residential and agricultural sectors with heat and electrical energy, our own included (Uyar 2006, pp.123-124).

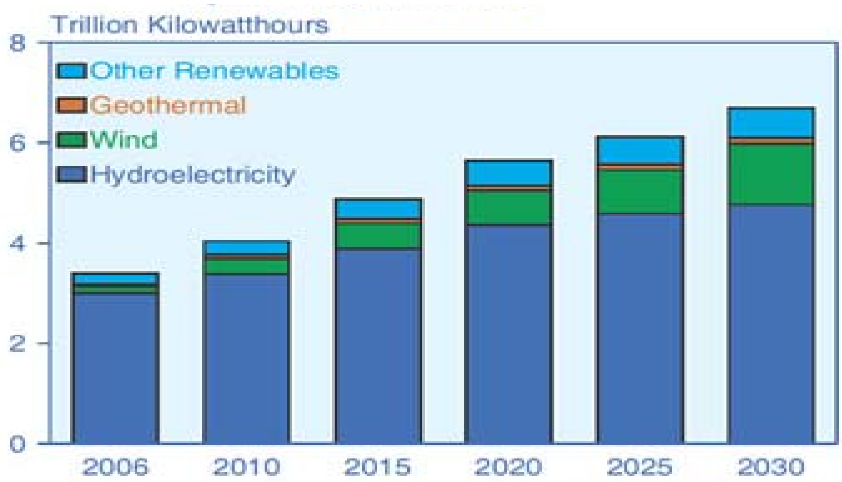

Figure 2.12: World renewable electricity generation by source, 2006-2030
Source: Energy Information Administration (EIA), international annual 2006 (June-December 2008). Projections: EIA World energy projections plus (2009)

The Energy Information Administration data presented in figure 2.12 illustrates the actual and the expected electricity generation of renewable energy around the world from 2006 to 2030. Here we are looking at the share of the total increase over the years and at the expected yearly allocation of resources. As in previous years, proportions in kilowatt-hours change as expected. Hydroelectric power plants are how widespread these days, and are expected to be especially prevalent in the future. The installation and maintenance costs of dams as a source of electricity are higher; nonetheless, the future demand for this particular resource renders the expense a lucrative investment. Nowadays, as often referred to by companies in this sector, wind energy will take up a large share of renewable energy in the future. This type of energy does not harm the environment; and despite the large numbers of tribunes it requires, it produces relatively little noise. The existing turbines are set up on hills where there is a large concentration of wind and no human settlement. Another clean and environmentally friendly resource is geothermal energy; though not very common in the world over. The necessity to install high steam energy stations at each point makes it impractical. Geothermal energy does not constitute a large share of total renewable energy (International Energy Outlook 2009, p.72).

The German parliament set up a plan in 2002 indicating their aim of supplying all of Germany's energy needs with renewable energy by 2050. It is a small measure in the grand scheme but with the dense population, concentrated use of energy and the sustained high standard of living, this small measure could be considered a big step. It is possible that by 2050, more than the total amount of energy used worldwide today can be supplied by renewable energy sources, only if the energy sector comes to an agreement works towards this aim as a unit. Global energy needs can be met, with the use of different technologies, by solar heating and electricity generation plants, wind power plants, dams, and by generating energy from organic waste. In addition, in order to limit the increase in world energy demand, energy saving technologies should be used (Uyar 2008, p.16).

As we understand from all of this, renewable energy must be the future of energy. But this sector needs government support. According to the director of finance of Horizon, David Berry, the top five priorities for congress should be: passing a national renewable electricity standard that would have a large short-term impact on the industry; passing and implementing climate legislation; cleaning up the tax equity market; creating federal sitting authority for interstate transmission projects; and figuring out a national transmission market structure (American Council on Renewable Energy 2009, p.15).

So far, however, larger countries are more aware of their consumption, more sensitive to environmental damage, and more productive in working to fix the pollution they create. The United States of America have begun a new policy. President Obama has announced that with this policy, the objective is to reduce carbon emissions, conserve oil, and build the best green workforce in the world (American Council on Renewable Energy 2009, p.11).

The emergence of this new source has created new jobs. Wind energy has surpassed nuclear energy in creating new jobs. Nuclear energy requires a high amount of capital whereas renewable energy requires extensive human labor. In the case of Germany, in 2002, nearly 30,000 people were working in the nuclear energy sector but 84 300 people worked in wind energy in 2007. Despite the low share of overall total fossil plus renewable energy production, the total number of people working in the field of renewable energy in

2007 was around 249 300. The number of people working in the renewable energy sector is growing every day. If it continues to develop the way it has, it can provide jobs to millions of people around the world (Uyar 2008, p.17).

2.2.1. Solar Power

Solar power is a natural energy source which has been widely used throughout history, especially before the development of more sophisticated technology. Considerably varying methods depending on the level of technology and materials were applied. Current technology can be classified into two groups: Thermal Solar Technologies and Concentrating Solar Power (CSP). In these technologies, whereby solar energy is used to generate heat, heat can be used either directly or for generating electricity. With CSP power plants use different mirror positions to generate electricity by converting solar energy into high-temperature heat. Since they can be built at desired power ratings, they are typically used for powering signaling equipment, meeting rural electricity demand, etc. Solar Cells: Semiconductors which are also called photovoltaic cells transform sunlight directly into electricity. But these photovoltaic cells are very expensive (Energy Ministry of Turkey 2010).

The solar energy falling on the world every minute is higher than the entire world's annual energy consumption. However, the availability of this energy is not great. Applications of solar energy are very broad. Available applications of solar energy include: building heating with obtained electricity; water heating; swimming pool water heating; boiling and baking; fresh and salt water distillations; hot air engines and other thermodynamic heat cycle generation; greenhouse warming; drying of herbal products; day and night lighting; performing photochemical and photosynthetic cycles (http://www.altenergy.org/renewables/solar.html 2010).

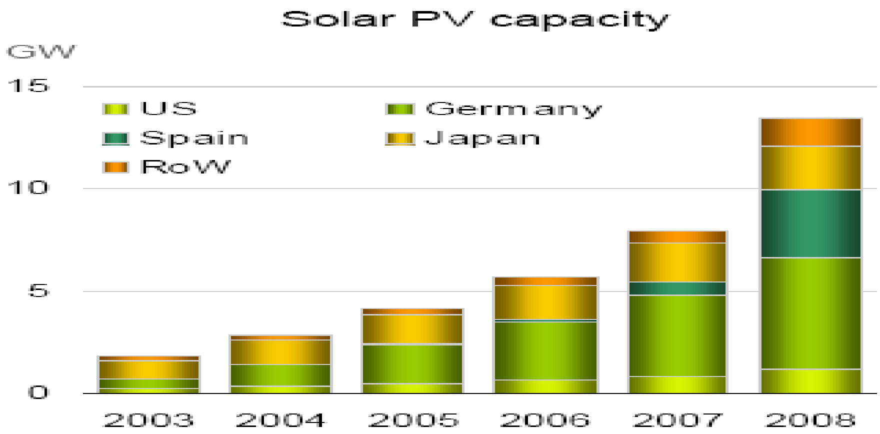

Figure 2.13: Solar pv capacity (2003-2008)
Source: Includes data from Btm Consult IEA, EPIA AND EUROBSERVER BP Statistical Review of world energy, June 2009 (http://www.usaee.org/usaee2009/submissions/presentations/Finley.pdf)

In figure 2.13 above, trends in investment distribution between countries in solar energy from 2003 to 2008, are presented. As of 2003, Japan has been the most active investor in solar energy. The importance of Germany's progress is not difficult to see. We may say that Germany and Spain's emphasis on solar power production is increasing. In the U.S.A, in 2003, the demand for solar energy was very little, however, there is an increase towards 2008 (Finley 2009).

Having a high potential for solar energy due to its geographical position, Turkey's average annual total sunshine duration is calculated at 2.640 hours (daily total is 7,2 hours), and average total radiation pressure at 1.311 kWh/m²-year (daily total is 3,6 kWh/m²). Solar energy potential is calculated at 380 billion kwh/year (Energy Ministry of Turkey 2010).

The average solar energy is the most intense in the Southeast region, then in the Mediterranean region, Aegean region, in Central Anatolia, Eastern Anatolia, the Marmara region; the most intense rainfall in the country being seen in the Black sea region, the least amount of solar energy can be produced there.

According to the Energy Ministry, the greatest disadvantage of solar cells is that their production is incredibly costly due to the use of silicon crystals and thin film technology. With the decrease in the cost of using solar cells and increase in their efficiency, solar cell dependent energy generation is expected to increase in Turkey. Furthermore, using the Turkey Solar Energy Potential Atlas and the CSP technology, it is calculated that an annual production of 380 billion kwh is possible (Energy Ministery of Turkey 2010).

The amount of solar collectors installed in our country is roughly 12 million m² with a technical solar energy potential of 76 TEP, and annual generation volume is 750.000 m², part of which is exported. Such an amount indicates that 0,15 m² of solar collectors are used per capita. The annual amount of solar-based heat generation is around 420.000 TEP. According to this data, Turkey has a significant effect globally on the manufacturing and using of solar collectors. In Turkey, installed solar cell capacity, which is used mostly in public bodies for supplying small amounts of power and for research purposes, has reached 1 MW. Work in the area of solar and hydrogen energy holds great importance for the future of energy in our country including our defense industry and military use (Energy Ministry of Turkey 2010).

2.2.2. Wind Power

Wind energy is created when masses of air with differing temperatures switch places. Of the energy from the sun that reaches the earth, only 1 or 2 percent is transformed into wind energy. Wind turbines transform air, which is of a renewable nature, to electric energy. Wind energy is very active in renewable energy sources. It has zero carbon emissions. Since the operation of wind turbines does not cause emissions of any environmentally harmful gases, they play a very significant role in preventing climate change. It is a domestic and available resource which, unlike conventional power plants, eliminates fuel costs and fuel price related long-term risks from an energy safety perspective, and lowers dependency on other countries in terms of economic, political and supply related support.

(http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=ruzgar_EN&bn=231&hn=&nm=40717&id=40734 2009).

There has been a wide range of uses of wind for energy purposes for thousands of years. Electricity production from wind energy started a century ago. The 1970 oil crisis initiated the development of wind turbines for such purposes as land farming, grazing and watering. Modern wind turbines have 2-3 wings with wing diameters ranging from 1 to 30 meters. Energy derived from wind turbines depends on wind speed in that region and wing length. Wind energy is a clean and environmentally friendly source of energy. (http://www.altenergy.org/renewables/wind.html 2010).

According to the Ministry of Energy, the world's total wind resource is estimated at 53 TWh/year, and presently the total installed wind energy power is 40.301 MW. One third of this power is in Germany. The amount of investment necessary for reaching the world wind energy target of 1,245 GW by 2020 is 692 billion Euros. By then, production costs are expected to decrease from 3, 79 Euro-cents/kWh to 2, 45 Euro-cents/kWh. Global business volume in wind turbines will increase from an annual 8 billion Euros to 80 billion Euros by 2020. In regions with a total potential of at least 48.000 MW and an annual average of 7, 5 m/s, it is possible to make potentially economical investments over present prices (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=ruzgar_EN&bn=231&hn=&nm=40717&id=40734 2009).

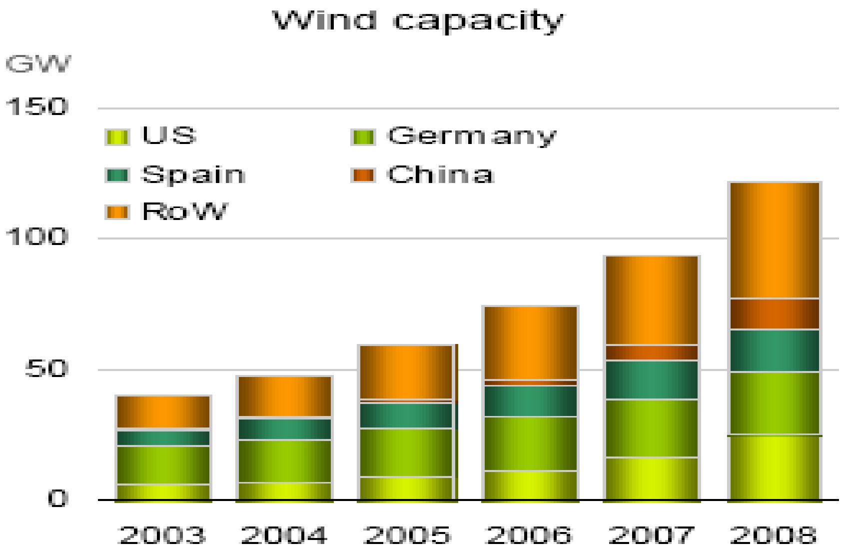

Figure 2.14: Wind capacity (2003-2008)
Source: Includes data from Btm Consult IEA, EPIA and EUROBSERVER BP Statistical Review of world energy, June 2009 (http://www.usaee.org/usaee2009/submissions/presentations /Finley.pdf)

In figure 2.14 above, during the five-year medium-term duration from 2003 to 2008 of cross-country exchanges, the importance of wind energy is shown. The progress of Germany and the U.S.A is clear. It should be taken into consideration that Chinese investment in this sector has become more active after 2005. Also, trends in the rest of the world, pertaining to energy installation, have been on the rise. Even when compared to America, Germany and Spain, the rest of the world has made a serious leap of interest in these resources. This resource does not require a large investment as its installation is not costly. The most important thing for this resource is air circulation (Finley 2009).

In Europe, the largest installed power (wind energy) is in Germany. Denmark, the Netherlands, the UK, Spain, Sweden, Italy and Greece follow Germany. Our country is rich in wind energy in coastal areas such as: the Marmara, Aegean, Mediterranean and Black Sea regions. The world's largest wind energy farm with 15 000 turbines is in the United States at Altamonte Pass (http://www.altenergy.org/renewables/wind.html 2010).

There is important wind energy capacity in Turkey but there is only about 380 Mw of power installation capacity. According to the Energy Ministry website and the Turkey Wind Energy Potential Atlas (REPA), established in 2007, it is calculated that our country has a minimum wind energy potential of 5.000 MW in regions with annual wind speed of 8, 5 m/s and higher, and 48.000 MW with wind speed higher than 7, 0 m/s. Progress has been made in efforts for increasing installed wind energy power, which was at the level of a mere 18 MW as of 2004. Our installed power for wind energy reached the level of 354, 7 MW as of the beginning of 2008. Upon taking effect of the Renewable Energy Law, licenses were granted to 93 new wind projects which deliver a total installed power of 3.363 MW. Out of these projects, powers plants which correspond to an installed power of 1.100 MW are presently under construction (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=ruzgar_EN&bn=231&hn=&nm=40717&id=40734).

2.2.3. Tidal Power

Tidal energy is one of the oldest forms of energy used by humans. Indeed, tide mills, in use on the Spanish, French and British coasts, date back to 787 A.D. Tide mills consisted of a storage pond, filled by the incoming (flood) tide through a sluice and emptied during the outgoing (ebb) tide through a water wheel. The tides turned waterwheels, producing mechanical power to mill grain (http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html 2010).

The tidal energy supply is reliable and plentiful, but converting it into useful electrical power is not easy. Around the world, there are 20 identified sites deemed suitable for the installation tidal power stations, 8 of which are located in Britain. Tidal stations work similar to hydroelectric power stations but they require larger dams. The largest tidal power station in the world (and the only one in Europe) is in the Rancé estuary in northern France, near St. Malo, built in 1966. Tidal energy stations would provide a number of benefits, including protecting a large stretch of coastline against damage from high storm tides, and providing a ready-made road bridge. However, the drastic changes to the currents in the estuary could have huge effects on the ecosystem, and huge numbers of birds that feed on the mud flats in the estuary when the tide goes out would have nowhere to feed (http://home.clara.net/darvill/altenerg/tidal.htm 2009).

Tidal power is a renewable energy resource. It is non-polluting, reliable and predictable. Barrages (undersea tidal turbines) are similar to wind turbines but driven by the power of the sea. Their contribution is similar to that wind or hydroelectric energy.

Tidal range may vary over a wide range (4.5-12.4m) from site to site. A tidal range of at least 7m is required for economical operation and for sufficient head of water for the turbines (http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html 2010).

The total world potential for ocean tidal power has been estimated at 64,000MWe. A 240MWe facility has operated in France since 1966, 20MWe in Canada since 1984, and a number of stations in China since 1977, totaling 5MWe. Tidal energy schemes are characterized by low capacity factors, usually in the range of between 20-35 percent (http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html 2010).

As the Ocean Energy Council states, "the waters off the Pacific Northwest are ideal for tapping into an ocean of power using newly developed undersea turbines. The tides along the Northwest coast fluctuate dramatically, as much as 12 feet a day. The coasts of Alaska, British Columbia and Washington, in particular, have exceptional energy-producing potential. On the Atlantic seaboard, Maine is also an excellent candidate. The undersea environment is hostile so the machinery will have to be robust" (http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html 2010).

According to the website of the Ocean Energy Council, the cost of tidal energy is high. Currently, although the technology required to harness tidal energy is well established, tidal power is expensive, and there is only one major tidal generating station in operation. This is a station producing 240 megawatts of power at the mouth of the La Rancé river estuary on the northern coast of France (a large coal or nuclear power plant generates about 1,000 MW of electricity). The La Rancé generating station has been in operation since 1966 and has been a very reliable source of electricity for France. La Rancé was supposed to be one of many tidal power plants in France, until their nuclear program was greatly expanded in the late 1960's. Elsewhere there is a 20 MW experimental facility at Annapolis Royal in Nova Scotia, and a 0.4 MW tidal power plant near Murmansk in Russia. UK has several proposals underway (http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html 2010).

Tidal power is a form of low head hydroelectricity and uses familiar low-head hydroelectric generating equipment, such as has been in use for more than 120 years. In tidal power technology is important. Technology must be well developed and the main barrier to increased use of the tides is that of construction costs. The installation of tidal power requires high technology and high capital cost with possibly a 10-year construction period. Therefore, the electricity cost is very sensitive to the discount rate (http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html 2010).

Three tidal energy projects (Swansea Bay 30 MW, Fifoots Point 30 MW, and North Wales 432 MW) are in development in Wales where tidal ranges are high, renewable source power is a strong public policy priority, and the electricity marketplace has a competitive edge (http://www.oceanenergycouncil.com/index.php/Tidal-Energy/Tidal-Energy.html 2010).

As with other sources, there are advantages and disadvantages associated with tidal energy. The advantages include: once built, tidal power is free; it produces zero carbon emissions, no greenhouse gases or other waste; it does not require fuel; it produces reliable electricity; after structuring, it is not expensive to maintain; and tides are totally predictable. The disadvantages include: a barrage across an estuary is very expensive to build, and affects a very wide area; the environment is changed for many miles upstream and downstream; many birds rely on the tide uncovering the mud flats so that they can feed; fish cannot migrate unless "fish ladders" are installed; and it only provides power for around 10 hours each day when the tide is actually moving in or out.

(http://home.clara.net/darvill/altenerg/tidal.htm 2009).

2.2.4. Hydroelectric Power

Hydroelectric power plants are the most common renewable energy resource around the world. The reason for this is that it is environmentally friendly and has a low potential for risk. Hydroelectric power plants are an environmentally-friendly, clean, renewable, lasting and efficient domestic resource with low operational costs and no fuel cost, which is not externally dependent and also serve as a fuse for energy prices (www.enerji.gov.tr 2010).

Hydroelectric power plant technology has been developed over a long period of time. It is now common in every country. Hydroelectric power is first converted into kinetic energy and then, with the help of generators into electrical energy. Hydroelectric energy production started in 1927. Previously, after 1910, this type of energy was generated from turbines in Europe, North America and Japan before the establishment of large dams and hydroelectric power plants (Yücel 1994, p.130).

Structuring of hydroelectric power plants is costly but once production starts, this energy is very efficient. Capacity utilization rate is much higher than other renewable energy resources. Large dams of hydroelectric power plants under construction should be dry and very large investments required for dam installation financing is inevitable in the process of government support or external funding.

Hydroelectric power plants in 26 river basins in Turkey have been established. The distribution of share of energy production is: 17 percent in the Euphrates, 11, 5 percent in Tigris, 8 percent in the Eastern Black sea, 6 percent in the Eastern Mediterranean, 5, 9 percent in Antalya. When building power plants, investment costs are really excessive and this delays completion of construction because finding the necessary funds is difficult. Another factor that delays construction is rainfall (http://www.altenergy.org/renewables/hydroelectric.html 2010).

According to the latest information from the Ministry of Energy, technically feasible hydroelectric potential in Turkey is 36000 MW of power. This is a really high rate in total. 150 hydroelectric power plants (HEPP) that are presently in operation correspond to an installed power of 13830 MW and 38 percent of the total potential power. 16, 77 percent of electricity generated in 2008 came from hydroelectric power plants. In 2004, hydroelectric power plants generated 46 billion kWh of energy. Although a new 600 MW hydroelectric power plant was commissioned from 2004 to 2008, Turkey hydroelectric production for 2008 remained at the level of 33 billion kWh. Due to reasons like failures, maintenance/repair works, operational policies, draughts, etc., the overall capacity utilization in energy generation is around 73 percent. Capacity utilization is 68 percent in thermal power pants, and 94 percent in hydroelectric power plants (www.enerji.gov.tr 2010).

The scope of Law no. 5346 on Renewable Energy Resources (YEK) has been expanded to include wave, stream and tidal energy, and all other sources for generating energy which are suitable for building canal or river type hydroelectric power plants, or hydroelectric power plants with a reservoir area of less than 15 km^2 (www.enerji.gov.tr 2010).

2.2.5. Biomass

Bio-diesel fuel is produced from animal fats and vegetable oils extracted from plants with oily seeds like canola, sunflower, soy, safflower, etc. Domestic frying oils and animal fats may also be used as bio-diesel raw material. Bio-diesel does not contain petroleum; but can be used as fuel in pure form or by being mixed at any ratio with petroleum-based diesel (www.enerji.gov.tr 2010).

Biomass is an example of energy acquired by photosynthesis and it is environmentally friendly. Modern biomass resources include: forest products, forestry and wood industry waste, agricultural products, plant and animal waste, urban waste, agricultural and industrial waste (Demirbaş 2000, p.1360).

Biomass is used in the form of bio-diesel, bio-ethanol, and biogas. The flash point of bio-diesel is higher than diesel (>110°C), which makes bio-diesel a safer fuel during use, transportation and storage. Biomass fuel is used to produce heat and electricity. This fuel requires similar technologies to that of traditional fuel technologies.

Bio-diesel is a kind of fuel that can be used wherever diesel is used with the exception of very cold regions. If bio-diesel replaces diesel fuel in the transportation sector, it can also be used in the housing and manufacturing industries instead of fuel oil. Another kind of biodiesel, bio-ethanol is an alternative fuel whose raw material is obtained through fermentation of sugar, starch or cellulose containing agricultural products like sugar beet, corn, wheat and other woody plants, and is used by blending at certain ratios with benzene. It is used in the transportation industry in mixture with benzene, in small household appliances and the chemical industry. Bio-ethanol increases the oxygen level of fuel, making combustion more efficient; it reduces harmful gases in exhaust; it is an environment-friendly alternative to carcinogenic substances, and it reduces exhaust emissions. In Turkey, the total of fuel oil consumption is 22 million tons. The total of this consists of 3 million tons of benzene and installed bio-ethanol capacity is 160 thousand tons (www.enerji.gov.tr 2010).

Another kind of biomass is biogas which is mainly methane and carbon dioxide gas which is a product of biological decomposition (of animal waste, vegetable waste, urban and industrial waste) under anaerobic conditions (i.e. anaerobic fermentation). Biogas technology allows us to obtain energy from organic waste, and also to put waste back into the soil (www.enerji.gov.tr 2010).

Biogas can be produced in Turkey, considering its animal waste potential, which is reported on the Energy Ministry website as 1, 5 to 2 MTEP (million tons equivalent of petroleum). Turkey's biomass sources include agriculture, forests, animals, organic urban waste, etc. While our waste potential is around 8, 6 million tons equivalent of petroleum (TEP), 6 million TEP is used for heating. In 2007, the total amount energy obtained from biomass sources was 11 thousand TEP (www.enerji.gov.tr 2010).

2.2.6. Geothermal Power

Geothermal energy is the energy from heat obtained from hot water, steam and dry steam and hot dry rocks, which is formed when accumulated heat in deep subterranean rocks is carried by fluids and stored in reservoirs. Geothermal resources mainly form around active fault systems and volcanic and magmatic units (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=jeotermal_EN&bn=234&hn=&nm=40717&id=40735 2010).

Geothermal energy is obtained from hot rocks deep under the earth's crust which heat the fluid temperature of the earth through a thin layer. The ancient Romans used geothermal energy for baths in natural hot water, and also for therapeutic purposes; in the U.S. it was first used for residential heating in 1891. The first time it was used for electricity (from dry steam) was in Italy in 1904. Geothermal energy is used for heating houses and for heat absorption cooling systems in production processes, agriculture, greenhouse cultivation, culture fisheries, saunas, and for heating of sidewalks for melting snow.

Geothermal energy produces continuous power without being affected by weather changes; it is a reliable source as well as being environmentally friendly. Geothermal energy reduces air pollution. Electricity derived from geothermal energy in the U.S. each year prevents the emission of 22 million tons of CO2 and 200 thousand tons of sulfur dioxide. The first geothermal heating system in Turkey in 1964 was used at a hotel in Balıkesir (Gonen). Turkish geothermal regions include: Aydin (Slavatlı, Buharkent, Germencik), Denizli (Kızıldere), Nevşehir (Acıgöl), Canakkale (Tuzla), Izmir (Balçova, Seferihisar), Kutahya (Simav) (Kagel, Bates and Gawell 2007, pp.28-29).

A disadvantage associated with geothermal energy is the production of sulfur dioxide which may harm the environment. However, this is not a very serious concern.

Globally, the total of installed geothermal power is 9700 MW with an annual production of 80 billion kWh. Top five countries of geothermal electricity generation are the USA, the Philippines, Mexico, Indonesia and Italy. Non-electricity utilization is 33.000 MW. The top 5 countries that use geothermal energy for heating and spa practices are China, Japan, the USA, Iceland and Turkey (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=jeotermal_EN&bn=234&hn=&nm=40717&id=40735 2010).

According to Energy Ministry, because Turkey is located on the Alpine-Himalayan belt, it has substantially high geothermal potential. The geothermal potential of Turkey is 31.500 MW. Areas with potential are concentrated in Western Anatolia (77, 9 percent). Presently, 13 percent of that said potential (4.000 MW) has been made available by the MTA General Directorate of our Ministry. 55 percent of the geothermal areas in Turkey are suitable for heating practices. In our country, 1200 hectares of greenhouses are heated using geothermal energy, and 100.000 households in 15 settlements are also heated with geothermal energy (http://www.mta.gov.tr/v1.0/index.php 2010).

Prospecting for geothermal energy was revived recently, and starting from 2003, prospecting works by the MTA General Directorate of our Ministry yielded to a geothermal energy source of 840 MW. While 1.500 MW of our geothermal energy potential is assessed to be suitable for electricity generation, finalized data is so far 600 MW. 39 MW is being used for electricity generation. A 55 MW geothermal power plant is currently under construction (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=jeotermal_EN&bn=234&hn=&nm=40717&id=40735 2010).

2.2.7. Wave Power

Ocean waves are a third form of solar energy, in that unequal heating of the Earth's surface generates wind, and wind blowing over water generates waves. Although nearly 75% of the Earth's surface is covered by water, wave energy has not been efficiently explored, especially when compared with the progress that has been made in harnessing the energy of the sun and wind. The problem is that it is not easy to harness this energy and convert it into electricity in large amounts. Thus, wave power stations are rare (Hagerman 1991).

There are different methods of deriving energy from wave power. One of them works like a swimming pool wave machine in reverse. A problem with this design is that rushing air can be very noisy, unless a silencer is fitted to the turbine. However, the noise is not a huge problem as the waves make quite a bit of noise themselves. Once a wave power station has been built, the energy is free, needs no fuel and produces no waste or pollution. One big problem is that of building and anchoring something that can withstand the roughest conditions at sea, yet can generate a reasonable amount of power from small waves. It is not much use if it only works during storms (http://home.clara.net/darvill/altenerg/wave.htm 2010).

Like other sources of energy, there are some advantages and disadvantages associated with wave energy. Advantages include: because it is a free energy, it does not require fuel, and therefore no waste is produced; it is not expensive to operate and maintain; it can produce a great deal of energy. Disadvantages include: the amount of energy produced fluctuates since it is dependent on waves; it requires a suitable site where waves are consistently strong; some designs of the wave plants can be noisy; plants must be able to withstand very rough weather (http://home.clara.net/darvill/altenerg/wave.htm 2010).

Ocean waves are caused by the wind as it blows across the sea. Waves are a powerful source of energy. The use of tidal energy in Turkey is unlikely, as is wave energy because ocean currents are the best source for them. In Istanbul and the Dardanelles Strait, because of heavy sea traffic and sea currents, sufficient energy cannot be harnessed.

According to Tom Heath, for more than two centuries, inventors have been filing patents for systems to capture power from waves and yet there still is not a wide application of wave energy devices as power generators. The long term problem is making the technology work at a cost of power which a consumer is willing to pay. In the future, costs will be reduced, but until then, the development of wave power is hampered by the need to introduce a fledgling technology into commercial use. Twenty years ago, the wind industry suffered similar problems; but largely through the far sighted long term support to manufacturers offered by the Danish government, that nation was able to develop an industry the premiums of which, offered for green power, can now compete on a commercial footing (Heath 2010, p.4).

In the 1980's, the wind industry privately funded prototype devices under development with public support and public money. Now the wave energy industry is developing in a similar fashion and receiving support. Of course, it will see some failures along its way because it requires technical development, but with sustained public support to create conditions where new energy sources can be introduced to the market, there is every expectation that wave power will mature to make a major contribution to energy needs. The technical challenge in wave energy is driven by the commercial challenge. The success of wave energy in relation to other energy supply technologies will ultimately be determined by the price at which it can deliver power to the market without political considerations. The cost of producing wave generated electricity is comprised primarily of the capital expenditure in building and installing the device and connecting to the electricity grid. Capital expenditure typically accounts for more than 90 percent of the cost of producing wave power. This is in marked contrast to fossil fuel plants where the input fuel is a high proportion of the cost. A successful wave energy device will therefore have a minimum capital expenditure and a maximum electrical output. This rather obvious fact creates a dilemma for the designer of the wave energy plant. The device structure has to survive the worst that the sea can throw at it; but only just. Looking at it simplistically, if you over-design a wave energy machine by a factor of two, it will cost twice as much and the price of power will be double. It will then be a very reliable wave power device that no-one will want to buy. We thus have to go through a development stage where we build prototype units which, as far as we can tell with the available information, will survive fabled storms and which may not be economic generators but will give us the information on loads and performance to enable the next design to be closer to the limit (Heath 2010, p.5).

The long term goal for the wave energy industry is to be bulk suppliers of power feeding national grids from offshore wave farms. The realities of wave energy are thus: there is an extremely large supply of power available. The technology already exists for the extraction of this power. The technical challenges are solvable. The problems lie in solving the problems at a cost that is acceptable to the market (Heath 2010, p.4).

3. APPRAISAL OF ENERGY INVESTMENT PROJECT

According to the United Nations Industrial Development Organization (UNIDO), an investment project is a community for a specific period of time in goods and services production, to increase, create and /or expand on some opportunities for development (Güvemli 2001, p.9).

A distinction can be made between saving and investing. Saving involves putting money away with little, if any, risk to the saved money. In the short run, saving involves few worries. Investing also involves putting money away, but in a risky endeavor. Both saving and investing amount to consumption shifting through time. By not spending money today, a person is able to spend more later (Strong 2005, pp.2-3).

Also, investment policies are important here. Once objectives and constraints are determined, an investment policy that suits the investor can be formulated. That policy must reflect an appropriate risk return profile as well as the need for liquidity, income generation and tax positioning. Asset allocation is the most important thing for the investor. As a result, when people decide to do investment project, they have to make a choice (Bodie, Kane and Marcus 2009, pp.95-97).

Investment is divided into two groups: real investment and financial investment. Real investments are tangible; they include real estate, land and physical goods. Financial investments are non-physical and are about future partnerships or shares that are granted (Karan 2004, p. 15).

Investment projects in a specific time period specified in the framework of a plan, and resources and activities related to the production of goods and services can be outlined. In other words, investment fixed assets require a decision to be made (Sarıaslan1990 p.13).

Whatever the description of an investment, deciding to make an investment means making a choice. Making the right decision is related to good forecasting skills. Gaining these skills requires knowledge of the steps involved and good time.

There are two types of assessment involved in the planning of a project: economic assessment and financial assessment. See below for detailed information.

Before starting the business fixed investment, rational decisions must be made. If foreign investment is required, benefiting from government incentives is necessary for the project to work. Investment projects, market studies, legal studies, as well as technical and financial studies must also be performed (Kula and Erkan 2001, p.149).

Preparing investment projects involve five steps: coming up with the idea, pre-feasibility study, feasibility study, project assessment and project planning (Sarıaslan 2006, p.29).

In addition, re-inventing the ideas for the new investment, expansion, completion, modernization, cost and quality correction, such as bottlenecks or production purposes make the investment. Project valuation, which is to be applied to investment projects to determines the deficiencies, weaknesses and faulty components; it also determines whether there is economic and technical life; it also determine whether payments can be made or whether profitability will be yielded from the project (Büker and Aşıkoğlu 1995, p.9).

Even if a project is feasible, finding funding can be a challenge and is very important. The project process and the steps involved are important. Especially in the first half of the twentieth century, many developed and developing counties have presented their infrastructure services to the State Economic Enterprise (SEE). Especially in the last two decades, in many developing countries, privatization and market competitiveness of plants was pulled from operation of infrastructure services for the state and these areas began to assume supervisory and regulatory functions (Hasan 2002, p.4).

The growth of international capital flows, the private sector, their quest for new global market opportunities, developing economies, and international capital with which investors try to attract the interest of the country is an indication pro-activity. However, political risk, managerial issues and business challenges emerging in many countries have led to significant problems. With private sector investment decisions and developing countries seizing opportunities, it assumed that the biggest risk is political.

Sustainable development to ensure sustainable goals and the necessary financial resources to be provided about the many examples are available (Hasan 2002, p.4).

In general network industries include electricity, natural gas, pipelines, railways, telecommunications, mail, irrigation and drainage. The common factor in this sector is being capital intensive and it includes high sunken costs. This sector sometimes becomes a monopoly in nature because it provides input for other sectors and related economic multipliers; it also affects social welfare of consumers and the scale and scope of savings (Hasan 2002, p.8).

The energy sector operates on a much larger scale. 60 percent of companies in the energy sector operating in major countries such as Britain, France, Germany, Spain and the USA are electricity suppliers; oil and gas giants have begun to enter the electricity and renewable energy industry, announcing it is targeting. The world's largest energy company Electricite de France, is in charge of energy production and distribution facilities in more than 30 countries. Similarly, the U.S. took over 7 of 12 regional electricity companies in the UK, and Europe has expanded in Latin America and the Asia-Pacific (Hasan 2002, p.11).

The point that must be known is that, after privatization, there came to be five main components to electricity bills. These are: generation, distribution, transmission, retail supply and a nuclear subsidy. Each is derived from a separate mechanism. In Turkey, these are provided by five main organizations: EÜAŞ (production of electricity), TETAŞ (traded company), TEİAŞ (transmission), TEDAŞ (distribution company), EPDK (pricing and auditing).

These organizations finance investment for energy projects. In recent years, the energy sector has been receiving a lot of attention. Banks have large loans in their portfolios to the energy sector. Despite the 2009 crisis, big banks did not cut payments for energy projects. Troubled economy or not, a good investment and the right investors will receive bank loans for financing their projects. However, environmental investment funds have become difficult to finding the USA and the UK because their largest banks were hit the hardest; but this does not apply to Turkey (Thomas 2002, p.13).

If we look at Turkey in terms of only seven banks this year's will transfer to resource to projects will exceed $ 5 billion. Turkey's energy needs from 2009 to 2017 are estimated to grow at a rate of 6-8 percent, and by 2020, this need will exceed 100 billion dollars. In the energy sector, by 2020, 16 thousand MW of additional renewable energy investments are expected and many of them have been commissioned (Zeybekoğulları 2010).

Energy projects require low interest rates and long term loans. Syndicated and commercial loans are usually applied for in this regard as bank credit is generally less capital intensive.

In 2009, the financing for energy projects from seven banks amounted to 3.4 billion dollars. The Industrial Development Bank (TSKB) last year alone, jointly with other banks, gave loans for all 30 renewable energy projects. Garanti Bank and İş Bank provided funding for 20 energy projects last year aimed at privatizing electricity, and natural gas distribution; their commitment to these projects made them the leading banks in this regard. In addition, DenizBank and Yapı Kredi respectively placed thirteenth and eighth in 2009 for their role in energy project loans (Zeybekoğulları 2010).

In 2010, with the approval of the EMRA, new investments projects for renewable resources are expected to be launched. Distribution of electricity in seven regions is expected to cost 7-8 billion dollars in financing. This figure will be higher once funding is taken into consideration. Customizations for power generation are estimated to require15-20 billion dollars in financing. The EMRA's pending approval of a 78 thousand MW wind farm project will distribute a portion of the licenses in 2010. Banks increased interest rates for loans in this sector to maximize their chances of capitalizing (www.epdk.gov.tr 2010).

Credit loans and investment in renewable energy projects in Turkey, as we understand from the perspective of big banks, are gaining interest as these projects are important for the future. However, it cannot be forgotten that there is always financial risk; and these days, due to globalization, a crisis in one area will have a ripple effect that will affect the entire world. In developing countries especially, managing the financial risks associated with renewable energy projects must be considered. According to UNEP, if credit loans and use and risks are properly managed, the costs of financing renewable energy projects will be reduced. Nowadays, renewable energy-related insurance and other financial risk management tools are implemented; the configuration of OECD countries is growing; while the emerging countries stay on a limited basis. The Global Environmental Organization and donor corporations analyze real and effective risk, high risk management in developing countries, and balancing risk. For this purpose, the World Bank, UNDP, the Global Environmental Organization, STAP, and a lot of industrial partnerships give support (Arabul 2009, pp.3-4).

Four or more risk management methods used in the feasibility study will help the adoption of the project. Today, experienced with financial difficulties, developing countries will directly affect energy investments. Investors seem to be more interested in non-energy investments because of the risks associated with the energy sector. It seems that existing investors will withdraw their investments. The size of the investment needed to sustain credit will increase and so there will be a severe shortage of credit. This will stop the recession and unemployment, and the size of investments in countries will increase. Developing countries, in 2008 and 2009, will shed light on the start of a new way of life. This development is expected by the end of 2010 (Arabul 2009, pp.3-4).

3.1. PROJECT DEVELOPMENT

Projects where the goods or services are produced by industry include: agricultural projects, mining projects, energy projects, industrial projects, manufacturing projects, transportation-communication projects, and tourism projects (Güvemli, 2001, pp.13-15).

Project development does not refer to setting up or identifying a target. Firstly, the current status must be reviewed and analyzed. Threats and challenges must be identified. After that comes the analysis of problems and cause and effect relationships. After all of this, sector research will be started. After the project sector analysis, environmental contributions will be looked, followed by budgeting. Each leg of the investment budget will be different. Here, I will analyze energy project costs and financing. After all these details are thoroughly researched, the project will be launched, taking care to maintain its sustainability. The right project fits into the flow of a plan (Sarıaslan 2006, pp: 29-36).

In energy investment projects, the adoption of the idea, and the establishment of enterprises are initiated and sustained efforts by certain organizations, and the starting and ending points are also identified as planning organizations.

In order to be prepared for a particular project, the establishment of an economical and efficient way of working is to be accomplished by large qualified enterprises. Efficiently handling of the project includes two parts: the first part is a pre-project phase; in the second part, a transition is made to certain investment projects. See below for details:

i. The exact realization of the investment decision,

ii. Enabling organizations to determine the place of business

iii. Determining the size capacity of the business to be set up

iv. Establishing the internal and external financing needs of enterprises based on findings; financing from banks and other financial institutions for the to pre-project phase,

v. The technical difficulties of the project and what equipment to acquire

vi. Credit and foreign exchange allocation from investment allowances and the opportunity to benefit from the similar incentives of investment projects and other agencies to provide a document identifier,

vii. Investigating legal obstacles for the realization of the project

viii. Difficulties to be encountered during project implementation and anticipating necessary measures to take (Sarıaslan 2006, pp: 29-36).

The project development phase steps are:

a. First stage: Coming up with the idea for investment:

An investment project is first of all an idea. In this first stage, based on research about the people, without an active management style and shape, in terms of profitability and technical competence of conformity, the idea is to be created.

b. Second stage: Pre-project studies:
Gathering of information about profitability and setting expectations according to the findings of that research. Prepared preliminary project work will form the basis for this research; economic, technical, financial and legal investigations will take place.

c. Third stage: Pre-project phase:
In the second phase of the research, results are evaluated and the information obtained is analyzed in terms of what it reveals. Entrepreneurial and investment projects enable people to know where to place their expectations about the accessibility of the project.

d. Fourth stage: Evaluation phase
The information obtained is presented before commencing the project, and all persons concerned with the investment review the plan one last time. These interviews and evaluations of the idea are essential. The evaluation will yield positive results given the informed investment decisions.

e. Fifth stage: Final project preparation phase:
Giving the result of investment decisions, the establishment of the business will begin by preparing for certain construction projects. Some preliminary research at this stage of the project may be conducted and the wider question is to be addressed in detail. Some issues may arise: legalities, technical qualifications, capacities, and quantities of products produced, etc. Definite plans are then made. In this final stage, unforeseen developments may cause the dissolution of the project. .

f. Sixth stage: Final project implementation phase:
With the establishment of business and all that has been planned now being operational, the investment is realized physically.

g. Seventh stage: Stage of trial production:
Completion of all the work specified renders the businesses established enough to pass. At this stage, certain trials take place to minimize and eliminate certain obstacles encountered during the establishment phase that may disrupt proceedings. Provided these trials yield positive results, the project will be operational.

h. Eight stage: Opening and completion of project investment phase:
Once the company has successfully completed the trial stage, the opening ceremony takes place before the intended commencement and planned activities. Thus the establishment of business-related investment projects is ended (Sarıaslan 2006, pp: 36-40).

3.2. ANALYSIS OF THE COST STRUCTURE OF THE INVESTMENT PROJECT

We can divide cost structure into two main items: fixed investment and business capital investment; fixed investment applies to the resources required for establishing the facility. Business capital investment applies to the requirements for the process of establishing the plant.
The amount of the fixed investment added to the working capital equals the total amount of project investment. There is detailed information about both types of investment below. (Güvemli, 2001, pp.456-500)

3.2.1. Fixed Investment

The amount spent from the birth of the idea of investing in the facility until the final transition to business fixed investment represents all of the expenditures. In other words, during the realization of the project and throughout the useful life of fixed assets (tangible and intangible) in the currency of business fixed investment, the project will appreciate in value (Güvemli, 2001, pp.250-275).

The amount of fixed assets consists of land costs, fixed plant investments, price increases and total financing costs during the investment period. Cost structure of fixed investment is shown in table 3.1 below:

Table 3.1: Component of fixed investment

Component of investment	Total	Internal Financing	External Financing
A – Land investment			
B – Fixed plant investment			
1 – Feasibility- Project			
2 – Technical assistance and license			
3 – Construction			
4 – Machinery and equipment			
5 – Freights and insurance			
6 - Import and clearance expenses			
7 – Assembling expenses			
8 - Vehicles and fixtures			
9 – Commissioning expenses			
10 – General overhead (expense)			
11 – Other expenses			
Total fixed investment amount (including land)			

Source: DPT and TKB project examination table

Expenditure items in table 3.1 depend on the nature of the project. Based on this, certain sections may be added or removed. The aim here is to calculate expenses as accurately, realistically, and in as much detail as possible.

Moreover, determining the need for external financing for the investment is absolutely necessary, hence the need for external financing in the table. This must be calculated separately and each item should appear in a separate column (Sarıaslan 2006, p.125).

The items in the table above should be considered separately. There is not detailed information here because the amounts change from project to project. When we look at specific projects in detail, determining the cost is very important because this stage is the starting point. If we analyze the wrong items, calculations of the total cost will be wrong.

3.2.2. Business Capital Investment

To continue to operate after a business has been established, the business needs sufficient "business capital investment". Therefore, some books refer to business capital investment as working capital management.

Business capital or working capital refers to a company's short term economic values. Working capital refers to deficiency of business capital; it takes into account production when the plant is fully operational and customer demand in an effort to eliminate the emergence of obstacles (Sarıaslan 2006, p.130).

Table 3.2: Cost structure of business capital

Component of investment	Total	Internal Financing	External Financing
1-Raw materials			
2-Suplementery materials			
3-Energy			
4-Labour costs and employees			
5-Licences and patents			
6 – Maintenance services			
7– General expenses			
6 – Depreciation costs			
7 – Selling costs			
8 – Interest expenses			
Total business capital investment amount (including land)			

Source: DPT and TKB project examination table

We can see the detail in the components of business capital above in table 3.2. Of course investment cost titles differ from investment to investment. When project cost titles are decided, this structure must be implemented correctly. Otherwise, it will affect the future of the project.

Three methods for calculating working capital are used: operating period coefficient method; the amount of daily expense method; or the Schmallenbech method. At the start of the project, only operating period coefficient method can be used because the other two methods of calculation require estimated costs in detail. As a result, these two are difficult calculation techniques. (Sarıaslan 2006, p.133)

That capital method refers to items such as: cash, banks, securities, receivables, inventories (raw materials, semi-finished goods) and prepaid expense items. As this is a new project, in calculating the working capital for the project, the value of securities and prepaid expenses will not be found.

Many factors affect the working capital requirements. These factors are: credit opportunities; buying and selling practices; inventory policies and inventory turnover rates; production time; production capacity and the unit cost of production; business type; and the level of competition in the market.

However, it is very difficult to estimate these factors in detail during project preparation. Average values can be estimated at best (Sarıaslan 2006, p.132).

3.3. METHODS OF PROJECT ANALYSIS

A wide range of businesses, regardless of what financial resources are considered, cannot benefit from finance investment projects. As a result, they must carry out their activities with limited resources. For this reason, businesses compete with one another for resources. To make a selection from among the bids, and ranking them according to severity, requires the relinquishing of some of their investment. Alternative use of business resources encompasses the ability to prioritize on what the allocated funds should be spent (Büker, Aşıkoğlu and Sevil 1997, p.253).

Based on important data and certain criteria based on valuation and prioritization, certain decisions must be made at the onset of the project, even if there is the contribution of mutual funds or an existing investment project. Since project processing is a long-term process because of the required analysis of various inputs and output of sources, certain limitations must be imposed. Funding is an important part perhaps, but the environment and sector specific components also affect the investment project. So, all of these things must be considered (Şahin 2000, p.95).

There are two stages of analyzing project evaluation: financial analysis and economic analysis. With economic evaluation, only profitability is measured. As we know, maximum profitability is the aim of any company. If the project is profitable, it is acceptable. If the project does not bring profitability, it is rejected. With project evaluation, an economic analysis is the first step because if it will not be profitable, then it is not necessary to examine it.

Economic evaluation in itself is divided into two groups: Commercial profitability analysis and social profitability analysis. In summary, commercial profitability analysis accounts for individual or company interests, as well as those of the community in terms of profitability analysis valuation. Social profitability analysis determines the country's interests. In brief, social profitability analysis methods around the world are: method of UNIDO, the OECD method, and the World Bank(IBRD) method (Sarıaslan 2006, p.286).

Also, according to Erdal Üstündağ (2005, p.7), there are a variety of methods used for valuation of investment projects. These in general can be grouped under three headings: Business Profitability Analysis, Sensitivity Analysis, and National Profitability Analysis.

In methods of analyzing investment projects, the cash flow statement is the most important part. The cash flow statement reports where a company generated cash and where cash was used over a specific accounting period. The cash flow statement assigns all cash flows to one of three categories: operating cash flows, investment cash flows or financing cash flows. The cash flow statement begins with net income, which is the principal accounting measure of earnings for a corporation. However, net income and cash flow are not the same and often deviate greatly from each other. A first reason why income differs from cash flow is that income contains non-cash items. For example, depreciation is a non-cash expense that must be added to net income when calculating cash flows (Corrado and Jordan 2002 ,pp-225-226).

Adjusting net income for non cash items yields operating cash flow. Operating cash flow is the first one of the three cash flows. The second and third ones are respectively, investment and financial cash flow. Investment cash flow includes purchases or sales of fixed assets and investments. Financing cash flow includes funds raised by an issuance of securities or expended by a repurchase of outstanding securities. We can see in equation 3.1 below net cash flow calculation: (Ross *et al*. 2007, pp.33-35).

$$\text{Net cash flow} = \text{Net income} + \text{depreciation and amortization} \qquad \textbf{(3.1)}$$

(Brigham and Ehrhardt 2008, p.91)

Economic Analysis Concepts are full cycle or full life economics; the economic value of an asset that was acquired in the past and had its value enhanced through additional investments. Results do not represent the current economic value to the firm since the analysis includes prior investment, revenue and expenses. Results include the benefit of hindsight and are useful to improve decisions made in the future (Delano 2004, p.25).

In general, all books, divide economic analysis into two methods; these methods are limited in size because of the time value of money. One of these methods does not take the time value of money into consideration whereas the other one does.

3.3.1. The Methods of Ignoring Time Value of Money

Not taking into account the time value of money is not very realistic, although it can be useful during some parts of the project. If we prepare a simple and short term project, this method of calculation will be significant and useful. These methods are static methods. The biggest drawback of this method of exclusion is the interest factor. Below, is a method more clearly presented and logically defined.

3.3.1.1. Rate of return method (ROR)

The most simple valuation method is a rate of return or return on investment (ROI) method. It is used for calculating feasibility for investment projects. This method shows the rate between the expected net profit (p) from the investment project and the total first investment (ı). As illustrated in equation 3.2:

$$RSP = \frac{net - profit}{total - investment} = P/I \qquad \textbf{(3.2)}$$

P: within the useful life of the investment that best represents the functioning of investment advice or a normal year, the profit after great interest and tax.

I: represents the total investment amount during the organization period, excluding interest amount.

If the project has been a source of foreign investment in the financing of the normal amount of net profit, it must be included in the interest expense. As demonstrated in equation 3.3 below:

$$RSP = \frac{net - profit + \text{int}\,erest}{total - investment} \qquad \textbf{(3.3)}$$

As shown, a simple method of profitability analysis is quite simple, not taking into consideration the time value of money. Whereas in long-term investments, especially energy investment projects, time value of money is very important. Also, a normal year of useful life is defined by the project practitioner. Findings acquired with this method rate (rsp) will be compared to the expected profit; if the rate of simple profit is greater than the expected value, the project will be favored. The purpose of this method is to assess whether a project is worth undertaking with a simple calculation (Sarıaslan 2006, p.169).

3.3.1.2. Payback period method

The payback period, defined as the expected number of years required to recover the original investment, was the first formal method used to evaluate capital budgeting projects. The basic idea is to start with the project's cost, determine the number of years prior to full recovery of the cost, and determine the fraction of the next year that is required for full recovery, assuming cash flows occur evenly during the year. As illustrated below in equation 3.4:

$$\sum_{t=0}^{m} I_t = \sum_{t=m+1}^{n} P_t \qquad \textbf{(3.4)}$$

I: total investment except interest

P: net cash flow yearly

m: installation period

n: economic life cycle of the project (installation+business life cycle)

(Berk 2007, p. 187).

When calculating the payback period, if what the investor receives as a benchmark for reimbursement is greater than, this project will be rejected. If the opposite occurs, it will be accepted. This method is useful method but there are some disadvantages. The most important disadvantage is not considering the time value of money. The other disadvantage is that cash flows beyond the payback year are given no consideration whatsoever, regardless of how large they might be. Unlike the net present value, which tells how much the project should increase shareholder wealth, and the internal rate of return, which tells how much a project yields over the cost of capital, the payback merely tells us when we get the investment back. There is no necessary relationship between a given payback and investor wealth maximization so we could not know how to set right a payback period. Nonetheless, in some cases, this method can be useful, like in risky conditions and markets, where advancement towards invested capital is driven by a smart investor during risky times (Brigham and Ehrhardt 2008, pp.392-393).

However, the payback period method is useful in financial planning or liquidity planning. As a result, it is beneficial in terms of obtained loans for cash flow and timely made payments and project revenues (Berk 2007, p.188)

The payback period method does not take into account the investment income after the repayment period. The project should pay for itself in a short time and priority is given to the strategic importance of having a long life (Büker and Aşıkoğlu 1995, pp.247-253).

The payback period and rate of return method do not take into consideration the time value of money invested in their projects because their valuation methods are static. With the payback period method, the aim of project appraisal is to determine the investment payback period. The implementation of this method is simple; the objective is to make back the invested capital as quickly as possible; and risk and uncertainty are minimized. In addition, with this method, the valuation of enterprises in which there is a lack of funds is ensured a return as soon as possible from the resource (Büker and Aşıkoğlu 1995, pp.247-253).

3.3.2. The Methods of Consideration Time Value of Money (Discounted Cash Flows Method)

This method takes into consideration the time value of money; this is logical ways because money is an asset that can decrease or increase in value. Therefore, these methods are called discounted cash flow methods because they take into consideration the time value of money, and are, therefore, dynamic methods. Moreover, large projects are often long term projects, and so these methods will give more accurate results. Standard deviation in this case will have been minimized.

3.3.2.1. Net present value method

Evaluating the time value of money enables a dynamic valuation of the project; the net present value method calculates cash inflows and outflows with specific discount bounds on the reduced amount of the difference between net present value returns on yearly basis. The investment is considered to be good if the project valuation "surplus value" is more than the largest investment, upon which the project is accepted. This method will be used to determine the rate of return and is of great importance. This ratio to determine low or high resolution affects the selection of investment projects. Other weaknesses, identified by a discount rate on the useful life of the income during the useful life cycle, provided promptly in the case of use, are subject to change (Büker and Aşıkoğlu 1995, pp.260-269).

The net present value is the economic value expected to be generated by the project at the time of measurement. It represents the value being added to the company by making the investment. Decision Rule is NPV>0 (Delano 2004, p.23).

Project pro forma operating income and cash flow statements in all cash inflows and outflows associated with the project as a whole for their net cash flows are calculated on the basis of distribution according to years. The net present value (NPV) method is based on the discounted cash flow (DCF) technique. The implementation approach is as such: finding the present value of each cash flow, including the initial cash flow, and discounting the project's cost of capital, represented with the symbol "r". The sum these discounted cash flows is defined as the project's NPV.

Equations 3.5 and 3.5a demonstrating the NPV are as follows:

$$\text{NPV}= CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + ... + \frac{CF_n}{(1+r)^n} \qquad \textbf{(3.5)}$$

$$\text{NPV}= \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t} \qquad \textbf{(3.5a)}$$

CFt = expected net cash flow at period t

r = project's cost of capital

n =useful life period

Cash flow = [(Revenue-Expense-Investment-Interest-Depreciation) (1-Tax)+Depreciation)]

If the net present value is greater than 0, the project is acceptable. If the value is smaller than zero (negative), the project is rejected.

NPV $\leq$ 0 REJECT

NPV > 0 ACCEPT

(Brigham and Ehrhardt 2008, p.380-381)

Commercial profitability analysis with a discount rate and project financing sources used for the average of the cost of capital or the entrepreneur's project yields the minimum profitability rate. For this reason, project financing resources used for capital costs need to be clearly identified. If the project is financed with the equity from the resource cost, and other resource investments are not deposited, the cost will be abandoned. This opportunity to express the rate of income which determines the opportunity cost is the best indicator of financial markets in terms of the interest rates. This is because making a connection with money valuation in terms of interest rates will probably produce less risk. But the situation triggers interest rates. These are both political and economic indicators. Therefore, the project would be connected to the opportunity cost of resources and the determination of these costs and showing the interest rate should be done carefully. In addition, if the project's equity financing is not stretched to cover the total cost of foreign resources, the weighted average cost of capital, equity and foreign sources are then averaged together (Sarıaslan 2006, p.174).

Net cash flow deficiencies also have some disadvantages. Net cash flow reduction, used in the cost of the capital rate constant, is taken, and as a result, the project life cycle, along with the generated funds, is assumed to be the cost of capital reinvested. But throughout the project's life cycle, the capital cost changes. Another drawback is 0, even in the case of a refusal. 0 is possible even when the level of minimum profitability of the project meets investors' requirements. Therefore, the net present value of zero is an acceptable project status. A positive net present value of the options investment yielding the maximum value of the project's profitability rate is said to not be possible. As a result, the drawback of the NPV method is that the net present value rate occurs in the general profitable index. Net present value cost of capital method is extremely sensitive to the smallest change (Sarıaslan 2006, p.173-175).

This method also has some advantages. The rationale for the Npv method is straightforward. An NPV of zero signifies that the project's cash flows are exactly sufficient to repay the invested capital and provide the required rate of return. This method is helpful with the using of the discount rate and it is possible to make a choice between opportunity costs. Net cash flow may even be in the negative some years; however, a solution is possible (Üstündağ 2005, p.4).

There is also direct relationship between the NPV and the economic value added (EVA). The NPV is equal to the present value of the project's future EVAs. Therefore, accepting positive NPV projects should result in a positive EVA. So, a reward system that compensates managers for producing a positive EVA is consistent with the use of the NPV for making capital budgeting decisions (Brigham and Ehrhardt 2008, p.382).

In the process of project evaluation, the feasibility of projects is usually determined by the net present values (NPV). In an environment of uncertainty and high risk, projects' NPV parameters should be estimated and studied to predict all possible values. The NPV change interval of a project is calculated taking variability into account so that the project is without risk. Therefore, as a project's level of risk should be measured, adding to the equation the numerical variability of the project to determine NPVs (Delano 2004, p.31).

3.3.2.2. Profitability index method (rate of net present value)

Another method used to evaluate projects is the profitability index referred by some sources as 'the rate of net present value or present worth index'. The Profitability index (PI) measures the relative attractiveness of projects per amount of investment; the ratio of the present value of cash inflows to the present value of the cash outflows. It is designed to address the limitation of NPV cited above (Delano 2004, p.34).

The net present value of the investment as compared to the discount amount of initial investment is presented in equations 3.6 and 3.6a below:

$$\text{PI}=\frac{PVofFuturecashflow}{Initial\cos t} \quad \textbf{(3.6)}$$

$$\text{PI}=\frac{\sum_{t=1}^{N}\frac{CF_t}{(1+r)^t}}{CF_0} \quad \textbf{(3.6a)}$$

CF0=investment during the installation period

This method for investment projects requires investments of various sizes for comparison.

PI > 0 ACCEPT

PI < 0 REJECT

(Sarıaslan 2006, pp.176-177).

3.3.2.3. Internal rate of return (IRR)

Another method used to evaluate projects is the internal rate of return. Some resources refer to this as “Discounted Cash Flow Return on Investment (DCFROI)’’. The internal rate of return method (IRR) measures the efficiency of the project in producing value without reference to any predetermined cost of capital. The discount rate equates the project's discounted net cash inflows with its discounted net cash outflows (Delano 2004, p.38).

As a dynamic and the most commonly used method, the internal rate of return will be provided throughout the useful life of the investment of cash, investments will be made to calculate the discount rate that makes expenditures equal. The highest rates shall be applied to alternative investments but not to income. During certain periods when cash outflows are significant, there may be difficulties in calculating the internal rate of return, in fact, in some cases to calculate the internal rate of return may not be possible (Büker ve Aşıkoğlu 1995, pp.260-269).

The IRR is defined as the discount rate that forces the net present value to equal zero. This refers to projects where the cash rate is equal to the project output. The yield rate and cost of capital compared to the acceptance or rejection of the project is decided. The internal rate of return is determined through trial and error. The real discount rate is considered a certain rate. (-) and (+) values are examined. If the result is (-), a smaller value is given (-) and a (+) is provided. (Üstündağ 2005, pp. 7)

Equations 3.7 and 3.7a below demonstrate the internal rate of return:

$$0 = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + ... + \frac{CF_n}{(1+IRR)^n} \quad \textbf{(3.7)}$$

$$\text{NPV} = \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t} = 0 \quad \textbf{(3.7a)}$$

This method's most different aspect from net present value is the unknown "r". We try to find this value. Thus we have an equation with one unknown, the IRR, and we need to determine IRR. Although it is relatively easy to find the NPV without a financial calculator, it is not easy to calculate the IRR. If the cash flows are constant from year to year, then we have an annuity and we can use annuity formulas. However, if the cash flows are not constant, as is generally the case in capital budgeting, then it is difficult to find with trial and error. Fortunately, we can find the IRR with the help of the interpolation method. The interpolation method as presented in equation 3.7b below:

$$\mathbf{r} = \text{rp} + \frac{\text{NPVp}}{\text{NPVp} + |\text{NPVn}|}(r_n - r_p) \quad \textbf{(3.7b)}$$

p indis= positive value

n indis= negative value

Decision rule is IRR>Cost of capital.

(Brigham and Ehrhardt 2008, p.383-385)

The value of "r" is determined through trial and error when looking for an increase not more than of 5 percent rate of return. The internal rate of return method provides a clear decision. When the project loan application requirement is the maximum interest rate on the payment, this is a clear calculation. Other methods do not provide such net information. Commonly, the internal rate of return method is not sensitive to cost of capital, and as a result, generally, the net present value method is preferred because of its sensitivity (Sarıaslan 2006, p.188).

The characteristics of these methods, taking into consideration the time value of money, make it possible to make comparisons. The economic life of the project should be taken into consideration, in order to reflect on the profitability of the invested capital. If the economic life of the project is a long term, calculating the internal rate of return becomes a very tiring and monotonous task (Üstündağ 2005, p.6).

Mathematically, the NPV and IRR methods will always lead to the same result: either the acceptance or rejection of independent projects. This occurs because if the NPV is positive, the IRR must exceed r. However, if the NPV and IRR give conflicting rankings for mutually exclusive projects, there is a discrepancy (Brigham and Ehrhardt 2008, p.384).

In many respects, the NPV method is better than the IRR method, so it is tempting to explain NPV only, making a note of stating that it should be used on select projects and the necessity to take another step. However, the IRR is a familiar method to many corporate executives, it is widely entrenched in industry, and it does have some virtues (Brigham and Ehrhardt 2008, p.384).

4. FINANCING THE ENERGY PROJECT

After the economic analysis result, if the project is found to be profitable, the project must be financed. But here, it is important to determine the long and short term money requirements and potential sources for these funds. To determine the profitability of the project's estimated cash flows, its connection to the source of the money by financial analysis, is difficult in terms of long or short term continuity. Economic analysis is inadequate for financing. This financial analysis, because of fluidity, whether the project is continued or not, due to internal and external activities, is affected by many factors. Perhaps the project can be profitable, even though the cash flows face problems, and despite liquidity shortfalls, delays, interest and inflation rate changes (Sarıaslan 2006, p.192).

The purpose of financial analysis is to, after predicting the profit margin, to determine the amount of fixed investment and working capital, and the unit cost of production (Büker ve Aşıkoğlu 1995, p.43).

After the business analysis shows an adequate profitability, we move on to the next stage. Assumptions related to the cash flows and the project's designated financial structure in light of cash flow fluctuations, and delays in project activities can affect the following issues:

a) Interest payment, capital
b) Payment of dividends
c) Payment for insurance premiums
d) Other non investment related payments
e) Short term bank loans to meet cash deficits, referring to cash inflows and outflows or re-crediting as possible solutions
f) Whether or not the owner's equity and long term loans are sufficient
g) Long term funding conditions, use of foreign resources
(Unido-endüstri projelerini değerlendirme elkitabı 1977, p.49).

Projects can be financed by various resources. Here, target and preference are important. Some projects can find resources from government funds, some projects from the private sector, some from international intermediaries.

Public finance has an important role in financing because it has two effects: one is financial and economic; the other is social. Because the private sector targets profitability, if the project is not profitable, it will not be accepted. As a result, the government has to step in to provide social balance. The public sector is blamed for this situation. Additional costs are required to protect the environment but the necessary measures cannot be taken because of the energy sector is a national asset and it is controlled by the government (Yiğitgüden 1999, p.59).

Financing a budget with public funds is not sufficient and additional funding is required from the private sector. Security provided by the media is missing in countries where international organizations provide long-term, low interest or zero interest rates and financing. These organizations are: World Bank Group, The United Nations Development Program, International Money Foundation, European Investment Bank, Export-Import Bank of the United States, The International Bank of Reconstruction and Development, European Bank of Reconstruction and Development, Regional Energy Center Black Sea, and The InterAmerican Bank. Here, it should be mentioned that The World Bank, especially this year, has made the greatest transfer of funds for renewable energy sources in Turkey.

The World Bank finances every kind of energy resource project. Before applying to the World Bank Fund, a perspectives analysis on financing must be done. The World Bank's financing policy: industry monopoly to be dismantled; arrangements to be made to regulate the price and financial policies and render foreign markets open to trade, investment policy to be determined, to determine the country to provide social protection to the people, to ensure the protection of the environment (www.worldbank.org 2010).

Financing by the private sector is also significant because the private sector's project financing is predominantly reliable and efficient. In the energy sector, there are various forms of private sector financing. These are auto-protection, build-operate-transfer, and build-operate methods. The auto-protection method is used if the investment is small. With this method, companies produce their own energy with a network of independent small energy production plants. For larger projects, the build-operate-transfer or build – operate models are used (Oluklulu 2003, p. 89).

The build-operate-transfer model is the most widely used method in developing countries. If this method is not an option, then the build-operate method can be applied. Build-Operate-Transfer Model (BOT) utilizes advanced technology and is backed by a lot of financing for the realization of projects. Build-operate-transfer (BOT) is a form of project financing, wherein a private entity receives a concession from the private or public sector to finance, design, construct, and operate a facility stated in the concession contract. This enables the project proponent to recover its investment, operating and maintenance expenses in the project (Oluklulu 2003, p. 91).

In recent years, “a growing trend emerged among governments in many countries to solicit investments for public projects from the private sector. The main reasons for this trend are a shortage of public funds and the hands off approach of government agencies. The Build Operate Transfer approach (BOT) is an option for the government to outsource public projects to the private sector. With BOT, the private sector designs, finances, constructs and operates the facility and eventually, after a specified concession period, the ownership is transferred to the government. Therefore, BOT can be seen as a developing technique for infrastructure projects by using private initiative and funding. Such infrastructure projects include a wide array of public facilities with the primary function to serve public needs, to provide social services and promote economic activity in the private sector. The most common examples are: roads, bridges, water and sewer systems, airports, ports and public buildings” (Menheree and Pollasis 1996, p.11).

In Turkey, the most common methods are BOO (build-own-operate) and BOT (build-operate- transfer). Our country also adopted on June 8, 1994, the Official Gazette dated 13.06.1994 No. 21959 Official Gazette, Law No. 3996, "Some Investment and Build-Operate-Transfer Model of Services in the Framework Law to be done". These laws, public institutions and organizations (including state-owned enterprises), the performance, advanced technology and high financial resources and services that require some investment, and the framework of BOT is suitable and intended for these jobs (Emek 2001, p.49).

The BOT model will be realized through investment projects, international organizations, the support of the private sector and foreign capital. The Build-Operate-Transfer model has been implemented in our country since 1984 for variousprojects. In 1994, work on the legal infrastructure for the BOT model was accelerated and, as a result, the number of projects requiring this model increased in number (Emek 2001, p.49).

In addition to BOT (build-operate-transfer) and BOO (build-own operate) companies have the following financing alternatives: issuing stock (equity), issuing debt or borrowing from a financial institution (external financing), and reinvesting retained earnings (internal financing) (Berk 2007, p.188).

4.1. EQUITY FINANCING

The starting point of equity financing is this question: "Who will provide the capital necessary to meet investment project goals?" Starting from this point, companies make a selection about equity financing for their investment projects. Equity financing involves selling shares of the company to interested investors, or putting the owners' money into the company. (http://entrepreneurs.about.com/od/financing/a/debtfinancing.htm 2010)

The other way of raising capital is to issue shares of stock in a public offering. This is called equity financing. The equity, or ownership position, that investors receive in exchange for their funds usually takes the form of stock in the company. There is in contrast to debt financing. Debt financing involves loans and other varieties of credit. Equity financing, in contrast, does not involve a direct obligation to repay the funds. Instead, equity investors become part-owners and partners in the business, and thus are able to exercise some degree of control over how it is run. Equity financing requires an entrepreneur to sell his or her ideas to people who have money to invest (Schilit 1990, p.8).

Financing investments with equity directly involves in the investor in a higher rate of risk. If the company goes bankrupt or a crisis hits, the equity investor is only entitled to the remaining shares after the debt financers receive what they are owed (Hamilton 1990, p. 15).

Most companies are optimistic about the future of the renewable energy sector. Closing markets are reopening. There is a general sense that the industry is moving in the right direction. As a result, companies are interested in investing in projects, as long as they have a good business plan. To access the market in the current climate, companies must have four things: proven technology that works, cash flow or a path to cash flow, the ability to operate for at least 12 to 18 months, and a defensible cost advantage over competitors (American Council on Renewable Energy 2009, pp.18).

According to Credit Suisse's Ray Wood, the market in 2007 and the first half of 2008 was driven partially by high prices for energy commodities, which gave renewable energy projects comparatively large returns. Thus, money flowed freely into the sector, and capital was readily available. After the 2008 crash, however, commodity prices dropped and credit froze, making renewable energy projects nearly impossible to finance. Now, as equipment and capital costs for renewable energy technologies decline, and energy commodity prices increase to moderate levels, the unit economics begin to make sense again, especially as government subsidies for renewable energy projects begin to enter the market (American Council on Renewable Energy 2009, pp.18).

Equity financing is one way of financing a new project. There are advantages and disadvantages associated with this method. The main advantage of equity financing, especially for small businesses which are likely to struggle with cash flow initially, is that there is no obligation to repay the money. In contrast to equity financing, bank loans and other forms of debt financing provide some penalties for businesses that fail to make monthly principal and interest payments. Another advantage of equity financing is that it provides more flexibility in the early stages of the business than debt financing. Investors who provide equity financing to businesses preferentially seek growth opportunities so they are often willing to take a chance on good and brave ideas. On the other hand, debt financiers primarily seek security so they usually require the business to have some sort of track record before they will consider making a loan. Another advantage of equity financing is that investors often prove to be good sources of advice and contacts for small business owners (Hamilton 1990, p. 18).

There are also disadvantages regarding equity financing. The most significant disadvantage is that the incorporator must give up some control of the business. If investors have different ideas about the company's strategic direction or day-to-day operations, they can pose problems for the entrepreneur. Equity financing requires complicated legal rules and a great deal of paperwork to comply with different regulations. Also, equity selling such as initial public offerings can be very complex and expensive to administer. For many small businesses, therefore, equity financing may necessitate enlisting the help of attorneys and accountants (Hamilton 1990, p. 18).

According to Brian Hamilton (1990, p.19), there are several factors entrepreneurs should consider when choosing a method of financing. First, the entrepreneur must consider how much ownership and control he or she is willing to give up, not only at present but also in future financing rounds. Second, the entrepreneur should decide how leveraged the company can comfortably be, or its optimal ratio of debt to equity. Third, the entrepreneur must decide the types of financing that are appropriate for the company. They have to compare the stage of capital needs and development to requirements of different types. The last factor is, as a practical consideration, the entrepreneur should ascertain whether or not the company is in a position to make set monthly payments on a loan.

W. Keith Schilit (1990) states in his book *The Entrepreneur's Guide to Preparing a Winning Business Plan and Raising Venture Capital*: “small business owners must keep in mind that the more equity they give up to investors, the more they are working for someone else rather than themselves. Some entrepreneurs tend to think of equity financing as a free loan, but in fact it can be quite an expensive way to raise capital. For a small business to make equity financing cost-effective, it must be able to command a fair price for its stock. This entails convincing potential investors that the business has a high current valuation and a strong potential for future earnings growth.” Schilit recommends that entrepreneurs proceed cautiously and try to use more than one form of financing to ensure business growth. They should also compare the cost of equity financing to that of other financing options, as well as considering the ramifications of equity financing on the company's current and future capital structure.

For small businesses, equity financing is available from a wide variety sources. Some sources of equity financing consist of business owners' friends and family. We can see small business equity financers in the form of private investors (from the family physician to groups of local business owners to wealthy entrepreneurs known as "angels"), employees, customers and suppliers, former employers, venture capital firms, investment banking firms, insurance companies, large corporations, and government-backed Small Business Investment Corporations (SBICs) (Schilit 1990, p. 21).

There are two main of equity financing: the private placement of stock with investors or venture capital firms; and public stock offerings. The methods of private placement are mostly used for young companies or new firms. Nevertheless, the private placement of stock still involves compliance with several government and state securities laws; it does not require formal registration with Securities and Exchange Commission. The significant requirements for private placement of stock are that the company cannot advertise the offering and must make the transaction directly with the purchaser. In contrast, public stock offerings entail a lengthy and expensive registration process. As a result, public stock offerings are generally a better option for mature companies than for startup firms. Public stock offerings may offer advantages in terms of maintaining control of a business, however, by spreading ownership over a diverse group of investors rather than concentrating it in the hands of a venture capital firm (Schilit 1990, p. 30).

Businesses interested in equity financing must prepare a formal business plan, including complete investment projects. Equity financing entails an entrepreneur to sell ideas to people who have money to invest. Competent managers do careful planning to convince potential investors.

Equity financing can be an attractive option for many small businesses. But some experts suggest that the best strategy is to combine equity financing with other types, including the entrepreneur's own funds and debt financing, in order to spread the business's risks and ensure that enough options will be available for later financing needs. Entrepreneurs must approach equity financing cautiously in order to remain the main beneficiaries of their own hard work and long term business growth (Schilit 1990, p. 31)

After the 2008 financial crisis, in the short term, equity markets will be dependent on supportive public policies, including provisions in the stimulus bill, as well as an energy legislation that has not yet been passed. Since the economic crisis of 2008, the market has become more stringent. Therefore, equity financing decelerated. Uncertainty, reservations, and with it world famous failures of banks halted interest in this method of financing.

4.2. DEBT FINANCING

Debt financing for energy projects, in general, is provided by banks or international institutions. Debt financing aims to ensure continued outsourcing at a certain interest rate in the face of a specific obligation for a particular term, in exchange for a return on their investment.

We can separate debt financing into two categories based on their maturities: long term and short term debt financing**.** Long term debt financing involves the acquisition of such assets as buildings, land, or machinery. With long term debt financing, the scheduled repayment of the loan and the estimated useful life of the assets extends over one year. In finance, debt is also referred to as “leverage.” The most popular source for debt financing is the bank, but debt can also be issued by a private company (http://entrepreneurs.about.com/od/financing/a/debtfinancing.htm 2010).

Debt financing is a form of borrowing money from a lender or investor with the understanding that the full amount will be repaid in the future with interest. Equity financing, on the other hand, in which investors receive partial ownership in the company in exchange for their funds, does not have to be repaid. There are various possible methods of debt financing available to businesses: private placement of bonds, convertible debentures, industrial development bonds, and leveraged buyouts, and by far the most common type of debt financing is a regular loan.

Debt financing also has some advantages and disadvantages associated with it. In contrast to equity financing, debt financing enables businesses to make key strategic decisions and also to keep and reinvest more company profits. The advantage of debt financing is that it provides financial freedom with a greater degree to business owners. Debt obligations are limited to the loan repayment period, and as a result, the lender has no further claim on the business. Unlike debt financing, equity investors' claim does not end until their stock is sold. Furthermore, a debt that is paid on time can enhance a small business's credit rating and make it easier to obtain various types of financing in the future. Debt financing is also easy to administer, as it generally lacks the complex reporting requirements that accompany some forms of equity financing. Debt financing tends to be less expensive for businesses over the long term, though more expensive over the short term, than equity financing. We understand from this that debt financing provides various types of advantages. It helps to maintain ownership, tax deductions, and lower interest rates in the long term. The drawbacks of debt financing are repayment, high rates, impact on company's credit rating, cash and collateral (Schilit 1990, p. 51).

The main disadvantage of debt financing is that it requires a small business to make regular monthly payments of principal and interest. Another disadvantage associated with debt financing is that its availability is often limited to established businesses. Finally, small businesses are generally able to take only a restricted amount of money for their debt financing which may not be enough for their capital needs. As a result, they may need to use other sources of financing as well (Schilit 1990, p. 52).

Debt financing can be provided from various different sources. They are categorized as private and public sources. Private sources of debt financing, according to W. Keith Schilit (1990, p.53) in *The Entrepreneur's Guide to Preparing a Winning Business Plan and Raising Venture Capital,* "include friends and relatives, banks, credit unions, consumer finance companies, commercial finance companies, trade credit, insurance companies, factor companies, and leasing companies. Public sources of debt financing include a number of loan programs provided by the state and federal governments to support small businesses."

In general, debt financing is provided from banks. Commercial banks especially have a more predominant role in making business loans than do regular savings banks. Commercial banks help to review the differences between the banks before choosing one as the target of a loan request. Credit unions are another common source of business loans. Since these financial institutions are intended to aid the members of a group such as employees of a company or members of a labor union they often provide funds more readily and under more favorable terms than banks. However, the amount of money that may be borrowed through a credit union is usually not as large. Finance companies are another option for loans. Although they generally charge higher interest rates than banks and credit unions, they also are able to approve more requests for loans (Smith 2000, p. 49).

Another form of debt financing is trade credit. Obtaining trade credit from the supplier allows a business to delay payment on the products or services it purchases. The other source for debt financing is a public source; state and federal governments sponsor a wide variety of programs that provide funding to promote the formation and growth of businesses (Smith 2000, p. 49).

As a result, debt financing can be a valuable option for businesses, especially small ones that require cash to begin or expand their operations, even though financial managers warn that carrying too much debt can cause businesses to encounter severe cash flow problems. We understand that it is best to use a combination of different forms of financing in order to spread the risk and facilitate future funding efforts.

4.3. PROJECT FINANCING

Generally, investors cannot provide financing with their own money as in most cases it will not enough, especially for the establishment of a big company. Therefore, project financing is usually the only way, especially in energy technologies, for companies to move their products from early adopter customers to mainstream customers. Project financing is, thus, an important enabler on the critical path to large scale deployment of these technologies. Consequently, the ability to attract an affordable combination of debt, equity, and other sources of funding for the project is key to commercial success (Goldman, McKenna and Murphy 2005, p.5).

Project finance is the long term financing of infrastructure and industrial projects based upon the projected cash flows of the project rather than the balance sheets of the project sponsors. Generally, project financing structure consists of various amounts of equity investors called sponsors, in addition to syndicates of banks that provide loans for the operation. The loans are most commonly non-recourse loans, which are secured by the project assets and paid entirely from project cash flow, rather than from the general assets or creditworthiness of the project sponsors, a decision in part supported by financial modeling. The financing is typically secured by all of the project assets, including the revenue producing contracts. Project lenders are given a lien on all of these assets, and are able to assume control of a project if the project company has difficulties complying with the loan terms (http://en.wikipedia.org/wiki/Project_finance 2010).

Successful project financing must provide a structure to manage and share risks in an optimal way that benefits all participants, allocating risks to those entities that are able to mitigate each specific risk, and to share information about putting risk management in the proper hands at the proper stage of project development. Project financing in general consists of the installing of a stand-alone project company that is the legal owner of the project assets, and that has contractual agreements with other parties, such as purchasers of the lenders, suppliers, sponsors, investors etc. and the constructing of the project. Project financing is mainly used for large scale projects. Therefore, it must be considered for the long term. Renewable energy projects, on the other hand, are much smaller, whose size does not allow them to easily absorb high administrative and transaction costs (Goldman, McKenna and Murphy 2005, p.7).

Because project financing requires a lot of big money, it must be evaluated carefully. Financial players also have a stake in the ultimate availability of project financing. For example, the public sector has invested a lot of money for these technologies, and its goals depend on their eventual commercialization. Further, there clearly is a gap between venture capital and project financing; venture capitalists want to see a clear path to commercialization even in their early venture investments (Esty 2003, p.148).

As a result, investment projects financiers can benefit and consequently help increase the yield on their investments and loan portfolios, if they develop a better understanding of early stage energy technologies and their inherent risk profile, and if they integrate this understanding into their project lending and investment criteria early on. Firstly, this can be accomplished by involving themselves in the planning stage of energy technology projects prior to the time that the company is seeking financing. It must be evaluated in detail and seeking to better understand the underlying technology risk and the specific issues for a given project, instead of assuming that all new technology projects are inherently risky. Finally, organizing a briefing for their credit committees and commitment committees, which would cover issues specific to advanced and renewable energy projects, is important. As a result, project financing emphasizes the need to develop a place in the company's capital structure between venture capital financing and (traditional) project financing (Esty 2003, p.148).

5. ENERGY IN THE TURKISH MARKET AND A CASE STUDY OF WIND ENERGY IN THE TURKISH MARKET

Turkey is located between Europe and Asia. This geographical location makes it a land bridge connecting Europe to Asia. It has an important role to play as an energy terminal and corridor among major oil and natural gas producing countries in the Middle East, Caspian Sea and the Western energy markets (Ayaz 2008, p.2).

According to data found on the EIE in 2007, the total energy consumption was 33, 9 percent oil, 32, 3 percent natural gas, 23, 7 percent coal and 10, 2 percent renewable sources. Renewable energy sources that are most in demand in turkey are: wind, solar, hydro, and geothermal. Of these resources, 3, 6 percent is hydro energy, 1, 1 percent is geothermal energy, 0, 4 percent is solar energy, and 0, 1 percent is wind energy. As we can see here, oil has a significant share in total consumption (http://www.eie.gov.tr/ 2010).

Figure 5.1 below illustrates consumption of electricity per person from 2000 to 2008. Clearly, electricity consumption increases from year to year. Also, the per capita consumption of electricity in Turkey has been 2773 kWh according to data obtained in 2008. In 2008, the total consumption of electricity was about 198 billion 804 million kWh. It can be said here that electricity now reaches the four corners of Turkey and is available to everyone.

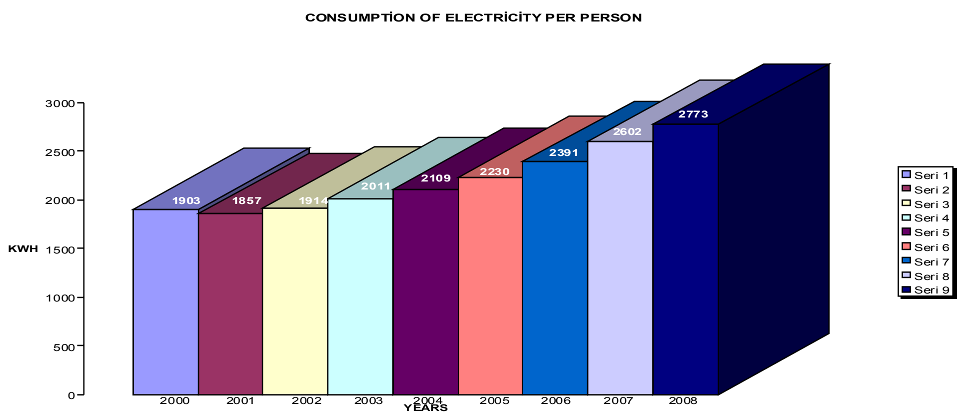

Figure 5.1: Consumption of electricity per person
Source: www.enerji.gov.tr

Table 5.1: Consumption of electricity per person, kWh

Years	Consumption of electricity per person, kwh
2000	1903
2001	1857
2002	1914
2003	2011
2004	2109
2005	2230
2006	2391
2007	2602
2008	2773

Source: www.enerji.gov.tr

Since 1985, Turkey's share in the energy sector has been rising; until then, external dependence policies were applied. After the year 1990, public and private sectors started to work together on investment projects under development and renewable energy resources became more important. Hydroelectric, solar energy and geothermal energy plants were built. Pertaining to hydroelectric plants, the capacity of the Ataturk dam, since it entered the circuit with 20250 MW, has increased to 22650 MW installed capacity. After 2000, the budgets allocated to the Ministry of Energy to promote investments went up from one to four units. With this process, Turkey started to grasp the importance of this vision in energy and begun to take measures accordingly.

There is 42 500 MW of installed capacity of Turkey. This capacity consists of 34 percent natural gas, 35 percent hydroelectric, and 31 percent thermal energy. In the USA, there is only 35062 MW of installed capacity for wind energy. The American Recovery and Reinvestment Act, (2010) passed by Congress in February of this year, provides $787 billion in appropriations, including $37.5 billion for energy efficiency and renewable energy. Policy initiatives including financial crisis actions and the prospective adoption of federal legislation on energy and climate policy, will affect renewable energy companies today and in the future. We can increase our installed capacity with renewable energy potential (http://www.awea.org/projects/ 2010).

Turkey's renewable energy potential is as follows: the most common renewable sources in Turkey are solar energy, wind energy, hydroelectric energy and geothermal energy. Firstly, Turkey has significant hydroelectric potential. In Europe, Norway has the highest potential for hydroelectric energy. After Norway, Turkey is second. Wind energy takes up a small share in total consumption because total installed capacity is only about 334 MW. But for this capacity, there is a really intense demand from businesses. Total license applications exceed 85000 MW and 3945 MW of these applications have been granted licenses. As a result, we can see that wind energy has a future in Turkey. Solar energy potential in Turkey is about 380000 Gwh. In Turkey, solar energy is used for water heating systems. Total installed photovoltaic capacity is about 1000 Kw and it is expected to be rise. This technology is used only in forest fire watching towers, highways, communication towers and meteorological stations. However, currently there is no solar thermal power plant. And the last common renewable energy is geothermal energy. Total geothermal potential is 31500 MWt. In conclusion, renewable energy resources have begun to be important for Turkey. In our country, there is significant renewable energy potential. But in general, because the projects are at the installation stage, they require large amounts of money. Renewable energy can compete with fossil fuels in the future. It is crucial to ensure continuity of the investments in order to meet the electricity demand, which is increasing rapidly, continuously and safely in the coming year (Ayaz 2008, p.8).

Turkey's energy demand will be doubled in the years 2000 -2010 and will be fourfold in the years 2000–2025. This rapid raise in demand is due to the high economic development rate of Turkey. Therefore, investment projects must be implemented more than they are now. The estimated amount of investments for production facilities by the year 2010 is around 45 billion dollars. In addition to this amount, transmission and distribution facilities will require a 10 billion dollar investment in the same period. The government has undertaken measures to attract local and foreign private sector funds for new investments, and also to transfer operational rights of existing units to the private sector for their renewal and efficient operation. As it is known, Turkey has been an energy importing country for a long time, with more than half of the energy requirement being supplied by imports. Oil has the biggest share in total energy consumption. As a result of the diversification efforts of energy sources, the use of natural gas, newly introduced into the Turkish economy, has been growing rapidly. Turkey has large reserves of coal, particularly of lignite. The proven lignite reserves are generally located in Afşin-Elbistan, Soma and Tuncbilek, and are characterized by high ash contents (Kaygusuz 2001, p. 500).

Turkey' energy demand growth rate in the period between 1990 and 2008 was three times the world average level of 4, 3 percent. Turkey will be among OECD countries in the next 10 years, and the energy demand will increase. Action is being taken in Turkey to reduce dependence on external energy policies, to continue efforts to diversify energy sources, and to increase energy efficiency. While giving incentives to the private sector in this regard, the efficiency of the public sector in late 2009 has also been noted (www.ekonomist.com.tr 2010).

The electric power industry as a whole consists of several businesses. Electricity production is provided by EÜAŞ. Energy trading is provided by TETAS. Energy transmission is provided by TEİAS. Energy distribution is provided by TEDAS. Pricing and license policies are provided by EMRA's approval. As a result, energy prices affect all of these businesses. On 1 July 2008, all these tariffs, combined and quoted a price of 0, 221 tl/kwh (Ay 2008, p.7).

TSKB, in the last 7 years, has funded 86 renewable energy projects: 78 hydroelectricity projects, 4 wind, 2 geothermal, and 2 bio mass. 2010 3267 kwh per capita in strength is expected to be installed. This means an increase of 42500 MW of installed power to to reach the 63500 MW level. Reaching this level requires 5 to 6 billion dollars annually to be invested. The year of 2008 was declared "Energy Efficiency Year" because that year the allocated amount for energy investment was at its highest at 757977000 tl (www.tskb.com.tr 2010).

According to Deloitte, as the demand in Turkey for energy increases, so does the interest of investors in this field. According to research about Turkey, by 2020, the total amount that will be required to be invested in energy is predicted to be 130 billion dollars. Otherwise, energy crises would a common occurrence in the future. The new term target for energy is 25 thousand megawatts of installed power with the private sector standing to benefit. Large companies, especially in the energy sector, are constantly involved project applications. Wind power plants have established 88 000 mw of installed power. It shows that companies of the energy sector understand the importance and they have already taken their place in this pie. According to the projections of the Energy and Natural Resources Ministry of Turkey, by 2020, investments for approximately 55 gigawatts over the next 12 years should be considered. Given that installed power in Turkey is 40 gigawatts, we have an understanding of the magnitude of these new investments (AB Entegre Uyum Stratejisi 2007-2023, p.28).

The rapid acceleration of industrialization and urbanization recorded in Turkey plays a role in environmental investments. Turkey is predicted to enter the European Union (EU) sometime between 2007 and 2023; it is expected to provide 59 billion Euros for environmental investments, one-third of which is to be provided by the private sector, and two-thirds by the public sector. As a result, the public sector maintains an important place in terms of investing in the energy sector (AB Entegre Uyum Stratejisi 2007-2023 2006, p.33).

Turkey's greenhouse gas inventory for the year 2007 showed an increase of 12 percent compared to 2006, when the total of the inventory was 373 million tons (Mt) of CO2. Since 1990, it has increased by 119 percent. In 2007, the largest share of CO2 emissions was from energy at 77 percent while 9 percent was from disposed waste, and 7 percent was from agricultural activities and industrial operations (TSKB Sürdürülebilirlik Raporu 2010).

Lending for projects by Turkey's largest banks is separated into two categories: energy distribution projects and energy production projects. On January, 2006, the work done by TEDAŞ for power distribution to be privatized by the Energy Market Law was accepted and approved. Following the completion of procedures for the law to be passed, loans for long-term projects especially were required. Funding for renewable energy projects is preferable because these issues are being supported throughout the world, especially by international organizations. Wind energy and hydroelectric power projects especially, which operate according to Build-Operate-Transfer (BOT) model, often have treasury support and hefty funding (Garanti bankası proje finansmanı 2006).

When investors decide to make a new investment, they consider two elements together: risk and return. The lender and institutions also consider the project funded payment period; they prefer a short payment period. Longer repayment periods for entrepreneurs are easier to spread over time. Clean-energy projects present risks in terms of technology, credit worthiness, revenue security and market competition risk. In addition, other issues within the larger context of today's project financing industry add to these challenges. Venture capitalists don not normally directly invest in projects. The time frames are typically too long, and the exit strategies, as well as the returns, are often not adequate for venture capital needs.

Each of the renewable energy sources technologies has a different form of risk profile. This is normal because renewable energy sources have a variety of origins. For instance, wind projects using well established wind turbines may have virtually no perceived technical risks (though they have a resource-availability risk). But a pioneering biomass-to-ethanol plant may have significant perceived technical risks (though little or no resource-availability risk). We know that risk plays an important part for the lender, investor, public, institutions, and businesses, etc. As a result, it must be determined carefully (Goldman, McKenna and Murphy 2005, pp.4-8).

Key specific risks are addressed next, each followed by suggested ways to address them. For instance, project investors and project financing lenders worry about technology risks because they are averse to them. Project financing lenders will not accept the risk that the technology will be unable to perform consistently in a commercial setting to commercial standards over the life of the project. One of the challenges with clean energy technologies is that it is hard to find information on which to make comparisons, or no experience base or track record in the marketplace, which is needed for due diligence and risk assessment by the project financiers (Goldman, McKenna and Murphy 2005, pp.4-8).

Another risk pertains to credit worthiness. Taking out a loan is often necessary for the project construction period because capital intense projects especially will need funding. As a result, debt financing can function at the project's expected capacity to service debt from project cash flow. This means that debt financing can be secured for project credit strength. The investment project has no operating history at the time of its initial debt financing. With many projects based on clean energy technology, especially with relatively new technology, credit worthiness is a concern to lenders. Credit worthiness for clean energy projects can be enhanced by integrating and monetizing all appropriate tax benefits and incentives in the project financing plans, in a way that credit risk is minimized; the use of insurance from nontraditional sources, subordinated debt, and loan guarantees from third parties is also considered (and maybe even from venture capital investors (Goldman, McKenna and Murphy 2005, pp.4-8).

Revenue Security Risk is another factor. According to the Massachusetts Renewable Energy Trust, another formidable risk is the need for revenue security over the time required to pay back the capital investment. To address this issue, the Trust has implemented "put" and "put back" options for clean energy projects. Also, because renewables tend to be so capital intensive, most of the costs must be amortized over a long period of time if debt is to become available (Goldman, McKenna and Murphy 2005, pp.4-8).

Market competition risk is also a consideration. For example, clean and renewable energy technology projects often have higher capital costs than projects utilizing traditional power-generation technologies (Esty 2003, p.188).

In Turkey, transition to renewable energy sources has just begun, and as a result, a new risk factor has become very important. If we make the best risk groups, the project will increase compliance. All investors and financial providers are averse to risk but look upon well-managed risk more favorably. This is especially true for foreign investors. However, reorganization of the energy law and establishing a sustainable path of development that emphasizes production rather than consumption promotes good investments.

5.1. A CASE STUDY ABOUT WIND ENERGY IN TURKEY

In recent years, wind energy has become one of the most popular energy sources because it produces zero emission of carbon emissions and it is renewable. But what kind of costs and economic resources do wind plants necessitate and can they have a negative impact on the national economy? These questions must be answered. The project is done and we will look at how accurate these estimates are. One of the most important features of wind as an energy source is that it does not require raw materials and does not depend on outside energy sources. As a result, other energy sources are not required and thus foreign dependence is minimized.

Wind power energy installed worldwide in 1996 had a capacity of 6000 MW; in 2008 installed capacity reached 120000 MW. Close to half of this power installation is in Europe. Also there is 35062 MW of installed power capacity in the USA. In conclusion, it is obvious that investment in this sector is increasing sharply. In 2015, a total of up to 10 billion euros are expected to be invested. Table 5.2 below shows the global distribution of total wind capacity in 2006. Germany was the leading country in this capacity. After Germany, Spain and the USA have a significant share of installed capacity. This indicates that wind energy is important globally, especially in developing European countries (Yüksel 2009, p.4).

Table 5.2: World distribution of total wind capacity between countries (GWEC, 2006)

Country	Total capacity (MW)	rate (%)
Germany	20622	27.8
Spain	11615	15.6
USA	11603	15.6
India	6270	8.4
Denmark	3136	4.2
China	2604	2.9
Italy	2123	2.9
United Kingdom	1963	2.6
Portugal	1716	2.3
France	1567	2.1
Total	**63217**	**85.2**
Other countries	**11004**	**14.8**
Total of the world	**74221**	

Source : http://www.limitsizenerji.com/makaleler/437-tuerkye-elektrk-enerjs-htyacinin-karilanmasinda-ruezgar-enerjsnn-yer

Turkey's total established power in 2008 was 41817 MW, 364 MW of which constituted installed power.

According to data from the EIE shown below in table 5.3, in Turkey, a total of 13 plants were in operation in 2008, their installed capacity reaching a total of 364 MW, and the total number of turbines was 236. In 1995, legal works pertaining to wind energy went underway. The first wind energy power plant was established in İzmir-Çeşme with the build-operate-transfer (BOT) model. For the first time, the law was the subject of renewable energy sources in the electricity market law (law no: 4628), passed in 2001. Unfortunately, this law was insufficient. Under this law, the state guarantees a certain purchase price only in the auto producer period, meaning that the project must depend on its own power generating companies. With the new renewable energy law (Renewable Energy Support Law) in 2005, there was reform in the Turkish energy sector. Thanks to this law, investor interest in renewable energy sources increased. There is now intense interest in this area. According to the EMRA website, 1420 MW of installed power of wind energy was licensed in 2008. In the table below, we can see installed power plants of wind energy between 1998 and 2008.

Table 5.3: Wind installed projects in Turkey

Placement	Companies	Starting of production year	Installed power(MW)	Producer	Turbine number
İzmir - Çeşme	Alize A.Ş	1998	1.5	Enercon	3
İzmir - Çeşme	Güçbirliği A.Ş.	1998	7.2	Vestas	12
Çanakkale - Bozcaada	Bores A.Ş.	2000	10.2	Enercon	17
İstanbul - Hadımköy	Sünjüt A.Ş.	2003	1.2	Enercon	2
Balıkesir - Bandırma	Bares A.Ş.	I/2006	30	GE	20
İstanbul - Silivri	Ertürk A.Ş.	II/2006	0.85	Vestas	1
izmir - Çeşme	Mare A.Ş.	I/2007	39.2	Enercon	49
Manisa - Akhisar	Deniz A.Ş.	I/2007	10.8	Vestas	6
Çanakkale - İntepe	Anemon A.Ş.	I/2007	30.4	Enercon	38
Çanakkale - Gelibolu	Doğal A.Ş.	II/2007	14.9	Enercon	18
Hatay - Samandağ	Deniz A.Ş.	I/2008	30	Vestas	15
Manisa - Sayalar	Doğal A.Ş.	I/2008	30.6	Enercon	38
İzmir - Aliağa	İnnores A.Ş.	I/2008	42.5	Nordex	17

Source: EIE 2008 data

Because land, sea and air have different capacities for heat absorption, the use of solar energy depends on the geographic distribution of temperature and environmental conditions. Differing temperatures occurring in the earth lead to pressure differences and create wind. All the dynamic weather events (meteorological events) take place in the troposphere; the layer closest to the earth. The movement of air between the poles and the equator, creating wind, is important for wind energy production over the sea, on land, in the mountains and valleys. Wind resource varies from the global scale to the regional scale, and the local scale. Surface winds will occur in the troposphere and are affected by the stratum. Surface winds are the main subject of wind energy.

There are two official wind atlases in Turkey: one is based on the measurement performed by the State Meteorological Institute (DMİ), the other on the EIE. DMİ measures wind speed in more than 2000 locations in Turkey and records have been available since 1950. The EIE started wind measurements in 34 sites in various regions back in 1997 (Türkiye Rüzgar Atlası 2010).

Although Turkey in large is situated in a Mediterranean geographical location where climatic conditions are quite temperate, the diverse nature of the landscape, and the existence in particular of mountains that run parallel to the coasts, result in significant differences in climatic conditions from one region to the other. While the coastal areas enjoy milder climates, the inland Anatolian plateau experiences extremes of hot summers and cold winters with limited rainfall. The southern parts of the region are particularly affected by the southwesterly and westerly winds caused by cyclonic disturbances coming from the Azores high pressure and Basra low-pressure centers depending on the season of the year. On the other hand, the northwestern part of Turkey is under the Iceland low-pressure influence, which gives rise to northerly and northwesterly winds, especially in the northern Aegean Sea. The so called "Etesian" winds play a significant role along the Aegean coast of Turkey which includes the most important wind energy potential areas along the Black Sea coastal line. There, Turkey is exposed to northerly and northeasterly winds originating from Siberia and the middle Black Sea range, where it receives most of the wind speed and hence energy. The interior of Turkey has a continental climate where there are some locations with rugged mountains such as eastern Turkey where wind speeds reach significant energy generable levels along many valleys. Previous technical research proves that some parts of Turkey are endowed with strong wind conditions. Particularly, the south of the Marmara region, the coastal and some inner parts of the Aegean region, some parts of the Black Sea, the eastern part of the Mediterranean, and locations with rugged mountains in Eastern Anatolia are especially promising regions. In general, the

Northern and Central Aegean coast is defined as one of the most promising regions. The North-Aegean island of “Gokceada” e.g. has a similar potential pattern compared to the potential with Denmark and Great Britain. Several reasons can be found for the high potential, the strongest point among them is attributed to the surface roughness gradients in the northern Aegean coast. These gradients cause a powerful wind structure, particularly on the Bozcaada and Gokceada islands and in the Canakkale region (Türkiye Rüzgar Atlası 2010).

After giving brief information about regions in Turkey with wind power potential, let us move on to how wind power is generated. The first step is to replace finite fossil resources and reduce the par value in the total energy consumption. The forecast of the depletion of the world’s resources indicates: 200 years for nuclear power, 200 years for coal, 65 years for natural gas, 40 years for oil. However, wind energy is interminable. Turbine placement does not require a lot of area and allows cross field use. Another advantage is that it enables efficient conversion of wind power into electricity. Turbine life is long and it is easy to dismantle and remove. As a result, land can be reused. Technological infrastructure is available for the development of wind energy. A wind farm loan is necessary, but since interest rates have fallen, investors have become interested in building wind power plants (Gökçınar and Uyumaz 2008, p.701).

There is variety of characteristics of wind energy. These are: modern wind turbines that have 2 or 3 blades; the average diameter of the wings is about 40 m. Wind speed at a particular time period is not fixed. However, network energy, the features of wind generators and wings are nearly always the same. The distance between any two wind turbines can vary between approximately 100-300 meters. Therefore, approximately 99 percent of the land can also be used for agriculture and livestock and other purposes. The production of energy depends on high energy rotors (hubs), wind speed, and the cube and sweep of the wings. Wind speed increases with height; most turbine has a height of 40-50 meter towers. The expected life of a turbine is minimum 10 years. Each turbine can be controlled with computer systems. As a result, it does not need lots of labor force; this means that the project will have less operating cost. The unit cost of electricity generated from wind has fallen steadily. Turbine power varies from a few ‘KW’’ to several ‘’MW’’. Wind turbines can also be established in the sea; these are called off-shore wind farms. In Turkey, there is no off shore wind farms. Because of the country's geopolitical placement between Europe and Asia, there is too much sea traffic to make this possible (Gökçınar and Uyumaz 2008, p.705).

The main aim of the project is increasing the amount of electricity production from privately owned renewable generation with wind power. In addition, in accordance with the Kyoto protocol, a reduction in carbon dioxide emissions as a result of replacing fossil based resources (natural gas, oil, coal) with renewable energy produced by the private sector is also an objective. Wind power plants do not depend on other sources; therefore, price changes of other sources will not affect wind energy. The amount of private capital raised for every dollar facilitates World Bank financing (SPDF-leverage ratio).

According to a World Bank report (report number: 25497-TU) about renewable energy projects, Turkey's power sector faces three main challenges: the first one is reforming the sector in order to shift sustainable private investment approaches to where commercial risk is borne by the private investors. There have been several applications employed over the last two decades to restructure the sector and obtain private investment. In private investment and ownership, assets have been raised sharply; these arrangements have been affected by the government's contribution because the contingent liabilities of the government have been increased by transferring much of the commercial risk for these plants to the government. The government has tried to attract private investors to the energy sector by employing four different models: the build-operate-transfer (BOT) model, the build-own-operate (BOO) model, the auto-producer model and the Transfer of Operating Rights (TOOR) model. The BOT, BOO, and auto-producer models have been commonly used to acquire private investment for new power plants. The other model, TOOR, has been used to try and concession existing generating assets and distribution companies to private investors. BOT and BOO models attract new investment but the application of the BOT model especially is extremely costly. As a result, both models have created huge contingent public obligations with the government, covering the market risk through take or pay contracts. The auto-producer model is more useful because it allows businesses to generate their own energy. As a result, a significant capacity can be produced without public liabilities. In response to the need for sustainable private involvement in the sector, the government has embarked on a far reaching reform program that aims to establish a competitive market structure with separate generation and distribution firms that will gradually be privatized. These reforms are progressing in accordance with the principles and time frames defined in the Electricity Market Law (Law 4628) which was enacted in February, 2001. A separate regulatory institution, the Energy Market Regulatory Authority (EMRA), has also been created per the provisions of the Electricity Market Law (World Bank Turkey renewable energy project 2004, p. 23).

The second challenge facing the power sector in Turkey is the process for applying for new investments requires lengthy reform. There are several important steps that need to be taken by the power sector. The first step is resolving the problem of revenue deficits. This problem affects the distribution sector and leads to problems in the electricity supply chain. Unless these problems are corrected to a level that ensures adequate cash flow in the sector, privatization of distribution and generation will be difficult without substantial government backstops. The second step is dealing with the above market price; especially contracts signed with BOT and BOO project sponsors. The law assigns these contract obligations to a government-owned electricity trader (TETTAS) who has to meet them by reselling the electricity to distributors. The tertiary step is achieving regulatory certainty and clarity. The last step is coordinating reform implementation across multiple agencies. With the new reform programs, eight main implementing agencies are affected including: the Ministry of Energy and Natural Resources (MENR), the EMRA, the Treasury, the Privatization Administration (PA), the Transmission Company (TEIAS), the Generation Company (EUAS), the Distribution Company (TEDAS), and the Trading Company (TETTAS). It is really hard to apply new reform to all of these agencies because they all have different characteristics. Collaboration among them is important. The Government and the EMRA are aware of these issues and have been working hard to address them (World Bank Turkey renewable energy project 2004, p.28).

The third challenge facing the power sector in Turkey is to ensure that renewable energy resources are adequately and safely exploited to meet the domestic energy demand. In Turkey, there are a variety of renewable energy resources. The most common one is hydropower. According to data collected in 2006, potential generation from hydropower is estimated at about 126 TWh, of which 112 TWh would be from large hydropower plants and 14.1 TWh from small plants. The Department of State Hydraulic Works (DSI) has made considerable progress in exploiting the larger hydropower sites but relatively little progress has been made in developing the smaller hydropower sites. In addition to these projects, topographical analysis of the basins indicates that there may be as much as an additional 5,000 MW of potential small hydropower capacity capable of producing around 19 TWh. As mentioned above, this means that the total small hydropower potential may be as much as 33 TWh which is equivalent to about 25 percent of current demand. Turkey is also rich in wind and geothermal resources. It is estimated that Turkey has the potential for up to 11,000 MW of wind capacity, capable of generating about 25 TWh of electricity per year. Most of this capacity is along the country's sea coasts especially along the Sea of Marmara, the Aegean and the Black Sea. Proven geothermal capacity is only about 200 MW of electricity generating capacity and about 2,250 MW of thermal (heat generating) capacity. However, the potential for electricity generation from geothermal resources (including proven resources) is thought to be as much as 4,500 MW (World Bank Turkey renewable energy project 2004, p.31)

I will examine here in detail the variety of characteristics pertaining to the wind project. Determining the phase of the wind resource, and the temporal and spatial variability is crucial to be because it constitutes the most important part of the feasibility report. Moreover, finding good locations with high wind potential is very important. In addition to selected wind resource locations having to be effective, the unit cost of energy for transportation facilities, the proximity to transmission lines, land size, land ownership, energy consumption and industrial centers, distance and characteristics of the region are also considerations.

In my wind farm project, there is no any problem with transportation as access to the project site will be very easily provided. Roads will be required only for residential turbines. It is not difficult to identify any feature of road construction along existing forest roads that can provide great convenience.

Another fixed cost is power transmission lines. A very important location in terms of energy transmission lines is located. Power transmission has an important place in the total of fixed cost because in general wind farms are located on hilltops.

The other cost component is land. The project area consists of several parts and the structure is completely naked. This way, the power plant will provide significant convenience and does not block the free flow of wind characteristics as shown. Wind farm plants can interact with the land application and do not have any residential properties. Any facility on the project site, such as zoning and national parks require planning because the topographical structure of the property should not have both. Measurements obtained based on the land are the most important forms of energy evaluation. In this wind project land is important because the installation capacity will be 645 MW and each turbine has 2, 5 MW of power. We will need 258 turbines.

Another important fixed cost component is the turbines. Factoring in the capacity here is important. Within the planned establishment of wind turbine power plants, the selection of the type and capacity depends on: the characteristics of wind, the performance and characteristics of turbines, the economic life of the turbines and guarantees, tried and running performance of the turbine, the price and performance factor, effects on the environment, technology, security, interconnected system connectivity, maintenance facilities and general services. In my project, each turbine has a capacity of 2, 5 MW because this capacity enables a highly cost effective operation, especially at wind sites where space is limited. It will have an economic life cycle of 10 years. As a result, the depreciation rate will be 10 percent (http://www.gib.gov.tr/fileadmin/user_upload/Yararli_Bilgiler/amortisman_oranlari2009html 2009).

In terms of wind farm cost components, engineering and feasibility studies of wind energy constitute an important stage as this means high costs at the establishment phase. In my project, the establishment period will take 2 years. The selection of the project site, testing the wind turbines, studying wind direction, temperature, humidity, pressure are all important factors. In table 5.4 below, we see a table of fixed average costs according to the European Wind Energy Association (EWEA) (Gökçınar and Uyumaz 2008, p.701):

Table 5.4: Association EWEA 2006 data of average fixed cost.

Source: EWEA 2006	Investment cost	rate(%)
Turbine	928	75,6
Network connection	109	8,9
Placement of turbine expense	80	6,5
Land rent expense	48	3,9
Energy expense	18	1,5
Consulting expense	15	1,2
Financial expense	15	1,2
Transportation	11	0,9
Control systems	4	0,3
Total	1228	100

Source: www.ewea.org

There is one main financial component of the project. Renewable energy industry loans are known as Special Purpose Debit Finance (SPDF). The World Bank established this type of loan through two Turkish financial intermediaries: ‘’TSKB and TKB’’, under the authority of the Treasury Ministry. These two institutions support renewable energy source projects in the long term with private sector investments. Lastly, the World Bank will loan 420 million dollars to TSKB and 180 million dollars TKB. I will use these loans for debt financing with a 10 percent interest rate. The liability will be repaid after the construction period of the project (5 years). Also, I will make an assumption about financial incentives. Government support is unlimited; it will not receive imports or impose a stamp tax from machinery and loans for the investment.

The cost of wind energy is composed of two parts: the cost of capital, also known as fixed cost and operating cost, commonly known as working capital. The capital cost is the highest amount during the construction period. The cost of maintaining the business once it is established will be lower as there is no need for fuel or raw materials.

Calculating external costs is very difficult. The following has to be taken into consideration: noise, harm to birds, agricultural fields and visualization. This is generally not prblematic. There are enviromental and legal criteria and international laws that must be complied for enviromental protection. In our country, the criteria of the Ministry of Environment and Forests must be taken into consideration.

This case study has been done on wind energy. I prefer wind energy resources because the cost structure is not complicated compared to other sources. Also, this type of energy does not produce carbon emissions and external costs (enviromental damage) are very low compared to other energy sources. And the price of wind energy does not require outsourcing or raw materials. As a result, this energy source will not be significantly affected by economic and financial crises. The total cost of investment at the onset of this project is $858000000. The assumption is that the World Bank will allocate $180000000 to the TKB and $420000000 to the TSKB. This amount is very important for Turkey; according to the newspaper, the World Bank's loans for Turkey are at record level. This means that renewable energy sources have a future in Turkey. Normally, the World Bank gives out loans in 4-6 year terms. In my case study, including construction and feasibility, the technical life cycle will be 12 years, making it a long term investment. Also, the loan interest rate will be 10 percent. According to literature on the topic, wind turbine amortization period is on average 10-20 years. Of course, with the development of technology, this period will be longer. According to the Turkish Revenue Administration Department, turbine amortization period is 10 years. The capacity utilization rate is lower than any other energy resource. Generally, the capacity utilization rate will vary from 25 to 60 percent. The World Bank will give loans for a capacity utilization rate which is more than 33 percent. As a result, I will examine a 40 percent capacity utilization rate. Turkey declared 3000 kWh per capita electricity consumption in 2008. In this case, after the capacity utilization rate is calculated on installed capacity, the establish plant will produce 2.260.080.000 kWh of electricity. This means 753360 (2.260.080.000kwh/3000kwh) people's energy consumption will be provided by this project.

Energy consumption is increasing day by day. There are two options: to reduce demand or provide new energy sources. Reducing demand is very difficult because energy is an indicator of development. Providing new resources is preferable but the effects on the environment must be considered. This approach has increased the demand for renewable energy sources. This wind energy project demonstrates the development and the financing method of one renewable energy source. On the EMRA website, there are many license applications for wind energy. Before applying for a license, companies must conduct serious feasibility studies. The purpose of my project is to show in my wind energy case study that a large investment can be made for a wind farm in Turkey with exemption of stamp and import tax granted. In addition, with wind energy projects, whether the depreciation cost should be counted or not affects the net cash flows and rates as was done below on two separate studies. This work is an empirical study that has emerged after a long review of the literature and assumptions. There is no relation to the institution or organization. All firms here tend to be the original purpose of the cash flow statement and wind energy is to be determined by the cost of their feet.

In the first case study, the deprecation cost is omitted. We assume here that the depreciation cost is zero. Unit cost calculation is shown below in table 5.5 (Şener and Aksoy 2008, pp.344-345).

Table 5.5: Unit cost calculation

Table of calculation of unit cost	
Installed power	645 MW
Total investment	858000000$/kw
Capital charge rate	16%
The amount of annual payback of investment	137280000$/kw
Average capacity utilization	40%
Total production amount (yearly)	2260080000kwh
Unit cost	6.08 cent/kwh
Per turbine power	2,5 MW
Total installed turbine number	258
Debt financing(%70) of total investment	600000000$
Equity financing(%30) of total investment	258000000$

In calculating the capital charge rates, some practitioners use equation 5.1 below: where "i" is the discount rate and "n" is the length of the investment. This is actually the same as the "PMT" FUNCTION. This formula is designed to calculate a constant annual amount (Stauffer 2006, pp.81-87).

$$\text{Capital charge rate} = \frac{i}{1-(1+i)^{-n}} = \frac{0,10}{1-0,386} = 0,16 \qquad \textbf{(5.1)}$$

Installed power: 645 MW

Total investment cost: 645 mw*1331$/kw*1000 = 858000000 $/kw

Capital charge rate: 16%

The amount of annual payback of investment: %16 *858000000$ =137.280.000 $

Average capacity utilization: 4%0

Total production amount yearly: 645000 kw *365 day*24 hour*%40=2.260.080.000kw/h

Unit cost: 100 cent*137.280.000/2.260.080.000 =6, 08 cent/kwh

Per turbine power: 2, 5 MW

Total installed turbine number: 258

%70 loan (SPDF)- debt financing of total investment

%30 owners capital -equity financing

VAT rate: %20

In table 5.6 below, we can see the total investment distribution between the owner's equity and liability. We know that total project costs consist of fixed capital and operating capital. Fixed capital especially plays a vital role in the total investment amount.

Table 5.6: Total investment of project and capital structure

	Period of construction(m=2 years)	
	t0	**t1**
I. Total Project cost		
Fixed capital	258.000.000	582000000
Operating capital		18000000
Interest expense	0	0
Total investment (yearly)	**258.000.000**	**600.000.000**
II. Financing		
Indicative cost-owner's equity	258.000.000	
Liability(TSKB and TKB loans)		600.000.000
Total financing required		**600.000.000**

First investment amount: $858.000.000kw

Working capital need: 18000000

Project internal finance: 600.000.000 (from World Bank to TSK and TSKB) with the %10 interest rate, payback 5 years with principal +interest on principal

From annuity table, present value interest factor of an annuity was found 3,791

PMT (PVIFA %10, 5 years) =$600000000kw

PMT: $158.311.345kw

Below in table 5.7, the annual calculation of interest and principal is shown. In table 5.8 there is a sinking fund table. These two tables give information about the investment's obligation to the source. We know that funding is provided by TSKB and TKB.

In addition to calculating interest and principal payments, the company needs another table for deciding whether or not a project appraisal is necessary. There is detailed information in the tables. Table 5.10 is about the operation costs of the firm. It consists of transmission costs, maintenance costs and insurance costs. Table 5.11 is about the expectation of annual increase of sales prices and operation costs. It can change yearly because of the conditions of the world market. Table 5.12 is about the total cost structure of the wind project. It consists of a fixed cost, working capital cost, operating cost at a given economic period, depreciation expense and interest expense. Table 5.13 presents the revenue of wind energy. Table 5.14 presents the pro forma income and net cash flow statements. This table is important in showing the annual net cash flows of the project.

Table 5.7: Interest and Principle Calculation

1.year interest: 600.000.000*0,10=60.000.000
1.year principal: 158.311.345-60.000.000=98311345
1.year balance:600000000-98311345= 501688655
2.year interest: 501688655*0,10=50.168.865
2. year principal: 158311345-50.168.865=108142480
2.year balance: 501688655 -108142480= 393546175
3. year interest: 393546175*0,10= 39354617
3.year principal: 158311345 -39354617= 118956728
3.year balance: 393546175 -118956728=274589447
4. year interest: 274589447*0,10=27458944
4. year principal: 158311345-27458944=130852401
4. year balance: 274589447-130852401=143737046
5. year interest: 143737046*0,10=14373704
5. year principal: 158311345-14373704=143937641
5. Yearbalance: 0

Table 5.8: Sinking fund table

Years	Yearly payment	Interest	Principal
1	158311345	60.000.000	98311345
2	158311345	50.168.865	108142480
3	158311345	39354617	118956728
4	158311345	27458944	130852401
5	158311345	14373704	143937641
total	791556725	191356130	600200595

Table 5.9: Interest and principal payments

Table of interest and principal payments(yearly)

Obligations	Years											
	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
Liabilities									0	0	0	0
Principal	0	0	98311345	108142480	118956728	130852401	143937641	0	0	0	0	0
Interest	0	0	60.000.000	50.168.865	39354617	27458944	14373704	0	0	0	0	0
Total			158311345	158311345	158311345	158311345	158311345					

Table 5.10: Operation cost table

Operation Cost	Per turbine	Total
Transmission Fees	48.000$	600.000$
Maintenance Cost	11.000$	2838000$
Administration/Management/Insurance		350.000$
Total	**58.000$**	**3788000$**

Table 5.11: Annual increase

Annual increase		
Sales Price		**4,00%**
Operating Cost		**2,00%**

Table 5.12 : Cost structure of wind energy

	Life cycle of the project(yearly)											
	construction period		economic period									
Expenses(cost structure)	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
I. First investment expense(fixed cost+working capital cost)	258000000	600000000	0	0	0	0	0					
II. Operating expense	0	0	3.788.000	3863760	3.941.035	4019855,904	4100253,022	4182258,1	4265903,24	4351221,3	4438245,74	4527011
III. Interest			60000000	50.168.865	39354617	27458944	14373704	0	0	0	0	0
IV. Depreciation expense	0	0	0	0	0	0	0					
Total	258000000	600000000	63788000	54.032.625	43.295.652	31478799,9	18473957,02	4182258,1	4265903,24	4351221,3	4438245,74	4527011

Table 5.13 : Wind energy revenue

	Revenue amount(yearly)$											
Revenue	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
I. Sales revenue			339012000	352572480	366675379,2	381342394,4	396596090,1	412459933,7	428958331	446116664,3	463961331	482519784,2
II. Salvage value	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0										

Revenue calculation= 15 cent kwh*2260080000kwh

Table 5.14 : Proforma income and net cash flow statements

	Life cycle of the project(years)											
	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
I. Revenue	0	0	339012000	352572480	366675379,2	381342394,4	396596090,1	412459933,7	428958331	446116664,3	463961331	482519784,2
II.Total of the first investment	258.000.000	600000000	0	0	0	0	0	0	0	0	0	0
III.Operating expense	0	0	3.788.000	3.863.760	3.941.035	4019855,904	4100253,022	4182258,083	4265903,24	4351221,309	4438245,74	4527010,65
IV.Interest expense	0	0	60.000.000	50.168.865	39.354.617	27.458.944	14.373.704	0	0	0	0	0
V.Depreciation expense	0	0	0	0	0	0	0					
VI.Gross profit	0	0	275.224.000	298.539.855	323.379.727	349.863.594	378.122.133	408.277.676	424.692.428	441.765.443	459.523.085	477.992.774
VII.VAT	0	0	55044800	59707971	64675945,4	69972718,89	75624426,62	81655535,13	84938485,6	88353088,61	91904617	95598554,7
VIII.Net profit	0	0	220.179.200	238.831.884	258.703.782	279.890.876	302.497.706	326.622.141	339.753.942	353.412.354	367.618.468	382.394.219
VIIII.Net cash flow	-258.000.000	-600000000	220.179.200	238.831.884	258.703.782	279.890.876	302.497.706	326.622.141	339.753.942	353.412.354	367.618.468	382.394.219

Appraisal of ROI method:

As we know, there are a variety of ways of conducting a feasibility study. The first one is the return on investment method. This is the most simple valuation method to calculate the rate of return or return on investment (ROI). This method shows the rate between the expected net profit from the investment project and the total of initial investment.

$$\text{ROI}=\frac{net-profit}{total-investment}=\frac{302497706}{858000000}=0,35$$

$$0{,}35\geq 0{,}10$$

Firstly, we have to determine how long the project will take to complete. I will estimate 6 years because the average net profit margin indicates this amount of years. We know the weighted average cost of capital of the project as 10%. The project's return on investment percentage is bigger than wacc. As a result, the project will be approved. This method is not reliable because it does not take into consideration the time value of money. But the advantage of this method is that it determines in the very early initial stages whether the project will be worth considering. If the project does not receive approval at this stage, we know not to go on with it.

Appraisal of payback period:

Calculating the payback period of the initial investment cost of the project is analyzed here. But the biggest deficiency with this method is that it ignores the time value of money. This method, in practice, is simple. The advantage of this method is that it can be applied to risky markets with uncertainty efficiently. This is an advantage because investors want to know when the money will be paid back, especially in risky markets. We know that wind project applications are not common. As a result, there is uncertainty with this project. The payback period is a useful indicator of the merits of the project.

$$\sum_{t=0}^{m} I_t=\sum_{t=m+1}^{n} P_t$$

Table 5.15: Payback period

(000$)	to	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
Total investment	258000	600000	0	0	0	0	0	0	0	0	0	0
net cash flow	0	0	220.179	238.831	258.703	279.890	302.497	326.622	339.753	353.412	367.618	328.394

I=258000000+600000000=858000000$

Net cash flow for 3 years=220179200+238.831.884+258.703.782=717714866

858000000-717714866=140285134

140285/279.890.876=0,50*365=183day

Payback period=3+0, 50=3, 50 year

As we can see above in table 5.15, the project can pay for itself in just over 3 years. This is very good because interest payments will finish in 5 years. There is no problem with project repayment and cash flow. We can proceed with the project. The next step is calculating net present value.

Appraisal of Net Present Value method:

The net present value method calculates the net cash flow. This method is dynamic because it does not ignore the time value of money. It discounts the cash flows of money. To use this method, net cash flows need to have normal distribution. Normal distribution means that during the project construction period, cash flows will be negative; during the operation period, net cash flow will be positive. If this is the case, we can calculate the net present value of the project. In my wind farm project, there is normal distribution according to my calculations. This method's disadvantage is that it ignores the magnitude of investment funds.

NPV= $CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + ... + \frac{CF_n}{(1+r)^n}$

$$NPV= \frac{-258.000.000}{(1+0,10)^0} + \frac{-600.000.000}{(1+0,10)^1} + \frac{220179200}{(1+0,10)^2} + \frac{238.831.884}{(1+0,10)^3} + \frac{258703782}{(1+0,10)^4} +$$

$$\frac{279890876}{(1+0,10)^5} + \frac{302497704}{(1+0,10)^6} + \frac{326622141}{(1+0,10)^7} + \frac{339753942}{(1+0,10)^8} + \frac{353412354}{(1+0,10)^9} + \frac{367618468}{(1+0,10)^{10}} +$$

$$\frac{382394219}{(1+0,10)^{11}} =$$

NPV=830754180 ≥ 0 project is acceptable

Application of Internal rate of return method:

The internal rate of return method tries to make the net present value of the investment equal zero with the help of a new discount rate. Calculation with this method is really hard. But nowadays, with the help of computers, it has become easier. This method's advantage is that it is not sensitive to changes in the cost of capital. In contrast, we know that the net present value method is sensitive to changes in the cost of capital. Another advantage of the IRR method is that if investor's fund supply is limited, this is more effective and, as a result, resources will not be wasted.

IRR= $r_p + \frac{Npv_p}{Npv_p + |Npv_n|}(r_n - r_p)$

r=0, 10+ $\frac{830754180}{830754180 + 60517287}$ (0,30-0,10)

IRR=%28 $\geq$ 0, 10

Because 10 percent of the project cost of capital is greater than and the project's internal rate of return, this is an important consideration.

Application of profitable index:

This method, unlike the net present value method, does not ignore the magnitude of funding sources.

Profitable index=NBD/$\sum_{t=0}^{m} I_t / (1+r)^t$

Profitable index= $\dfrac{830754180}{258000000 + \dfrac{600000000}{(1+0,10)^1}}$ =1, 03 ≥ 0 project is acceptable

Economic evaluation methods can be applied to these five methods to estimate the results of this project. At this phase, we can evaluate liquidity and capital structure.

Liquidity analyses of project:

Liquidity analysis provides information about the balance between the project's cash inflows and cash outflows. The purpose of this analysis is to ensure the flow of business funds after the project goes into operation. If there is a problem with how this flow of funds can be financed, with this analysis, measures can be taken. Financing can be provided by debt or equity financing methods. Expectations can be determined before and precautions can be taken. With the help of this method, certain scenarios can be drawn up.

As we can see below in table 5.16, there is no liquidity problem; there is no problem with finishing the payment of interest and principal money, and the project net cash balance is increasing sharply. Liquidity management is important for companies because cash balance must be assessed correctly. Perhaps, the opportunity for new investments, being competitive within the market or to lower prices may be born. Competitiveness is important because, as we know, interest in this area is increasing every day. Few players entering this sector will benefit us at this point.

Table 5.16 : Liquidity analyses

	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
I. Cash inflow												
1.Sales revenue	0	0	339012000	352572480	366675379,2	381342394,4	396596090,1	412459934	428958331	446116664	463961330,9	482519784
2.Salvage value	0	0	0	0	0	0	0	0	0	0	0	0
3.Equity capital	258000000	0	0	0	0	0	0	0	0	0	0	0
4.Liabilities	0	600000000	0	0	0	0	0	0	0	0	0	0
II. Cash outflow												
1.First investment amount	258.000.000	600.000.000	0	0	0	0	0					
2.Operating expense			3.788.000	3.863.760	3.941.035	4019855,904	4100253,022	4182258,08	4265903,24	4351221,31	4438245,735	4527010,65
3.Payment of principal	0	0	98311345	108142480	118956728	130852401	143937641	0	0	0	0	0
4.Interest expense	0	0	60.000.000	50.168.865	39.354.617	27.458.944	14.373.704	0	0	0	0	0
5.Tax expense	0	0	55044800	59707971	64675945,4	69972718,89	75624426,62	81655535,1	84938485,6	88353088,6	91904617,04	95598554,7
6.Dividend	0	0	0	0	0	0	0	0	0	0	0	0
Cash balance	0	0	121.867.855	130.689.404	139.747.054	149.038.475	158.560.065	326.622.141	339.753.942	353.412.354	367.618.468	382.394.219

Capital structure of project:

This stage is important during the decision making process because the capital structure indicates how much of the equity will be provided, and how much debt will have to be incurred. If the interest is paid under this net profit, the owner's equity low-holding, and a large borrowing fund will create financial leverage. But it should not be forgotten that debt is a serious obligation with liabilities. Debt is an equal obligation for firms; it makes the project more risky project but if we can manage this risk efficiently, we can make higher profits.

My project's initial investment is $858 million in total. The amount of equity is 258 million dollars, the rest is long-term debt.

$$\frac{liability}{owner'sequity} = \frac{600000000}{258000000} = 2,32 \qquad \textbf{(5.2)}$$

In equation 5.2, the project liability amount is larger than the owner's equity. This means that the capital structure is mostly financed by debt.

Moreover, how much of the equity project is financed by foreign sources should also be considered:

$$\text{Liability investment rate} = \frac{600000000}{858000000} = 0,70$$

This project is financed with two components: equity and debt financing. Equity financing comprises 30 percent of the total investment. Debt financing is provided by a loan from TSKB and TKB. This value is 70 percent in total. As we can see, this project has significant financial leverage in terms of funds. It must be managed carefully because debt is always risky and an obligation for the owner of the business.

The first case study was conducted without factoring in a depreciation expense. I assume the depreciation rate is zero. In the second case study, there is a depreciation expense and this is especially important for the wind farm project because with some projects, amortization is not a significant indicator. We can skip this point. But with the wind project, depreciation has a dense effect. Depreciation expense is important in the wind project as turbine costs are a big factor, especially in the construction period. But to be liable for depreciation, the economic life of the business must be underway. In my case study, the economic life starts two years after the construction period. I will examine the differences in the projects below in table 5.17. We can see the differences clearly with the help of some figures.

Table 5.17: Depreciation expense for turbine (yearly)

	Amount($)	Depreciation rate (%)	Depreciation expense
0.year	0	0	0
1.year	0	0	0
2.year	643500000	10%	64.350.000
3.year	643500000	10%	64.350.000
4.year	643500000	10%	64.350.000
5.year	643500000	10%	64.350.000
6.year	643500000	10%	64.350.000
7.year	643500000	10%	64.350.000
8.year	643500000	10%	64.350.000
9.year	643500000	10%	64.350.000
10.year	643500000	10%	64.350.000
11.year	643500000	10%	64.350.000

Calculation of the amount of turbine depreciation: 858000000*%75=643350000

I will only include depreciation in the modified table as it will not affect the entire table, and I will provide an explanation for the differences in the tables (http://www.gib.gov.tr/fileadmin/user_upload/Yararli_Bilgiler/amortisman_oranlari2009html 2009).

Table 5. 18: Adjusting total investment of project and capital structure

	Period of construction(m=2 years)	
	t0	**t1**
I.Total Project cost		
Fixed capital	258.000.000	512366633
Operating capital		87633367
Interest expense	0	0
Total investment yearly	**258.000.000**	**600.000.000**
II. Financing		
Indicative cost-owner's equity	258.000.000	
Liability(TSKB and TKB loans)		600.000.000
Total financing required		**600.000.000**

First investment amount: $858.000.000kw

Working capital need: 87633367

Project internal finance: 600.000.000

When we add the depreciation cost in the total of business expenses, the average of operating capital will change as shown above in table 5.18. Adding the depreciation to the total business expense increases the operating capital.

Table 5.19 : Adjusting cost structure of wind energy

	Life cycle of the project(yearly)											
	construction period		**economic period**									
Expenses(cost structure)	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
I. First investment expense(fixed cost+working capital cost)	258000000	600000000	0	0	0	0	0					
II. Operating expense	0	0	3.788.000	3863760	3.941.035	4019855,904	4100253,022	4182258,08	4265903,24	4351221,31	4438245,735	4527010,65
III. Interest			60000000	50.168.865	39354617	27458944	14373704	0	0	0	0	0
IV. Depreciation expense	0	0	64350000	64350000	64350000	64350000	64350000	64350000	64350000	64350000	64350000	64350000
Total	258000000	600000000	128.138.000	118.382.625	107.645.652	95828799,9	82823957,02	68532258,1	68615903,2	68701221,3	68788245,74	68877010,6

Table 5.20:Adjusting pro forma income and net cash flow statements

	Life cycle of the project(years)											
	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
I. Revenue	0	0	339012000	352572480	366675379,2	381342394,4	396596090,1	412459934	428958331	446116664	463961330,9	482519784
II. Total of the first investment	258.000.000	600000000	0	0	0	0	0	0	0	0	0	0
III.Operating expense	0	0	3.788.000	3.863.760	3.941.035	4019855,904	4100253,022	4182258,08	4265903,24	4351221,31	4438245,735	4527010,65
IV.Interest expense	0	0	60.000.000	50.168.865	39.354.617	27.458.944	14.373.704	0	0	0	0	0
V.Depreciation expense	0	0	64350000	64.350.000	64350000	64350000	64.350.000	64350000	64350000	64.350.000	64350000	64350000
VI.Gross profit	0	0	210.874.000	234.189.855	259.029.727	285.513.594	313.772.133	343.927.676	360.342.428	377.415.443	395.173.085	413.642.774
VII.VAT	0	0	42174800	46837971	51805945,4	57102718,89	62754426,62	68785535,1	72068485,6	75483088,6	79034617,04	82728554,7
VIII.Net profit	0	0	168.699.200	187.351.884	207.223.782	228.410.876	251.017.706	275.142.141	288.273.942	301.932.354	316.138.468	330.914.219
VIIII.Net cash flow	-258.000.000	-600000000	233.049.200	251.701.884	271.573.782	292.760.876	315.367.706	339.492.141	352.623.942	366.282.354	380.488.468	395.264.219

In tables 5.19 and 5.20 above, we can see the depreciation expense valuation affect other expenses. The depreciation expense changes the total value of the business expense. In addition, it affects the gross profit, tax expense, net profit and as a result net cash flows. It has a negative effect on gross profit and net profit. Both of the expenses decrease. Also, the tax value, known as VAT, falls. But the most important thing for business is that the net cash flow increases. What does all this mean for business? Why would businesses prefer to factor in a depreciation expense? Management of the company needs a good management account because the business can change this number how they want. The depreciation rate is not a tangible value like that of a building, equipment etc. This value is intangible. Firms prefer to add this value because they do not want to pay large amounts of tax to the government. I will examine the application of an economic and financial model again. We can compare the value.

Application of return on investment:

Adjusting ROI= $\dfrac{net-profit}{total-investment} = \dfrac{251017706}{858000000}$ =0,29

$0{,}29 \geq 0{,}10$ project is acceptable**.**

(The first case study was conducted applying the ROI method without factoring in the depreciation expense, is 0, 35).

According to the ROI method, if it is necessary to choose between two separate projects, the one yielding the highest return rate will be chosen. But as we know, this method of calculation is very simple and does not factor in the time value of money. So this method is not reliable when it is used to decide between two projects. In my first case, without considering the depreciation cost, the ROI was equal to a value of 0, 35. The other case that included the depreciation cost had a smaller value (0, 29). If we have to make a choice depending on this method, we have to choose without considering the depreciation model. But as I said before, this method is not sufficient to make a decision. It is only good to give an indication of whether the project should be undertaken.

Application of payback period

$$\sum_{t=0}^{m} I_t = \sum_{t=m+1}^{n} P_t$$

Table 5.21: Adjusting payback period

(000$)	to	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
Total investment	258000	600000	0	0	0	0	0	0	0	0	0	0
net cash flow	0	0	233.049	251701	271.573	292760	315367	339492	352623	366282	380488	395264

I=258000000+600000000

Payment for 3 years=233.049.200+251.701.884+271.573.782=756.324.866

858000000-756324866=101675134

101675134/292760876=0,34*365=126 day

Payback period=3+0,34=3,34

(The first case study's payback period is 3, 50 years)

Table 5.21above shows the payback period. The faster project payback period will be selected. But this method is not sufficient in making a decision between two projects. There are some advantages associated with this method. One of them is that it ignores the time value of money. However, this method is a simple method. The return of capital cost invested in particular determines how much time we have to pay for our own property is important. This method is especially helpful in risky markets. In my case, the project which included the depreciation expense is more preferable. Also one of the weaknesses of this model is ignorıng the following years' net cash flows. But here in my case, this is not a problem because the project with the depreciation expense has more net cash flows than the other one.

Application of NPV:

NPV= $CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + ... + \frac{CF_n}{(1+r)^n}$

$$NPV=\frac{-258.000.000}{(1+0,10)^0}+\frac{-600.000.000}{(1+0,10)^1}+\frac{233049200}{(1+0,10)^2}+\frac{251701884}{(1+0,10)^3}+\frac{271573782}{(1+0,10)^4}+$$

$$\frac{292760876}{(1+0,10)^5}+\frac{315367706}{(1+0,10)^6}+\frac{339492141}{(1+0,10)^7}+\frac{352623942}{(1+0,10)^8}+\frac{366282354}{(1+0,10)^9}+\frac{380488468}{(1+0,10)^{10}}+$$

$$\frac{395264219}{(1+0,10)^{11}}$$

Npv =902633130

npv $\geq$ 0

(In the first one NPV is found 830754180)

It is obvious that the second project's NPV is higher than the first one's. If we make a choice between the projects, the one with the higher NPV is preferable because this method shows the minimum profitability expectations to the investors. An advantage of this method is that it considers the time value of money. In this case, investors will be aware of the net cash flows' current value. But this method has some shortcomings. When choosing between projects, it always favors the one that will yield the highest profit. It ignores the first total investment/profit ratio. Also, the NPV method is very sensitive to changes on capital cost. For improving this model, a profitable index can be used.

Application of IRR

$$IRR= r_p + \frac{Npv_p}{Npv_p + |Npv_n|}(r_n - r_p)$$

$$\mathbf{r=0,10+}\frac{902633130}{902633130+29379887}\mathbf{(0,30-0,10)}$$

IRR=0,30 $\geq$ 0,10

(The first one's IRR is 0,28)

An investment internal rate of return method is used to equalize the net present value to zero. The IRR is an indicator of total capital profitability. Also, if the investor prefers to use liability, the internal rate of return helps to identify the maximum interest rate. According to the IRR amount, the investor who has limited funds can determine the valuation for necessary funds. We know that small changes in the cost of capital have a significant effect on the amount of net present value amount. In contrast to NPV, the IRR method's effects are not consequential. On the other hand, this method has some disadvantages. The IRR method is not efficient on mutually exclusive projects. It can cause on investment amount to idle. Also, in order to apply this method, the project must have normal distribution. In my case studies, the net cash flows have normal distribution. As a result, there is no problem with the calculations. The project with the depreciation cost factored in the IRR is higher than the project where the depreciation cost was not factored in the IRR.

Application of profitable index

Profitable index=NBD/$\sum_{t=0}^{m} I_t / (1+r)^t$

$$\text{Profitable index}=\frac{902633130}{258000000+\dfrac{600000000}{(1+0,10)^1}}=1,12\geq 0$$

(The first case study's profitable index was 1,03)

This model presents better results because the net present value is calculated ignoring the amount of the initial investment. This method's main purpose is to discount the total investment amount at the present time to calculate the rate of the net present value. In this case, it is easy to compare different sizes of investment. I conducted my case studies with the same investment amount for both projects so there was no problem. But the projects' net present values are different and this affects the profitable index amount. The project that included a depreciation expense has a higher profitable index and is therefore preferable.

Financial analysis with liquidity analyses:

Project liquidity analysis is important to be able to see the cash inflows and outflows. In table 5.22, we can see the cash balance of the project. This way, we can predict whether or not the project needs funds. The results of these measures are taken into consideration. For the continuity of the project, it is necessary to make estimates with liquidity analyses. Also, this method is useful for companies' strategic decision-making. When implementing the project, it may be difficult to find funding. In addition, if the cash balance is over, it must be managed carefully. The project dividend accounts to 0. Prior to the dividend, it will be difficult to decide. I have found a positive cash balance for both studies. However, the cash balance of the project where the depreciation amount was considered is more than the other one because of the tax reduction. The decrease in the amount of tax causes a reduction in cash outflows. In this case, a higher cash balance amount will come out.

Financial analyses with cost structure method:

There are no any changes on the total investment amount, and as a result, I will not calculate the cost structure of the project again. We know that this is an intense loan project. In the total capital ratio, the loan ratio is 70 percent. The remaining capital consists of 30 percent of the owner’s equity.

Table 5.22 : Adjusting liquidity analyses

	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11
I. Cash inflow												
1.Sales revenue	0	0	339012000	352572480	366675379,2	381342394,4	396596090,1	412459934	428958331	446116664	463961330,9	482519784
2.Salvage value	0	0	0	0	0	0	0	0	0	0	0	0
3.Equity capital	258000000	0	0	0	0	0	0	0	0	0	0	0
4.Liabilities	0	600000000	0	0	0	0	0	0	0	0	0	0
II. Cash outflow												
1.First investment amount	258.000.000	600.000.000	0	0	0	0	0					
2.Operating expense			3.788.000	3.863.760	3.941.035	4019855,904	4100253,022	4182258,08	4265903,24	4351221,31	4438245,735	4527010,65
3.Payment of principal	0	0	98311345	108142480	118956728	130852401	143937641	0	0	0	0	0
4.Interest expense	0	0	60.000.000	50.168.865	39.354.617	27.458.944	14.373.704	0	0	0	0	0
5.Tax expense	0	0	42174800	46837971	51805945,4	57102718,89	62754426,62	68785535,1	72068485,6	75483088,6	79034617,04	82728554,7
6.Dividend	0	0	0	0	0	0	0	0	0	0	0	0
Cash balance	0	0	134.737.855	143.559.404	152.617.054	161.908.475	171.430.065	339.492.141	352.623.942	366.282.354	380.488.468	395.264.219

I've done the above work related to wind energy projects in order to see the impact of spending the depreciation expense. The first of my applications did not include depreciation in the accounts. In the second model, the numbers change when I added the depreciation value. Wind energy projects have a significant share in cash flow increases when depreciation expenses are taken into account. The five methods of economic analysis (ROI, payback, NPV, IRR, profitable index), when applied to projects which have the same total investment expenditure, allocating funds to allow depreciation is a more efficient model.

5.2. ANALYSING NEW ENERGY TREATIES

With the considerable change of the balance of power in the world in 2000 onwards, governments started to search for new solutions in order not to have another energy crisis. Energy's being a political issue, increased the significance of projects and international agreements and put them in a critical position. Besides, the importance of the environment has increased with the climate change and new precautions have been taken in order to hamper climate change and international agreements were signed. Turkey, considering its geopolitical position, participated in these international agreements. The three agreements that have been noteworthy in recent decades are: the Baku-Tbilisi-Ceyhan pipeline, the NABUCCO project and the Kyoto agreement.

5.2.1. Baku-Tbilisi-Ceyhan (BTC)

The oldest pipeline in Turkey that should be mentioned is the Iraq-Turkey Raw Petroleum Pipeline. This pipeline transports Kirkuk petroleum between Northern Iraq and the Western world. The capacity of this transportation was 305 million barrels in 1999; it decreased to 10.9 million barrels in 2006 due unrest in Kirkuk. The Baku-Tbilisi-Ceyhan (BTC) Raw Petroleum Pipeline is another pipeline the commission of which was initiated on May 28, 2006. Despite the fact that petroleum carried through that pipeline is limited, the authorities state that there will be an increase in the medium and long term (www.enerji.gov.tr 2010).

The potential of Turkey for carrying petroleum from domestic sources is 6, 72 billion barrels. Since August 2008, it has been said that "Turkish petroleum reserves are 37, 3 million tons", and "in 2007 consumption was 31 million tons, and raw petroleum production from the beginning of petroleum prospecting activities in our country until September 2008 was 130, 1 million tons." The installed power of thermal power plants in Turkey, basing on petroleum and petroleum products was 1.973 MW at the end of 2008, which equals to 4,8 percent of total installed power in Turkey (enerji gov.tr 2010).

A total of 1050 prospecting pits and 1808 production, injection and development pits were opened, and 23 large and small natural gas fields and 102 petroleum fields were discovered within 57 years in Turkey. The production-consumption balance of world petroleum shows that new reserves are also being discovered as there is an increase in consumption. It is crucial for the Turkish economy to activate new domestic sources of hydrocarbon and privatizing investments through that aim (enerji gov.tr 2010).

Foreign petroleum prospection and production activities of the Turkish Petroleum Corporation (TPAO) increased considerably in Turkey from 2002 onwards. As a result, prospecting and the production budget of the TPAO increased seven fold between 2002 and 2007, and went up to 1 billion US Dollars in 2008 (http://www.enerji.gov.tr/index.php?dil=en&sf=webpages&b=petrol_EN&bn=222&hn=&nm=40717&id=40730 2010).

5.2.2. NABUCCO Project

The NABUCCO project originated from the Italian composer Giuseppe Verdi's opera, and was signed in Ankara on July 15, 2007.

The NABUCCO is a project that plans to transfer the Caspian Basin natural gas to Southern Europe via Turkey, Bulgaria, Romania, Hungary and Austria. Being poor in natural gas resources, European countries and Turkey are bound to Russia for their gas supply. In Europe, 40 percent and in Turkey, 65 percent of natural gas is imported from Russia. In this case, Russia uses natural gas as a weapon.

According to Serdar Iskender, as a natural gas monopoly, Russia, besides holding the ability to change or retain natural gas prices, uses this power as a threat of increasing the price of natural gas for the Baltic states, especially the Ukraine and Belarus, which want to act independent of Russian politics (İskender 2010, p.1).

In European energy security, coastal states on the Black Sea have a significant role because they are important participants of major European consumer markets. As Roberts puts it: “They can be expected to continue to do so even as the European Union attempts to diversify its supply sources” (Roberts 2006, pp. 207 – 223).

In fact, the main goal here is stop being dependent on Russia because Russia monopolizes the prices of that resource which is reflected in an increase in prices, especially for industries that supply inputs to products with higher prices, and as a result, it has an influence on countries' gross national product and growth”(Roberts 2006 , pp. 207 – 223).

In 2002, the Pipeline Petroleum Transport (BOTAS) was initiated by project partners, in equal shares by BOTAS (Turkey), Bulgaras (Bulgaria), Transgas (Romania), MOL (Hungary), OMV (Austria) and RWE (Germany). The project that was planned to carry 31 billion cubic meters of natural gas is expected to cost 7.9 billion euros. In addition, the project will invest 4-5 billion euros which will provide employment for thousands of people in Turkey. Turkey, where the most important part of the line passes through the soil, will take 60 percent of tax revenues.

The NABUCCO project, with the signing of the project's partner countries, especially in Turkey, has come forward. This has become an indication of confidence in our country. Turkey's geopolitical position which forms a bridge between the east and west, was approved by this project and adopted. Trying to enter the EU, Turkey, being a corridor, has come one step closer to the European Union.

According to Necdet PAMİR (2007, pp.245-263): Diversification emerges as the most vital concept to decrease insecurity in the global energy field. The rapidly increasing oil export volumes via the Black Sea raises environmental risks since the Black Sea and the Straits of Bosporus and Dardanelles are under severe threat from increasing oil tanker traffic. Therefore, not only the benefits, but also the risks should be recognized and evaluated accordingly. To that end, a regional approach and cooperation are vital necessities. The Black Sea is certainly a gateway to energy security and diversification if the countries in the region can cooperate rationally. If they fail to cooperate and rivalry overcomes mutual understanding, allowing emotions to overcome rationality, the gateway may turn instead into a locked iron door and become a source of instability.

5.2.3. Kyoto Protocol

The Kyoto Protocol which takes its name from Kyoto city of Japan was signed within the UN Framework Convention on Climate Change. Countries that signed the protocol agreed on decreasing the oscillation of the five gasses that cause carbon dioxide and greenhouse gas emissions; or, if they cannot do that, they agreed to increase their right to trade with emissions. The protocol required a decrease in the amount of carbon released into the atmosphere since 1990. The protocol, signed in 1997, was implemented in 2005. As one of the countries that produce the most greenhouse gases, the United States refrained from signing the protocol. Turkey, compared to industrialized countries such as the United States and Western Europe, produces less greenhouse gases. However, Turkey, as a country where oil, coal and natural gas dependence is increasing day by day, has a rapid increase in greenhouse gas emissions. (http://www.euractiv.com.tr/cevre/article/turkiye-kyoto-protokolune-taraf-oldu-004466 2009).

The Kyoto Protocol obliged all signatories to agree to reduce greenhouse gas emissions in 2010 to less than total emissions in 1990. The protocol, which started to be applied on February 16, 2005, made signatories work on three fundamental strategies to decrease the amount of carbon dioxide (CO_2). They also took into account greater efficiencies in electricity generation, recycling, capturing, utilization, disposal/storage, and the use of renewable and nuclear sources of energy (Chiue and Chang 2008, pp.1669-1674).

The importance of the Kyoto Protocol has been acknowledged by all countries in the world. Therefore, with regard to fossil resources, in the face of high costs in terms of renewable energy sources, countries are trying to take measures to achieve a preferable situation. Feed-in-tariffs, tax deductions, subventions, investment subsidies, support credit only for renewable energy etc. can be given as the best examples.

Kyoto protocol analyzes the issues and attempts to find solutions to combat climate change. The promotion of energy from renewable resources, technology transfer, the relocation of companies with high levels of fossil fuel consumption to developing nations, for instance, the cement industry, are some of the debates. The reason why forest conservation is needed is the negative impacts of logging on carbon sequestration. As the UN Framework Convention stresses: "Carbon trading and the meaningful participation of developing nations; emissions limitations for all countries irrespective of their level of development; focusing on both short and long-term reductions" (UNFCCC The Copenhagen Protocol 2009, p.5).

In the short-term, it is crucial that the U.S. decreases the costs of implementing this Protocol. International trade in emission rights can reduce these costs. The number of countries participating in the trading market, the shape of each country's marginal abatement cost curve, and the extent to which buyers can satisfy their obligation through the purchase of emission rights determine the amount of cost. It is also important to mention that in the long term, the protocol may be inconsistent with the strategy for stabilizing global concentrations (Manne and Richels 1999, pp.8-9).

Nevertheless, most renewable sources are weaker economically than fossil fuel sources. This is the reason why many countries provide incentives (e.g., feed-in-tariffs, investment subsidies and tax credits, etc.) to enhance the proportion of their renewable energy supply.

Countries that have signed the Kyoto protocol can only produce CO2 emissions up to a certain limit and it is forbidden for them to exceed the limit. In the case that one of the signatories exceeds the limit, they get a share from another signatory whose emissions of CO2 are low. In this case, countries that produce exceeding amounts of CO2 emissions have to pay reparations. If Turkey is concerned, as Tanel Yüksel (2009) mentions in his book, Turkey within the framework of Kyoto Protocol, emissions targets provides funding from a mandatory carbon market.

In the current era, most countries are aware of the importance of Kyoto, however, the public is not well informed about the implications of the Kyoto agreement. For one thing, regulations will be revised to reduce the amount of greenhouse gasses which are emitted by industries, motor vehicles and heating. Secondly, heating with less energy, less energy-consuming means, and less energy-consuming industries will be provided with technology systems. Moreover, solar energy will pervade the market and alternative energy resources will become more attractive. Transportation and waste disposal will be dealt with keeping in mind the basic principles of environmentalism. Furthermore, cement, lime, iron and steel and factory waste, such as in high energy-consuming processes in enterprises will be reorganized. Instead of fossil fuels such as bio-diesel fuel, thermal power plants will be used and systems that put out less carbon will be introduced. Since nuclear energy includes zero carbon energy, it will be highlighted in the world. Finally, vehicles that consume more fuel and produce more carbon will be highly taxed. (http://www.euractiv.com.tr/cevre/article/turkiye-kyoto-protokolune-taraf-oldu-004466 2009)

5.3. TREASURY ENCOURAGEMENT FOR RENEWABLE ENERGY IN TURKEY

The research I have so far done pertaining to Turkey, in both the public sector and private sectors, we have seen the importance of energy resources. Effort is now being made towards the use renewable resources. Especially in the energy efficiency of government units, the importance of environmental protection is very important. If government agencies support and stand behind the new project, the private sector will be more inclined to invest in renewable sources. TSKB and the Energy Ministry of Turkey especially are effective in drawing support for renewable energy sources. Other than these two organizations, the EMRA, TKB, EÜAŞ etc. are also effective but do not have the same impact as TSKB and the Energy Ministry.

5.3.1. Ministry of Energy and Natural Resources

According to the Annual Report issued by the Energy Ministry in 2008, shown in figure 5.2 below, the distribution of investment within the sector in 2008 was as follows: energy 46.8 percent, mining 38 percent, transportation 8.5 percent, and other 6.6 percent. In 2008, the allocation of investments for the energy sector was 757.977.000TL, for mining 617.246.000TL, and for transportation 137.493.000TL. As can be seen from these figures, the largest share of their budgets, they invested in new energy.

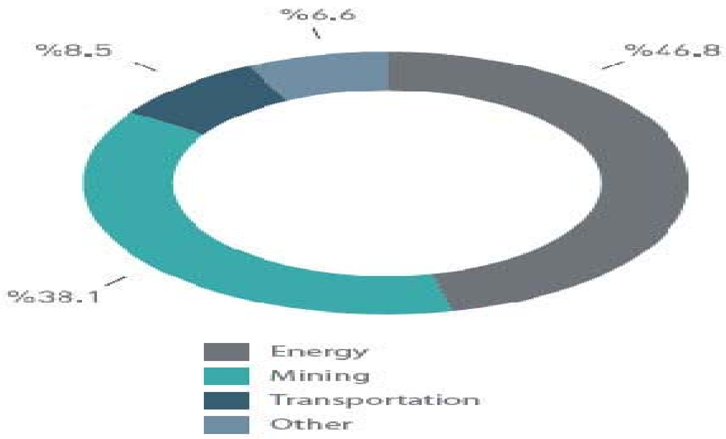

Figure 5.2: Distribution of 2008 investments by sectors
Source:http://www.enerji.gov.tr/yayinlar_raporlar_EN/2008_Faaliyet_Raporu_EN.pdf

Until now, the Energy Ministry of Turkey (MENR) was slow in its development. If we examine in brief the facts between 1984 and now, we can understand the developing energy regulations. In 1984, the Turkish government enacted Law No. 3096 "Regarding the Authorization of Enterprises other than the Turkish Electricity Authority for Generation, Transmission, Distribution and Trading of Electricity" (BOT Law) allowing private companies to generate, distribute and trade electricity. Until the enactment of Law No. 3096, the foregoing services were only carried out by the Turkish Electricity Agency ("TEK"), which was later divided into the Turkish Electricity Generation and Transmission Co. ("TEAS") and Turkish Electricity Distribution Co. ("TEDAS"). As a result of the promulgation of Law No. 3096, private companies including foreign investors have been permitted to establish or operate power plants under the models "Build, Operate and Transfer" (BOT), "Build and Operate" (BO), "Transfer of Operating Rights" (TORR) and "Auto-production" (AP). In Turkey, Law No.3096 formed the legal basis for BOT model applications in the electricity sector. But BOT projects have been plagued by legal problems, which have slowed their implementation. A significant problem with BOT projects was that they obligate the government to commit to long-term power contracts at predetermined, and often very high, prices and the Treasury had to guarantee these payments for up to twenty years.

As a result, another law came into existence. The Market Law (No. 4628), in 2001 faced intensive discussions and strict impediments with respect to Treasury guarantees available to projects under the BOT model. The purpose of Law No. 4628 is to ensure the development of a financially sound, constant and transparent electricity market, operating in a competitive environment in accordance with private law, and to provide for an autonomous regulation and supervision of such a market. Law No. 4628 regulates generation, transmission, distribution, wholesale, retailing and retailing services, import and export of electricity, and rights and obligations of real persons or legal entities directly involved in these activities (2008 annual report of Energy Ministry 2009, pp.8-15).

The Energy Market Regulatory Authority ("EMRA") was established and principles for its operation were also set forth within the scope of Law No. 4628. The law enables privatization in generation and distribution areas, whereas transmission activities still remain the property of the state in a public legal entity. Law No. 4628 also covers the privatization methods to be utilized for electricity generation and distribution assets, principles relating to tariffs and provisions concerning Treasury guarantees applicable to energy projects. But this law also is not efficient for BOT systems. Many investors, especially in the area of renewable energy resources, were negatively affected by this law. Only auto-producer companies were not affected by this law. Later, another law (Law no 5346) related to renewable resources come into being in 2005. Law no 5346 is very crucial for Turkey's energy outlook. Now, renewable energy has a place in the whole of energy consumption and production. Also, 2008 was declared energy efficiency year by the government. In addition, with the'' ENVER'' project, more than two million energy efficient lamps were distributed to schools (2008 annual report of Energy Ministry 2009, pp.8-15).

In 2005, the renewable energy law and in 2007, and the energy efficiency legislation in Turkey pertaining to wind, water and heat energy in different fields, allowed for substantial amounts of renewable energy potential. From 1987 to 2008, the total investment amount in the electricity sector reached 45.3 billion dollars. Turkey's current installed capacity of renewable energy consists of 14301 MW hydroelectric, wind 364 MW, 77 MW geothermal, 81 MW biogas / bio-fuel (2008 annual report of the Energy Ministry 2009, pp.10).

It was recently announced on The Energy Ministry website that a strategic plan was in works to give importance to local resources. On the 100th anniversary of the Turkish Republic in 2023, the main goal is to improve the condition of local energy resources. There will also be changes made to the mining and oil law regulations. Quitting a project after establishing the preliminaries for the said project causes the loss of a great deal of money; abandoning a project halfway through does a great deal of harm to the economy. However, the ministry has said they will make arrangements in this regard (Electricity Energy Market and Supply Security Strategy Paper 2009, pp.5-6).

MENR works in cooperation with other government departments such as: EÜAŞ, TETAS, TEIAS, TEDAS, and EMRA. They all have different missions. Electricity production is provided by EÜAŞ. Energy trading is provided by TETAS. Energy transmission is provided by TEİAS. Energy distribution is provided by TEDAS. Pricing and license policies are provided by the EMRA's approval (Ay 2008, p.7).

Finally, after 2000, new agreements were signed and projects went underway. The Baku-Tbilisi-Ceyhan pipeline, the NABUCCO project and the last part of the Kyoto Protocol have conjured awareness and influenced Turkey's energy policies.

5.3.2. The Facilities of Investment and Development Banks

TSKB, in the last seven years, financed 86 renewable energy projects. These consist of 78 hydroelectric projects, 4 wind projects, 2 geothermal projects, and 2 bio-mass projects. In 2010, it is expected that two pieces per person of 3267 kWh of installed capacity will be available. This means an increase from 42 500 MW of current installed power to 63 500 MW. In Turkey, this requires an annual investment of $5-6 billion. 2008 was declared energy efficiency year. In 2008, 757977000 TL was allocated for renewable energy investment. This is a seriously high amount (www.tskb.com.tr 2010).

In addition to TSKB fundings, big banks are supporting the new joint project with TSKB. Recently they announced financing for 4 hydropower plant projects with an installed capacity of 68 MW, for which total funding is 78 million euros, 55 million euros of which will be provided by TSKB. It is obvious that TSKB is instrumental in financial support for the future of minimizing the energy demand.

TSKB General Manager Halil Eroglu said that (2010), in the last 6-7 years, the World Bank and the European Investment Bank, have provided 1.5 billion dollars in funding to such organizations.
Also by 2010, World Bank loans for renewable energy sources will be $ 420 million. This is a very serious figure. According to the statement of the president of TSKB, this is the highest amount of credit allotted in the last 20 years. This means that Turkey has serious potential in the future of renewable energy sources.

In the recent past, renewable energy, energy efficiency, as well as other environmental issues have been gaining importance worldwide. TSKB in Turkey in 2003, decided to focus on increasing the sustainable development of renewable energy. At end of a seven-year period, renewable energy and energy distribution sectors, in accordance with TSKB, will constitute a significant portion of the total loan portfolio.

TSKB follows certain policies in addressing a customer's credit conditions in the search for environmental protection and compliance for the life of a loan. TSKB credit projects, using natural resources and may run out of resources (energy, raw materials, water and other inputs) unless they are used efficiently or re-used; this takes precedence for the sake of the economy (http://www.tskb.com.tr/sustain/tr/m-7-3.aspx 2010).

TSKB is the leading bank for big investment funding. The bank financed nearly 80 renewable energy projects until 2009. Banks have so far evaluated about 150 renewable energy projects in detail. TSKB energy projects funded with 2218 MW are planned. Turkey's total renewable energy installed capacity of 15 percent is equivalent to 5 percent total capacity. TSKB financing of energy projects addresses all of Turkey's current fossil fuel-weighted energy production to be transferred to renewable energy sources. When these projects are completed, Turkey's total CO2 reduction will amount to four million tons (http://www.tskb.com.tr/sustain/tr/m-7-3.aspx 2010).

TSKB also started financing for "energy efficiency'' in 2009; this issue has raised awareness and energy efficiency investment projects are on the agenda. Three such projects involve the iron, steel, and paper industry. Steel and paper industries have huge energy saving potential.

In 2009, the World Bank provided $ 420 million in loans to establish the Clean Technology Fund (CTF). TSKB, on June 9, 2009, signed a loan agreement for 350 million dollars with the World Bank and a 70 million dollar portion of that went to CTF (Clean Technology Fund - Clean Technology Fund) from a total of 420 million dollars in loans. The CTF and the World Bank Group are aiming to establish a low-carbon economy; transitioning countries will require a provision of financial resources. Turkey, the first country to transfer resources from around the world, is once again selected to be a business partner of TSKB (http://www.tskb.com.tr/sustain/tr/m-7-3.aspx 2010).

Thanks to TSKB, on January 16, 2009 with the Clean Energy Fund, a guaranteed return of 10 percent was exported and presented to investors. TSKB and the Clean Energy Index, based on the Clean Energy Fund, have signed a policy in Turkey. Renewable energy, energy efficiency and waste management are essential components of the Clean Energy Fund. TSKB has been calculating the carbon footprint since 2006. In 2008, according to data, a carbon footprint from the equivalent of 1249 tons of CO2 comprised 74 percent of electricity. In the study carried out by Ecofys and TSKB electricity, natural gas, water, paper and travel miles and carbon neutral were analyzed. This study has the characteristics of being a carbon neutral bank (http://www.tskb.com.tr/sustain/tr/m-7-3.aspx 2010).

In June 2009, the size of TSKB's loan portfolio was 2 billion 542 million dollars. According to Orhan Beskok, this figure represents the 28 percent of sectors opened to Apex loans, 23 percent of the power generation and distribution sector, 7 percent the transport and the communications industry. As we understand, TSKB provided serious funding for renewable energy investment improvement. This is really important because private sector investors only need encouragement for funding incentives. One of them is provided by the help of the TSKB

(http://www.radikal.com.tr/Radikal.aspx?aType=RadikalHaberDetay&Date=25.08.2009&ArticleID=951280 2009).

6. CONCLUSION

Energy resources have always been an important part of human life. For centuries, these resources have been consumed and more and more have been sought. However, these resources will not last forever and according to research their end is not very far. In fact, the complete depletion of fossil resources threatens to arrive before alternative resources can replace them.

Immediate action is required to prevent a crisis due to this depletion. New concepts regarding sources of energy are being looked into for possible solutions. The less than controlled and controversial use of fossil resources has led to war and the destruction of the environment. It is important now to take action before the effects of global warming do further damage to our fragile planet.

Technological development, an important indicator of civilization, has been directly linked to energy consumption. Therefore, instead of restricting the use of resources, consuming resources that will do the least amount of environmental damage is the most logical approach. The alteration of the balance of the world because of uncontrolled consumption, especially in China and India in particular, as well as the ever-increasing demand pose serious risks to the environment. A country's economic standing and their importance to sustainable development with environmental sensitivity will very soon depend on their use of renewable energy sources.

In fact, the concept of renewable energy is centuries old but its prevalence has fluctuated in different eras. The latest renewal of this trend took place after 2000 when more detailed studies were conducted. Some countries have been using these resources for many years; on the other hand, for some countries this concept is still very new.

So even though these resources are known, why are they not used instead of fossil based resources? Because to convert these sources into usable energy, serious technology is required. This means that extensive funds are required. The use of renewable energy sources, in the initial setup stages, is very costly. However, once established, the operating cycle costs of these sources remain lower than those of fossil sources.

Other issues that need to be considered here is the cost of externalities of fossil resources. External costs are difficult to assess because these things were ignored before. However, the development of environmental policies and the importance of working together are starting to be understood. Nowadays, measuring the external costs of carbon emissions has become popular. Companies try to add this expense to their calculations. The external costs of renewable energy sources are very low, and therefore they are more advantageous in this regard than fossil resources.

Renewable resources are environmentally friendly; fossil sources in the face of these resources do not preclude the cost disadvantage. This source requires careful attention for new and long feasibility studies. Preparation of projects based on renewable energy sources present advantages and disadvantages and if these are detected correctly, this will reduce fallibility. This is also the source for new units by the public sector and international support is needed. The Kyoto protocol is evidence that the world is taking action. But it is very clear that in many areas of the public, the funds for resources needed for assessment of energy resources is less than expected. As a result, the private sector must take attention on new investments. Private sector investors are encouraged by the state. The Build-operate-transfer (BOT), Build-own-operate (BOO) and auto-production models were developed for this purpose. But these models are not necessary for the private sector. At this point, the state is still engaged in a long term, low duty application stage.

Perspective to these resources in each country varies. All countries perceive that renewable resources are the future. OECD countries are more sensitive to the importance of these resources and have been reducing their consumption of fossil sources. As a result of the projects, huge renewable energy resource reserve funds have been established.

Turkey has great potential in terms of renewable resources. However, the use of these resources requires significant investments. This means that every year, investment projects will require approximately 5-6 billion dollars. This is a significant amount and it is not easy to find these funds. The hard-to-find funds are not the only obstacle; attracting public interest is very important as governments alone cannot fulfill the obligations required to make this change. The support of the private sector too is necessary.

After the energy crisis in 1996, developing the electricity market and issuing the natural gas law was put on the agenda for 2001. However, this source of renewable energy, that was intended to be utilized by implementing the BOT, is fragile. A lot of companies cannot afford the costs. During this period, only those who adopt the method of auto production have continued to sustain investors. However, as predicted, these investments also are very small scale. He demand for energy continues to increase. The laws of the electricity market in 2005, with the emergence of renewable energy source projects, became more attractive. 2008 becoming energy efficiency year is an indicator that people understand the importance of these resources. Participation in the Kyoto protocol in 2009 with the signing of the applications has increased investments in these resources. Especially on the EMRA's official page, hundreds of renewable energy sources that will appear in the license application of the project are present. Realizing the importance of these resources, the stamp duty exemption, and exemption from import laws when bringing in products to private companies have increased the demand of the renewable sources. Moreover, renewable energy investments from international organizations, especially from institutions like the World Bank may find long term funds. Private banks in Turkey, especially after 2007, understand the benefits of this source of funds and began to allocate significant shares. Deployment of these resources needs substantial investment in the construction period, but during the operation period, there is no dependency on other sources; they can renew themselves and lower external cost due to the return advantage when compared fossil based sources. Our country has been through the transition phase to these sources, but the state's largest private sector investment decisions and cooperation with the installed capacity of these sources can vary rapidly.

Finally, as this study reveals, renewable energy resources in the world today are less preferable compared to fossil resources due to lack of support on the costs of renewable energy. Renewable energy enables governments to act more independently and to contribute to sustainable economy world-wide. Moreover, renewable energy will help people to create a livable world. Therefore, new regulations are vital for entrepreneurs to take risks and invest in renewable energy resources and to put pressure on the world to protect the environment before it is too late.

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