Hacettepe University Graduate School of Social Sciences

Department of Economics

THE EFFECT OF UTILIZATION OF DOMESTIC COAL RESOURCES ON TURKEY'S CURRENT ACCOUNT BALANCE: AN EXAMPLE OF AFSİN-ELBİSTAN LIGNITES

Muhammet Enes Çıraklı

Master's thesis

Ankara, 2019

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ETİK BEYAN

Bu çalışmadaki bütün bilgi ve belgeleri akademik kurallar çerçevesinde elde ettiğimi, görsel, işitsel ve yazılı tüm bilgi ve sonuçları bilimsel ahlak kurallarına uygun olarak sunduğumu, kullandığım verilerde herhangi bir tahrifat yapmadığımı, yararlandığım kaynaklara bilimsel normlara uygun olarak atıfta bulunduğumu, tezimin kaynak gösterilen durumlar dışında özgün olduğunu, **Doç. Dr. Dilek BAŞAR** danışmanlığında tarafımdan üretildiğini ve Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü Tez Yazım Yönergesine göre yazıldığını beyan ederim.

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ABSTRACT

ÇIRAKLI, Muhammet Enes. "The Effect of Utilization of Domestic Coal Resources on Turkey's Current Account Balance: An Example Of Afşin-Elbistan Lignites", Master's Thesis, Ankara, 2019.

The purpose of this study is to detect how much current account deficit burden could be reduced if we utilize Afşin-Elbistan lignites which are local energy sources. In this study, firstly literature survey in energy economics are made. After the literature survey; structure, characteristics and historical improvement of the electricity energy sector are explained. In addition to them, data on energy and electricity energy sector at the world and Turkey level are presented from a historical perspective and energy policies of important countries are included in order to see the current situation. Furthermore, the role of energy dependency on the current account deficit of Turkey is investigated by analyzing data. In this study, it is assumed that the lignite-fired power plants, which are expected to be established in Afsin Elbistan region, will be operational as of 2023 and the positive effect of the said power plants on the current account balance is calculated. The findings indicate that utilizing lignite sources will decrease the amount of natural gas consumption and it will have a positive effect on the current account balance of Turkey. This will also increase the share of the lignite in total electricity mix and decrease the share of the natural gas in the total electricity mix. Calculations utilized in this study also takes into account nuclear power plants which will be into operation in the following years. The reason why we do this is that they will affect the total electricity energy mix.

Key Words: Current Account Balance, Lignite, Energy, Electricity, Energy Dependency.

ÖZET

ÇIRAKLI, Muhammet Enes. "Yerli Kömür Kaynaklarının Kullanımının Türkiye'nin Cari İşlemler Dengesi Üzerindeki Etkisi: Afşin Elbistan Linyitleri Örneği", Yüksek Lisans Tezi, Ankara, 2019.

Bu çalışmanın amacı; yerli bir enerji kaynağı olan Afşin-Elbistan linyitlerini kullanırsak, cari işlemler açığındaki yükün ne kadar azaltılabileceğini tespit etmektir. Bu çalışmada, ilk olarak enerji ekonomisi alanında çalışılan literatür incelenmiştir. Literatür incelenmesinden sonra; elektrik enerjisi sektörünün yapısı, özellikleri ve tarihsel gelişimi izah edilmiştir. Bunlara ek olarak, Dünya ve Türkiye düzeyindeki enerji ve elektrik enerjisi sektörüne ilişkin veriler tarihsel bakış açısıyla sunulmuş ve mevcut durumun görülebilmesi için önemli ülkelerin enerji politikalarına yer verilmiştir. Ayrıca, enerji bağımlılığının Türkiye'nin cari işlemler açığı üzerindeki rolü, verilerin analiziyle incelenmiştir. Bu çalışmada, Afsin Elbistan bölgesinde kurulması beklenen linyit yakıtlı elektrik santrallerinin 2023 itibariyle faaliyete geçeceği varsayılmış ve söz konusu enerji santrallerinin cari işlemler dengesine olumlu etkisi hesaplanmıştır. Bulgular, linyit kaynaklarının kullanılmasının doğal gaz tüketim miktarını azaltacağını ve bu durumun cari işlemler hesabı üzerinde olumlu etkiye sahip olacağını göstermektedir. . Bu durumun, toplam elektrik üretimi içindeki doğal gaz payını düşürmesi beklenirken linyitin toplam elektrik üretimi içindeki payını arttırması beklenmektedir. Bu çalışmada kullanılan hesaplamalar, önümüzdeki yıllarda faaliyete geçecek nükleer santralleri de dikkate almaktadır. Bunu yapmamızın nedeni, söz konusu nükleer santrallerin toplam elektrik üretimi içindeki birincil enerji kaynakların payını etkilemesidir.

Anahtar Kelimeler: Cari İşlemler Dengesi, Linyit, Enerji, Elektrik, Enerji Bağımlılığı.

TABLE OF CONTENTS

ABBREVIATIONS AND SYMBOLS LIST

BOO: Build Own Operate

BOT: Build Operate Transfer

BOTAŞ: Boru Hatları ile Petrol Taşıma Anonim Şirketi

BP: British Petroleum

BRICS: Brazil, Russia, India, China, South Africa

BRICTS: Brazil, Russia, India, China, Turkey, South Africa

CO_2: Carbon Dioxide

EIA: Energy Information Administration

EİGM: Enerji İşleri Genel Müdürlüğü

EPDK: Enerji Piyasası Düzenleme Kurumu

ETKB: Enerji ve Tabii Kaynaklar Bakanlığı

EÜAŞ: Elektrik Üretim Anonim Şirketi

EVDS: Elektronik Veri Dağıtım Sistemi

GDP: Gross Domestic Product

GNP: Gross National Product

GWh: Gigawatt hour

IEA: International Energy Agency

IGCC: Integrated Gasification Combined Cycle

KWh: Kilowatt hour

LCOE: Levelised Costs of Electricity

LNG: Liquefied Natural Gas

Mbtu: One Thousand British Thermal Units

mtoe: Million Tonnes of Oil Equivalent

MWh: Megawatt hour

NGS: Nükleer Güç Santrali

NO_X: Nitrogen Oxide

OECD: Organisation for Economic Co-operation and Development

SO_2: Sulfur Dioxide

TCMB: Türkiye Cumhuriyet Merkez Bankası

US: United States

USD: United States dollars

TEAŞ: Türkiye Elektrik Üretim İletim Anonim Şirketi

TEDAŞ: Türkiye Elektrik Dağıtım Anonim Şirketi

TEİAŞ: Türkiye Elektrik İletim Anonim Şirketi

TKİ: Türkiye Kömür İşletmeleri

TTK: Türkiye Taşkömürü Kurumu

TETAŞ: Türkiye Elektrik Ticaret ve Taahhüt Anonim Şirketi

TEK: Türkiye Elektrik Kurumu

TMMOB: Türk Mühendis ve Mimarlar Odaları Birliği

TOR: Transfer of Operational Rights

TP: Türkiye Petrolleri Anonim Ortaklığı

TÜİK: Türkiye İstatistik Kurumu

TWh: Terawatt hour

YEGM: Yenilenebilir Enerji Genel Müdürlüğü

YEKA: Yenilenebilir Enerji Kaynak Alanları

YEKDEM: Yenilenebilir Enerji Kaynakları Destekleme Mekanizması

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Energy has been very important for human needs throughout history. It could be used in heating, industry and power generation. Its demand rose when the modernity of human lives get improved. Increasing industrial activities, population and technological change surged the need for world energy consumption. Countries tried to make infrastructure investments on electricity, build new power plants and develop new prescriptions for their energy sector to meet energy needs and to reach economic and social goals.

Energy can be both input for a production process and a consumer good. In other words, if consumption on energy increases, it will affect economic growth positively. Similarly, economic growth raises energy consumption. However, this relationship can be different in terms of country examples, analysis period and kinds of energy when we look at different academic researches. For this reason, conflictive policy implementations can be seen from one country to another country. For example, while some countries can make energy conversion policies, others can incentivize the energy infrastructure and power plant investments.

Due to the vital role of energy consumption in economic and social development; continuous, cheap and accessible energy is one of the main objectives for all countries. That's why they try to use their national and local energy sources preferably instead of importing other energy sources. Although there is some enforcement from the international authorities about reducing the fossil fuel energy sources for decreasing the greenhouse gas and mitigating the effects of global warming such as Kyoto Protocol, some developed countries do not choose to reduce their fossil fuel energy sources for the sake of their economic growth and current account balance. For instance, Germany's coal share in electricity generation is over %37 in 2017 (BP, 2018). The reason behind this issue is that Germany has local coal resources and uses them for generating electricity without creating any burden on its current account balance and does not want a dependency on foreign countries. As another example, the United States (US) recently made a decision about withdrawing from the Paris Agreement for economic reasons. Especially the countries with insufficient energy sources should be very sensitive about using its own energy sources preferably. They need to prepare their investment program and build the power plants and grid in accordance with their local resources. Otherwise, they could become addicted to energy sources which they do not have.

Turkey is also one of the countries whose energy sources are not enough for its energy demand. Energy dependency of Turkey reached around 74% in 2016. This ratio was about 32% in 1972. There are several reasons for this increase. These are inadequate energy resources, economic growth and take or pay practices and long term agreements in natural gas imports (ETKB, 2018).

Turkey is located between the Middle East and Caspian countries which are mostly natural gas and oil producers and European countries that have a substantial amount of energy consumption. Although Turkey has a very strategic location for energy trade, it could not use this advantage due to the lack of local resources. While total oil gas reserve in Turkey is 334,5 million barrel, total natural gas reserve in Turkey is 3,7 billion m^3 in 2015. Assuming the current production levels of both commodities, the expected life span for natural gas is estimated at 9,3 years whereas the expected lifetime for oil is estimated as 19 years in 2015 (TP, 2017).

Turkey has also coal reserves in its different regions. There are two types of coal in Turkey namely lignites and hard coals. Hard coal reserves are situated in the Western Blacksea Region, Zonguldak and its surroundings. Even though hard coal has higher calorific value in comparison with the lignite coals, its reserve is very limited for the energy needs of Turkey. However, lignite reserves are more spread all over the country. While the total reserve for lignite coal is 16 billion tonnes, the total reserve for hard coal is 1,5 billion tonnes. Because of its abundance, lignite coal became a very strategic energy source for continuous, cheap and secure energy supply. Whereas hard coal is usually utilized mainly in the electricity generation, heating, industry sector and coke factories, a good part of the lignite resources are allocated for the electricity generation. The share of the lignite usage in the other activities is so low that it could be ignored. That's why, lignite sources could be a very strategic energy source for electricity generation (TKİ, 2017). Usage of lignite sources could reduce the consumption of natural gas and imported coal. Thus, the current account balance of Turkey could be better off.

Using lignite coal resources in electricity generation instead of the imported energy sources has several benefits for home countries. These benefits are to provide security of supply, creating new employment opportunities, reliable production and reducing import of energy sources. That’s why, lignite resources could be attributed as a source which provides the security of supply (Sitti, Tanrısever, Külfetoğlu, & Derinkuyu, 2016).

Like inadequacy of energy sources, Turkey has problems with its current account balance. The current account balance raises from the deficit in its foreign trade balance. While the total current account deficit is about 47 billion USD, the total foreign trade deficit is around 59 billion USD in 2017. The service balance gives a surplus since 1984 (TCMB, 2018).

The item which contributes to the deficit of foreign trade balance mostly is the import of intermediate goods. The share of intermediate goods' import in total import is %74 in 2017. That's why policymakers should focus on decreasing foreign dependency on intermediate goods. When we analyze the intermediate goods' import in detail, we could see that %21 of the import of the intermediate goods comes from only energy in 2017 (TÜİK, 2018). These numbers indicate that if we take serious action about reducing the import of energy, we could reduce some burden of the current account balance.

There are two core measures to reduce the current account deficit in the energy sector. These are to implement energy efficiency policies and to utilize local energy sources instead of imported energy sources. The main purpose of our study is to show how much the current account deficit could be reduced if we try to use our local and national energy sources. Lignite is one of the significant energy sources among very limited energy sources in Turkey. That's why, Afşin Elbistan lignites are taken for our model due to the non-use or non-efficient use and abundance of these coal resources.

In the second part, following the introduction, literature survey in energy economics is summarized. These studies are mostly about the relationship between energy consumption and GDP, GNP or national income. A lot of studies on this topic was made at both world level and Turkey level and their conclusions vary in terms of country examples, analysis period and kinds of energy. However, there is no important study focusing on how much Turkey’s current account balance could be better off if local energy sources are utilized instead of importing natural gas. Unlike, in this study, the effect of utilizing the lignite on the current account balance of Turkey is analyzed. Therefore, this study is expected to be very beneficial for the energy economics literature when we take into account the current account balance and energy dependency problems of Turkey.

In the third part, the structure and characteristics of the electricity energy sector are provided. In addition to this, world energy and world electricity trends and coal specific information are presented. The energy policies of different countries are also summarized in this section.

In the following part, Turkey's energy sector will be evaluated as a whole. The market structure for different energy sources, players in those markets, information about the energy sources, demand and supply balance for the total energy consumption and electricity consumption, the share of the energy sources in total energy consumption and electricity generation are presented. This information is evaluated in a historical perspective. In addition to that, energy dependency and current account balance situation of Turkey is highlighted.

In the fifth part, the data, assumptions, models, other calculations based on our model and the results are presented. In this part, while International Energy Agency (IEA) and Ministry of Energy and Natural Resources (ETKB) data, assumptions, models and calculations are mainly used. Besides, information taken from other articles and reports is utilized. Our base reports are "Turkey Electricity Demand Projections Report" of ETKB which includes the electricity demand projection between the years of 2017 and 2037 and "Projected Cost of Generating Electricity 2015", which is the report prepared by IEA. Scenarios are created for the calculations of how much current account deficit could be reduced and how the share of the primary energy sources in the total energy mix if we utilize Afşin Elbistan lignites in electricity generation by decreasing the natural gas consumption. In addition to them, nuclear power plants (Sinop NGS and Akkuyu NGS), which will be in operation in the following years, are also taken into account and electricity generation from them is reduced from natural gas consumption.

In the conclusion section, the main findings of the analysis are summarized, limitations and contribution of the thesis are provided.

CHAPTER 1

1. LITERATURE REVIEW

In the international literature on energy, there are vast amount of studies for developed and developing countries. The subject of these studies varies in terms of their concern, method, point of view, period, place, etc. Although energy seems to be a technical field, it caught economists' interest because it has an impact on the economy. The studies in the energy area related to economics are mostly about the relationship between energy consumption and GDP growth. In this section, the academic research which focuses on the relationship between energy consumption and GDP is presented.

1.1. STUDIES ON THE RELATIONSHIP BETWEEN ENERGY CONSUMPTION AND GDP

The main discussion in the energy economics studies has been whether there is a causal relationship between energy consumption and GDP, and the direction of this relationship between two variables such as unidirectional causal relationship running from GDP to energy consumption, vice versa or bidirectional relationship. The conclusion of these studies is very crucial for policymakers in the related countries when they try to make a decision about energy policy field.

The major conflict in this field is seen between biophysical and neoclassical economists. While the scientists from the former adopted to Law of Thermodynamics and they think that energy is the most important and ultimate input in the production process, the latter one supporters think that energy is only an intermediate input and its importance is very limited in the production process. The research of both groups is shaped by their main assumptions mentioned above (Stern, 1993).

The pioneering and fundamental study in the energy economics field is the study of Kraft and Kraft (1978). In this study, two situations were examined. The first one is whether there is a strong relationship between energy consumption and GNP and its direction such as bidirectionality and unidirectionality for the US.

The period used for this study is the years between 1947 and 1974. The findings indicate that there is a causal relationship between energy consumption and GNP and this causal relationship is a unidirectional relationship running from the GNP to energy consumption (Kraft & Kraft, 1978). On the other hand, Akarca and Long, (1980) shortened the period used in the study of Kraft & Kraft (1978) and found no causal relationship between two variables (Akarca & Long, 1980).

Like the conflicts above, this relationship and its directions vary from one researcher to another due to the method, the period of data and several countries used in these studies. If we classify the studies in terms of their outcomes, we need to constitute four subtitles: no relationship between energy consumption and GDP, bidirectional causal relationship between these economic variables, unidirectional causal relationship running from energy consumption to GDP and unidirectional causal relationship running from GDP to energy consumption.

1.1.1. No Causal Relationship Between Energy Consumption to GDP

Erol and Yu (1987) found this outcome for England and France as Akarca and Long, (1980) did. They studied six countries, West Germany, England, France, Italy, Canada, and Japan, for the years between 1952 and 1982. In their study, no causal relationship between energy consumption and GDP is found for England and France (Erol & Yu, 1987). Similarly, Aqeel and Butt (2001) investigated the causal relationship between energy consumption and GDP; and the causal relationship between energy consumption and employment for Pakistan by applying the techniques of “cointegration” and “Hsiao's version of Granger causality”. Both aggregate and disaggregate analysis were made. According to results, there is no causal relationship between gas consumption and GDP in this country (Aqeel & Butt, 2001). Another study which shares the same outcome with previous ones is Jumbe (2004). This paper examined that relationship for Malawi for the period between 1970 and 1999 by using the methods of “Granger causality” and “error correction model”. Unlike the other studies, a sectoral distinction was made such as agricultural and non-agricultural GDP in this study. The results indicate that electricity consumption was not cointegrated with the agricultural GDP (Jumbe, 2004). Furthermore, Wolde-Rufael (2004) investigated the causal relationship between various kinds of industrial energy consumption and GDP in Shangai for the period between 1952 and 1999 by using “Granger causality”. The result is the same as previous ones only for the relationship between oil consumption and GDP (Wolde-Rufael, 2004). Lee (2005) examined this analysis for G-11 countries by using “Granger non-causality testing procedure” developed by “Toda Yamamoto”. The period chosen for this study is 1960-2001 except for Germany (1971-2001) and Canada (1965-2001). According to some parts of the result, there is no causal relationship between energy consumption and GDP in the United Kingdom, Germany, and Sweden (Lee, 2005). Likewise, Chiou-wei, Chen, and Zhu (2008) made the same analysis for newly industrialized countries and the US by both the linear and non-linear “Granger causality”. The results show that neutrality between the variables for the US, Thailand, and South Korea exists for the period between 1954-2006 (Chiou-wei, Chen, & Zhu, 2008). In addition to all, Soares, Kim, and Heo (2014) examined this causal relationship for Indonesia by applying “vector error correction of pairwise Granger causality model” for the period between 1971 and 2010. The result indicates no causal relationship between these economic variables in the long run (Soares, Kim, & Heo, 2014). Finally, another analysis was made for the BRICS countries which are Brazil, Russia, India, China, and South Africa for the period between 1985 and 2009 by Chang, Deale, Gupta, Hefer, Inglesi-lotz, and Simo-Kengne (2017). The overall result indicates that there is no causal relationship between coal consumption and GDP. The results were found by using “panel-Granger causality analysis” (Chang, Deale, Gupta, Hefer, Inglesi-lotz, & Simo-Kengne, 2017).

For Turkey, Altınay and Karagöl (2004) investigated the causal relationship between energy consumption and GDP for the period between 1950 and 2000 by using “Hsiao's version of Granger causality method”. The results from the study indicate that there is no meaningful causal relationship between these economic variables (Altınay & Karagöl, 2004).

All in all, these studies back up the study of Akarca and Long (1980). The common conclusion from the findings obtained, there could be a possibility of reducing the emissions without harming economic growth. Therefore, energy conservation policies can be implemented for the mentioned countries.

1.1.2. Unidirectional Causal Relationship Running From GDP to Energy Consumption

This outcome was first brought forward by Kraft and Kraft (1978) as mentioned above. Erol and Yu (1987) supported the conclusion of Kraft and Kraft (1978) for West Germany and Italy. In other words, there is a unidirectional causal relationship running from GNP to energy consumption in West Germany and Italy for the period between 1952 and 1982 according to that study (Erol & Yu, 1987). Similarly, Cheng, Benjamin S.; Lai and Tin Wei (1997) studied the causal relationship between energy consumption and GNP; and energy and employment by applying "techniques of cointegration and Hsiao's version of Granger causality" for Taiwan between the years of 1955 and 1993. The result of the study suggests that causality between energy consumption and GDP exists and this causal relationship runs from GDP to energy consumption (Cheng, Benjamin S.; Lai, Tin Wei, 1997). The same outcome was found for the second conclusion of the study of Aqeel and Butt (2001). According to their paper, there is a unidirectional causal relationship running from economic growth to total energy and petroleum consumption for Pakistan. This finding is reached by applying "the techniques of cointegration" and "Hsiao's version of Granger causality" in this paper (Aqeel & Butt, 2001). Ghosh (2002) also found that there is one-way direction running from GDP per capita to electricity consumption per capita for India between 1950-51 and 1996-1997 by using "the Phillips–Perron test" (Ghosh, 2002). In addition to them, Soytaş and Sarı (2003) examined the causal relationship between energy consumption and income in top emerging 10 countries, excluding China due to the lack of data, and G-7 countries. According to the results, there is a unidirectional causal relationship running from GDP to energy consumption for Italy and South Korea (Soytaş & Sarı, 2003). Likewise, Jumbe (2004) found that there is a unidirectional causal relationship running from non-agricultural GDP to electricity consumption in Malawi for the period between 1970 and 1999 by using the methods of "Granger causality" and "error correction model" (Jumbe, 2004). Like these papers, Al-Irani (2006) also studied to detect the existence and direction of the causal relationship between energy consumption and GDP for the six countries from the Gulf Council by using "the panel cointegration and causality techniques". The main finding is that there is a unidirectional causal relationship running from the GDP to energy consumption (Al-Iriani, 2006). Lee (2005) is another researcher who found this relationship for France, Italy, and Japan by using “Granger non-causality testing procedure” developed by “Toda Yamamoto” from his second conclusion (Lee, 2005). Moreover, Wolde-Rufael (2006) studied the causal relationship between electricity consumption per capita and real GDP per capita in 17 countries for the period between 1971 and 2001 by using “the cointegration test developed by Pesaran” and “modified version of Granger causality test”. The results of the study indicate that 12 of the 17 countries have a “Granger causality”; 6 of them have a unidirectional causal relationship running from GDP per capita to electricity consumption per capita (Wolde-Rufael, 2006). Similarly, Mozumder and Marathe (2007) studied the causal relationship between electricity consumption per capita and GDP per capita for Bangladesh by employing “cointegration” and “vector error correction model”. The result of the paper indicates that there is a unidirectional causal relationship running from GDP per capita to electricity consumption per capita in Bangladesh (Mozumder & Marathe, 2007). From the second result of Chiou-wei, Chen, and Zhu (2008), a unidirectional causal relationship running from GDP to energy consumption in the Philippines and Singapore was found (Chiou-wei, Chen, & Zhu, 2008). Wolde-Rufael (2009) also studied the causal relationship between coal consumption and real GDP in six major coal consuming countries India, Japan, China, South Korea, South Africa, and the US for the period between 1965 and 2005 using a “vector autoregressive framework” by adding capital and labor. According to some conclusions of the study, there is a unidirectional causal relationship running from GDP to coal consumption for China and South Korea (Wolde-Rufael, 2009). Lastly, From the second finding of Chang, Deale, Gupta, Hefer, Inglesi-lotz, and Simo-Kengne (2017), unidirectional causal relationship running from GDP to coal consumption for South Africa was found by using “panel Granger causality analysis” (Chang, Deale, Gupta, Hefer, Inglesi-lotz, & Simo-Kengne, 2017).

The common characteristic of these findings is to give an opportunity to policymakers for the energy conservation policies without damaging the economic growth like the studies whose findings are no causal relationship between energy consumption and GDP. In other words, the countries that have this kind of relationship could decrease their energy use and provide a cleaner environment for their people.

1.1.3. Unidirectional Causal Relationship Running From Energy Consumption to GDP

In the third conclusion of Erol and Yu (1987), unidirectional causal relationship running from energy consumption to GDP in Canada was found for the period between 1952 and 1982 (Erol & Yu, 1987). Furthermore, Stern (1993) studied the causal relationship between energy, labor, capital and GDP in the US for the period 1947-1990. He added two more factors in his study as compared to the previous studies. In this study, multivariate adoption of test vector autoregression method was used to examine the relationship between these economic variables. The advantage of using this method instead of using “bivariate Granger analysis” is to get rid of artificial correlation between the variables. Additionally, conventional energy consumption variables were not used. Instead, an index of final energy use weighted for the changing fuel composition of energy input was selected for the model in this study. Moreover, Stern disagreed with some arguments and doctrines of both biophysical and neoclassical economists. Namely, he ignored the biophysical economist's hypothesis of that energy is the ultimate and only factor of production and the neoclassical economist’s hypothesis of that energy is just an intermediate input and it does not have a significant effect on income level. In his study, a “vector autoregression (VAR)” of energy, capital, labor, and GDP were estimated. After changing the gross energy consumption with an index of final energy use weighted for the changing fuel composition of energy input, it can be argued that he provided a new approach in the field. He found that there is a unidirectional causal relationship running from an index of final energy use weighted for the changing fuel composition of energy input to GDP (Stern, 1993). Stern (2000) extended the previous study, namely Stern, (1993), by using the period between 1948 and 1994 and he found robust results which imply that there is a unidirectional causal relationship running from an index of final energy use weighted for the changing fuel composition of energy input to GDP (Stern, 2000). Likewise, Asafu-Adjayehu (2000) studied the causal relationship between energy consumption and income for India, Indonesia, the Philippines, and Thailand by using "cointegration" and "error correction modeling techniques". The results of the study indicate that there is a unidirectional causal relationship running from energy consumption to GDP for India and Indonesia in the short run (Asafu-Adjayeu, 2000). Similarly, according to the third conclusion of the study of Aqeel and Butt (2001), there is a unidirectional causal relationship running from electricity consumption to GDP for the power sector of Pakistan. This outcome is found by applying "the techniques of cointegration" and "Hsiao's version of Granger causality" (Aqeel & Butt, 2001). Likewise, Shiu and Lam (2004) examines the causal relationship between electricity consumption and GDP in China for the period between 1971 and 2000 by applying an "error correction model". The findings suggest that real GDP and electricity consumption variables are "cointegrated" and there is a unidirectional causal relationship running from electricity consumption to real GDP (Shiu & Lam, 2004). In a similar manner, Lee (2005) also examined the causal relationship between energy consumption and GDP in 18 developing countries for the period between 1975 and 2001 by using "the panel unit root test", "heterogeneous panel cointegration", and "panel-based error correction models". According to the findings of the study of Lee (2005), there is a unidirectional causal relationship running from energy consumption to GDP in Canada, Belgium, Netherland, and Switzerland by using "Granger non-causality testing procedure developed by "Toda Yamamoto" (Lee, 2005). Lee and Chang (2005) distinctly examined the stability between the variables of energy consumption and GDP for Taiwan during the period between 1954 and 2003 by using "the unit root and cointegration tests". Both aggregate and disaggregate analysis (coal, oil, gas, electricity) were made. According to the results, there is a unidirectional causal relationship running from oil, gas and electricity consumption to GDP (Lee & Chang, 2005). Accordingly, from the second conclusion of Wolde-Rufael (2006), a unidirectional causal relationship running from electricity consumption per capita to GDP per capita for 3 countries was found from the analysis of 17 countries for the period between 1971 and 2001 (Wolde-Rufael, 2006). Moreover, in the last analysis of Chiou-wei, Chen, and Zhu (2008), a unidirectional causal relationship running from energy consumption to GDP for Taiwan, Hong Kong, Malaysia, and Indonesia was discovered (Chiou-wei, Chen, & Zhu, 2008). In addition to them, Abosedra, Dah and Ghosh (2009) examined the causal relationship between electricity consumption and economic growth for Lebanon between 1995:1 and 2005:12. The results indicate the absence of a long term equilibrium relationship between electricity consumption and GDP in Lebanon. However, examination under “the bivariate vector autoregression framework” with the change in temperature and relative humidity as exogenous variables enables us to see a unidirectional causality running from electricity consumption to GDP (Abosedra, Dah, & Ghosh, 2009). In a similar vein, the result of Wolde-Rufael (2009) shows that there is a unidirectional causal relationship running from coal consumption to GDP for India and Japan (Wolde-Rufael, 2009). Along these lines, another of the individual result of Chang, Deale, Gupta, Hefer, Inglesi-lotz, and Simo-Kengne (2017) indicates that there is a unidirectional causal relationship running from coal consumption to GDP for China (Chang, Deale, Gupta, Hefer, Inglesi-lotz, & Simo-Kengne, 2017). Lastly; Zang, Chu, Chang, and Inglesi-Lotz (2017) reexamined the causal relationship between coal consumption and economic growth in China and India for the period between 1969 and 2013 first time using “a frequency domain–based Granger causality test” proposed by “Brietung and Candelon (2006)”. The result indicates that there is a unidirectional causal relationship running from coal consumption to economic growth for China (Zang, Chu, Chang, & Inglesi-Lotz, 2017).

For Turkey, according to the second conclusion of Soytaş and Sarı (2003), there is a unidirectional causal relationship running from energy consumption to GDP for Turkey, France, Germany, and Japan (Soytaş & Sarı, 2003). Another study focused on Turkey is Soytaş and Sarı (2004). This study aimed to indicate how much variance in national income growth can be explained by the growth of different source of energy consumption and employment level by using “generalized forecast error variance decomposition technique”. The main finding from the study is that energy consumption explains the 21% of the forecast error variance of domestic product. This ratio shows that energy is as important as an employment source in Turkey (Soytaş & Sarı, 2004). Furthermore, Ertuğrul (2011) studied the causal relationship between electricity consumption and economic growth with dynamic analysis. The result of the study is that there is an increasing effect of electricity on economic growth since 2003 (Ertuğrul, 2011).

According to these studies, energy is an input for the GDP like labor and capital. For this reason, energy conservation policies may damage economic growth. The countries having this characteristic should make the investment in their energy infrastructure and increase its energy consumption for enhancing their economic growth.

1.1.4. Bidirectional Causal Relationship Between Energy Consumption and GDP

The last finding of study of Erol and Yu (1987) is that there is a bidirectional causal relationship between energy consumption and GDP in Japan for the years between 1952 and 1982 (both from energy consumption to GDP and from GDP to energy consumption) (Erol & Yu, 1987). Likewise, the second conclusion of Asafu-Adjayeu (2000) implies that there is a bidirectional causal relationship between energy consumption and income for Thailand and the Philippines. This outcome is found by using “cointegration” and “error correction modeling techniques” (Asafu-Adjayeu, 2000). The last finding of Soytaş and Sarı (2003) indicates the same relationship exists for Argentina (Soytaş & Sarı, 2003). In addition to these studies, the last finding of Jumbe (2004) states that there is a bidirectional causal relationship between electricity consumption and GDP in Malawi for the period between 1970 and 1999 by using the methods of “Granger causality” and “error correction model” (Jumbe, 2004). Moreover, the last conclusion of Lee (2005) is that there is a bidirectional causal relationship between energy consumption and GDP in the US by using “Granger non-causality testing procedure” developed by “Toda Yamamoto” (Lee, 2005). Accordingly, the second conclusion of Lee and Chang (2005) also indicated that there is a bidirectional causal relationship between GDP and both total energy and coal consumption. This outcome is reached by using “unit root” and “cointegration” tests (Lee & Chang, 2005). In a similar way, Wolde-Rufael (2006) lastly shows that there is a bidirectional causal relationship between electricity consumption per capita to GDP per capita for 3 countries from the analysis of 17 countries for the period between 1971 and 2001 (Wolde-Rufael, 2006). Likewise, the last result of Wolde-Rufael (2009) is that there is a bidirectional causal relationship between coal consumption and economic growth for South Africa and the US (Wolde-Rufael, 2009). The final study, the conclusion of Chang, Deale, Gupta, Hefer, Inglesi-lotz, and Simo-Kengne (2017) reveals that there is a bidirectional causal relationship between coal consumption and GDP in India for the period between 1985 and 2009 (Chang, Deale, Gupta, Hefer, Inglesi-lotz, & Simo-Kengne, 2017).

For Turkey, Erdal, Erdal, and Esengün (2008) investigated the causal relationship between energy consumption and economic growth in Turkey for the period between 1970 and 2006 by using “unit root test”, “augmented Dickey-Fuller”, “Phillips-Peron”, “Johansen cointegration test”, and “Pair-wise Granger causality test”. The results indicate that there is a bidirectional causal relationship between GDP and energy consumption (Erdal, Erdal, & Esengün, 2008). In addition, Bildirici and Bakırtaş (2014) examined the causal relationship between economic growth and coal, natural gas and oil consumption by using “the autoregressive distributed lag bounds” for the period between 1980 and 2011 in BRICTS countries, Brazil, Russia, India, China, Turkey, South Africa. According to long-run causality test, there is a bidirectional causal relationship between oil energy consumption and income for all countries; there is a bidirectional causal relationship between coal consumption and income for China and India; and there is a bidirectional causal relationship between natural gas consumption and income for Brazil, Russia, and Turkey (Bildirici & Bakırtaş, 2014).

According to these studies, energy is both exogenous and endogenous for GDP. In this context, these two economic variables jointly affect each other. Therefore, policymaker should take into account how much they need to forgo from economic growth when they decide about implementing an energy conservation policy.

When we look at the overall energy economics field, we see lots of discussions took place about the existence of the causal relationship between energy consumption and economic growth and, its direction. This issue is very important because it gives some ideas to policymakers about what to do in the energy sector for stimulating economic growth or reducing emission from the power plants. Nevertheless, there is no significant study focusing on how much Turkey's current account balance could be better off if local energy sources are utilized instead of importing natural gas. That's why in this study we do not focus on the relationship between energy consumption and GDP. Instead, we analyze how much we could lower the current account deficit if we use the local energy sources in the electricity generation process.

CHAPTER 2

2. STRUCTURE OF THE ELECTRICITY SECTOR AND ENERGY OUTLOOK IN THE WORLD

In our daily life, we can not do almost all works without using electricity such as washing clothes, cooking dinner, studying on the computer, surfing the net, etc. In older times, its need was relatively limited due to the low population, lack of or less amount of industrial activities, unadvanced technology. However, humanity is extremely dependent on it now by rapid advancement in technology, increased industrial activities thanks to capital accumulation and population increases.

Electricity is used in so many areas for industry and for daily needs in residences. That's why, the inability of the provision of electricity, even for a very short time, might cause serious damages in economies and social life in countries. That's why the procurement of electricity should be performed on time and responsible authorities should not permit any interruption of its supply for the sake of its own countries' economy and their people's social life.

In this section, the characteristics and structure of the electricity energy sector, functional structure of electricity supply, electricity sector models, world energy trends and coal and electricity specific information, some countries' energy policies and Turkey's energy outlook are provided.

2.1. THE STRUCTURE OF ELECTRICITY ENERGY SECTOR

Electricity is a secondary energy source which is generated from any other energy sources. Although electricity, which is a commodity, has common characteristics with other commodities, it has some special and different features such as demand fluctuations during the day and the year and difficulty in storage. That's why the supply and demand for electricity should meet each other instantaneously. To deal with this issue, generation and transmission capacity should be adequate for needs in the peak demand periods and reserve capacity should be enough in the case of for more energy (OECD, 2001)

Because the price elasticity of demand for electricity consumption is inelastic and it has a characteristic of the public good; continuous, cheap and quality electricity provision to all people is significant for the authorities ((Çeliker, 2011) (Deryugina, MacKay, & Reif, 2016)). Due to the non-storability of electricity, countries should establish the mechanism which guarantees continuous electricity supply. This mechanism is always a complex one and it needs very high coordination among the functions. In the case of failure in coordination, unaffordable economic and social costs are inevitable for all parties. That's why a system operator is needed for the transactions to balance supply and demand in real time by meeting the needs for the fluctuating demand over the year. The electricity generation could be increased in the peak demand times and could be decreased in the lower demand times by the central system operator. This is the difference in the electricity sector from the other sectors (Atiyas, 2006).

The electricity energy sector consists of functions such as generation, transmission, distribution, wholesale selling, retail selling and system operation which all have different characteristics economically. While generation, transmission, distribution, and system operation are the physical functions; wholesale and retail selling functions are the merchant functions (Çeliker, 2011), (Hunt, 2002).

2.1.1. Functions of the Electricity Sector

2.1.1.1. Generation

Electricity generation is the first circle of the electricity supply chain. Like said before, it is a secondary energy source which is produced from primary energy sources such as coal, diesel fuel, natural gas, nuclear energy, the potential energy of water, wind and solar energy, etc. Although their costs of generating electricity and working principles are different from each other, usage of all sources is kept on (Hunt, 2002).

Due to the fact that electricity generation is performed by using distinct energy sources by several producers, it carries competitive characteristics. In addition to that, scale economies became very limited for this sub-sector by the advanced technologies implemented in the electricity generation power plants ((Çeliker, 2011); (OECD, 2001)).

2.1.1.2. Transmission

Electricity transmission is the next circle of the electricity supply chain. Electricity transmission, which is carried out on poles and wires, transports the electricity from the power plants to the distribution centers to deliver it to the final consumer (Hunt, 2002).

Because the transmission system is too sensitive to making mistakes, this function should be fulfilled carefully. For this reason, this system is observed by a system operator. When the system is overloaded, the whole system might collapse and all people who get electricity over this system could meet the condition of a blackout (Hunt, 2002).

Because of high constant costs, high investment need, the existence of economies of scale, this duty is performed by only one firm which has monopoly power. The transmission also requires very high coordination with other function of the electricity industry. That's why, transmission functions are better to be performed under regional or national monopolies (Çeliker, 2011).

2.1.1.3. System Operation

System operation is the function which provides the supply security of the electricity by balancing supply and demand instantaneously and guaranteeing the stability of the transmission system. System operator should watch the load on the transmission system and give the order to generators for decreasing or increasing the electricity generation according to load on the transmission line and demanded electricity.

System operation is the most critical function of the electricity supply industry. In the case of any mistake, consequences could be very harsh. To avoid any possible mistakes, the best-qualified engineers should be employed in this sector.

The system operator should hold plants in reserve, ready to be used in a case, and calling for special outputs known as ancillary services (Hunt, 2002). Due to the critical and coordination needed job of the system operation, this function should be performed under a monopoly.

2.1.1.4. Distribution

Electricity distribution is the function that takes the diminished high voltage electricity from the transmission system and transports it to the final user (Çeliker, 2011).

A transmission line provides security of supply to all end users while a distribution line benefits only one group of the users (OECD, 2001).

Like the transmission sector, distribution sector carries the characteristics of the monopoly market due to the high constant costs (Çeliker, 2011).

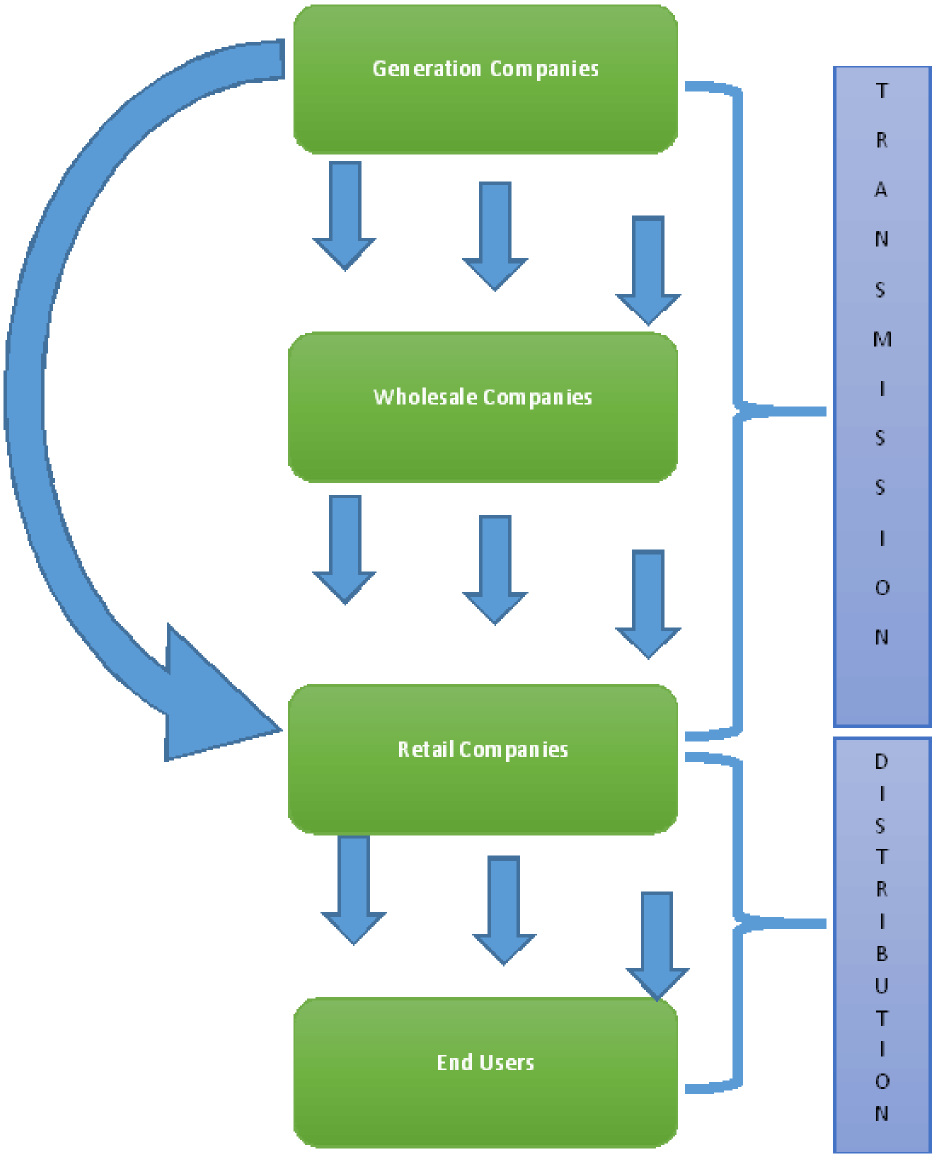
2.1.1.5. Retailing

While generation, system operation, transmission, and distribution are the physical functions; retailing and wholesaling are merchant functions. Retailing, which is the function of sales to final consumers, includes a series of commercial function such as procuring, pricing, and selling electricity, and also metering its use, billing for it, and collecting payment. In the typical electricity industry until the 1990s, the retailing function was thought as integrated with the distribution sector (Hunt, 2002). However, this function shows competitive characteristics and could be separated from the distribution function.

2.1.1.6. Wholesale

Wholesale electricity power function means selling electricity to the reseller. This function is realized between wholesale electricity seller and retail electricity seller. This function could be operated by competition (Hunt, 2002).

Figure 1: The Structure of the Electricity Sector



Source: (Hunt, 2002)

In figure 1, the main structure of the electricity sector is presented. However, there are different electricity sector models which may differ the picture of this diagramme.

2.1.2. Electricity Sector Models

There are four kinds of electricity sector models which are described by Hunt and Shuttleworth (1996). They are a vertically integrated structure, single buyer, wholesale competition and retail competition (Hunt, 2002).

While the structure of the world electricity sectors is vertically integrated in the older times, world electricity sectors were started to be restructured after the 1980s when privatizations started to be implemented. Thus, the electricity sector in overall the world became more open to private entrepreneur and roles of the governments in this sector was lowered (Çetintaş & Bicil, 2015).

2.1.2.1. Vertically Integrated Structure Model

There is an integrated entity which performs all functions of the electricity supply industry in this model. There is no competition in generation, wholesale selling, and retail selling sectors. All operations are done by a monopoly firm which could be both public owned or privately owned. The advantage of this model is that there is no transaction cost between the operations and coordination is very strong due to the integrated structure (Hunt, 2002). However, there is a disadvantage that a vertically integrated firm does not have any motive to reduce its costs due to the lack of competitiveness. Figure 2 illustrates the vertically integrated structure model schematically.

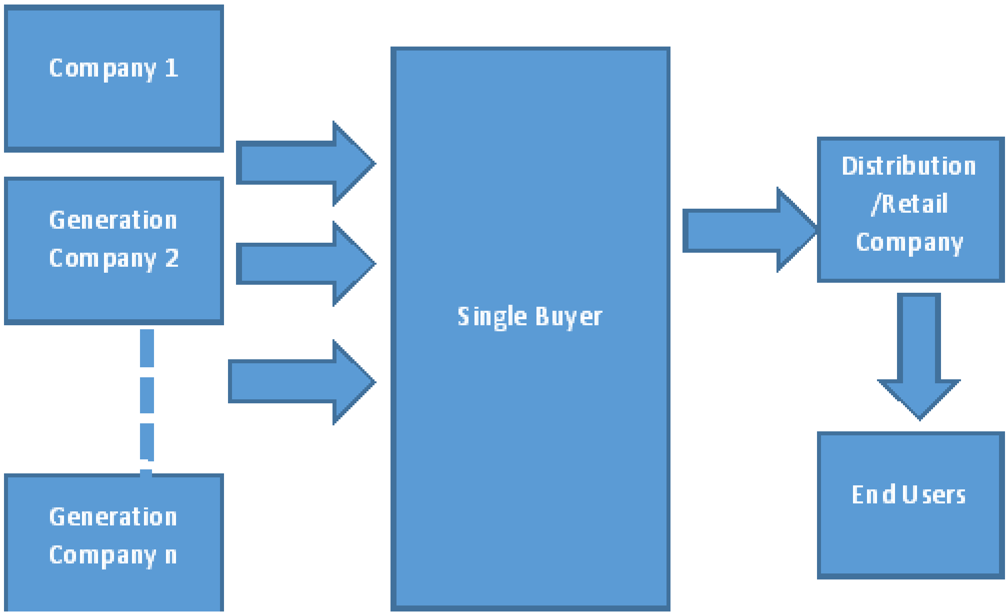
Figure 2: Vertically Integrated Structure

Source: (Boisseleau, 2004)

2.1.2.2. Single Buyer Model

Single buyer model includes only one firm which purchases all electricity generated by the generation companies. In this model, whereas there is a competition in the generation function, the purchasing of electricity is realized by a single buyer. This model was applied by especially in Asian countries to attract more generation companies to make the investment for meeting the needs of the sector (Hunt, 2002). Illustration for this model is seen in figure 3.

Figure 3: Single Buyer Model



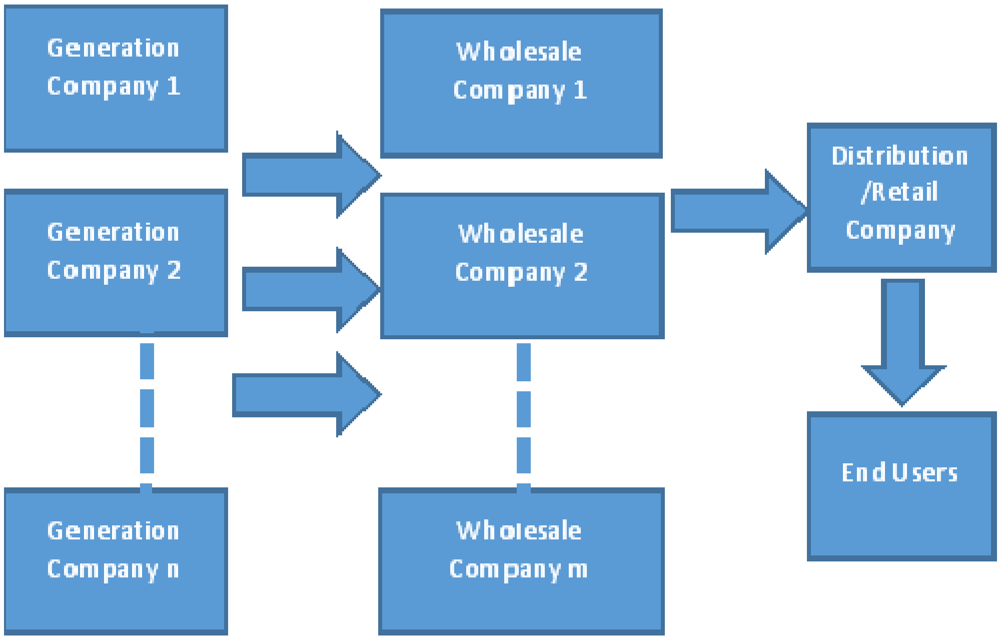
Source: (Boisseleau, 2004)

2.1.2.3. Wholesale Competition Model

In the wholesale competition model, wholesale has also competitive besides generation function. Unlike first and second models, generation companies do not have to sell their electricity to a defined wholesale firm and distribution/retail companies do not have to buy the electricity from a defined wholesale firm (OECD, 2001).

While we have a great number of companies operating in the generation and wholesale functions, there is a monopolistic power in distribution/retail sub-sectors. Therefore, whereas great efficiencies could be seen in generation and wholesale functions, retail activities are expected to be inefficient in this model. In figure 4, the wholesale competition model is summarized.

Figure 4: Wholesale Competition Model



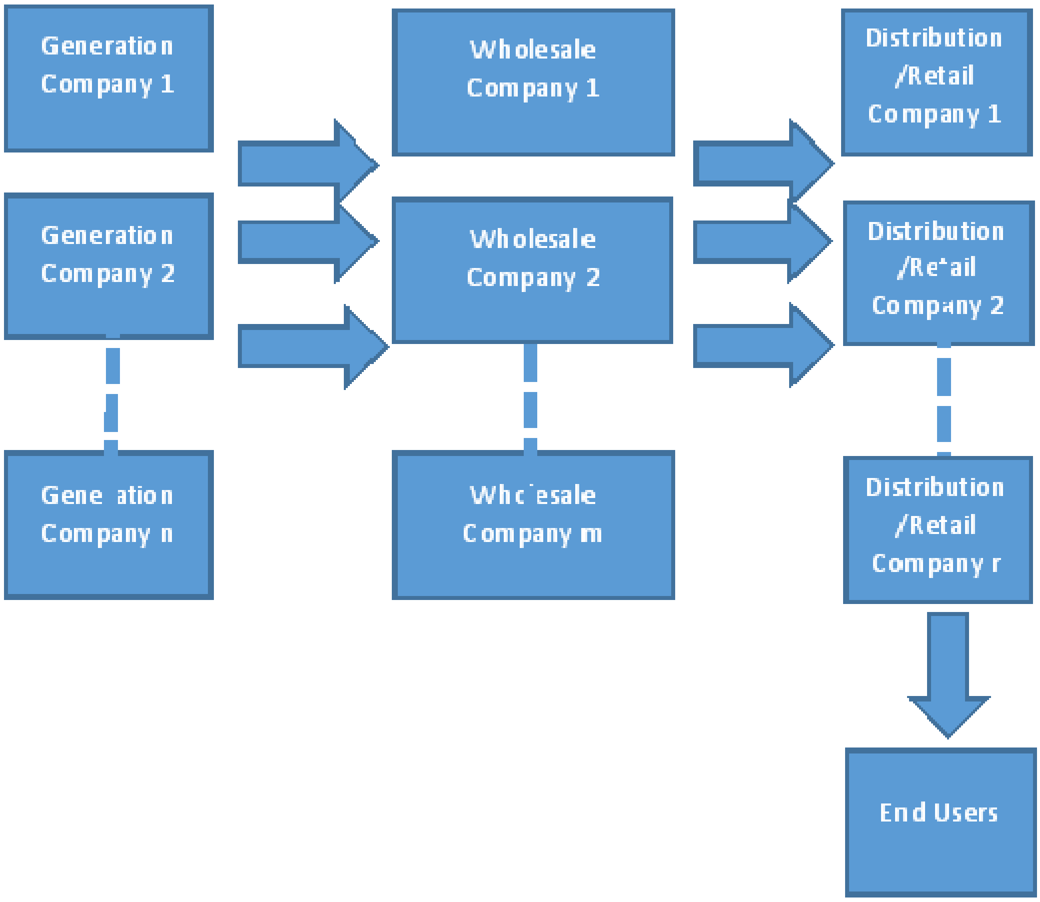
Source: (Boisseleau, 2004)

2.1.2.4. Retail Competition Model

In the retail competition model, generation, wholesale and retail functions are competitive. The differences in retail competition from the wholesale competition are that there are so many companies in the retail activities and consumers could choose their electricity suppliers by the notion (Boisseleau, 2004).

The advantage of this model is that competition in all functions makes the whole electricity supply industry more efficient. By doing so, the aim of cheap, quality, continuous electricity supply could be attained. The structure of retail competition model is summarized in figure 5.

Figure 5: Retail Competition Model



Source: (Boisseleau, 2004)

2.2. WORLD ENERGY OUTLOOK

In this section, types of energy are classified and defined. The detail information about coal and electricity is presented. Besides, the energy policies of different countries are represented. Furthermore, we touch upon energy statistics at the global level and compare them according to different countries. We present global supply and demand for energy and electricity and the share of different energy sources in total energy production. Thus, we could see the global level and country-specific information about energy.

2.2.1. Definitions of Different Energy Sources

There are different kinds of energy in the world. They are quite different from each other in terms of usage area, generation and storage method, and states of matter. For example, while coal is a solid matter, natural gas is in the form of gas and their generation and storage requires distinct processes. Different kinds of energy are defined below.

2.2.1.1. Renewable Energy Sources

This kind of energy sources is produced by continuous natural events. These resources are solar energy, wind power, geothermal energy, hydraulic energy, and biomass energy. The common characteristic of all renewable energy sources is that they can be regenerated in nature before they are totally run out of. Despite these energy sources are seen as the cleanest way of generating electricity or heating, the continuous supply of this energy kind may not be attained because of the high dependency of on nature, weather and climate conditions. The kinds of renewable energy sources are briefly defined below (ETKB, 2018).

2.2.1.1.1. Hydraulic energy

Hydraulic energy is the energy generated from the kinetic and potential energy of the water. The water standby in the dams could be thought of as a type of storage (IEA, 2017)

2.2.1.1.2. Solar Energy

Solar energy is the energy generated from solar radiation. Its working principle is to generate electricity or provide heating by photons hitting to solar energy (IEA, 2017).

2.2.1.1.3. Wind Power

Wind energy is the energy generated from the kinetic energy of the wind turbines (IEA, 2017).

2.2.1.1.4. Geothermal Energy

Geothermal energy is the energy which comes out of underground and it is generally in the shape of hot water or steam. Its usage is in the area of electricity generation, heating and agriculture (IEA, 2017)

2.2.1.1.5. Biomass Energy

Biomass energy is the energy converted from scrap lumber, forest debris, certain crops, manure and some types of waste residues (ETKB, 2018)

2.2.1.2. Non-renewable Energy

Non-renewable energy sources are the energy sources whose recycling process very slow (National Geographic, 2018). That's why people are generally worried about their running dry. In addition to this, most of the international authorities conduct the policies to reduce the usage of non-renewable energy sources to mitigate the negative effects of these sources to the environment due to the fact that they give too many harmful gases when they are used in the power generation or heating. The examples of non-renewable energy sources are coal, natural gas, crude oil, and nuclear energy.

2.2.1.2.1. Coal

Coal is the common name of several solid organic fuels and involves several combustible sedimentary. Ease of storage and transportation and equally distribution all around the world makes the coal critical for the countries' economies. Despite their classification is made according to different criteria, it is divided into two categories namely hard coal and brown coal according to The International Coal Classification of the Economic Commission for Europe.

- **Hard Coal:** Hard coal is the coal whose calorific value is not less than 5.732 kcal/kg. Its structure is ash-free but moist. There are two types of hard coal in the world namely anthracite and bituminous coals. While anthracite coal refers to coals which calorific value is very high, bituminous coals refer to coal whose calorific value is between medium and high. Whereas the usage area for anthracite coal is industry and residential heating, bituminous coal is used in the gasification, industrial cooking, heating, and residential heating. Bituminous coals are separated into two subgroups that are coking coal used in production for the porous coke capable of supporting a blast furnace charge and other bituminous coal known as thermal coal.
- **Brown Coal:** There are two types of brown coals which are sub-bituminous coal and lignite. While the calorific value of the former one is between 4.777 kcal/kg and 5.732 kcal/kg, the calorific value of the latter one is less than 4.777 kcal/kg (IEA, 2017).

Total proved reserve for coal is 1.035.012 million tonnes in the world in 2017. While %69 of this amount (718.310 million tonnes) belongs to the hard coal reserves, the share of the brown coal in total reserve is %31 (316.702 million tonnes) (BP, 2018).

2.2.1.2.2. Natural Gas

Natural gas, which is a derivative of a petroleum and lighter than the air, is an unscented and colorless energy source. It consists of hydrocarbons, mainly the ethanes and methanes gases (ETKB, 2018). Unlike coal, it is not equally distributed in the world and this situation makes the natural gas politically strategic and critical. Some countries with an abundance of natural gas could use it as a political tool.

2.2.1.2.3. Crude Oil

Crude oil is defined as mineral oil which is comprised of the blend of hydrocarbons (IEA, 2017). Like natural gas, its unequal distribution around the world makes it strategic and valuable for the countries.

2.2.1.2.4. Nuclear Energy

Nuclear energy is the energy which is the outcome obtained by fragmentation of big atoms (uranium or plutonium) (fission) or union of small atoms (hydrogen) (ETKB, 2018)

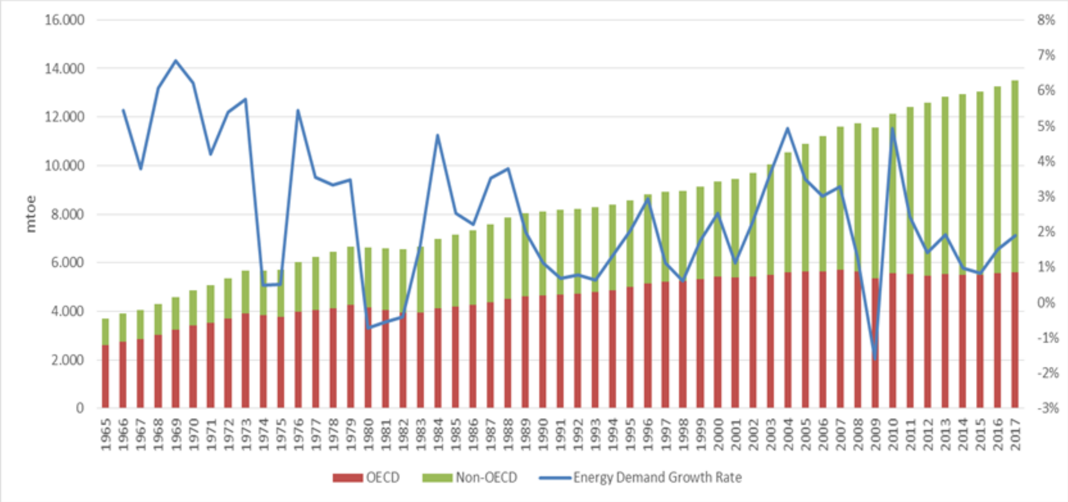
2.2.2. Total Energy, Electricity and Coal Energy Trends Throughout the World

In this section, the total energy, electricity, and coal trends are represented. In addition to this, policies related to these issues are mentioned.

2.2.2.1. World Energy Demand

As people get more comfortable and modern life, their demand for energy increased throughout time. This increase is boosted by population, an increase in industrial activities and technological advancement. To illustrate, world total energy demand was 3.701,5 me in 1965, this amount rose the 13.511,2 mtoe in 2017 by %265 increase. In figure 6, world consumption of primary energy between 1965 and 2016 (BP, 2018).

Figure 6: World Energy Demand (mtoe)



Source: (BP, 2018)

As seen in figure 6, world energy demand has increased since 1965 except the beginning of the 1980s and 2009 that correspond to the oil crisis and the 2008 global financial crisis. This increase is mainly due to the rise in the demand for energy of non-OECD countries. While average energy demand growth for the world is 2,5% between 1966 and 2017, the average energy demand growth rate for OECD and non-OECD countries are respectively 1,5% and 3,9% for the same period.

In figure 7, the OECD and non-OECD countries shares in the total energy demand are presented.

Figure 7: The OECD and non-OECD Countries Shares in Total Energy Demand

Source: (BP, 2018)

According to figure 7, the share of OECD countries in total energy consumption has decreased since 1965 while the share of non-OECD countries increased. Whereas the energy consumption share of OECD countries is 71% in 1965, it declined to 41% in 2017.

In table 1, the countries, who have the highest energy consumption and their share in the total energy consumption, in the world are illustrated.

Table 1: The Countries Who Has the Highest Energy Consumption (Mtoe)

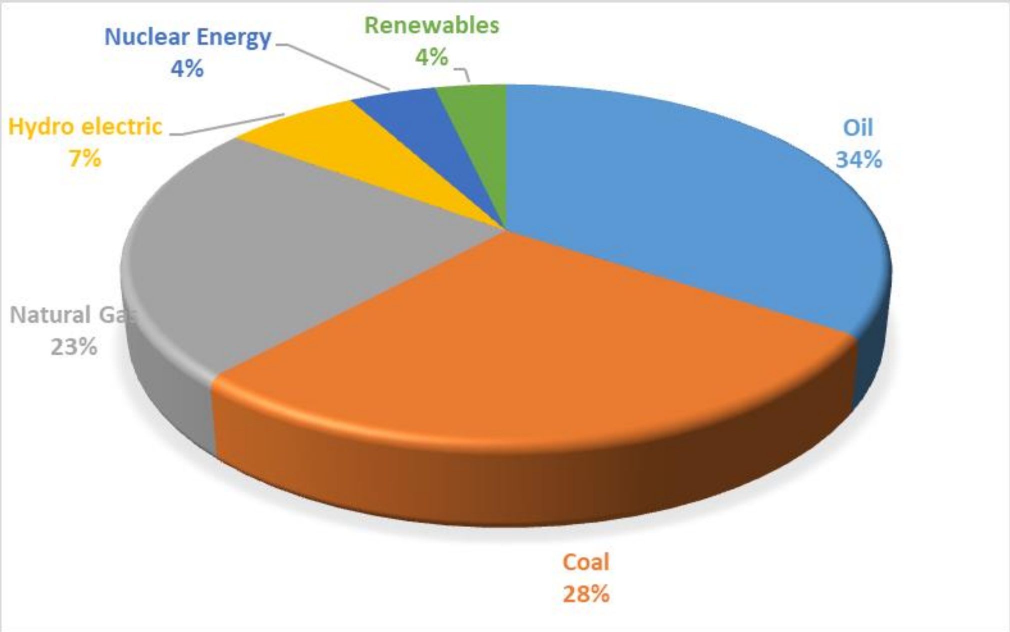
Countries	1965	1980	2000	2016	2017	1965 Share	1980 Share	2000 Share	2016 Share	2017 Share
China	131	417	1.011	3.047	3.132	3,6%	6,3%	10,8%	23,0%	23,2%
USA	1.250	1.774	2.260	2.228	2.235	33,8%	26,8%	24,2%	16,8%	16,5%
India	53	103	317	722	754	1,4%	1,6%	3,4%	5,4%	5,6%
Russia	593	1.150	613	690	698	16,0%	17,4%	6,6%	5,2%	5,2%
Japan	153	359	522	451	456	4,1%	5,4%	5,6%	3,4%	3,4%
Canada	116	217	300	339	349	3,1%	3,3%	3,2%	2,6%	2,6%
Germany	255	363	339	328	335	6,9%	5,5%	3,6%	2,5%	2,5%
South Korea	6	39	194	292	296	0,2%	0,6%	2,1%	2,2%	2,2%
Brazil	22	92	188	293	294	0,6%	1,4%	2,0%	2,2%	2,2%
Iran	9	35	125	260	275	0,2%	0,5%	1,3%	2,0%	2,0%
Saudi Arabia	20	36	115	264	268	0,5%	0,5%	1,2%	2,0%	2,0%
France	111	195	258	239	238	3,0%	2,9%	2,8%	1,8%	1,8%
United Kingdom	199	204	227	192	191	5,4%	3,1%	2,4%	1,4%	1,4%
Mexico	25	77	139	195	189	0,7%	1,2%	1,5%	1,5%	1,4%
Indonesia	7	26	102	167	175	0,2%	0,4%	1,1%	1,3%	1,3%
Turkey	8	25	73	144	158	0,2%	0,4%	0,8%	1,1%	1,2%
Italy	79	147	178	154	156	2,1%	2,2%	1,9%	1,2%	1,2%
Australia	35	72	110	139	139	0,9%	1,1%	1,2%	1,1%	1,0%
Spain	29	75	129	137	139	0,8%	1,1%	1,4%	1,0%	1,0%
Thailand	3	13	64	127	130	0,1%	0,2%	0,7%	1,0%	1,0%

Source*:* (BP, 2018)

As you can see from table 1, China consumed the highest amount of energy in the world. Its share in the world energy consumption is 23,2% in 2017. The second country following China is the US which consumes the 16,5% of the total energy consumption in the world in the same year. The US had the largest share of world energy consumption until 2008. After this year, China becomes to consume more energy than the US. Turkey consumes 1,2% of total world energy supply.

In figure 8, the share of the primary energy sources in total energy consumption in 2016 is presented.

Figure 8: The Share of the Primary Energy Sources in Total Energy Consumption in 2017



Source: (BP, 2018)

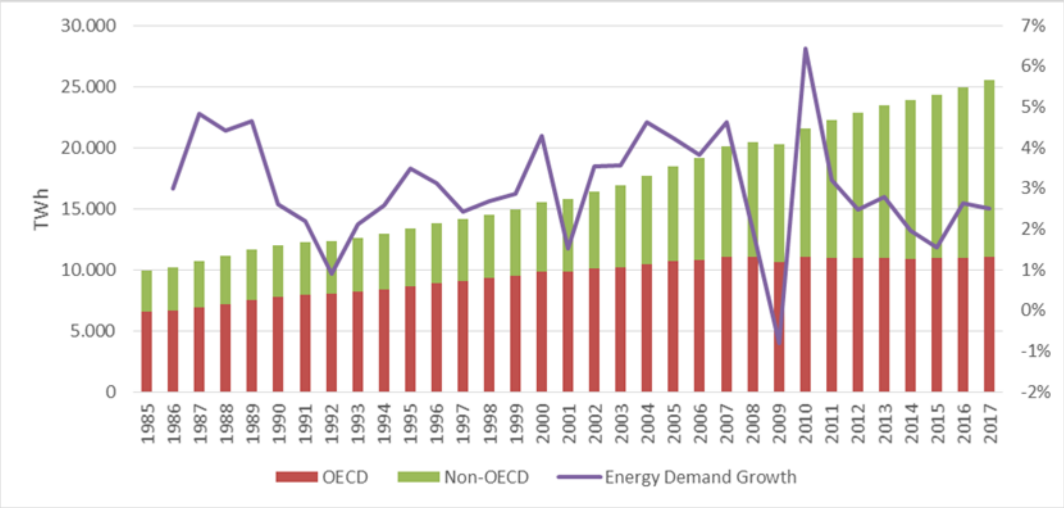
As seen in figure 8, oil has the largest share in total energy consumption. Second highest used fuel in total energy consumption is coal. Despite the criticism of international authorities, utilization of coal resources maintains its importance.

2.2.2.2. World Electricity Generation

Electricity is seen as a mean of cleaner consumption of energy. Especially increasing the share of renewables in the total electricity generation make its generation cleaner and less harmless. Electricity generation rose by 114% while total energy consumption increased only by 66% between 1990 and 2017. Despite this demand increase, 1,1 billion people are still lack of electricity access. In addition to them, total electricity demand in the world is projected to increase by 60% until 2040 according to “New Policies Scenario”[1] (IEA, 2017).

In figure 9, electricity generation development throughout history is shown.

Figure 9: Word Electricity Generation (TWh)



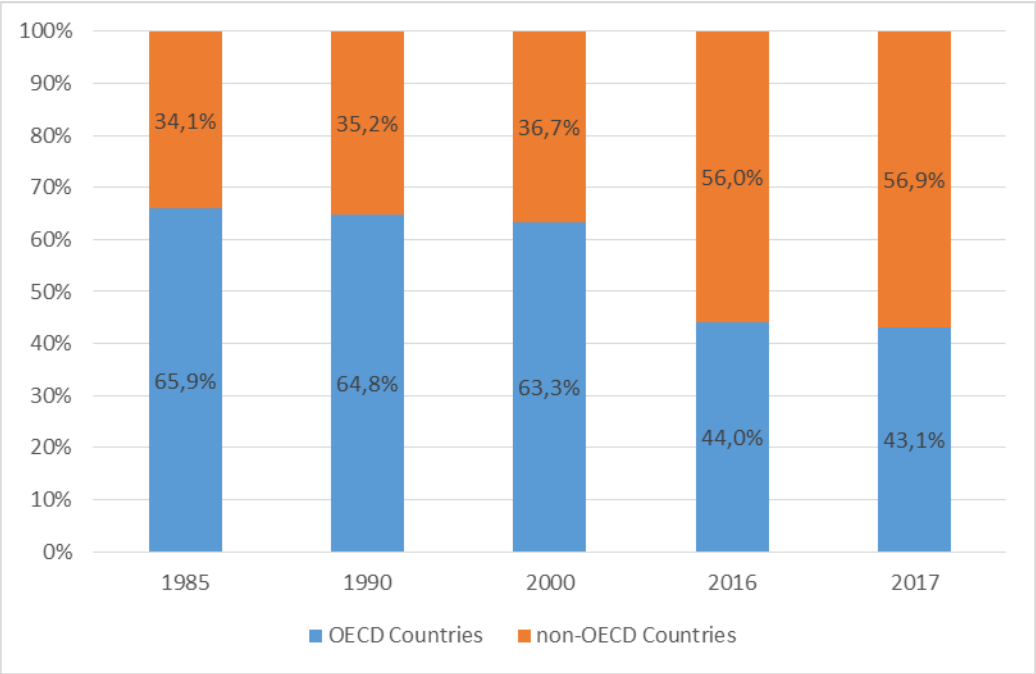
Source: (BP, 2018)

As seen in figure 9, world electricity generation continuously rose by making fluctuations except for the year of 2009 which corresponds to the global financial economic crisis. Electricity generation trend has similarity with that of the total energy demand trend. Like total energy demand trend, this increase is mainly because of the rise in the electricity generation of non-OECD countries. While average electricity generation growth for the world is 2,9% between 1990 and 2017, the average electricity generation growth rate for the OECD and non-OECD countries are respectively 1,4% and 4,6% for the same period.

In figure 10, the OECD and non-OECD countries shares in the total electricity generation are presented.

[1]“New Policies Scenario” is one of the scenarios which is used for electricity demand projection by IEA. It takes into account both implemented policy measures and announced policy measures.

Figure 10: The OECD and non-OECD Countries Shares in Total Electricity Generation



Source: (BP, 2018)

According to figure 10, the share of OECD countries in total electricity generation has decreased since 1985 while the share of non-OECD countries increased like the situation of total energy demand. Whereas the electricity generation share of OECD countries is 65,9% in 1985, it declined to 43,1% in 2017.

In table 2, the countries, which have the highest electricity generation and their share in the total electricity generation in the world are shown.

Table 2: The Countries Who Has Highest Electricity Generation (TWh)

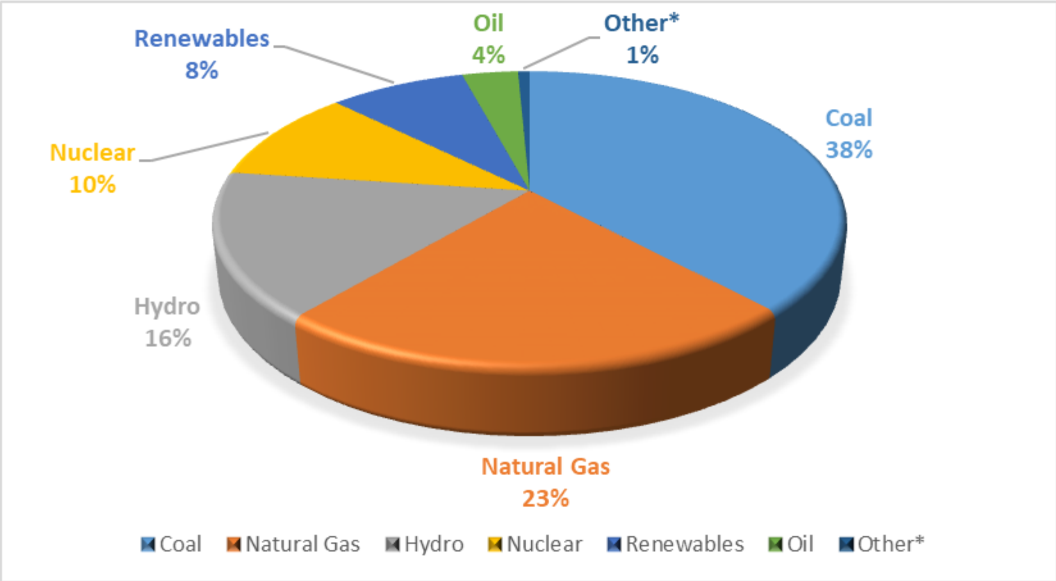
Countries	1985	1990	2000	2016	2017	1985 Share	1990 Share	2000 Share	2016 Share	2017 Share
China	411	621	1.356	6.133	6.495	4,2%	5,2%	8,7%	24,6%	25,4%
USA	2.657	3.233	4.052	4.348	4.282	26,9%	27,0%	26,1%	17,4%	16,8%
India	186	288	571	1.422	1.497	1,9%	2,4%	3,7%	5,7%	5,9%
Russia	962	1.082	878	1.091	1.091	9,7%	9,0%	5,6%	4,4%	4,3%
Japan	672	882	1.100	1.002	1.020	6,8%	7,4%	7,1%	4,0%	4,0%
Canada	459	481	604	665	693	4,6%	4,0%	3,9%	2,7%	2,7%
Germany	523	550	577	649	654	5,3%	4,6%	3,7%	2,6%	2,6%
Brazil	194	223	349	579	591	2,0%	1,9%	2,2%	2,3%	2,3%
South Korea	63	118	290	561	572	0,6%	1,0%	1,9%	2,3%	2,2%
France	343	421	540	556	554	3,5%	3,5%	3,5%	2,2%	2,2%
Saudi Arabia	52	80	139	370	376	0,5%	0,7%	0,9%	1,5%	1,5%
United Kingdom	298	320	377	339	336	3,0%	2,7%	2,4%	1,4%	1,3%
Mexico	96	118	204	320	315	1,0%	1,0%	1,3%	1,3%	1,2%
Iran	39	58	119	286	304	0,4%	0,5%	0,8%	1,1%	1,2%
Turkey	34	58	125	274	296	0,3%	0,5%	0,8%	1,1%	1,2%
Italy	186	217	277	290	295	1,9%	1,8%	1,8%	1,2%	1,2%
Spain	127	152	224	275	275	1,3%	1,3%	1,4%	1,1%	1,1%
Taiwan	56	90	185	264	270	0,6%	0,8%	1,2%	1,1%	1,1%

Source: (BP, 2018)

According to table 2, China generated the highest amount of electricity in the world. Its share in the world electricity generation is 25,4% in 2017. The second country following China is the US which generates 16,8% of the total electricity generation in the world in the same year. The US had the largest share of world electricity generation until 2010. After this year, China becomes to generate more electricity than the US. Turkey generates 1,2% of total electricity generation.

In figure 11, the share of the primary energy sources in total electricity generation in 2017 is presented.

Figure 11: The Share of the Primary Energy Sources in Total Electricity Generation



Source: (BP, 2018)

As seen in figure 11, coal has the largest share in the total electricity generation. Second fuel used in the total electricity generation is natural gas. Due to the fact coal is cheaper relatively than other fuels and has opportunities such as ease of transportation and storage, coal protects its dominant position. The details about coal are given under the next heading.

2.2.2.3. Coal Information

Coal is used in several sectors such as electricity generation, steel production, and cement manufacturing and as a liquid fuel (World Coal Association, 2018). Despite some reproof from the international authorities due to environmental concerns about its utilization, the usage of coal could be realized in a cleaner way with clean coal technologies. These technologies are created for decreasing the effects of harmful gases such as CO_2, SO_2, and NO_x in the process of coal combustion. These technologies are defined as four groups which could reduce the CO_2 emission from coal combustion by IEA. They are;

- Coal upgrading,
- Efficiency improvements at existing power plants,
- Advanced Technologies (e.g. IGCC (Integrated Gasification Combined Cycle)),

- Near-zero emission Technologies

Coal Upgrading: This stage contains ashing/drying, and briquetting of coals. This stage is commonly used in the world. Up to 5% decrease in CO_2 emission could be realized in this stage.

Efficiency Improvements At Existing Power Plants: It includes the upgrade inefficiency of the old power plants. By doing so, until a 22% decrease in CO_2 emission could be realized in this stage.

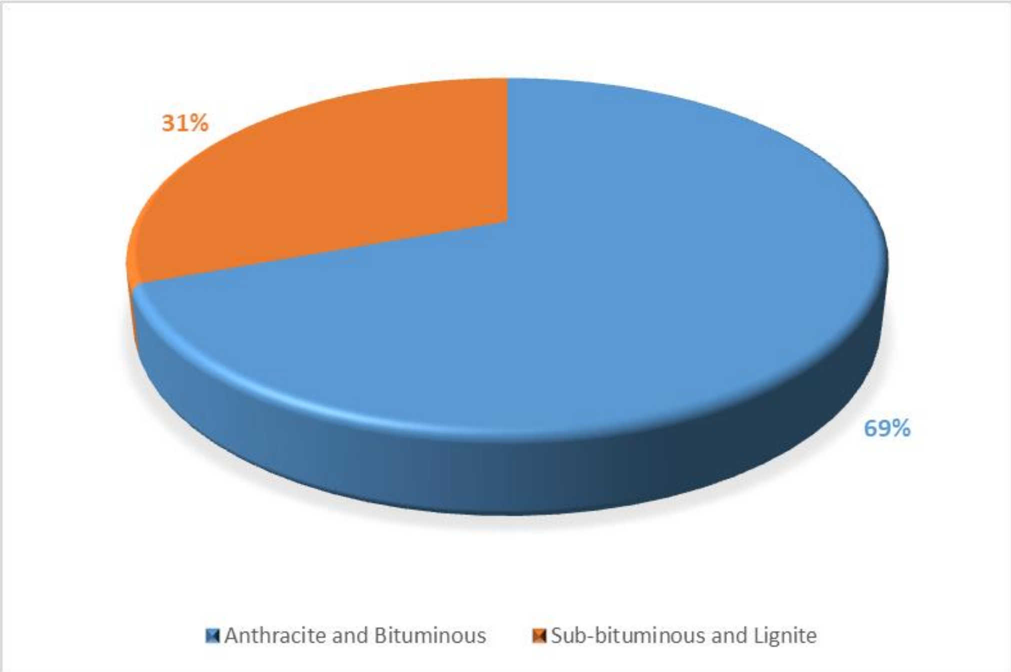
Advanced Technologies: It includes innovations such as integrated gasification combined cycle and pressurized fluidized bed combustion plants. These innovations lead to higher efficiencies and lower emissions. CO_2 emission could be realized until 25% in this stage.

Near-zero Emission Technologies: It includes the process of carbon capture and storage. In this way, CO_2 emission reduction could be realized until 99% (IEA, 2008).

Total reserve for coal in the world is 1.035,3 billion tonnes by 2017. Whereas 498 billion tonnes of this amount belongs to OECD countries, non-OECD countries have an amount of 537 billion tonnes coal reserve (BP, 2018).

The distribution of this total reserve with respect to the quality of coal is shown in figure 12.

Figure 12: The Distribution of Total Coal Reserve with respect to Quality in 2017

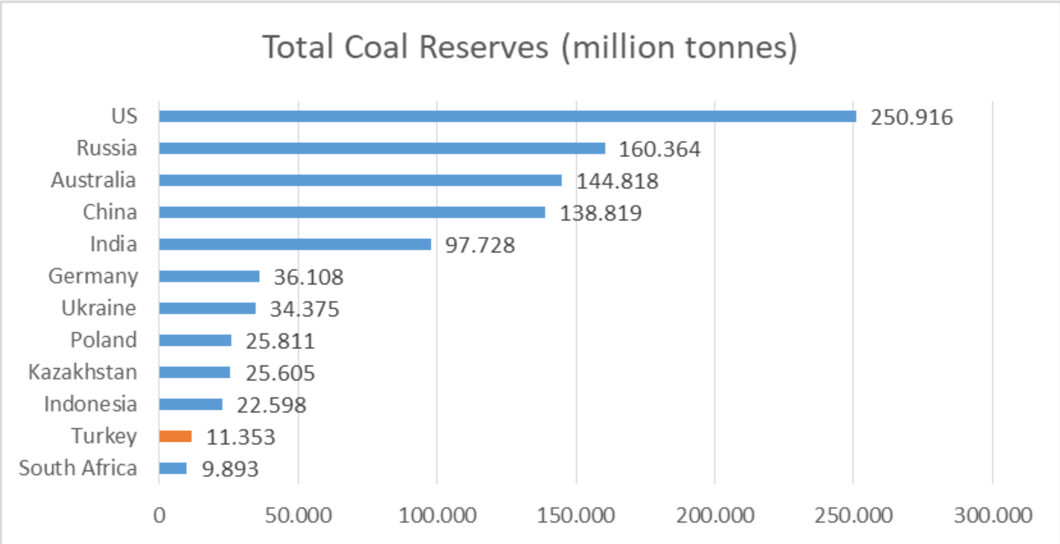


Source: (BP, 2018)

The great deal share of total coal amount comes from the qualified coals such as anthracite and bituminous (69% of total) in 2017. While the total reserve for the anthracite and bituminous coal is 718 billion tonnes, sub-bituminous and lignite coal has 317 billion tonnes. When we look at the discrimination of this distribution according to OECD countries and non-OECD countries, we see that the share of the qualified coal (64%) in OECD countries (anthracite and bituminous coal) is lower than that of non-OECD countries (74%). From this point of view, we could infer that OECD countries have fewer advantages about their coal resources than non-OECD countries because less qualified coals are more inefficient in the combustion process.

The countries which have the most coal reserves are presented in figure 13.

Figure 13: The Countries Which Has the Most Coal Reserves in 2017 (million tonnes)

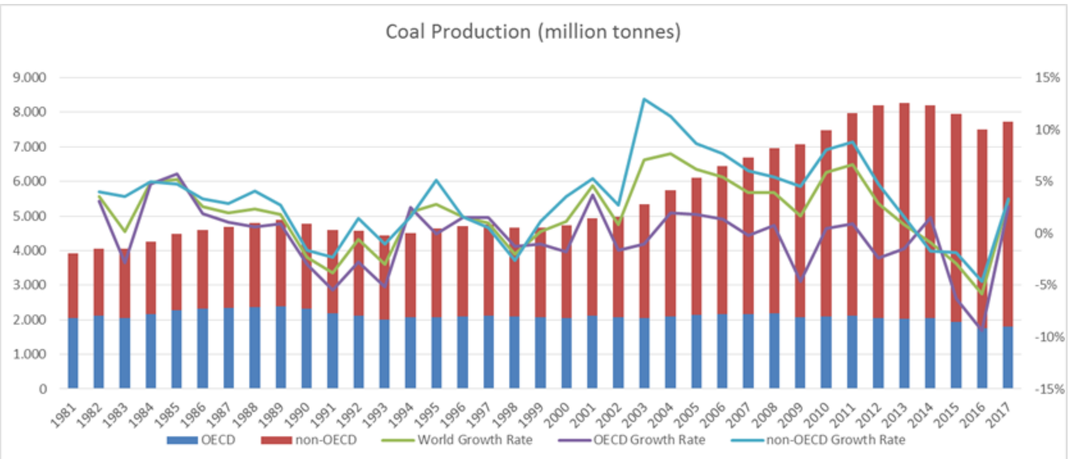


Source: (BP, 2018)

According to figure 13, the most proved coal reserves take part in the US which has 24,2% of total coal reserves. The second country after the US is Russia. Russia has 15,5% of the total proved coal reserves. The coal reserves of the first five-country, the US, Russia, Australia, China, and India which own the highest amount of coal reserves constitute the 76,6% of total proved coal reserves of the world. Turkey has approximately 1% of total proved coal reserves of the world.

Total coal production is presented in the world level, OECD and non-OECD countries in figure 14.

Figure 14: Total Coal Production in the World, OECD Countries, and non-OECD Countries

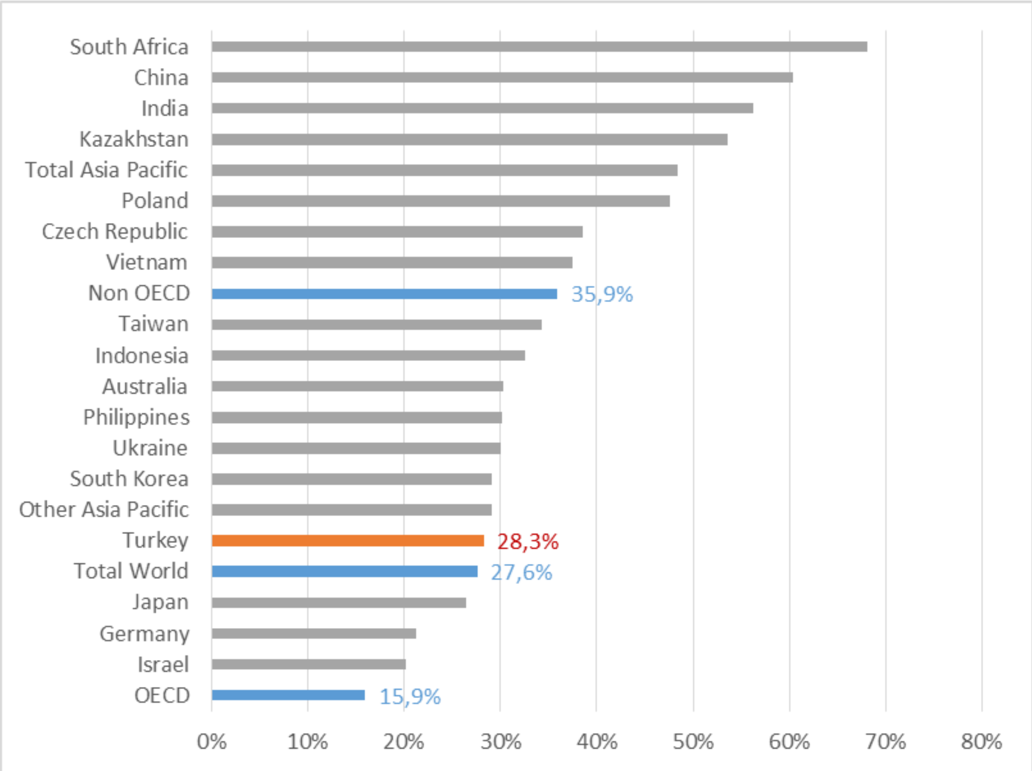


Source: (BP, 2018)

As we see from the figure 14, total coal production has generally an increasing trend until the year 2012. After that year, it started to continuously fall. The second thing related to this figure, coal production growth rate of non-OECD countries is usually greater than that of OECD countries. In this period, the average growth for coal production in the world is 2%. Whereas the average growth for coal production of non-OECD countries is 3,3%, the average growth for coal production of OECD countries is -0,3%.

The share of the coal utilization in the total energy mix is presented in figure 15.

Figure 15: The Share of The Coal Utilization in The Total Energy Mix Across The Countries in 2017

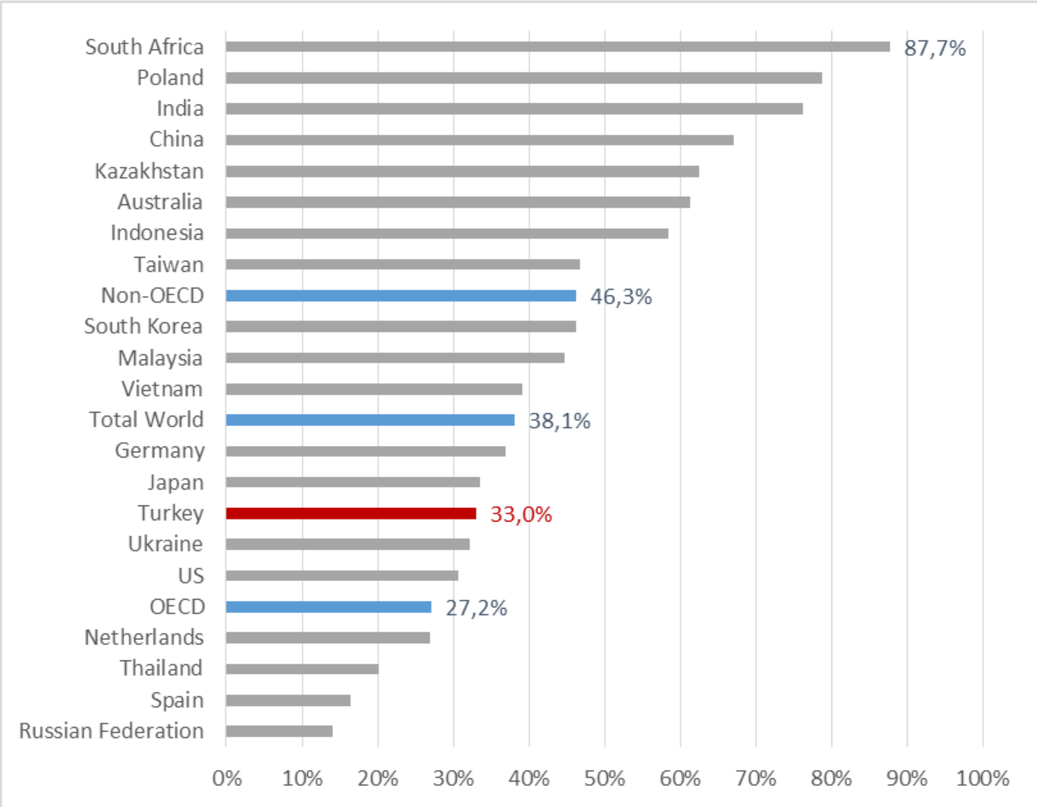


Source: (BP, 2018)

The figure 15 indicates that coal share in the world energy mix in 2017 is 28,3%. The situation of Turkey in this issue is similar to the world level. There is a large number of countries whose coal share in their total energy mix is more than that of world level. For example, South Africa, which has the highest coal share in the total energy mix, is consuming the amount of coal that is 69,6% of its total energy supply. In this figure, we may infer that Turkey which uses coal in its energy supply approximately equal to world level as percentages, should not be criticized for utilizing the excessive amount of coal in its energy supply because there are some other countries that use the coal more than Turkey in percentages. Turkey already should increase the coal share of the total electricity generation due to the lack of any other local energy sources than coal resources and concerns of the current account balance.

For our analysis, seeing the share of the coal resources in the total electricity generation could be beneficial. In the figure 16, the share of the coal in the total electricity generation is shown.

Figure 16: Coal Share in Electricity Generation in World and Across Some Countries in 2017



Source: (BP, 2018)

As we see from the figure 16, the coal share in total electricity generation differs from one country to another. The main reasons behind this are that abundant energy resources, energy policies, existing power plants, etc. in different countries. For example, while France produces the most of electricity from existing nuclear power plants, there is no nuclear power which is in operation in Turkey by 2018.[2] In addition, a country may have more coal resources than others and this could affect its policy implementation about using more coal relatively than other in electricity generation. Energy policies could be an important factor which determines the share of the coal in total electricity generation. For instance, some countries could reduce coal utilization in electricity generation by investing more in renewable technologies. According to figure 16, Turkey's coal share in its total electricity mix is quite below the world level. That's why Turkey is thought to have some righteous space to invest more coal-fired power plants than most of

[2] There are two nuclear power plants, namely, Akkuyu NGS and Sinop NGS, which will be built in the following years in Turkey.

the countries in the world to deal with the problem of external dependency on energy.

2.2.3. Energy Policies of Some Countries

2.2.3.1. The US

The US is one of the most important countries in terms of the energy sector. The country is the second highest energy consumer in the world with consumption of 2.235 Mtoe in 2017. Coal share in this total is 14,9% which is quite below the world level. The largest share of the total energy mix belongs to the oil and natural gas with percentages of 41% and 28% respectively. While the US is capable of producing the 66% of its total consumption of oil, 99,3% of the natural gas demand could be met by the US own production in 2017 (BP, 2018).

Total electricity generation of the US is 4.282 TWh. 30,7% of total electricity generation is provided by coal-fired power plants. This level is quite below the world average level (38,1%) (BP, 2018).

In the US, 92,7% of produced coal is utilized in electricity generation (EIA, 2018).

Recently, the US promulgated a couple of policy documents related to its energy sector. These are “President’s Blueprint for a Secure Energy Future (2011)”, “All of The Above Energy Strategy (2012)”, “American Recovery and Reinvestment Act of 2009” and Clean Power Plan (2014) (IEA, 2014).

In the “President Blueprint for a Secure Energy Future (2011)”, there are issues which include the improving domestic energy supply, reducing cost and energy saving issues and innovative clean energy futures (IEA, 2014).

“All of the Above Energy Strategy (2012)” contains the pillars of supporting economic growth and employment creation, improving energy security and deployment of low carbon-intensive energy technologies (IEA, 2014).

“American Recovery and Reinvestment Act of 2009 ” was passed by American Congress as “Recovery Act” or stimulus package as a response to the economic crisis. This document has three goals which are to create new jobs and save the existing ones, to increase the economic activities and invest in the long run growth and to promote the accountability and transparency in government spending. To deal with these targets, the Recovery Act provided funds for tax cuts and benefits for business world; unemployment benefits and the like; and federal contracts, loans, and grants (IEA, 2014).

Another policy document is "Clean Power Plan" under "Clean Air Act" which firstly brought some standards about CO_2 emissions of existing power plants. However, this regulation started to be criticized by the last government of the US and repeal of this document are thought by the current President (The New York Times, 2018)

As understood from all of the above, there are so many policy documents which affect the future energy outlook of the US. When we evaluate these regulations in general, it could be understood that the US made so much effort to secure its energy supply by taking measure in demand and supply sides, to make cleaner and more efficient production of energy. However, the US is capable of rejecting the demands of international authorities about reducing the greenhouse gas emission and coal use in total electricity generation when these demands are not compatible with the interest of the US such as the repeal of Clean Power Plan. Therefore, the US government review "Paris Agreement", which aims to strengthen the global response to the threat of climate change by keeping a global temperature rise well below 2 degrees Celsius above pre-industrial levels in the long term and "Clean Power Plan" (United Nations Climate Change, 2018).

2.2.3.2. China

China is the country that makes the most energy consumption in comparison with other countries. Its total energy consumption corresponds to the amount of 3.132 Mtoe in 2017. Coal share in its total energy mix is 60,4% which is the second highest rate after South Africa in the world. China is foreign dependent in terms of both natural gas and oil consumption (BP, 2018).

When we look at the Chinese energy strategies, a great transition in energy policies was seen throughout history. Energy demand growth for the Chinese economy has been decreasing in comparison with the previous years from an annual average of more than 8% between 2000 and 2010, to less than 3% per year since 2010. Coal use has been also declining since 2013. Conversely, China is still the world's largest investor in the renewable-based generation and is a flag-bearer in energy efficiency and new technologies. These indicate that China experiences a big transition in energy policies. The reason behind these is that although China manages high economic growth, this growth had harmful effects on the environment and public health. That's why, the Chinese government implements the policies to reduce the harmful effect on the environment and public health (IEA, 2017). There are so many energy-related issues in Chinese five-year plans throughout history.

In every five year plan has specific targets for China because each plan period has its own characteristics. For example, there are specific goals for energy production in the earlier five year plans while, especially in eleventh five-year plans, there are energy efficiency targets because China changed its energy strategy from supporting the energy production increase to the energy efficiency policies. Furthermore, China also changed its international energy trade strategy in oil commodity. The country became net oil importer in 1993 which corresponds to the eighth five year plan period (Yuan & Zuo, 2011).

In the last five year plan, thirteenth five-year plan, there are so many issues about the transition of cleaner energy production, energy efficiency targets, and energy conversion policies. There are commitments about using the alternative energy sources which are cleaner in the rural and urban areas. Even, there is a section about the energy conversion policies. The energy-related policies are summarized in table 3.

Table 3: Some Policy Targets in Thirteenth Five Year Plan of China

High-Efficiency Smart Power System	• Increase the development of quality peak shaving power sources such as pumped-storage hydroelectric plants, main hydropower plants, and natural gas peaking power plants,
	• Improve the development of storage power plant and efficient power plant demonstration projects,
	• Strengthen integration and complementarity between different power sources and storage facilities,
	• Change the power system into more adaptive and efficient ones.
Clean and Efficient Coal Utilization	• Implement the upgrading action plan for energy conservation and emissions reductions in coal-based power generation,
	• Carry out nationwide upgrades of coal-fired power units to achieve ultra-low emissions and energy efficiency,
	• Ensure average coal consumption per kilowatt-hour is kept below 310 grams in existing power plants and below 300 grams in new power plants,
	• Increase the proportion of coal used for power generation.
Renewable Energy	• Building extra capacities for hydropower plants,
	• Accelerate the wind power plants and photovoltaic power in some regions of China,
Nuclear Energy	• Capacity increases in nuclear energy by building new ones,
Unconventional Oil and Gas	• Build coal seam gas industrial bases in some regions.
	• Increase the exploration and usage of shale gas in some regions,

Source: (Compilation and Translation Bureau, 2016)

To conclude, although China has a shy at an energy transition, national interests are playing a great role in determining the energy policies. The coal share in both total energy mix and power generation are still too high in comparison with the other countries. In the last five year plans, China tries to achieve energy conversion policies to reduce the damage in the environment and public health issues and more importantly to import less. There are other attempts to decrease the foreign dependency in energy such as energy efficiency policies, clean coal technologies, increasing the share of the renewable energy sources, capacity increases in nuclear power plants, exploration of alternative oil and gas resources. These policies are for China to hold its current account balance stable and provide the energy supply security (Compilation and Translation Bureau, 2016).

2.2.3.3. India

India is one of the most important countries in the world energy sector. Its total energy consumption in 2017 is 753,7 mtoe. Its coal share in the total energy mix is 56,3% which is the third highest rate after South Africa and China. (BP, 2018).

In Indian tenth five year plan which covers the period between the years of 2002-2006, there are aims of increasing the coal and electricity production, enhancement of hydrocarbon exploration and development, joining the overseas oil activities, restructuring and deregulation of energy sector, management of demand side to increase the energy efficiency, increase the attempts for the anti-pollution measures. Like the Chinese government, the Indian government also take measure for energy security issue. Therefore, Indian government accorded priority treatment about domestic energy production, alternative energy development, and energy saving policies to curb oil imports, improving relations with the oil-producing countries and improving the oil stockpiling (Ishida, 2007).

We see some energy policy tools in several documents for the Indian energy sector. In Integrated Energy Policy 2008, there are commitments about the sustainable growth which takes into account energy security, accessibility, affordability and cost while Electricity Act 2003 includes components that enable the development of electricity industry, healing the situation and protection of interests of electricity consumers and environmentally friend energy policies. In addition to them, the Tariff Policy is developed. In this policy, ensuring the accessibility of electricity to consumers at reasonable prices and financial viability of the sector; promoting transparency, consistency, and predictability in regulatory approaches and improvements in quality of supply are covered. Lastly, India has a “National Action Plan on Climate Change” promulgated in 2008. It has some actions about the development of solar power instead of conventional energy sources. It has also some statements which promote the research and development of IGCC and supercritical Technologies and mandating the retirement of the inefficient coal-fired power plant (Goyal, Mishra, & Bhatia, 2017).

Like China, India has an energy dependency on foreign countries. It develops some policy implementation to deal with the issue of energy security. Despite it emphasizes the importance of the development of renewable energy sources in its total energy mix, it has also some applications about utilizing the coal resources, clean energy sources, etc.

2.2.3.4. Germany

Germany has the most energy consumption level among the European countries in 2017. Its world ranking in this area is seven after the countries of China, the US, India, Russia, Japan and Canada for the same year. Its total energy consumption is 335,1 mtoe. Germany has a serious amount of coal reserves in comparison with most of the countries. However, almost all of the coal reserves consist of the low quality of coals, namely, sub-bituminous and lignite. These coals are more harmful to the environment in comparison with the coals with higher calorific value. The share of the coal with high calorific value is negligible (BP, 2018).

Before beginning with Germany, there are a couple of general policy implementations about the European energy sector. These are deregulation and liberation of the energy sector, the policies about climate change and energy security policies. These are also adopted by Germany. For instance, while some other countries such as Poland and Czechoslovakia kept using the coal, Germany promised about reducing the greenhouse gas emissions for the environmental concerns on “Kyoto Protocol” to “the United Nations Framework on Climate Change. Until 2010, half of the total energy mix produced from the coal, the rest came from the other sources like nuclear, gas and renewables. On the other hand, renewables share began to increase while nuclear has decreased after 2010. The coal tracks the static trend in the mentioned period (Renn & Marshall, 2016).

The policies related to energy sector varies from the period to period for Germany as other countries mentioned above. However, today, Germany has a unique policy implementation about the shutdown of nuclear power plants by 2022 due to the safety concerns after the events of Fukushima in Japan. In addition to that, Germany promised about reducing the harmful effect of energy use by decreasing greenhouse gas emissions. Decreasing or depletion of the nuclear share in the total energy mix are expected to be offset by increases in the capacities of renewable energy sources. However, Germany hesitates about reducing the lignite share in the total energy mix for the precaution for the periods called if the “wind does not blow and the sun does not shine” (Renn & Marshall, 2016).

Germany has also similar policy implementations. To give an example, these policies are “Integrated Energy and Climate Programme of August 2007”, “Energy Concept 2010” and “The Energy Packet”. Whereas “Integrated Energy and Climate Programme of August 2007” and “Energy Concept 2010” which have the statements and targets for reducing the greenhouse gas emissions and increasing the share of the renewable energy sources in the total energy mix, Energy Package 2011, which includes roadmap after phase-out decision about nuclear energy power plants. (IEA, 2013).

To sum up, lignite coal reserves are very important for its energy security and economy because Germany is also a country which is energy dependent on other countries. Despite the government favors renewable energy sources instead of fossil fuels, lignite stays in a very special place for being a secured, cheap and continuous energy source. Together with the decision to shut down the nuclear power plants, its importance for the energy sector, economy, and current account balance are highlighted once more.

2.2.3.5. Australia

Total primary energy consumption is realized as 139,4 mtoe for Australia in 2017. The coal share in this total is 30,3% which is the second highest share in total energy mix after oil (37,6%). For Australia, coal is one of the most important energy sources. Australia is the third among the countries who have the most coal reserves after the US and Russia. Besides, Australia is the country with the largest amount of coal exports. Its total export 392,3 million tonnes in 2015 which corresponds to 30% of the total export of coal in the world (BP, 2018). Australia is also the net exporter of the uranium and natural gas and has abundant of renewable energy sources (IEA, 2018).

There are some policy implementations about the Australian energy sector. One of them is “National Greenhouse and Energy Reporting Act” promulgated in 2007 which contains imposing sanctions for the mine owners who exceed the determined level of the greenhouse gas emissions. The second regulation is a plan called “Securing a Clean Energy Future” which was introduced in 2011. In this plan, carbon pricing concept is defined to deal with the pollution problem (Küçükönder, 2014). The other policy paper is “Energy White Paper” which is published in 2015. It has some pillars which are greater competition in energy markets, more productive use of energy to lower costs, boosting economic growth, encourage innovation and resources development and increase the employment and exports. It has some undertakings about greenhouse gas emission reduction, rise in the renewable energy share in the total electricity generation (IEA, 2018).

All in all, Australia tries to make the production of energy in a continuous, cheap and secure way as other countries do. For this purpose, while it plans to increase the share of the renewable energy sources and reduce the greenhouse gas emissions, it also protects its coal-dominant role in both its energy sector and international platform.

Although these country examples may be different from each other in terms of abundance of sources, dependency on other countries, energy production level, the number of reserves of several energy sources, they share some common points. Firstly and more generally, they all want to provide energy in a continuous, cheap and secure way. For this reason, they try to adopt world energy trends while taking into account their own situations. Secondly, they all care about utilizing the local energy sources with high priority. We can see the positive relationship between which resources they are abundant mostly and which resources they consume mostly. Thirdly and lastly, they all have policy implementations about improving cleaner energy technologies to reduce the harmful effect of greenhouse gases without finishing up coal activities totally. Rather, they generally develop the technologies to address the question of how we can utilize our coal resources in a cleaner way.

CHAPTER 3

3. TURKEY’S ENERGY OUTLOOK AND CURRENT ACCOUNT BALANCE

Turkey is poorly endowed by the energy sources in comparison with the other countries. Therefore, the energy dependency of Turkey reached around %74 in 2016. This ratio was about %32 in 1972 (ETKB, 2018). There are several reasons for this increase. They are inadequate reserves of oil and natural gas, economic growth and take or pay practices and long term agreements in natural gas imports. Take or pay practices mean that buyer country is obliged to pay for a determined amount of natural gas regardless of completing the purchasing transaction. Therefore, countries, which accepted this term, choose the buy the determined amount of natural gas even if they do not need it (Açıkel, 2010)

Unlike the inadequacy of oil and natural gas, Turkey has several coal reserves which are located in its several regions. Most of these sources are lignite which is the less calorific valued coal resources. Because of the high growth and insufficient amount of other resources such as oil and natural gas, lignite plays a very critical and significant role for Turkey's energy security. That's why their utilization should be somehow undertaken. Otherwise, the vulnerable external balance of Turkey would be worsened by becoming a more dependent country. Besides the point of the decreasing burden on current account balance, utilization of lignite sources provide serious employment opportunities, energy supply security and reliable energy production. Due to the fact that natural gas provision is affiliated with political issues and international relations between countries, its supply could be cut because of non-economic reasons. In these situations, countries' own energy resources play a great role to prevent any interruption in energy supply thanks to its cheapness and accessibility. In these cases, Turkey could use its lignite resource to compensate for the decreased amount of natural gas or any other imported energy source. That's why lignite reserves are seen as an energy source which provides supply security. Lignite power plants also provide serious employment opportunities in comparison with natural gas and imported coal power plants. Thus, governments could prevent some amount of immigration from rural to urban areas and minimize the inequality between these regions by constructing the lignite power plants in the county sides. Thirdly, lignite-fired power plants provide reliable electricity generation for the periods when “the wind does not blow and the sun does not shine”. Since electricity storage costs are very high in these days continuous and reliable electricity generation is significant for countries, utilizing the lignite sources in electricity generation is inevitable for a reliable electricity generation (Sitti, Tanrısever, Külfetoğlu, & Derinkuyu, 2016).

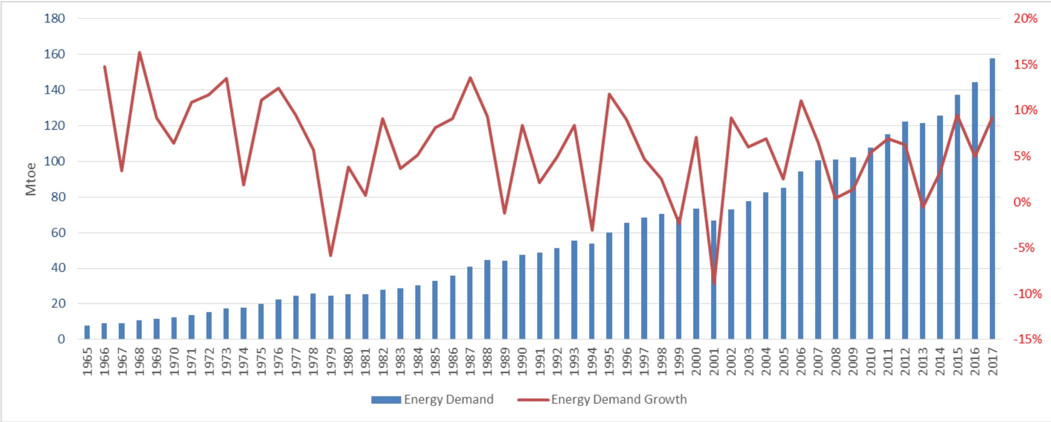
Just as the inadequacy of energy sources, Turkey has problems with its current account balance. The problem with Turkey's current account balance raises from the deficit in its foreign trade balance. While the total current account deficit is about 47 billion USD, the total foreign trade deficit is around 59 billion USD in 2017. The service balance gives a surplus for a long time. The item which contributes to the deficit of foreign trade balance mostly is imports of intermediate goods. The share of intermediate goods' import in total import is %74 in 2017. That's why policymakers should focus on decreasing foreign dependency on intermediate goods. When we analyze the intermediate goods' import in detail, we could see that 21% of intermediate goods import comes from only energy. These numbers indicate that if we take serious action about reducing the import of energy, we could reduce some burden of the current account balance ((TCMB, 2018), (Hazine ve Maliye Bakanlığı, 2018)).

After giving brief information about the energy sector situation of Turkey, details of energy demand, details of electricity generation and coal resources and energy position within the current account balance.

3.1. TURKEY’S ENERGY DEMAND

The energy demand development of Tukey, throughout history, is presented in the figure 17.

Figure 17: Turkey's Energy Demand Development (mtoe)

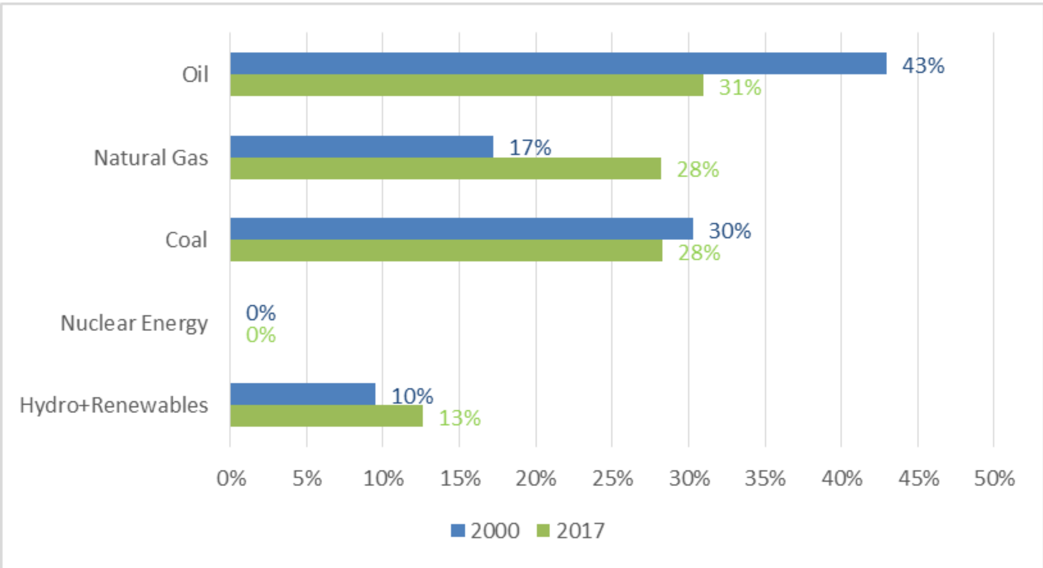


Source: (BP, 2018)

As seen from figure 17, the demand for total primary energy increased throughout the time by fluctuations. While the demand for the total primary energy was around the 70 mtoe in the earlier stages of the 2000s, it exhibits more than 100% increase as of 2017 by reaching the amount of 157,7 mtoe. The average growth rate between 1966 and 2017 is 6% which is quite high.

Figure 18 illustrates the share of the primary energy sources in the total primary energy supply.

Figure 18: The Share of the Primary Energy Sources in Total Energy Mix



Source: (BP, 2018)

When we look at the primary energy shares in the total energy mix, a big shift from the natural gas to oil is observed. Whereas the share of the natural gas in the total energy mix is 17% in 2000, this share increased to the rate of 27% in 2016.

The share of the oil decreased from the levels of 43% to levels of 30%. There is no large change in the coal share in the total energy mix for the same period (from 30% in 2000 to 28% in 2016). In addition to these deductions, there is splashing in the share of renewable energy share in the total energy mix for the mentioned period. The reason behind this issue is that there are numbers of a governmental effort to subsidize renewable energy sources such as "Yenilenebilir Enerji Kaynakları Destekleme Mekanizması (YEKDEM)". Add to this, support mechanism for the renewable energy sources are ongoing such as "Yenilenebilir Enerji Kaynak Alanları" (YEKA) (ETKB, 2018). The two energy sources, which Turkey is dependent on mostly, gets the respectable share of the total energy mix. This issue is the answer to the question of why Turkey is so much dependent on foreign countries to provide its supply security. The increase in the share of the natural gas in total energy demand could be linked to the affidavits to the international authorities, the environmental concerns and increase in the living standards of people such as changing their heating method by changing the fuel from the coal to natural gas.

3.2. TURKEY'S ELECTRICITY SECTOR

The Turkish electricity sector consists of generation, transmission, wholesale, distribution and retail selling sub-sectors like the other electricity sectors in the world. Although these sub-sectors are undertaken by the different companies nowadays, they were in a vertically integrated structure in older times. As time passed, the functions of electricity started to be separated.

3.2.1. Short History and Structure of Turkey's Electricity Sector

The first electricity generation began with the 2 kW capacity dynamo connected to a watermill in Tarsus in 1902 in Turkey. In 1914, the first significant electricity power generating unit named as, Silahtarağa Power Plant, was established. In 1935, the first power administration namely, Etibank, was established to deal with the various and different work functions such as providing to operate underground resources efficiently, carrying out the electricity generation and distribution and perform banking businesses. Because of the expansion of the Etibank's functions, Türkiye Elektrik Kurumu (TEK) was established in 1970 to transfer the Etibank's functions related to electricity. TEK was in a vertically integrated structure which included all the functions of the electricity sector. The dominant role of the public in the electricity sector continued until 1983. In 1984, implementation of electricity sector functions was allowed to the private sector. Build Own Operate (BOO), Build Operate Transfer (BOT) and Transfer of Operational Rights (TOR) power plants were encouraged to execute the electricity sector functions by the promulgation of Law No. 3096 Türkiye Elektrik Kurumu Dışındaki Kuruluşların Elektrik Üretimi, İletimi, Dağıtımı ve Ticareti İle Görevlendirilmesi Hakkında Kanun. TEK was divided into two structure, namely, Türkiye Elektrik Üretim İletim Anonim Şirketi (TEAŞ) and Türkiye Elektrik Dağıtım Anonim Şirketi (TEDAŞ) in order to provide more effective, efficient and modern services in 1993. The decomposition of the vertically integrated structure took place in 2001 and TEAŞ was separated into three different companies which are Elektrik Üretim Anonim Şirketi (EÜAŞ), Türkiye Elektrik İletim Anonim Şirketi (TEİAŞ) and Türkiye Elektrik Ticaret ve Taahhüt Anonim Şirketi (TETAŞ) ((TEİAŞ, 2018); (Eti Maden İşletmeleri Genel Müdürlüğü, 2018)).

- EÜAŞ performs the electricity generation from publicly owned power plants. EÜAŞ is also the owner of most of the lignite mine sites (EÜAŞ, 2017).
- TEİAŞ carries out the transmission activities and performs the system operation (TEİAŞ, 2018).
- TETAŞ[3] performs wholesale activities such as energy sales, purchase agreements, prepare the wholesale electricity tariffs and implement the approved tariffs by Enerji Piyasaları Düzenleme Kurumu (EPDK) (TETAŞ, 2018).

TEDAŞ was introduced into the privatization program in 2004 by the decision of Özelleştirme Yüksek Kurulu (2004/22) and Turkey is divided into 21 distribution regions. The privatization of affiliate companies of TEDAŞ was completed by 31.08.2013 and TEDAŞ kept its old legal status with limited authority and responsibility. In addition to them, the separation of retail sale activities was

[3] Although TETAŞ is unified with EÜAŞ by the delegated legislation with number 703 on 2/7/2018, they are described and shown in this thesis separately because their functions are very different from each other.

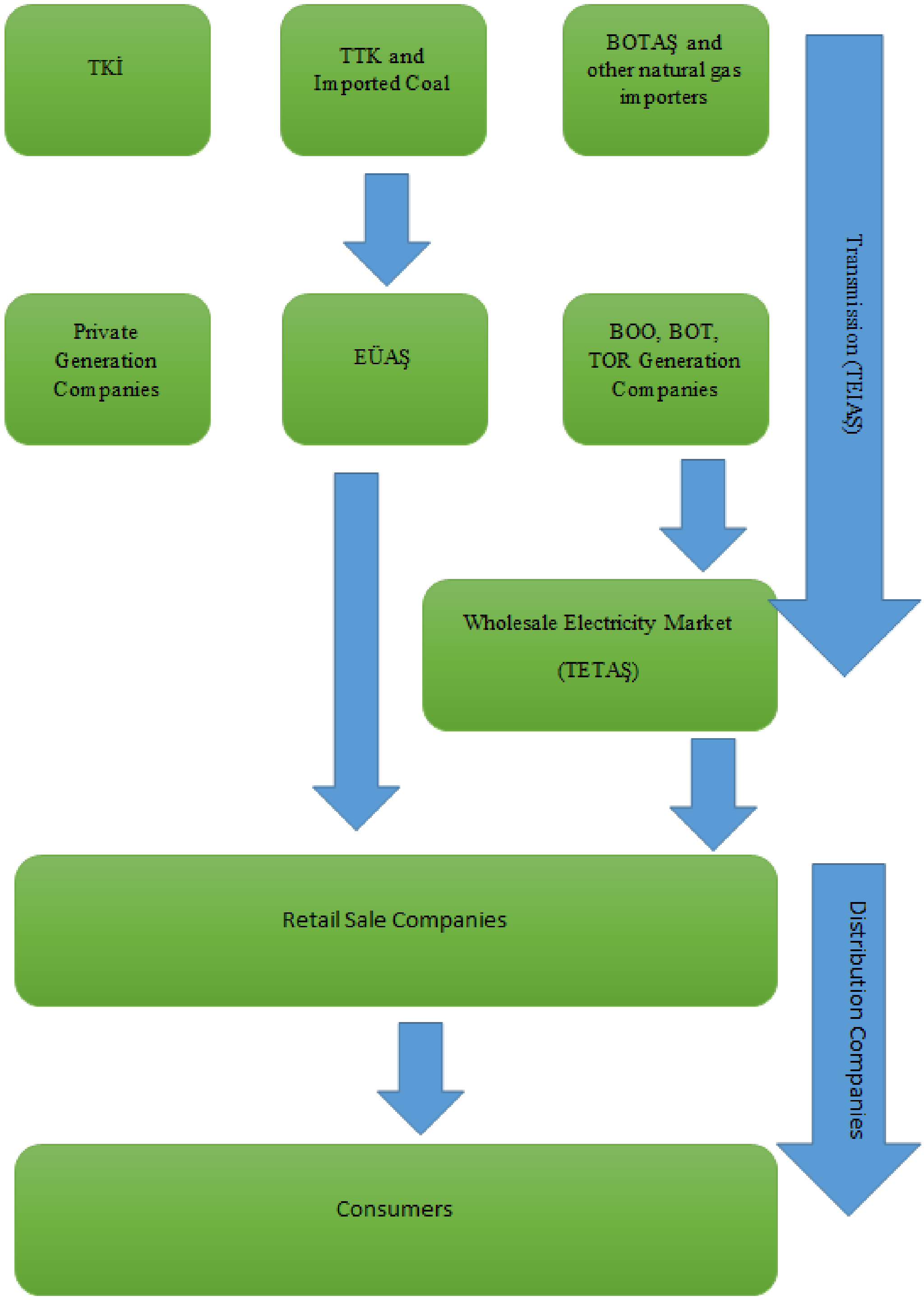
separated from the distribution companies and new companies were created for maintaining this function (TEDAŞ, 2018).

The other electricity sector players are Türkiye Kömür İşletmeleri (TKİ), Türkiye Taşkömürü Kurumu (TTK), Boru Hatları İle Petrol Taşıma A.Ş. Genel Müdürlüğü (BOTAŞ), distribution companies, and retail companies.

- TKİ puts into good use lignites and other energy sources. TKİ is also the owner of some lignite mine sites (TKİ, 2018).
- TTK puts into good use the hard coal resources ((TTK, 2018).
- BOTAŞ is the company undertakes the functions of operations of petroleum and natural gas pipelines, trade of natural gas and LNG (BOTAŞ, 2018)

The overall scheme for Turkey's electricity sector is drawn in figure 19.

Figure 19: The Overall Scheme for Turkey's Electricity Sector



Source: Author's Own Drawing

As seen in figure 19, contemporary Turkey's electricity market structure and players of this sector are shown. According to figure 19, TKİ, TTK, and BOTAŞ, which are all state-owned enterprises, provides input for electricity generation. While TKİ and TTK supply the lignites and hard coal respectively, BOTAŞ is the main provider of natural gas for electricity generation.

Electricity generation is realized by EÜAŞ which is a publicly owned company, private sector and BOO, BOT and TOR companies which are the examples for public-private partnership.

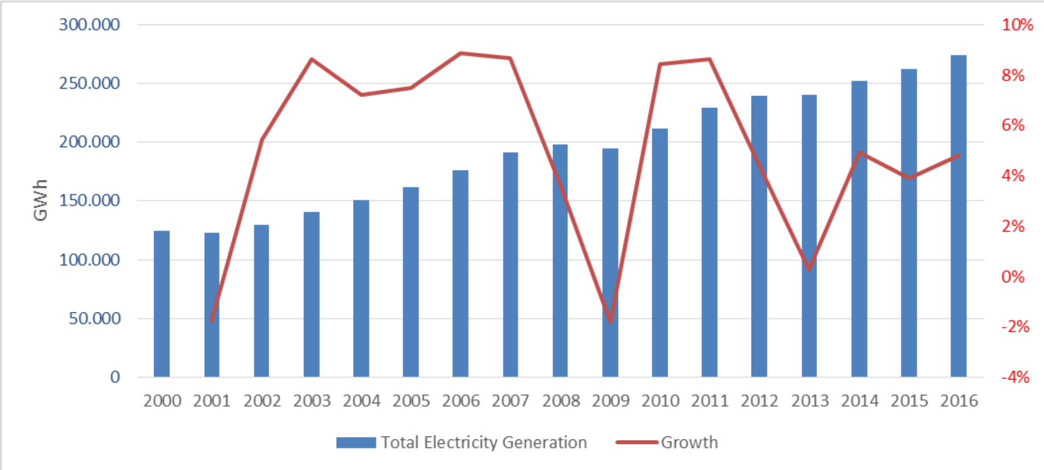
The trade part of the electricity sector is composed of wholesale and retail selling. TETAŞ is the first and only wholesale company in Turkey (TETAŞ, 2017). EÜAŞ and the companies which have public-private partnership contracts could sell their electricity to TETAŞ. In addition to them, TETAŞ buys the amount of electricity generated by power plants which use the local coals the determined by "Cabinet Decree No. 2016/9096 and 2017/11070" to support the usage of local coal resources in electricity generation. While the "Cabinet Decree No. 2016/9096" envisaged this support only for the power plants that produce electricity with domestic coal, "The Cabinet Decree No. 2017/11070" has extended this support to include coal-fired power plants which use both local and imported coal for their electricity generation. However, according to "the Cabinet Decree No. 2017/11070", this incentive is given based on the local coal rate of the total coal used in electricity (T.C. Resmi Gazete, 2018).

In the consumption part, there are two types of consumers in terms of being free for choosing their suppliers, namely, eligible consumers and non-eligible consumers. Eligible consumers are the consumers whose yearly consumption level exceeds the determined limit by EPDK. This limit was determined 2000 kWh/year for 2018. While these consumers are free to choose their electricity provider, non-eligible consumers do not have such an option. (EPDK, 2018)

3.2.2. Electricity Generation

The historical development of Turkey's electricity demand is shown in figure 20.

Figure 20: The Historical Development of Turkey's Electricity Demand (GWh)

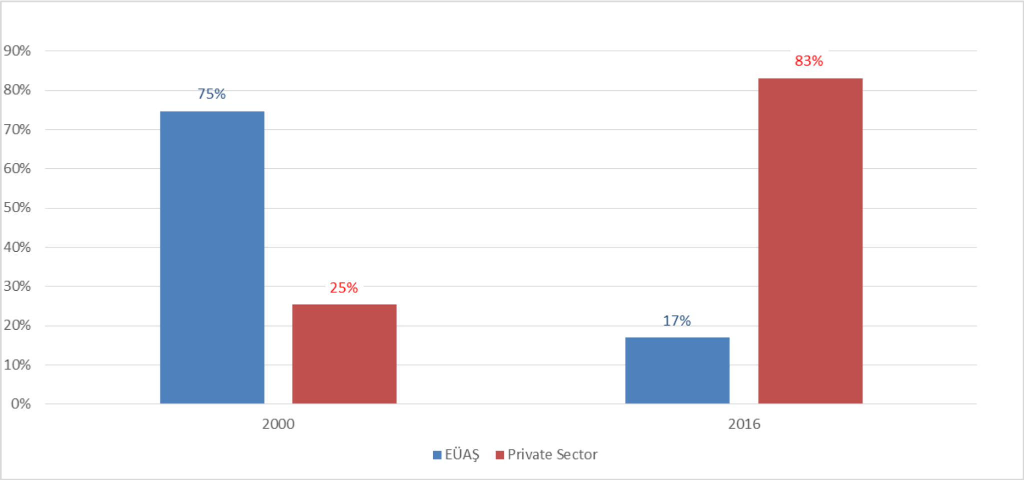


Source: (TEİAŞ, 2018)

As seen in figure 20, demand for electricity in Turkey continuously increased yearly except the crisis terms. While demand for electricity in 2000 is 125 TWh, it approximately increased to levels of 275 TWh by 2016. The average electricity demand growth between 2001 and 2016 is about 5%.

Electricity generation is undertaken by the private sector, EÜAŞ and public-private partnership companies (BOO, BOT, and TOR). The companies rather than EÜAŞ could be thought as private sector companies and EÜAŞ is a state-owned enterprise. The share of the public generation in total electricity generation is illustrated in figure 21.

Figure 21: The Share of the Public in Total Electricity Generation

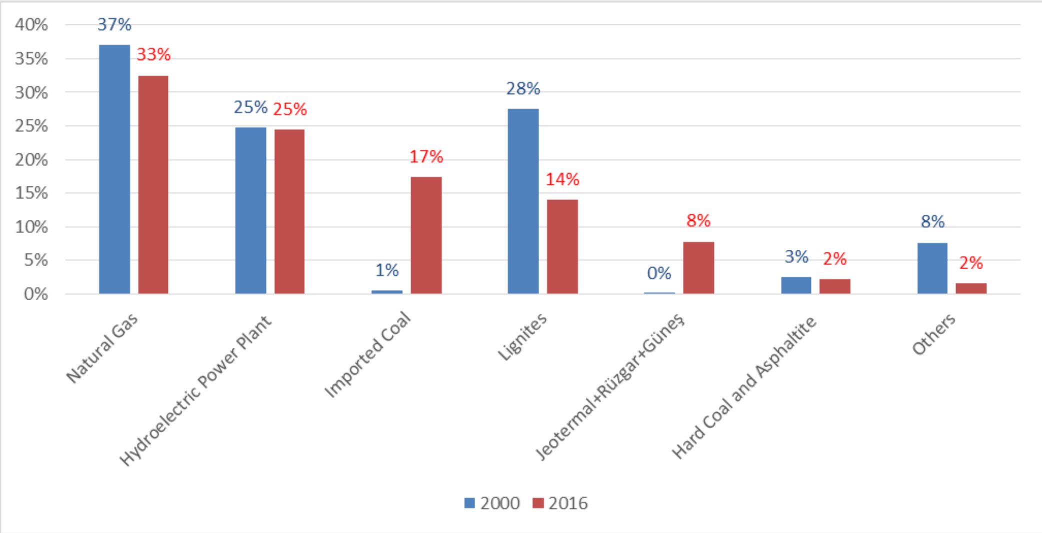


Source: (TEİAŞ, 2018)

The dominant role of the state in total electricity generation declined sharply between the years of 2000 and 2016. While the share of the EÜAŞ in total electricity generation is 75% in 2000, this share declined to the level of 17%. Whereas 93 TWh of 125 TWh total electricity come from the EÜAŞ in 2000, roughly 47 TWh of 274 TWh total electricity generation originates from EÜAŞ in 2016. This indicates that the role of EÜAŞ, (i.e. public) decreased in total electricity not only relatively, but also absolutely.

Figure 22 shows the change in the share composition of the total electricity between the years of 2000 and 2016.

Figure 22: The Change in The Share Composition of The Total Electricity in 2016



Source: (TEİAŞ, 2018)

In figure 22, the share of the primary energy sources in total electricity generation is depicted. According to figure 22, despite a decrease in the share of the natural gas in total electricity generation, its dominant role still maintains. Its share decreased from the level of 37% to 33% between 2000 and 2016. When natural gas is thought to be an imported input for electricity generation, it can be said that this ratio is still too much for the electricity generation. There is no significant change in the share of the hydroelectric power plant during the same period. Its level in both years is about 25%. The most significant increase realized in the share of the imported coal in total electricity generation. This ratio rose sharply from the level of 1% to 17% between 2000 and 2016. Because of the scarcity of the hard coal in Turkey and low calorific value of the lignites, coal started to be imported from abroad. Unlike the share of the imported coal, the share of lignites, which are the most critical energy sources for Turkey's energy security, decreased substantially. Its share in total electricity generation fell from the %28 to %14 during the same period. The decrease in the share of the lignites compensated by the increase in the share of the imported coal during the mentioned period by harming the current account balance of Turkey. Last inference from this figure is that there is a significant increase in the share of the renewables in total electricity generation.

3.3. TURKEY'S COAL INFORMATION

Due to the famine of the energy sources such as natural gas and oil, coal play a critical and significant role for energy security and economy. As we mentioned before, the negligible amount of the natural gas and oil is domestically produced and hard coal reserves are quite limited. Table 4 indicates the total energy reserves in Turkey.

Table 4: Total Energy Reserves of Turkey in 2015

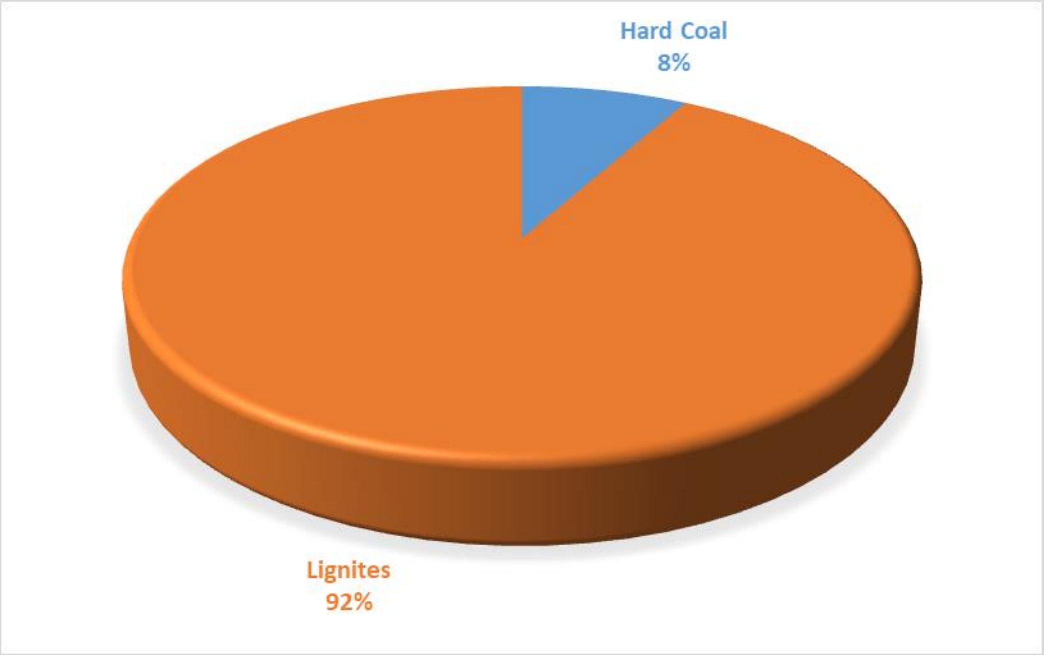
Sources	Visible	Probable or Possible	Total
Hard Coal (million tonnes)	506,5	793,4	1.300
Lignites (million tonnes)	13991,5	773,4	14.765
Afşin-Elbistan	*4.845,50*		*4.845,5*
Others	*9.146,00*	*773,4*	*9.919,4*
Asphaltite (million tonnes)	82		82
Bitumens	1641,4		1.641
Hydraulics			0
GWh/Year	59.245,80		59.246
MW	22.748,90		22.749
Crude Oil (million barrel)	7.167		7167
Natural Gas (billion m3)	23,2		23,2
Nuclear Sources (tonnes)			0
Uranium	9.129		9.129
Thorium	380.000		380.000

Source: (ETKB, 2016)

Table 4 gives the overall information about the total energy sources of Turkey. According to table 4, scantiness of the hard coal is seen in comparison with the lignite coal resources. The other issue we could infer from table 4 is that the one-third of the lignite reserves of Turkey is located in the Afşin- Elbistan region.

In figure 23, the share of the coals in terms of their quality is presented for the year 2015.

Figure 23: The Share of Coal Types of Turkey in 2015

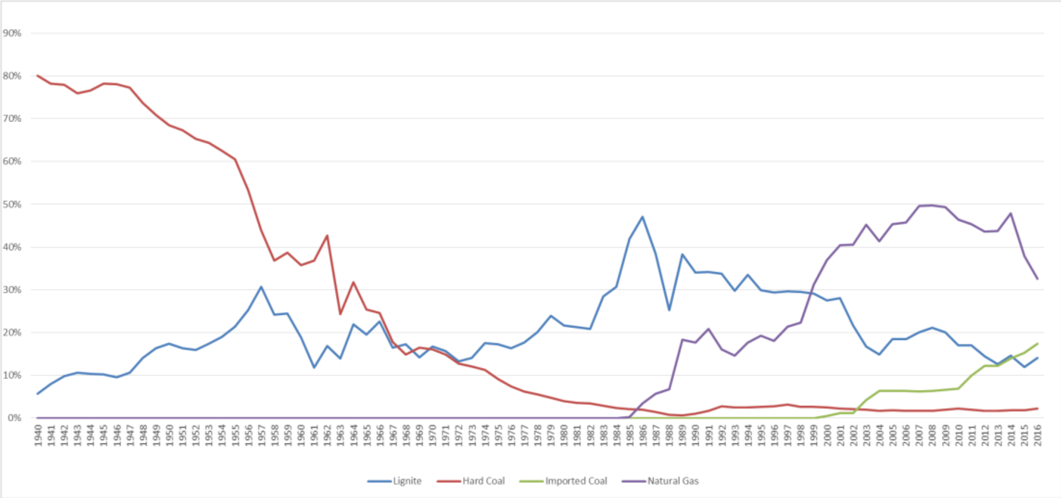


Source: (ETKB, 2016)

As seen from the figure 23, 92% of total coal reserves comes from the lignites. This share indicates that Turkey's coal mostly consists of the low calorific valued coals. Due to the low calorific value, they are hardly ever used for heating purposes. Therefore, they come to the forefront as a domestic input for electricity generation.

Figure 24 indicates the historical development of the different energy sources in the total electricity generation.

Figure 24: The Development of Lignite, Hard Coal, Imported Coal and Naural Gas Shares in Total Electricity Generation



Source: (TEİAŞ, 2018)

Figure 24 shows the different energy sources share in total electricity generation throughout history. According to figure 24, while hard coal share was about 80% at the beginning of the 1940s, it continuously declined and its share reached to the level of 2% in 2016. Together with the hydraulic power plant, lignite met the electricity demand which was not offset by hard coal in the same years. While the lignite share in total electricity generation approached the level of 50% in 1986, its share started to decline to very low levels today by starting imports of natural gas and coal. The share of coal in total electricity is now low in comparison with the world level and more than half of coal-based electricity generation comes from the imported coals. This is thought as a very serious structural problem for Turkey's energy sector.

3.4. THE ROLE OF THE ENERGY FOR TURKEY’S CURRENT ACCOUNT BALANCE

3.4.1. The Concept of Balance of Payments and Current Account Balance

Balance of payment is a statistical report which records all the economic transactions between the residents of different countries economies. In this definition, there are two main concepts which are residents and economy. While the concept of residents refers to the juridical persons and people who reside in an economy for more than one year, the concept of the economy refers to a geographical region managed by a government.

Balance of payment has three components which are current account balance, capital account, and financial account. In general, while current account and capital account records the real transactions which include flows of goods, services, and income revenues and transfers; finance account indicates how to finance of the summation of current account and capital account (TCMB, 2018)

One of the main components of the balance of payment is the current account balance. The current account balance is the record of a nation's transactions of goods and services with the rest of the world. It is accepted as one of the most significant economic indicators for all countries. Therefore, the sustainability of the current account balance became a focal point for academic research. In literature, there are academic researchers and discussions which suggest that there is a threshold for the current account balance sustainability. For instance, after the 1994 Mexico Crisis, old U.S. Treasury Secretary claimed that the countries with current account deficits which are above of the level of 5% would have serious problems about the sustainability of their current account balances. Like this statement, Edward (2005) claimed that this threshold is 6% of the GDP. However, there are several academic research which emphasized that there are various factors such as the countries' investment/saving, economic growth, openness to trade, the composition of external liabilities, financial structure, and energy prices affecting the current account sustainability. That's why, evaluation of current account sustainability would be fallacious if we took into account the only one model for all countries (Kızılkaya & Sofuoğlu, 2018).

3.4.1.1. Foreign Trade and Services

3.4.1.1.1. Foreign Trade Balance

Foreign trade balance includes the trade in general goods, goods provided for the vehicles in harbors, net transit trade income, commercial gold, and suitcase trading. Incomes gained by foreign trade are defined as exports whereas expenditure from foreign trade is called as imports. When the export is greater than import, foreign trade balance gives surplus; but when the import is greater than export, foreign trade balance gives deficit (TCMB, 2018)

3.4.1.1.2. Services Balance

Services balance indicates the flow of payments raised by the export and import of services. It shows the difference between the foreign currency incomes and expenditures raised by the activities of shipping, insurance, financial services, other commercial services, official services, etc. (TCMB, 2018)

3.4.1.2. Primary Income Balance

Primary income balance records the amount of income earned and the amount of expenditure from the provision of labor, financial or natural resources. Employee wages and investment revenues and expenditures related to direct investments, portfolio investments and other investments are recorded under this account (TCMB, 2018)

3.4.1.3. Secondary Income Balance

Secondary income balance records the unilateral transfers and donations of goods and services or financial assets between the different countries' residents. This component is divided into two groups which are general government and other sectors. While the general government includes grants from foreign countries, other sectors contain personal transfers such as workers' remittances and all cash and in-kind transfers between residents of different countries (TCMB, 2018)

After giving a brief summary of the balance of payments and its components. The role of energy in the current account balance and international trade balance is emphasized. The other components of the balance of payment are not mentioned in the later parts.

3.4.2. The Current Account Balance of Turkey

Turkey has one of the highest amounts of current account deficit in the world. Therefore, Turkey could be more vulnerable and sensitive to the external shock overall the world. In the table 5, the countries which have the highest amount of current account deficit in the World are presented.

Table 5: The Countries Which Have the Highest Amount of Current Account Deficit in the World for 2017

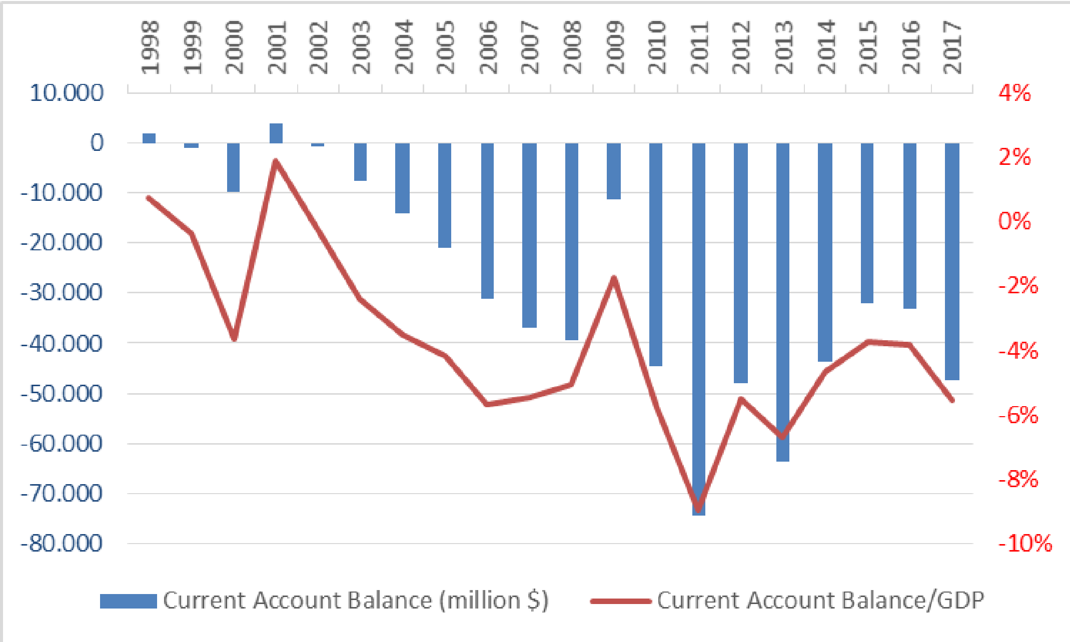
Country Name	Current Account Balance (Current US $)	GDP (Current US $)	GDP Share of CAB
United States	-466.248.000.000	19.390.604.000.000	-2%
United Kingdom	-106.504.800.784	2.622.433.959.604	-4%
Canada	-48.799.617.904	1.653.042.795.255	-3%
Turkey	-47.378.000.000	851.102.411.118	-6%
India	-39.072.571.848	2.597.491.162.898	-2%
Australia	-32.653.402.813	1.323.421.072.479	-2%
Argentina	-30.791.835.247	637.590.419.269	-5%
Mexico	-19.354.125.310	1.149.918.794.766	-2%
France	-18.513.505.692	2.582.501.307.216	-1%

Source: (World Bank, 2018)

As we see from table 5, the US has the most current account deficit in the world in 2017, but this current account deficit is quite limited according to its GDP. Turkey is ranked fourth in the world in terms of having the highest current account deficit. Turkey's ranking of the current account deficit in the world is much higher than Turkey's ranking of GDP in comparison with the countries in table 5. As a result, It could be inferred from here that Turkey is one of the countries which give a critical level of current account deficit.

The historical path for Turkey's current account balance for the Turkish economy is presented in figure 25.

Figure 25: The Historical Path for Turkey's Current Account Balance For Turkish Economy



Source: ((TCMB, 2018) and (Hazine ve Maliye Bakanlığı, 2018))

The most remarkable conclusion could be drawn from figure 25 is that current account balance always gave deficit in the period between 1998 and 2017 except the years of 1998 and 2001. While the reason of recovery in current account balance in 1998 is crisis occurred in Russia and decline in our import from this country, the reason of recovery in 2001 is the economic downturn because of decline in domestic demand in 2001 crisis. Together with "Transition to the Strong Economy Program" in 2002, the Turkish government implemented tight monetary policy and managed to decrease the inflation rate. This caused Turkish Lira to be appreciated and contributed to harm to the current account balance. After this year, the current account deficit always increased until 2008. Worsened current account deficit between 2002 and 2008 declined in 2009 due to low economic growth in that year. (Genç, Yardımcı, & Göçeri, 2017). After this year, the current account balance worsened when the economic activities turned back to normality. Due to the macroeconomic precautionary measures which were carried into, the current account balance is enhanced in 2012 ((Kaya, 2016). The recovery in current account balance after 2014 maintained until the third quarter of 2016. The reason for this recovery is the decrease in energy prices. (TCMB, 2016). However, the current account balance passed on the rising trend since 2016 due to geopolitical tensions, terrorist incidents and problems with Russia (TCMB, 2017)

3.4.3. The Reasons for Current Account Deficits in Turkey

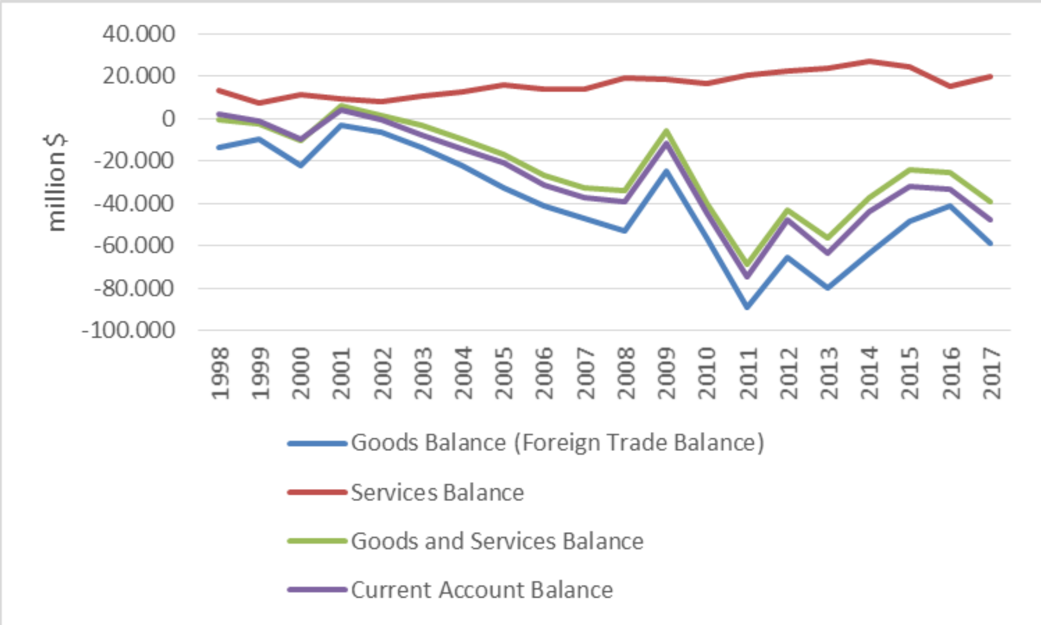
There are numbers of reasons why an economy gives high amounts of current account deficit. They are foreign trade deficit, energy deficit and energy dependency on foreign countries and saving inadequacy (Emirkadı, 2016)

3.4.3.1. Foreign Trade Deficit

The foreign trade balance is the most important component of the current account balance for the Turkish economy. Before the 1980s, Turkey was implementing an import substitution industrialization. When Turkey opens its economy to international trade without constituting the proper legal and structural environment, the economy started to give international trade deficits after the 1980s (Emirkadı, 2016).

In figure 26, the historical development of the current account balance, goods balance, services balance and goods and services balance are presented.

Figure 26: Historical Development of the Current Account Balance, Balance of Goods, Balance of Goods and Services and Balance of Goods and Services



Source: (TCMB, 2018)

According to figure 26, it is seen that while the foreign trade balance gives deficits, services balance gives surpluses. However, the surpluses from the service balance could not compensate for the deficit of foreign trade balance. That's why the current account deficit occurred. The close relationship between the trend of current account balance and foreign trade balance could be seen in the same figure.

3.4.3.2. The Inadequacy of the Domestic Savings

In literature, the current account deficit is defined as the difference between domestic savings and investments (Genç, Yardımcı, & Göçeri, 2017). According to this truth, more current account deficits will occur unless the domestic saving does not meet the investments. In figure 27, the relationship between the saving gap and the current account balance was emphasized.

Figure 27: The Relationship Between Saving Gap and Current Account Balance For Turkey[4]

Source: ((Strateji ve Bütçe Başkanlığı, 2018) and (Hazine ve Maliye Bakanlığı, 2018))

It could be seen from figure 27 that when there is a decline in saving gap, current account balance generally also decreases.

3.4.3.3. Energy Deficit and Energy Dependency On Foreign Countries

3.4.3.3.1. Energy Dependency

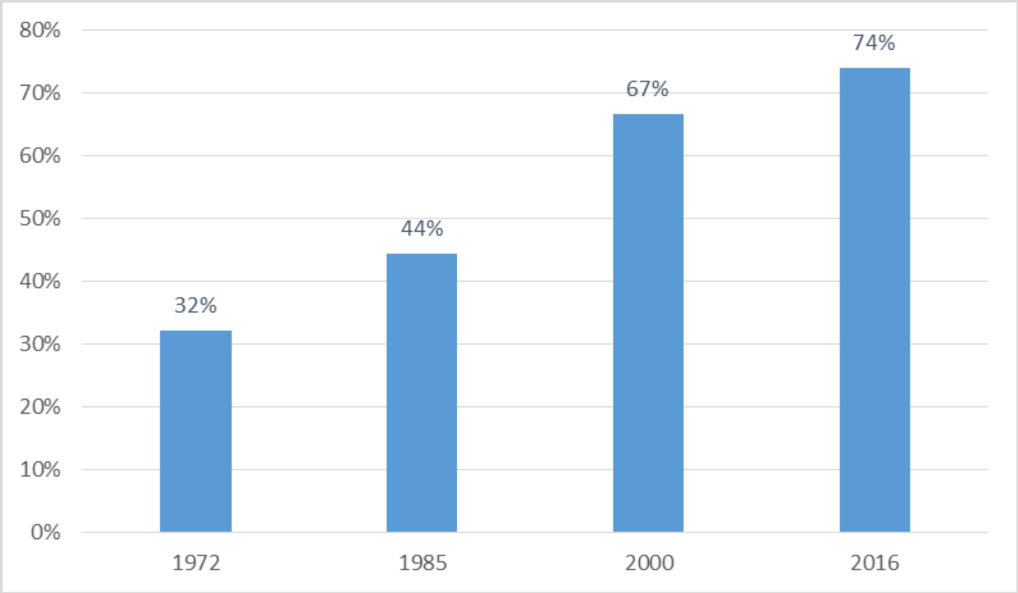
Turkey is an energy-dependent country. Energy dependency of Turkey reached around %74 in 2016. This ratio was about %32 in 1972 (ETKB, 2018). There are various reasons for this increase. The most important one is inadequate reserves of oil and natural gas. Whereas the share of the local natural gas in the total natural gas consumption is %0,8 in 2016, the share of the local oil in the total oil consumption is %6,4 in 2015 (TP, 2017). Another important reason is economic growth. When the countries grow economically, they generally need more energy sources as we see this outcome from the studies in Literature Review. In the earlier times, national resources were enough for the energy demand because the economy is relatively small and industry was not very developed. Economic growth leads Turkey to import energy sources from other countries due to

[4] Old data series were used to make a meaningful comparison.

inadequate local reserves. The last reason is that take or pay practices and long term agreements in natural gas imports. Take or pay practices mean that buyer country is obliged to pay for a determined amount of natural gas regardless of completing the purchasing transaction. Therefore, countries, which accepted this term, choose the buy the determined amount of natural gas even if they do not need it (Açıkel, 2010).

The historical development of Turkey's energy dependency is presented in figure 28.

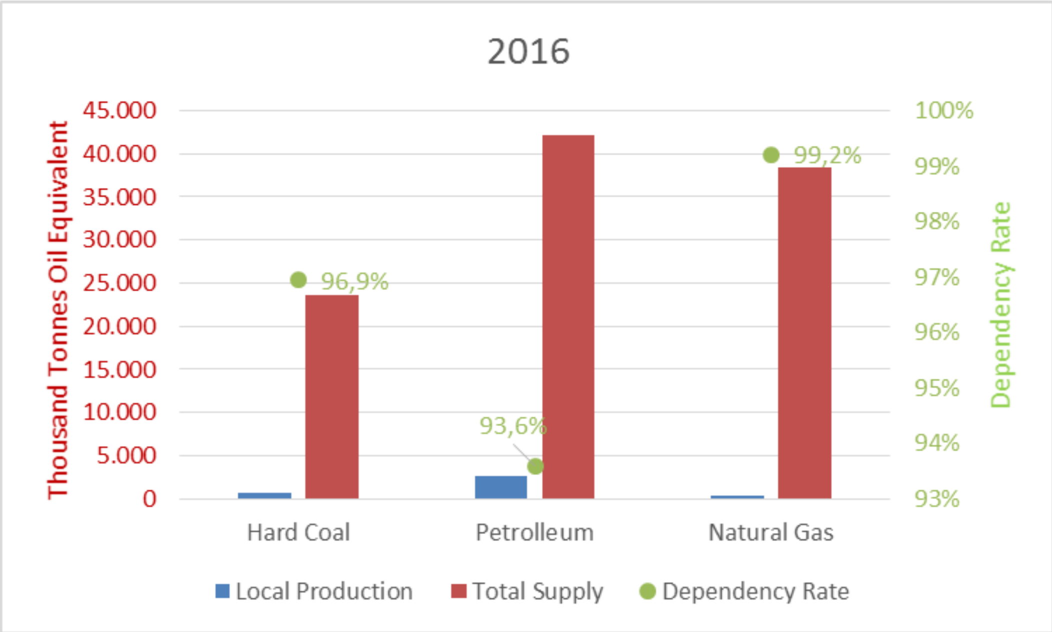
Figure 28: The Historical Development for Turkey's Energy Dependency



Source: (ETKB, 2018)

According to figure 28, the energy dependency of Turkey increased throughout time. This dependency is rooted in by mainly oil, natural gas, and hard coal. Their dependency on foreign countries in 2016. are shown in figure 29.

Figure 29: Oil, Natural Gas and Hard Coal Dependency of Turkey in 2016



Source: (ETKB, 2018)

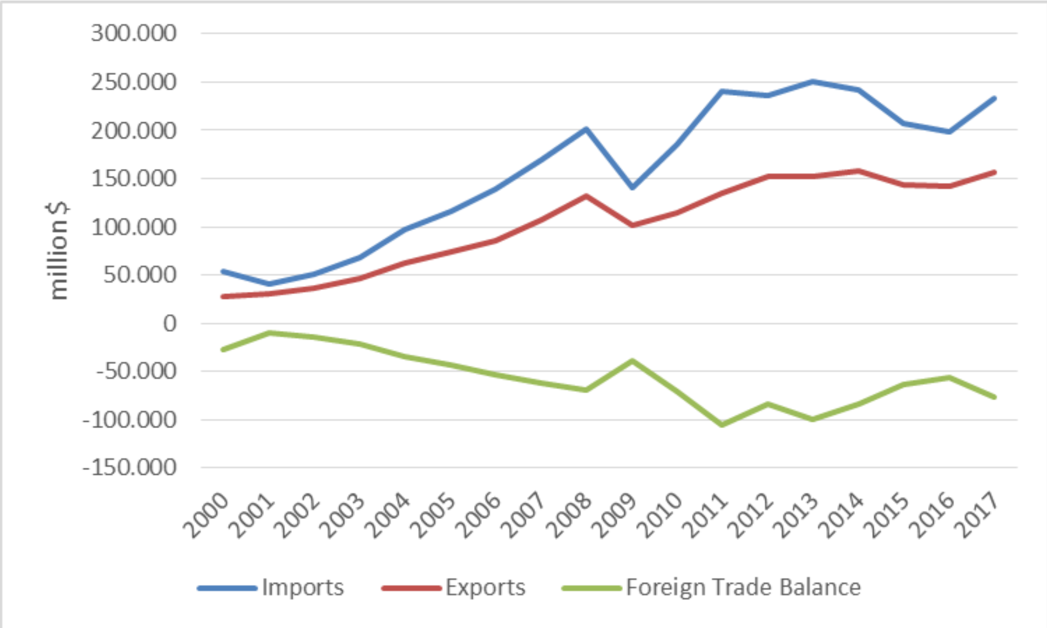
According to figure 29, the dependency rate for hard coal, and natural gas are respectively 96,9%, 93,6% and 99,2% in 2016. These rates indicate that local production is negligible for these energy sources. These dependency rates result from the inadequacy of these energy sources' reserves. These energy sources cannot be increased unless we find new reserves. Therefore, we need to utilize existing local energy sources. This energy source is lignite for Turkey. Turkey has lignite abundancy in comparison with the other countries.

3.4.3.3.2. Energy and Current Account Balance:

Turkey's energy dependency reflects on its current account balance. That's why seeing the role of energy on current account balance could be very beneficial for us.

Figure 30 indicates the export, import and foreign trade balance level of Turkey extending to years.

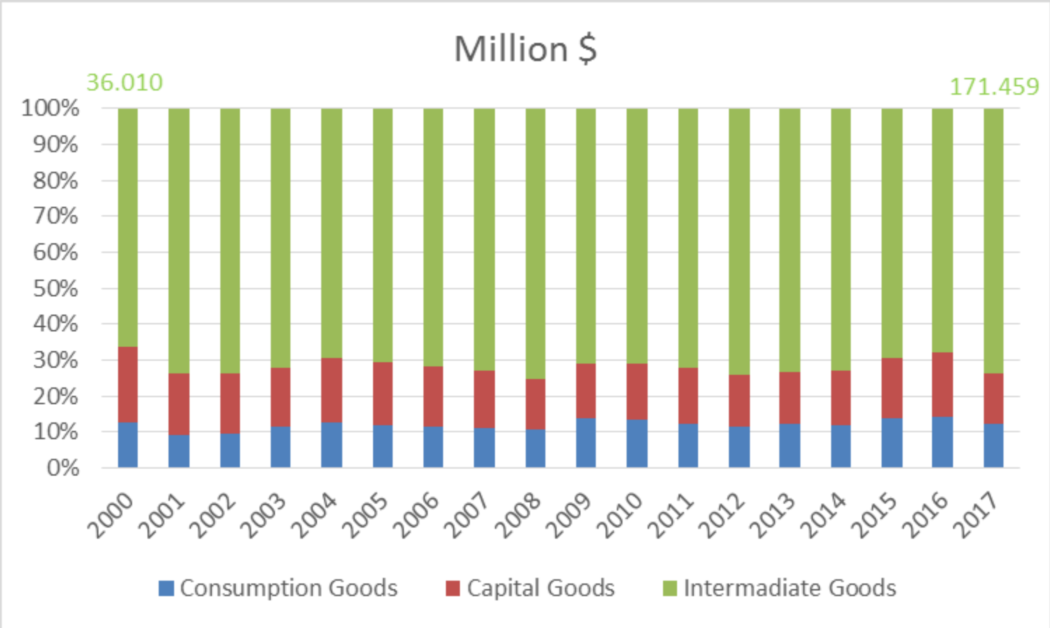
Figure 30: Export, Import, and Foreign Trade Balance Level of Turkey Extending to Years



Source: (TÜİK, 2018)

Figure 30 indicates that the significant difference between the export and import preserves its position. The way to close the gap is to increase the export or decrease the import. However, a great amount of export is made by using imported intermediate goods (Kızılkaya and Sofuoğlu, 2017). Therefore, export rises will inevitably increase the amount of the import of intermediate goods. The figure 30 shows the imports by classification of broad economic categories.

Figure 31: Turkey's Imports by Classification of Broad Economic Categories



Source: (Hazine ve Maliye Bakanlığı, 2018)

According to figure 31, 74% of total import comes from the intermediate goods in 2017 while the shares of the consumption and capital goods in the total import are quite limited relatively. That's why intermediate goods are the main cause for foreign balance and current account deteriorations. While the import of the intermediate goods is 36 billion dollars in 2000 (66% of total imports), this amount reached to the level of 171,5 billion dollars in 2017 (74% of total imports. Energy is one of the main components which contributed to intermediate goods. Its share in total import and intermediate import realized 16% and 21% respectively. Therefore, energy policies which focus on the utilization of local resources and energy efficiency policy will enhance the current account balance situation of Turkey.

CHAPTER 4

4. ANALYSES: THE EFFECTS OF UTILIZING THE AFŞİN-ELBİSTAN LIGNITES

4.1. OVERVIEW

In this section, the effects of utilizing the Afşin-Elbistan lignites are discussed. The estimates of "Turkey's Electricity Demand Projections Report" prepared by ETKB, which includes the period between 2017 and 2037 and the "Projected Cost of Generating Electricity 2015", which is the report prepared by IEA, are utilized for the analyses. Two analyses are focused in this study. The first analysis is the change of the composition in total energy mix after envisaged Afşin-Elbistan lignite-fired power plants are taken into operation. The second one is the effect of this change on the current account balance during the operational periods of aforesaid power plants.

Furthermore, we make several assumptions while making calculations by using various sources. Analyses are based on these assumptions, which are mentioned in detail later in this chapter.

In the following heading, the characteristics of Afşin-Elbistan lignites are briefly introduced. After this subsection, the method used for the analyses, assumptions, and results of the analyses is provided respectively.

4.2. AFŞİN-ELBİSTAN REGION

Afşin and Elbistan are two separate towns of the province of Kahramanmaraş (Türkiye Cumhuriyeti Kahramanmaraş Valiliği, 2018). The region is very strategic in terms of energy security for Turkey due to having an abundant amount of lignites. The region has the amount of 4,8 billion tonnes visible lignite reserve which has great potential for providing energy security and this amount corresponded to 30% of total lignite reserves of Turkey as of 2016. The calorific value for the lignites is very low despite their abundance. The average calorific value for Afşin-Elbistan lignites is 1.136 kcal/kg ((TKİ, 2017); (EÜAŞ, 2017)).

Afşin-Elbistan energy mine site is divided into five sections which are A, B, C, D and E. Two of them, A and B, are in use. Lignites are mined from Kışlaköy field in sector A and from Çöllolar field in sector B. Two power plants exist for the utilization of the lignite resources in these regions, namely Afşin Elbistan A and Afşin Elbistan B power plants with the 1.335 and 1.440 MW installed powers respectively. However, the electricity generation is quite limited from these power plants especially due to the landslip occurred in Çöllolar field in February 2011. Therefore, their capacity utilization, which realized as 19,3% and 3,6% in 2016, is too low. As a result, this important lignite mining field is not completely in use ((Yıldırım & Doğuç, 2015); (EÜAŞ, 2017)).

In light of this information, the Afşin-Elbistan mining field matters for Turkey, which has chronic problems with energy dependency. That's why the utilization of these lignites benefits Turkey's energy security and decreases the current account deficit burden. To reduce the energy dependency of Turkey, commissioning the new power plants for the full utilization of these lignite sources is designed in this study.

4.3. METHODOLOGY AND ASSUMPTIONS

4.3.1. The Change of Composition in Energy Mix

The main source for the analysis is "Turkey's Electricity Demand Projections Report" prepared by ETKB that projects Turkey's electricity demand between 2017 and 2037. This report takes into account subjects which affect the electricity demand, namely, economy, population, calendar effect, temperature, electric car, energy efficiency, network loss, and internal consumption.

The models that are utilized in this study are:

- "Sectoral Regression Model",
- "Model Created by Leap Software",
- "Artificial Neural Networks & Regression – Monthly Demand Model",
- "Regression and Monte Carlo Model",
- "Model of elasticity method".

Three scenarios, which are studied in this report, are the low scenario, reference scenario, and high scenario. We only used the reference scenario for simplicity.

In this projection, although there are estimates of electricity demand for Turkey until the year 2037, there are no projections about the primary energy sources' demands. Therefore, our first assumption for this analysis is to peg the share of the primary energy sources in total electricity demand with that of 2016 to make another simplification. The second assumption is about the nuclear power plants to be in operation in the following years. The start-up time for the units of nuclear power plants, yearly electricity generation, and their installed power information is taken from the report of "Türkiye'nin Nükleer Santral Projeleri: Soru-Cevap" prepared by ETKB. According to this report, the start-up time for the units of nuclear power plants is presented in table 6.

Table 6: The Start-up Times for The Units of Nuclear Power Plants

Akkuyu NGS	
Unit 1	2022
Unit 2	2023
Unit 3	2024
Unit 4	2025
Sinop. NGS	
Unit 1	2023
Unit 2	2024
Unit 3	2027
Unit 4	2028

Source: (ETKB, 2016)

While Akkuyu NGS's installed power is 4800 MW and each unit has the 1200 MW installed power, Sinop NGS has the 4600 MW and each unit has the 1150 MW installed power. Whereas the expected yearly electricity generation from Akkuyu NGS is 35 billion kWh, the expected yearly electricity generation from Sinop NGS is 34 billion kWh (ETKB, 2016). The third assumption is that the electricity generation from nuclear power plants reduces the electricity generated from natural gas. The final assumption related to our calculations is that envisaged Afşin-Elbistan lignite-fired power plants with 10.000 MW installed capacity will be in operation in 2023 and it will work with the 75% capacity factor. The total lignite reserve for this power plant with very large capacity is enough for the lignite-fired power plant with 10.000 MW installed power. We chose 2023 because the report of "Projected Cost of Generating Electricity" points out that the construction time for the coal-fired power plants is 4 years ((IEA, 2015); (Aslan, 1996)).

Our method for this analysis is to use the "Turkey's Electricity Demand Projections Report" as the main source and the share of the primary energy sources are kept constant during the analysis period by using the share of the primary energy sources in total electricity in 2016 and reduce the amount of electricity generated from the natural gas-fired power plants thanks to increasing in nuclear power plants' electricity generation. In addition to that, we reduce the generated electricity from natural gas and increase the electricity generation from envisaged Afşin-Elbistan power plants. The electricity demand projection and our scenario are illustrated in the appendix. In this report, while 2016 and the years before 2016 values are realized, post years are estimations.

Consequently, we find the new primary energy mix in the total electricity demand if we start up the aforementioned power plants which will utilize the Afşin-Elbistan lignites.

4.3.2. The Effect of Utilization on the Current Account Balance

Because the lignite is a local energy source, its fuel cost never cause a burden for Turkey's current account balance. That's why their usage in the electricity generation is expected to decrease the current account deficit for Turkey. In this section, we give the assumptions for the calculations of the decrease in current account deficit due to the usage of lignite resources in electricity generation instead of importing natural gas. Our primary source for the analysis is the report of Projected Cost of Generating Electricity 2015 prepared by IEA. There are so many assumptions made to make a proper calculation. The sources for these assumptions are the reports and statistical databases of IEA, TKİ, EÜAŞ, and ETKB.

We calculate the effect of the lignite resources utilization in electricity generation on current account balance by subtracting the cost raised from the construction of the aforementioned power plants creating additional current account deficit from the decrease in imported natural gas expenditures.

Our method for this analysis consists of a couple of steps. The first step is to determine the assumptions related to this power plant, its characteristics, and reserve. The second step is to calculate the possible largest sized power plant to be built in this region. The third step is to calculate the present value of the possible all lifetime cost and determine which costs create additional current account deficit. The fourth step is to calculate the electricity generation and the amount of natural gas to be substituted when the power plant gets into the operation. The last step is to sum and/or subtract the items which affect the current account balance with each other.

In the first step, we try to find a sensible basis for the assumptions used in the calculations. We take them from various studies, reports, and databases. The only assumption that we made is that the modeled power plant will be built by EÜAŞ which also owns the Afşin Elbistan mine site. Therefore, there will be no fuel cost for EÜAŞ.

For the second step, we determine the capacity of the power plant to be built by taking into account the lignite reserve and average calorific value of Afşin Elbistan lignites; and capacity factors and efficiency of other lignite-fired power plants. Total reserve in Afşin Elbistan region is approximately 4,8 billion tonnes and the calorific value of these lignite sources is 1.136 kcal/kg. The lifetime of the lignite-fired power plant is taken as 40 years by taking an example of a lignite-fired power plant in Germany ((EÜAŞ, 2017); (IEA, 2015)). In addition, a capacity factor of the modeled power plant is determined as 75% and efficiency is determined as 43% which is the efficiency rate of a lignite-fired power plant in Germany ((IEA, 2015); (Aslan, 1996)).

We use Levelised Costs of Electricity (LCOE) term to determine the present value of all lifetime costs and comb out the cost items which cause current account balance in the third step. In the fourth step, we calculate the effect of decreasing the natural gas consumption on the current account balance. To determine it, we need to find the total electricity to be generated by this modeled power plant throughout its lifetime and find the natural gas equivalence of that electricity generation. However, these are not enough for determining the effect of a decrease in natural gas consumption on the current account balance. We also need the efficiency of the natural gas-fired power plant and natural gas prices. We determined the efficiency of natural gas-fired power plants as 60% (IEA, 2015).

In the end, we compare the effects of the outcomes generated from and the third step and the fourth step and see the decrease in the current account deficit with 2013 USD prices.

4.3.2.1. LCOE

LCOE gives us an idea of what the costs of generating electricity are. One component of this term, which is overnight costs, is seen as having an effect on the current account balance. We calculate the overnight cost for Afşin-Elbistan lignite power plants by using data of "Projected Cost of Generating Electricity 2015". We base a German lignite power plant for the assumptions which are used in our modeled electricity power plants.

LCOE is a term which calculates the total cost for the power plant during its lifetime by discounting the values by using the 2013 USD prices. IEA uses this term to calculate "the costs of generating electricity from different sources" by taking into account all the costs by using 3%, 7%, and 10% discount rates.

LCOE is a very "useful tool" to see "the present value of all costs of a power plant". That's why it may give ideas about the rationality of planned investment. The formula could be seen below:

"$LCOE = P_{MWh} = [\sum[(Capital_t + O\&M_t + Fuel_t + Carbon_t + D_t) * (1+r)^{-t}]]/[\sum MWh\ (1+r)^{-t}]$"

Different variables refers to:

- "P_{MWh} = The constant lifetime remuneration to the supplier for electricity";
- "MWh = The amount of electricity produced in MWh, assumed constant";

- "$(1+r)^{-t}$ = The discount factor for year t (reflecting payments to capital)";
- "$Capital_t$ = Total capital construction costs in year t";
- "$O\&M_t$ = Operation and maintenance costs in year t";
- "$Fuel_t$ = Fuel costs in year t";
- "$Carbon_t$ = Carbon costs in year t";
- "D_t = Decommissioning and waste management costs in year t".

The LCOE term is calculated for the period between 2023 and 2063 by using the %3 discount rate assumption. According to this calculation, Total LCOE for the modeled power plant is 173.553.120.000 USD. The costs of other items are summarized in table 7.

Table 7: The Breakdown of LCOE

	0,03
LCOE (USD/MWh)	66,04
Total Cost (USD)	173.553.120.000
Investment Cost (USD/MWh)	11,77
Investment Cost (USD)	30.931.560.000
Refurbishment and decommissioning costs (USD/MWh)	0,12
Refurbishment and decommissioning costs (USD)	315.360.000
Fuel Costs (USD/MWh)	14,88
Fuel Costs (USD)	39.104.640.000
Carbon Costs (USD/MWh)	28,2
Carbon Costs (USD)	74.109.600.000
Operation and Maintainance Cost (USD/MWh)	11,07
Operation and Maintainance Cost (USD)	29.091.960.000
Overnight Cost (USD)	20.540.000.000

Source: (IEA, 2015) and author's own calculations

The parts of the LCOE which causes the current account deficit are 49% of the overnight cost (70%*70%*20.540.000.000) and 50% of the operation and maintenance cost (50%*29.091.960.000). The import ratio assumption for the overnight cost is determined 70% because 70% of the overnight cost comes from the machinery and equipment cost and 70% of machinery and equipment is imported. The rest of the overnight costs do not necessitate any import. The import ratio assumption for the operation and maintenance cost is determined by taking into account the import ratio of machinery and equipment cost and other costs such as labor, water, and energy costs. Among these costs, while machinery and equipment maintenance cost causes a burden on current account balance, other cost items are not considered to lead to a serious amount of imports. We assumed the import ratio of machinery and equipment's operation and maintenance cost and the import ratio of machinery and equipment cost as equal to 70%. However, we assumed the import ratio of operation and maintenance cost as 50% logically because other items are not expected to affect current account balance extremely. ((IEA, 2015); (TMMOB Makine Mühendisleri Odası, 2014)).

Total capital construction and operation and maintenance cost, are used in our calculations. There is no carbon cost for the power plants in Turkey and fuel cost is zero for EÜAŞ.

4.3.2.2. Natural Gas Price Assumption

Natural gas import prices are confidential because of the secret treaties between the countries. Thus, we do not have any official data for the import price for Turkey. That's why we need to make an assumption for natural gas prices.

We use "World Energy Outlook 2017" report prepared by IEA for making a feasible assumption. As the natural gas prices depend on several unpredictable and political factors such as crude oil, political dialogues on the international level, the future movement of the natural gas prices cannot be estimated easily. Therefore, the scenarios of the aforementioned report are utilized. There are three scenarios, that are used by IEA, which are "New Policies Scenario", "Current Policies Scenario", and "Sustainable Development Scenario". According to this scenario, the natural gas price trend is shown in table 8.

Table 8: Natural Gas Import Price by Scenario

	Realizations			New Policies Scenario				Current Policies Scenario		Sustainable Development Scenario	
Natural Gas Prices (USD/MBtu)	2000	2010	2016	2025	2030	2035	2040	2025	2040	2025	2040
United States	5,9	4,8	2,5	3,7	4,4	5	5,6	4,3	6,5	3,4	3,9
European Union	3,8	8,2	4,9	7,9	8,6	9,1	9,6	8,2	10,5	7	7,9
China	3,5	7,4	5,8	9,4	9,7	10	10,2	10,4	11,1	8,2	8,5
Japan	6,4	12,1	7	10,3	10,5	10,6	10,6	10,8	11,5	8,6	9

Source: (IEA, 2017)

Before we choose our price that is a basis for our analysis, we need to introduce the scenarios created by IEA.

- "New Policies Scenario": Under this scenario, not only the policies and measures that are in operation, but also announced policies and measures by governments are taken into account.
- "Sustainable Development Scenario": This scenario covers the internationally agreed targets which are climate change, "air quality" and "universal access to modern energy".
- "Current Policies Scenario": Under this scenario, only announced policies and measures as of mid-2018 by the government are taken into account (IEA, 2018).

We take an average of the European Union's import prices of natural gas for the year 2016 and years of 2025, 2030, 2035 and 2040 under "New Policies Scenario". We choose the European Union for the geographical closeness to Turkey and we choose the "New Policies Scenario" because it covers both applied and announced policies and measures. The reason for taking the average of prices is that natural gas prices may sharply fluctuate over time due to the sensitivity to political issues. Taking average seems to be a feasible way to assume future prices.

In here, when we take an average of the natural gas import prices belonged to the years of 2016, 2025, 2030, 2035 and 2040, we find our imported natural gas price assumption as 8,02 USD/Mbtu.

In addition to this calculation, we apply sensitivity analysis to cover the deviations. We calculate the 2 USD less and 2 USD more prices effect.

4.4. RESULTS

4.4.1. The Change of Composition in Energy Mix

When the modeled lignite-fired power plant started to be in operation, the serious decline in the amount of natural gas import could be realized. Thus, the local energy sources in the total energy mix could increase.

When we take into account the fact that nuclear power plants are set into operations fragmentarily by 2022, we may say that the opportunity to decrease natural gas import will start. In addition to this, taking into operation of the modeled power plants will contribute to an increase in the share of the local energy sources in the total energy mix.

In the analysis period (2016 and 2037), while the natural gas share in total electricity generation is 33% in 2016 and 12% in 2037, the lignite share in total electricity generation is 14% in 2016 and 24% in 2037. The tables which contain data are provided in the appendix.

4.4.2. The Effect of Utilization on the Current Account Balance

When we use the lignite resources instead of natural gas in the electricity generation process, we can see the gain related to current account balance during the period between the years of 2023 and 2063.

As we mentioned above, we do not have official data for Turkey's natural gas import price. That's why we use the assumptions derived from different sources. Our assumption about natural gas import prices is calculated as an average of 2016 realized prices and 2025, 2030, 2035 and 2040 IEA’s projection prices under “New Policies Scenario”.

To protect our study from the deviations, we apply the sensitivity analysis. Our base scenario is created by the way mentioned above. The low and high scenarios are calculated by basing the 2 USD less and more respectively than the calculated price. According to this analysis, we have one result for each scenario. The results are summarized in table 9.

Table 9: The Effect on Current Account Balance

Scenario	Natural Gas Import Price (USD/Mbtu)	The Effect on Current Account Balance (2023-2063) (USD)
Low Scenario	**6,02**	65.359.405.707
Base Scenario	**8,02**	95.249.766.407
High Scenario	**10,02**	125.140.127.107

Source: Authors' Own Calculations

According to table 9, the effect of utilizing the Afşin Elbistan lignites on the current account balance is different for each scenario. While under the base scenario, the current account balance is expected to be better off by 95.249.766.407 USD for the period between 2023 and 2063, it is estimated that current account balance would be improved by 65.359.405.707 USD and 125.140.127.107 under the low scenario and the high scenario respectively for the same period.

CONCLUSION

Energy is one of the most important things for all human beings throughout history and its importance has been rising as time passes. Its importance lies in the dependency of human needs from it. For instance, when people want to go to the cinema, they need fuel for their cars to reach where the cinema is and the cinema company needs the electricity to maintain its activities. As social activities, the role of energy in industrial activities are prominent.

Besides the importance of energy itself, provision of all forms of energy must be in a continuous, cheap and accessible way. This is undoubtedly critical for all countries. That's why countries try to design their energy policies to serve these three targets. The countries which fail to accomplish one of these targets, their activities in industry and social life will be affected negatively and this situation will harm the economic activities. To design the energy policies, special characteristics of energy should be taken into consideration.

In real life, we see the policy documents from different countries which try to guarantee their energy supply security. These documents are mostly prepared for their own national interests. For example, China, which is an energy-dependent country on oil and natural gas, tries to improve its renewable energy sector and clean coal technologies. By doing so, China could preserve its current account balance stability. Like China, the US thinks about the withdrawal of the Paris Agreement because the objectives of this agreement are not consonant with the country’s national interests. When we look at the countries’ energy policy documents and energy indicators, we may see the proper actions to country's profiles on their energy sectors. In other words, if a country has a great number of natural gas reserves, natural gas consumption is expected to be higher in this country than the countries lack of natural gas reserves.

The countries, which are lack of sufficient amount of energy, have to meet their energy demand by importing them. However, this situation causes these countries to give energy trade deficit and accordingly this situation worsens the external trade balance and current account balance. The measures to reduce imported energy sources such as increasing the share of renewable and local energy sources and applying energy efficiency policies to reduce the burden on the current account balance.

Like other countries, Turkey must follow the energy policies which are compatible with its own national interests. Because Turkey gives a serious amount of current account deficit and its energy dependency is very high, Turkey should be more careful than the other countries while making a decision about its energy sector. Policies relating to the energy sector in Turkey should be assessed by taking into consideration of current account deficit and energy dependency.

When we look at Turkey’s energy sector, we see the overall dependency on foreign countries. This dependency originates from the inadequate reserves of oil, natural gas, and hard coal. While this dependency is lower in the previous years, this dependency reached around 75% today.

The most common energy reserves of Turkey is lignites. Lignite is more spread than any other energy reserves. Despite its low calorific value, it is an abundant energy source for Turkey. The general use area of these lignite sources is electricity generation.

There are two main ways to reduce the energy dependency of Turkey. Firstly, Turkey could apply energy efficiency policies and secondly invest more on renewable and local energy sources. Thus, Turkey could meet its energy demand by decreasing the importation.

When we look at the current account deficit problem of Turkey in detail, we realize that the problem arises from intermediate goods' importation and the energy import in total intermediate goods' importation is 21%. That's why dealing with the energy sector dependency contributes to solving the current account deficit problem of Turkey.

In this study, we choose to increase the local energy sources in total electricity generation to reduce the energy dependency of Turkey. By doing so, natural gas consumption could be projected to decrease in the following years. The local energy sources are chosen as lignites due to its abundance.

Although lignite sources are spread all around the country, the great amount of them is clustered in the Afşin Elbistan region. This great potential could provide a decrease in the current account deficit, employment creation, reliable production, and energy supply security. Since imported energy sources are usually more expensive and are subject to international politics, they remain incapable of lowering the current account deficit, providing additional employment, reliable production, and energy supply security.

The aim of this study is to calculate how much current account deficit burden could be reduced if we utilize Afşin-Elbistan lignites which are local energy sources. Because there is no significant study similar to this topic, this study is thought to contribute to the energy economics literature. The literature survey in energy economics mainly consists of studies focusing on the relationship between energy consumption and economic growth. A lot of studies on this topic was made at both world level and Turkey level and their conclusions vary in terms of country examples, analysis period and kinds of energy used in these studies. However, there is no significant study focusing on how much Turkey’s current account balance could be better off if local energy sources are utilized instead of importing natural gas. That's why in this study, we do not focus on the relationship between energy consumption and GDP. Instead, we analyze how much we could lower the current account deficit if we use the local energy sources in the electricity generation process. For this reason, this study is expected to be very beneficial for the energy economics literature when we take into account the current account balance problem of Turkey.

The presence of Turkey's current account deficit problem and the problem of energy dependency were the main motivations for this study. The results of this study can be seen as a tool to show the importance of the use of domestic energy resources to policymakers. That's why the current status of Turkey and the world in this field is shown and compared.

In the analysis section in this study, we focus on what the share of the primary energy sources in total electricity mix will be between 2017 and 2037 and how much current account balance could be lowered until 2063 when Afşin-Elbistan lignites are started to be utilized and the importation of natural gas are reduced. The assumptions are taken from several national and international reports and the calculations are made according to these assumptions. All calculation is made by basing 2013 USD prices.

There are some limitations while making calculations in the analysis. The limitations are that there are no newly built lignite-fired power plants in Turkey and natural gas prices are confidential. That's why we need to make some assumptions for the data of power plants cost items and natural gas prices. The assumption about the cost items of the power plant was based on a lignite-fired power plant in Germany while natural gas prices assumption is made by taking an average of European Union's import prices of natural gas for the year of 2016 and years of 2025, 2030, 2035 and 2040 under "New Policies Scenario". Instead of these assumptions, if we knew the cost items of newly built lignite-fired power plants in Turkey and natural gas import prices, our analysis would be built on more solid foundations.

According to the results of the total electricity mix analysis, natural gas share in total electricity generation is 33% in 2016 and 12% in 2037, the lignite share in total electricity generation is 14% in 2016 and 24% in 2037. While making this analysis, two nuclear power plants namely Akkuyu NGS and Sinop NGS are taken into consideration. In the current account balance analysis, there are three different scenarios because of the natural gas price assumption. These scenarios are low, base and high. According to these scenarios, current account deficit decrease is expected to be 65.359.405.707 USD, 95.249.766.407 USD and 125.140.127.107 USD in low, base and high scenarios respectively.

Overall, Turkey has a serious current account deficit problem. This problem could cause some vulnerabilities. To get rid of these vulnerabilities, Turkey should take some actions about its current account deficit problem. In this context, lots of things could be realized, but there are two main things in the energy sector to reduce the current account deficit. These are to implement the energy efficiency policies and to utilize the local energy sources. Implementing the energy efficiency policies are seen as a less effective way to decrease current account deficit than utilizing the local energy sources because both local and imported energy sources could be decreased when the energy efficiency policies are implemented. Unlike, utilizing the local energy sources could give an opportunity to decrease the imported energy sources in the total energy mix. In addition, it also provides employment creation, reliable production, and energy supply security. Afşin-Elbistan region has great potential to get these advantages. That's why their usage into our economy could be very beneficial for mainly in the current account balance. However, we also need to continue accelerating investments in renewable energy sector for the following years. The reason behind this, because lignite is not a renewable energy source, it is expected to be depleted over a period of time. That’s why, we need to increase the capacity of renewable energy sources to meet the future electricity demand.

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APPENDIX

APPENDIX 1: Electiricity Generation by Primary Energy Sources (TWh)

Appendix 1: Base Scenario 2000-2018																			
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Hard Coal+Asphaltite	3	3	3	3	2	3	3	3	3	4	5	5	4	4	5	5	6	6	7
Imported Coal	1	1	1	6	10	10	11	12	13	13	15	23	29	29	35	40	48	50	53
Lignite	34	34	28	24	22	30	32	38	42	39	36	39	35	30	37	31	39	41	43
Liquid Fuels	9	10	11	9	8	5	4	7	8	5	2	1	2	2	2	2	2	2	2
Natural Gas	46	50	52	64	62	73	81	95	99	96	98	104	104	105	121	99	89	94	99
Renewable+Waste	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3
Thermic Total	**94**	**99**	**96**	**105**	**104**	**122**	**132**	**155**	**164**	**157**	**156**	**172**	**175**	**172**	**200**	**179**	**186**	**197**	**206**
Hydraulics	31	24	34	35	46	40	44	36	33	36	52	52	58	59	41	67	67	71	75
Geotermal+Wind+Solar	0	0	0	0	0	0	0	1	1	2	4	5	7	9	11	15	21	23	24
Total	**125**	**123**	**129**	**141**	**151**	**162**	**176**	**192**	**198**	**195**	**211**	**229**	**239**	**240**	**252**	**262**	**274**	**290**	**304**
Rate of Increase	7%	-2%	5%	9%	7%	7%	9%	9%	4%	-2%	8%	9%	4%	0%	5%	4%	5%	6%	5%

APPENDIX 1: Electiricity Generation by Primary Energy Sources (TWh)

Appendix 1: Base Scenario 2019-2037																			
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Hard Coal+Asphaltite	7	7	8	8	8	9	9	10	10	10	11	11	12	12	13	13	13	14	14
Imported Coal	56	58	61	64	67	70	73	76	80	83	86	90	93	97	100	103	107	110	114
Lignite	45	47	49	52	54	57	59	62	64	67	70	73	75	78	81	84	86	89	92
Liquid Fuels	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5
Natural Gas	104	109	114	119	125	131	137	143	149	155	161	168	174	181	187	193	200	206	213
Renewable+Waste	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6
Thermic Total	**216**	**227**	**237**	**249**	**260**	**272**	**285**	**297**	**310**	**323**	**336**	**349**	**363**	**376**	**389**	**403**	**416**	**430**	**444**
Hydraulics	78	82	86	90	94	99	103	108	112	117	122	126	131	136	141	146	151	156	161
Geotermal+Wind+Solar	25	26	27	29	30	31	33	34	36	37	39	40	42	43	45	46	48	49	51
Total	**319**	**335**	**351**	**367**	**385**	**402**	**421**	**439**	**458**	**477**	**497**	**516**	**536**	**555**	**575**	**595**	**615**	**635**	**656**
Rate of Increase	5%	5%	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	3%	3%	3%	3%

APPENDIX 2: Electricity Generation by Primary Energy Sources (TWh)

Appendix 2: Nuclear Power Plants Included Scenario 2000-2018																			
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Hard Coal+Asphaltite	3	3	3	3	2	3	3	3	3	4	5	5	4	4	5	5	6	6	7
Imported Coal	1	1	1	6	10	10	11	12	13	13	15	23	29	29	35	40	48	50	53
Lignite	34	34	28	24	22	30	32	38	42	39	36	39	35	30	37	31	39	41	43
Liquid Fuels	9	10	11	9	8	5	4	7	8	5	2	1	2	2	2	2	2	2	2
Natural Gas	46	50	52	64	62	73	81	95	99	96	98	104	104	105	121	99	89	94	99
Renewable+Waste	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3
Thermic Total	**94**	**99**	**96**	**105**	**104**	**122**	**132**	**155**	**164**	**157**	**156**	**172**	**175**	**172**	**200**	**179**	**186**	**197**	**206**
Hydraulics	31	24	34	35	46	40	44	36	33	36	52	52	58	59	41	67	67	71	75
Geotermal+Wind+Solar	0	0	0	0	0	0	0	1	1	2	4	5	7	9	11	15	21	23	24
Nuclear																			
Total	**125**	**123**	**129**	**141**	**151**	**162**	**176**	**192**	**198**	**195**	**211**	**229**	**239**	**240**	**252**	**262**	**274**	**290**	**304**
Rate of Increase	7%	-2%	5%	9%	7%	7%	9%	9%	4%	-2%	8%	9%	4%	0%	5%	4%	5%	6%	5%

APPENDIX 2: Electricity Generation by Primary Energy Sources (TWh)

Appendix 2: Nuclear Power Plants Included Scenario 2019-2037

	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Hard Coal+Asphaltite	7	7	8	8	8	9	9	10	10	10	11	11	12	12	13	13	13	14	14
Imported Coal	56	58	61	64	67	70	73	76	80	83	86	90	93	97	100	103	107	110	114
Lignite	45	47	49	52	54	57	59	62	64	67	70	73	75	78	81	84	86	89	92
Liquid Fuels	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5
Natural Gas	104	109	114	111	99	88	85	91	88	86	92	99	105	112	118	124	131	137	144
Renewable+Waste	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6
Thermic Total	**216**	**227**	**237**	**240**	**234**	**229**	**233**	**245**	**250**	**254**	**267**	**280**	**294**	**307**	**320**	**334**	**347**	**361**	**375**
Hydraulics	78	82	86	90	94	99	103	108	112	117	122	126	131	136	141	146	151	156	161
Geotermal+Wind+Solar	25	26	27	29	30	31	33	34	36	37	39	40	42	43	45	46	48	49	51
Nuclear				9	26	43	52	52	61	69	69	69	69	69	69	69	69	69	69
Total	**319**	**335**	**351**	**367**	**385**	**402**	**421**	**439**	**458**	**477**	**497**	**516**	**536**	**555**	**575**	**595**	**615**	**635**	**656**
Rate of Increase	5%	5%	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	3%	3%	3%	3%

APPENDIX 3: Electricity Generation by Primary Energy Sources (TWh)

Appendix 3: Afşin Elbistan Lignites and Nuclear Power Plants Included 2000-2018																			
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Hard Coal+Asphaltite	3	3	3	3	2	3	3	3	3	4	5	5	4	4	5	5	6	6	7
Imported Coal	1	1	1	6	10	10	11	12	13	13	15	23	29	29	35	40	48	50	53
Lignite	34	34	28	24	22	30	32	38	42	39	36	39	35	30	37	31	39	41	43
Liquid Fuels	9	10	11	9	8	5	4	7	8	5	2	1	2	2	2	2	2	2	2
Natural Gas	46	50	52	64	62	73	81	95	99	96	98	104	104	105	121	99	89	94	99
Renewable+Waste	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3
Thermic Total	**94**	**99**	**96**	**105**	**104**	**122**	**132**	**155**	**164**	**157**	**156**	**172**	**175**	**172**	**200**	**179**	**186**	**197**	**206**
Hydraulics	31	24	34	35	46	40	44	36	33	36	52	52	58	59	41	67	67	71	75
Geotermal+Wind+Solar	0	0	0	0	0	0	0	1	1	2	4	5	7	9	11	15	21	23	24
Nuclear																			
Total	**125**	**123**	**129**	**141**	**151**	**162**	**176**	**192**	**198**	**195**	**211**	**229**	**239**	**240**	**252**	**262**	**274**	**290**	**304**
Rate of Increase	7%	-2%	5%	9%	7%	7%	9%	9%	4%	-2%	8%	9%	4%	0%	5%	4%	5%	6%	5%

APPENDIX 3: Electricity Generation by Primary Energy Sources (TWh)

Appendix 3: Afşin Elbistan Lignites and Nuclear Power Plants Included 2019-2037																			
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Hard Coal+Asphaltite	7	7	8	8	8	9	9	10	10	10	11	11	12	12	13	13	13	14	14
Imported Coal	56	58	61	64	67	70	73	76	80	83	86	90	93	97	100	103	107	110	114
Lignite	45	47	49	52	120	122	125	127	130	133	135	138	141	144	147	149	152	155	158
Liquid Fuels	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5
Natural Gas	104	109	114	111	33	22	19	25	23	20	27	33	39	46	52	59	65	72	79
Renewable+Waste	3	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	5	5	6
Thermic Total	**216**	**227**	**237**	**240**	**234**	**229**	**233**	**245**	**250**	**254**	**267**	**280**	**294**	**307**	**320**	**334**	**347**	**361**	**375**
Hydraulics	78	82	86	90	94	99	103	108	112	117	122	126	131	136	141	146	151	156	161
Geotermal+Wind+Solar	25	26	27	29	30	31	33	34	36	37	39	40	42	43	45	46	48	49	51
Nuclear				9	26	43	52	52	61	69	69	69	69	69	69	69	69	69	69
Total	**319**	**335**	**351**	**367**	**385**	**402**	**421**	**439**	**458**	**477**	**497**	**516**	**536**	**555**	**575**	**595**	**615**	**635**	**656**
Rate of Increase	5%	5%	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	3%	3%	3%	3%

APPENDIX 4: Electricity Generation by Primary Energy Sources (%)

Appendix 4: Nuclear Power Plants Included Scenario 2019-2037																						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Hard Coal+Asphaltite	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Imported Coal	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
Lignite	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Liquid Fuels	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Natural Gas	33%	33%	33%	33%	33%	33%	30%	26%	22%	20%	21%	19%	18%	19%	19%	20%	20%	21%	21%	21%	22%	22%
Renewable+Waste	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Thermic Total	68%	68%	68%	68%	68%	68%	65%	61%	57%	55%	56%	54%	53%	54%	54%	55%	55%	56%	56%	56%	57%	57%
Hydraulics	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Geotermal+Wind+Solar	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Nuclear	0%	0%	0%	0%	0%	0%	2%	7%	11%	12%	12%	13%	14%	14%	13%	13%	12%	12%	12%	11%	11%	11%
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

APPENDIX 4: Electricity Generation by Primary Energy Sources (%)

Appendix 4: Afşin Elbistan Lignites and Nuclear Power Included Scenario 2019-2037																						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Hard Coal+Asphaltite	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Imported Coal	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
Lignite	14%	14%	14%	14%	14%	14%	14%	31%	30%	30%	29%	28%	28%	27%	27%	26%	26%	25%	25%	25%	24%	24%
Liquid Fuels	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Natural Gas	33%	33%	33%	33%	33%	33%	30%	9%	5%	5%	6%	5%	4%	5%	6%	7%	8%	9%	10%	11%	11%	12%
Renewable+Waste	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Thermic Total	68%	68%	68%	68%	68%	68%	65%	61%	57%	55%	56%	54%	53%	54%	54%	55%	55%	56%	56%	56%	57%	57%
Hydraulics	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Geotermal+Wind+Solar	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Nuclear							2%	7%	11%	12%	12%	13%	14%	14%	13%	13%	12%	12%	12%	11%	11%	11%
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

APPENDIX 5: ETHICS BOARD WAIVER FORM

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SOSYAL BİLİMLER ENSTİTÜSÜ
TEZ ÇALIŞMASI ETİK KOMİSYON MUAFİYETİ FORMU

HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
İKTİSAT ANABİLİM DALI BAŞKANLIĞI'NA

Tarih: 04/07/2019

Tez Başlığı: Yerli Kömür Kaynaklarının Kullanımının Türkiye'nin Cari İşlemler Dengesi Üzerindeki Etkisi: Afşin Elbistan Linyitleri Örneği

Yukarıda başlığı gösterilen tez çalışmam:

1. İnsan ve hayvan üzerinde deney niteliği taşımamaktadır,
2. Biyolojik materyal (kan, idrar vb. biyolojik sıvılar ve numuneler) kullanılmasını gerektirmemektedir.
3. Beden bütünlüğüne müdahale içermemektedir.
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Gereğini saygılarımla arz ederim.

04/07/2019

Adı Soyadı:	Muhammet Enes ÇIRAKLI
Öğrenci No:	N14229369
Anabilim Dalı:	İKTİSAT
Programı:	İKTİSAT (İNG.)
Statüsü:	[X] Yüksek Lisans [ ] Doktora [ ] Bütünleşik Doktora

DANIŞMAN GÖRÜŞÜ VE ONAYI

Uygundur

Doç. Dr. Dilek BAŞAR

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ECONOMICS DEPARTMENT

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My thesis work related to the title above:

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Program:	ECONOMICS (ENG.)
Status:	☒ MA ☐ Ph.D. ☐ Combined MA/ Ph.D.

ADVISER COMMENTS AND APPROVAL

approved

Doç. Dr. Dilek BAŞAR

APPENDIX 6: ORIGINALITY REPORT

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Tarih: 04/07/2019

Tez Başlığı : Yerli Kömür Kaynaklarının Kullanımının Türkiye'nin Cari İşlemler Dengesi Üzerindeki Etkisi: Afşin Elbistan Linyitleri Örneği

Yukarıda başlığı gösterilen tez çalışmamın a) Kapak sayfası, b) Giriş, c) Ana bölümler ve d) Sonuç kısımlarından oluşan toplam 105 sayfalık kısmına ilişkin, 02/07/2019 tarihinde tez danışmanım tarafından Turnitin adlı intihal tespit programından aşağıda işaretlenmiş filtrelemeler uygulanarak alınmış olan orijinallik raporuna göre, tezimin benzerlik oranı % 16 'dır.

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Gereğini saygılarımla arz ederim.

04/07/2019

Adı Soyadı:	Muhammet Enes ÇIRAKLI
Öğrenci No:	N14229369
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Programı:	İKTİSAT (İNG.)

DANIŞMAN ONAYI

UYGUNDUR.

Doç. Dr. Dilek BAŞAR

HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
MASTER'S THESIS ORIGINALITY REPORT

HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
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Thesis Title : The Effect of Utilization of Domestic Coal Resources on Turkey's Current Account Balance: An Example Of Afşin-Elbistan Lignites

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ADVISOR APPROVAL

APPROVED.

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