THE EFFECTS OF THE RENEWABLE ENERGY INVESTMENTS ON SUSTAINABLE DEVELOPMENT

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ABSTRACT

THE EFFECTS OF THE RENEWABLE ENERGY INVESTMENTS ON SUSTAINABLE DEVELOPMENT

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Energy is one of the most important inputs of the contemporary economies. In order to produce goods and services, human beings need more energy than before. Parallel to the technological and economic development, the energy needs of human beings have been increasing steadily since the industrial revolution. Although the population and energy needs of the world have been increasing steadily, the world's energy needs have been mainly met by the fossil based energy resources. Since the distribution of the fossil based resources is not equal in the world, the countries having lack of fossil based energy resources are highly dependent on those countries having rich reserves. Therefore, any political or social instability can directly affect the supply of the energy and the price of these commodities can easily be hiked like being in 1974 and 1979 crisis. This reality, however, creates energy dependency for the countries which do not have enough energy resources and make their economy more

fragile against the energy supply and price shocks. Therefore, to maintain energy security, reliable and cheap energy supply become priority of policy makers of the many developed and developing countries in the globalized world.

Apart from the amount and distribution of fossil based reserves in the world, sustainability of the development depending on these energy types has been questioned since the beginning of the 1970s, because of the harmful environmental effects of fossil based energies. Global warming, climate changes, environmental pollution forced the United Nation to take precaution against the excessive usage of the fossil based resources. In this context, to decrease the gas emission and to limit the harmful effects some summits were organized by the UN. As a result of these summits, *"Our Common Future"* report was prepared and Kyoto Protocol was accepted by the UN members.

Turkey is a poor country in terms of fossil-based energy sources. Therefore, the country's energy needs are met by paying at about 50 billion dollars to the importer countries every year. The country has experienced 15 economic crises throughout the republic periods and nearly all economic crises are directly or indirectly related with the current account deficit. As a result of economic crises, the social and political stability of the country was deeply affected and some undesired political coup or social events were lived in our country. However, when the energy import is excluded, the trade balance of Turkey is relatively balanced. Turkey does not have enough fossil based resources but its renewable energy potential is very high comparing with the European Union. Hence, it is believed that if they can be evaluated efficiently, renewable energy resources can make significant contribution to the sustainable development and growth of the country.

In this study, the effects of the renewable energy investments, made under the sustainable development concept, on the social and political stability of Turkey were investigated. The analysis was based on the effects of the renewable energy investment to the current account

deficit of Turkey. To make the concept more understandable, the renewable energies, their potential, current account deficit and economic crises experienced throughout the republic periods were investigated in detail. As a result of the study findings some recommendations were made in the conclusion section.

Keywords: Energy, Renewable Energy, Sustainable Development, Current Account Deficit, Economic Crises, Political and Social Stability.

ÖZET

YENİLENEBİLİR ENERJİ YATIRIMLARININ SÜRDÜRÜLEBİLİR KALKINMA ÜZERİNDEKİ ETKİSİ

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Enerji günümüz ekonomilerinin en önemli girdilerinden biridir. Mal ve hizmet üretebilmek için insanlık günümüzde geçmişe göre çok daha fazla enerjiye ihtiyaç duymaktadır. Ekonomik ve teknolojik ilerlemelere paralel olarak endüstri devriminden bu yana enerji ihtiyacı her geçen gün artmaktadır. Ancak, nüfus ve enerji ihtiyacı sürekli artmasına rağmen enerji ihtiyacının çoğunluğu fosil bazlı enerji kaynakları tarafından karşılanmaktadır. Fosil bazlı enerji kaynaklarının dünya üzerindeki dağılımı eşit olmadığından, enerji kaynakları az olan ülkeler, kaynak bakımından zengin olan ülkelere bağımlı hale gelmektedirler. 1974 ve 1979 krizlerinde olduğu gibi, herhangi bir politik veya siyasi istikrarsızlık enerji arzını doğrudan etkilediğinden enerji fiyat şoklarına neden olabilmektedir. Bu gerçeklik ise enerji kaynakları bakımından fakir olan ülkeleri enerji şoklarına karşı kırılgan yapmaktadır. Bu nedenle, bugün küreselleşen dünyada enerji arz güvenliği, ucuz ve kesintisiz enerji arzının sağlanması gerek gelişmiş, gerekse de gelişen pek çok ülkenin politik önceliği haline gelmiştir.

Fosil bazlı enerji kaynaklarının miktar ve dünya üzerindeki dağılımı dışında bir çok zararlı çevresel etkilerinin olması nedeniyle bu enerji türüne bağlı gelişmenin sürdürülebilirliği 1970'li yılların başından bu yana sorgulanır olmuştur. Küresel ısınma, iklim değişikliği ve çevresel kirlenme gibi nedenler Birleşmiş Milletleri bu enerji kaynağının aşırı kullanımına

karşı önlem alınmasına zorlamıştır. Bu kapsamda, gaz emisyonunu azaltmak ve zararlı etkilerini sınırlandırmak için Birleşmiş Milletler tarafından zirveler düzenlenmiştir. Bu zirvelerin sonucunda *"Ortak Geleceğimiz"* raporu hazırlanmış ve üye devletler tarafından Kyoto Protokolü kabul edilmiştir.

Türkiye fosil bazlı enerji kaynakları bakımından fakir bir ülkedir. Bu nedenle ülkenin enerji ihtiyacı her yıl ithalatçı ülkelere yaklaşık 50 milyar dolar ödenerek karşılanmaktadır. Türkiye cumhuriyet tarihi boyunca 15 ekonomik kriz yaşamıştır ve bu krizlerin hemen hepsinin nedeni cari işlemler açığı olmuştur. Bu ekonomik krizlerin sonucunda ülkemizdeki sosyal ve siyasi istikrar ciddi ölçüde etkilenmiş ve istenmeyen bazı sosyal olaylar ve siyasi darbeler yaşanmıştır. Enerji ithalatı çıkarıldığında ülkemizin ticaret dengesi görece olarak dengelidir. Ülkemiz fosil bazlı enerji kaynakları bakımında zengin olmamasına rağmen Avrupa Birliği ile karşılaştırıldığında yenilenebilir enerji potansiyeli oldukça yüksektir. Bu nedenle, eğer verimli bir şekilde değerlendirilebilirse yenilenebilir enerji kaynakları ülkenin sürdürülebilir kalkınmasına önemli katkıda bulunabileceğine inanılmaktadır.

Bu çalışmada, sürdürülebilir kalkınma kapsamında yapılacak yenilenebilir enerji yatırımlarının Türkiye'nin sosyal ve siyasal istikrarına etkileri incelenmiştir. Analizler yenilenebilir enerji yatırımlarının cari açığa etkisi üzerine yapılmıştır. Kavramı daha anlaşılır kılmak için yenilenebilir enerji kaynakları ve potansiyeli, cari açık, cumhuriyet dönemi boyunca yaşanmış olan ekonomik krizler detaylı bir şekilde incelenmiştir. Çalışmanın sonucunda elde edilen bulgular doğrultusunda sonuç bölümünde tavsiyelerde bulunulmuştur.

Anahtar Kelimeler: Enerji, Yenilenebilir Enerji, Sürdürülebilir Kalkınma, Cari İşlemler Açığı, Ekonomik Krizler, Siyasi ve Sosyal İstikrar.

To my parents…

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LIST OF ABBREVIATIONS

Bcm	: Billion cubic meters
BP	: British Petroleum
BTEP	: Billion Tons of Equivalent Petroleum
CSP	: Concentrating Solar Power
CTL	: Coal to a Liquid Fuel
DME	: Dimethyl Ether
DPT	: State Planning Organization
EMRA	: Energy Market Regulatory Authority
EPC	: Electricity Production Company
EU	: European Union
Ftc	: Trillion feet cubic
GDP	: Gross Domestic Production
GDRE	: General Directorate of Renewable Energy
GEA	: Geothermal Energy Agency
GW	: Gigawatts
IEA	: International Energy Agency
IMF	: International Monetary Fund
LPG	: Liquefied Petroleum Gas
Mboe	: Million Barrels of Oil Equivalent
MENR	: Ministry of Energy and Natural Resources
MERA	: Mineral Research and Exploration Agency
MD	: Ministry of Development
Mtce	: Million Tons of Coal Equivalent
MTEP	: Million Tons of Equivalent Petroleum
MTMAC	: Ministry of Transport, Maritime Affairs and Communications
Mtoe	: Million Tons of Oil Equivalent

MW	: Megawatts
OECD	: Organization for Economic Cooperation and Development.
O&M	: Operating and Maintenance
OPEC	: Organization of the Petroleum Exporting Countries
PV	: Photovoltaic
R&D	: Research and Development
SHW	: State Hydraulic Works
TCE	: Turkish Coal Enterprises
Tcm	: trillion cubic meter
TÇSV	: Turkey Environmental Issues Foundation
TEP	: Tons of Equivalent Petroleum
THCE	: Turkish Hard Coal Enterprises
TMEC	: Turkey Mechanical Engineers Chamber
TPC	: Turkish Petroleum Company
TWh	: Terawaat hours
TurkStat	: Turkish Statistic Institution
UK	: United Kingdom
UN	: United Nations
UNDESA	: United Nations Development of Economic and Social Affairs
UNDP	: United Nations Development Program
USA	: United States
WCED	: World Commission on Environment and Development
WEC	: World Energy Council
WEHAB	: Water, Energy, Health, Agriculture, Biodiversity
WW	: World War
WWEA	: World Wind Energy Agency

INTRODUCTION:

Energy consumption is one of the major indicators of development in contemporary world economy. In order to produce goods and services, today human beings need more energy than before. Although the population of the world and the need for energy resources have been increasing steadily, the world's energy needs have been mainly met by the fossil based energy resources, which are very limited and the reserves have been decreasing continuously, since the discovery of the oil in Pennsylvania in 1859. Therefore, unless new reserves are discovered or the consumption level is decreased, it is estimated that, with the current consumption level, the oil reserves will be completely exhausted in 50 years.

Beside this, as a result of the excessive use of fossil based energy resources, environmental costs have been increasing day by day. If people do not take enough precautions, the next generation cannot find any habitable place in the world. In other words, the excessive usage of fossil based energy resources threat the sustainable development of the world. Because of its harm to the environment, such as global warming and climate change, the United Nations has been trying to find a solution to decrease the consumption of those commodities. In order to achieve this goal, the United Nations World Commission on Environment and Development (WCED) declared a report known as "*Our Common Future" or "Brundtland Report"* and defined the Sustainable development as *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987).*

Due to the fact that the present usage of the fossil based energy resources directly affect the future generation's life, the Kyoto Protocol was adopted by United Nation to decrease the gas emission to the 1990s level. However, because of the economic cost of protocol, some of the developed countries and Turkey hesitated to participate the protocol for years. As a result of the international pressure, Turkey and some other developed countries, including USA, participated to protocol at the end but, the world countries failed to the reach The

Kyoto Protocol's goals to decrease the emission level to the 1990s. As the direct and hidden cost of fossil based energy resources are very high, most of the countries have been trying to develop new technologies not only to reach that goals but also to diversify their energy supply by using reliable and domestic resources. These efforts cannot be reached to the desired level yet and it is estimated that fossil based energy resources will remain the main source of the energy needs in the next 30 years.

Because of being limited and not homogeneously distributed in the world, the price of the fossil based energy resources is not stable and sometimes this instability may cause severe economic crisis in the world. For example, when the world economy grows faster than expected or the supply of the oil is decreased by OPEC or other oil producer countries, the price of that commodity is increased rapidly. The price hike does not only depend on the supply-demand equilibrium but also depends on the political decision, like being in 1973 after Arab-Israel War, and the political instability, as occurred in Iranian revolution crisis in 1979. In other words, the limited resources are affected both by supply-demand equilibrium and political situation of the producer countries. Therefore, if a country, like Turkey, does not have enough energy resources to support its economy, it can be said that the country is open to the energy crisis' effects.

As a result of huge dependency of world economies to the energy, the countries need reliable and cheap energy supply to maintain sustainable development and to increase the welfare of their citizens. This policy becomes priority of politicians of the many developed countries. Hence, it can be said that in contemporary world, the energy plays a more important role in international relations than before and today's political games are played on keeping the reliable and cheap energy resources in control.

Turkey, although it seems as if the corridor or bridge of the energy supply between east and west, does not have enough energy resources and nearly 91 % of the oil consumption and 98.5 % of natural gas consumption are provided by importing that commodities from abroad. Beside this, more than 50 % of the electric production, which is also called as secondary energy, depends on the imported natural gas and coal. While Turkey spent 38.5 billion dollars for its primary energy needs in 2010, which is equal to 21 % of Turkeys'

total import, due to the high oil and natural gas price, this number increased to the 54 billion dollars in 2011 and 60 billion dollars in 2012. In other words, in 2012 energy import constitutes nearly 25 % of total import of Turkey and this number is nearly equal to the current account deficit of the country.

Another important issue that should be mentioned in here is that the ratio of Turkey's export dependency to import is nearly 77 %. That is to say, in order to make one dollar export Turkey has to make at least 0.77 dollar import. After the intermediate goods, the main item in import is the energy resources. In order to produce goods and services, the companies need energy inputs, both primary inputs, like oil for transportation, and secondary one, like electricity. Because of the correlation between the energy prices and cost of producing goods and services, when the energy prices increase, the price of Turkey's goods and services also increases. This situation directly affects the Turkey's competition power in the world market. The high dependency to foreign energy resources does not only reduce the competitiveness of the country in the world market but also affects the growth ratio, balance of payments and sustainable development of the economy negatively.

It should be emphasized that the current account deficit is the Achilles heel of the Turkish economy. When we look at the reasons of the economic crises of Turkey lived in republic period, we see that the main reason of the nearly all economic crises, like being experienced in 1958, 1974, 1978, 1994 and 2001, is the current account deficit and devaluation of the currency. As mentioned above, Turkish economy mainly depends on the importation of raw materials and energy resources, and this dependency is one of the main factors of the current account deficit. Since the fragility of the economy against the current account deficit is very high, it is very important to decrease the current account deficit to maintain sustainable development of the country. In this sense, I want to elaborate the definition of the sustainable development by adding "the stable growth of economy" to the definition of *"Brundtland Report"*.

On the other hand, with the beginning of Arab Spring, the political structure of the Middle East countries, holding the 65 % of energy resources in the world, becomes more fragile.

This situation directly affects the supply and security of the energy, especially oil. West-Iran nuclear tensions, and possibility of war between Iran-USA and/or Israel are also threats for the reliable and cheap energy supply not only for Turkey but also for the rest of the world. While Turkey is in alliance with Western and USA, it buys nearly 75 % of its natural gas from Russia and Iran, which are the other polar of the tensions in Syrian crisis. In this picture, Turkey faces with some political difficulties to take part an active role in the international events due to the blackmail of energy suppliers. As it can be seen, the energy dependency directly affects Turkey's foreign policy and security of the energy supply. All those indicators show that in order to be independent with the exact meaning of the word and become an important country in the international area, Turkey has to solve its energy dependency and develop a new energy policy that depends on the domestic and cheaper energy resources.

At this point, the renewable energy investment policy and its implementation gains importance, as it has a potential to decrease the current account deficit and to provide clean and reliable energy supply for Turkey. Although Turkey does not have enough fossil based energy resources, its renewable energy resources potential is much bigger than most of the EU countries. If they can be evaluated efficiently and effectively, the renewable energy resources, which are not only clean and friendly to the environment but also important for the security of the energy supply of the countries, can help to decrease its current account deficit. Since renewable energies' production cost is very low, they have the potential to increase the competitiveness of the country. Therefore, it can also contribute the sustainable growth ratio and development of the country.

Because of the mentioned reasons, the reliable, clean and cheap energy resources are very important not only for our country and but also for the rest of the world. Hence, the main purpose of this dissertation was to investigate energy dimension of the sustainable development and its effect on macroeconomic balances of Turkey. It was tried to demonstrate the importance of evaluation of the renewable energy potential and its effect on current account deficit and sustainable development in Turkey. Our research question focused on "Whether the renewable energy investments, which are made on the scope of

the sustainable development, can contribute the social, economic and political stability of Turkey by decreasing the current account deficit?" Our hypotheses are:

H1: Renewable energy investment can contribute the ecological sustainability of country,

H2: Renewable energy investment can help to decrease the current account deficit

H3: Renewable energy investment can contribute the social and economic stability of country by decreasing the current account deficit.

The study tried to explore the answer of above mentioned question by examining the relationship between current account deficit and energy consumption. It was tried to find whether there was a correlation between the current account deficit, economic crisis and political stability in Turkey and the renewable energy investment can support political stability of Turkey by decreasing the current account deficit. In order to understand better, the concepts of the sustainable development, renewable energy, renewable energy potential of Turkey, current account deficit, the economic crisis that Turkey experienced since the establishment of the Republic were investigated. By showing the costs and benefits of the renewable energy resources, it was intended to make contribution to the solution of the energy dependency and current account deficit problems of Turkey.

This study emphasized the critical role of renewable energy resources in decreasing Turkey's energy dependency and current account deficit, by maintaining its energy security, minimizing the environmental cost of traditional fossil fuels and providing social, economic and political benefits. It was aimed to bring a different perspective to the Turkish energy market and contribute a long-term solution-based permanent approach to traditional fossil fuel related, environmental, political, economic and social problems of Turkey.

Apart from introduction, literature review and conclusion sections, the dissertation has five chapters. The summary of the existing literature related with renewable energy, sustainable development, the effects of renewable energy investment on environment and current account deficit in Turkey and the world was given in the literature review section.

In the first chapter, the concept of development and sustainable development was defined. The emergence of the sustainable development, its development and objectives of it was explained briefly. The relationship between the sustainable development and energy consumption and the concept of sustainable energy were also given in this section.

In the second chapter, the concept of energy was examined. The security of energy supply and classification of energy resources were explained briefly. After giving basic information about the energy and renewable energy, the types of renewable and non-renewable energy resources were described. In this context, the coal, oil, natural gas and nuclear power in non-renewables and the wind, solar, geothermal, biomass and hydroelectric energy resources in renewables were examined.

In the third chapter, the energy outlook of Turkey was examined. While explaining these terms, the relation between energy usage and economic growth, security of the energy supply and the renewable energy resource potential and current energy situation of Turkey were investigated. Historical energy policy of Turkey and the importance of the energy efficiency were examined in this section.

In the fourth chapter, the concept of the balance of payments was described. In here, the correlation between the economic growth and current account deficit, the effect of the energy usage on current account deficit and reasons of the some big economic crisis lived in Turkey was investigated. Structure of the manufacturing sector and role of the renewable energy on competitiveness of the Turkish goods and services was also examined.

In the fifth chapter, the analysis of the renewable energy investment was done. The effects of renewable energy investment on sustainable development, current account deficit and energy dependency was analyzed by using the current data of remaining economic energy potential and efficiency of each renewables. While analyzing the data, only economically producible potential of renewables and minimum amount of efficiency of each renewable energy resources were taken.

In the conclusion chapter, the results of the study were evaluated and recommendations were done to the policy makers about the implementation of the renewable energy investment.

MATERIAL AND METHODS

The data used in this study are obtained from previous studies, made by other researchers, International Energy Agency, Ministry of Energy and Natural Resources, World Energy Council, Turkish Statistic Institution (TurkStat), Ministry of Finance, and other official web sites. I have tried to use the most recent data especially about the Turkey's energy situation. Literature review was made by using the relatively new essay about the topic. While studying development and sustainable development concepts I have benefited from the books written about these subjects.

To make comparison and analysis, tables and figures were constituted by using the data of TurkStat, WEC and IEA and MENR. To elaborate the topic, the economic terminology was investigated and balance of payment, economic crisis of Turkey and other related concept was examined.

In this study, domestic and foreign secondary data sources, obtained from the results of the screening, were used. Optimized energy-related data, created based on the data in graphs and tables, were collected regularly. In addition, on the basis of these data, some simple calculations, arithmetic averages and ratios derived from statistical techniques and their comments were made. Largely, descriptive method was used while interpreting the result of the study and calculations. It was intended to make the topic more understandable by making consistent comparison and analysis in dissertation.

LITERATURE REVIEW

Renewable energy and its effects on balance of payments and sustainable development is a very large concept that consist of three main titles: renewable energy, sustainable development and balance of payments. Therefore the literature that was reviewed includes all these titles. While previously the concept of sustainable development only consisted of the economic development in monetary term, today its meaning is elaborated very largely. It includes food security, new and renewable energy, harmony with nature, promotion of human rights, friendly technological development etc (Morgera, 2010). Therefore, sustainable development cannot be contemplated without energy and its social, political and environmental effects in contemporary world.

In literature, the concept of energy is classified by many writers. According to Kruger (2006), there are three kinds of energy resources; primordial, fossil and renewable. Demirbaş (2009), however, classified the energy resources in three main titles but instead of primordial, the writer uses the fissile energy resources, which are uranium and thorium. When we look at the literature from the renewable energy perspective Twidell and Brice (1992) make a classification as follows: Accepted renewable energy, new renewable energy, clean up renewable energy and integrated renewable energy. While doing this classification the writers took into consideration the historical and technological development of renewable energy. For example, the reason of clean up classification is the municipalities' energy production from garbage, which is very new and very popular especially in metropolitan municipalities.

When we look at the renewable energy studies in Turkey, it can be seen lots of works on this area. Kirtay (2009), in his study "Role of the Renewable Energy Resources in Meeting Turkey's Electrical Demand", demonstrated that nearly 97 % of natural gas and 93 % of oil requirement of Turkey were provided from abroad and because of this situation the cost of energy have been increasing steadily. He recommended that this imbalance situation

should be corrected by making investment in renewable energy resources. In her study Erdem (2010) also emphasized the negative effects of the huge dependency on foreign energy resources.

While Erdem did not mention the environmental effect of the renewable energy, Yaylalı (2008) designed a study on this topic to show the environmental effect of the renewable energy. According to him, in order to reach the Kyoto Protocol standards, Turkey must accelerate its investment on renewable energy resources. Like Yaylalı, Demirbaş (2009) also investigated the relationship between renewable energy and environment and reached a result that the renewable energy was not only a solution to the environmental problem but also a necessity for the sustainable development of the country.

Kleviene, (2011) emphasized the importance of the renewable energy resources by showing its effect on energy security and environment. He examined the cost of the renewable energy by adding the environmental effect and cost of the fossil based energies. He revealed that with the policy of increasing energy supply efficiency, energy transformation efficiency development of public transport and heat conservation in buildings, the renewable energy could contribute not only diversification of energy supply but also clean, domestic and reliable energy supply. Kalnins, (2011), in his study "The Role of Renewable Energy Sources in Electricity Production", also reached the same result with that of Kleivene's that with the cost of greenhouse gas emission, the fossil based energy resources are the most costly energy resources.

Despite the previous writers, who approached the topic from environmental perspective, Yüksel (2010) made a study about the financial opportunity of making an investment on renewable energy field. According to him when the investors decided to make investment on the renewable energy market of Turkey, they can use loan from World Bank that meets nearly 40 % of the capital cost of their investment. The writer indicates that there is a financial opportunity in this field, hence, Turkey should encourage and canalize the private investors to this area.

Kaygusuz (2004) also worked on this topic to show the social benefits of the renewable energy investment. For him, investment on this area can be a solution for the poverty problem of Turkey. The same result found by Öğütçü (2010) in his study that since different types of renewable energy investments can be done in every region of the country, it can contribute the job opportunities in every region of Turkey. As a result of this, poverty and disparities among the regions can be reduced.

Albostan, Çekiç and Eren, (2009), contributed the literature by analyzing contribution of the renewable energy resources to Turkey energy supply. In the article of "The effect of the wind energy on Turkeys' energy supply security", they emphasized that today's world energy demand is mainly met by fossil based energy resources and that kind of energy is not only limited but also have a negative effect on environment. Furthermore, they said, price of the energy is very changeful and when the demand increases rapidly, the prices of oil and natural gas hike and they have a negative impact on economic development. On the other hand, security of the energy supply is as important as the price of it, because with the terrorist attack or lack of investment to the energy sector, the supply of the energy could be interrupted. In their article, they clearly showed that 54.7 % of electricity need of Turkey is met from imported resources and Turkey dependency on oil and natural gas is very high. In order to maintain sustainable development, they said, Turkey should decrease its dependency to the imported energy resources.

One and very reliable way of doing this is to increase investment on the renewable energy resources according to the writers. Today, Turkey's potential renewable energy resources are, as they revealed, 34,729 MW/year from hydro-electric dam, 50.000 MW from wind energy, 4.500 MW from geothermal energy, 8.8 million equivalent oil energy from solar energy. Established energy plant potential of Turkey is 51.766 MW in 2011 and it is estimated that in 2020 this number will reach to the 90.000 MW/year. When we look at this picture, as Albostan, Çekiç and Eren showed, Turkey can meet nearly all of its electric needs from its domestic, clean and renewable energy resources, if the policy makers can plan and implement a correct policy on renewable energy.

Telatar and Terzi (2009) designed a research on the relationship between economic growth and current account balance between the 1991/4-2005/4 periods. In their study they analyzed the relationship by using the Granger causality and VAR analysis. According to their study result, there is one way relation from growth to the current account deficit. That is to say, Turkey's economic growth depends on the current account deficit and an increase in the growth rate will also increase the current account deficit. Although the biggest part of the import was the energy import, they did not mention about it and they said that nearly 70 % of the import was raw materials. In order to decrease the current account deficit, they recommended, Turkey must give incentives to the domestic production of the raw and finished goods. By giving the incentives, they claimed, the employment will also increase and this will also contribute to the solution of the unemployment problem of Turkey. In their study, they ignored both the security of the energy supply, which is mainly based on oil and natural gas import, and its effect on current account deficit. However, to solve current account deficit problem permanently, Turkey has to increase the domestic reliable energy supply and, for today, the only way of producing domestic energy is renewable energy, such as solar, wind and hydro-electric plant.

Demirbaş, Türkay and Türkoğlu (2009) examined the development of the oil prices and its effect on Turkeys' current account deficit. In their article they classified energy resources as primary energy resources, such as oil, natural gas and coal, and secondary energy resources. Primary energy resources are used directly to produce energy, like electric, or to transport goods and commodities, and dependence of Turkey on this kind of energy resources is nearly 93 %. Although the dependency of the secondary energy needs is relatively low, comparing with the primary energy resources, Turkey produces more than 50 % of the electricity from natural gas and coal plants and this situation also gives alarm to the country's about the reliability of its energy supply. In their work, they empirically proved that there was a direct relationship between the current account deficit and oil prices. In other words, when the oil prices increase, the current account deficit of Turkey also increases. They recommended that in order to decrease current account deficit and its negative effects to the economy, alternative energy resources should be emphasized and oil exploration activities should be accelerated.

Erbaykal (2007), made a causality analysis between the current account deficit, growth ratio & real exchange rate in Turkey. He examined the real exchange rate and current account deficit between the 1987 and 2006 periods. According to his test result, obtained from the framework of Toda and Yamamoto causality analysis, there was one-way causality from the economic growth and exchange rate to the current account deficit. He found that current account deficit was affected both by economic growth, by increasing the total demand of the citizens to the goods and services, and real exchange rate, which was determined by short-term capital flow. To maintain sustainable development, he claimed, the growth rate of the economy should not be so high and over appreciation of the TL should be prevented.

Apart from above mentioned literatures, there are a lot of studies on renewables and they made very big contribution to the development of the concept. I hope this study will also contribute to the literature of the renewable energy concept. This study shows the environmental and economic benefits of renewable energy resources to our country. The study will also demonstrate the contribution of the renewables to Turkey's economy, social and political stability by decreasing the energy dependency and current account deficit. I wish this study will be a guide not only for local and central government agencies but also for the domestic and foreign investors to accelerate their investment on the renewable energy area. In addition, the study will be a guide for the students to make further studies by adding current the account deficit, economic crisis, social and political stability to the sustainable development and renewable energy concept.

CHAPTER I

1. DEVELOPMENT AND SUSTAINABLE DEVELOPMENT

The history of human beings has been progressing steadily since the emergence of the nations. The development and sustainable development can be defined as the desired changes and progress in the social and political life of the nations. In contemporary world, the development of the nations and countries directly depends on the energy usage. Since the majority of energy needs are met by fossil based energy resources, the sustainability of development has been questioned since the emergence of the sustainable development concept at the beginning of the 1970s. Therefore, the concept of development, sustainable development, and their relationship between the energy and sustainable energy will be examined in this chapter.

1.1. Development

The development has been using in different meaning since the emergence of the concept. It was sometimes used for the industrialization, modernization, economic progress, economic growth and structural changes. Therefore, the meaning of the concept can be different both from time to time and from one society to another. In fact, the meaning of the development is nested with above mentioned concepts not only in the theory but also in the daily life usage. (Yavillioğlu, 2002a: 63). There are two main issues of development theory. The first of them is the specification of the factors that determine the development and the second one is how to ensure the optimal allocation of available production factors (Savaş, 1989, 107).

Development is a process, in which the countries try to reach to the determined goal of the society (Ingham, 1995; 33). Overall description of the development is the regulation of economy as a whole to reach the desired level of development. More broadly, the

development can be defined as any desired changes and progress in the social and political life of the nations. Historically, it involves the meaning of reducing the human suffering and mobilizing the potential of country to increase the prosperity of the societies (Gasper, 1996: 209).

Although there are a lot of definitions of the development, there is not any agreed definition of the concept. Because, the development is illustrated by both subjective and objective factors. At the same time, since every countries' economic, social and cultural structures are different from each other, it is difficult to make a valid and comprehensive definition of development. For the less developed countries, the development is the effort of the countries to reach the developed countries' level. These efforts include national income increase, changes in socio-economic structure and citizens values in accordance with the standards of the developed countries. However, for the Human-axis definition, the development means creating the conditions necessary for the realization of human personality. In this context, the development can be evaluated in accordance with the decrease in the poverty, unemployment and inequality criteria of the human beings.

Development is not only means of increasing the production and income per capita but also it has meaning of the socio-cultural improvement and changes in a society of the developing countries. Beside this, structural changes such as the increase of the production factors efficiency, increase in the share of industrial sector in GDP and export, can be seen as the basic elements of the development. (Han and Kaya, 2008: 2)

The emergence of the economic development as a subfield of the economics coincided with the years after World War II. For classical economist, the concept of development is generally related with the production and national income increase. Apart from the production and national income increase, they were not interested in other factors such as environment. For classical economist, there is no function of the state in the development. However, after 1929 economic crisis Keynesian economics was emerged. Keynes' contribution to development economy was not direct but his suggestion about government intervention was one of the most emphasized issues in the economics history. Requirement

of the state intervention and degree of intervention for the economic development found place in the debate of the development concept.

Promotion of the development economics continued until 1970's. With the beginning of the 1970's some of the economic crises and oil shock deteriorated the economies and new liberal politics was started by western economies (Şenses, 2003). Development economics has left the agenda to the neo-liberals, and especially after 1980's, the privatization and neo-liberal economy politics gained speed in the world. Therefore, the concept of the development was changed again. In short, economic development concept may include various meaning and methods based on the time, society and living conditions.

1.2. Emergence of the Sustainable Development

After industrial revolution, the world countries entered into the rapid development and economic growth period. In this period, the economist did not make any distinction between the economic growth and development. In order to heal wounds of the wars, 1st and 2nd World War, and increase the national income, the world countries focus on the economic growth and international trade especially after the second half of the 20th century. They did not pay attention to the harm of this type of economic growth. In later years, due to the effects of the encountered environmental damage, understanding of economic growth as the increase in the per capita national income was started to be criticized (İşgüden at all, 1995; 203-206).

According to the classical economists, the water, air and other natural resources were assumed as unlimited. Therefore, they did not give any importance to the environment. They saw natural resources as free goods and the only way of development was seen as the production increase and growth of the economy. This situation prevented the development of the environmental awareness not only in developing countries but also in developed countries. (Dulupçu, 2001:1). Although the Keynesian revolution changed the lots of concept in economy literature, the concept of development was seen as equal to the economic growth by Keynesian economists.

According to the some authors, the main mistake that classical economist had done is on the conceptualization of the welfare term. Because in the classic theory, there is no value of the environment quality or natural balances. They explained the environment in the context of the alternative cost that if the people give 1 dollar for the protection of the environment, they have to give up one dollar production of the goods and services. (Dura at all, 1985: 39). Classics argued that the technological development can prevent the deterioration of the environment. Their Environmental Kuznet Curve was an answer to the Rome Club's *"Limits of the Growth Report"*. According to Kuznet's curve, at the beginning of the development the environmental pollution will also increase but later, with the technological innovation and development of the service sector, the pollution will decrease.

The classics neglected not only environment but also human resources in the concept of the development. They did not deal with the health, education or social development of the society. Their only criterion for development was the production increase in the economy. However, with the beginning of the 1970's, the scientists started to question the limits of the growth. The report, *"Limits to Growth"*, which was prepared by Rome Clubs, was the beginning of this discussion. According to this report, the natural resources cannot meet the rapid population growth and in 150 years and the world will lose its habitable property. Therefore, in order to protect the environment, the rate of development should be decreased.

Since the last quarter of the 20th century, the negative consequences of the GDP growth have been realized and it is understood that material production increase cannot provide the social welfare by itself. Therefore, today it is begun to understand that the social welfare depends on a number of other factors, such as environment, social justice etc. The GDP growth that leads to deterioration of the quality of life is insufficient to explain the development concept. Because, deterioration of environment has been decreasing the quality of life and causing the serious problems. Hence, contemporary development concept is an approach that deals with the quantitative and qualitative development of the society and economy (Kuleli and Sonat, 1991: 3).

With the effect of the Rome Club, the development of society is accepted not only in economic term but also in social, human, and environmental terms. In this context, the traditional concept of development has undergone significant criticism and change. As a result, the development concept is being addressed in a comprehensive manner including the environment, natural resources and human. Thus, a multi-dimensional concept of "sustainable development" has emerged (Han and Kaya, 2008: 257).

The sustainable development concept became very popular, especially after 1970s, because social awareness about the environment increased at that time. Although there are many factors about why sustainable development policy was born and developed very late, the Keynesian economics and restructuring process of the world can be seen the most important factor. Because after great depression of 1929 and World War II, the short term economy policy such as prevention of unemployment and accelerating the growth rate, became dominant in world economy agenda. However, when we came to the 1970s, sustainable development began to raise question until which point welfare and international wealth can be continued with the current rapid industrialization and increased international trade level. (Dulupçu, 2006).

Although the sustainable development concept was emerged with the Stockholm Conference in 1972, it became very popular after UN Environment and Development Commission's "Our Common Future" Report, known as Bruntland Report, in 1987. With this report, UN invited all nations to protect the environment and rights of the future generation while growing the economies. After this conference and report, the UN held a summit in Rio in 1992 and 5 fundamental documents related with the sustainable development was accepted by the participators. However, since the accepted principles could not be realized at a desired level, UN held United Nations Conference on Human Settlements (Habitat II), in Istanbul in 1996, New York Conference in 1997, and Johannesburg Sustainable Development Summit in 2002. During the last summit, the governments have discussed on what to do in the five priority areas; water, energy, health, agriculture and biodiversity issues (WEHAB). In Johannesburg Summit, "Implementation Plan" and the "Johannesburg Declaration on Sustainable Development" was adopted as the two main outcomes of the summit.

1.3. Definition of the Sustainable Development

With the simplest word, the sustainable development can be defined as to meet the needs of the current and future generations without exhausting natural resources by establishing a balance between nature and human beings. This definition consist of the programming the development of today and future life of the generations and nature. Therefore, sustainable development is a concept that has social, economic, ecological and cultural dimensions (UNDESA, 2002).

To examine the definition of sustainable development and to make sense of what is meant primarily, the concept of being sustainable is to be understood. Sustainability is to be permanent. Daily and Ehrlich defined the sustainability as the protection of the social, economic and ecological systems at least at the needed level. (Kılıçoğlu, 2005:14) Social dimension focuses mainly on human beings and deals with participation, social mobility, social cohesion, cultural identity and institutional development of the people. Economic sustainability focuses on economic growth, distribution of income and efficiency in economic factors. Ecological dimension, on the other and, deals with the protection of ecological systems, biodiversity and global issues, such as global warming (Kettner, et al., 2006)

The use of the resources without exhausting them is the basis of the sustainable development. According to the ecologists, this situation can only be ensured when the usage of the natural resources do not exceed the annual increase rate of this natural resources (Madran, 1991:140) Pearce defined the sustainable development as non-decreasing human welfare over the time period. According to this definition if a development decreases the next generation welfare, it cannot be described as sustainable development. In other words, if the development continues at the expense of the next generation, it cannot be named as sustainable development. (Kula, 1997:150)

When the economic policies only deal with the economic growth or national income increase, these policies may cause ecological imbalances. Because every economic growth requires the natural resource usage. The relationship between the ecosystem and

environment arises mainly in two ways. The first one is the use of natural resources as inputs for the economic production and consumption of goods and services. The other one is the environmental waste that is produced as a result of the economic activities. Sustainable development is development that takes into account the environmental impact of recycling economic activity (İşgüden at all, 1995: 205). In harmonious with this definition, for Demirayak, the sustainable development can be defined as improving of the quality of life in line with ecosystem (Demirayak, 2002: 4).

The concept of the sustainable development for the first time used in an official document in 1987 by Norwegian Prime Minister G.H. Bruntland, chaired the World Commission on Environment and Development, in the report entitled as *"Our Common Future."* This report defined the sustainable development as *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."(WCED, 1987).* In this definition two concepts were emphasized; the needs of present generation and the needs of the future generation. In other words, development can only be acceptable as the sustainable development if it meets both present generation needs without giving any harm to the future generation. With the concept of the "needs" the report pointed out the poor people's needs in the world. The report bring the equality between the present generation and future generation in the usage of the natural resources, investment orientation, hence present generations are responsible from the adjustment of this usage.

Sustainability consists of three different dimensions; economic, social and environmental. For example, for the developed countries when the concept of sustainability was debated, generally environmental dimension come to fore. However, for most of the developing countries sustainability in terms of the ecological perspective does not very important. On the other hand economic sustainability is not enough to define the term. Obtained social welfare must be considered together with the sustainability. In here social participation, the fight against poverty and civil society are the important concepts, because distribution of the income in a society and social sustainability are closely related. Therefore, "A primary goal of sustainable development is to achieve a reasonable and equitably distributed level

of economic well-being that can be perpetuated continually for many human generations." (Goodland and Ledec, 1986).

Although the priority of developed and developing countries can be different in terms of the sustainable development, the target and objectives of the concept are the same for all countries. The targets related with achieving economic development, the realization of social solidarity and environmental protection objectives are concerned all individuals, societies and countries both in local and global level without distinguishing developed or developing. In this regard, the main distinction arises from the implementation of these policies, establishing the institutional structure, and making needed legal regulation for countries. Sustainable development, in brief, tries to find harmony between the development and environment.

1.4. Objectives (Targets) of the Sustainable Development

In order to understand better the concept of sustainable development, it is very important to determine the objectives of the sustainable development. In the Our Common Future report (TÇSV, 1989,: 87, WCED, 1987; 78) the objectives of sustainable development are listed in following way:

1. To stimulate growth,
2. To change the quality of growth,
3. To meet basic needs of people in employment, food, energy, water and health,
4. To guarantee a sustainable population levels,
5. To protect and enhance resource base,
6. To redirect the technology and manage risk,
7. To combine economy with the environment in decision making process.

The main objective of sustainable development is, as described below, to ensure social solidarity, to improve the economic feasibility and to place ecological responsibility in the society. In this context, it is possible to handle the objectives of sustainable development in terms of economic, human, environmental and technologically.

According to the concept of the sustainable development, the first and foremost priority of economy is to meet individual and social needs in an effective and efficient manner. Economic conditions should be determined to encourage the individual initiatives, but at the same time, these conditions can protect the present and future generations' overall benefits. To maintain these, justice in the distribution of income, education and social services must be provided. By changing lifestyle and increasing efficiency, extravagance in the use of energy and other natural resources has to be reduced in an orderly manner.

From the human context, it is necessary to stabilize population growth, to prevent migration to the urban area. Educational standards, health services must be improved. Protection of cultural diversity, social situation, giving importance to environmental protection, education, launching and dissemination are required for sustainable development. Every member of society has the right to develop his or her personality. Democracy, legal security, respect for cultural diversity and human dignity of present and future generation are very important. (Han and Kaya, 2008:272) Fair share and equal opportunities is essential in the understanding of sustainable development. No one shall be subjected to discrimination due to any internal or external feature. Every member of society can have equal rights and opportunities.

Environmentally; basic principles that can be considered to improve the ecological responsibilities are; to secure natural life in a long run perspective, to diminish the ecologic harm of the economic development and to protect the biologic diversity in the world (Mengi ve Algan, 2003: 10). To do these, implementation of the polluter pays principle and to interfere the market mechanism with the free market tools are accepted as an essential things in the sustainable development (İşgüden at all, 1995:208).

Consumption of renewable resources has to be kept under the regeneration capacity of those resources and the level of consumption of the non-renewable resources must be below the growth potential of renewable resources. Harmful substances and solid wastes must be minimized; especially the level of emissions and solid waste cannot be disposed to the nature. Pollution should never be above the absorbing level of the ecosystem. The

protection of the natural resources and effective usage of the fertile lands are very important to maintain ecological equilibrium.

From a technological perspective; to minimize the pollution of the air, water and other environmental resources, existing technologies should be changed with the new ones which are environmentally friendly. Traditional technologies that pollute the environment very heavily must be given up. To decrease the carbon emission, the usage of alternative energy resources, such as renewable energy, and recycling ought to be encouraged and the public transportation has to be improved. (US, 2001 :1-3)

Ensuring of the sustainable development will be possible with the realization of the factors mentioned above. However, to realize all of these factors simultaneously is not possible for every country. Therefore, in order to minimize side effect of the economic growth, both developed and developing countries should work altogether. Since most of the harmful effects of the economic growth are the result of the developed countries' activities, this cooperation is not only necessity but also compulsory for all of the world countries (Alagöz, 2004:9).

1.5. Sustainable Development and Energy

Energy is one of the most important requirements of the economic and social development of the countries. However, because of the excessive use of the fossil based resources, the climate change and global warming started to threat not only human beings but also other species. On the other hand, since the fossil based energy resources are limited, with the current demand level, it is estimated that between the 50-200 years the reserves will be completely exhausted. For these reasons, the importance of the energy issues has been increasing in every passing day. Efficient use of energy, security of energy, and clean energy are the main topics of the all world countries. Therefore, today most of the countries have been trying to find a way to reach the inexpensive, reliable, clean and uninterrupted energy resources.

Sustainable development policies include economic, social and environmental factors. Since the energy meets the basic needs of the people, being the engine of the economic growth, and affects the environment directly or indirectly, there is a close relationship between the sustainable development and energy. In the Our Common Future Report the relationship between the energy and sustainable development was emphasized and to realize the sustainable development without compromising the energy usage, following four topics were stated (TÇSV, 1989:232):

1. To increase the supply of energy enough to meet the needs of people,
2. In order to minimize the primary energy usage, energy efficiency and energy-saving measures should be implemented,
3. To protect the public health by minimizing the security risks of energy resources
4. To prevent local pollution and to preserve biosphere.

With the 1973 and 1979 oil crises, the world witnessed the effect of the high energy prices on economy for the first time. These two crises contributed to the improvement of the sustainable development and energy relationship. After those crises, a new international organization was founded; International Energy Agency (IEA). The correlation between oil prices and economy revealed clearly by the cooperation of IEA with OECD and IMF. For example, according to the IEA report, published in 2004, every 10 dollars increase in oil prices decreases the GDP at 0,4 % and increases the inflation rate 0,5 %. At the same time, it increases the unemployment rate in the countries, whose oil reserves cannot meet their own needs. The result is worse in oil-importing developing countries comparing with the developed ones. Since developing countries' economy depends on energy intensity sectors, when the oil prices increase the 10 dollars, the GDP will decrease more than 0,8 % in Asia, and 3 % in Africa (IEA, 2004; 8). All these situations bring a new concept to the world agenda; sustainable energy concept.

1.6. Sustainable Energy

"Sustainable energy is the production and use of energy resources in ways that promote or at least are compatible with long-term human wellbeing and ecological balance" (UNDP,

2000). The main objectives of the sustainable energy are the protection of ecology, management of natural resources and provide energy security (Stanford, 1997). In fact, there is a very close relationship between the concept of sustainable development and sustainable energy. Since energy consumption causes the emission and deteriorates the environment, ecological dimension of these two concepts looks like each other.

On the other hand, energy is the main element of the current economies. To produce goods and services human beings needs more energy than before. In this sense, economic objectives of these two concepts resemble each other. Finally, to protect the social wellbeing is the common objective of sustainable development and sustainable energy.

As mentioned above, the sustainable development has three dimension; environment, economy and society. Like being in sustainable development, sustainable energy also has similar dimensions. Economic growth stimulates the energy demand because energy is the inevitable inputs of the contemporary economies. In order to grow and produce goods and services, the countries need to access energy at an affordable cost, in a secure, sustainable and uninterrupted way. When the countries reach the adequate, reliable and affordable energy resources, this situation increases their investment, facilitate industrialization, raise their competition power in global market and improve their foreign trade. Therefore, the goal of sustainable energy intersects with the economic dimension of sustainable development. For the social development of the communities, the energy is required because, for cooking, cooling, heating, lighting and transportation, todays' people need more energy than before (Schwartz, 2009).

By providing these facilities, energy contributes to the human welfare. To alleviate poverty, promote economic growth and improve social development, it plays a crucial role. Sustainable energy also tries to increase efficiency of energy use and aims to decrease fossil based energy usage, as this kind of energy causes environmental problems at local, national and global levels. It supports technological development to promote the efficiency of the energy production and consumption. Briefly, the goals of sustainable development and sustainable energy intersect with each other.

When we look at the targets of the sustainable energy we see that there are five targets of the sustainable energy; to improve the supply security of energy, to reduce the cost of energy, to develop usage of renewable energy, to eliminate environmental impact of energy and to provide net zero emission of harmful gases. Due to the fact that excess use of energy cause some environmental problem, such as global warming, sustainable energy aims to decrease harmful effect of energy consumption until the carrying capacity level of ecosystems (UNDP, 1997).

Energy consumption is the basic right of the human being. Hence, accessibility of energy at a low cost, securely and in an uninterrupted way is very important to sustain well-being of the societies. For these reasons, sustainable energy tries to get cheap, reliable and uninterrupted energy for the societies. Eventually, since finite energy resources are not sustainable, to increase the renewable energy use is very essential for achieving the target of the sustainable energy (Acres, 2007). Beside these, to increase the energy efficiency and to decrease the energy intensity is as important as the renewable energy use for the sustainable energy concept (Standford, 1997).

Sustainable energy policy consists of all policies, technologies and implementations that provide our energy requirement with a minimum cost on environment, society and economy. With this definition, we see that sustainable energy directly related with the technology, efficiency both in the production and consumption of energy, replacing the old technology with eco-friendly one, encouragement of the usage of renewable energy instead of fossil based fuels, recycling the waste by converting them to the new energy. (Selici at al, 2006:3).

Sustainable energy concept combines efficient energy usage with the economic growth, because all of these policies affect the economy directly or indirectly. While the sustainable energy policies try to develop fossil based fuel technologies to reduce the weight of fossil fuel based energy system and harmful effect of them, at the same time try to increase efficiency of the energy use especially in appliances, buildings and motor vehicles. In order to minimize the adverse effects of energy use, it supports renewable energy usage (UNDP, 1997).

According to the World Energy Council's (WEC) declaration, social, economic and environmental dimensions of the sustainability were covered under the "accessibility", "available" and "acceptability", criteria in the sustainable energy concept (WEC, 2004). To provide sustainability in energy;

1. Energy diversification and energy efficiency,
2. Energy infrastructure investments,
3. Energy market intervention,
4. Reliability of supply,
5. Regional integration of energy systems,
6. Climate change policies on market conditions,
7. Technological innovation and technology development,
8. Ensuring the public's understanding and trust,

are necessary for every countries (WEC, 2004).

Fossil based resources, such as coal, oil and natural gas, are the non-renewable resources and they have been consumed since the discovery day of them. Due to the fact that they have been diminishing in everyday and they cannot be replaced in a very short period of time, it is estimated that with the current consumption level, the fossil based reserves will be exhausted between the 50-200 years. Therefore, the energy policy depending on the fossil based resources cannot be named as sustainable (Acres, 2007; (Selici at all., 2006:4). Besides, excessive consumption of this resources cause the environmental pollution, climate change, and global warming in the world. As a result of these side effects, the diseases have been increasing, the species are decreasing or completely disappearing, the floods and drought become widespread in the world. For these reasons, it is very clear that fossil based energy policy cannot be called as sustainable energy policy (Selici at all., 2006:4).

Today renewable energy usage becomes necessary for sustainable energy. Energy produced from renewables does not leave any waste and they do not pollute the air. Also the waste, such as burned fat, used paper etc, produced by people can be converted to the energy by using the renewable energy technology and this situation also contributes the

clean environment policy. As a result of renewable energy usage, the cleaner world is unavoidable. (Selici at all, 2006: 4)

Sustainable energy policy gives great importance to the energy efficiency and renewable energy resources (Standford, 1995). In order to promote renewable energy usage it is very important to improve renewable technology and infrastructure. Today especially developed countries and EU countries give weight to these two concepts. According to the estimation of EU, with the rise of the efficiency in the production side, it is possible to produce 20 % more energy. At the same time, with the rise of efficiency in the consumption side the energy consumption can be decreased considerably. EU aims to produce at least 20 % of energy from renewable resources by 2020. Like EU, Turkey also targets to produce 30 % of its electric need from renewable energy resources by the year 2023.

1.7. Summary

In this chapter the concept of the development, sustainable development and sustainable energy was defined briefly. Historical development of the sustainable development, its relation objectives and relation with the energy was explained. In the next chapter, the world energy outlook and energy resources will be examined.

CHAPTER II

In this chapter, it is aimed to show the world energy outlook by using the latest data of international energy organizations. The security of energy supply, classification of the energy resources, types of energy resources, their establishment and production cost will also be examined under the current technological and political situation.

2. WORLD ENERGY OUTLOOK

Energy is an indispensable phenomenon in the development of the countries and its importance has been increasing steadily. In order to produce goods and services and to maintain social wellbeing of human being the energy is more important input than any others. Therefore, despite the serious nuclear power accident, side effect of the fossil based resources and financial crisis, living since 2008, the demand of energy has been increasing. According to the IEA report, the world primary energy supply increased 49 %. This increase rate realized 17 % in OECD countries and 14 % in USA between 1990-2011 periods (IEA, 2013). In this period, Turkey was the third country with 117 % increase ratio in the primary energy supply increase after China and India. While the global primary energy supply was 8.769 MTEP in 1990, it reached to 13.070 MTEP in 2011 with the 49 % increase in 21 years. When we look at the composition of the world energy supply in 2011, we see that nearly 87 % of total energy supply comes from fossil based resources and the share of oil, natural gas, coal and nuclear power was 37 %, 19 %, 25 % and 6 % respectively (WEC, 2013).

Table 1: World Primary Energy Supply Development 1990-2011 (MTEP)

Countries	1990	2011	Increase Ratio (%)
China	879	2.743	212
India	317	750	137
Turkey	53	115	117
Brazil	138	267	94
USA	1915	2.189	14
Japan	439	461	5
OECD	4.522	5.304	17
WORLD	**8.769**	**13.070**	**49**

Resource: World Energy Outlook, IEA 2013.

International Energy Agency has been preparing a scenario about the energy outlook by taking into account the climate change, depletion of resources, technology, economic and social conditions in the world. In other words, since energy demand depends on the climatic changes, economic growth of global economy, population increase and technological development in the world, IEA tries to make prediction by evaluating all these factors.

Since the emergence of the sustainable development and global warming concepts, the human beings became more sensitive towards the climatic changes in the world. The world countries try to find a way of development that gives no or little harm to the environment. Therefore, this phenomenon affects the future energy prediction of the IEA. Economic growth and population increase are the two main reasons of the energy demand. IEA takes into account the IMF and World Bank's predictions about the economic growth of the countries while preparing its energy projections. The technology can increase or decrease the energy usage. Because while energy efficient equipment are decreasing the energy usage, innovations in technology, such as smartphone and tablets, can make people addicted to these new technology and this situation may increase the energy demand of the global world.

IEA uses three kinds of scenario while predicting the energy demand. These are: current policies, new policies and 450 scenarios. All of these scenarios reflect the different level of government's actions in the world, since governments actions have a great influence on energy (IEA, 2013). The current policies scenario did not take into account any policies

adopted by the time the report was preparing. New policies scenario takes into consideration the existing policies and recently announced programs. The 450 scenario assumes that policies of the countries are consistent with limiting the long-term global temperature increase to 2°C. In the Table 2 world primary energy demand by fuel between the 1990 and 2035 according to the new scenario and comparison of the new scenario and current scenario between the 2011 and 2035 was given.

Table 2: World Primary Energy Demand by Fuel in the New Policies Scenario (MTEP)

	1990	**2010**	**2015**	**2020**	**2030**	**2035**	**2010-2035**
Coal	2.231	3.474	3.945	4.082	4.180	4.218	0.8 %
Oil	3.230	4.113	4.352	4.457	4.578	4.656	0.5 %
Gas	1.668	2.740	2.993	3.266	3.820	4.106	1.6 %
Nuclear	526	719	751	898	1.073	1.138	1.9 %
Hydro	184	295	340	388	458	488	2.0 %
Bioenergy	903	1.277	1.408	1.532	1.755	1.881	1.6 %
Other Renewables	36	112	200	299	554	710	7.7 %
Total	**8.779**	**12.730**	**13.989**	**14.922**	**16.417**	**17.197**	**1.2 %**

Resource: World Energy Outlook, IEA, 2012

According to the New Policies Scenario, the total global energy demand will increase at a ratio of 1.2 % between 2010-2035 time periods. Although the increase rate of renewables is above the fossil based energy resources, they cannot reach at a level that meets the considerable portion of the energy demand in 2035. Today the energy demand has been mainly met by the fossil based resources and this figure will continue in the next 20 years. In other words, although some other energy resources are developed, the fossil based resources will protect their weights in the energy composition. It is expected that by the year 2030, the energy demand will reach the 16.5 billion TEP, and nearly 84 % of this demand will be met by fossil based resources. In spite of the fact that the share of the fossil based resources will decrease 82 % in 2035, the global energy demand will be 17.2 billion TEP and fossil based resources will protect their dominant position in the world energy demand (IEA, 2013).

Table 3: World Primary Energy Demand Quantity and Ratio by Fuel 2035 in Scenarios

		1990	2011	Current Policies 2035	New Policies 2035
Coal	MTEP	2.230	3.773	5.435	4.428
	%	25	29	29	25
Oil	MTEP	3.231	4.108	5.094	4.661
	%	37	31	27	27
Natural gas	MTEP	1.668	2.787	4.369	4.119
	%	19	21	23	24
Nuclear	MTEP	526	674	1.020	1.119
	%	6	5	5	6
Hydro	MTEP	184	300	471	501
	%	2	2	3	3
Bioenergy	MTEP	893	1.300	1.729	1.847
	%	10	10	9	11
Other Renewables	MTEP	36	127	528	711
	%	0	1	3	4
Total	MTEP	8.779	13.070	18.676	17.197
	%	100	100	100	100

Resource: World Energy Outlook, IEA 2013

In Table 3, although the share of oil demand in the total energy demand was decreased from 37 % to 31 % in 2011, its amount of oil used in energy consumption increased to 877 MTEP between the 1990-2011 time periods. In both current and new policies scenarios the share of oil will be 27 % in 2035. However, its quantity will increase to 986 MTEP in current scenario and 553 MTEP in new policies scenario. Since 2/3 of the total demand of oil comes from the transportation sector, it is not expected that oil will be replaced by any new energy alternative by the year 2035. Annually, the expected demand increase in oil changes between 0.5 % and 1.6 % in 20 years.

Expected natural gas demand growth will be more than oil, annually 2.3 % in current scenario and 1.6 % in new policies scenario, and the share of it in the primary energy use will increase to 24 % in 2035. Since it is relatively clean energy and it does not pollute the air as the coal pollute, most of the developed and developing countries change their energy consumption in favor of the natural gas. The main demand for the natural gas especially comes from the electric generation plants. Comparing with the 1990 demand level, it is expected that the natural gas consumption will rise nearly three times when we come to the 2035.

Despite the fact that the share of coal use will decrease to 25 % according to the new scenario, the amount of consumption will increase from 3.773 MTEP to 4.428 MTEP in 2035. The coal will protect its importance because it can be produced nearly in every country. Therefore, it is accepted as the domestic energy resource of nearly every country of the world.

The annual expected growth rate of hydroelectric demand will be 2 % in current scenario and 3 % in new policies scenario. Since the significant portions of the hydro potential are not used yet in developing countries, the main growth of the hydroelectric production will depend on the investment of developing countries.

Comparing with the 1990 supply and demand level of bioenergy and other renewables, the demand of them will increase 2 times and 20 times respectively. The main contribution of bioenergy and renewables will come from the electricity production. Although the highest annual demand increase is expected in the bioenergy and other renewable energy resources, such as solar, wind etc., in the 1990-2035 energy projection period of the IEA, the share of these resources in the global energy demand does not increase too much.

As mentioned above, economic growth, demographic effects and technology play the main role at the demand increase. All of above scenarios are prepared according to the expected changes in these factors. Among the all mentioned factors the economic factors play dominant role in energy demand. According to the result of the most of the investigations, there is a strong correlation between the economic growth and energy usage of the countries.

When we look at the supply side of the energy, we see that the price, reserve status, political stability, seasonal conditions and international relations are the main factors that affect the supply of the energy resources. In contemporary world, decision of cartel, OPEC, may also affect the price and supply level of energy. Since the demand of energy is inelastic against the price increase, the producer countries, especially OPEC, can increase the price of energy by decreasing the supply level. Embargo of producers, as being in

Arab-Israel war, or political tension, like being in Arab Spring and Iran–west tension, may also influence the supply level and cost of energy.

Since the sensitivity of energy price towards the energy security is very high, both developed and developing countries try to guarantee the supply of energy and this situation brings us to the energy security issue.

2.1. Security of Energy Supply

There is a very big cost of the energy shortage not only for developing countries but also for developed countries. Therefore, security of energy supply has a vital importance for all countries. To ensure this, the countries have been trying to evaluate their domestic resources and diversify their energy supply.

If a country's dependency is very high to one of the energy supply or one of the energy supplier countries, like being Turkey's dependency to Russia in natural gas, then the country's economy becomes very vulnerable against the energy shortage or price changes. Hence, diversification of the energy resources, investigation of new and domestic energy resources, development of the new energy efficient technologies, and usage of the renewable energy resources are very important for the diversification and security of the energy supply.

When we look at the world energy reserve, we see that nearly 65 % of the oil and natural gas reserves are located in Middle East, one of the most complex and instable region in the world. Because of the dispute between the countries, like Arab-Israel war and 1973 oil crisis, or political instability, like being in Arab Spring, the energy supply can be interrupted. This situation affected the energy importer countries and global economy negatively. On the other hand, this and similar energy supply crises contribute the development of the new policies at the energy side.

Turkey's position in terms of the energy supply security is very critic. Since Turkey does not have enough fossil based resources, it has to import nearly 91 % of oil and 98.5 % of

natural gas from abroad. Beside this, composition of energy import is also very immoderate especially in the natural gas import, since Turkey imports nearly 65 % of natural gas from Russia. In case of any interruption in the stream of natural gas, Turkey most probably will face with heating problem in houses and the power cut in electricity. Because nearly 45 % of electricity was produced by using natural gas and more than 50 cities' (especially metropolitan cities, including Istanbul and Ankara) main heating tool is natural gas. In other words, in any interruption of the natural gas stream from Russia may cause power cut and heating problem more than half of the Turkey.

In 2006, Russia and Ukraine lived political dispute and a result of this dispute Russia cut off the natural gas to Ukraine. European Union and Eastern European affected seriously from this crisis and this situation reminds the importance of the diversification of the energy supply not only for EU but also for Turkey. Turkey has also experienced similar natural gas cut with Iran and Turkmenistan, because of the harsh winter conditions or sabotage to the pipelines. Nearly every winter, Iran cut the natural gas stream to Turkey because of the political, heavy winter conditions or technical reasons. This and similar situations show that diversification of the energy supply and stock management of the natural gas and other storable energy sources are vital topics for the sustainable development of both Turkey and energy importer countries.

Therefore, Turkey has to develop alternative policies to secure the energy supply not only in natural gas but also for oil and other resources' supply. The policies required to ensure security of the energy supply can be summarized as follow:

1. Encouraging the use of domestic resources,
2. The exploration of new resources,
3. Promotion of new energy technologies (especially in terms of energy efficiency),
4. Promotion of renewable energy sources,
5. Diversification of the energy import,
6. Promotion of the regional cooperation

After giving brief information about the energy economy and importance of the security of energy supply we will investigate the classification of energy resources in the next title.

2.2. Classification of the Energy

Energy, which is indispensable sources of the economy, can be classified in different ways. One of the most widely used classifications is the renewable and nonrenewable energy classification. If the energy can be replenished in a very short period of time and derived from natural processes then we call them as renewable energy. (Uyar, 2004:3). Sometimes it is named as green energy since it has no or very little harm to the environment. Renewable energy can be used again and again and will never run out. These resources are naturally replenished but their flow is limited. They are actually inexhaustible in duration but their available amount is limited in per unit of time. Solar, hydroelectric, biomasses, wind, geothermal are the examples of this kind of energy. Nonrenewable energies, on the other hand, encompass a variety of energy sources, such as oil, natural gas and coal, and they diminish when they are used. In other words, when they are used they cannot be put in place in a very short period of time. They are also named as stock or stream sources. (Özsabuncuoğlu and Uğur, 2005:103,).

Another widely used classification is classification of the primary energy resources and secondary energy resources. Primary sources are energy sources readily available in nature. Secondary energy sources are obtained as a result of a transaction. Therefore, oil, coal, solar and wind are accepted as primary energy since they are available in nature and can be used for heating or other purposes. However, electricity and nuclear energy are accepted secondary energy because in order to get that kind of energy variety of transactions is needed.

In this study, the renewable and nonrenewable energy classification was used to differentiate them.

2.2.1. Nonrenewable Energy Resources

2.2.1.1. Petroleum

Today petroleum is the basic inputs of the social life and production sector since it has been used for transportation, heating, industry, energy and housing. The word petroleum is formed by the association of the latin Petra (means rock, stone) and oleum (oil) words.

Although it has been used since the ancient age, the first commercial usage of the oil started in middle of the 19th century, when the oil was discovered in Pennsylvania in 1859. (Özsabuncuoğlu ve Uğur, 2005:179).

While the share of oil among the primary energy demand was 48 % in 1970s, it has been decreasing steadily. 33.1 % of the world energy needs was met by oil as of 2013. Despite the increase in the amount of oil used, the share of oil in the primary energy supply is expected to fall to 27 % in 2035 with the help of the renewable energy investment.

While the demand of oil is relatively stable in developed countries, it has been increasing rapidly in developing countries especially in China and India. The expected demand increase of oil is 0.8 % for OECD countries and 2.7 % for non-OECD in 20 years. As a result, between the 2002-2030 periods the demand of petroleum will rise 39 % at the non-OECD countries (WEC, 2013).

Among the all factors, the economic growth is the most effective one that accelerate the oil demand in the world. According to the International Energy Agency forecast, the average annual growth rate of world economy will be 3 % between the 2002-2030 time periods. Under this growth assumption, it is estimated that the global demand of oil will rise at about 1.6 % annually and the daily oil demand will reach 121.3 million barrel/day in 2030 (IEA, 2004; WEC, 2013).

Table 4: Oil Demand by Region (MTEP)

	2002	2010	2020	2030	2002-2030
OECD	**45.4**	**49.7**	**54.4**	**57.1**	**0.8**
OECD North America	22.6	25.5	28.7	31.0	1.1
USA and Canada	20.7	23.2	25.8	27.6	1.0
Non-OECD countries	**28.6**	**37.5**	**48.8**	**60.4**	**2.7**
China	5.2	7.9	10.6	13.3	3.4
India	2.5	3.4	4.5	5.6	2.9
Other Asia countries	3.9	5.1	7.0	8.8	3.0
Latin America	4.5	5.4	6.8	8.4	2.3
Africa	2.4	3.1	4.4	6.1	3.4
Middle East	4.3	5.4	6.8	7.8	2.1
European Union	13.6	14.4	15.3	15.6	0.5
World	**77.0**	**90.4**	**106.7**	**121.3**	**1.6**

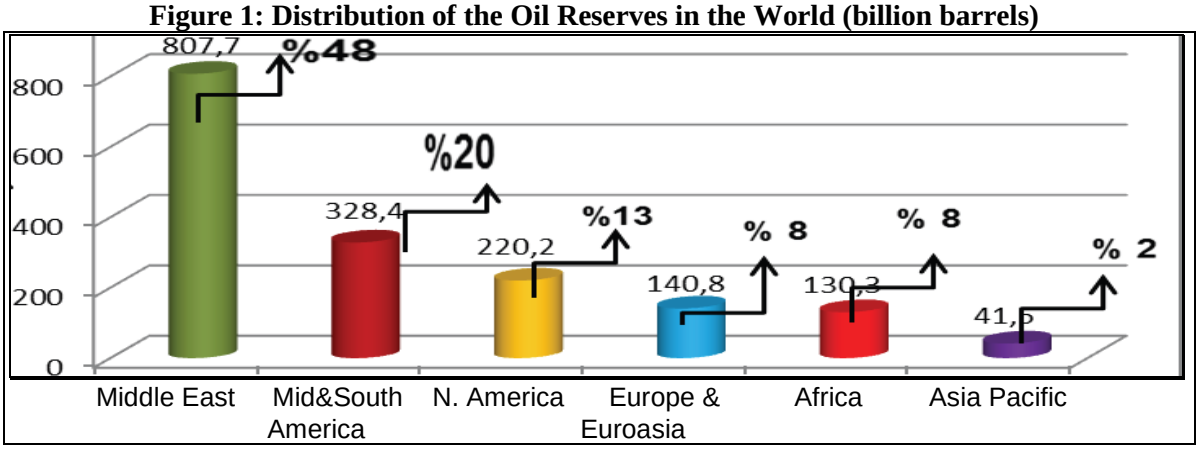
Resource: World Energy Outlook, (IEA, 2004 and WEC, 2013)

At the global level, the most important reason of the oil demand comes from transportation sector. Today, nearly 52 % of the oil demand comes from the transportation sector, 6 % from electricity and 30 % from the industry. According to the IEA data, while the share of transportation at the oil demand was 33 % in 1971, it is estimated that this ratio will reach to 54 % in 2030. However the share of electricity produced from oil is expected to fall to 3 % and the usage of industry will rise to 32 % by the year 2035 (IEA, 2004:84, WEC,2013).

According to the World Energy Council report, compared to 2012, the world oil reserves were increased 0.8 % in 2013 and reached to the 1.669 billion barrel (235.8 billion tons) (WEC, 2013, IEA, 2013). Since the beginning of the 2000s, the oil reserves increased at about 30 % in the world. More than 30 % of the reserve increase comes from the new reserve but rest of them from revisions of the reserves by oil exporter countries, especially in OPEC. OPEC countries have nearly 70 % of total proven reserves in the world. Outside the OPEC members, Kazakhstan and Russia have significant oil reserves and they increased their reserve since 2000.

While the Saudi Arabian Peninsula was known as the biggest reserve area until recently, the share of it has been decreasing in the total oil reserves with the new reserve discovery in the world. Today Venezuela is the leading country for proven oil reserves that it has overtaken Saudi Arabia with the discovery of the Orinoco Belt reserves in 2010 (IEA, 2012: 97). Today, nearly half of the oil reserves are located at Middle East region. Saudi Arabian, Iran, Iraq Kuwait, United Emirates and Qatar are the main producers in this region. As of 2013, the oil reserves and their ratio are shown in the figure 1:

Figure 1: Distribution of the Oil Reserves in the World (billion barrels)



Resource: BP Statistical Review of World Energy, June 2013

One of the most notable events on the supply side of oil was the shale gas revolution of America. With the development of the horizontal well technology, the USA began to produce oil from shale rock. In 2012, USA recorded the highest oil and gas production of its history. While the USA was the biggest importer of oil until the shale gas revolution, it is estimated that by the end of 2016, it will be one of the oil exporter countries in the world. This development changed rules of the oil and energy game in the world and decreased the dependency of USA to the Middle East oil reserves. It is expected that by the year 2030, rock oil-gas takes the 5th place in the total energy supply and USA, Saudi Arabian and Russia will meet the 1/3 of the world oil supply. With the current demand and consumption level, the life of oil reserves was estimated as 53 years (WEC, 2013).

The price of oil has been fluctuating since the discovery date of it. The price of oil can be used as a weapon by the producers like being in Arab-Israel war. Economic growth, political decision of OPEC, supply demand equilibrium and instability in the supplier countries can easily jump the price of it (WEC, 2013).

2.2.1.2. Coal:

Coal is a carbon based solid fossil fuel that mostly consisting of carbon, hydrogen and oxygen in its body. Carbonization time of coal varies between the 15-400 million years and generally the elderly are more high-calorie and high-quality coal. Coals are divided into two classes as hard coal and brown coal (or lignite) according to their calorific value. If the calorific value of coal is above the 5.700 kcal/kg, it is named as hard coal. If the calorific value is below the 5700 kcal then it is called as brown coal (WEC, 2013).

The coal is the first fossil based resources used in industrial revolution. Although its popularity decreased especially after the discovery of the oil and natural gas, it has been used at a significant level to meet the energy need of the world. The share of coal at the primary energy consumption is nearly 25 % and it is not expected any decrease in this ratio in 20 years. The main reason of why the coal can protect its importance is its intensive usage both in electricity and steel production. Today nearly 41 % of electricity and 70 % of steel are produced by using the coal. Another important reason is that the coal reserves can

be found nearly in 100 countries and comparing with the oil and natural gas, its distribution is relatively equal in the world countries. Therefore, to decrease the dependency to the foreign resources and to sustain security of energy supply, the countries choice coal usage especially in electricity generation.

As mentioned above, it is the most abundant energy resource among the fossil based fuels in the world. It can be found nearly in all continents, but the largest reserves are located in Asia. According to the most recent study, made by Germany's Federal Institute of Earth Sciences and Natural Resources (BGR), the total coal reserves are 1.038 billion tons in the world. While the coal reserves were 634 billion tons in 1978, it increased at about 63 % since that time and reached to 1.038 billion tons (WEC, 2013: 20). Despite the fact that the coal reserves can be found almost in 100 countries, 75 % of these reserves are located in 4 countries: USA 31%, China 25 %, India 10 % and Russia 10 % (IEA, 2012: 163).

Table 5: 2003-2013 World Coal Reserves and Production

Years	Proven Coal Reserves (Billion Tons)	Production (Billion Tons)
2003	984	4.92
2004	907	5.27
2005	909	5.67
2006	990	6.01
2007	935	6.33
2008	1019	6.56
2009	990	6.74
2010	997	6.84
2011	1000	7.21
2012	1004	7.61
2013	1038	7.83

Resource: World Energy Resources, WEC 2013 and BGR 2013

China and USA are the largest producers of the world. With the 2.701 (Mtce) production level, China alone supplied the 48 % of total coal production. USA produced 711 (Mtce) coal and took second place with 13 % share in the world coal supply. India, Australia, Indonesia, Russia and South Africa followed them in the production of the coal. With the 23 (Mtce) production level Turkey produced only 0.4 % of world coal supply in 2012. According to the current production and consumption level the life of the coal reserves are estimated around the 140 years (IEA, 2012).

Table 6: Coal Production by Type and Scenario (Mtce)

			New Policies		Current Policies		450 Scenario	
	1990	**2010**	**2020**	**2035**	**2020**	**2035**	**2020**	**2035**
OECD	**1.533**	**1.406**	**1.403**	**1.259**	**1.516**	**1.689**	**1.203**	**690**
Steam Coal	986	930	962	855	1.048	1.202	804	423
Coking Coal	282	278	270	289	279	321	248	226
Lignite	265	198	171	115	188	166	151	41
Non-OECD	**1.668**	**3.718**	**4.428**	**4.767**	**4.794**	**6.200**	**3.895**	**2.649**
Steam Coal	1.250	3.101	3.762	4.128	4.114	5.493	3.273	2.129
Coking Coal	290	517	554	539	565	582	528	470
Lignite	129	100	112	100	115	125	95	51
World	**3.201**	**5.124**	**5.831**	**6.026**	**6.309**	**7.889**	**5.098**	**3.339**
Steam Coal Share	70 %	79 %	81 %	83 %	82 %	85 %	80 %	76 %
Coking Coal Share	18 %	16 %	14 %	14 %	13 %	11 %	15 %	21 %
Lignite Share	12 %	6 %	5 %	4 %	5 %	4 %	5 %	3 %

Resource: World Energy Outlook, IEA, 2012

Although it is production is less than China and USA, Indonesia was the biggest exporter of coal in the world and nearly 31 % of coal export belongs to this country. Australia is the second biggest country in the export quantity with share of 24 %. While China imported only 8 % of its total consumption, it became the first importer in 2012 (IEA, 2012).

Depending on the different scenario the share of coal in the global energy market is changing between the 16 % and 30 % by the year 2035. In table 7 International Energy Agency's forecast of coal demand by region and scenario is given.

Table 7: Coal Demand by Region and Scenario (Mtce)

			New Policies		**Current Policies**		**450 Scenario**	
	1990	2010	2020	2035	2020	2035	2020	2035
OECD	1.544	1.552	1.482	1.181	1.581	1.578	1.312	649
Non-OECD	1.644	3.411	4.349	4.845	4.728	6.311	3.787	2.690
World	3.187	4.963	5.831	6.026	6.309	7.889	5.098	3.339
Non-OECD Share	52 %	69 %	75 %	80 %	75 %	80 %	74 %	81 %

Resource: World Energy Outlook, IEA, 2012

In general, the demand for coal comes from the non-OECD and Asians' growing countries, especially from China. Today, Asian countries consume 48 % of the total coal supply. China has very rich coal reserves and to maintain its economic development the country

needs cheap, domestic and reliable energy resources. Therefore, China intensively uses the coal especially in electricity production. Apart from China, the demand of developing countries is expected to grow and the share of them will reach to 80 % by the year 2035. In contrast to Asian countries, IEA does not estimate any demand increase for OECD countries. Because of the heavy working regulations and environmental concern, OECD countries preferred the natural gas and renewable energy instead of coal (IEA, 2012).

When we look at the sectorial distribution of global demand for coal, we see that 65 % of the demand for coal comes from the electricity generation. The main demand of coal comes from the electricity sector, because today nearly 41 % of global electricity is produced from the coal. Two countries, China and USA, produce 62 % of world's coal-based electricity generation (IEA, 2012). The coal will protect its dominant position in the electricity generation in the near future.

Because of the global warming and climate changes, today the countries have been trying to obtain clean energy from coal. In this context, in addition to construction of the high efficient and low emission coal power plants, liquid fuels from coal and gasification studies are ongoing. South Africa obtains 160.000 barrel liquid fuel from coal by using the converting coal to a liquid fuel (CTL) technology. Currently, the country meets nearly 30 % of gasoline and diesel needs from liquid fuels derived from domestic coal. Liquid fuel not only protects the country from the effects of sudden price changes of crude oil but also protects the environment because dimethyl ether (DME), liquid fuels of coal, is a non-toxic and non-carcinogenic fuel and create less carbon monoxide than LPG (WEC, 2013). Therefore, the biggest demand grow, 8.2 % per year, is estimated in this field and if a country has appropriate domestic coal supply, IEA recommends application of CTL and underground coal gasification process to that country.

2.2.1.3. Natural Gas:

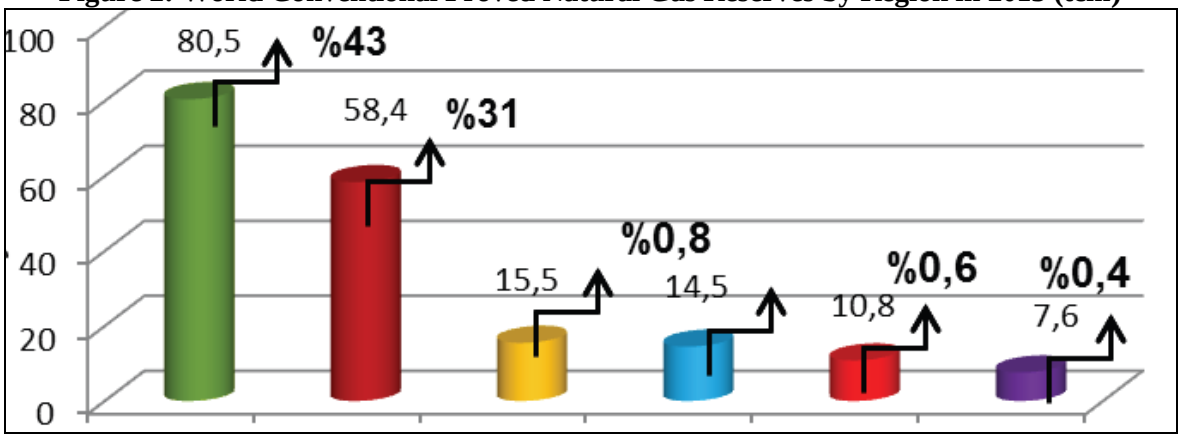
Natural gas has been meeting a significant part of the world energy demand. For the first time, Chinese used the natural gas in 900s (BC) in history. However, the widespread use of natural gas started in UK in 1790. With the development of pipeline transportation, the use

of natural gas increased rapidly especially after World War II. While the share of natural gas in the total energy consumption was less than 10 % in 1950s, with the help of power generations and economic developments, the share of natural gas reached to 24 % in 2012 and became the third most used energy resources after oil and coal in global economy.

The average demand increase rate of natural gas is bigger than other fossil based energy resources. According to the IEA estimation, the average annual demand growth ratio of the natural gas will be 1.6 % between the 2010 and 2035 time period. The main reason of this increase is the widespread usage of the natural gas in the electricity generation. Another important reason is the economic growth and environmental concern of the developed country. Since natural gas' emission is less than coal, it is widely preferred by developed countries for building, heating and industry.

Proven natural gas reserves were 185.7 trillion cubic meter (tcm) at the end of the 2013 in the world. Nearly 80.5 tcm of natural gas is located in Middle East and the share of Middle East is 43.2 % in total reserves. Iran has the biggest reserves with the 33.2 tcm and 18 % share in the world and Russia and Qatar follow it with 17 % and 13.4 % share respectively (BP, 2013). The reserve quantity and share of other regions are shown in figure 2.

Figure 2: World Conventional Proved Natural Gas Reserves by Region in 2013 (tcm)



Resource: BP Statistical Review of World Energy, June 2013

According to the current reserve and consumption level, the life of natural gas is estimated around the 56 years (BP, 2013). However, IEA assumes that theoretically the natural gas

reserves can be increased to 790 tcm and this amount will be sufficient to meet the natural gas demand of the world at about 230 years (IEA, 2012:134). Like being in the oil sector, the shale gas revolution of the USA affected the energy market deeply and changed the predictions about the future of the natural gas. With the help of the shale gas, USA became the biggest producer and took 20.4 % share in global market. Another high production increase was realized as 12.6 % in Norway, 7.8 % in Qatar, 11.1 % in Saudi Arabian in 2012 (WEC, 2013).

World producible shale gas reserve is almost 7.8 trillion feet cubic (ftc) as of 2012 and nearly 1.16 ftc of this reserve is located in USA, 1.11 ftc in China and 0.8 ftc in Argentina. Today, it is planned to obtain natural gas from shale gas, coal bed methane and tight sandstone gas reserves in many parts of the world. When the countries, which have shale gas reserves, start the production of this gas, the global energy outlook will be quite different from that of todays and these developments will have significant economic and geopolitical consequences in the world. Hence, parallel to these developments, it is calculated that approximately half of the production increase of natural gas will be provided from non-conventional natural gas resources, e.g. the shale gas (WEC, 2013).

Table 8: Remaining Technically Recoverable Natural Gas Resources by Type and Region

	Conventional	**Non-Conventional**			**Total**
		Tight Gas	**Shale Gas**	**Coal bed Methane**	
Europe/Eurasia	144	11	12	20	187
Middle East	125	9	4	-	137
Asia Pacific	43	21	57	16	137
OECD Americas	47	11	47	9	114
Africa	49	10	30	-	88
Latin America	32	15	33	-	80
OECD Europe	24	4	16	2	46
World	**462**	**81**	**200**	**47**	**790**

Resource: World Energy Outlook 2012, IEA

Environmental policies to reduce carbon emissions in the world have led to the strengthening of natural gas against to coal and other fossil based resources. Therefore, although it is below the historical average growth rate of 2.7 %, the world natural gas consumption growth was realized as 2.2 % in 2012. (WEC, 2013: 78).

Table 9: Natural Gas Demand by Region in the New Policies Scenario (bcm)

			New Policies		2010-2035	
	1990	**2010**	**2020**	**2035**	**Amount Growth**	**Annual Growth Rate**
OECD	**1.036**	**1.597**	**1.731**	**1.937**	**341**	**0.8 %**
Americas	628	845	940	1.032	187	0.8 %
Europe	325	569	585	669	100	0.7 %
Asia Ocenia	82	182	206	236	53	1.0 %
Non-OECD	**1.003**	**1.710**	**2.213**	**3.018**	**1.348**	**2.3 %**
Europe/Eurasia	737	692	747	842	150	0.8 %
Asia	84	393	660	1.111	717	4.2 %
Middle East	87	376	485	640	264	2.1 %
Latin America	60	146	182	249	103	2.2 %
Africa	35	103	139	176	73	2.2 %
World	**2.039**	**3.307**	**3.943**	**4.955**	**1.648**	**1.6 %**
Share of Non-OECD	**49 %**	**52 %**	**56 %**	**61 %**		

Resource: World Energy Outlook, IEA, 2012

From the sectorial point of view, the most important area that supports the natural gas demand is the electricity generation. Due to the fact that natural gas can be burned with high efficiency and having less greenhouse emission effects comparing to the other fossil based fuels, it is widely preferred as a cheap and safe alternative in power generation. Therefore, regardless of the how policies develop, the power sector will remain the pioneer of the natural gas demand in many regions. As a result, the demand of power sector is expected to increase 40 % (1.6 % per year) between the 2011 and 2035 (IEA, 2012: 132). Apart from power sector, the building sectors' demand will also be strong with the help of the environmental concern.

2.2.1.4. Nuclear Power:

The first commercial nuclear energy for electricity generation applications began in 1964 in USA. After 1973 oil crisis, the investment on nuclear power accelerated to decrease the dependency on the fossil based energy resources especially in developed countries. However, because of the environmental problem of nuclear waste and after 1986 Ukraine - Chernobyl accidents anti-nuclear movement increased in the world. (ITO, 2007:22)

Although the nuclear plants are protested by the environmentalist because of its harmful effects, due to the price increase in fossil based resources and energy security concern, debates about the establishment of the new plants are resumed again. (Yıldırım and Örnek, 2007: 1)

Today 32 countries have nuclear power and nearly 432 nuclear power plants have been working in the world. These countries provide the 16 % of total global electricity production from nuclear power. Furthermore, more than 250 ships and submarines are working with nuclear power. Besides, more than 1.000 commercial, military and research reactors are operated in the world. The world's largest nuclear-capable state is the USA and it is the first countries in the electricity generation from nuclear power. (Yıldırım and Örnek, 2007: 2). The first five countries in the nuclear capacity are USA, France, Russia, South Korea and Germany, and these countries generated the 67 % of electricity from nuclear power in the world. Currently there are 70 nuclear plants under construction and the total capacity of them is 73.366 MW (WEC, 2013; 261-269).

Comparing with the thermal and hydro power, the nuclear plants are more efficient in the electricity generation. Initial investment costs of the nuclear plants are generally high but their fuel and operating costs are very low. Therefore, once a nuclear power was established, the cost of electricity generation will remain approximately constant. (Kadiroğlu ve Sökmen, 1994: 27).

Unlike other fossil based resources, nuclear power plants do not cause carbon dioxide emissions hence they are considered as a source of clean energy. However, the toxic of burned fuels are more dangerous than fossil based resources and its effect cannot be eliminated for years. Therefore, despite the advantages of nuclear power plants, they are criticized seriously. The most important problems of the nuclear plants are the risk of leaks and accident that may occur in their operation like being in Chernobyl in 1986 and Fukishima in 2011. Besides, waste of the plants cannot be cured and its storage is very big problem. Unless they are stored securely, they may cause permanent environment problem. These accidents and storage problems increase the reaction against them. Since the technology of nuclear power is very complex and they can be established by the foreign

companies. Hence, even if the developing countries have the uranium reserves, it cannot be evaluated as the domestic energy resources with the exact meaning. In other words, dependency of country to the foreign inputs can be continued because of the nuclear and enrichment facilities of fuels.

The share of nuclear power decreased to 11 % in the total energy supply of the world. Comparing the previous year production, the electricity generation from nuclear power decreased 6.8 % and realized as 2.346 TWh in 2012. The main reason of decrease in nuclear power electricity generation was Fukushima accident in Japan. While Japan was 3rd country in nuclear energy production, it dropped to 18th with 139 TWh electricity production decrease (50 %) in nuclear power in 2012 (WEC, 2013; 261-269).

2.2.2. Renewable Energy Resources

2.2.2.1. World renewable Energy Outlook

In the last century, the world's energy consumption increased 17-fold and CO_2 and harmful emission produced by fossil based resources increased at the same ratio. In contemporary world majority of the energy needs are met by the fossil based resources. However, because of being limited and having harmful environmental effects, today human beings are trying to develop more reliable, harmless and domestic energy resources. Due to the fact that renewable energy resources are harmless, domestic and inexhaustible, they gained popularity especially after the sustainable development concept.

The world energy demand has been increasing parallel to the development of economy and population increase. Therefore, in a very short period of time the fossil based resources cannot meet the total energy demand of the world. According to the IEA data, with the current demand and reserve level, the life of the fossil based resources is estimated as 50 years for oil, 56 years for natural gas (although it can rise to 230 years with the new technology and technical reserve level) and 140 years for the coal. Beside this, due to the uncertainty in the international relationship, energy supply security issue becomes as important as the reserve level. Moreover, price of the energy has been increasing steadily depending on the reserve decline and political instability in the world.

Apart from these problems, today the global warming effects and environmental concerns of fossil based sources are revealed more apparently. Therefore, the renewable energy resources have been increasing their importance in contemporary world. Being native, environmentally friendly and can be found almost in every country, the renewable energy can play a significant role on sustainable development, energy policy and security of energy supply in the world.

Environmental issues, such as carbon dioxide (CO2) reduction, are the main key driver of the renewable energy investment. Besides, the renewable energy investments are also supported to diversify energy supply, enhance energy security and stimulate the economies. The main investments are made on the electricity sector and then biofuels. UN launched Sustainable Energy for All Initiative and aimed to increase the share of renewable two times by 2030. The IEA has been working together with UN to define the baseline of targets and to monitor the progress. Apart from UN and IEA, EU also released the Renewable Energy Directive in 2009 and targeted to increase renewable energy share (covering the biofuels, electricity and heating) to 20 % in the final consumption in 2020. EU forced each member to prepare an action plan and regular progress report to ensure that their targets are met. While the renewable energy could only meet less than 10 % of EU energy need in 2010, the latest report, prepared by European Commission, indicated that renewable energy can meet between the 55-75 % of final energy consumption of the Union in 2050 (EC, 2011, IEA, 2012).

The most significant increase in the usage of renewables is expected in developed countries. In OECD-European countries the share of renewables will increase from 3 % to 17 % between the 2002-2030 time periods. Since EU does not have enough energy resources and accepted some regulations, such as white paper, to prevent the environmental effects of fossil based sources, EU gives significant support to the renewables to realize its targets. Therefore, the biggest increase in the investment and use of renewable are expected from the EU countries (IEA, 2012).

Between the 2012 and 2035 years, 6.4 trillion dollars investment is required for renewables to reach the targets and nearly 94 % of this investment is needed only for power sector.

Distribution of the investment in power sector will be as: 2.1 trillion dollars for wind, 1.5 trillion dollars for hydro, and 1.3 trillion dollars for photovoltaic energy and rest of them for biofuels. While the OECD countries focus their investment mainly on wind and solar PV energy, the non-OECD countries concentrate their investment on hydro and wind sector (IEA, 2012: 211).

According to the IEA data, the share of renewables in the primary energy use has been increasing in all scenarios with the help of government subsidies, falling cost, high price of fossil based resources and CO2 pricing in some regions. As of 2035, half of the renewable-based supply will be provided by hydropower, nearly 1/3 from wind and 7.5 % from solar photovoltaics energy. Consumption of biofuels will increase more than three times and reach to 4.5 million barrels of oil equivalent per day over the 2010-2035 periods. In the new polies scenario of IEA, it is predicted that nearly 37 % of road transport demand of Brazil, 19 % of USA and 16 % of EU will be met by the biofuel by the year 2035. Globally, the share of traditional biomass will decrease but protect its significance especially in developing countries. The production of heat from modern renewables continues to be dominated by bioenergy throughout the International Energy Agency's projection period. Geothermal heat, which is another important renewables that are used mainly in housing, will grow at 7.8 % per year from 3 Mtoe in 2010 to 19 Mtoe in 2035 (IEA, 2012: 211). In table 10, the use of renewable energy by type and scenario is given.

Table 10: World Renewable Energy Use by Type and Scenario

		New Policies		**Current Policies**		**450 Scenario**	
	2010	2020	2035	2020	2035	2020	2035
Traditional biomass (Mtoe)	751	761	687	764	697	748	653
Electricity generation (TWh)	4.206	6.999	11.342	6.648	9.627	7.443	15.293
Bioenergy	331	696	1.487	668	1.212	750	2.033
Hydro	3.431	4.513	5.677	4.390	5.350	4.658	6.263
Wind	342	1.272	2.681	1.148	2.151	1.442	4.281
Geothermal	68	131	315	118	217	150	449
Solar PV	32	332	846	282	524	376	1.371
Concentrating Solar Power	2	50	278	39	141	61	815
Marine	1	5	57	3	32	6	82
Heat Demand (Mtoe)	337	447	604	429	537	461	715
Industry	207	263	324	258	308	263	345
Buildings	131	184	280	170	229	198	370
Biofuels (Mboe)	1.3	2.4	4.5	2.1	3.7	2.8	8.2

Resource: World Energy Outlook, IEA, 2012

The supply of renewable energy was almost 1.700 (MTEP) in 2010 and this amount met the 13 % of global primary energy demand. Although the investment of renewables is affected from global economic crisis, growth of China and nuclear accident of Japan prevented the decrease in global market. To compensate the nuclear power accidents' effect and to lower the nuclear power share, Japan has been increasing its support to renewable energy (IEA, 2012: 213).

The consumption of renewable energy rises significantly from the current level in all scenarios of IEA. While the amount of renewable energy usage was 1.684 MTEP in 2010, it reaches to 3.079 MTEP in New Policies Scenario, 2.702 MTEP in Current Policies and 3.924 MTEP in 450 scenario (table 14). According to the central scenario of IEA, new policies scenario, annual growth rate of renewable energy is 3.4 % in 2010-2035 periods. The growth rate of OECD countries is expected to be above the non-OECD countries and grows 4.7 % per year throughout the projection period of IEA (IEA, 2012: 214).

Table 11: Total Primary Demand for Renewable Energy by Region and Scenario (mtep)

			New Policies		**Current Policies**		**450 Scenario**	
	1990	2010	2035	2010-2035 (%)*	2035	2010-2035 (%)*	2035	2010-2035 (%)*
OECD	**277**	**443**	**1.005**	**3.3**	**861**	**2.7**	**1.393**	**4.7**
Americas	153	199	461	3.4	402	2.9	686	5.1
Europe	98	208	423	2.9	373	2.4	533	3.8
Asia Ocenia	26	36	121	5.0	86	3.6	173	6.5
Non-OECD	**847**	**1.241**	**2.073**	**2.1**	**1.840**	**1.6**	**2.500**	**2.8**
E.Europe/Eurasia	40	47	103	3.2	84	2.3	165	5.2
Asia	497	676	1.133	2.1	955	1.4	412	3.0
Middle East	2	2	33	11.5	19	9.1	68	14.8
Africa	196	339	483	1.4	478	1.4	500	1.6
Latin America	112	177	322	2.4	305	2.2	355	2.8
World	**1.124**	**1.684**	**3.079**	**2.4**	**2.702**	**1.9**	**3.925**	**3.4**

- **Annual Growth Rate Between 2010-2035**

Resource: World Energy Outlook, IEA, 2012

Only one third of the renewable energy resources are used in electricity generation. It is expected that this ratio will increase in the coming years. Although the share of renewables is very small comparing with fossil based resources, the higher rate of investment and production increase is seen in renewables, especially in wind and solar energy. Since the 2000s, the electricity production from wind and solar photovoltaics has grown 27 % and 43 % per year on average respectively. The countries, such as Denmark, Spain and Germany,

illustrate the significant achievements in wind power. These countries provide important facilities to the producers. Hence, the usage of renewables, especially in electricity production, has been increasing significantly in OECD European countries (IEA, 2012).

The world electricity production from renewables will increase 2.7-fold between 2010-2035 years. In all scenarios of IEA, electricity production share is higher than biofuels and heat production throughout prediction period. According to the New Scenario of IEA, renewable energies will become the world's second largest source of electricity production. World's installed electricity capacity of renewable energy will increase from 1.465 GW in 2011 to 3.770 GW in 2035. Yearly renewable energy capacity addition will exceed 170 GW per year by the end of the 2035. Nearly half of the world's renewables based electricity production will come from hydropower, 1/3 from wind and 7.5 % from solar. Both in OECD and Non-OECD countries, the share of electricity supply will reach nearly 1/3 of total generation, (33 % in OECD and 30 % in non-OECD, world average is 31 %) (IEA; 2012).

Table 12: Renewables-based electricity generation by region in the New Policies Scenario (TWh)

	Renewable electricity generation							**Share of total generation**	
	1990	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2010**	**2035**
OECD	**1.339**	**1.960**	**2.493**	**2.963**	**3.444**	**3.936**	**4.436**	**18 %**	**33 %**
Americas	718	896	1.105	1.297	1.504	1.724	1.953	17 %	29 %
Europe	472	887	1.138	1.351	1.545	1.734	1.937	24 %	44 %
Asia Oceania	149	177	250	315	396	477	546	9 %	24 %
Non-OECD	**977**	**2.245**	**3.038**	**4.037**	**4.904**	**5.851**	**6.906**	**21 %**	**30 %**
E.Europe/Eurasia	266	309	315	347	391	446	516	18 %	22 %
Asia	281	1.090	1.688	2.445	3.039	3.663	4.320	17 %	27 %
Middle East	12	18	28	46	72	119	208	2 %	12 %
Africa	57	110	141	198	275	374	495	17 %	36 %
Latin America	361	718	866	1.000	1.127	1.248	1.367	67 %	73 %
World	**2.316**	**4.206**	**5.531**	**6.999**	**8.348**	**9.786**	**11.342**	**20 %**	**31 %**
European Union	310	687	922	1.113	1.285	1.450	1.626	21 %	43 %

Resource: World Energy Outlook, IEA, 2012

Renewable energy investments contribute the world economy in several ways. First of all, they will decrease the CO2 emission 4.1 Giga tons (Gt) and help the sustainable development of the global economy by decreasing the greenhouse effects of the fossil based resources in 2035. Moreover, they can reduce the stress on water resources in many place of the world with the help of the hydro dams. Secondly, while they are reducing the

air and water pollution, they also maintain the energy security by diversifying the energy supply. Since they are domestic resources they help the reduction of the external dependency and protect countries from the price fluctuation of the international energy prices. These situations reinforce the countries against the price and supply shocks of crude oil. Thirdly, they lower the oil and gas imports bills of the countries and help to decrease current account deficit of the countries. Lastly, although their initial investment costs are high, their operation and fuel cost is very low. Therefore, they can help to decrease the energy cost of global economy, especially for industry sector, and accelerate the economic growth in the world.

2.2.2.2. Installation Costs of Renewable Energy Sources

Despite the above mentioned advantages, the renewable energy resources are not able to become a major source in a global sense yet. One of the main reasons of this is the high initial investment cost of renewable energy sources. Although the cost of them has been decreasing gradually, they cannot compete with the fossil based sources yet. According to the IEA, it is estimated that the cost of wind, solar thermal and solar photovoltaic energy will decrease from 75 dollar/MWh to 50 dollars/MWh, from 75-150 dollars/MWh to 50-100/MWh, from 300-600 dollars/MWh to 150-325/MWh respectively in 2030. (IEA, 2004: 231).

As mentioned above, between the 2010 and 2035 years, 6.4 trillion dollars investment is required for the renewables and nearly 6.0 trillion of these investments will be on electricity generation. In other words, 300 billion dollars annual investment must be made to reach the 2035 targets. The biggest investment will be made on wind power, and then hydro and solar PV, with 2.1, 1.5 and 1.3 trillion dollars respectively. With the 2.9 trillion dollars investment, the investment of the OECD countries will be over the non-OECD countries in this period.

Investment costs of renewables have been decreasing for many years and this situation reduces the production costs. However, despite these developments, most of the renewable technologies cannot compete with fossil based technologies. Among the renewables, it is expected that the largest cost decrease will be realized in solar PV generating cost.

Between the 2011 and 2035 periods the cost decrease of solar PV will be between the 40 % and 60 %. However, this is not enough to decrease the average cost below the fossil based resources. Today, the cost of onshore wind power can compete with fossil based resources in a few countries and close in several others. It is expected that with the help of technological developments, the wholesale price of wind energy will fall to the competitive level in the EU around the 2020 (IEA, 2012).

In table 13, estimated investment and fuel cost of some renewable energy sources are given. In general, renewable energy sources have lower fuel costs, but the initial investment costs are quite high. This is the most important disadvantages of renewable energy sources (Türe, 2003).

Table 13: The Investment and Fuel Cost of Renewable Energy Resources.

Resource	Estimated Investment Cost ($/kW)	Estimated Fuel Cost (cent/kWh)
Biomass	600-1000	0.8-2
Solar (heat)	700-1200	9-12
Solar (PV)	5400-6000	55-75
Wind	800-1300	4-6
Hyraulic (Small Scale)	1300-1600	2-3
Geothermal	2000-2500	5-7

Resource: Türe, 2003:9

2.2.2.3. Types of Renewable Energy Resources

2.2.2.3.1. Hydraulic Energy:

The water is the main source of living life. Total amount of water on Earth is 1.400 million km³ and nearly 97.5 % of this water is salty seas and oceans and remaining, 35 million km³, is freshwater resources. The amount of surface water is only 0,001 of the total water potential of the world (WEC, 2013: 113).

Hydraulic energy can be obtained by converting the static energy of water to the kinetic energy by using the dams. The power of flowing water is converted to the electricity by hydroelectric power plants. It is a very clean, efficient and effective energy sources.

Today, hydroelectric energy is the largest renewable energy source in global economy and according to the 2010 data, hydro power provides the 16 % of world electricity needs with 3.431 TWh productions. Although its share is predicted to drop 15 %, global hydropower capacity is expected to increase from 1.067 GW in 2012 to 1.680 GW. The amount of electricity generation will reach to 5.677 TWh in 2035. Since OECD countries have already exploited their hydro potential, almost all production and capacity increase will come from the non-OECD countries between 2010 and 2035. (IEA, 2012: 225)

In contemporary world, hydroelectric plants have been meeting 50 % of total electricity needs in 53 countries and 80 % in 21 countries and almost all needs of 17 countries. With 5.327 dams and 200.000 MW capacities, China is the first country in hydroelectric production in the world (table 14). However, it uses only 23 % of its technical capacity and plans to increase its established power capacity 50 % by the year 2020. Brazil comes in the second place in installed hydro power capacity in the world. Although it uses only 25 % of total technical capacity of its hydroelectric energy, Brazil meets nearly 84 % of its electricity needs from hydropower (WEC, 2013:115).

Table 14: The Top 5 Countries in World Hydropower Production

	Installed capacity (MW)	**Production (GW/year)**	**Share in the Total Electricity Production (%)**
China	200.000	860.000	15.5
Brazil	84.000	391.000	83.9
Canada	74.433	358.000	59
USA	78.200	270.000	6
Russia	49.700	180.000	19

Resource: World Atlas& Industry Guide, 2012

Initial investment cost of hydroelectric power plants is very high. In addition, cropland, and even some residential and historical areas can be left under water. During the periods of drought, electricity generation decreases and these are the disadvantages of the hydroelectric plants. However, the hydroelectric power cannot cause the environmental pollution. If the half of the economically viable potential of the hydropower can be evaluated, the greenhouse emission can be reduced at about 13 % in the world. Also, they can be used for the water needs of the cities, and can help the prevention of flood, develop the fishing, facilitate the irrigation for the agricultural activities (WEC, 2013).

Among the other energy sources the hydroelectric power plants stand out with their environment friendly and low risk potential. These plants are capable of responding sudden demand change of energy. To meet demand especially at the peak demand hour is very important for electricity because the electricity cannot be stored. The most important thing in the consumption of the electricity is to harmonize the supply and demand equilibrium. Therefore, hydroelectric power plants are not only clean but also very efficient energy in the electricity production. Their efficiency is more than 90 % and comparing with the other sources, the most efficient plant is the hydro powers in electricity generation (SHW, 2014).

Beside these, they are domestic resources and do not have fuel cost, the production and operation cost of the hydro plants are very low, approximately 0.2 cent/kWh and with these peculiarities they can play a fuse role at the electricity plants. Their life is relatively longer than other sources and payback period is changing between the 5-10 years. All of these advantages make the hydro power plant an important source of the countries (SHW, 2014).

In table 15 theoretical, technical and economic potential of hydroelectric power is shown. The world hydroelectric potential is mainly located in America, Asia and European continental.

Table 15: World Hydroelectric Potential

	Theoretical Hydroelectric Potential (GWh/year)	**Technical Feasible Hydroelectric Potential (GWh/year)**	**Economically Feasible Hydroelectric Potential (GWh/year)**	**Established Power (MW)**	**Average Production (GWh/year)**
Africa	4.000.000	1.750.000	1.100.000	20.921	83.360
Asia	19.4000.000	6.800.000	3.600.000	244.819	800.605
Australia	594.000	200.000	90.000	13.274	43.336
Europe	3.200.000	1.035.000	791.000	177.397	568.726
N.&Middle America	6.312.000	1.663.000	1.000.000	157.681	693.719
S.America	6.200.000	2.700.000	1.600.000	114.433	553.876
Total	**39.706.000**	**14.148.000**	**8.181.000**	**728.525**	**2.743.622**

Resource: ITO, 2007: 17

The gross potentials show the total producible potential of the hydro power. However, it is not possible to evaluate all gross potential, at least with the current technology. Therefore, technical potential shows the maximum feasible potential of the hydro power with the

current technology. On the other hand, every facility that can technically feasible does not mean that they are economically feasible. Economically viable hydroelectric potential reflects the section of the technical potential that can be developed under the current and expected economic conditions (SHW, 2014). Currently, considering the annual production capacity of established hydro plants, only 24.3 % of technically and 40.7 % of economically feasible potential of hydro power is evaluated in the world (WEC, 2013:115).

2.2.2.3.2. Biomass Energy:

Biomass energy, which has been used by the least developed countries at a large scale in their energy consumption, is a kind of renewable energy source, usually obtained by direct combustion of organic substances or their outputs. Animal and vegetable waste, food scraps and paper industries, organic municipal waste, sewage sludge, forests, sugary, starchy and oil-seed crops, energy crops, are the main source of biomass energy. Being renewable, environmentally friendly and domestic, today biomass energy can find a place in the developed countries' energy portfolio and accepted as a strategic energy resource of the world.

Biomass energy can be divided into two classes as modern biomass and classical (also called as traditional or conventional) biomass. Burning of the animal waste and wood are the example of the conventional biomass. However, energy forest and fuels such as biodiesel, biogas, ethanol, which are obtained from the waste of energy plants or biological waste, are defined as the modern biomass energy.

Biofuels can be also classified as solid, liquid and gas. While the liquids biofuel are used in automobile, ships and other transportation vehicles, the solid and gas biofuel are generally used in electricity production, heating and cooking area. Today nearly 39 % of people (2.7 billion) have been using traditional biomass energy for cooking. The most produced liquid biofuel is the bioethanol. In 2011, more than 101 billion liter bioethanol and 22 billion biodiesel were produced in the world. The biggest producers of the bioethanol and biodiesel are USA, EU, Argentina and Brazil in the world. The size of the biodiesel market

is 82.7 billion dollars in the world and globally biodiesel production is supported by 38 countries in several ways (WEC, 2013).

Biomass is a sustainable energy resource. While fossil fuels are completely disappearing when they burned and require very long time period to replace them, biomass energy can be obtained in a very short period of time. For example, the energy forest can be obtained in a very short period of time with the generation of the fast-growing trees. Although they consume oxygen and generate carbon dioxide while they are burning, they eliminate these side effects while the energy plants and energy forests are produced. Energy plants and energy forest reduce the carbon dioxide and produce oxygen while they are growing. Therefore, their side effect to the environment is nearly zero, they are environmentally friendly. Apart from above mentioned benefits, biomass energy can contribute the environment with the incineration of the municipal and organic wastes (IEA, 2012).

Since biomass energies are renewable, environmentally friendly, provide socio-economic development, domestic and can generate electricity and fuel for vehicles, they are accepted as strategic energy source of the world. According to the some authors, when we consider the growing population, industrialization and ever-growing energy needs of the world, the biomass is the most important sources to provide sustainable development without polluting the environment and meeting the energy requirements. (Özsabuncuoğlu and Uğur, 2005: 204-207).

The number of modern biogas plant in the world is over 10,000 and nearly 80 % of them have capacity below the 500 kWh. The sector is estimated to increase by 60 % over the next 5 years. The EU is moving rapidly on the biogas production and Germany, UK, Italy, Spain, France, the Netherlands, Austria and Denmark are important producers (WEC, 2013).

Biomass energy has the second biggest potential of electrical energy among the renewable energy resources. The share of biomass in electricity generation varies between the 1 % and 3 % in the world. Finland has been meeting nearly 14 % of the electricity needs from biomass. Between the 2000 and 2010 global electricity production from biomass increased

at 6.9 % per year and growth rates of OECD countries were above the non-OECD countries. As of 2010, the electricity production from biomass resources reached to 331 TWh globally. According to the New Policies Scenario of IEA, bioenergy generation will reach to 1.487 TWh in 2035. Today, EU, USA, Brazil and Japan are the biggest producers of electricity from bioenergy. (IEA, 2012:217-223) Although many of the developing countries have very big potential in terms of biomass energy, they cannot sufficiently benefit from these resources. It is expected that electricity derived from biomass energy will increase more than threefold in 20 years. (WEC, 2013: 281-290)

Bioenergy is also used in heating sector. According to the 2013 report of IEA, 8 joule heat energy was generated from biomass. In the New Policies Scenario of IEA, world biomass consumption for heat will grow from 294 MTEP to 480 MTEP in 2035. It is expected that world total bioenergy demand, excluding conventional biomass, will grow 3.3 % per year and increase from 526 MTEP in 2010 to 1.200 MTEP in 2035. The highest demand increase for bioenergy will be in EU in this period. USA and Brazil are also important countries for the biomass energy because of their rich sources to produce biomass. However, conventional biomass will decrease in the same period as a result of modern fuels development. The largest demand of the bioenergy will come from industrial sector and then from power sector (IEA, 2012:217-223).

Today, there are 2.200 garbage plants that processed 255 million tons of waste per year worldwide. On the other hand, the number of hazardous waste treatment plant is 1.150 units. With this peculiarity the bioenergy not only contributes the electricity and production but also supports the sustainable energy by cleaning the waste in the world (IEA, 2012: 217-223).

Separation of arable lands for the biodiesel and bioethanol production, thereby creating a global risk in terms of food safety is the most criticized aspects of biofuel’s agriculture. Therefore, production of biomass plants should be made in less fertile lands. In this way, underutilized land can be evaluated and rural development can be accelerated.

2.2.2.3.3. Wind Energy:

Since the ancient time, the wind energy has been used by human being for different purposes. Today, however, the wind energy is increasingly used for the generation of the electricity. While the share of electricity production from wind energy was only 1.6 % in 2010, which is equal to 342 TWh electricity, it is expected that this ratio will be 7.3 % by the year 2035, and the amount of generated electricity will reach to 2.680 TWh (IEA, 2012). In other words, the share of wind energy will increase eight-fold by the year 2035. With this growth ratio, it will take the second place among the renewable energy resources.

According to the New Policies Scenario of IEA, electricity output of wind power will also be greater than any other renewable resources. The highest level of increase will be in EU. It is predicted that nearly 20 % of electricity of the Union will be generated from wind power in 2035 (IEA, 2012). Denmark, Germany, USA, China, India and Spain were the pioneer of the wind energy and nearly ¾ of the total world wind energy was produced by these countries. Denmark meets all of the electricity need from wind energy and the country has the significant share in wind turbine in the world (WWEA, 2014).

Table 19: Installed Onshore and Offshore Wind Power Capacity by Region in the New Policies Scenario

	Wind Onshore			**Wind Offshore**			**Total Wind**		
	2011	2020	2035	2011	2020	2035	2011	2020	2035
OECD	**150**	**285**	**441**	**4**	**31**	**113**	**154**	**315**	**555**
Americas	53	107	175	-	4	26	53	112	202
Europe	91	161	231	4	24	72	95	184	304
European Union	90	159	218	4	23	70	94	182	288
Asia Oceania	6	16	34	0	3	14	6	19	49
Non-OECD	**84**	**262**	**482**	**0**	**9**	**62**	**85**	**271**	**544**
E.Europe/Eurasia	2	6	16	-	0	3	2	6	19
Asia	79	239	411	0	9	53	79	248	464
Middle East	0	2	21	-	-	2	0	2	23
Africa	1	4	15	-	-	1	1	4	16
Latin America	2	11	19	-	-	3	2	11	22
World	**234**	**546**	**923**	**4**	**40**	**175**	**238**	**586**	**1.098**

Resource: World Energy Outlook, IEA, 2012

However, cumulative installed wind power is increasing logarithmically since 1996. In 2013, the global wind power installed capacity reached to 318.488 MW by commissioning

13.978 MW new wind power plants (WPP). 5 % growth was observed at the global wind energy market by the end of the 2013. Last year, the largest growth in the installed wind energy capacity was seen in China with the 5.503 MW increase. UK and India followed China with 1331 MW and 1.243 MW new investments. According to the 2013 data, with 91.413 established capacity, the biggest installed wind energy is in China and then in USA with 61.108 MW (WWEA, 2014).

When the first six months of 2014 years' wind installed capacity values are examined, it is seen that 17.613 MW new capacity was added to the wind energy market and global wind capacity reached to 336.327 MW. Comparing with the last years' total investments amount, current years' wind investment in six months exceeds the total investment of 2013. Given the upward trend in wind installed capacity, wind power is expected to reach 360,000 MW globally by the end of 2014 (WWEA, 2014).

Table 16: Top 10 Countries in the Global Wind Energy Market in 2014

Countries	Installed Power	Global Market Share (%)	Capacity Growth in 2014
China	98.588	0,29	7.175,00
USA	61.946	0,18	835,00
Germany	36.488	0,11	1.830,00
Spain	22.970	0,07	0,10
India	21.262	0,06	1.112,00
England	11.180	0,03	649,00
France	8.592	0,03	338,00
Italy	8.586	0,03	30,00
Canada	8.526	0,03	723,00
Denmark	4.855	0,01	83,00
Other Countries	53.334	0,16	4.838,00
Total	336.327	100,00	17.613,10

Resource: Half Year Report 2014, Global Wind Energy Council (GWEC)

The cost of wind power investment has been decreasing steadily and today in some EU countries the onshore wind power can compete with the fossil based resources. However, despite the all cost improvements, the offshore wind prices are still above the whole sale price of fossil based resources. Since the shale gas revolution of USA, the gas price decreased dramatically and it is not expected that wind power can compete with fossil based resources in the short run.

Although the first investment cost of wind energy is seen relatively high, the return ratio of the wind energy is 18 %. With this peculiarity, it is the most profitable energy investment among the renewable energy resources (Kubiszewski and Cleveland, 2007:5).

The advantages of wind energy can be listed as follow: its raw material is air, therefore it does not need any external energy input like being in thermic plants. Since it is a clean and domestic resource, it is a sustainable energy resource nearly for every country. It decreases the energy dependency of the countries and contributes the stability of the world economy and political life. The cost of wind energy has been decreasing steadily. Therefore, its first investment cost and production efficiency can compute with the fossil based energy resources (Şen, 2002:130).

On the other hand, even if it has advantages as mentioned above, because of the noise, visual pollution and bird death it caused, the wind energy is criticized by several environmentalists. However, the vast majority of these environmental side effects can be eliminated by the technological advancements.

2.2.2.3.4. Solar Energy:

Solar energy is a very clean, free and domestic renewable energy resource. Especially in the solar belt countries, this energy resource can finish the energy dependency of the countries with its tremendous potential. The worlds' annual solar radiation is 167.000 times bigger than annual energy consumption and if it is evaluated correctly, solar power can meet the total energy demand of global economy.

Today, solar energy is used by two kinds of systems; active and passive system. Active system, also called photovoltaic (PV) systems, based on semiconductor technology and constitutes 99 % of the global installed solar power plants. In this system solar radiations are directly converted into the electricity. Other solar energy system is based on thermal technology. Working system is similar to the thermic plant and this type of solar system is divided into two kinds as collector and tower kind. Several countries have small scale power plants and the first commercial plant was established in California in USA.

Solar power has a significant potential in terms of electricity potential. It is expected that by the year 2035, the electricity production from solar energy will be 846 TWh and more than 80 % of this amount will be produced by photovoltaic technology. The cost of photovoltaic energy investment is still very high comparing with all other energy systems. For example, while the cost of electricity generated from natural gas was 40 dollars/MWh, the cost of photovoltaic energy changes between the 350-600 dollars/MWh (IEA, 2004: 236) The main reason of this high cost range can be explained by different sunshine hours of different regions. In other words, while some region takes 1.500 hours sunlight in a year, the other region takes 3.000 hours and this difference directly affects the production cost of the solar energy.

Investment cost of PV energy has been declining steadily and this situation is expected to continue in the future. However, today the cost of electricity generation from solar resources is still very expensive. Apart from the high establishment cost, the solar energy needs large surfaces to concentrate sunlight and its production period is limited only in daytime. Its storage is very difficult due to the current high storage cost. All of these factors limit the solar energy investment in the world. However, environmental problem, global warming and operational cost become more important issue in contemporary world and the establishment cost has been decreasing steadily. It is expected that the cost of solar power can be at a level that can compete with the price of the some fossil based resources by the year 2030. In addition, with its low operation cost, zero harmful emission and domestic characteristics, solar energy increases its popularity not only in Turkey but also in other countries. Besides, it can be established in a very short period of time and it needs no external fuel to generate electricity.

Currently, with the present capacity, only small part of global electricity demand (nearly 0.5 %) is met by solar PV modules. This ratio is around 5.6 % in Germany and in Italy. However, PV capacity has been growing rapidly in recent years and only in 2012, 30.000 MW new PV installations were realized on a global scale. According to the New Policies Scenario of IEA, electricity production of PV will be 26 times bigger than 2010 number and increased from 32 TWh to 846 TWh by the year 2035. Installed capacity of PV energy is also raised from 67 GW in 2011 to 600 GW in 2035 with the help of government

subsidies and cost reduction in PV modules. Electricity generation from concentrating solar power (CSP) plants soars from 1.6 TWh to about 280 TWh and capacity from 1.3 GW to 72 GW between 2011 and 2035 (IEA, 2012:227-229).

Germany and Italy are the leader countries in solar PV energy with 25 GW and 13 GW installed capacity respectively. Only in 2012, 7.5 GW of solar energy system was connected to the electricity grids of Germany. EU has the three-quarter of the world solar capacity and by the year 2035, it plans to produce 5 % of its electricity needs from PV energy. It is expected that by the year 2035 EU, USA, China, India and Japan will be main players in the solar market with their expected capacity of, 146 GW, 68 GW, 113 GW, 85 GW and 54 GW respectively (IEA, 212: 228).

Weight of PV module production activities have shifted from west to east, but Europe continues to be central of PV installations. China, Taiwan and Japan have the highest share in the production of PV module with the 45 %, 16 % and 11 % ratio. The share of all European countries and USA is 10 % and 4 % respectively. (WEC, 2013: 233). Another important development in the solar energy sector is Saudi Arabians' plan to increase renewable energy power to 54.000 MW until the year 2030. With this new strategy, Saudi Arabia wants to ensure national energy demand from renewable energy sources and direct all-natural resources to the export of energy (WEC, 2013: 234).

Solar energy seems as if solution of energy needs of world but, the cost, surface and efficiency problems should be solved by the technological innovations.

2.2.2.3.5. Geothermal Energy:

The geothermal hot water has been used for the health purposes since the early times. For the first time, it was used in industry to obtain boric acid in 1827 in Italy. In 1905, the first geothermal electricity plant, having 250 KWh power, was built in the same country. The usage of geothermal power increased both in electricity and other fields such as heating of the houses, greenhouses, food drying, lumber etc.

While the usage of geothermal power in the electricity generation was increased 17 %, the other usage of that resource, especially heating, increased 87 % in the world. Today residential geothermal heating is spreading rapidly. The top five countries in the world in geothermal electricity production are the USA, Philippines, Italy, Mexico and Indonesia. However, the top 5 countries in geothermal heating and spa applications are China, Japan, USA, Iceland and Turkey (MENR, 2014).

Table 21: Established Geothermal Market Installed Capacity in Megawatts

USA	Philippines	Indonesia	Mexico	Italy	New Zealand	Iceland	Japan
3.389	1884	1.333	980	901	895	664	537

Resource: Geothermal Energy Association, 2013

Geothermal energy is produced by the heat of the earth. The heat of the earth creates the chemical hot water, vapor and gases and this can be used directly or indirectly. Although there are different classifications, the geothermal energy can be divided into three groups according to their temperature content:

1 - Low-Temperature Fields (20-70 ° C)
2 - Medium -Temperature Fields (70-150 ° C)
3 - Field of High Temperature (150 ° C high)

Under the current technology and economic condition, the low and medium temperature fields are used particularly for heating (greenhouses, buildings, agricultural uses), industry (food drying, lumber, paper and textile industry, leather, the refrigeration facilities), and for chemical production (boric acid, ammonium bicarbonate, heavy water, in the preparation of dry ice of CO2 in the fluid). High temperature fields can also be used for electricity production.

Geothermal resources are also divided into classes according to their fluid temperature. They are separated into the three groups depending on their fluid temperature; the low enthalpy (liquid temperature 160 °C lower than), the medium enthalpy (fluid temperatures 160 °C -190 °C), and the high enthalpy (fluid temperatures 190 °C greater than). As

mentioned above, in high enthalpy the electricity generation has been already done but with the technological development, the production of electricity is also available in the medium enthalpy. (SPO, 2001a : 5).

Geothermal energy is not affected by short-term atmospheric conditions. Therefore, they are renewable and sustainable energy resources. However, in order to protect the environment and to maintain the sustainability, the reinjection of the geothermal source is necessary. Otherwise, some of the undesirable consequences can realize for the environment. Hence, drainage has been made compulsory by law in many countries.

When we look at the cost of the electricity production from the geothermal resource we see that nearly 40 % of the total cost comes from exploration, wells and reinjection activities, 50 % from power plant construction, and rest of the 10 % consisted of other activities, such as operation and maintenance cost. For the large capacity geothermal power plant, the establishment cost is 1.000 dollars/kWh. However, for the small scale power plant the cost can be changed between the 1.250 and 1.500 dollars/kWh. Today, the estimated unit cost for electricity produced from geothermal is 46 cents/kWh. Geological structure of the steam quality, well yield and plant type, are the most important factors that influence the production cost (SPO, 2001a: 29).

The geothermal power market has been growing substantially all around the world. As of August 2013, the global geothermal industry reached to 11.765 MW of installed geothermal capacity (GEA, 2013). It is expected that by the end of the 2035, global geothermal electricity production will increase more than 300 TWh and installed capacity will reach to 40 GW in the world (IEA, 2012). The target of electricity generation from geothermal is 150,000 MW by 2050. The use of geothermal energy apart from electricity generation is 50.583 MW and this number is equivalent of 6.2 million residential heating (Ministry of Development, 2014).

There are three main types of geothermal turbines: binary, flash, and dry steam. Although dry steam is the oldest power technology, single flash power plants are the most used technology for geothermal power in the world with 39 % share and 4.557 MW installed

capacity. The share of dry steam is 25 % and comes in the second place with 3,005 MW installed capacity. Double flash ranks and binary have 19 % and 14 % share with 2.184 1.654 MW of global installed capacity (GEA, 2013).

2.2.2.3.6. Hydrogen Energy:

Hydrogen, which was discovered in 1.500s, is the simplest and most abundant element of the world. It is completely non-toxic, colorless and odorless gas and 14.4 times lighter than air. It does not give any harm to the environment and human life. It is considered as the energy carrier rather than energy resources and with this aspect it looks like the electricity but it is more efficient than electricity.

Hydrogen is clean, having high efficiency, can be stored and carried easily and securely from one place to another, harmless to environment and human being, can be converted easily to the other energy types, such as electricity and heat energy. With these peculiarities, hydrogen is called as the ideal fuel of the future. (Aslan, 2007:285).

Although the renewable energy resources' adverse effect is very low comparing with the fossil based resources, they have some limitation on the energy supply. Some of them can be used intermittently, their dependency to the climatic conditions is very high and their technology cannot be developed at a desired level yet. According to the many energy experts, limited aspects of renewable resources can be solved by using hydrogen energy system (Aslan, 2007:284).

Today nearly 500 billion m^3 hydrogen is produced in the world and the main user of the element is the petrochemical industry. The most important feature of the hydrogen is its storable characteristics and the boron is the most advantageous method in its storing. It can be transported easily and safely from one place to another with the pipeline.

There are three scenarios about the usage of the hydrogen. These are niche scenarios, transition scenarios and sustainable hydrogen scenarios. According to the niche scenarios, the hydrogen is used only in selected vehicles and with the use of it the harmful effects of

the fossil based resources can be decreased but it will not be used at an amount to lessen the foreign dependency in energy. In the transition scenario, however, it is accepted that the hydrogen can meet the significant part of the world energy needs. The primary source of the hydrogen will be fossil based fuels because of their existence infrastructure and low cost. With the development of nationwide network of hydrogen's storage and distribution, human beings can easily use it as an alternative energy resource. In the sustainable scenario the hydrogen is generated from renewable energy resources especially from solar and wind energy. Although this scenario is the most expensive one among the others, the result of this scenario will be more beneficial to maintain energy security and to diminish the environment harm of the fossil based resources. (Aslan, 2007:290-291).

2.2.2.3.7. Summary:

This chapter described the general energy outlook of the World in the World by using the descriptive method. Classification of the energy, types of energy, current reserves, potential of each energy types and consumption level of used energy resources were examined by using the IEA, WEC and other resources. The next chapter will cover the general energy outlook of Turkey. The energy photo of the country will be shown and the potential, threats and opportunities of the country will be examined in the coming chapter.

CHAPTER III

3. ENERGY OUTLOOK OF TURKEY

This chapter provides an insight regarding current situation of the Turkish renewable and non-renewable energy resources and illustrates the development process of renewables in Turkey. Turkey's non-renewable energy resources; such as oil, natural gas, coal and renewable energy resources; wind energy, solar energy, hydraulic energy, biomass, hydrogen and geothermal energy, their potential, share in total energy and electricity production will be presented. This chapter will also inform the energy policy and energy efficiency of Turkey under the recent developments.

3.1. Primary Energy Outlook

Like being in all world economy, the main input of the industry is energy and its demand has been increasing steadily parallel with the development of economy in Turkey. According to the study results, the most important factors that affect the energy usage are the population growth and income increase. Since the establishment of the Republic both population and economy have been growing steadily even if sometimes there could be fluctuations in economy. In table 17, Turkey's economic situation and energy demand were given.

Table 22 Population, Economy and Energy Data of Turkey

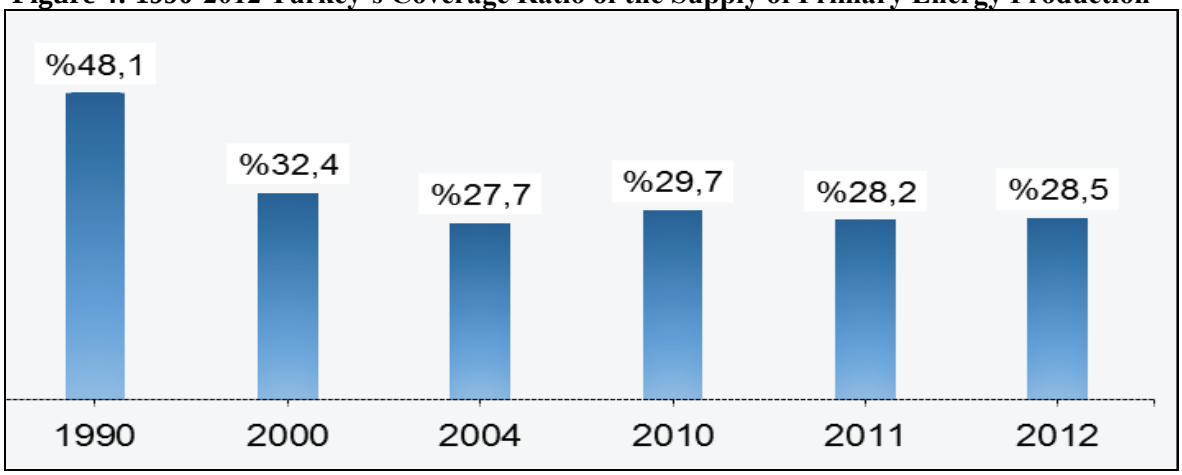
	Population (*1000)	GDP Billion $	GDP Per Capita $	Energy Demand (MTEP)	Energy Demand Per Capita	Electricity Demand Per Capita (kWh/Person)
1973	38.072	76	1.994	24.6	646	326
1990	56.098	150	2.674	53.7	957	1.013
1995	62.171	178	2.861	64.6	1.039	1.376
2000	67.804	214	3.158	82.6	1.218	1.892
2010	73.722	732	10.079	109.3	1.483	2.841
2013	76.667	823	10.822	122.79	1.601	3.201

Resource: MENR, Energy Statistics, 2013

As it can be seen from the table, the demand of the energy has been increasing parallel with the population and income level developments in Turkey. Between the 1973-1.990 the primary energy demand rose from 24.6 MTEP to 53.7 MTEP and in this period the average energy growth rate is 3.2 % per year (table 17). However, between the 1990-2010 periods, the energy demand increased nearly 2.9-fold. According to the IEA projection, the average annual growth of primary energy supply in Turkey is estimated as 2.48 % in 2013-2023 periods. Between the 2024 and 2034 years, it is expected that the increase rate will decline slightly and will be realized as 2.36 % (WEC, 2013).

While Turkey's primary energy supply could meet the 48.1 % of its consumption in 1990, it fell to 28.5 % in 2012 (Figure 4). In other words, domestic energy production of Turkey declined at a ratio of 20 % between the 1990 and 2012 periods and its dependency to foreign resources increased with the same ratio. The primary energy supply of Turkey was 121 MTEP and, total domestic primary energy production of the country was 34.47 MTEP in 2012. Nearly 57 % of this domestic production was provided from coal, 14 % from hydraulic, 10 % from renewable. As it can be seen, the domestic production has been decreasing steadily. Since the domestic fossil based resources are very limited, the energy bill, foreign dependency and high import necessity have become a heavy burden for the economy of Turkey. The country's energy import was 31 MTEP in 1990 and in the mentioned periods it increased 3.2-fold and reached to 98.7 MTEP in 2010 (MENR, 2012).

Figure 4: 1990-2012 Turkey's Coverage Ratio of the Supply of Primary Energy Production



Resource: MERN, 2012

As mentioned above, the primary energy supply of Turkey was 122.79 MTEP in 2013. The share of the resources in the primary energy supply of Turkey between the 1990-2012 periods is shown in table 18. According to this table, while the share of coal in the primary energy supply was 30 % in 1990, it slightly increased and realized as 31 % in 2012. Although the share of oil declined from 45 % to 25 % in the mentioned period, compared to 1990 the volume of it increased 6.713 MTEP and reached to 30.614 MTEP.

In this period, the largest increase occurred in natural gas consumption. While the share of natural gas was 6 % in 1990, it increased more than 5 times and reached to 32 % in 2012. Compared to 1990, the volume of natural gas increased 12-fold and reached to 37.373 MTEP. The share of hydraulic power remains stable and realized as 4 %. However, the amount of hydraulic power increased 2.5 times and realized as 4.976. Both the share and volume of bioenergy declined in the last twenty-two years. Due to the widespread of natural gas usage in cities, the needs to traditional bioenergy (wood etc) decreased. Comparing to 1990 level, the share of bioenergy declined from 14 % to 3 %. In short, Turkey's primary energy supply distribution on the base of sources was realized as: 31 % coal, 25 % oil, 31 % natural gas, 4 % hydraulic, 3 % bioenergy and 3 % other renewables as of 2012 (MENR, 2012).

Table 18: Amount and Share of Sources in Primary Energy Supply of Turkey

		1990	**2000**	**2011**	**2012**
Coal	MTEP	16.110	22.928	33.879	37.977
	%	30	29	30	31
Oil	MTEP	23.901	32.297	30.499	30.614
	%	45	40	27	25
Natural gas	MTEP	3.110	13.729	36.909	37.373
	%	6	17	32	31
Hydro	MTEP	1.991	2.656	4.501	4.976
	%	4	3	4	4
Bioenergy (wood, waste etc)	MTEP	7.208	6.457	3.537	3.465
	%	14	8	3	3
Other Renewables (solar, wind, geothermal etc)	MTEP	461	978	3.096	3.508
	%	1	1	3	3
Others	MTEP	206	1.456	2.071	3.071
	%	1	1	3	3
Total	MTEP	52.987	80.500	114.490	120.984
	%	100	100	100	100

Resource: General Energy Balance Sheets, MENR, 2012

When we analyzed the Turkey's energy import development by resource, we see that natural gas and oil import increased to 38 MTEP. However, while oil import was increased 62 %, the natural gas increased 13-fold in the same period. Likewise, the hard coal imports increased approximately 5-fold and reached to 19.5 MTEP in the last 22 years. Despite the negative impact of the economic crisis that occurred 4 times (in 1994, 1999, 2001 and 2008 years) in last 21 years, Turkey came after China and India in terms of primary energy growth ratio (MENR, 2012).

Since the growing energy needs cannot be met by the domestic resources, the import of energy has been increasing steadily. Turkey's ratio of net imports of primary energy supply has increased from 52 % to 72.4 % in 1990-2012 periods. This situation creates significant risk not only for the economy but also for the foreign relationship of the country.

In Turkey, 98 % of natural gas and 90 % of oil are imported. 67 % of natural gas is used in electricity production and 52 % of the oil is used in transportation sector. Since Turkey's import dependency is very high, energy prices and energy security have a vital importance for the economy of the country. Because of high dependency to the foreign energy supply, the competitiveness of Turkey in the global market reduces and this situation undermines its development (Sabır, 2008:3). When the price of the energy increases, it affects all economy and the cost of goods and services increases. This situation reduces the competition power of our country in the global market. Beside these, as a result of high foreign energy dependency, Turkey cannot play active role against the energy exporter countries, especially to Russia and Iran, in the international relationships.

On the other hand, the main risk of Turkey's economy comes from the high current account deficit ratio. When we look at the macroeconomic balance of Turkey, we see that except for the energy import, our economy nearly does not give current account deficit. In other words, apart from the energy, the export ratio meets the import ratio. The current account deficit creates the fragility on economy and price of the oil and other energy resources accelerate this fragility. In 2012, energy imports beat the record of the republic period and reached to 60.1 billion dollars. The share of energy in the foreign trade of Turkey was 25 % and more than 60 % of the reason of trade deficit was energy import in

that year. Although the imports of energy and its share decreased to 55.9 billion dollars and 22.21 % respectively in 2013, energy import constituted more than half of the trade deficit of the country. Turkey paid 385.2 billion dollars to the energy import in last ten years and this number equals nearly half of the gross domestic product of the country.

Today, Turkey's energy situation has reached to a critical stage not only in terms of price but also for the energy supply security because of its huge dependency to the foreign energy resources. Since the geography of Turkey is extremely sensitive, dependence on foreign energy should be reduced as soon as possible. Due to the fact that energy is the main input of the development and economic growth, it is very important to obtain energy securely and uninterruptedly. To sustain energy security and decrease the negative effects of energy import on economy, energy investment on domestic resources (both renewable and fossil based) should be accelerated.

3.2. Secondary Energy (Electricity) Outlook of Turkey:

When we look at the electricity outlook of Turkey, we see that with the effect of the high growth rate in economy, the electricity consumption increased 5.81 % per year in last 11 years. While the consumption of electricity was 141.151 GWh in 2003, it increased 1.74-fold and reached to 245.484 GWh in 2013. Between the 2004 and 2010 years, Turkey's electricity export was higher than its import in electricity trade. However, because of the Arab Spring and civil war in Syria, the electricity export decreased dramatically. Today our country becomes net importer both in sources used in production of electricity and in consumption of electricity.

Table 19: Electric Energy Outlook of Turkey's (GWh)

Year	Production	Import	Export	Consumption	Production Increase Rate (%)	Consumption Increase Rate %)
2003	140.581	1.158	588	141.151	8.6	6.5
2004	150.698	464	1.144	150.018	7.2	6.3
2005	161.956	636	1.798	160.794	7.5	7.2
2006	176.300	573	2.236	174.637	8.9	8.6
2007	191.558	864	2.422	190.000	8.7	8.8
2008	198.418	789	1.122	198.085	3.6	4.3
2009	194.813	812	1.546	194.079	-1.8	2.0
2010	211.208	1.144	1.948	210.434	8.4	8.4
2011	229.395	4.556	3.645	230.306	8.6	9.4
2012	239.497	5.826	2.954	242.370	4.4	5.2
2013	239.293	7.425	1.235	245.484	-0.08	1.2

Resource: Energy Report, MENR, 2014

In table 19, the electricity production of Turkey on the basis of source is shown. According to the Ministry of Energy and Natural Resources' data, except for 2008 and 2013, electricity production increased steadily in last decade. While the electricity production from thermal plants and hydroelectric plants rose 63 % and 67 % respectively, the electricity generation from wind and geothermal power increased 59-fold in this period. In other words, while the share of wind and geothermal power were only 0.001 in total electricity production in 2003, they reached to 3.7 % in 2013 and 4 % as of September 2014. The renewable energy regulation and incentive about the electricity production from renewables plays a great role in this increase.

Turkey produces nearly 71.6 % its electricity from thermal resources, 24.7 % from hydraulic, 3.7 % wind, geothermal and other renewables. As of September of 2014, the share of thermic plants rose to 78.8 %. The share of hydraulic fell into the 17.2 % with the effects of drought. The share of other renewables increased slightly and reached to 4 % in the total electricity production of our country. In the 2003-2014 periods, composition of the sources used in electricity production has been changing between the 69.3 % and 82.7% for thermic plant, 16.8 % and 30.6 % for hydraulic, 0.1 % and 4 % for wind, geothermal and other renewables (MENR, 2014).

Table 20: Turkey's Electricity Generation on the Basis Source

Year	Thermic	Hydraulic	Geothermal and Wind	Total	Increase rate (%)
2003	105.101	35.330	150	140.581	8.6
2004	104.464	46.084	151	150.698	7.2
2005	122.242	39.562	153	161.956	7.5
2006	131.835	44.244	221	176.300	8.9
2007	155.196	35.851	511	191.558	8.7
2008	164.139	33.270	1.009	198.418	3.6
2009	156.923	35.958	1.931	194.813	-1.8
2010	155.828	51.796	3.585	211.208	8.4
2011	171.638	52.339	5.418	229.395	8.6
2012	174.872	57.865	6.760	239.497	4.4
2013	171.256	59.246	8.792	239.293	-0.08
Ratio of 2013	**71.6 %**	**24.7 %**	**3.7 %**	**100 %**	
2014 (September)	**148.947**	**32.581**	**7.563**	**189.091**	**-**
Ratio of 2014/9	**78.8 %**	**17.2 %**	**4 %**		

Resource: Energy Report, MENR, 2014

When we look at the distribution of Turkey's electricity production in primary energy sources, we see that nearly 70 % of the electricity is produced from natural gas and coal. The share of coal and natural gas was 25.70 % and 43.81 % respectively in 2013. Because of the effects of drought, the share of the coal and natural gas increased to 78.8 % and the largest share belongs to natural gas with the 47.84 % ratio at the end of the September in 2014. This situation shows that the foreign dependency of electricity production is more than 50 % and this can directly affect the security of energy supply. Since 98 % of natural gas is imported and more than half of this import is made from only one country, Russia, sustainability of the electricity production is very risky for Turkey. Both foreign dependency and distribution of this dependency to the country make Turkey's electricity policy vulnerable against the foreign effects.

Table 21: Distribution of the Electricity Generation of Turkey in Primary Energy Resources

	2012		2013		End of September 2014	
Primary Energy Resources	**Electricity Generation Billion kWh**	**Share in Total Generation (%)**	**Electricity Generation Billion kWh**	**Share in Total Generation (%)**	**Electricity Generation Billion kWh**	**Share in Total Generation (%)**
Coal	68.013	28.40	61.476	25.70	54.958	29.06
Liquid Fuels	1.639	0.70	3.890	1.63	2.551	1.35
Natural Gas	104.499	43.60	104.835	43.81	90.453	47.84
Renewables waste	721	0.30	1.055	0.44	984	0.52
Total Thermic	**174.872**	**73**	**171.256**	**71.57**	**148.947**	**78.77**
Total hydraulic	57.865	24.20	59.246	24.76	32.581	17.23
Wind	5.861	2.40	7.518	3.14	5.989	3.17
Geothermal	899	0.40	1.274	0.53	1.575	0.83
Total non-thermic	**64.625**	**27**	**68.038**	**28.43**	**40.145**	**21.23**
Total	**239.497**	**100**	**239.293**	**100**	**189.091**	**100**

Resource: Energy Report, MENR, 2014

The installed electricity capacity of Turkey was 35.587 MW in 2003. It increased nearly 92 % in last 12 years and reached to 68.230 MW as of September 2014. The average growth rate is realized as 7.67 %. As of September, distribution of the installed power according to the primary energy resources are 20.6 % coal, 31.1 % natural gas, 8.3 % other thermic sources, 34.4 % hydraulic, 5.1 % wind, 0.5 % geothermal and 0.03 % solar power. Except for renewables, the distribution of all resources stayed stable between the 2003-2014 periods. However, while the installed capacity of renewables, geothermal, wind and solar, was only 0.1 % in 2003, it rose more than 50-fold and reached to 5.6 as of September 2014. In 2014, Turkey added the first solar power plant to its national grid by bidding 600 MW solar licensing.

The share of private sector in the total electricity production and installed capacity increased to 71 % and 65 % respectively in 2014. While some of the share increase comes from the direct investment of the private sector, the other part comes from the privatization of the public institutions. In order to maintain competition in electricity market and to accelerate the investment on electricity generation, the government started the privatization program in electricity plants.

Table 22: Installed Electricity Capacity of Turkey

Year	Thermic			Hydro	Wind	Geo-thermal	Solar	Total	Growth Rate (%)
	Coal	Natural Gas	Others						
2003	8.239	10.053	4.683	12.579	18,9	15	-	35.587	11.7
2004	8.296	11.349	4.500	12.645	18,9	15	-	36.824	3.5
2005	9.117	12.275	4.487	12.906	20,1	15	-	38.820	5.4
2006	10.197	12.641	4.520	13.063	59	23	-	40.502	4.3
2007	10.097	12.853	4.322	13.395	146,3	23	-	40.836	0.8
2008	10.095	13.428	4.072	13.829	363,65	29,8	-	41.817	2.4
2009	10.501	14.555	4.284	14.553	791.6	77.2	-	44.761	7.0
2010	11.891	16.112	4.276	15.831	1.320	94,2	-	49.524	10.6
2011	12.491	16.003	5.438	17.137	1.729	114,2	-	52.911	6.8
2012	12.530	17.162	5.337	19.620	2.261	162,2	-	57.072	7.9
2013	12.428	20.254	5.965	22.289	2.760	311	-	64.007	12.2
2014 (Sept.)	**14.034**	**21.189**	**5.689**	**23.455**	**3.484**	**358,4**	**20,3**	**68.230**	**6,6**
Ratio	**20,6%**	**31,1%**	**8,3%**	**34,4%**	**5.1%**	**0.5%**	**0.03 %**	**100%**	

Resource: MENR, 2014

3.3. ENERGY RESOURCES OF TURKEY

3.3.1. Non-renewable Energy Resources

3.3.1.1. Asphaltite:

Asphaltite is a black hard bitumen that is formed as a result of oxidation and solidification of petroleum over times. It is a kind of hardened petroleum product. It resembles coal and used as a solid energy resource. The proved visible reserves of Turkey is 60 million tons and all of the reserves are located in Southeastern Anatolian Region especially in Siirt, Şırnak and Silopi provinces (Özsabuncuoğlu and Uğur, 2005:167) Although it has no economic value until 1964, the asphaltite is used for heat and electricity purposes in east Southeastern Anatolian today.

Table 23: Reserves of Asphaltite in 2013

Province	District	Visible (1000 tons)	Probable (1000 tons)	Possible	Total	Licensee
Şırnak	Silopi	28.446	21.067	-	49.513	TCE
Şırnak	Central	32.038	23.054	-	55.092	TCE
	Total	**60.484**	**44.121**	**-**	**104.605**	

Resource: Turkish Coal Enterprises (TCE), Yearly Report, 2013

An important part of the reserves are hold by Turkish Coal Enterprises (TCE), and there is no reliable information about the reserves of the private sector. However, the production of

asphaltite was has been made by Şırnak governor and private sector since 2003. While the Şırnak governor is producing for industrial needs and calandria, the private sector uses it for power plants having 135 MW electricity production capacity in Silopi.

According to the 2012 data, 868.000 tons of asphaltite was produced in this year and comparing to 2011, the production increased 17 %. Nearly 47 % of this production was used in electricity plant, 31 % in industry and rest of them in buildings. While the consumption of asphaltite is increasing in power plant and industry, the usage of housing decreased 26 % in 2012.

3.3.1.2. Bituminous Shale:

Today, especially after USA revolution in oil market, the bituminous shale is shown as the hopefully energy resources for the countries like Turkey. Although USA was the biggest importer of the energy resources in contemporary world, with the development of the new technology, energy dependency of the USA decreased very rapidly and it is expected that by the year 2016 the country can be one of energy exporter of the world.

Turkey also exited from this revolution because our country has rich shale reserves. The total reserves are 1.5 billion tons, 60 % of them are proved and rest of them is potential reserves (Özsabuncuoğlu and Uğur, 2005:167). However, according to the World Shale Gas Resources report of US Energy Information Administration, issued in 2011, Turkey's removable shale gas reserves are approximately 424 billion m^3. On the other hand, Turkey has not investigated its land intensively yet. Therefore, removable reserves can be higher with the acquisition of new geological and seismic data (Demirtaş, 2013).

3.3.1.3. Coal:

Despite the very limited natural gas and oil reserves, Turkey has approximately 1.3 billion hard coal and 14 billion tons lignite reserves as of 2013 year. With the new exploration activities, the lignite reserves increased 5 billion tons in recent years and this situation shows that coal reserves can be increased further by new explorations.

In this sense, coal is one of the most important domestic fossil based energy resources of Turkey. Coal reserves are mainly operated by the public sector but the share of private sector has been increasing gradually. Turkish Coal Enterprises (TCE) and Turkish Hard Coal Enterprises (THCE) are public institutions engaged in this business.

Turkey's coal reserves can be examined under the hard coal and lignite title. According to research and calculations done so far, Turkey has 1.313 million tons hard coal reserves that 512 million tons of them are visible, 424 million tons are probable and 368 million tons are possible reserves. Nearly 40 % of hard coal reserves are ready and visible reserves, while remaining 60 % is probable and possible reserves and at about 69 % of hard coal reserves are in coking qualities. Almost 67 % of these reserves are in Zonguldak and 33 % is in Bartın and Amasra. While reserves of Zonguldak have a feature of coke, reserves of Bartın and Amasra does not have this character (THCE, 2014).

Since the boundaries of the basin of hard coal reserves were determined and reserve studies and drilling have been made, it is not expected too much development in the hard coal reserves. With the current production level, hard coal reserves have 100 years life (THCE, 2013). However, present production of the hard coal cannot meet the consumption demand and domestic production can only meet the 7 % of the demand. Besides, the production of hard coal has been decreasing steadily since 1990. While the production was 2.7 million ton in 1990, it decreased to 1.916 million ton in 2013. In other words, compared to 2012 data, hard coal production decreased 17 % in 2013 (WEC, 2013).

Table 24: Hard Coal Reserves in 2013

Province	District	Property of Coal	Ready	Visible	Probable	Possible	Total
Bartın	Amasra	Non-coking	386	**170.036**	**115.052**	**121.535**	**407.009**
Zonguldak	Armutçuk	Semi-coking	**1.702**	**7.595**	**15.860**	**7.883**	**33.040**
	Kozlu	Coking	**2.393**	66.222	40.539	47.975	157.129
	Üzülmez	Coking	789	135.534	94.342	74.020	304.685
	Karadon	Coking	2.593	132.863	159162	117034	411.652
		TOTAL	**7.864**	**512.250**	**424.955**	**368.447**	**1.313.516**

Resource: Turkish Hard Coal Enterprise, THCE, 2013

Despite the reduction in production, hard coal consumption has been increasing steadily. Since the 2000, the consumption of hard coal increased more than 3 times. As mentioned above, domestic production can only meet the 7 % of the total demand and nearly 93 % of the hard coal demand was met by import. Electricity plants are the biggest consumers of the hard coal and nearly 38 % hard coal was consumed by these sectors. Apart from electricity plants, housing, industry and coke factories are the main consumers and their share was 13 %, 29 % and 17 % respectively in 2012 (WEC, 2013).

Table 25: Hard Coal Production Between the 2000-2013

Years	THCE (*1000)	Private Sector	Total	Consumption	Production / Consumption
2003	2.011	48	2.059	11.201	18
2004	1.881	65	1.946	12.326	15
2005	1.666	511	2.177	12.514	17
2006	1.523	796	2.319	14.721	15
2007	1.675	817	2.492	25.224	10
2008	1.587	1.044	2.630	22.720	11.5
2009	1.880	1.000	2.879	23.698	12
2010	1.709	883	2.592	25.569	10
2011	1.593	1.027	2.619	26.228	10
2012	1.457	835	2.292	31.460	7
2013	1.366	549	1.916	N.A.	

Resource: Sectorial Report of THCE, 2014

Due to the fact that hard coal production cannot meet the total demand, coal imports and amount of money paid for coal bill of Turkey has been increasing steadily parallel with the economic development (table 26). Between the 2004-2012 periods, the coal bill increased nearly 5 times and reached to 4.6 billion dollars in 2012. In the last five years, 116.3 million tons coal was imported and 18.5 billion dollars was paid for coal.

Table 26: Turkeys' Coal Import and Fees Paid in 2008-2012 Periods

	Import (Million tons)	Fees Paid (Billion $)
2008	19.7	3.4
2009	20.6	3.1
2010	22.3	3.3
2011	24	4.1
2012	29.7	4.6
Total	**116.3**	**18.5**

Resource: TurkStat, Statistical Report, 2012

Although the hard coal reserves are very limited and located only in the north-west of the country, the distribution and reserve amount of lignite is very large in Turkey. The lignite reserves can be found in every region and more than 40 provinces of the country. Turkey is the 7th country at the level of lignite reserves and 6th in the production of the lignite in the world. Afşin-Elbistan, Kütahya-Seyitömer, Tavşanlı-Tunçbilek, Manisa-Soma, Muğla-Yatağan and Sivas-Kangal are the important reserve areas in Turkey (Özsabuncuoğlu and Uğur, 2005). According to the 2013 data, total lignite reserves of the country reached to 14 billion tons. Nearly 56 % of this reserves operated by Electricity Production Company (EPC), 19 % by Turkish Coal Enterprises, 13 % by Mineral Research and Exploration Agency (MERA) and 12 % by private sector (WEC, 2013).

Table 27: Lignite Reserves of Turkey in 2013

	Visible	**Probable**	**Possible**	**Total**
Public	11.834.625	398.730	4.524	12.237.879
Private	1.235.956	336020	136081	1.708.057
Total	**13.070.581**	**734.750**	**140.605**	**13.945.936**

Resource: TCE, Yearly Report, 2013

Calorific value of the lignite reserves are changing between the 1.000-5.000 kcal/kg. 6.9% of the reserves' calorific value is above the 3.000 kcal/kg, 13.2 % of them has a value changing between the 2.500-3.000 kcal/kg and 79.9 % of them have the value behind the 2.500 kcal/kg (SPO 2001b: 53).

Production of lignite increased with the oil crisis of 1970s and it reached to 65.2 million tons in the mid of 1990s. After that time, the production was decreased because of the widespread usage of the natural gas in electricity production. Because of the pay or use contracts, Turkey established new electricity plants, based on natural gas, and decreased the coal usage in the electricity production especially in the second half of the 1990s.

In Turkey, 74 % of the lignite is used in thermal plants to generate electricity. Apart from electricity generation, lignite production has been meeting the demand of industry and heating (residential) in Turkey. However, since the calorific values of the lignite used in thermal plants are low, it caused the air pollution and environmental problem. Therefore, in addition to legal legislation, to support sustainable development and to obtain alternative

products, TCE attaches great importance to efficiency and new coal technology. In this context, the Research & Development projects, such as liquid fuel production, gasification of coal, humic acid production, have been initiated by making cooperation with universities and research institutions to evaluate large the coal reserves of country without giving any harm to the environment (WEC, 2013).

World Energy Council Turkish National Committee examined the power plants based on coal reserve under the title of current account, employment, market situation, domestic industry development and energy security in 2013. According to the result of this study, theoretically Turkey can establish 17.975 MW power plants based on domestic coal reserves and can produce 117 billion kWh electricity in a year. Producible electricity cannot be less than 100 billion kWh and with this amount of electricity Turkey can save 20 billion m^3 of natural gas. In other words, Turkeys' current account deficit can be reduced 7 billion dollars by establishing domestic coal based power plants. Besides, if the all potential can be evaluated 59.066 people will be employed directly and nearly 600.000 persons can find job indirectly. Moreover, these investments contribute security of the energy supply by decreasing the dependency to the natural gas in electricity production. Since the electricity production cost of coal plant is less than other thermic plants, this investment can also support the national companies at the international market by decreasing their production cost (WEC, 2013: 57-59).

Turkeys' dependency on foreign energy resources increased 20 % in the 22 years. While the level of external dependency was 52 % in 1990, it rose to 72.4 % in 2012. Dependency ratio reached to 56 % in electricity generation. Nearly 44 % of electricity was generated from natural gas and 12 % from imported coal. While the average share of the natural gas use in the electricity production is 17 % in the world, this share is nearly 44 % in Turkey. Today Turkey's dependency to Russian gas is very high (at about 60 %). Energy import bill reached to $ 56 billion at the end of the 2013 and deteriorated the foreign trade balance of the country. High dependency of Turkey on energy supply threats the security of the country. Therefore, to ensure energy security and to decrease foreign dependency, national coal reserves must be evaluated as soon as possible.

3.3.1.4. Oil:

Oil has been one of the most important hydrocarbon energy sources of the world and our country. While the share of oil in total primary energy supply of Turkey was around the 40.6 % in 2000, it dropped to 25 % in 2012. However, the widespread usage of oil especially in transportation sector makes it indispensable energy resource both for Turkey and global economies. Since Turkey does not have enough oil reserves to meet its needs, foreign dependency of our country has been increasing steadily.

Although Turkey produced 48.166 barrel oil per day, it consumed nearly 480.000 barrel oil per day in 2013. In other words, the import dependency of Turkey in oil consumption in 90.4 % and domestic production can only meet less than 10 % of the total consumption. With the current price and consumption level, it is estimated that Turkey will pay nearly 540 billion dollars for the energy import and nearly 200 billion of this amount will belong to the oil import in next ten years (WEC, 2013).

Table 28: Crude Oil and Natural Gas Production Based on Years

Years	Crude Oil Production (M.Tons)	Natural Gas (Cubic Meter)
2003	2.375.044	560.633.511
2004	2.275.530	707.008.763
2005	2.281.131	896.424.950
2006	2.175.668	906.587.974
2007	2.134.175	893.055.000
2008	2.160.067	1.014.530.570
2009	2.401.799	729.414.369
2010	2.496.113	725.993.340
2011	2.367.251	793.397.572
2012	2.337.551	664.353.885
2013	2.398.454	561.544.788

Resource: TPC, 2013

The first oil reserves were found in Raman in 1940 and since that time drilling activities has been continuing especially at the Southeast Anatolian region. However, domestic oil reserves are far from meeting our demand. Oil exploration and production activities are regulated by oil law. According to this law, Turkey is divided into 18 oil region and

companies that want to make exploration have to take exploration licenses from the official institutions.

In Turkey, the oil can be discovered in a very deep area, hence the cost of production is very high comparing with the oil rich Middle East countries. The minimum deep of the wells is changing between the 1000-1.500 meters and it can be reach up to 3.500 meters. Moreover, the quality, which is measured with the gravity number, of the oil fields are also very low, and majority of gravity of oil changing between the 10-25 API (Özsabuncuoğlu ve Uğur, 2005:181).

As of 2013, total recoverable oil reserves of Turkey is 296 million barrels (43.1 tons) and 77.3 % of these reserves belongs to TPC, 4.8 % TPC and Partnership and rest of them to the private sector. Unlike new explorations are made, oil reserves of Turkey will completely exhaust in 18.5 years. 7 % of oil field of Turkey has 25-500 million barrel reserves, also called as middle class field, while remaining 93%, called as small fields, have less than 25 million barrel reserves (TPC, 2014: 29).

Between the 1934-2012 period, 4262 wells were drilled and at about 7.9 million meters of drilling carried out. So far at about 140 million tons of oil and 13.5 billion m^3 natural gas were produced in Turkey. However, in the last decade, Turkey has observed a decrease of 4 % in oil production. With the discovery of new oil fields and development of secondary production process of oil, the decline ratio was partially blocked. Discovery hit ratio is about 10 % in Turkey and 20 crude oil and 30 gas fields were discovered in last 10 years. Up to today, only 20 % of land and 1 % of marine could be searched by drilling. Nearly 75 % of this search was made in Southeast Anatolia, 17 % in Thrace and 8 % in other regions. (TPC; 2014). Since the oil and gas reserves are in a deep area in Turkey, the search activities are very costly comparing with the Middle East Countries. As a result of drilling activities, Turkey could meet nearly 10 % of oil and 1.5 % of natural gas need with domestic production.

Table 29: Cost of Drilling in Turkey

Location	The Average Depth of Drilling (meters)	Cost (Million Dollars)
Lands	2.500-3.000	3-5
Seas	1.500-1.750	5-10
	1.750-2.500	20-30
	2.500-3.500	200

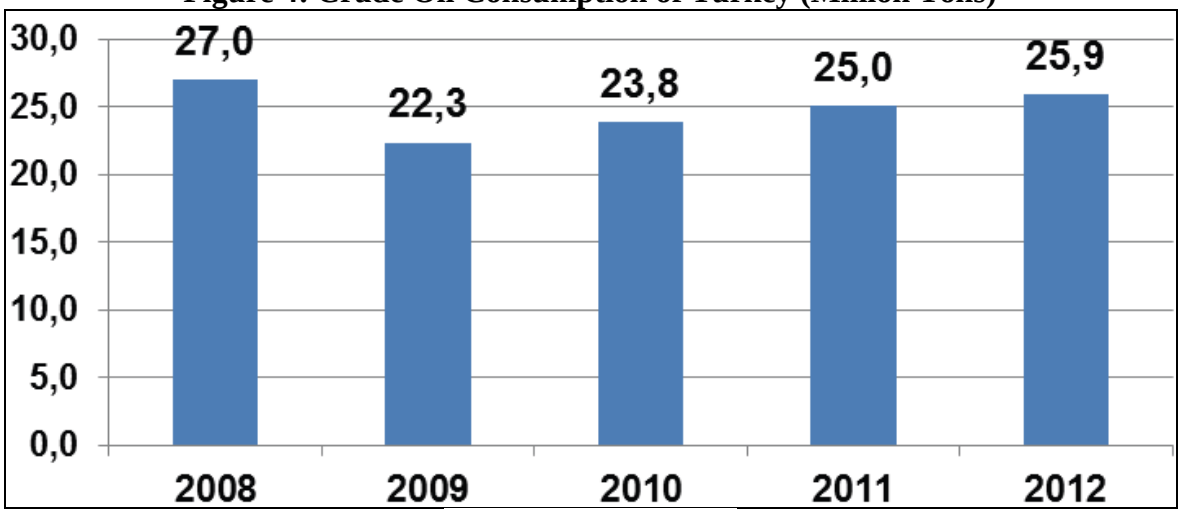
Resource: Turkey Mechanical Engineers Chamber (TMEC), 2013

Like being in all over the world, the demand for petroleum products has been growing in line with GDP growth. According to the prediction of MENR, compared to 2011 data, oil demand will rise 80 % by the year 2023, but its share (25 %) in the total primary energy consumption will not change. Today, at about 30 million tons of crude oil and petroleum products (such as gasoline, diesel and LPG) are consumed annually in Turkey. While the consumption of gasoline was not changed too much in last ten years, the LPG consumption increased rapidly because of the price effect.

It is estimated that oil and petroleum products consumption will reach 41 million tons in the next five years. Nearly half of oil consumption is used in transportation sector. Parallel with the rising crude oil prices, our oil bill increased approximately 3-fold compared to 2002 level and reached to $ 18.5 billion in 2012. Approximately 9 % of Turkey's total import is crude oil and in order to maintain economic development, Turkey spent more than 2 % of its GDP for the oil import. Due to the fact that Turkey meets more than 90 % of its oil needs by import, this situation creates a major risk for the economy of country (WEC, 2013: 106).

Since demand elasticity of oil is very low, any price or supply crisis can affect the economy deeply especially in developing countries, like Turkey, having high import dependency. First of all, the price of oil has an impact on almost all costs of production. Therefore, competitiveness of the Turkish goods in the international market falls. Secondly, inflation is affected deeply and makes a negative impact on many economic indicators. Lastly, the increase in the oil bill, the foreign trade deficit and current account deficit, soft underbelly of the country, increases and this may cause the serious economic crisis. Therefore, Turkey has to find a way to decrease its oil dependency to maintain its sustainable economic growth.

Figure 4: Crude Oil Consumption of Turkey (Million Tons)



Resource: WEC, 2013

3.3.1.5. Natural Gas:

Although it did not have any share in the primary energy supply of Turkey in 1970, the natural gas usage in electricity and housing increased rapidly especially after 1990s and it became the first primary energy supply of Turkey with the 32 % share in 2012 (WEC, 2013).

The first commercial natural gas consumption started with the 500 million m³ import from Russia after the second half of the 1980s. From that time to 2013, the consumption level increased more than 90-fold and reached to 45.3 billion m³ in 2013. While there was only 5 city of Turkey using natural gas in 2001, it reached to 71 provinces by the end of the 2013. According to the estimation of MENR, the level of consumption will rise to 50 billion m³ by the year 2023 (MENR, 2014).

Comparing with the other fossil based resources, natural gas is a clean and efficient energy. Therefore, it is preferred by the policy makers for electricity generation and for heating both in Turkey and in most of the developed countries. However, since Turkey does not have enough reserves, nearly 98.5 % of natural gas demand was provided by import. This situation increased the dependency of the country to the foreign energy resource in the primary energy consumption. Beside these, today nearly 48 % of electricity was produced by using the natural gas and nearly 58 % of the natural gas was imported from Russia (MENR, 2014). In other words, Turkey's energy composition makes it depended on

natural gas and Russia. This situation creates very big risk for the security of energy supply.

Turkey has nine natural gas and LNG purchase agreements with six countries. According to these agreements, Turkey contracted 63.65 billion m³ natural gas supply agreements with these countries. After the first agreement, signed with Russia in 1986, to diversify energy supply and to increase the energy security, Turkey signed LNG and natural gas purchase agreements with Algeria, Nigeria and Iran. However, since the demand of natural gas increased rapidly, in order to meet the demand, Turkey increased the capacity of west line and added Blue Stream Line to its supply resources. Under the scope of purchase agreement, signed on 03.12.2001, Turkey has started to purchase gas from Azerbaijan since 2007. Turkey signed another long term purchase agreement with Turkmenistan in 1999 but it is not enabled yet. Today, natural gas supply was provided from 5 different countries but significant part of this import has been done from Russia. When we examine the distribution of natural gas, we see that nearly 58 % of natural gas was provided from Russia, 19.3 % from Iran, 9 % from Azerbaijan and rest of them from Algeria, Nigeria and spot market (MENR, 2014).

Table 30: Natural Gas Purchase Agreements

Existing Agreements	Amount (billion m³)	Signing Date	Status	End Date
Algeria	4.4	1988	Enabled	2024
Nigeria	1.3	1995	Enabled	2021
Iran	9.6	1996	Enabled	2026
Russia (Blue Stream)	16	1997	Enabled	2025
Russia (West)	4	1998	Enabled	2021
Turkmenistan	15.6	1999	-	-
Azerbaijan I	6.6	2001	Enabled	2021
Azerbaijan II	6	2011	2017/2018	2032/2033
Azerbaijan	0.15	2011	Enabled	2046
Total	63.65			

Resource: BOTAŞ, Yearly Report, 2014

Before the liberalization of the market, BOTAŞ was monopoly in the importation of the natural gas. However, after the end of the some contracts, the government started to transfer import rights to the private sector. Since Russia did not accept the desired discount

rate, West Line contract was not renewed with Russia and the first import right transfer was made from this line in 2011. Today, nearly 6 billion m³ natural gas, which was previously imported from Russia by BOTAŞ, was imported by private sector. The main reason of this transfer is to get rid of the take or pay obligation that may cause serious problems especially while the economy is in depression.

Table 31: Natural Gas Imports by Country

Years	Russia	Iran	Azerbaijan	Algeria	Nigeria	Spot LNG	Total
2003	12.460	3.461		3.795	1.107		**20.823**
2004	14.102	3.498		3.182	1.016		**21.798**
2005	17.524	4.248		3.786	1.013		**26.571**
2006	19.316	5.594		4.132	1.100	79	**30.221**
2007	22.762	6.054	1.258	4.205	1.396	167	**35.842**
2008	23.159	4.113	4.580	4.148	1.017	333	**37.350**
2009	19.473	5.252	4.960	4.487	903	781	**35.856**
2010	17.576	7.765	4.521	3.906	1.189	3.079	**38.036**
2011	25.406	8.190	3.806	4.156	1.248	1.069	**43.874**
2012	26.491	8.215	3.354	4.076	1.322	2.464	**45.922**
2013	26.212	8.730	4.245	3.917	1.274	892	**45.270**
2014 **(End of Sep.)**	20.489	6.537	4.323	3.064	983	772	**36.168**

Resource: MENR, Energy Resources, 2014

Total producible domestic natural gas reserves of Turkey is 6.84 billion m³ and 561.5 million m³ natural gas were produced from 54 fields in 2013. So far, Turkey produced at about 14 billion m³ natural gas from domestic resources. Unless new reserves were discovered, natural gas reserves have 10.3 years life span with the current production level (MENR, 2014).

Table 32: Natural Gas Production and Consumption in 2003-2013 Period

Years	Total Production	Production of TPC	Consumption	Production / Consumption
2003	560,6	353,3	21.384	0,026
2004	707,0	432,8	22.505	0,031
2005	896,4	566,9	27.467	0,033
2006	906,6	412,6	31.128	0,029
2007	893,1	421,5	34.600	0,026
2008	1.014,5	495,6	36.100	0,028
2009	729,4	277,3	34.400	0,021
2010	726,0	260,7	36.900	0,020
2011	793,4	312,5	43.800	0,018
2012	664,4	339,7	45.242	0,015
2013	561,5	307,6	45.270	0,012
2014 **(End of Sep.)**	226,3	111,7	32.790	0,007

Resource: MENR, 2014

According to the projection made by MENR, compared to 2011 data, total energy demand of Turkey will increase from 115 MTEP to 218 MTEP with the 90 % increase in 2023. With the 32 % share, natural gas consumption is ranked in the first place in primary energy consumption in 2012. As of September 2014 nearly 48% of electricity was produced from natural gas. Its share in the installed capacity reached to 37 % in 2012. Because of the high dependency in electricity production, MENR prepared a strategic plan to evaluate the domestic natural resources (both renewables and non-renewables) and targeted to decrease the natural gas' share both in the primary energy supply and in electricity production by the year 2023 (MENR, 2014).

If the strategic plan can be implemented successfully, the share of natural gas will be decreased from 32 % to 23 % in primary energy demand and decreased from 48 % to 30 % in the electricity production with the contribution of nuclear power, renewable energies and domestic coal. The sectorial distribution of natural gas consumption is shown in table 33. According to the this table, the share of electricity 48 %, industry 26.5 %, heating 25.5 % in the total consumption of natural gas in 2012. The largest demand comes from the electricity generation for natural gas.

Table 33: The Sectorial Distribution of Natural Gas Consumption (%)

	Electricity Generation	Industry	Heating
Sectorial Consumption Share in 2011	47.89	26.46	25.65
Sectorial Consumption Share in 2012	48.10	25.40	26.50

Resource: EMRA, Yearly Report, 2013

Along with the widespread use of natural gas, underground storage of natural gas came on the agenda. Nearly all countries using natural gas have the natural gas storage. For example, Germany has 75-day, England has 90-day storage facilities. Because of the natural gas cuts encountered with Iran in recent years and Russia-Ukrainian crisis, the necessity and importance of the storage was understood very clearly.

Beside natural gas cut from the supplier countries, take or pay obligation of the natural gas is also necessitates the storage. Turkeys' demand for natural gas reaches peak in winter but decreases in summer. In other words, the supply and demand of the natural gas cannot be in compliance every time. Therefore, in order to harmonize the supply and demand, the natural gas storage is needed. Otherwise, although you do not use them, you have to pay the bill of the gas. This obligation is one of the main reasons of widespread of the power plants based on natural gas in Turkey. Because, especially in the economic crisis, the natural gas demand decrease sharply and Turkey had to pay the non-used natural gas bill to the supplier countries. To prevent this, Turkey supported the new electricity plants based on natural gas in 1990s.

As mentioned, like being in electricity consumption, harmonization of natural gas supply and demand very important for our country. Because of the increasing heating needs, the natural gas demand increases in winter but decreases in summer. In case of any supply cut of natural gas, Turkey can easily fall into the dark because of the high dependency on electricity production to the natural gas. Therefore, storage of natural gas is very important to sustain energy security and harmonization of demand. For these reasons, Turkey built an underground storage facility in Silivri having 2.6 billion m^3 capacity. Since the reproduction capacity of this facility is low, the TPC has been trying to increase reproduction capacity of Silivri storage.

Apart from Silivri, another storage facility has been building in Salt Lake having 1.478 m³ capacity. When the storage fields are finished in 2018, excess supply can be stored in summers and totally 115 million m³/per day natural gas can be injected from these storages (75 million m³/per day from Marmara and 40 million m³ per day from Salt lake). Turkey targets to balance the supply and demand of natural gas, particularly to meet the peak traction, and to bring a solution security problem of the country with these two underground storage projects.

3.3.2. Renewable Energy Resources:

As it can be understood from above mentioned situation, Turkey's fossil based energy resources are far from meeting its needs. Today, foreign dependency of Turkey is more than 72 % and in any supply or price crisis its economy can be affected seriously. Therefore, evaluation of the renewable and domestic energy resources is very important for Turkey. Renewable energy resources cannot be neglected to maintain sustainable economic development of Turkey. Although the share of renewable energy in overall energy production is very low, Turkey has an important renewable energy potential. According to the 2023 strategic plan, Turkey has a target to increase the renewable energy sources in total energy supply, especially in electricity production.

3.3.2.1. Hydraulic Energy:

Hydroelectric power plants are environmentally friendly, clean, renewable, high efficient and domestic energy resource of the countries. Therefore, with these peculiarities, hydroelectric power plants are preferred among the various sources of energy in the world. Turkey has a significant hydroelectricity potential and electricity generated from hydraulic power is one of the most important energy sources of Turkey. According to the calculation of MENR, Turkey has 433 billion kWh theoretical, 216 billion kWh technically feasible and 140 billion kWh (36.000 MW) technically and economically feasible hydroelectricity potential (MENR, 2014).

Developing technology, incentives given to renewable energy and increasing energy prices closer the technical potential of hydroelectric plants to the economic potential. Therefore, a lot of projects, which are accepted as technical potential before, become economical in hydroelectricity investments. According to this estimation the economic potential of hydroelectric plants can be 165.000 GWh in Turkey. As of June 2013, private sector applied 1.598 projects having 47.524 MW installed capacity and capacity of these applications support the new potential thesis. However, even if some of these projects are economically viable, they cannot be realized due to the environmental and social reasons. Today, Turkey's technical hydropower potential corresponds to 1.5 % of the world's technical potential and 17.6 % of the European technical potential (SHW, 2014).

By the end of 2013, operating hydroelectric power plants number was 467 in our country. Installed capacity of hydroelectric power plants reached to 23.455 and its share in total installed capacity is 34.4 % as of September 2014. The drought experienced in recent years limited the expected contribution of hydropower. However, compared to 2012 the electricity production increased 2.2 % and realized as 59.245 MW in 2013 (MENR, 2014).

Today, production capacity of hydroelectric power plants in operation is 80.060 GW. Currently, Turkey can evaluate 37.1 % of its technical potential. This ratio reached to 86 % in USA, 78 % in Japan, 72 % in Norway and 56 % in Canada. In other words, Turkey cannot use its water power efficiently until now. However, it is targeted that all technical and economic potential of hydroelectric plants will be evaluated until 2023 (SHW, 2014).

When the Republic was declared, the installed electricity capacity of Turkey was 33 MW and only 0.1 MW of this capacity was the hydraulic plants. The first important dam of republic, Çubuk-1, was built in 1936 to meet the drinking water need of Ankara. In 1950, the total installed electricity capacity reached to 408 MW and hydroelectric power plants share was 4.4 % in total capacity. Between the 1950-1960 years, hydroelectric investment lived its golden age and installed capacity increased more than 23-fold in ten years and reached to 412 MW. In 1965, the share of hydraulic energy in the installed electricity capacity and production was 34 % and 44 % respectively (SHW, 2014).

Hydraulic energy protected its situation until 1990. As a result of the wrong policies in energy area, the share of hydraulic energy was reduced up to 17 %, while natural gas' share was increased to 50 % in electricity generation. However, since foreign energy dependency increased significantly, dependence on foreign resource jeopardized the reliability of supply and increased the current account deficit, an orientation to domestic sources has started in recent years.

Although the initial investment cost is high, the hydraulic energy is domestic and does not need to any external fuel. Therefore it is extremely important to decrease the long term foreign dependency of the country. The unit establishment cost of the power plants for natural gas 680 $/kw, for hydraulic power plants 1.200 $/kw, for imported coal power plants $ 1,450 / kW, for lignite plants $ 1,600 / kW, for nuclear power plants 2700 U.S. $ / kW. As it can be seen the cheapest power plants is the natural gas and then the hydraulic. However, in order to produce 1 kWh electricity, the natural gas plants consume 0.212 m^3 natural gas and nearly all of the gas was imported and for every 1.000 m^3 natural gas Turkey has to pay between the 350-500 $ to the exporter countries. These situations show that although the first establishment cost of the hydraulic power is high, the operational cost is very low and fuel cost of the hydraulic plants is zero. Hence, hydraulic energy decreases the foreign dependency of country in energy production. Moreover, while the coal and combined thermal plants' economic life is 25 years, the economic life of the hydraulic plant is changing between the 40-50 years. All of these factors indicate the importance of the hydraulic plants (Altun, 1996: 13).

Beside these, because of the maintenance of the thermal plants, some of the reactors cannot be worked in every time and the efficiency of the thermal plant is nearly 60 %. These side effects of the thermal plants cannot be lived in hydraulic plants and they can be operated with the 90 % efficiency. With this efficiency ratio, they have the highest efficiency ratio among the power plants. They can play a fuse role in electricity price and in case of the rapid demand increase they can be enabled very easily

3.3.2.2. Geothermal Energy:

Geothermal resources are extensively formed around the active fault systems and volcanic areas. Since Turkey is located on the Alpine-Himalayan belt, it has a very high geothermal potential. Therefore, geothermal energy is one of the important domestic and renewable energy sources of Turkey. Turkey's theoretical gross geothermal energy potential is 31.500 MW. 79 % of these potential areas are located in Western Anatolia, 8.5% in Central Anatolia, 4.5 % in Eastern Anatolia and 0.5 % in other regions. Proven technical available capacity is 4.078 MW and nearly 34 % of this capacity (1.306 MW) is currently used. Producible electricity potential is 600 MW but with the new field research and exploration, this potential can be increased up to 2.000 MW. In terms of geothermal potential, Turkey ranked at the seventh place in the world and it can meet 5 % of electricity and 30 % of heating needs theoretically (MENR, 2014).

Geothermal energy usage covers any direct or indirect benefits from geothermal sources. Low temperature fields (20-70 °C) are mainly used in heating, industry and chemical manufacturing. Medium temperature (70-150 °C) and high temperature (higher than 150 °C) fields can be used in electricity production and integrally heating application. Nearly 95 % of geothermal resources of Turkey is low and medium temperature and suitable for direct application, such as heating, thermal tourism etc, and rest of 5 % is eligible for indirect applications (electricity production).

Currently, there are 227 geothermal fields in Turkey (MENR, 2014). The temperature of Aydın-Germencik (200-232°C), and Salavatlı (171°C), Denizli-Kızıldere (200-212°C), Çanakkale-Tuzla (173°C) is suitable for electricity generation, while others are suitable for central heating. Today, geothermal energy is used for heating, health tourism, electricity production and some chemical manufacturing in Turkey. The importance of the geothermal energy lies in the heating for Turkey, because nearly 95% of the geothermal fields are suitable for heat rather than electricity production. (DPT, 2001a: 37-39).

Geothermal energy, especially in the Aegean region, has a significant potential for residential heating. If these potentials can be evaluated, energy demand for heating will also be reduced and electricity savings can be made by using the geothermal energy.

Technically 5.000.000 residential can be heated by geothermal energy. However, since some of the settlements are small and away from the main settlements, with the current technology, 1.000.000 house can be heated by geothermal energy in Turkey (DPT, 2001a).

Since the emission of CO_2 and NO_x is very low in modern geothermal power plants, geothermal energy is considered as clean and environmentally friendly energy resource. Therefore, another advantage of the geothermal energy is the reduction of greenhouse gas emissions. With the heating of 100.000 residential nearly equivalent of 1.000.000 tons of carbon dioxide emissions can be prevented. This value is equivalent to the pollution created by 600.000 vehicles in a year (DPT, 2001a: 46).

In order to evaluate the geothermal resources effectively, Turkey legislated new regulation called as "Geothermal Resources and Mineral Water Act" in 2007. In this regulation; exploration, development, production, protection, rights, the environmental effects and the economic evaluation of the procedures and principles regarding abandonment are arranged.

As a result of new law and incentives given to renewable energy, the exploration facilities have been accelerated especially after 2007. The number of thermal institution for tourism and health has reached to 350 in our country. The greenhouse heating rose from 500 acres in 2002 to 2.924 acres in 2103 and residential heating increased from 30.000 in 2002 to 89.443 housing in 2013. Since 1960, 576 units and 328.711 meters of drilling were made and 227 geothermal fields were discovered by the General Directorate of Mineral Research and Exploration. At about 4,900 MW heat energy is obtained from the discovered geothermal wells (MENR, 2014).

As of August 2013, the installed electricity capacity of geothermal energy was 11.766 MW in the world and nearly 69 billion kWh electricity were produced from geothermal. USA, Philippines, Indonesia, Mexica and Italy are first five countries in the electricity generation from geothermal power plants. Although Turkey cannot find a place in the first five ranks, it has been trying to increase its electricity production from geothermal resources.

Theoretically Turkey's producible electricity potential of geothermal energy is estimated as 2.000 MW. While the installed capacity of geothermal power plants was only 15 MW in 2003, with the effects of the incentives and new regulation about renewables and geothermal energy, power plants' installed capacity reached to 358.4 MW in 2014. 1.575 billion kWh electricity was produced from 13 geothermal power plants at the same time period. Turkey planned to increase its installed capacity to 600 MW by the year 2023 and today more than 50 % of this target is succeeded. In 2013, the electricity production potential reached to 706.4 MW with the new license, received from EMRA and this figure is expected to reach 1.000 MW by the end of the 2018 (MENR, 2014).

With the advancement of technology, electricity can be produced from low and medium temperature fields. For these reasons, to evaluate domestic resources, R & D efforts should be increased. Generation of electricity from low-temperature geothermal fields should be developed. (Ünalan, 2003:44). In table 34 the geothermal fields studied for electricity projects are given.

Table 34: Geothermal Fields Studied and Planned for Electricity Generation Projects

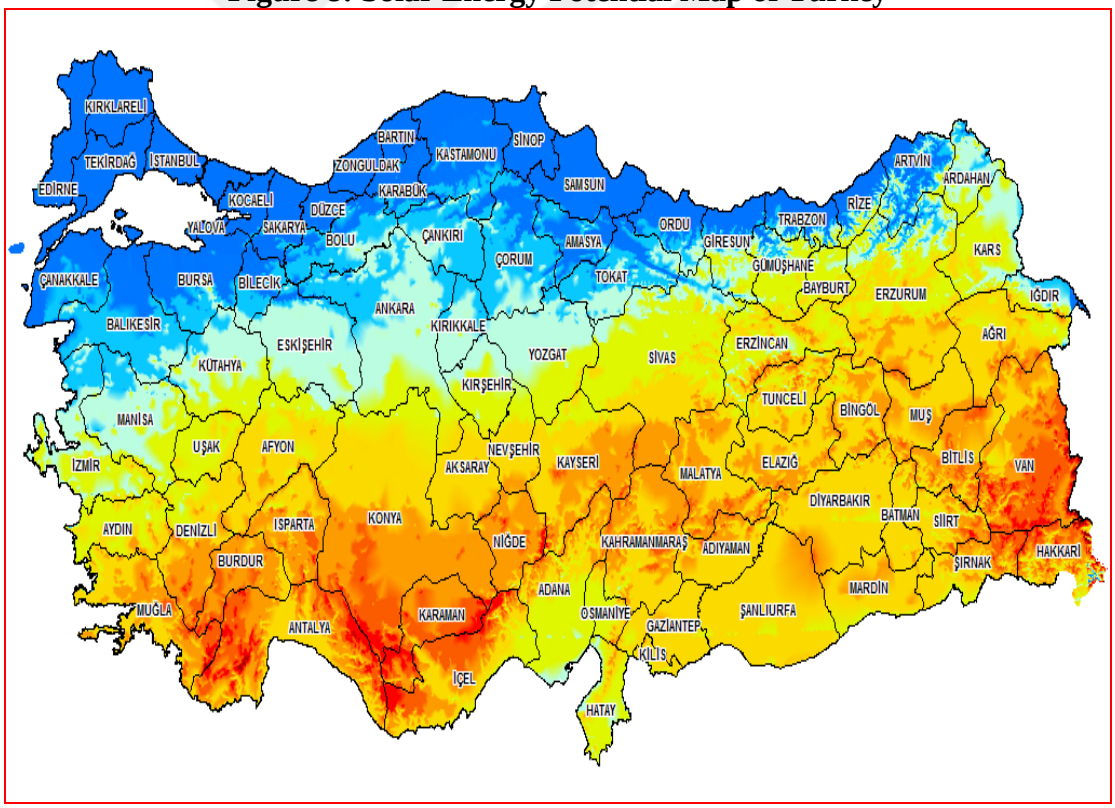
Name of the Fields	**Temperature (°C)**	**Name of the Fields**	**Temperature (°C)**
Manisa-Alaşehir-Köseali	**287**	Kütahya-Simav	**162**
Manisa Alaşehir X	**265**	Aydın-Umurlu	**155**
Manisa-Salihli-Caferbey	**249**	İzmir-Seferihisar	**153**
Denizli-Kızıldere	**242**	Denizli-Bölmekaya	**147**
Aydın-Germencik-Ömerbeyli	**239**	Aydın-Hıdırbeyli	**146**
Manisa-Alaşehir-Kurudere	**214**	İzmir-Dikili-Hanımınçiftliği	**145**
Manisa-Alaşehir-X	**194**	Aydın-Sultanhisar	**145**
Aydın-Yılmazköy	**192**	Aydın-Bozyurt	**140**
Aydın-Pamukören	**188**	Denizli-Karataş	**137**
Manisa-Alaşehir-Kavaklıdere	**188**	İzmir-Balçova	**136**
Manisa-Salihli-Göbekli	**182**	İzmir-Dikili-Kaynarca	**130**
Kütahya-Şaphane	**181**	Aydın-Nazilli-Güzelköy	**127**
Çanakkale-Tuzla	**174**	Aydın-Atça	**124**
Aydın-Salavatlı	**171**	Manisa-Salihli-Kurşunlu	**117**
Denizli-Tekkehamam	**168**	Denizli-Sarayköy-Gerali	**114**

Resource: TMEC, Energy Outlook, 2013

3.3.2.3. Solar Energy:

Due to the geographical location, Turkey is in a fortunate position in terms of solar energy. According to the Solar Energy Potential Map of Turkey (figure 5), prepared by General Directorate of Renewable Energy (GDRE), the annual total sunshine duration of Turkey and the amount of annual solar energy was determined as 2.737 hours (7.5 hours/day) and 1.527 kWh/m²-year (4.2 kWh/m²-day) respectively (MENR, 2014). The South Eastern Anatolia Region ranked on the first place in term of sunshine duration and it is followed by the Mediterranean region. However, as it can be seen from table 35, there is no significant difference between the geographical regions about the sunshine duration and solar energy potential. When we take into consideration that solar energy can be used economically where the sunny hours per year is 2000 hours and upwards, it can be said that in every region of Turkey, the solar energy usage is economically viable (Özsabuncuoğlu and Uğur: 195).

Figure 8: Solar Energy Potential Map of Turkey



Resource: GDRE, 2014

Table 35: Solar Energy Potential by Region

Region	Total Solar Power (Kwh/m^2-year)	Sunny Hours (h/year)
Southeast Anatolia	1460	2993
Mediterranean	1390	2956
Eastern Anatolia	1365	2664
Central Anatolia	1314	2628
Aegean	1304	2738
Marmara	1168	2409
Black sea	1120	1971

Resource: TMEC, Energy Report, 2013

Solar energy technology can be divided into two main groups: the first one is Solar Thermal Technologies and Concentrating Solar Power (CSP): these systems derived from solar heat, heat can be used directly as a hot water or be used for generating electricity. The other one is Solar Cells. In this system, semiconductor materials, also called photovoltaic solar power systems (PV), convert sunlight directly into electricity.

The usage of solar collectors, which convert solar energy into heat energy to produce hot water, is widespread especially in Mediterranean and Aegean regions. The total installed solar collector area is estimated to be around 18.64 million square meters in 2012. Annual production of flat plate solar collector and the vacuum tube collector have been calculated as 1.164.000 m² and 57.600 m² respectively. With solar collectors, approximately 768,000 TEP heat energy were produced in 2012. Nearly 500.000 TEP of heat energy was used in residential and while rest of 268.000 TEP was used by industry. It can be said that Turkey is one of important producer and user of the solar energy in the world (MENR, 2014).

Table 36: Solar Energy: Realized Production and Targets

Yıl	Production (1000 TEP)	Year	Production (1000 TEP)
1997	179	2004	375
1998	210	2007	420
1999	236	2010	495
2000	262	2015	605
2001	290	2020	862

Resource: MENR, 2008

Photovoltaic system, another way of harnessing solar power, has not used widely in Turkey yet. Photovoltaic system, also called PV solar cells, can be used economically in a place away from the residential areas. Since it has a low density characteristic, it complies with the demand of the rural area and dispersed settlements. With these features, contributions of the solar energy to meet the energy demand of developing regions are taken into account in the world. Therefore, they are used widely in signaling and rural area to meet electricity needs as they can be installed at a desired power.

Renewable Energy Sources Act No. 5346, which is necessary for the widespread use of photovoltaic systems, has been revised in 2010 and legislative works were completed in 2013. It is expected that with the fall in the cost of photovoltaic systems and increase in productivity, the usage of photovoltaic energy will be widely used in Turkey.

Although until recently neither public sector nor private sector give the sufficient importance to the photovoltaic electric energy, because of the new law about the renewable energy and new incentives given to renewables, the application of both licensed and unlicensed photovoltaic energy increased enormously. Up until 2014, solar power was only used for heat water needs of the country. The usage of the photovoltaic energy was limited (about 3.5 MW) and most of them were used for research purposes of public institutions. However, the first licensed electricity production tender was finalized in 2014 by the Ministry of Energy and Natural Resource (MENR), and 600 MW photovoltaic license was given to private sector. As of September 2014, the total installed photovoltaic power plants reached to 20 MW and it is expected that the capacity will rise rapidly in the coming years. According to the 2023 target of MENR, installed PV power capacity will be at least 3.000 MW (MENR, 2014).

Southeastern Anatolia Region is the most suitable area for the application of solar energy in Turkey. Theoretically, the electricity that might be produced by solar thermal power plants can easily meet the Mediterranean and Southeastern Anatolia region's total electricity needs. However, because of the high first establishment cost, thermal solar power plants cannot be used widely yet.

The solar energy can also be used for heating and cooling purposes. By using the solar energy for cooling, the phase difference of this energy can be disappeared, because in summer the cooling needs of the human beings is at the highest level, and the sun light is at the most abundant level. The excess energy produced in summer can be tolerated by using them for cooling purposes in summer.

According to the study of TMEC, below the 38.5 parallel of Turkey (red and yellow area in figue 8), 11.000 km² fields are suitable for the PV energy investment. Even if half of the these areas are used, under the 1.600 kWh/m² solar energy potential and 10 % efficiency assumption, at least 287.000 MW solar power plant can be established and 363 TWh electricity can be produced from these areas. If the unlicensed practices are added to this estimation, producible electricity reaches to 400 TWh. This amount is 1.65 times more than the 2013 electricity consumption of our country (TMEC, 2013:145-148).

Since solar energy can be produced in every country of the world, it has the potential for the sustainable energy needs (Şen, 2002: 57). However, although Turkey is located on the sun-belt, research, production and application related the solar technology does not reach to the desired level yet. Therefore, Turkey has to develop a strategic plan to evaluate its huge potential and to decrease the energy dependency of the country by using the solar power efficiently.

3.3.2.4. Wind Energy:

Turkey has one of the best wind potential not only in Europe but also in the world. Theoretically the wind resources of Turkey can meet all energy needs of the country. Technical wind energy potential of Turkey is about 83.000 MW and this number is nearly 1.5 times more than currently installed electricity capacity of the country. (Delikanlı and Bayrakçı, 2007: 79). Real wind energy market value of Turkey is changing between the 8-10 billion Euro, but potential wind power market has a value between 18-20 billion Euro.

Wind turbines can only be started to electricity production at a certain wind speed. They can perform their energy production between the cut-in and cut-out wind speeds. Modern

wind turbines' cut-in, nominal and cut-out speeds are changing between the 2-4 m/s, 10-15 m/s and 25-35 m/s respectively.

Since the speed is the main determinant of wind power, wind energy is classified as medium, good, great and extraordinary according to the speed of wind. In table 37 this classification is shown. According to this classification, the medium wind potential of Turkey is 83.000 MW. However, wind speed between the 7.5 m/s and 9 m/s is assumed as economic potential of the country. In Turkey, it is accepted that 5 MW per square wind plant can be established in a location where the wind speed is 7.5 m/s or high at the 50 meters above from the ground level. In the light of these assumptions, the Wind Energy Potential Map was prepared and economic potential of Turkeys' wind energy determined as 48.000 MW. The total area in which wind power can be installed corresponds 1.30 % of Turkey's surface. However, since the cost of wind energy has been decreasing steadily, in the near future, some of the medium speed wind areas of Turkey can become economically feasible areas and its potential can be increased.

Table 37: Turkeys' Wind Potential

Wind Resource Degree	Wind Class	Wind Power Density at 50 m (W/m²)	Wind Speed at 50 m (m / s)	Total Area (km²)	Percentage of Windy Land (%)	Total Capacity (MW)
Medium	3	300 – 400	6,5 – 7,0	16.781,39	2,27	83,906
Good	4	400 – 500	7,0 – 7,5	5.851,87	0,79	29.259,36
Great	5	500 – 600	7,5 – 8,0	2.598,86	0,35	12.994,32
Perfect	6	600 – 800	8,0 – 9,0	1.079,98	0,15	5.399,92
Extraordinary	7	> 800	> 9.0	39,17	0,01	195,84
TOTAL				**26.351,28**	**3,57**	**131.756,40**

Resource: TMEC, 2013

While the installed capacity of wind energy was only 18.9 MW in 2000, with the help of cost decrease and incentives given by renewable energy law, it increased nearly 184-fold in 14 years (table 38). In the last three years, yearly average growth rate of installed wind power is above the 20 % and as of September 2014, the installed capacity reached to 3.484 MW. In the first 9 month of the 2014, compared to end of 2013, the installed wind power capacity increased 26.2 % and its share in the total installed capacity realized as 5.1 %. Apart from installed capacity, more than 6.000 MW investment licenses were taken from

EMRA for wind project. While the electricity production from wind energy was 7.568 GWh in 2013, with the effect of the new capacity increase, 5.989 GWh electricity was produced from wind power in the 9 months of 2014 (MENR, 2014).

Distribution of the installed capacity of wind energy was realized as 40 % in Aegean region, 37 % in Marmara region, 16 % in Mediterranean region, 3 % in Black Sea region, and rest of them in other region. As it can be seen, majority of wind power (77 %) is located in Marmara and Aegean regions. Currently, only 7.25 % of Turkey's wind energy potential can be evaluated. With the received licenses, this number can be increased up to ¼ of total potential. Installed capacity of wind power is targeted to be increased to 20,000 MW by the year 2023. As of today, only 17.5 % of this target is realized.

Table 38: Development of Wind Power Installation in Turkey by Years

	Installed Power (MW)	**Annual Newly Added Capacity (MW)**	**Annual Installed Capacity Growth Rate (%)**
2000	18.9	10.2	117
2001	18.9	0	0
2002	18.9	0	0
2003	20.1	1.2	6.3
2004	20.1	0	0
2005	20.1	0	0
2006	65	44.9	223.4
2007	207	142.0	218.5
2008	333	126.0	60.9
2009	801	468.0	140.5
2010	1.329	528.0	65.9
2011	1.800	476	35
2012	2312	512	28.4
2013	2.760	448	19.4
2014 As of Sep.	3.484	724	26.2

Resource: MENR, 2014

The initial investment cost of wind energy is relatively high and production level depends on the meteorological condition. However, wind energies are reliable, domestic, free, clean and sustainable energy. They can decrease the foreign dependency and current account deficit of Turkey. Their maintenance and operation cost are low and they can be installed in a very short period of time. It is an indispensable energy resource of the Turkey.

Therefore, wind energy investment should be accelerated to decrease the foreign dependency of the country.

3.3.2.5. Biomass Energy:

Our country has very rich biomass resources. Therefore, energy production from biomass can be a valuable option to enhance energy portfolio of Turkey. However, despite the great potential, required attention to the biomass energy is not given yet. In Turkey, classical biomass resources have been used for a very long time in rural areas especially for heating. In this sense, our country has a very big potential in energy production from classical biomass resources. On the other hand, the energy generation from modern biomass resources is relatively new issue and it pervades only in metropolitan cities.

Unlike the other renewable energy resources, electricity and fuel can be produced from biomass energy, and it creates significant the socio-economic contribution in rural areas. It takes very large place in the energy policies of the many developed and developing countries in contemporary world.

Biomass energy can be classified as solid, liquid and gas, and can be used in automobiles, heavy vehicles, aircraft, trains, and in all areas where natural gas is used (electricity, heating, cooking, refrigerating). Bioethanol is one of liquid form of biofuels, which can be used by blending it with gasoline and diesel fuel. Biodiesel is another liquid biofuels that can be used directly instead of diesel or by blending with diesel fuels. Biogas fuels, also called synthesis gas, contain 50-70 % methane and by cleaning them a new gas having the quality of natural gas can be obtained. Although the biogas is mainly used in electricity production, by enriching it, it can be used in every fields of natural gas (WEC, 2013).

Except for the very cold region, biodiesel can be used in all areas where diesel is used in our country. Since biodiesel is obtained from agricultural plants, it does not increase the greenhouse effect. By mixing the gasoline at a certain ratio, the bioethanol increases the oxygen level of the fuel, provides more efficient combustion, reduce emission and harmful gases in exhaust.

As of 2013, there are 23 companies having biodiesel production license in Turkey. However, only one company engaged in active production of biodiesel from domestic agricultural products. Installed bioethanol capacity of our country is 160.000 tons. The amount of mandatory ethanol blending in gasoline was about 54 million liters (2 %) in 2013. Even if the amount and share of ethanol usage is very little, the contribution of the ethanol use is significant for the country economy. Contributions of 54 million liters bioethanol use can be summarized as follow (WEC, 2013):

- with the cultivation of energy crop, 3.255 person can be employed directly or indirectly,
- the contribution of this new created jobs to the economy of the country will be $ 387.4 million,
- $ 42.8 million worth of demand for raw materials can be created,
- By blending the 54 million liters ethanol, 2.1 million barrels oil will not be imported and $ 203.4 million can be saved.
- 106,080 tons of high-protein feed ($ 30.7 million value) can be obtained,
- $ 2.5 million tax can be obtained from feed market,
- $ 2.8 million volume of business will be created in service sector,
- 119,500 tons of CO_2 will be saved

Although professional works on biogas began in 1980 under the Ministry of Agriculture, it could not be sustained. In 2012, nearly 0.3 % of electricity was produced by using biomass energy in Turkey. According to the 2011 data of EMRA, there are 14 biogas, 5 biomass and 9 landfill gas facilities in our country and their installed capacities are 22.34 MW, 16.43 MW and 120.02 MW respectively. As of 2014, the number of biomass energy facilities increased to 42 and their capacity raised to 293.5 MW (MENR, 2014).

Some of the municipalities started to produce electricity from waste biogas in recent years. For example, Mamak dumpster, having 22 MW installed power, are lighting 20.000 houses and excess heat is used for the greenhouse activities. There are some facilities that produce from waste water and animal waste but lots of these facilities are belongs to the public sector (WEC, 2013). The expected development has not been achieved in private sector. Although the state gave the guarantee to buy the electricity generated from biogas with 13.3 $/cent/kWh, this incentives are not accepted as economic by the investors.

The usage of the modern biomass is very important in terms of environmental pollution and economy. In contemporary world, lots of the countries provide alternative energy resources according to their ecological conditions, they produce most convenient and most economical agricultural products. Turkeys' ecological structure is convenient for energy agriculture and has very big potential for the alternative energy generation by using the modern biomass resources (Özsabuncuoğlu and Uğur 2006:206)

The technical potential of classic biomass energy is 10 MTEP/year and available potential is 7 MTEP/year. The modern technical potential is about 40 MTEP/year and available potential is 25 MTEP/year. The amount of biomass that can be obtained from various plants is changing between the 37-48 million tons and the total energy that can be derived from these resources is changing between the 14.8-19 MTEP/year. The amount of waste that can be derived from animals is about 11 million tons. 200 m³ biogas can be provided from 1 ton animal waste and Turkey can produce 1.117 BTEP/year energy from animal waste potential. Turkeys' total waste level is about 21 million tons/year and 7.150 BTEP energy can be produced from these wastes (TMMOB report, 2006:51). According to the Biomass Energy Potential Atlas, prepared by the General Directorate of Renewable Energy, the potential of biomass energy is summarized as follow:

Table 39: Biomass Energy Potential

Total Number of Animals	362.734.882,00
Animal Waste (tons / year)	156.759.836,61
Energy Value of Animal Waste (toe / year):	1.323.714,67
Crop Production (ton / year):	142.418.566,47
Vegetable Waste (tons / year):	142.441.285,37
Vegetable Waste Energy Equivalent (toe / year)	15.941.321,26
Urban Solid Waste (tons / year):	29.618.188,14
Urban Energy Value of Organic Waste (toe / year):	2.186.228,09
Forest Energy Value of Waste (toe / year):	855.805,00
Total Energy Equivalent of waste (toe / year):	20.307.069,02
Biodiesel processing License owner Companies	24
Bioethanol processing company License Owner	3
Biomass Power Plant Source	42

Resource: GDRE, 2014

The knowledge and infrastructure needed to make the biofuels applicable for energy production is available in Turkey. However, apart from the heating and cooking, the

modern biomass usage level is very low in our country. Although the first studies about the biogas started in 1960s, the country cannot reach to the desired level yet. Energy forests are the solid form of the biomass energy. Turkey has 4 billion hectares forest area convenient for the energy forestry. Beside these, our country has the fast-growing and valuable for the energy production native tree species such as poplar, aspen, alder, pine, oak, ash, pine, larch, cedar and cypress trees. Although they are foreign origin, eucalyptus, euramericana, pinus pinaster, are the valuable trees species for energy production and can be grown in Turkey (Özsabuncuoğlu and Ugur, 2005: 206).

The energy value of the 1 kg wood is equal to the 3/10 kg fuel-oil. In Turkey, if the current capacity is used exactly, 9.2 million ton wood can be produced and the energy value of these woods is equal to the 2.76 million tons fuel-oil. In other words, 2.8 million tons of energy needs, which are provided by import, can be met by using the energy forestry in Turkey (Saraçoğlu, 1996: 52).

Apart from above mentioned economic and environmental contributions, biomass energy has a very big socio-economic benefit for our country. For example, since more labor is needed in order to obtain energy from biomass, it is an ideal choice of development and job creation in rural areas. By doing this, it is possible to prevent migration from rural areas to big cities. Thus, structure of cities can be protected and excessive swelling of the city can be prevented.

3.3.2.6. Hydrogen energy:

Hydrogen energy is accepted as the future of energy and Turkey is one of the most important centers in the study of hydrogen energy in the world. The agreement which is about the establishment of the *International Center for Hydrogen Energy Technologies-ICHET* was signed between the United Nations and Turkey on 21 October 2003. With this agreement, İstanbul became one of the important centers for the hydrogen energy. Since both Turkey and international community pay great importance to this energy, following studies will be made in the center in İstanbul;

- Hydrogen energy policy creation, large amounts of hydrogen production and hydrogen energy technologies and environmental studies, economic analysis of implementation,
- Integration of the hydrogen energy production techniques with other renewable energy systems,
- Hydrogen storage techniques,
- Development of usage of hydrogen energy in the transportation sector.

Providing that Turkey's energy dependency is very high, Turkey has to be leading country in the development of the hydrogen energy. Some of the domestic resources, such as solar energy, of Turkey are convenient for the production of hydrogen. Hence, some systems, as being solar-hydrogen, can be used for the production of energy in our country. With the help of the photovoltaic solar panels, converting the solar energy directly to electric energy, 108 kg hydrogen can be obtained from 1 m^3 water by means of the electrolysis of water. (Özsabuncuoğlu ve Uğur, 2005:216).

Although it is not combustible gas, since it can be exploded when it is compressed, the hydrogen must be stored in air-tight structure and the most suitable material for storage is boron. Turkey has the 72 % of world boron reserves. Hence, it has an important opportunity in hydrogen energy storage. Turkey also has very big potential in renewable energy resources, such as hydraulic, wind, solar and geothermal energy, and these resources can be used in the production of the hydrogen energy. While most of the developed countries aim to make transition to hydrogen energy, Turkey should take necessary precaution not to miss the big opportunity.

3.4. Historical Overview of Turkish Energy Policy

Energy policy of Turkey has been changing very frequently because of the changing condition and political preferences of the ruling parties since the establishment of the republic. In the early years of the Republic, a significant portion of the energy was required only for heating purposes. At the transportation and industry sectors, the energy demand was met by using the coke and wood.

At the beginning of the republic period, Turkey's energy policies were affected from the decisions of İzmir Economy Congress, made in 1923. In this congress, it is recommended that energy needs of the country should be met as much possible as from the domestic resources. When the republic was declared, only three cities, Istanbul, Tarsus and Adapazarı, were lighted with the electricity and nearly 94 % of the population was in dark. The consumption of the electricity was very low and the lighting needs were generally met by kerosene. The countries' total established power was only 33 MW and total electricity production was 45 GWh. In this period, with the effect of the world economic crisis and inflation, the price of the electricity raised. Due to the low capital accumulation of the private sector, the state played an important role in the establishment and operation of the energy institutions. Therefore, nearly all of the investments were made by the state in this period (Yılmaz and Uslu, 2007: 259).

In the second period, covered the 1930-1950 periods, the main target was to decrease the foreign dependency in energy demand. To realize this target, some institutions like Mineral Research and Exploration Institute (MREA), Electrical Power Resources Survey Administration, Etibank and Petroleum Agency were established. Because of the Second World War, economic depression was lived and most of the targets could not be succeeded (Yılmaz and Uslu, 2007: 259).

In the multiparty era, important steps were taken in the energy sector. New and important hydroelectric, such as Sarıyar, Seyhan, and thermic plants, such as Tunçbilek and Soma, were established to increase the energy production. To widespread the hydraulic plants, State Hydraulic Works (SHW) was established in 1953. To accelerate the oil and coal exploration, Turkish Petroleum Company and Turkish Coal Enterprises were established. Energy consumption was increased depending on the industrialization and economic growth in this era (Yılmaz and Uslu, 2007:260).

From the 1960 coup to 1980, the state increased its weight in the energy sector. Accordingly, the activities of foreign companies were restricted and in 1978 the government adopted a draft law on the nationalization of all private mining enterprises. While the investment ratio of the public sector rose to 13.8 %, the private sectors' investment rate remained constant. Although the investment of hydraulic and thermic

plants increased significantly, the electricity production could not meet the demand ratio (Hiç, 1994: 374). This situation caused a bottleneck in the energy sector. (Yılmaz and Uslu, 2007). In the fourth planned period, it was targeted that 53 % of the total energy consumption was met by using the coal and hydraulic plants. This target could not be succeeded, because at that period the oil price was very cheap in the world but establishment of the hydroelectric plants was very costly (Hiç, 1994: 375).

Turkey seriously affected from 1973 and 1979 oil crises. Because of these crises, the lignite resources were evaluated intensively and the lignite resources were nationalized. However, this policy could not be maintained consistently and continuously. Between the 1960-1980 periods, the economy grew 5.5% yearly, primary energy production increased from 9.54 MTEP to 19.86 MTEP and primary energy consumption increased from 11.22 MTEP to 33.47. By the year 1980, nearly 80% of the population could use the electricity in Turkey (Yılmaz and Uslu, 2007).

Between the 1980-2003, with the introduction of liberal economy, significant changes occurred in the field of energy. Although energy was described as a strategic public service in the 1982 Constitution, privatization policy was started and electricity generation and distribution were included to the privatization. The 'build-operate' and 'build-operate-transfer' type investments in the energy sector were also trying to increase the share of the private sector in the fifth period (Yılmaz and Uslu, 2007: 262).

During this period, the composition of the resources used in electricity generation was largely changed. While the share of the lignite in the electricity production was 42% in 1985, the ratio was decreased to 16.8% in 2003. Similarly, the share of the hydroelectric plants was fallen to the 25.1% from 35% (Yılmaz and Uslu, 2007:262). The main reason of this change can be explained with the natural gas import. Since the natural gas is clean and the establishment of the plants is comparatively cheap and fast, the preferences shifted from other resources to natural gas.

At end of this period nearly 60 % of the electricity needs was met by natural gas. While the import of the natural gas was only 0.5 billion m^3 in 1987, it reached to the 31.3 m^3 by the year 2001. Since almost all of the natural gas need is obtained by import, this high import

composition creates high risk and high foreign dependency especially in electricity generation. The private sector investment in this field increased from 17% to 45% in this period (Yılmaz and Uslu, 2007:262).

After 2002 election, new energy policy generally deals with the liberalization of the energy market and harmonization of the Turkish legislation with the EU acquis. The new petroleum law numbered as 5015 was adopted and import restriction on energy was cancelled. With the adoption of the new law, the number of the companies working on distribution of the fuel increased rapidly. Boron institution was established to evaluate the strategic mineral. In this period, the energy efficiency policy gained speed and new legislation was adopted to realize the efficiency targets and to decrease the burden of the energy cost on economy in 2007.

In order to evaluate and develop domestic renewable energy resources the use of Renewable Energy Sources in Electricity Production Act was adopted in 2005. In this period, 2023 strategic plan was adopted and the share of the renewable energy sources in the electricity production target was determined as at least 30 % by the year 2023. With the effect of the incentive, there was a boom in the renewable energy investments, especially in wind and hydro energy.

In addition to renewable energy investments, two nuclear plant agreements were signed with Russia and Japan. In the strategic plan, it was planned that Turkey will produce nearly 10 % of its electricity from nuclear power by the year 2023. Besides, in order to decrease the share of natural gas in the electricity production, the government supported the coal plant, working with domestic lignite. The target of government is to fall the share of natural gas in electricity production to 30 % in 2023 (MENR, 2014).

As it can be seen, Turkey has been trying to find a way to obtain its energy from domestic resources. However, because of the structural reasons, such as long term natural gas agreements and high cost of renewables, it cannot succeed its targets yet. In the strategic plan, it is aimed to increase the share of domestic resources.

3.5. Renewable Energy Policies in Turkey:

Although Turkey has a significant renewable energy potential, the usage of renewable energy and investment on this area cannot be reached to the desired level yet. Like being in the world and EU, Turkey tries to increase the share of the renewable energy especially in the electricity generation. In the context of EU accession, EU wanted to Turkey to prepare a program to increase energy generation from the renewable energy resources in the Accession Partnership Documents**.** Besides, Turkey adapted the Kyoto Agreement and in order to fulfill its commitments, it has to increase its investment on this area. As it can be understood, not only international commitments but also national needs and interest force Turkey to develop and implement its own renewable energy policy (Arat and Baykal, 2004: 88)

For this purpose, the law of "Renewable Energy Resources for the Purpose of Generating Electrical Energy" promulgated in the Official Gazette on 18.05.2005. The aim of the Law was declared as; to widespread the production and usage of the electricity generated from renewable energy resources, to diversify energy resources by using the domestic, reliable, affordable and high quality energy resources, to protect the environment both by decreasing the greenhouse effect and by using the waste in the production of the electricity, and to develop the domestic manufacturing sector in this field.

With this regulation, legal entities having "Renewable Energy Certificate" are allowed to buy and sell green electricity, produced from renewable energy resources such as solar, wind and water, at internal and external markets. In addition, the law allowed real and legal persons, who want to produce electricity to meet their own needs (up to 1 MW), to generate electricity without taking license. The State Hydraulic Works and Electrical Power Resources Survey Administration give services about the studies, planning and projects of the renewable energy without taking any fees from these persons.

If a person wants to make investment on renewable energy resources to produce electricity, the new law provides some conveniences in the usage of the state properties, including forest, to the real and legal persons. However, the regulation was criticized for not to be a

comprehensive law concerning the dissemination of the use of renewable energy resources, since it only covered the electricity generation from renewable resources.

Another special law, "Geothermal Resources and Natural Mineral Water Law", on renewable energy resources was adopted on 13.06.2007. This law regulates the principles of the effectively research, development, production, preservation and evaluation of the geothermal and mineral water and environments.

Apart from these laws, the "Energy Efficiency Law" also promotes the usage of the renewable energy resources. According to the 7th article of this law, State Hydraulic Works and Electrical Power Resources Survey Administration give services, such as final design, planning, master planning, preliminary investigation or preliminary studies, related with the electricity generation from renewable energy resources to meet the their own needs (up to 1.000 kWh) without taking any fees. Domestic production and R & D activities related with the renewable energy are encouraged with this law.

Beside above regulations and studies about the renewable energy resources, the General Directorate of Electrical Power Resources Survey and Development Administration, which operates under the Ministry of Energy and Natural Resources, launched the Bioenergy Project to evaluate bioethanol, biodiesel and biomass resources effectively across the country in 2003. With this project, development of the production, use and dissemination of biofuel are targeted in Turkey.

Although there are some sincere research in the field of renewable energy, since these research are isolated from each other, stay at a small scale, and there is not sufficient allocated funds on these area, these research cannot be resulted at a desired level yet. (Arat and Baykal, 2004:88)

3.6. Energy Efficiency in Turkey:

Energy efficiency is defined as a reduction of energy consumption for the same of level goods, services and activities. In terms of primary energy density, Turkey is one of the energy-intensive countries in the world. According to the 2009 data, while the energy

intensity of OECD was 0.18, Turkeys' energy density is 0.27. In other words, energy intensity of our country is 50 % higher than OECD countries' average. Therefore, Turkey has to make further research and investment to increase the energy efficiency. To reduce the energy intensity, infrastructure of the countries must be renewed, and changes in the consumption patterns of behavior should be encouraged.

The economy and energy intensity of Turkey improved between the 1990-2008 periods. However, compared to many the other countries, the energy intensity improvements are not significant in our country. Between the 1978-2008 period, energy intensity of European countries decreased more than 30 %, but Turkeys' energy intensity did not show much change in the same period. This situation indicates the existence of significant potential for the improvement of the energy efficiency. Industrial and building sectors offer the biggest opportunity for the energy efficiency improvement.

The most important area for the energy efficiency is the building. Today nearly 34 % of total energy and 43 % of total electricity are consumed by the households. Since lots of the buildings were produced with old technology and while they were producing the energy efficiency was not taken into account, the most risky field in the energy efficiency is buildings (Kavak, 2005:76). While the household energy demand is 100 kWh /m² in developed countries, this number is 195 kWh /m² in Turkey. This figure shows that Turkey's household and building efficiency is very low and there are a lot of leakage and losses in energy usage of the households (Özsabuncuoğlu ve Uğur, 2005:282).

When we look at the type of energy used in residential and commercial building, we see that nearly 80 % of the energy is used for heating purposes. However, the efficiency of the heating system and insulation of the building are not at the desired level. The same problems also continue in new buildings. Even if they were built in accordance with the regulation, the energy consumption of new buildings is at least 30 % higher than other countries having similar climatic conditions. It is known that nearly 60 % of the heating losses come from the roof, windows, walls and floors and with the basic measures it is possible to minimize that heat losses (Kavak, 2005:77).

Another important factor that has a significant share in the energy usage of the building is the electrical home appliances. Today nearly 30 % of the electric is used for lighting and 70 % of it is used for household appliance running. With the harmonization studies of the EU Directives, Ministry of Science, Industry and Technology published several label regulations about the efficiency of the electrical equipment. With this label regulation, people see how many electricity is consumed by the home appliances. By showing the consumption quantity, people are encouraged to use more efficient and less electricity consuming home appliances (Kavak, 2005; 79).

Turkey published the 5267 number Energy Efficiency Law in 2007 to increase the energy efficiency and to decrease the energy losses in building. According to this provision, not only electrical appliances but also buildings will be labeled in accordance with their energy usage. With this regulation, the buildings are also labeled like being home appliance and if the buildings have the less efficient level some sanctions are implemented to the owners of the building. Apart from the above regulations, Ministry of Energy and Natural Resources started a campaign, called as ENVER, to increase the energy efficiency in Turkey. In this context, the advertising and education facilities have been used intensively.

With the Energy Efficiency Strategy, published in 2012, it is aimed to identify a roadmap for energy efficiency between the 2012-2023 periods. According to this strategy document, compared to 2011, it is expected that energy density of Turkey will be reduced 20 % in 2023.

Although there are some regulations about the efficiency of the building and home appliance, there is not any regulations, standards or sanctions about the transportation sector. Transportation sector uses more than 20 % of the total energy and more than 99 % of this energy consumption is the petroleum or petroleum products. In other words, the sector entirely depends on imports and majority of this petroleum is mainly used by the highway sector. If the share of the highway is decreased by giving the emphasis to the other transportation sectors and by increasing the public transportations' quality and infrastructure, it can be possible to save the significant amount of oil used in transportation sector (Kavak, 2005:80). In addition, by changing the old vehicles with energy efficient one, energy efficiency of the transportation sector can be increased. In this way, our

country's dependence on oil can be reduced, carbon emissions can be diminished. In spite of the fact that the share of the highway has been decreasing by performing the high-speed train line, the highway has been protecting its weight in the transportation sector.

According to the studies made on industrial plants, an average energy saving potential of industry sector is calculated as at least 20 % of current consumption. The amount of energy that can be saved in industry is 5.7 MTEP and has a value of 2.9 billion dollars. In order to increase efficiency, 7.25 billion dollars investment is required. As it can be seen, the average payback period of this investment is 2.5 year. After 2.5 years, almost all of the money we paid for energy imports can be saved and this situation creates very positive impacts on Turkey's balance of payments. In addition, at least 40 % of saving will return to the market of Turkish economy and creates a new source for the economy. On the other hand, permanent employment can be provided for at least 6,000 people with this saving (WEC, 2013).

Another important area that is ignored by the society about the efficiency field is the power plants. When the efficiency of the fuel becomes variable, the efficiency of the plants is directly affected from those changes. This situation is encountered mostly in coal-fired plants because of the variable value of the coal combustion. According to the estimation yearly energy loss of the power plants is more that 500 million kWh.

The last but very important factor that affects the energy prices in Turkey is the losses and leakage rate (or illegal use of electricity) in the electricity market. Although the rate has been decreased by the government fight from 19 % to 14.1 % since 2002, this ratio still very high comparing with the developed countries. While the loss and leakage ratio is 7 % in the west part of the country, it can reach to the 80 % of total consumption in some part of the Southeast Anatolian regions' cities of the country. Since the price of the losses and leakage is reflected to the electricity bills of the whole consumers, this problem increases the electricity bill of the honest consumers. In addition, because of the high electricity price, the competition power of the honest industrialists is decreased. Therefore, this problem is also as important as the other efficiency factors and the government must take precaution, both legal and technical, to prevent the unfair energy use in the country.

In order to compete with other companies in the global market, it is very important to produce goods and services at a cheap price. However, while the density of electricity use in Turkey is higher than OECD average, the cost of electricity is also high. In this case, Turkish companies use more electricity at an expensive price and lose the completion power in the global market.

It is estimated that by increasing the energy efficiency in residential, industry, transportation and leakage and loss, 14 billion dollars can be saved yearly and with this yearly saving amount, 38 Atatürk dams can be built in ten years (with 140 billion dollars). This situation shows that energy efficiency and energy saving is as important as the domestic production of energy (WEC, 2013: 322).

In 2023, in conjunction with the new needs of Turkey, the energy consumption is projected to increase by 90 %, and this value is seven times bigger than the OECD average. Today, nearly 70 % of current account deficit results from the energy import and to reduce current account deficit and foreign dependency in energy, renewable energy investment and efficiency in energy usage are very important for our country. Beside these, CO_2 emission of our country has increased 124 % compared to the 1990 data. The main way of rein the emission increase is to evaluate the 25 % saving potential of the country and use renewable energy resource.

3.7. Summary:

In this chapter general energy outlook of Turkey was examined. Energy policy, implemented since the establishment of the Republic, and energy resources, both fossil based and renewable energy resources, are investigated. Potential of renewables and their contribution to the economy was shown. In addition, importance of the energy efficiency and its effect to the economy was also demonstrated. The main aim of this chapter was to show the energy photo of Turkey. Since there is a direct relationship between the current account deficit and energy consumption, the concept of balance of payment, current account deficit, production structure of Turkish economy and economic crises lived in the republic era will be investigated in the later section.

CHAPTER IV.

4. THE ROLE OF THE ENERGY ON CURRENT ACCOUNT DEFICIT AND SUSTAINABLE DEVELOPMENT IN TURKEY

Current account deficit is one of the structural problems of our country. Turkey has experienced 15 economic crises throughout the republic history and nearly all of the economic crises were directly or indirectly related with the current account deficit. Since Turkey does not have enough domestic energy resources, it has to import large amount of its energy needs from abroad and this situation creates rigidity in current account deficit. Because significant part of the imported energy is consumed inside the country. Therefore, the concept of current account deficit, the factors that affect the deficit, Turkey's production structure, energy consumption and its relation with current account deficit and economic crises lived in republic era will be examined in this chapter.

4.1. Definition of the Balance of Payment and Current Account Deficit

A country's economic relation with the outside world is called the balance of payment and this information is monitored in the balance sheet of the country. This balance sheet shows the equilibrium of the countries' revenue generated from abroad with the payment made to other countries. Balance sheet also reflects the improvement or deterioration of the economic situation of the countries. Therefore many times balance of payment shows the economic and financial standing of the countries in the international arena (Şahin, 2011; 48).

Payments of the balance sheet consists of four main sections; current account balance, capital account balance, reserves and net errors and omissions. Current account balance is one of the main account of the balance of payment. It composes of import and export of goods and services, investment revenue and expenses, and current transfers' revenue and expenses of a country with the rest of the world countries. If a country's income obtained from the current account process is greater than the expenses, this situation is called as the

current account surplus, if vice versa situation is lived then it is called current account deficit (Peker and Hotonluoğlu, 2009: 222, Şahin, 2011: 49). When the countries encounter with the current account deficit, this deficit has to be paid by borrowing from abroad or by selling the domestic assets of the countries. In the opposite case, the capital of the citizens is transferred to the abroad by lending debt or by buying the foreign assets (Obstfeld ve Rogoff, 1996:5, Şahin, 2011:49).

Current account balance is a very important indicator for every country. Any changes in a country's current account balance directly related with the economic performance of the country. Hence, it affects the decision and expectation of both domestic and foreign investors. In developing countries, like Turkey, Brazil and Southeast Asian countries, the main reason of the economic crisis is generally related with the high current account deficit. Therefore, for the economic stability and sustainable development, the balance of current account is very important especially for the developing countries (Labonte, 2010: 7, Şahin, 2011, 49).

There are two main reasons of the current account deficit problem. The first reason is lack of domestic saving for new investment. If the required saving cannot be maintained for the economic growth, the country has to use the foreign resources to close its domestic saving gap. The other important reason is the overvalued national currency. If the currency becomes overvalued by the fast and speculative capital flow or by the pressure of the central bank, the imports of the goods and services become cheaper (Yeldan, 2005: 57, Şahin, 2011: 51). Therefore, not only final consumers but also investors and industrialist inclined to use foreign goods and services because of their relatively cheaper price. In order to sell their goods in the international market, the producers use more imported intermediate goods and, current account balance, domestic intermediate goods producers, national income are negatively affected from this situation. At the end, the deficit problem becomes more unsustainable for the country. (Günçavdı at all, 2008: 68, Şahin, 2011: 51).

Sustainability of the current account deficit can be measured by using the different criteria. The ratio of deficit to GDP, the level of budget deficit to GDP, ratio of import to GDP, changes in reserve levels and capital flow are some of the criteria for measuring the

sustainability of current account deficit (Akdiş at al, 2006). Generally, when a country's current account deficit exceeds the 5 % of GDP, it is accepted as a risky for economy and this situation is assumed as unsustainable. Because, the sustainability of economic stability is directly related with the solvency of the country and when the current account deficit is high, financing of that deficit becomes problem (Şahin 2011, 49). However, according to the some economist, only the share or amount of the current account deficit cannot be enough to interpret it as the crisis herald of the economy. The exchange rate policy of the country, the amount, maturity and composition of foreign debt should also be taken into account, when evaluating the current account deficit (Edwards, 2001).

Although there is no consensus on this matter, the country's economy experienced with high current account deficit is considered to be more vulnerable to attack (Zenghieri, 2004). The situation of the current account contains important information about the crisis that may be encountered. Since large-scale current account deficit has the potential to cause major economic problems, it must be followed carefully and necessary measures should be taken immediately (Taylor, 2002).

As mentioned above, if a country's current account deficit is high, it has to be financed by borrowing from abroad with high interest rate or selling assets. The other main financing methods of foreign deficits are direct foreign investments, short term capital flows and reserves of central bank. Among the all financing methods, foreign direct investment is the most reliable financing method of the current account deficit (YASED, 2011: 10). Because foreign direct investment cannot leave the country right away (Keskingoz and Bozgeyik, 2012.

However, the short term capital flows are generally works in a speculative way. These speculative capital flows can easily change the economic outlook of the country. Turkey and some South-East Asian countries have experienced the painful consequences of fast money inflow and outflow of the short term capital investments in 1990s. When the central bank uses the reserves of the country for the current account deficit, the reserves decreases and it may change the outlook of the country for the next period. Because, generally the

reserves are kept for the bad days of the country and when it decreases the country cannot protect itself from the external shocks in the next periods.

According to the data of IMF, with the 451 billion dollars, USA is the first country in the current account deficit quantity in 2013. USA is followed by India, Brazil, England and Turkey with the 77.6, 74.0, 69.0 and 65 billion dollars deficit respectively. Although Turkey was the 5th country in the quantity, its deficit share to GDP is 7.9 % and very high compared to other countries and this situation creates very big risk for the sustainability of the deficit.

4.2. Turkey's Balance of Payment Outlook

Since the establishment of the republic, the current account deficit has been one of the fundamental chronic and structural problems of Turkey. Apart from the 1930-1946 period, in which except for 1 or 2 years the economy always gave the current account surplus, Turkish economy has lived current account deficit problem in Republic periods. In our country high current account deficit played an important role behind the nearly all economic crises. Therefore, it has been one of the main reasons of instability not only in liberal period but also during the relatively closed period. (Yılmaz and Karataş, 2009:70).

In our country, the most important reason of the current account deficit is the foreign trade deficit. Generally the import of Turkey is bigger than its export. Especially intermediate goods imports are very high. This situation makes the economy dependent on import and creates imbalances in the current account balance (Yılmaz and Karataş, 2009: 72, Şahin, 2011: 51). Since Turkey's production structure became depended on the imported intermediate goods, while the export was increasing, the import was also increased. When we examine the republic period except for the 16 years, in 1930-1946 period, foreign trade always gave deficit in our country.

Table 40: Foreign Trade Data

Years	Export	Import	Export/Import
1923	50.790	86.872	58,5
1925	102.700	128.953	79,6
1930	71.380	69.540	102,6
1935	76.232	70.635	107,9
1940	80.904	50.035	161,7
1945	168.264	96.969	173,5
1950	263.424	285.664	92,2
1955	313.346	497.637	63,0
1960	320.731	468.186	68,5
1965	463.738	571.953	81,1
1970	588.476	947.604	62,1
1975	1.401.075	4.738.558	29,6
1980	2.910.122	7.909.443	36,8
1985	7.958.008	11.343.375	70,2
1990	12.959.288	22.302.126	58,1
1995	21.637.041	35.709.011	60,6
2000	27.774.906	54.502.821	51,0
2005	73 476 408	116 774 151	62,9
2010	113 883 219	185 544 332	61,4
2011	134 906 869	240 841 676	56,0
2012	152 461 737	236 545 141	64,5
2013	151 802 637	251 661 250	60,3

Resource: TurkStat, Statistical Indicators, 2014

The ratio of foreign trade volume to gross domestic product was 30.9 % between the 1990-1999, and it reached to 39.4 % between the 2000-2008. At the same time, the ratio of the current account deficit to GDP was 1 % between the 1990-1999, and it increased to 4,1% between the 2000-2008. All these development shows that while the foreign trade volume was expending, the current account deficit was also increased (Karabulut and Danışoğlu, 2006:48, Şahin, 2011:50). Certainly, Turkey has to think and take precautions about the reasons and results of this situation. Because this picture shows us that Turkeys' economy meets difficulty in compliance with the requirement of international competition (Yılmaz and Karataş, 2009:82).

The coverage ratio of export to import is around the 60 % and the total export of Turkey decreased slightly and realized as 151.8 billion dollars in 2013. The first five countries in export were Germany, Iraq, UK, Russia and Italy (Table 41). The highest export has been made to Germany, but, because of the technological import, Turkey gives deficit in the

trade with Germany. Iraq is the second market of Turkish company and trade relation has been developing especially with the North Iraq Region since the 2005.

Table 41: The Top Five Countries in Export of Turkey

	Country	2013	2012	2011	2010
	Total export	**151.802.637**	**152.461.737**	**134.906.869**	**113.883.219**
1	Germany	13.702.577	13.124.375	13.950.825	11.479.066
2	Iraq	11.948.905	10.822.144	8.310.130	6.036.362
3	UK	8.785.124	8.693.599	8.151.430	7.235.861
4	Russia	6.964.209	6.680.777	5.992.633	4.628.153
5	Italy	6.718.355	6.373.080	7.851.480	6.505.277

Resource: TurkStat, Statistical Indicators, 2014

The import of Turkey was 251.66 billion dollars and the first five countries in import were China, Russia, Germany, Italy and USA in the same year. The biggest trade deficit was given against the China, because Chinese goods have price advantage not only against Turkey but also for all world countries. Because of this advantage, China increased its export significantly especially after the admission to the World Trade Organization in 2001. Due to the energy import Turkey has been giving trade deficit against Russia and Iran.

Table 42: The Five Ten Countries in Import of Turkey

	Country	2013	2012	2011	2010
	Total Import	**251.661.250**	**236.545.141**	**240.841.676**	**185.544.332**
1	Russia	25.064.214	26.625.286	23.952.914	21.600.641
2	China	24.685.885	21.295.242	21.693.336	17.180.806
3	Germany	24.182.422	21.400.614	22.985.567	17.549.112
4	Italy	12.884.864	13.344.468	13.449.861	10.139.888
5	USA	12.596.170	14.130.546	16.034.121	12.318.745

Resource: TurkStat, Statistical Indicators, 2014

Lack of domestic saving is another reason of the current account deficit. There is a very big correlation between the economic growth and current account deficit of Turkey. Because of the lack of domestic saving, the economic growth was supported by the foreign resources. The economy was financed by capital flow or foreign credits taken either by private and public sector. These funds are generally used to finance the private consumption.

Turkey's growth policy in recent years depends on the domestic demand. Therefore, with the increasing income level, the demand for consumption rose rapidly and the saving ratio decreased from 23 % in 1990 to 12.8 % in 2011. In the same period, the share of investment to GDP was 23.1 % (IMF, 2011). Since the domestic saving cannot finance the investment, in order to make investment Turkey has to borrow or attract the foreign capital from the rest of the world. However, to borrow or attract the foreign capital flow, the interest rates must be higher than world average and the high interest rate is also increased the current account deficit.

In 1990s, public sectors' saving deficiency was financed by the private sectors and foreign resources. However, after 2001 economic crisis this table was changed. In this period, because of the cyclical effect, the liquidity abundance was lived in world economy and Turkey has achieved a high economic growth rate based on external debt and capital flow (Subaşat ve Yetkiner, 2010). In accordance with the economic program of Turkey, public sectors' borrowing needs and foreign debt was lessened but private sectors' debt was increased.

The fight with the inflation was the priority of the economy administration and with the help of tight fiscal, monetary and exchange rate policy, public sector generally succeeds its targets. Since the relatively overvalued TL contributed to inflation and economy policy targets of the government, the private sectors' excess borrowing was tolerated in this period. However, implemented policy augmented the dependency on foreign resources and caused the current account deficit. It was argued that this policy increased the fragility of economy against the foreign shocks and it could not be survived in the mid and long term. In other words, while the implemented policy, which was depended on private sector's borrowing, was contributing the economic growth and inflation, it created new fragility about the current account deficit (Yılmaz and Karataş, 2009:75-80).

Another important factor that increases the foreign trade and current account deficit is the energy imports of Turkey. As mentioned in above chapters, Turkey's known fossil based energy resources cannot meet its needs. Therefore, nearly 91 % of oil and 98,5 % of natural gas are imported from abroad. Today, energy import covers more than 20 % of the total import of Turkey. When the energy prices increase, the cost of energy bill and

production cost of manufacturing sector also increase and this situation decreases the competition power of the country. Hence, the portion of current account deficit caused by oil or energy import creates rigidities in the economy of the country (Karabulut and Danışoğlu, 2006; 49, Şahin, 2011, 52). When the energy import is excluded, the current account deficit was minimized in most of the years and sometimes current account balance gave significant amount of surplus.

Since the demand elasticity of energy is very low, it is very difficult to eliminate the pressure of the energy on import in the short term. Because, today nearly 48 % of electricity was produced by using the imported natural gas and transportation sector is depended on oil import at a ratio of 91 %. Therefore, in order to decrease the weight of energy import on the current account deficit, the domestic resources; coal, renewables, and nuclear power should be evaluated immediately. It has a vital importance for the security of Turkish economy and balance of payment.

The increase observed in the current account deficit in recent years, especially since 2004, is directly related with the oil, energy, commodities and base metal prices. There was a substantial increase in the price of those commodities after 2002. However, the high rate of dependence on imports of intermediate goods production and export structure of Turkey's economy is another important factor of the deficit. Therefore, while the economy is expanding, the current account balance deteriorated as a result of the rapid increase in the price of imported goods in this period. In other words, increased import accelerates the growth and growth is stimulating import. This situation increases the current account deficit (Türeli, 2008;14).

In order to ensure high economic growth, the governments have been implementing expansionary monetary and fiscal policies. Since these policies increase the domestic demand, the current account deficit may be affected negatively. Implementation of expansionary monetary and fiscal policies increases the aggregate demand in markets and brings changes in the internal and external balance (Uğur and Karatay, 2009). When the expansionary fiscal policy is implemented, the budget deficit and interest rates increase. Increase in interest rate attracts more capital flow from abroad and appreciate the currency of the country. However, because of the appreciation of currency, the export of country

decrease and import increases. As a result, the current deficit of the country increased (Marinheiro, 2006). Therefore, expansionary fiscal and monetary policies are accepted one of important reason of the high deficit in Turkey. In order to eliminate the effects of the 2008 global economic crisis as soon as possible and to increase the employment level, the government implemented expansionary fiscal and monetary policy and increase the domestic demand. As a result, the current account deficit increased to 9.7 % of GDP in 2011.

In the economy literature, when the current account deficit exceeds the 5 %, it is accepted that this situation cannot be sustainable and economy will meet high devaluation and crisis. However, Turkey's current account deficit in recent decades has broken the record and reached to 9.7 % of its GDP. While the deficit was 7.5 billion in 2003, it reached to 65 billion dollars in 2013. The import was increased with the help of high domestic demand, but the export could not be increased as expected because of the global economic crisis and political situation living in middle-east countries (Kalkan 2011:1, Şahin, 2011, 52). Therefore, it is expected that the current deficit of Turkey cannot be decreased at least in the short run.

Until now Turkey can succeed to close its current account deficit generally by using high interest rate and the short term capital flow. Although the short term capital flow plays an important role in the closing of the current account deficit, it overvalued the TL and made the import attractive for both producers and consumers. They indirectly increased the import and deteriorate the current account balance. Therefore, this kind of financing is not healthy and increases the country’s debt and amount of the speculative capital flow. It is very likely that, as being in South-East Asia, it may cause the serious economic crisis. Instead of short term capital flow, direct foreign investment should be selected and structural and permanent reforms have to be done to prevent the unsustainable deficit level. One of the positive developments that lived after 2002 was the increase in the share of long term capital flow and direct foreign investment in the financing of the current account deficit. However, one should be emphasized in here that direct investment increase was the result of privatization and asset sales, rather than contributing to the capital stock of foreign investment (Türeli, 2008; 16).

Because of the international competition and with the effect of the money and exchange policy, the composition of the manufacturing sector was changed dramatically and even the traditional sector started to use import input in their production. As a result, while these traditional sectors were contributing the current account balance before the 2000, their contribution decreased and the deficit reached to the record level (Yılmaz and Karataş, 2009:89-90).

The share of manufacturing sector's import to the total imports reached to 74,3 % in 2008 and today this ratio is still more than 70 %. While import dependency of manufacturing sector was 32 % in 1997, it reached to 65 % in 2007 and 72,4 % in 2013. In other words, while Turkey was importing the 1/3 of its total production in 1990s, today this ratio reached to 72.4 % of its total production. Because of the overvalued TL, the foreign goods became relatively cheaper. To compete with both domestic and foreign rivals, Turkish manufacturing sector used the foreign inputs in their production. In order to produce and make export, Turkish economy needs to import. Hence, while the economy was growing the deficit was also growing (Yılmaz and Karataş, 2009:71-76). As a result, domestic contribution of manufacturing sector has been decreasing steadily.

4.3. Examination of the Production Structure of Turkish Economy

With the 1980s, the globalization gained speed and with the effect of the globalization the production process transformed to the international character. In most of the developed countries, the firms restructured their organization and by the direct investment they shifted their labor-intensive sectors to the developing countries in which the labor power is cheap and plentiful. In other words, they reorganize their firms according to the vertical specialization and their production structure changed by this reorganization (Saygılı at al, 2010;1-2).

Globalization provides the firms to get intermediate and investment goods with low cost from any countries in the world. While these facilities are providing competitiveness to the firms using imported input equips, the firms which have used the relatively expensive domestic goods are adversely affected. This global transformation caused the

comprehensive changes in the production and foreign trade indicator in all over the world (Saygılı at al, 2010;1-2).

One of the most fundamental reflections of the changes in production and trade structure is the increase in the share of imported inputs used in the production of goods. This situation can be observed as the significant increase in the share of foreign trade in national income. Therefore, today in many countries, the production is internationalized and the unit of production creates less value added than before. Parallel to the development in globalization, the firms chose vertical specialization rather than horizontal specialization.

In vertical specialization, the different stages of the same product are produced in different countries. In order to provide competitive advantage, the companies take into account some factors such as labor cost, proximity to the market and other incentives. According to the result of their investigation, they make their investment in different countries. For example, while the battery of the smartphone is produced in China, the monitor is produced in Korea and software is produced in India. By using the cost advantage of each productions, the companies try to decrease their production cost and increase the competitive power of their firms (Saygılı at al, 2010; 26). As a result of vertical structuring of companies, the added value of the export and foreign trade has been decreasing in all over the world.

We can also observe these changes in Turkey. In 1980s, Turkey gave up import substitution growth policy and implemented the export-led growth strategy in its economy. As a result of this strategy, the labor-intensive industries, such as textile, leather, foods, gained weight. Due to the competition power lost in traditional sectors against the Asian countries, the structure of the Turkish export changed towards the relatively capital intensive sector. With the establishment of the Custom Union with EU, the share of the relatively capital intensive sectors, such as vehicle, electrical machinery, increased both in economy and in total export. Turkish economy integrated to the global economy, the production and export volume have increased significantly. While the ratio of foreign trade was 24.5 % in 1990s, it increased up to the 52.3 % in 2000s (Aydın at al, 2007). However, increase in production and export volume have brought with the increase in the import and in current account deficit (Saygılı at al, 2010;6).

Foreign trade deficit or with large definition the current account deficit has been one of the main obstacles of Turkish economy to reach the high sustainable growth ratio. Because, like being in 1994 and 2001 crises, it was the main reason or trigger of the many economic crises of Turkey. Foreign trade deficit generally occurs when the firms, which mainly work for domestic market, use imported investment and/or intermediate goods in their production. In contrast, when the exporters use domestic intermediate and investment goods, the current account deficit decreases (Saygılı at al, 2010; 3). The main sources of the foreign trade deficit in Turkey's economy are the capital and intermediate goods such as energy, chemicals, basic metals, machinery, communications, broadcasting, medical and optical instruments. Although some part of these sectors work in exports area, lots of them are producing their goods mainly for domestic consumption (Saygılı at al, 2010; 11).

The energy import also plays an important role in the development of the foreign trade deficit because the energy imports are mainly used for domestic consumption. Indeed, with the contribution of rising energy prices, the energy trade deficit accounted for 59.4% of total foreign trade deficit as of 2008 (Saygılı at al, 2010;11). Although it was slightly decreased in 2013, its ratio is still at about 50 % of total foreign trade deficit. Turkey is dependent on the imported goods in major ingredient. The high dependency on imported energy is one of the significant reasons of having a fragile structure of the balance of payment.

The intermediate goods' share in total imports of goods was realized as 72.8% in 2008 (Saygılı at al, 2010; 8). Intermediate goods succeeded to protect its high level in the total import with the help of the increase in intermediate goods prices, especially in oil prices, and strengthening relationship between imported inputs and total production. While intra-industry trade and widespread use of imported inputs in industrial production was limiting the sensitivity of exports to the exchange rate, it increased sensitivity of export to external demand (Aydın at al, 2007). However, overvalued Turkish Lira particularly contributed to the acceleration of capital and consumer goods imports (Saygılı at al, 2010;8).

There are limited numbers of studies about the development of the use of imported inputs in Turkey's economy. Common findings of these studies are that Turkey's industry is increasingly turning to a structure in which the industry uses more imported inputs and this

situation makes the economy more fragile in term of the external balance (Saygılı at al, 2010;29). There are different reasons of this situation for different researchers. Eşiyok (2008) claims that the main reason of this imported input increase is the custom union and exchange rate. According to Türkan and Yükseler (2008), however, there are four main reasons of this import increase; increase in vertical specialization or organization of firms, valued exchange rates, change in production structure of firms and integration of the far east countries, such as China and India, to the global system. Türkan and Yükseler (2008) argue that the main reason of this tendency of domestic firms is to protect their share in the international markets.

According to the survey result of Saygılı at al, the raw and the intermediate goods constitute the 75 % of the production cost in Turkey. In order to decrease their production cost, most of the companies make imports. As of 2007 the average of import share in total raw material cost is 72.6% and this ratio is rising to 87 % in petro-chemical, 83.4 in electronics, 83 % in transportation and 76.9 in paper and printing (Saygılı at al, 2010; 67). Since the main demand of imported input usage comes from manufacturer sector, the factors that affect the imported input use in manufacturing sector will be examined in below.

4.3.1. Factors Affecting the Imported Input Use in Manufacturing Industry

One of the remarkable points of Turkish Economy is that although there is a significant success in the export increase of economy, the current account deficit continues to deteriorate. This situation shows that the production and export structure of Turkish economy depends on the import goods. While the share of import input in total production was 57 % in 1996, it increased to 69 % in the period of 2000s, and 72 % after 2010. In other words, the ratio of the added value in the production is only 31 % in 2006 and 28 % after 2010. When we look at the sub-items of the manufacturer sectors that have high share in the export of economy, we see worse picture than above table. The import input rate of electronic is 74 %, iron-steel 76 %, non-ferrous metal 76 % and automobile 66 %, (Türeli, 2008; 15).

There are many factors to guide companies to provide the intermediate and investment goods from abroad. We can categorize the reasons of imported input use as structural and conditional reasons. The structural reasons are the globalization, quality of goods, technologic transfer, widespread of multinational companies and organization of the firms. The conditional reasons are exchange rate changes, custom duties, tax incentives and foreign credits (Saygılı at al, 2010;73-120).

The absence or inadequate domestic production of raw and intermediate goods is the main reason of the imported input use in Turkey. For example, the energy sector is completely dependent on the imported input because the production of crude oil, natural gas, and other energy resources are very limited in Turkey and the production level cannot meet the total demand of the country. Like energy sector, the transportation sector is also highly dependent on the imported input, because some parts of the automobile, such as motor and electronic equipment, are not produced in Turkey and in order to create final production, the sector has to import those commodities. In other words, domestic contribution of the transportation vehicles is very low or at an insufficient level. Therefore, lack of domestic production of the raw materials and intermediate goods are forcing the firms to use imported inputs in Turkey. In some kind of goods, such as electronics, the imported inputs may contain nearly 80 % of the total cost of that production. In this case, the montage industry's contribution may turn negative due to the domestic consumption in Turkey (Saygılı at al, 2010;73-120).

There is a linear relationship between the quality of goods and intermediate goods, used for the production of final goods. Because of the rapid globalization, today the consumers can buy high quality goods by comparing the quality of them, even if they are not produced in their country. With the development of the high quality standard and competition in the global area, the firms pay attention to use high quality intermediate goods in their production. According to the survey result, this factor is the second important factor for the Turkish firms to use import inputs in their production (Saygılı at al, 2010;73-120).

Because of the domestic and foreign competition, the firms try to produce their goods at a cheapest price. Therefore, when the firms find the same quality goods at a cheaper price,

they tend to use import input in their production. With the integration of China, India and other South-East Asian countries to the global system, the countries can find cheaper goods in these countries. The organization of the companies and exchange rate also contribute to this situation. When the money appreciate, the foreign goods becomes relatively cheaper than the domestic ones and all these factor force the companies to use imported inputs (Saygılı at al, 2010;73-120).

Apart from above mentioned factors, the organization of the companies and foreign credit facilities are very important factors that affect the decision of companies in their production. When the multinational companies make investment in one country, they take into account the highest profit facilities. Therefore, if a countries' labor cost is low, they produce the goods, which needs more labor power, in that country. Like labor cost, the multinational companies may make investment in a country to take advantage of their cheap raw material cost. These and similar reasons develop the vertical integration and specialization of the companies in their production (Saygılı at al, 2010;73-120).

In fact all of above factors are affected by each other. Globalization, widespread of multinational companies, exchange rates, lack of or abundance of raw materials, price and quality of the goods are interrelated with each other and a change in one of the factor directly or indirectly affects the others. Therefore, in contemporary world, the production process is internationalized and the firms are organized in a vertical specialization model. Turkey, like being in other countries, is also affected from this development and its production and economic structure is designed according to this development. However, the main problem of Turkish economy is the supply-demand disequilibrium. In other words, rather than cheaper price of the foreign goods, the supply-demand disequilibrium affects the country.

This situation is also felt in production structure. In order to produce goods and services Turkey has to import raw or intermediate goods because Turkeys' raw and intermediate goods production cannot meet or support its demand. In some categories, such as oil, natural gas and energy, the natural resources of the country is not sufficient. In the period of economic expansion, this deficiency is felt very severely and while the economy is

growing, the import and current account deficit is also extended. In order to get sustainable development and economic growth, Turkey has to overcome this structural problem (Saygılı at al, 2010;73-120).

To close the foreign deficit, the performance of the export is very important. However, when the import input dependency is high, the contribution of the export becomes very limited and in some cases it turns to the negative because of the domestic consumption (Saygılı at all, 2010; 120).

4.4. Effects of the Energy Imports on Current Account Deficit in Turkey

In 2013, 4.2 billion tons of oil was produced and nearly 2.2 billion of them were sold in the international oil markets. The first five places in oil imports were shared by USA, Chine, Japan, India and South Korea in that year. With the 35 million tons net import Turkey was ranked to the 13th place in the list (Tamzok, 2014).

Each year about 3.4 trillion cubic meters of natural gas was produced in the world and at about 1 trillion cubic meters of this amount was subject to foreign trade. With the 120 billion cubic meters of natural gas imports, Japan ranked in the first place and United States, Germany, Italy, UK, South Korea, France, Turkey and Chine are listed respectively in the first 10 countries. According to the total import number, Turkey has realized 45.2 billion cubic meters of natural gas imports and ranked to the ninth place among the importing countries in 2013. However, since USA and UK has been exporting at a large amount of natural gas in the world, we have to discount their export from import to reach the net import number. Therefore, in order to reach to correct number we have to use “net import” number. According to this calculation, Turkey is ranked at the fifth place among the natural gas importing countries. (Tamzok, 2014)

According to calculations made by the International Energy Agency; the first "net energy importing" country in the world is China with more than 468 million tons of oil equivalent energy import. This country is followed by Japan at the close call. Afterwards, USA, India, South Korea, Germany, Italy, France, Spain and Taiwan are ranked respectively. Turkey is

at the 11th place with its 89 million tons of oil equivalent energy import at the world "net energy imports" league (Tamzok, 2014)

As it can be seen, Turkey is one of the biggest net importers of energy in the world. Today, nearly 55 % of primary energy consumption of Turkey consists of oil & natural gas and, nearly 91 % of oil and 98.5 % of natural gas need of the country was met by import. Beside this, the share of imported coal in electricity production exceeded the 10 %. While the amount of crude oil import has stayed stable since 1998, the natural gas import has been increasing constantly. Oil import has remained stable since 1998, but the price of it increased 10 times and this situation influenced the current account deficit at a large amount (Demirci and Er, 2007;1).

As mentioned above, the current account deficit of Turkey is mainly affected from three factors; dependency of Turkish manufacturer sector to import, high energy prices and low exchange rate (Demirci and Er, 2007; 2). Energy import is the second important item in the total import of Turkey. While the manufacturing sector's share was around the 75 % in total import, the energy import took 20 % in our country. In other words, manufacturing sector and energy imports constitute nearly all imports of the economy and the share of other import items is very limited. (Yılmaz and Karataş, 2009: 85). Since the energy prices is directly related with the oil prices, when the oil prices decrease, natural gas and other related goods' prices also decrease. Therefore, every 10 dollars decrease in oil prices decreases the current account deficit of Turkey at about 4 billion dollars. In addition, decrease in oil price can contribute the economic growth and help the fight with inflation (Demirci and Er, 2007; 2).

While the share of energy imports was 20 % in total import in 1990, it decreased to 9 % at the end of the 1990s. However, it started to increase after 2002 and reached to 20 % in 2000s. The average share of energy import to total import was 14 % in 1990s but it increased to 18 % in 2000s (Yılmaz and Karataş, 2009:86). When we look at the net energy imports share in the foreign trade balance, we see that the ratio was 37 % in 1990s, but this number rose to 48 % in 2000s. Certainly, distorting effect of the energy imports not only arises from the quantity but also from the price increase. There are substantial

increases in the prices of the oil, energy and commodity prices after 2002 and there is a strong relationship between the current account deficit and these price increases in recent years (Türeli, 2008;14). Between the 2002 and 2008 years, the energy prices increased 5 times in world economy. Since our country completely dependent on the import in energy consumption, this development increased the energy bill of Turkey and lived a price shocks in economy. These situation shows that the fragility of the Turkish economy to the energy price shock is very high. Therefore, the policy to decrease the dependency to the foreign resources should be applied (Yılmaz and Karataş, 2009:86-87).

The price volatility of energy products plays an important role in the monetary policy of the countries. Oil prices, generally determined according to the supply and demand, started to be affected from the policy of the exporting countries since the 1974 crisis. While the demand of oil and gas has been increasing on a regular basis, with the effects of the structural reasons, politic decisions or political instability, the supply of it cannot be increased simultaneously (Demirci and Er, 2007;1). Recent developments, such as Arab Spring and war in Middle-East, have been playing a pressure role on the crude oil prices. This situation is reflected to the prices negatively and gives harm to the economic growth and development especially in developing countries.

4.5. Examination of the Economic Crises in Turkey

Economic crisis can briefly be defined as decrease in the Gross National Product in a very short time period. Crisis is a reflection of the concerns to the economy (Koç, 2009; 52). It is a previously unknown, not taken into account or unforeseen developments that affect the states seriously at macro level and at the same time the firms at micro level (Turan, 2011, 56). In the crisis period, real sector, banking sector, stock exchange and other economic actors are affected by each other and generally the crises are resulted in a very big unemployment and decrease in the real wages and income of the citizens. In short, the crisis influences the all concepts that are related with the economy.

Because of the globalization and general structure of the crisis, today it is nearly impossible to escape from the negative impact of the any economic crisis lived in any part of world for all world economies. The main indicators of the crisis can be seen from the

growth rate of the country. Therefore, the growth rate of Turkish economy since the establishment of the republic was given in table 43.

Table 43: Growth rate in Republic Periods (%)

Years	Growth rate	Years	Growth rate	Years	Growth rate	Years	Growth rate
1924	14.9	1947	4.2	1970	4.4	1993	8.1
1925	12.8	1948	16.4	1971	7.0	1994	-6.1
1926	18.2	1949	-5.0	1972	9.2	1995	8.0
1927	-12.8	1950	9.4	1973	4.9	1996	7.1
1928	11.0	1951	12.8	1974	3.3	1997	8.3
1929	21.6	1952	11.9	1975	6.1	1998	3.9
1930	2.2	1953	11.2	1976	9.0	1999	-6.1
1931	8.7	1954	-3.0	1977	3.0	2000	6.3
1932	-10.7	1955	7.9	1978	1.2	2001	-9.5
1933	15.8	1956	3.2	1979	-0.5	2002	7.9
1934	6.0	1957	7.8	1980	-2.8	2003	5.9
1935	-3.0	1958	4.5	1981	4.8	2004	9.9
1936	23.2	1959	4.1	1982	3.1	2005	7.6
1937	1.5	1960	3.4	1983	4.2	2006	6.0
1938	9.5	1961	2.0	1984	7.1	2007	4.6
1939	6.9	1962	6.2	1985	4.3	2008	1.1
1940	-4.9	1963	9.7	1986	6.8	2009	-4.7
1941	-10.3	1964	4.1	1987	9.8	2010	9.2
1942	5.6	1965	3.1	1988	1.5	2011	8.8
1943	-9.8	1966	12.0	1989	1.6	2012	2.2
1944	-5.1	1967	4.2	1990	9.4	2013	4.1
1945	-15.3	1968	6.6	1991	0.3		
1946	31.9	1969	4.3	1992	6.4		

Resource: TurkStat, Statistical Indicators, 2014

When we look at the history of the republic, we see that the Turkey's economy lived 15 economic crises. Six of these economic crises were felt very deeply and caused significant policy changes in Turkey (Kazgan, 2002). The ratio of economic downturn was changing between the -0.5 % (in 1979) and -15.3 % (in 1945) in these time periods. However, apart from these 15 years, the economy lived economic growth changing between the 0.3 (in 1991) and 31.9 % (in 1946) and the average growth realized 5 % in republic history. (Koç, 2009; 53) In order to show whether there is a relationship between the reason of the economic crisis and current account deficit and energy consumption, without going into deep analysis, the 15 economic crises were examined briefly in below.

The first economic crisis of the republic was experienced in 1929. Turkish economy was seriously affected from the great depreciation lived in the world. For the first time the value of the TL and agricultural products, which were the main export items at that time, had been decreased since the establishment of the republic. When the structural problems of the Turkish economy and the debts inherited from Ottoman Empire were added, the economy faced with the serious crisis (ATO, 2005: 1; Koç, 2009; 53; Turan, 2011, 59). The main reason of the crisis was the current account deficit. Because of the bad air condition and economic depression in the world, the export could not be increased as it was desired. Beside these, with the fear of custom duty increase, the speculators imported large amount of foreign products and the deficit rose significantly. Current account deficit was doubled and reached to 101 million Turkish Liras in 1929 (Turan, 2011; 59). As a result of this crisis, the structure of the economy shifted to the statism (Koç, 2009; 53). To create capital accumulation and to cope with the economic crisis the government established state-owner enterprises.

The second economic crisis lived in 1948. Because of the World War II, the economy was depreciated and the government experienced high budget deficit in the war times. The export decreased 11.9 % but the import increased 12.4 % in 1948. The coverage ratio of export to import decreased to 71 %. The balance of economy deteriorated in whole of the world and new economic policy was implementing in the world. In order to adapt new economic order and increase the export of country, the TL was devaluated for the first time in 1946 (Koç, 2009; 53). While the value of 1 dollar was 1.3 TL before the devaluation, it increased to the 2.8 TL after devaluation. Since IMF was not established yet, there was not any effect of the IMF in the first comprehensive devaluation of the country (Turan, 2011;64). The main aim was to increase the export and to accelerate the development of the country. However, these measures did not work as it was planned and economy was fallen into the crisis (Koç, 2009; 53).

The third crisis occurred in 1954. With the election of 1950, the Democrat Party began to govern the country. 1950-1954 periods was named as transition period to the free market economy by some economist. However, as a result of the wrong and unplanned

investment, the budget deficit, inflation and foreign debts were increased and Turkish economy experienced first economic crisis of the multiparty era (Koç, 2009; 53).

When we come to 1958, there were two main crises in front of Turkey; foreign exchange crisis and 256 million dollars foreign debt. In this year, Turkey signed first stand-by agreement with IMF and devaluated its currency at a ratio of 320 % (Turan, 2011;64). This devaluation was the highest devaluation of the republic history at that time. Turkish Liras lost its value very fastly and while the 1 dollar was equal to 2.8 TL before the devaluation, it reached to the 9 TL. Nearly 600 million dollars of foreign debts was postponed and 359 million dollar new credit was obtained with the first IMF agreement (Turan, 2011, 64). Although tight fiscal and monetary policy was applied, the government could not prevent the inflation. Foreign deficit was also increased in that period. (ATO, 2005, 1; Koç, 2009; 53). With the effect of the economic crisis, the social problems also increased and this period was ended with the 1960 military coup.

In 1968, while the export was decreasing 5 %, the import increased 11.5 % compared to previous year. The ratio of export to import decreased to 65 %. As a result, Turkey's economy was slightly shaken by a crisis in 1969. The TL was devaluated at a ratio of 66 % and IMF program was implemented again. While the 1 dollars was equal to 9 TL before the devaluation its value became 15 TL (Turan, 2011; 64). After this devaluation, fifth economic crisis was ended with the 1971 military coup (Koç, 2009; 53).

In the first half of the 1970s, Turkey and the world economy faced with a lot of important events. First of all, the additional protocol, signed with European Economic Community, entered into force in 1973. Between the 1973-1974 the oil prices increased 4 times and this situation affected both world and Turkish economy negatively. Because of the high oil price, the cost of the imported industrial products was also increased and all these situation deteriorated Turkish economy. Besides, because of the Cyprus operation, the western countries implemented implicit embargo against Turkey. While all of the world countries tried to prevent excess oil consumption, Turkey subsidized the oil consumption. All of these developments jumped the foreign deficit from 769 million dollars to 2.3 billion dollars. The budget deficit reached to highest level of republic with 303 million dollars.

Turkey came to the threshold of a new downturn (Koç, 2009; 54). As a result, the economy fell into the deep economic crisis and Turkey experienced its sixth economic crises in republic period.

In Turkey, the seventh economic crises lived in 1978. The governments of 1970s used the low-interest loan to increase the development level in this period but these expenditures were generally used in the inefficient areas. As a result of the populist public expenditures, the public debts and imports increased enormously. While the import was increasing, the export cannot be increased and the coverage ratio of export to import decreased up to 30 %. Consequently, the debt increased to 10 billion dollars. In that period the share of the short-term debt to the total debt reached to the 52 % and the economy faced again a new crisis (Koç, 2009; 54).

Because of the inconsistent monetary and fiscal policy, Turkish economy lived serious inflation and balance of payment crisis in 1970s. While Turkey was living an economic crisis inside, the OPEC countries increased the oil prices at an amount of 150 %. As result of this energy price shock, the inflation and unemployment ratio increased to 63,9 % and 20 % respectively. 1974 and 1979-1980 economic crises were directly related with the high oil price shock. A lot of basic consumption goods fell into the black market. In order to control the inflation and to finish the foreign resource deficit, Prime Minister DEMİREL and his undersecretary ÖZAL prepared 24 January decree. One of the main aims of the 24 January decree was to control the inflation and to liberate the economy in a very short period of time (Kibritçioğlu, 2001, 177).

In other words, the main aim and strategy of these decisions was to provide a transition from import substitution to outward-oriented liberal economy (Başkaya, 1986, 183-188). With the implementation of this decree the TL was devaluated 48 %. While the government was trying to implement this decree, a new military coup was made by the Turkish Armed Forces on September 12 (ATO, 2005; 2; Koç, 2009; 54). In other words, the eighth economic crises of Turkey again ended with the military intervention. However, after the military intervention the economy and the country was entrusted to Özal and the 24 January decrees were implemented firmly by him.

The effect of the 24 January Decree perceived immediately and while the amount of the export was 2.3 billion dollars in 1978, it reached to the 5.7 billion dollars in 1983. However, because of the high public expenditure, the budget deficit and foreign deficit increased enormously. As a result of this economic imbalances the TL was devaluated again, and ninth economic crisis experienced in 1986 (ATO, 2005;2, Koç, 2009; 54).

When we come to the 1989, Turkey has become one of the free market economies in the world. The convertibility of TL was adopted in the same year. However, because of the increase in public expenditure and wave in the fiscal market, the balance of the economy deteriorated. Foreign debt increased to 41.7 billion dollars in 1989 and 49 billion dollars in 1990. The ratio of the short term debt increased to the 19 % and foreign deficit rose to the 9.3 billion dollars. Because of this situation, the economy entered into the new economic crisis (ATO, 2005;2, Koç, 2009; 54).

1991 year started with big political and economic events in the world. Iraq invaded Kuwait and the oil crisis emerged. Since the UN implemented an embargo against Iraq, neighbor of that countries, including Turkey, were affected negatively from this situation. Because, the trade volume of Turkey and Iraq was very high before the Kuwait war. With the military intervention of the UN, Turkey was perceived as a risky country by the capital. The panic in the financial markets rose and 2.6 billion dollars capital outflow was lived. Growth rate decreased to the 0.3 % and the inflation increased to the 64 %. Because of the fluctuation in the financial market, TL was devaluated and the economy fell into the crisis (ATO, 2005;2, Koç, 2009; 54).

Before the 1994 economic crisis, the economy structure of the country deteriorated seriously. Current account deficit and foreign debt stock increased 6.4 and 12 billion dollars respectively and the short run debt quantity jumped to 18.5 billion dollars. The coverage ratio of export to import decreased to 52.1 %. As a result, the economy fell into the crisis and famous April 5 decisions were taken to regulate the economy. The money was devaluated again and nearly 500.000 persons became jobless and unemployment rate reached to the 20 %. For most of the economist this crisis was accepted as the worst

economic crisis of the republic history since the establishment of the republic and the ratio of depression reached to the 6.1 % (ATO, 2005;2, Koç, 2009; 55).

The main characteristic of the 1994 was that the effects of this crisis continued in other years because of the some decisions taken to exit from the 1994 economic crisis. In this period, the credits given by foreign firms and all of the bank deposits were taken into the state guarantee. Because of these guarantees, the number of the bank was increased very fastly and lots of them went into bankruptcy in economic crisis in later years.

While Turkey was trying to eliminate the effect of the 1994 crisis, the Asian and Russian crisis emerged in 1997 and 1998. These two crises affected the country's financial situation seriously and nearly 6 billion dollars were outflowed from the country. Beside these, the country faced with the biggest earthquake of its republic history on August 17. As a result of all these developments, the inflation rate jumped to the 64 % and the real interest rate reached to 37 % in 1999. This year economy depreciated at about 6.1 % and 13th economic crisis was lived. Turkey again signed a new stand-by agreement with IMF to control the inflation, to decrease interest rate and to eliminate the economic instability (ATO, 2005;3, Koç, 2009; 55).

For most of the economist the main reason of the 2001 crisis was the wrong IMF prescriptions. Before the agreement, the main problems of the economy were the high public debt, inflation, the structure of the public debt and high current account deficit. In order to control all of these imbalances, the government signed a new stand-by agreement with IMF. According to this agreement, the foreign exchange anchor was used to control the inflation. However, as a result of this wrong policy, the exchange rate was pressured and the import was exploded. When we came to end of the 2000, the current account deficit reached to the 9.8 billion dollars. The coverage ratio of export to import decreased to 51 % in 2000. At the same time, the total foreign debt and short term debt increased to the 114.3 and 28.9 billion dollars respectively.

The first signal of the crisis came on 22 November but the government and IMF insisted on continuing the program. However, the belief towards the success of this program

minimized at the financial market and with the effect of the president-prime minister dispute, the crisis exploded and the program collapsed on February 2001. Turkey gave up the foreign exchange anchor and allowed the fluctuating of currency. The money was devaluated again and while the 1 dollar was equal to 670.000 TL, it increased to 1.161.000 after crisis. Nearly 1.5 million persons lost their job and like great depression of 1929, this crisis was the greatest depression of the Turkish Republic in the Republic history (ATO, 2005;3, Koç, 2009; 55). New election was made in 2002 and then all of the coalition parties could not succeed to enter the parliament. The political situation of the country changed completely and one party, Justice and Development Party, won the election with a huge majority in the parliament.

The last crisis of Turkey was lived in 2008. However, neither reason nor result of this crisis was directly related with the faulty policy of Turkey. In other words, the root of this crisis was in abroad and like being in 1929 crisis Turkey was negatively affected from this crisis. The crisis firstly emerged in USA and then spread to EU and world market. The mortgage market collapsed in USA and it jumped to EU and consequently the financial market fluctuated deeply in global market. The developing countries, whose economy largely depended on the export, affected from the economic crisis of the developed countries. Because their export was decreased and large amount of capital outflow was lived in their financial market.

The effects of this crisis have been continuing in the world and for most of the economist unless otherwise structural precautions are taken, the crisis cannot be prevented but it can be shifted to the future. However, destructive effect of the postponed next crisis will be much worse than present. Although Turkey was affected from this crisis, because of the precaution taken by economy administration, it can succeed to overcome or minimize the effect of this crisis (Koç, 2009; 55). Expansionary monetary and fiscal policy implemented to reduce the negative effects of global economic crisis but this policy increased the current account deficit to 9.7 % of GDP.

4.5. Relationship Between the Social-Political Stability and Economic Crises in Turkey

When we look at the literature about economic crises and social and political stability, we see that there is a strong relationship between the political stability and economic development. Since the capital and investors are looking for the safety harbor for their investment, political instability directly affects the decision of the investors. Therefore, nearly all of the studies indicated that political instability affects the economic development of Turkey negatively.

Economic crises, however, also affected the decision of the voters and this economic unrest could also cause political instability. Since the citizens charged political power as giving rise to economic crises, they generally punished them in election. When the election system cannot create a strong government, uncertainty is increased in economy and political area. Therefore, economic crises fostered the political and social unrest in the country. In other words, these two factors, economic crises and political instability, are influenced by each other.

According to the report of the Union of Chambers and Commodity Exchanges of Turkey (2001) and Turkish Confederation of Employer Association (2001), political instability is hampering the investors to make prediction about future. This uncertainty situation affects not only the decision of the domestic investors but also foreign investor. As a result, the economy falls into crises and with the effects of the election system this unrest situation caused the new instability in the country.

Since the 1950, Turkey experienced 16 general and 14 local government elections. Throughout the republic period 62 governments were established. Average life of the government was 1.4 year and the life of more than 50 % of the governments is below the 1 year. Between the 1946 and 1980, 29 governments were established and the average life of the governments was 1 year and 2 months. There is a very big correlation between the economic development and life of the governments (EFE, 2000). For example, after 1958 economic crises, however, social stability was deteriorated and the term was ended with the military coup. Likewise, between the 1970-1980 years economic crises caused serious political and social unrest in Turkey and this term was also ended with the military

intervention. After 1994 crises, the average life of the governments fell into the 1 year until 2003 and Turkey was also experienced a post-modern military intervention in this era. As it can be seen economic crises affects political stability and political instability also causes economic crises and social unrest in the country.

Comparing with the economically problematic periods, the life of the governments is relatively longer between the 1950-1958, 1963-1970, 1980-1993 and 2003-2014 periods. Common feature of these periods was the economic stability. In other words, the economy was growing steadily in these periods. For example, between the 2003 and 2015 years the economy of Turkey developed more than 3 times and this picture was reflected the social and political stability of the country. In short, economic development supports the political and social stability in Turkey.

4.6. Summary:

In this chapter the concept of balance of payment, outlook of Turkey's balance of payment structure and economic crises that Turkey has experienced throughout the republic periods were examined. While looking at the Turkey's balance of payment outlook, the production structure of the economy and factors that affect the imported input usage in manufacturing sectors was also investigated. The effects of the energy import were also examined to show the relationship between the crises and energy import. At the end, all of the economic crises was described briefly in this chapter. In the coming chapter, the analysis will be made about the effects of the renewable energy investment on sustainable development, current account deficit and economic and politic stability of the country by using the information given in above chapters.

CHAPTER V.

5. ANALYSIS OF THE EFFECTS OF RENEWABLE ENERGY INVESTMENT ON SUSTAINABLE DEVELOPMENT, CURRENT ACCOUNT DEFICIT AND ENERGY OUTLOOK OF TURKEY

Renewable energy and its effects on balance of payment and sustainable development is a very large concept that consists of three main titles: renewable energy, sustainable development and balance of payment. Since the main aim of this dissertation is to investigate whether or not the renewable energy investments can contribute the current account deficit and social stability of Turkey in context of the sustainable development, to make clear analysis the concepts of the sustainable development, energy resource, energy outlook and current account deficit of Turkey were explained in above sections. In this chapter, the effects of the renewable energy investments on sustainable development, current account deficit and economic and political stability of Turkey will be analyzed by using information given in previous chapters. By doing this, we will try to find whether our hypotheses are true or not.

5.1. Environmental Sustainability Analysis of Renewables in Turkey:

While previously the concept of sustainable development only consists of the economic development in monetary term, today its meaning is elaborated very largely. It includes food security, new and renewable energy, harmony with nature, promotion of human rights, friendly technological development etc (Morgera, 2010). Therefore, today, the sustainable development can be defined as to meet the needs of the current and future generations without exhausting natural resources by establishing a balance between nature and human beings. This definition consist of the programming the development of today and future life of the generations and nature. Hence, sustainable development is a concept that has social, economic, ecological and cultural dimension in contemporary world.

Since the beginning of the 20th century, the energy consumption, CO_2 and harmful emission increased 17 times in the world. The greenhouse effect has been felt more commonly in contemporary world. Since the majority of energy demand was met by fossil based resources, the main reason of the greenhouse effect and harmful emission is the fossil based energy resources. Hence, today the countries have been trying to develop more reliable, harmless and environmentally friendly domestic energy resources to limit the harmful effects of the fossil based resources. Due to the fact that renewable energy resources are harmless, domestic and inexhaustible resources, they gained popularity especially after the emergence of sustainable development concept in 1980s. In table 44 The CO_2 emission of the energy resources were given.

Table 44: Carbon Dioxide Emissions Per kWh of Energy Sources

Energy Resource	Carbon Dioxide Emission (gram)
Coal	900-1200
Oil	700-900
Natural Gas	350-900
Nuclear	10-30
Solar	0
Wind	0
Hydraulic	0

Resource: MENR, Energy Resources, 2014

In terms of environmental sustainability, the renewable energy has an unchallenged superiority against the fossil based resources. Because, in order to produce 1 kWh energy, the coal cause 900-1.200 gram emission, oil 700-900 gram and natural gas 350-900 gram emission. However, the renewable energy resources do not produce any carbon emission or their emissions are very little and at the tolerable level, when they are generating energy.

Although some of the writers criticize the hydraulic and wind energy for their harm to environment, such as migratory bird death and noise, they are not permanent effects. In addition, their side effects are very little compared to fossil based resources and today lots of the harmful effect of these two resources can be eliminated.

In table 45 the remaining economic capacity of renewable energy of Turkey and their contribution to the emission reduction was calculated. Since most of the houses are heated

by natural gas and nearly half of the electricity production is made by using the natural gas, we took the average value of natural gas emission (natural gas' emission is changing between the 350-900/gr emission per 1 kWh electricity) as 625 gr/1 kWh, while calculating the emission reduction. Besides, State Planning Organization showed that 1.000.000 residential can be economically heated by using geothermal energy in Turkey. If the 100.000 residential are heated by geothermal energy, nearly equivalent of 1.000.000 tons of carbon dioxide emissions can be prevented and this number is equal to the emission of the 600.000 vehicles. (DPT, 2001a: 46). Therefore, we took the geothermal energy, used in residential and the vehicle's emission in our calculation.

Table 45: Emission Contribution of Remaining Economic Capacity of Renewable Energy

	Total Economic Potential (MW)	Installed Capacity (MW)	Installed Capacity Ratio (%)	Remaining Capacity (%)	Efficiency of Energy Sources (%)	Producible Energy Quantity From Remaining Capacity	Emission Contribution (million tons)
Hydraulic Power	36.000	23.455	65	35	45-90*	65.7 TWh	41.06
Solar Energy (1) (TMEC)	287.000	20	0.00007	99.9	10-20	400 TWh	250
Solar Energy (2) (MENR)	50.000	20	0.00007	99.9	10-20	65.7 TWh	41.06
Wind Energy	48.000	3.484	7.25	92.75	30-35	118 TWh	73.75
Geothermal Energy (Electricity)	600	358.4	59.7	40.3	84	1.8 TWh	1.12
Geothermal Energy* (Heating Residential)	1.000.000	100.000	10	900.000	-	-	9
Biomass Energy (modern)	2.000	293.5	14.7	85.3	80	12 TWh	7.5
TOTAL						**263.2-597.5 TWh**	**173.5-382.44**

Resource: This table was prepared by us according to the latest data of natural gas cost, remaining capacity, and efficiency ratio of renewable energy resources under the current technological level.

***** Average efficiency is taken 60 %, ****** (1) TMEC: 287.000, **** (**2) MENR 50.000 *** 1 TWh is equal to 1 billion kWh **** Average emission of natural gas is taken as 625 gr/kWh in our calculation.

According to the table 45, by using remaining the economic (or feasible) capacity of renewable energy resources in Turkey, at least 173.5 million tons of carbon dioxide emission can be prevented. This number is equal to the 108.000.000 vehicles' emission. With the contribution of the other renewables, used both in electricity production and heating, the carbon dioxide emission can be decreased significantly. All of these situations

support our first hypothesis that renewable energy investment can contribute the ecological sustainability of Turkey.

As it can be seen from table 45, in terms of environmental sustainability, Turkey should increase renewable energy investment and its share in total energy supply. Because, our country is the 13th country in the carbon emission in the world and it has the highest emission increase ratio in the world between the 1990-2010 years. To fulfill the obligation of Kyoto Protocol, Turkey has to find new and clean energy resources.

Comparing with the EU countries Turkey's renewable energy potential is very substantial. The solar, winds, geothermal and hydraulic energy potential of country can contribute its sustainable development in term of environmental sustainability. They are not only clean but also domestic and do not have side effect like being fossil based resources. Therefore, renewable potential of Turkey should be evaluated as soon as possible. To increase renewable energy investment is not only necessity but also obligatory for our country to fulfill its international obligation and to protect its environment.

5.2. Renewable Energy Investment and Current Account Deficit Analysis

In order to make clear analysis, efficiency, capacity factors, initial investment and operating and maintenance cost of energy plants should be examined. Because, even if a plant's initial investment cost is low, the fuel cost or efficiency problem can make it more expensive than other resources. Therefore, while analyzing the renewable energy resources we have to consider the all aspect of the renewables.

In table 46 the capacity factor, initial investment cost and unit energy production cost of energy plants were given. Capacity factor defines the energy production ratio of plants in a given period when they are working in full capacity. In other words, it describes the efficiency of each power plant. Among the all power plants the highest capacity factor belongs to nuclear, natural gas and geothermal plants with 95 % and 90 % efficiency respectively.

Table 46: The Capacity, Unit Energy Production and Initial Investment Cost of Power Plants

Plants Types	Domestic/ Foreign Input	Capacity Factor (%)	Initial investment cost ($/kW)	Unit cost of energy production (cent/kWh)
Natural Gas Plants	Foreign input	85-90	500-1,300	3.6-10.6
Thermal Plants (Lignite)	Domestic	50-85	2,000-3,000	4.6-12.0
Thermal Plants (Imported coal)	Foreign input	50-85	1,500-2,500	4.5-8.8
Hydroelectric Plants	Domestic	30-45	1,900-2,600	2.7-3.5
Nuclear Plants	Domestic/ Foreign	85-95	2,500-5,000	3.0-8.2
Winds	Domestic	25-45	1,200-2,500	5.1-14.6
Geothermal Energy	Domestic	80-90	1,700-4,000	3.3-4.0
Solar Photovoltaic Plants	Domestic	10-25	4,000-8,000	12.3-24.5
Biomass	Domestic	80-90	2,000-3,500	4.8-8.0

Resource: MENR, Energy Resources, 2008

Currently, the highest initial investment cost belongs to the solar power and nuclear power with (4.000-8000 $/kW) and (2,500-5,000 $/kW) respectively. Unit cost of energy production calculated by adding the initial investment cost of each power plants to the total producible electricity. For instance, if the economic life of the power plants is 20 years, the initial investment cost is added to the total electricity amount that can be produced in the economic life of the plants. The more expensive electricity can be obtained from solar power since solar PV plants can be worked only in day time. Their efficiency is changing between the 10-25 %.

The initial investment and production cost of wind energy is close to fossil based power plants. However, except for the wind energy, initial investment cost of renewables is relatively higher than fossil based resources. Although the initial cost of hydraulic is relatively high, with the effect of the zero fuel and low operating & maintenance cost, it has the cheapest production cost of electricity among the all power plants. Since the capacity factors of almost all renewables depend on the climatic condition, the efficiency of them is generally lower than thermic plants. Nevertheless, the technologic innovation started to overcome the efficiency problem of renewables. It is estimated that efficiency and production capacity of renewable can compete with the fossil based resources in near future.

Although the efficiency of renewables is low and initial investment cost is high, they have nearly no fuel cost. In case of the foreign dependency, fuel cost of the power plants should also be taken into account more carefully. Because, the security risk of foreign input and long term effects of the imported inputs on current account balance may be more important than the initial investment cost. Beside these, with the development of technology, the cost of renewables has been decreasing steadily. In the next two decades, it is estimated that the cost of renewables will decrease more than 50 %.

In table 47, fuel, operating and maintenance (O&M) cost of energy plants are given comparatively. Among the all power plants, the natural gas has the highest fuel cost with 3.6 $/cent, and it is followed by imported coal energy plants, lignite plants and nuclear power with the 1.96 $/cent, 1.84 $/cent and 1.00 $/cent respectively.

Compared to fossil based plants, the operation and maintenance cost of some renewables, solar and geothermal, are a little higher. Nonetheless, relatively high O&M costs are offset by the absence of fuel costs in renewables. In addition, the share of operating-maintenance cost in the total production of electricity is very little (Changing between 10-15 %) and can be kept constant for years. Besides, while the fuels are generally obtained from abroad, the maintenance and operation services can be provided from inside the country. In other words, foreign dependency of the operating and maintenance cost of renewables is very little. Therefore, they are domestic and they cannot affect the balance of payment.

Table 47: Operating-Maintenance and Fuel Costs of Power Plants

Plants Types	**Operating-Maintanance Cost (cent/kWh)**	**Fuel Cost (cent/kWh)**
Natural gas	0.415	3.60
Thermic Plants (Lignite)	1.495	1.84
Thermic Plants (import coal)	1.413	1.96
Hydroelectric Plants	0.203	0
Nuclear Power	0.780	1.000
Winds	1.2	0
Geothermal	1.8	0
Solar (Photovoltaic)	1.6	0

Resource: MENR, Energy Resources, 2008

In table 48, the effects of the fuel cost of energy plants in case of any price shocks was shown. According to this table, the share of fuel in total cost of the electricity production for coal, natural gas and nuclear power is 77 %, 90 % and 30 % respectively. In any price shock, such as 2-fold increase in fuel price, the cost of electricity will increase 66 % in natural gas, and 31 % in coal plants. This situation shows that the fossil based resources are open to the price shock risk of the producer countries. However, since renewables does not need any fuel, they cannot be affected from exogenous price shock of fossil based resources.

Table 48:The Share of Fuel in Operating Cost and Changes When the Fuel Cost Increase

Fuel Type	Operating and Maintenance	Fuel	Change in the Production Cost of Electricity When the Fuel Price Doubled
Coal	% 23	% 77	% 31 increase
Natural Gas	% 10	% 90	% 66 increase
Nuclear	% 70	% 30	% 9 increase

Resource: MENR, Energy Resources, 2008

After showing the capacity factor, initial investment and operating and maintenance cost of the renewables, we can analysis whether current and remaining economic potential of renewable energy resources of Turkey can be solution to the energy dependency and current account deficit problem of our country.

Installed capacity of Turkeys' renewable energy was 23.455 MW in Hydraulic energy, 20 MW in solar energy, 3.484 MW in wind energy, 358.4 MW in geothermal energy and 293,5 MW in biomass energy. Although the share of hydro is bigger than natural gas' installed capacity, because of the effects of the drought and efficiency problem, only 24.7 % of electricity was produced from hydraulic energy in 2013. As mentioned before, efficiency problem is also lived in other renewable energy resources. The efficiency of solar power is changing between the 10-25 %, wind power 30-35 %, geothermal 90 %, biogas 60 %. Therefore, while calculating the producible electricity, energy efficiency of the each energy resources should be taken into account.

In table 49, the installed capacity and economic potential of renewable energies are shown as of September 2014. According to this table, Turkeys' hydraulic installed capacity reached to 65 % in terms of economic potential. However, technical potential of hydraulic energy is higher than economic potential and Turkey only used 37.1 % of its technical potential. In USA, Canada and other developed countries, the ratio of technical potential (not economical) reached to 90 %. Comparing to developed countries it can be said that there are lots of ways to be covered. With the technologic development and price increase in fossil based resources, some of the technical potential will become economical for Turkey. However, since our calculation is based on current technology and price level, we omitted the technical potential and made our calculation according to the economic potential of renewable energies.

Since Turkeys' natural gas purchase price was changing between the 350-450 dollars/ 1000 m^3 in 2013, we took the lowest price \$ 350/1000 m^3. 1 kWh electricity can be produced by using 0.212 m^3 natural gas. With the 1000 m^3 imported natural gas, at about 200 kWh electricity can be produced and 350 dollars are paid for this natural gas import (WEC, 2013).

According to these calculations, made under the above mentioned assumptions, remaining economic renewable energy potential of Turkey is changing between the 263.2-597,5 TWh. The difference arises from the different estimation of solar energy by Ministry of Energy and Natural Resource and Turkish Mechanical Engineers Chamber. MENR calculated the economic potential of solar energy as 50.000 MW (MENR, 2010). Nevertheless, according to the study of TMEC, below the 38.5 parallel of country, 11.000 km^2 fields are suitable for the PV energy investment. Even if half of the these areas are used, under the 1.600 kWh/m^2 solar energy potential and 10 % efficiency assumption, at least 287.000 MW solar power plant can be established and 363 TWh electricity can be produced from these areas. If the unlicensed practices are added to this estimation, producible electricity reaches to 400 TWh. This amount is 1.65 times more than the 2013 electricity consumption of our country (TMEC, 2013:145-148). Therefore we made our calculation by taking both of the assumptions.

As mentioned, to produce 1 kWh electricity, 0.212 m³ natural gas is used. So, according to the MENR assumption, the needed natural gas for 263.2 TWh electricity is 55.79 billion m³. Even if we take the minimum price as 350 dollars for 1.000 m³ natural gas, the needed money for the importation of this amount of natural gas is found as 18.43 billion dollars.

263 billion kWh * 0.212 =55.79 billion m³ natural gas
55.79 billion m³ natural gas * 350/1000 =19,53 Billion dollars.

When Turkish Mechanical Engineers Chamber's estimation is taken:
597.5 Billion kWh *0.212 = 126.67 Billion m³ natural gas
126.67 billion m³ natural gas * 350/1000 = 44,33 Billion dollars

Table 49: Remaining Economic Capacity of Renewable Energy in Turkey as of 2014

	Total Economic Potential (MW)	Installed Capacity (MW)	Installed Capacity Ratio (%)	Remaining Capacity (%)	Efficiency of Energy Sources (%)	Producible Energy Quantity From Remaining Capacity	Monetary Value of Producible Energy (Billion Dollars)
Hydraulic Power	36.000	23.455	65	35	45-90*	65.7 TWh	4.6
Solar Energy (1) (TMEC)	287.000	20	0.00007	99.9	10-20	400 TWh	28
Solar Energy (2) (MENR)	50.000	20	0.00007	99.9	10-20	65.7 TWh	4.6*
Wind Energy	48.000	3.484	7.25	92.75	30-35	118 TWh	8.26
Geothermal Energy (Electricity)	600	358.4	59.7	40.3	84	1.8 TWh	0.13
Biomass Energy (modern)	2.000	293.5	14.7	85.3	80	12 TWh	0.84
TOTAL						**263.2-597.5 TWh**	**19.53-44.33**

Resource: This table was prepared by us according to the latest data of natural gas cost, remaining capacity, and efficiency ratio of renewable energy resources under the current technological level.
* Average efficiency is taken 60 %, ** (1) TMEC: 287.000, ** (2) MENR 50.000, *** 1 TWh is equal to 1 billion kWh

In other words, Turkey can produce between the 1,07-2,5-fold of current electricity consumption by using the remaining economic capacity of renewable energy resources. The monetary value of this electricity is changing between the 19.53 and 44.33 billion dollars. In our calculation, the minimum efficiency value of each renewable energy resources are taken into account under the current technologic conditions. Therefore, in case of the favorable weather conditions and with the development of the new technology, producible electricity quantity can be much bigger than our calculation. Moreover, these

calculations cover only economical available value of remaining renewable energy resource. With the current consumption level, the fossil based resources will be more expensive in near future and some of the technical potential of the renewable energy resources will become economic for the investors. Hence, producible energy can be higher than our calculation when the technical potential of the renewable energy becomes economic for the country.

When we look at the above picture, we can say that renewable energy resources can meet all of the electricity needs of Turkey and decrease the current account deficit. However, there are some weaknesses of the renewable energy resources. First of all, renewable energy resources are highly depends on the climatic conditions and efficiency of them can be decreased or completely stopped in case of the bad weather conditions. For example, because of the drought, the capacity of the hydraulic energy cannot be used effectively in 2013. Secondly, harmonization of the demand and supply may be problem especially for wind and solar powers, because the highest energy production is made in summer but the highest energy demand is made in winter. Since the electricity cannot be storable, to harmonize the supply and demand is very important. Lastly, power problem of the some renewable energy resources, such as wind energy, may affect the quality of electricity and creates network problems and give harm to the electricity appliance of the users. Therefore, in order to harmonize the supply and demand equilibrium and stabilize the some of the deficiency of the renewable energy resource, the renewables must be supported by other energy resources, such as coal, nuclear and thermal plants.

Beside these, even if Turkey can succeed to evaluate all of its renewable energy potential at the maximum efficiency ratio, it cannot be enough to completely reset its current account deficit in energy side. Because, the large part of energy imports is made for the transportation sector's usage. Today, nearly 60 % of energy import is used by transportation sector and around the 34 billion dollars were paid for this import. In other words, even if we succeed to terminate the imported energy consumption in heating and electricity, the contribution of these will be around the 21 billion dollars (table 50).

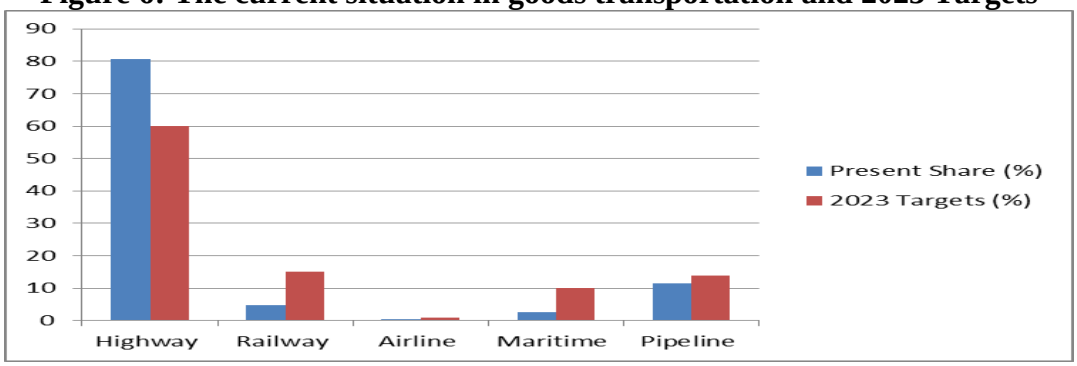
Table 50: The Share of Transportation Sector in Total Energy Import

	Total İmport (Billion $)	Energy Import (Billion $)	Transportation (Billion $)	The Share of Transportation Sector in Total Energy Import (%)	Energy Import (Billion $)	The Share of Energy Sector in Total Energy Import (%)
2002	51,5	9,20	5,41	58,80	3,79	41,20
2003	69,3	11,58	6,58	56,82	5,00	43,18
2004	97,5	14,41	8,64	59,96	5,77	40,04
2005	116,7	21,26	12,41	58,37	8,85	41,63
2006	139,5	28,86	16,61	57,55	12,25	42,45
2007	170,1	33,88	19,34	57,08	14,54	42,92
2008	201,9	48,28	27,03	55,99	21,25	44,01
2009	140,9	29,91	15,17	50,72	14,74	49,28
2010	185,5	38,49	21,03	54,64	17,46	45,36
2011	240,8	54,1	33,6	62,11	20,50	37,89

Resource: Turkish Mechanical Engineers Chamber (TMEC), 2013.

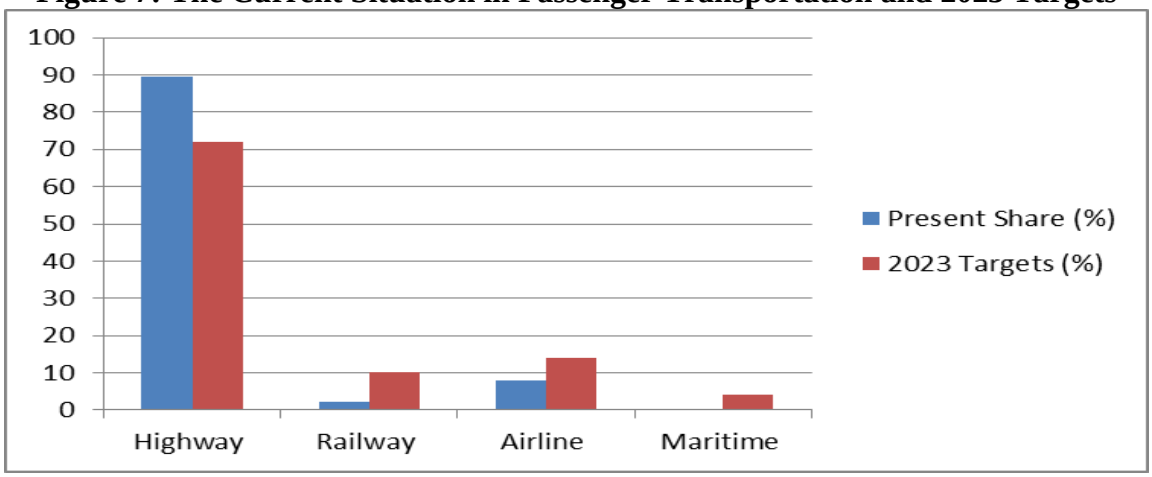
According to the data of Ministry of Transport, Maritime Affairs and Communications (MTMAC), the share of highway in load and passenger transportation is 80.63 % and 89.59 % respectively. The Ministry of Transportation prepared a strategic plan to decrease the weight of highway both in load and passenger transportation. Today, the high-speed railway network has been increasing steadily in intercity passenger transportation and underground project has been completed especially in metropolitan cities. It is expected that with the contribution of the high-speed trains and undergrounds, the share of railway in the passenger transportation will increase 5 times from 2.2 % to 10 % in 2023. In order to decrease Turkeys' dependency to foreign energy resources, the share of railway, maritime and airline should be increased. Unless the share of highway was decreased both intercity and inner city transportation, desired contribution cannot be provided by the renewable energy resources in energy import.

Figure 6: The current situation in goods transportation and 2023 Targets



Resource: Ministry of Transport, Maritime Affairs and Communications

Figure 7: The Current Situation in Passenger Transportation and 2023 Targets



Resource: Ministry of Transport, Maritime Affairs and Communications

The result of our findings supports our second hypothesis: renewable energy investment can help to decrease the current account deficit. With the evaluation of remaining renewable energy resources, at least 19.53 billion dollars can be saved and this amount can be increased up to 44.33 billion dollars. Current account deficit can be decreased at the same amount.

In conclusion, the renewable energy investment can contribute the sustainable development, energy security, current account balance and economic and social stability of our country. Since nearly all of the economic crises are directly or indirectly related with the current account deficit, renewable energy can reduce the crisis risk of the country and support the social stability of the country. Dependency of foreign energy resources can be decreased and this situation also contributes the security of energy supply and protection of the environment. However, unless the energy needs in transportation sector are decreased by increasing efficiency and/or decreasing the share of highway, the desired result cannot be obtained. Therefore, the energy policy should be taken in integrity and must be created to include the transportation sector and energy efficiency. Otherwise, the impact of the renewable energy investment will be limited and desired yield cannot be produced.

5.3. Economical Sustainability and Social Stability Analysis of Renewables

Energy is one of the fundamental inputs of the economic and social development of the societies. Its consumption has been increasing parallel with the population and economic

growth. Since the establishment of the Republic, population, GDP and energy consumption of Turkey have been growing steadily. In table 51 energy, population and economic situation of Turkey between 1973-2013 were summarized.

Table 51: Population, Economy and Energy Situation of Turkey Between 1973-2013

	Population (*1000)	GDP Billion $ (1990 Prices)	GDP Per Capita $	Energy Demand (MTEP)	Electricity Consumption (TWh)	Energy Demand Per Capita	Electricity Demand Per Capita (kWh/Person
1973	38.072	76	1,994	24.6	12.4	646	326
1990	56.098	150	2,674	53.7	56.8	957	1,013
1995	62.171	178	2,861	64.6	85.6	1,039	1,376
2000	67.804	214	3,158	82.6	128.3	1,218	1,892
2005	71.000	212	2,986	90.1	132.7	1,254	1,849
2010	73.722	732	10.079	105.13	211.21	1,426	2,864
2013	76.667	823	10.807	122.79	245.48	1.601	3.201

Resource: TurkStat, Statistical Indicators, 2014

As it can be seen from above table, the population of Turkey was 38 million in 1973, and it increased more than 2-fold and reached to 76.7 million at the end of the 2013. However, the primary energy and electricity consumption increased 5 times and 20 times respectively in last 40 years. In other words, energy and electricity consumption increase ratio of Turkey is higher than its GDP and population increase. Since Turkey does not have enough domestic resources, energy demand has been met by the import of fossil based energy resources. As a result, while the economy and population were growing, the energy consumption also grew and the balance of payment deteriorated. Because nearly 91 % of oil and 98.5 % natural gas and 12 % of coal, which is used in coal thermal plants, were imported in Turkey.

As of 2013, Turkey exported 151.8 billion dollars commodity and imported 251.66 billion dollars goods and services. The trade deficit was realized as 99.8 billion dollars. However, with the help of the tourism and other service sector's revenues, the current account deficit realized as 65.1 billion dollars. In the same year, Turkey's energy import was 55.9 billion dollars and the share of energy in the total import was 22.2 %. With this level, energy import constitutes the 85.9 % of the current account deficit and 56 % of trade deficit. In other words, when the energy import was excluded, Turkeys' current account balance can be sustainable without meeting any problem. Therefore, in order to decrease the current

account deficit, it is necessary to find an urgent solution to the energy dependency of Turkey. In table 52, last eleven years current account balance and energy imports and their share were given.

Table 52:Energy Import and Its Share in Total Import and Current Account Deficit

Years	Energy Import (Billion $)	Total Import	The Share of Energy Import in Total İmport (%)	Current Account Deficit (Billion $)	The Share of Energy Import in Current Account Deficit %	Current Account Balance Excluding Energy Costs (Billion $)
2003	11.528	69.340	16,6	7.554	152.6	3.974,00
2004	14.384	97.540	14,7	14.198	101.3	186,00
2005	21.226	116.774	18,2	21.449	99	-223,00
2006	28.828	139.576	20,7	31.836	90.5	-3.008,00
2007	33.846	170.063	19,9	37.781	89.5	-3.935,00
2008	48.252	201.964	23,9	40.372	119.5	7.880,00
2009	29.889	140.928	21,2	12.124	246.5	17.765,00
2010	38.467	185.544	20,7	45.420	84.6	-6.953,00
2011	53.999	240.842	22,4	75.082	71.9	-21.083,00
2012	60.117	236.537	25,3	48.497	124	11.620,00
2013	55.915	251.661	22.2	65.066	85.9	-9.151,00

Resource: TurkStat, Statistical Indicators, 2014.

Since the establishment of the Republic, Turkey has been confronting with current account balance and energy deficit problems. When we examine the current account balance outlook of Turkey in above table, we see that except for the energy import, Turkeys' current account balance can be sustainable and even sometimes it gives surplus. Apart from energy import, current account balance of our country can be positive five times, (in 2003, 2004, 2008, 2009 and 2012), with the contribution of the tourism revenues in last eleven years.

As mentioned in above chapters, there is a very strong correlation between the current account deficit, economic crisis and social stability of Turkey. Throughout the history of the Republic, Turkey experienced 15 economic crises and without any exception, all of the crises ended with the devaluation of the currency. In other words, nearly all of the economic crises are directly or indirectly related with current account deficit in the Republic history. As a result of these economic crises, lots of people lost their jobs, social stability was deteriorated and some of them ended with the military intervention. In table

53 the reasons, effects and results of the economic crises in republic periods are summarized.

Table 53: Reasons, Effects and Result of the Economic Crises in Turkey

	Economic Crises	Reason of Crises	Effects of the Crises	Results of the Crises
1	**1929**	Great depression, high current account deficit.	TL was devaluated	Statism was implemented and production structure of the economy changed.
2	**1948**	High budget and current account deficit	TL was devaluated	The government changed in the first election.
3	**1954**	High budget, current account deficit and high foreign debts	TL was devaluated	Some social turbulence was lived.
4	**1958**	High budget and current account deficit and high foreign debts	TL was devaluated	Some social turbulence was lived in Turkey and the first coup of the Turkish republic was done by Turkish Armed Forces in 1960.
5	**1969**	High budget and current account deficit	TL was devaluated	Some social turbulence was lived in Turkey and the second coup of the Turkish Republic was done by Turkish Armed Forces in 1971.
6	**1974**	Energy prices shocks, high current account and budget deficit.	TL was devaluated	Some social turbulence was lived and political instability was experienced.
7	**1978**	Populist public expenditures, public debts and high imports.	TL was devaluated	Some social turbulence was lived and political instability was experienced.
8	**1979-1980**	Oil crisis and high current account and budget deficit.	TL was devaluated	Some social turbulence was lived in Turkey and the third coup of Turkish Republic was done by Turkish Armed Forces in 1980. With the 24 January decision the import substitution policy was given up.
9	**1986**	High current account deficit and budget deficit.	TL was devaluated	There was no clear effect of the crisis on social or political life.
10	**1989**	High current account deficit and budget deficit.	TL was devaluated	There was no clear effect of the crisis on social or political life, however Turkish capital market was liberalized in 1989.
11	**1991**	High current account deficit and budget deficit.	TL was devaluated	The government changed the coalition periods were lived in Turkey.
12	**1994**	High current account deficit and budget deficit.	TL was devaluated	There was no clear effect of the crisis on social or political life but nearly 500.000 persons lost their jobs. Turkey was governed by coalitions for years
13	**1999**	Asian and Russian economic crisis and earthquake.	TL was devaluated	Because of the crisis and earthquake the social life was affected deeply.
14	**2001**	High current account deficit and budget deficit. Wrong prescription of IMF	TL was devaluated	The government changed in the first election and all of the coalition partners collapsed.
15	**2008**	Global economic crisis and decrease in demand in foreign markets.	Economic growth realized as (-4.7 %)	There was no clear effect of the crisis on social or political life.

Resource: Prepared by us by examining the economic crises of Turkey.

When we examine the table 53, we see that apart from 2008 crises, all of the crises are related with the economic structure of our country. Three of the economic crises, 1958, 1969 and 1979, ended with military intervention and 7 of them caused serious social turbulence and 2 of them, 1929 and 1979-80, changed the economic structure of the country. In the multiparty period, with the effect of the economic crisis, political parties, which were governing the country until the election, were pushed to the background in political life, like being in 2001 crisis. In short, economic crises affect the Turkish economy deeply and cause serious social and political changes in the country. Therefore, it can be said that there is a direct correlation between the economic crises and social and political stability in Turkey.

Economic structure of the country, however, depends on the foreign resources. Because of the lack of capital accumulation and high energy needs, Turkey has to borrow to finance its investment and energy expenditure by attracting foreign resources. Since the production structure of Turkey depended on imported input, the contribution of export is very limited compared to previous periods. As a result of the globalization and internationalization of the production process, the dependency of the countries in manufacturing sector was increased enormously. In order to produce and export their goods, the companies have to import at least some part of the final product from other countries, where the needed intermediate goods can be obtained at a cheapest price. Otherwise, the companies cannot compete in the international market.

Compared to developed countries, population of Turkey is very young, and the domestic demand of our country is higher than those countries. Therefore, even if the companies work on export sector, when they sell their goods inside the country, the current account deficit are affected negatively from this situation. Since the foreign dependency of the manufacturing sector is more than 75 %, when the companies sell more than 25 % of their goods inside the country, the current account balance gives deficit.

The situation of energy trade is worse than other commodity trade, because the energy import is the net import of the country due to the lack of domestic fossil based resources. In other words, while some of the other produced goods can be exported, the energy import

is largely consumed inside the country and creates the rigidity in current account deficit. Nearly all of the energy import is the “net import” of the country. However, since the energy is indispensable source of economic development, Turkey has to find a way to obtain its energy needs reliable and at an affordable price. In order to do this, domestic resources, both renewable and non-renewables, must be evaluated as soon as possible.

Turkey does not have enough oil and natural gas reserves but its coal and renewable energy potential is at a satisfactory amount. Nonetheless, Turkey cannot evaluate its domestic resources effectively. Today, nearly 65 % of hydraulic power, 7.25 % of wind energy, 59.7 % of geothermal energy and very small part of solar energy have been evaluating for the electricity production in Turkey. These ratio are the only economically potential of Turkey. In the technical side, the share of hydraulic decreased to 37 % in hydraulic, 4 % in wind 17 % in geothermal.

Turkey consumed 245 billion kWh electricity in 2013. 239.497 GWh of this consumption was produced in Turkey from different kinds of resources, 7.425 GWh electricity was imported and 1.235 GWh electricity was exported. The share of natural gas is nearly 44 % in 2013 and with the effect of the drought, this share rose to the 48 % as of September. Besides, the share of imported coal was nearly 12 % in electricity production and 3 % of electricity was directly imported from abroad. Today, nearly 75 % of primary energy and 59 % of electricity needs are met by imported energy inputs or direct electricity import in Turkey.

Sustainability comprises the economic, environmental and social development of the countries. Sustainable energy, which is the sub branch of sustainable development, includes provision of energy in a secure way, at an affordable price and in an uninterrupted manner. To maintain security, the country should meet their energy needs by using domestic resources or by diversifying the energy supply. Although Turkey cannot meet its oil needs from domestic resources, our country’s oil import is relatively diversified compared to natural gas. Turkey has been buying oil more than six different countries and neither of these countries have a dominant share in the oil import.

However, today, nearly 48 % of electricity was produced by using the natural gas. Turkeys' natural gas import composition was also very unbalanced because it is largely depended on Russia (nearly 58 %). Iran came in the second place in natural gas import and these two countries meet the 75 % of natural gas needs of our country. Due to the high dependency to these two countries, especially to Russia, natural gas supply of Turkey is under the risk. In case of any political dispute, like being in Ukraine and Syria, or technical problem, as experienced with Iran in recent years, natural gas supply can be interrupted by directly supplier countries or transition countries. In addition, the supplier countries may use the energy as a weapon against our country and this situation may threat the national security and international benefits of our country. Turkey experienced to these two risks with Russia in the Russia-Ukraine crisis and at the civil war Syria with Iran. Therefore, to increase sustainability in terms of security of energy supply and to decrease the high dependency to one energy resource and one country's energy supply, Turkey has to take precautions in natural gas energy field.

As it can be understood from above mentioned situation, the current economic situation of Turkey mainly depends on the foreign inputs and foreign energy resources. The distribution of primary and secondary energy supply is not balanced and this situation directly threats the economic independence and energy security of the country. High dependency to foreign inputs and foreign energy resources increase the current account deficit of the country. Since all of the economic crises lived in republic era are directly or indirectly related with the current account deficit, the structure of the country makes it vulnerable against the energy and economic crises. As seen in table 53, the economic crises cause serious social and political changes in the country. Therefore, our finding supports our third hypothesis that renewable energy investment can contribute economic, social and political stability of country by maintaining energy security, decreasing the foreign dependency and current account deficit in the economic structure.

The government understood the importance of the domestic resources in energy area and prepared a new strategic plan to decrease the dependency to foreign energy resources. According to this plan the share of natural gas in electricity production will be decreased to 30 % by the year 2023. At the same time, the share of renewables will be increased at least

30 % at the same year. If this target can be succeeded, the energy security can be maintained, dependency to foreign resources can be decreased and current account deficit can be limited at a sustainable level. As a result, the economy will become more reliable against external shocks and social stability can be provided easily.

5.4. Summary:

In this chapter, the effects of the renewable energy investment on environment, economic and social stability and current account deficit were analyzed. While analyzing the each topic, the data described in the previous section has been used. Some basic calculations were made to find the monetary value of the contribution of the renewable energy resources. In the conclusion section, all of the study finding will be evaluated.

CONCLUSION:

Energy is one of the most important items of the social, economic and cultural development in contemporary world. Since the industrial revolution, energy dependency of the human being has been increasing steadily. In order to develop, communicate, transport, produce goods and services, and to maintain social wellbeing of human beings, modern people need more energy than before. Therefore, despite the serious nuclear power accidents, side effects of the fossil based resources and financial crisis, living since 2008, the demand for energy has been continuing to increase.

Economic growth, demographic effects and technology play the main role at the demand increase. Among the all factors, the economic factors are the most important factors in energy demand increase. According to the result of investigations, there is a strong correlation between the economic growth and energy usage of the countries. Therefore, IEA takes into account the IMF and World Bank's predictions about the economic growth of the countries while preparing its energy projections.

Although some of the technologic developments decrease the energy usage of electricity appliance, their overall effect is to increase the dependency of human being to the energy, especially electricity. For example, today the televisions and other home appliance use less energy than before but, the big led television became indispensable item of the social life. Like being television, the pocket cells became an essential need of modern man. In other words, while energy efficient equipment are decreasing the energy usage, innovations in technology can make people addicted to these new technology and this situation may increase the energy demand of the global world.

The world's energy needs have been mainly met by the fossil based energy resources, which are limited and the reserves have been decreasing continuously. When we look at the composition of the world energy supply, nearly 87 % of total energy supply is provided by fossil based resources. Therefore, in a very short period of time the fossil based

resources cannot meet the total energy demand of the world. According to the IEA data, with the current demand and reserve level, the life of the fossil based resources is estimated as 50 years for oil, 56 years for natural gas and 140 years for the coal. The total global energy demand will increase at a ratio of 1.2 % between the 2010-2035 time periods. In spite of the fact that the share of the fossil based resources will decrease 82 % in 2035, the global energy demand will be 17.2 billion TEP and fossil based resources will protect their dominant position in the world energy demand in the next 20 years.

Being limited and not homogeneously distributed in the world, the price of the fossil based energy resources is not stable and sometimes this instability may cause severe economic crisis in the world. Because of the disputes between the countries or political instability, like being Arab Spring, the energy supply can be interrupted very easily. In other words, the limited resources are affected both by supply-demand equilibrium and political situation of the producer countries. Since the sensitivity of energy price towards the energy security is very high, both developed and developing countries can be affected negatively from the interruption of the energy supply.

As a result of huge dependency of world economies to the fossil based energy, the countries try to find reliable and cheap energy supply to maintain sustainable development and to increase the welfare of the citizens. Hence, it can be said that in contemporary world, the energy play more important role in international relations than before and today's political games are played on keeping the reliable and cheap energy supplies in control. Beside these, the countries have been trying to evaluate their domestic resources and diversify their energy supply to guarantee energy supply. Today, diversification of the energy supply, investigation of new and domestic energy resources, development of the new energy efficient technologies, and usage of the renewable energy resources become priority of the world countries in the energy issue.

Apart from supply, price and security problems, today the global warming effects and environmental concerns of fossil based sources are revealed more apparently. In other words, excess use of fossil based resources caused the environmental problem in global scale. In last century, the world's energy consumption increased 17-fold and CO_2 and

harmful emission produced by fossil based resources increased at the same amount. As a result, global warming, climatic changes, and environmental pollution have been discussed in every society and their effects have been felt more in every passing day.

Until the 1970s, no one questioned the sustainability of the development in the world. After industrial revolution, the world countries entered into the rapid development and economic growth period. For the classical economists the water, air and other natural resources were assumed as the unlimited. They saw natural resources as free goods and the only way of development was seen as the growth of the economy with production increase. Therefore, they did not pay attention to the environment. They claimed that industrialization and production increase would eventually result in the environmental pollution, but environmental effect of the development is temporary and in the long run the pollution will decrease with the technologic development.

The classics neglected not only environment but also human resources in the concept of the development. They did not deal with the health, education or social development of the society. Their only criteria for development are the production increase in the economy. Therefore, in order to heal wounds of the wars and increase the national income, the world countries focus on the economic growth and international trade especially after mid of the 20^{th} century.

In later years, however, due to the effects of the encountered environmental damage, understanding of economic growth as the per capita increase in national income was started to be criticized. With the beginning of the 1970 the scientist started to question the limits of the growth. The report, *"Limits to Growth"*, which was prepared by Rome Clubs, was the beginning of this discussion. According to this report, the natural resources cannot meet the rapid population growth and in 150 years the world will lose its habitable property.

With the effect of the Rome Club, the development of society is accepted not only in economic term but also in social, human, and environmental terms. In this context, the traditional concept of development has undergone significant criticism and change. As a

result, the development concept is being addressed in a comprehensive manner including the environment, natural resources and human beings. Thus, a multi-dimensional concept of "sustainable development" has emerged.

With the simplest words, the sustainable development can be defined as to meet the needs of the current and future generations without exhausting natural resources by establishing a balance between nature and human beings. In other words, development can only be acceptable as the sustainable development, if it meets both present generation needs without giving any harm to the future generation. Sustainable development brings the equality between the present and future generation in the usage of the natural resources and investment orientation.

Sustainable development is a concept that has social, economic, ecological and cultural dimension. Social dimension focuses mainly on human beings and deals with participation, social mobility, social cohesion, cultural identity and institutional development of the people. Economic sustainability focuses on economic growth, distribution of income and efficiency in economic factors. Ecological dimension, on the other and, deals with the protection of ecological systems, biodiversity and global issues like global warming.

There is a close relationship between the sustainable development and energy. Therefore, sustainable development policies should be considered in conjunction with sustainable energy policy. Sustainable energy is the production and use of energy resources in ways that promote long-term human wellbeing and ecological balance. The main objectives of the sustainable energy policies are the protection of ecology, management of natural resources and provide energy security.

Sustainable energy policy consists of all policies, technologies and implementations that provide our energy requirement with a minimum cost on environment, society and economy. To alleviate poverty, promote economic growth and improve social development, energy plays a crucial role. Sustainable energy policies try to increase efficiency of energy use and aim to decrease fossil based energy usage, as this kind of energy causes environmental problems at local, national and global scale. It supports

technological development to promote the efficiency of the energy production and consumption. Briefly, the goals of sustainable development and sustainable energy intersect with each other.

Fossil based resources, such as coal, oil and natural gas, are the nonrenewable resources and they have been consumed since discovery day of them. They have been diminishing in everyday and they cannot be replaced in a very short period of time. Besides, excessive consumption of this resources cause the environmental pollution, climate change, and global warming in the world. As a result of these side effects, the diseases have been increasing, the species are decreasing or completely disappearing, the floods and drought become widespread in the world. Therefore, the energy policy depending on the fossil based resources cannot be named as sustainable.

Since the emergence of the sustainable development and global warming concepts, the human beings became more sensitive towards the climatic changes in the world. The use of the resources without exhausting them is the basis of the sustainable development. According to the ecologists, this situation can only be ensured when the usage of the natural resources do not exceed the annual increase rate of this natural resources. Being native, environmentally friendly, domestic and inexhaustible, and can be found almost in every country, the renewable energy resources can play a significant role on sustainable development, sustainable energy policy and security of energy supply in the world. Therefore, the renewable energy resources have been increasing their importance in contemporary world.

Today, human beings have been trying to obtain, secure, affordable, uninterrupted and environmentally friendly energy resources to meet their energy need. Hence, renewable energy usage becomes necessary not only for sustainable energy but also for sustainable development. Because energy, produced from renewables, does not leave any waste and they do not pollute the air. Moreover, the waste, such as burned fat, used paper etc, produced by people can be converted to the energy by using the renewable energy technology and this situation is also contribute the clean environment policy. Since they can be produced nearly in every region of the world, they are accepted as domestic and

reliable energy resources.

UN launched Sustainable Energy for All initiative and aimed to increase the share of renewable double by 2035. Apart from UN and IEA, EU also released the Renewable Energy Directive in 2009 and targeted to increase renewable energy share (covering the biofuels, electricity and heating) to 20 % in 2020. EU forced each member to prepare an action plan and regular progress report to ensure that their targets are met. Between the 2012 and 2035 years, 6.4 trillion dollars investment is required for renewable to reach the targets and nearly 94 % of this investment is needed only for power sector.

If the UN, IEA and EU can succeed their targets at renewable energy area in 2035, renewable energy investments contribute the world economy in several ways. First of all, in terms of environmental sustainability, the renewable energy has the unchallenged superiority against the fossil based resources. In order to produce 1 kWh energy, the coal cause 900-1.200 gram emission, oil 700-900 gram and natural gas 350-900 gram emission. However, the renewable energy resources do not produce any carbon emission or their emissions are very little or at the tolerable level. Therefore, they will reduce the CO2 emission 4.1 Giga tons (Gt) in 2035 and help the sustainable development of the global economy by decreasing the greenhouse effects of the fossil based resources. Moreover, they can reduce the stress on water resources in many place of the world with the help of the hydro dams.

Secondly, while they are reducing the air and water pollution, they also maintain the energy security by diversifying the energy supply. Since they are domestic resources, they help the reduction of the external dependency and protect countries from the price fluctuation of the international energy prices. These situations reinforce the countries against the price and supply shocks of crude oil. Thirdly, they lower the oil and gas imports bills of the countries and help to decrease current account deficit of the countries. Lastly, their operation and fuel cost is very low and therefore they can help to decrease the energy cost of global economy, especially for industry sector, and accelerate the economic growth in the world.

Despite the above mentioned advantages, the renewable energy resources are not able to become a major source in a global sense yet. One of the main reasons of this is the high initial investment cost of renewable energy sources. Although the cost of them has been decreasing gradually, they cannot compete with the fossil based sources yet. Today, the cost of onshore wind power can compete with fossil based resources in a few countries and close in several others. However, most of the renewable technologies cannot compete with fossil based technologies yet.

Comparing with fossil based resources, the efficiency of renewables is low and initial investment cost is high. However, they have nearly no fuel cost. Since renewables does not need any fuel, they cannot be affected from exogenous price shock of fossil based resources. Therefore, foreign dependency, fuel cost of the power plants should also be taken into account more carefully. Because, the security risk of foreign inputs and long term effects of the imported inputs on current account balance may be more important than the initial investment cost.

When we look at Turkey in terms of energy, sustainable development and renewable energy concepts, we see that, like being in all of the world economy, the main input of the industry is energy and its demand has been increasing steadily parallel with the economic development. According to the study results, the most important factors that affect the energy usage are the population growth and economic development. Since the establishment of the Republic, both population and economy have been growing steadily. While the population of Turkey was 38 million in 1973, it increased more than 2-fold and reached to 76.7 million at the end of the 2013. However, between the 1973-2010 periods, the primary energy demand increased from 24.6 MTEP to 153.9 MTEP. In other words, Energy demand of Turkey increased more than 6 times in last 40 years. According to the IEA projection, the average annual growth of primary energy supply in Turkey will be 2.42% between the 2013-2034 years.

However, since Turkey does not have enough domestic resources, energy demand has been met by the import of fossil based energy resources. While Turkey’s domestic primary energy supply could meet the 48.1 % of its consumption in 1990, it fell to 28.5 % in 2012.

In other words, domestic energy production of Turkey declined at a ratio of 20 % between the 1990 and 2012 periods and its dependency to foreign resources increased at the same ratio. As a result, while the domestic production has been decreasing, the import of energy has been increasing steadily. According to IEA data, Turkey is at the 11th place with its 89 million tons of oil equivalent energy import at the world's "net energy imports" league. Since the domestic fossil based resources are very limited, the energy bill, foreign dependency and high import necessity have become a heavy burden for the economy of Turkey.

In Turkey, 98.5 % of natural gas and 91 % of oil and 12 % of coal consumption are imported and 67 % of natural gas is used in electricity production. Since Turkey's import dependency is very high, energy prices and energy security have a vital importance for the economy. Because of the high dependency to the foreign energy supply, the competitiveness of Turkey in the global market reduces and this situation undermines its development. When the price of the energy increases, it affects all economy and the cost of production and price of goods and services increase. This situation reduces the competition power of Turkey in global market. Beside these, as a result of high foreign energy dependency, Turkey cannot play active role against the energy exporter countries, especially Russia and Iran, in the international relationships.

On the other hand, the main risk of Turkey economy comes from the high current account deficit ratio. Since the establishment of the Republic, Turkey has been confronting with chronic and structural current account balance and energy deficit problems. When we examine the current account balance outlook of Turkey, apart from the 1930-1946 period, Turkish economy has lived current account deficit problem in Republic periods. In Turkey, high current account deficit played an important role behind the nearly all economic crises. Therefore, it has been one of the main reasons of instability not only in liberal period but also during the relatively closed period.

The current account balance of Turkey is mainly affected from three factors; dependency of Turkish manufacturer sector to import, foreign energy dependency and low exchange rate prices. After 1980s, the globalization gained speed and with the effect of the

globalization the production process transformed to the international character. In most of the developed countries the firms restructured their organization and by the direct investment they shifted their labor-intensive sectors to the developing countries where the labor power is cheap and plentiful. In other words, they reorganize their firms according to the vertical specialization and their production structure changed by this reorganization.

In vertical specialization, the different stages of the same product are produced in different countries. In order to provide competitive advantage, the companies take into account some factors such as labor cost, proximity to the market and other incentives, and according to the result of their investigation, they make their investment in different countries. For example, while the battery of the smartphone is produced in China, the monitor is produced in Korea and software is produced in India. By using the cost advantage of each production, the companies try to decrease their production cost and increase the competitive power of their firms. As a result of vertical structuring of companies, today, the production is internationalized and the unit of production creates less value added than before.

We can also observe similar changes in Turkey. Due to the internationalization of the production process, the contribution of the export decreased steadily and import dependency reached to 77 % as of 2012. To compete with both domestic and foreign rival, Turkish manufacturing sectors are using foreign inputs in their production. As a result, domestic contribution of manufacturing sector has been decreasing continuously. Hence, while the economy is growing, the import also increases and in case of the domestic sales the current account deficit is deteriorated seriously. Therefore, the production structure of Turkey should be changed as soon as possible and domestic contribution should be encouraged.

The situation of energy trade is worse than other commodity trade, because nearly all of the energy import is the “net import” due to the lack of domestic energy resources of the country. In other words, while some of the other produced goods can be exported, the energy import is largely consumed inside the country and creates the rigidity in current account deficit. As mentioned, Turkey’s known fossil based energy resources cannot meet its needs and nearly 91 % of oil and 98.5 % of natural gas are imported from abroad. In

case of 10 dollars increase in oil prices, the current account deficit of Turkey increases at about 4 billion dollars.

The current account deficit creates the fragility on economy and price of the oil and other energy resources accelerate this fragility. When we look at the macroeconomic balance of the country, we see that except for the energy import, the Turkish economy nearly does not give net current account deficit. In other words, apart from the energy, the export ratio meets the import ratio. Turkey paid 385.2 billion dollars to the energy import in last 10 years and this number equals nearly half of the gross domestic product of the country. Therefore, in order to decrease the current account deficit, it is necessary to find an urgent solution to the energy dependency of Turkey.

Today, nearly 48 % of electricity was produced by using the natural gas. Turkeys' natural gas import composition is very unbalanced and it is largely depended on Russia (nearly 58%). Iran came in the second place in natural gas import and these two countries meet the 75 % of natural gas needs of our country. Due to the high dependency to these two countries, especially to Russia, natural gas supply of Turkey is under the risk. In case of any political dispute, like being in Ukraine and Syria crises, or technical problem, as experienced with Iran in recent years, natural gas supply can be interrupted by directly supplier countries or transition countries. In addition, the supplier countries may use the energy as a weapon against our country and this situation may threat the national security and international benefits of our country. Turkey experienced to these two risks with Russia in the Russia-Ukraine crisis and at the civil war Syria with Iran.

As it can be seen, the energy dependency directly affects Turkey's foreign policy and security of the energy supply. Therefore, to increase sustainability in terms of security of energy supply and to decrease the high dependency to one energy resource and one country's energy supply, Turkey has to take precautions in natural gas energy field. In order to be independent with the exact meaning of the word and become an important country in the international area, Turkey has to solve its energy dependency and develop new energy policy, depends on the domestic and cheaper energy resources.

Turkey does not have enough oil and natural gas reserves but its renewable energy potential is at a satisfactory amount. Nonetheless, Turkey cannot evaluate its domestic resources effectively. Today, nearly 65 % of hydraulic power, 7.25 % of wind energy, 59.7 % of geothermal energy and very small part of solar energy have been evaluating for the electricity production in Turkey. These ratio are the only economically potential of Turkey. In the technical side, the share of hydraulic decreased to 37 % in hydraulic, 4 % in wind, 17 % in geothermal. In developed countries, the ratio of technical potential (not economical) reached to 90 %. Comparing to developed countries, it can be said that there are lots of ways to be covered. Besides, with the technologic development and price increase in fossil based resources, some of the technical potential will become economical for Turkey.

The remaining economic renewable energy potential of Turkey is changing between the 263-597.5 TWh. Turkey can produce between the 1.07-2.5-fold of current electricity consumption by using the remaining economic capacity of renewable energy resources. The monetary value of this electricity is changing between the 19.51 and 44.33 billion dollars. In our calculation, the minimum efficiency value of each renewable energy resources are taken into account under the current technologic conditions. Therefore, in case of the favorable weather conditions and with the development of the new technology, producible electricity quantity can be much bigger than our calculation. Moreover, these calculations cover only economical available value of remaining renewable energy resource. With the current consumption level, the fossil based resources will be more expensive in near future and some of the technical potential of the renewable energy resources will become economic for the investors. Hence, producible energy can be higher than our calculation when the technical potential of the renewable energy becomes economic for the country.

Apart from current account deficit and foreign dependency, environmental concern and international relations also necessitate renewable energy investment for Turkey. In the context of EU accession, EU wanted to Turkey to prepare a program to increase energy generation from the renewable energy resources in the Accession Partnership Documents. In addition, Turkey adapted the Kyoto Agreement and in order to fulfill its commitments, it

has to increase its investment on this area. Therefore, in terms of environmental sustainability, Turkey must increase renewable energy investment and its share in total energy supply. Because, Turkey is the 13th country in the carbon emission in the world and it has the highest CO_2 emission increase ratio in the world between the 1990-2010 years. As it can be understood, not only economy but also environmental concerns and international commitments force Turkey to develop and implement its own renewable energy policy.

On the other hand, our investigation shows that there is a very strong correlation between the current account deficit, economic crisis and social stability of Turkey. Throughout the history of the Republic, Turkey experienced 15 economic crises and without any exception, all of the crises ended with the devaluation of the currency. In other words, nearly all of the economic crises are directly or indirectly related with current account deficit in the Republic history. As a result of these economic crises, lots of people lost their jobs, social stability was deteriorated and some of them ended with the military intervention.

Apart from 2008 crises, all of the crises are related with the economic structure of our country. Three of the economic crises, 1958, 1969 and 1979, ended with military intervention and 7 of them caused serious social turbulence and 2 of them, 1929 and 1979-80, changed the economic structure of the country. In the multiparty period, with the effect of the economic crisis, political parties, which were governing the country until the election, were pushed to the background in political life, like being in 2001 crisis. In short, economic crises affect the Turkish economy and political life deeply and cause serious social and political changes in the country. Therefore, renewable energy investments can also contribute the social and political stability of Turkey.

The importance of renewable energy investment is undeniable. However, the energy efficiency is also as important as renewables for Turkey's energy policy. In terms of primary energy density, Turkey is one of the energy-intensive countries in the world. While the energy intensity of OECD was 0.18, Turkeys' energy density is 0.27. In other words, energy intensity of our country is 50 % higher than OECD countries' average.

Between the 1978-2013 period, energy intensity of European countries decreased more than 30 %, but Turkeys' energy intensity did not show much change in the same period. Therefore, Turkey has to make further research and investment to increase the energy efficiency. To reduce the energy intensity, infrastructure of the countries must be renewed, and changes in the consumption patterns of behavior should be encouraged.

Beside these, even if Turkey can succeed to evaluate all of its renewable energy potential at maximum level and increase the efficiency, it cannot be enough to reset its energy dependency and current account deficit completely. Because, the large amount of energy import is made for the transportation sector's usage. Today, nearly 60 % of energy import is used by transportation sector and around the 34 billion dollars were paid for this import. In other words, even if we succeed to terminate the imported energy consumption in heating and electricity, the contribution of these will be around the 21 billion dollars under the current consumption level.

The data of Ministry of Transport, Maritime Affairs and Communications (MTMAC) show that the share of highway in load and passenger transportation is 80.63 % and 89.59 % respectively. Although there are some regulations about the efficiency of the building and home appliance, there is not any regulations, standards or sanctions about the transportation sector. If the share of the highway is decreased by giving the emphasis to the other transportation sectors and by increasing the public transportations' quality and infrastructure, it can be possible to save the significant amount of oil used in transportation sector. In addition, by changing the old vehicles with energy efficient one, energy efficiency of the transportation sector can be increased. In this way, our country's dependence on oil and carbon emissions can be also reduced.

In 2023, in conjunction with the new needs of Turkey, the energy consumption is projected to increase by 90 %, and this value is seven times bigger than the OECD average. Today, more than 50 % of current account deficit results from the energy import. To reduce current account deficit and foreign dependency in energy, the renewable energy investment and efficiency in energy usage are very important for our country. One of the main ways of rein the emission increase is to evaluate the 25 % saving potential of the country and use

renewable energy resource. It is estimated that by increasing the energy efficiency in residential, industry, transportation and by decreasing the leakage-loss ratio in electricity, 14 billion dollars can be saved yearly and 38 Atatürk dams can be built in ten years (with 140 billion dollars). Therefore, energy policy should be considered in integrity with energy efficiency and all energy sectors, including transportation.

As it can be understood from above mentioned situation, the current economic situation of Turkey mainly depends on the foreign inputs and foreign energy resources. The distribution of primary and secondary energy supply is not balanced and this situation directly threats the economic independence and energy security of the country. High dependency to foreign inputs and foreign energy resources increase the current account deficit of the country. Since all of the economic crises lived in republic era are directly or indirectly related with the current account deficit, the structure of the country makes it vulnerable against the energy and economic crises. The economic crises caused serious social and political changes in the country. Therefore, renewable energy investment and energy efficiency can contribute economic and social stability of country by maintaining energy security and by decreasing the foreign dependency and current account deficit.

It should be emphasized in here that although there are a lot of advantages of the renewables, they cannot be named an absolute solution for energy and economic problem of Turkey. Because, there are some weaknesses of the renewable energy resources. First of all, renewable energy resources are highly depends on the climatic conditions and efficiency of them can be decreased or completely stopped in case of the bad weather conditions. For example, because of the drought, the capacity of the hydraulic energy cannot be used effectively in 2013.

Secondly, harmonization of the demand and supply may be problem especially for wind and solar powers, because the highest energy production is made in summer but the highest energy demand is made in winter. Since the electricity cannot be storable, to harmonize the supply and demand is very important. Lastly, power problem of the some renewable energy resources, such as wind energy, may affect the quality of electricity and creates network problems and give harm to the electricity appliance of the users. Therefore, in

order to harmonize the supply and demand equilibrium and stabilize the some of the deficiency of the renewable energy resource, the renewables must be supported by other energy resources, such as coal, nuclear and thermal plants. In other words, the renewables should not be thought as the absolute solution. It can be evaluated as a complementary energy resource for the country to support the energy supply.

Consequently, the main aim of this dissertation was to investigate whether or not the renewable energy investments can contribute the current account deficit and social stability of Turkey in context of the sustainable development. Turkey has experienced 15 economic crises throughout the Republic history and nearly all crises were related with the current account deficit directly or indirectly. Our assumption was that if Turkey can succeed to reduce its current account deficit, the crisis can be avoidable. Since the energy was the one of the main items of the import, we gave our weight on renewable energy resources.

Our findings support our hypotheses. The renewable energy investment can contribute the sustainable development, energy security, current account balance and economic and social stability of our country. With the evaluation of remaining renewable energy resources, at least 19.51 billion dollars can be saved and this amount can be increased up to 44.33 billion dollars. Current account deficit can be decreased at the same amount. Since nearly all of the economic crises are directly or indirectly related with the current account deficit, renewable energy can reduce the crisis risk of the country and support the social stability of the country. Dependency of foreign energy resources can be decreased and this situation also contributes the security of energy supply and protection of the environment. However, unless the energy needs of transportation sector are decreased by increasing efficiency and/or decreasing the share of highway, the desired result cannot be obtained. Therefore, the energy policy should be taken in integrity and must be created to include the transportation sector and energy efficiency. Otherwise, the impact of the renewable energy investment will be limited and desired yield cannot be produced.

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