Financial Development, Renewable Energy and Economic Performance: Evidence from Turkey

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ABSTRACT

Financial Development, Renewable Energy and Economic Development: Evidence from Turkey

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SUSTAINABLE ENERGY MASTER PROGRAM

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The concept of energy and the sustainability of energy resources is one of the most important issues in the world. Population growth, industrialization, increased welfare and technological devopment, especially in developing countries, means that the world's need for energy is gradually increasing day by day. Therefore, in the future, the global energy demand will be much higher than it is today.

The rapid depletion of energy resources, the use of resources such as oil, coal, and nuclear energy, and the pollution caused by these resources to the environment, as well as the atmosphere, have led people to the use of renewable energy sources. Renewable energy sources have created interest due to the following reasons, such as serious environmental issues caused by fossil energy sources, potentially decreasing reserves, various political and economic problems caused by dependency on source providing countries and price instability. In developed countries, particularly, renewable energy sources such as wind, geothermal, solar and biomass energy, wave and hydrogen have utilized in different forms, especially in electricity production. (Mutlu Y. 2012). Despite all these developments, the superiority of fossil energy resources in world primary energy consumption consumption continues unquestionably and will continue to maintain this advantage in the short term.

Thus, the formulation and implementation of proper energy policies for the countries is of crucial importance in all over the world.

Turkey, as an emerging country, challenged by a growing demand for energy due to economic and population growth. The effective and efficient use of energy sources as well as the wider use of alternative energy sources gains more importance for the sustainable development of Turkey. Therefore, the aim of this thesis is to investigate the short and long-term relationship among renewable and nonrenewable energy, financial development, and economic performance for a developing country, namely, Turkey, over the period 1980-2016. The stationarity of the series is tested by using Augmented Dickey Fuller (ADF, 1979) and Philips-Perron (PP, 1988) unit root tests. Long-run dynamic cointegrating relationship is examined by Johansen Juselius cointegration test (1990), short and long-run dynamic causal relationship through Vector Error Correction Model. The results of unit root test show that each series is non-stationarity at levels, however, after taking the first difference, all series are stationary at the test results. The empirical findings of the cointegration test indicate that there is a long-run relationship between financial development, renewable energy, nonrenewable energy, and economic performance. The statistical evidence based on the Vector Error Correction model indicates that the above variables do not have a statistically significant impact on economic development in the short-run. Morevoer, using Multiple Linear Regression analysis to determine the factors that affect the economic development in Turkey, the findings show that financial development and nonrenewable energy have a positive and significant relationship with the economic development, whereas renewable energy does not have a statistically significant relationship.

Key Words: Renewable Energy Consumption, Economic Development, Financial Development, Nonrenewable Energy Consumption, Cointegration-Causality

ÖZET

FİNANSAL GELİŞME, YENİLENEBİLİR ENERJİ, EKONOMİK BÜYÜME: TÜRKİYE ÖRNEĞİ

DEMİRCİ, Burak

SÜRDÜRÜLEBİLİR ENERJİ YÜKSEK LİSANS PROGRAMI

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Dünyada enerji kaynaklarına olan ihtiyaç her geçen gün artarak devam etmektedir. Özellikle gelişmekte olan ülkelerde nüfus artışı, sanayileşme, insanların refah seviyesinin yükselmesi ve teknolojik gelişmelere paralel olarak önümüzdeki yıllarda enerji talebi daha da yoğun olacaktır. Fosil enerji kaynaklarının dünyada ciddi çevre sorunlarına yol açması, rezervlerinin yakın gelecekte tükenecek olması, kaynak ülkelere bağımlılığın çeşitli siyasi ve ekonomik sorunlara yol açması ve fiyat istikrarsızlıkları gibi nedenlerden dolayı yenilenebilir enerji kaynaklarına olan ilgi artmıştır. Özellikle gelişmiş ülkelerde yenilenebilir enerji kaynakları olan hidrolik, rüzgâr, jeotermal, güneş, biyoküte, dalga, hidrojen vb. enerji kaynaklarından başta elektrik üretimi olmak üzere çeşitli yollarla yararlanılmaktadır. Tüm bu gelişmelere rağmen fosil enerji kaynaklarının dünya birincil enerji kaynakları tüketimindeki üstünlüğü tartışmasız bir şekilde devam etmektedir ve kısa vadede bu üstünlüğünü korumaya devam edecektir.

Gelişmekte olan bir ülke olan Türkiye'nin de artan nüfus ve büyüyen ekonomisine paralel olarak enerji kaynakları tüketimi yükselerek devam etmektedir. Bu nedenle sürdürülebilir kalkınma hedefleri doğrultusunda tüm enerji kaynaklarının etkin ve verimli kullanımı, aynı zamanda alternatif enerji kaynaklarının kullanımı önem arz etmektedir. Bu amaçla, bu tezin amacı Türkiye'de yenilenebilir enerji kullanımı, finansal gelişmişlik ve tükenebilir enerji kullanımı ile ekonomik büyüme arasındaki uzun ve kısa dönemli ilişkinin varlığını ve yönünü 1980-2016 yıllık verileri kullanarak incelemektir. Serilerin durağanlığını test etmek için ADF ve PP birim kök testleri kullanılmıştır. Yenilenebilir enerji kullanımı, finansal gelişmişlik ve tükenebilir enerji kullanımı ile ekonomik büyüme arasındaki uzun dönemli ilişkinin varlığı Johansen-Juselius Eşbütünleşme testi ile seriler nedensellik ilişkisi ise Vektör Hata Düzeltme Modeli kullanılarak tespit edilmiştir. ADF ve PP birim kök test sonuçları serilerin düzey değerlerinde birim kök içerdiklerini fakat 1. Dereceden farkları alındığında ise serilerin durağanlaştığını göstermiştir. Johansen-Juselius Eşbütünleşme testi sonucunda seriler arasında bir eşbütünleşme olduğu, diğer bir ifadeyle, ekonomik büyüme, yenilenebilir enerji, finansal gelişme ve tükenebilir enerji kullanımı arasında uzun dönemli bir ilişkinin varlığı belirlenmiştir. Vektör Hata Düzeltme Modeline dayalı Granger nedensellik testi sonuçlarına göre kısa dönemde söz konusu değişkenlerin ekonomik büyüme üzerinde istatistiki olarak anlamlı bir etkilerinin olmadığı tespit edilmiştir. Bunun yanı sıra, Türkiye'de yenilenebilir enerji kullanımı, finansal gelişmişlik ve tükenebilir enerji kullanımının ekonomik büyümeye etkisi Çoklu Regresyon Analizi yöntemi ile test edilmiş ve elde edilen bulgular doğrultusunda finansal gelişme ve tükenebilir enerji kullanımının ekonomik büyümeyi anlamlı ve pozitif etkilediği, yenilenebilir enerji kullanımının ise ekonomik büyümede anlamlı bir etkisinin olmadığı belirlenmiştir.

Anahtar Kelimeler: Yenilenebilir Enerji Tüketimi, Ekonomik Büyüme, Finansal Gelişme, Tükenebilir Enerji Kaynakları Tüketimi, Eşbütünleşme-Nedensellik

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Burak DEMİRCİ

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CHAPTER 1

INTRODUCTION

Energy is considered as a crucial factor for sustainable economic development (Sebri, 2015) even if the perspective of energy has been changing in terms of globalization. Due to the increase in the world population, the energy consumption increases day by day and therefore, energy is becoming an even more important concept in our lives. It is clear that the traditional energy sources such as oil, coal, and natural gas will not be enough for all after a certain period with the intense consumption. Since the volume and cost of production is directly affected by the use of energy sources, the lack of access of these sources will result in a decline in economic development in the countries, where the industrial structure is based upon the use of non-renewable energy sources. Therefore, due to the increased energy demand and its limitations, the effective use of traditional non-renewable energy sources, as well as, the use of renewable energy sources will become the most important issues in many countries in the following years.

The use of renewable energy sources for the development of the modern world seems to be possible with its contribution to the national economy. Sustainable resources, which are the answer to the question of renewable energy sources in the world, can be listed as follows: Solar energy, wind energy, hydropower, geothermal energy, biomass including biofuel energy. In addition to supporting the supply side of the energy request, many countries always come up with the wider use of these renewable energy sources, which have the following advantages, such as less pollution, inexhaustible, no security or safety problem (Menegaki, 2011), less dependency on imported sources (Vaona, 2016), and boosted employment (Alper and Oğuz, 2016).

Turkey, as a developing country, has a great location for energy transfers. It also occupies a unique geographic position, lying partly in Asia and partly in Europe. Through its history, it has acted as both a boundary and a bridge between the two landmasses. (Britannica, 2019). Moreover, Turkey has a wealthy energy potential for sun powered, hydropower, geothermal control and wind control. Moreover, it is the leading country in solar energy. This reason has led us to analyze whether the use of renewable energy consumption has any impact on economic welfare in Turkey. Due to its environmentally friendly clean energy, renewable energy sources are very important for the people to live in a healthy environment. Additionally, it is the most important source of energy that can meet the world's growing energy needs. It also provides development of renewable energy sources in terms of sustainability.

Turkey has experienced a considerable development in energy demand in recent years, which has had a major impact on its energy supply (Energy balance sheets 1980–2014). Therefore, it has become increasingly dependent on energy imports, to the extent that currently about 75% of the total primary energy supply met by energy imported from other countries such as natural gas and oil.

Republic of Turkey Ministry of Energy and Natural Resources has the highest share in energy imports. Turkey's energy production is not adequate to meet increasing energy demand. Turkey is a developing country and energy consumption is rapidly developing day by day. Subsequently, Turkey has been a net importer of energy and these imports result in a huge trade deficit; therefore, Turkey has to move forward producing electricity from renewable energy sources. These issues have become the need of a rapid move to renewable energy sources in Turkey. Considering economic and political reasons, renewable energy sources are crucial to meet the major part of the Turkey's energy demands, and then, these sources seem to be the most realistic alternative for Turkey. Moreover, Turkey's energy import dependence with fluctuations in the price of energy imports makes energy security one of the government's most important roles. In energy security, commissioning of new energy production investments, providing the diversity of energy sources, and providing the highest level of energy efficiency stand out as important goals for the effects of Turkey on economic growth. In order to prohibit risks from high levels of energy dependence and to develop a sustainable energy model, the government has made significant reforms for economic welfare. For example, with the liberalization of energy markets, private companies have entered energy markets, which in turn, has created more competitive energy markets. In this way, the share of private establishment in electricity generation increased to 75% in 2017 while it was 32% in 2002 (Invest in Turkey, 2018). In addition, Turkey's Ministry of Energy has plans for promoting alternative solutions based on renewable energy. Turkey needs an innovative energy policy for the future, where renewable energy plays an important role.

Moreover, Turkey signed the Kyoto Protocol in 2009 and declared the National Renewable Energy Plan for Turkey in 2014 due to the EU's Renewable Energy. In this plan, the energy policy of the government has been declared, which puts special emphasis on the role and the share of renewable energy. According to the plan, by 2023, Turkey aims to increase renewable energy sources in electricity production and in total energy consumption. It aims to reduce the energy heavy schedule, calculated as units of energy consumption per unit of GDP by 2023 (MENR, 2014). According to forecasts (Apergis and Danuletiu, 2014), primary energy demand will continue to grow until 2030 at a rate of 1.5% per year. The active use of fossil fuels with the increasing growth of consumption will lead to an increase in CO2 emissions. It also inclines to exacerbate problems of environmental and energy security. This, in turn, will lead to a revision of the strategy of energy development and could lead to a paradigm shift from the use of non-renewable energy to renewable energy for not polluting the environment. Each year, the demand for clean energy sources is rising globally. For instance, this trend is observed in both developed and rapidly developing countries, like the USA, EU and China (IEA, 2009).

Since energy consumption is one of the key determinants of the economic development, due to the increase in the volume and cost of the production, the energy supply and energy dependency are of particular interest for the countries to grow. Turkey, as a rapidly developing country, is also accompanied by a rapid population growth, leading to increasing energy consumption. Considering the energy needs for future as well as the increasing interest in environmental issues, the inexhaustible, intensive use of renewable energy will support the need for the energy demand as well as to decrease the energy dependence from the world market. Therefore, the importance of renewable enegy sources will increase. This thesis aims to investigate the existence of long-term relationship among renewable energy, financial development, nonrenewable energy and economic development, as well as to determine the existence of a causal relationship among the above variables in the long and short term in Turkey. Moreover, this thesis aims to determine whether nonrenewable energy, renewable energy and financial development have significant impacts on the economic development of Turkey. Due to the extensive literature in the energy consumption-economic development nexus, the impacts of renewable and non-renewable energy consumption on economic growth is limited.

The contribution of this thesis to the literature is two-fold. First of all, to the best of our knowledge, this is one of the pioneering studies examining the long and short-run cointegrating relationship and causal links between financial development, renewable and nonrenewable energy as well as economic growth in Turkey over the period 1980-2016. Even if there is a vast literature on the energy consumption-economic growth nexus in Turkey, there is no study, which examines the relationship among renewable and nonrenewable energy consumption, financial development and economic growth in Turkey with a large dataset. While investigating the relationship within these variables, this thesis also includes the financial development as an explanatory variable in the renewable energy-economic development nexus. Secondly, the analysis based on a longer and more recent annualy time series data.

This study aims to answer the following research questions:

a) Is there any long term relationship between renewable energy, nonrenewable energy, economic growth and financial development?
b) Is there any causal relationship between renewable energy consumption-economic developments in Turkey?
c) Is there any causal relationship between non-renewable energy consumption-economic developments in Turkey?
d) Which of four different hypotheses are validated for the relationship between economic growth and renewable energy consumption in the case of Turkey?
e) Is there any significant impact of renewable and nonrenewable energy on the economic growth in Turkey? If yes, is the impact is negative or positive?

This study is organized into five parts. Chapter 1 introduces the topic and describes the contributions of the thesis to the literature. Then, it formulates the research questions to be answered through the thesis.

Chapter 2 presents an overview of the literature review about the relationship between renewable, nonrenewable energy consumption, economic growth and financial development as well as theoretical background. The first part of this chapter discusses the hypotheses on the energy-economicg growth nexus. The second part gives a brief information about the empirical literature review. Furthermore, a detailed and comprehensive literature review part is presented about the energy-growth studies in Turkey.

Chapter 3 provides a brief overview of the energy sources in Turkey, namely, non-renewable energy sources and renewable energy sources. Furthermore, it describes the energy utilization of

Turkey and then the significance of the wider use to renewable energy sources. Lastly, renewable energy sources and its usage in Europe are also discussed in detail.

Chapter 4 describes the dataset used and introduces the methodology to analyze the relationship among renewable and non-renewable energy consumption, economic growth and financial development.

Chapter 5 presents the empirical results of the thesis. The long run relationship as well as the casual relationship among the variables is discussed, then, the findings about whether nonrenewable energy, renewable energy and financial development have significant impacts on the economic development of Turkey are outlined.

Chapter 6 contains concluding remarks. It provides a final evaluation about the empirical results of the thesis; finally, I will end the thesis with a number of policy implications for the governments, and regulators.

CHAPTER TWO

LITERATURE REVIEW

2.1. Theoretical Background

There is a vast number of empirical studies investigating the relationship between energy consumption (renewable and non-renewable) and economic growth in the literature since the pioneering study of Kraft and Kraft (1978). Following this research, the relationship between energy consumption and economic growth has been extensively become a very popular field of study. The Granger Causality test has been applied to energy prices and economic growth 1948-1972 in the US (Hamilton 1983). Narayan and Smyth (2008) examined the cointegration and Granger causality analysis for G7 countries between 1972 and 2002 periods and found that there is a cointegration between capital accumulation, the energy consumption and real GDP in the long run. Akarca and Long (1980) mentioned Granger causality test between 1973 and 1978. According to these results, energy market accumulation and energy consumption were the causes of economic growth. There was also a cointegration between energy consumption and economic growth according to Stern (2000), who examined the data between 1948-1994 periods for US.

In the article on economic growth-energy, Ozturk (2010) describes the contemporary state of the directions of studies on the relationship between renewable energy consumption and economic growth, in terms of causal relationships as a set of different hypotheses. Several studies in the literature have investigated the relationship between renewable energy consumption and economic growth. The results of these studies show positive and negative impacts of renewable energy on economic growth using different data and periods. When Yazdi and Bahram Shakouri (2018) examine the relationship between the renewable energy, CO2 emissions, and economic growth, the empirical results show that economic growth and energy consumption play a significant role for CO_2 emissions. Therefore, governments need to design and make effective support policies to encourage investment in new renewable energy policies and technologies. The relationship between economic growth and energy consumption and the direction of the relationship is of crucial importance for the governments and energy agencies to make energy policy decisions.

Four different hypotheses are validated in the literature for the relationship between economic growth and renewable energy consumption. These hypotheses are as follows: growth hypothesis, conservation hypothesis, and feedback and neutrality hypothesis. *"Growth hypothesis"* supports the existence of a unidirectional causal relationship from renewable energy consumption to eceonomic growth, meaning that the increase in the renewable energy consumptions leads to an increase in the economic growth. *"Conservation hypothesis"* refers to the existence of a uni-directional causal relationship from economic growth to renewable energy-consumption, which suggests that the policies for the use of renewable energy do not have any significant influence on the economic development. As the third one, *"feedback hypothesis"* allows for the presence of a bi-directional causality between economic growth and renewable energy consumption. When this hypothesis is validated, a decrease (increase) in renewable energy consumption (economic growth) will result in a decline (rise) in the economic growth (renewable energy consumption). Lastly, *"neutrality hypothesis"* supports the existence of no causal relationship between renewable energy consumption and economic growth, suggesting that any conservative or expansionary policy on the use of renewable energy sources is not expected to affect the economic growth (Apergis and Payne, 2009).

2.2. Empirical Literature

Concerning the causal relationship between energy consumption and economic growth, many econometric papers in the recent literature have tested the validity of the four-essential hypothesis, namely, the growth hypothesis, conservation hypothesis, feedback hypothesis, and the neutrality hypothesis and concluded different conclusions depending upon the sample countries, time period and the used empirical methodology.

The empirical literature is partitioned into three parts. The first part covers the empirical studies investigating the relationship between energy consumption and economic growth. The second part includes the researches about the links between renewable energy consumption and economic growth. The final part of the empirical literature review part mentions the recent studies about the comparative effects of the renewable and nonrenewable energy consumption on economic growth.

The literature review for the first part includes many studies in different countries, different methodologies, and time period. The studies by Apergis aznd Payne (2010) in 11 Common Wealth of independent states, Ozturk et al. (2010) in 51 countries, confirm the existence of feedback hypothesis. Moreover, there is vast number of researches that finds the evidence of growth hypothesis. These studies generally include cross-country dataset, Pao and Tsai (2010) on Brazil, Russia, India and China; Odhiambo (2010) on a few African countries. However, some recent studies analyze the existence of the relationship between energy consumption-economic growth using single country data set (Shahbaz et al., 2013). The second part of the literature examines the relationship between renewable energy consumption and economic growth, using single country as well as cross-country data set.

All the existing investigators partitioned between different speculations. For example, (Apergis and Payne, 2010; Fang, 2011) some studies which used several countries as regional samples, find bi-directional causality between economic growth and renewable energy consumption, which confirms the hypothesis of a "feedback effect" (Rafindadi and Ozturk, 2017; Tugcu, 2013). Other investigators found that there is a unidirectional causality from energy utilization to financial development, bringing the conclusion that the effect of energy utilization on financial development exist, supporting the development speculation (Fotourehchi, 2017, Bhattacharya et al., 2016; Esso, 2010; Fang, 2011; Leitão, 2014; Payne, 2010). The study by Ocal and Aslan (2013) about Turkey gives the contentions in favor of the preservation speculation, portraying the reliance of renewable energy from financial development. Moreover, it is important to notice that the number of considerations which ended up undecided, about the intermediaries between financial development and energy utilization (Bowden and Payne, 2010; Jebli et al., 2016; Pao and Fu, 2013; Tugcu et al., 2012; Yildirim et al., 2012). Among the works, they talk in favor of the theory of non-attendance of causality between the considered factors one ought to highlight the papers by Menegaki (2011) and Payne (2010), which provide distinctive intermediaries utilized to degree renewable energy utilization. A study on Indonesia by Shahbaz et al. (2013) concluded that the development of national GDP and utilization leads to higher CO2 emanations, whereas budgetary advancement and liberalization stifle them. In other words, they found proof that budgetary improvement encourages the spread of renewable clean energy sources. Çoban and Topcu (2013) examines the issue of causality on the case of the Eurozone nations for the period 1990-2011. The findings of the investigators appeared to show that monetary advancement has noteworthy affect on energy utilization among the EU individuals. Chang (2015) on the test of 53 nations for the period 1999-2008, analyze the nonlinear effect of monetary markets on utilization and pay. Ozturk and Acaravci

(2013) explores long-term connection between energy, financial development, openness and money related segment advancement on the case of Turkey for the 1960-2007, and their results are evidence to a long-term relationship between the factors. The improvement of the monetary segment has no factually noteworthy impact on the outflow of carbon within the long term. Ali et al. (2015) examined the relationship between monetary advancement and energy utilization on the case of Nigeria, utilizing ARDL approach. It appeared that the factors examined are in integration, and so have a long-term relationship. Within the brief term, monetary improvement and financial development have a negative effect on energy utilization.

Yazdi and Shakouri (2017) examine the relationship between financial development, renewable energy conspumption, money related advancement, and exchange openness over the period 1979-2014 in case of Iran, utilizing ARDL approach and Granger causality test. Their findings illustrate that renewable energy utilization encompasses a negative affect on financial development within the brief run and the long run. The investigators discover unidirectional causality from renewable energy utilization to financial development. Zeren and Koc (2014) consider the relationship between energy consumption and monetary union in terms of working on seven nations for period 1971-2010. It may seem that financial improvement and energy consumption may influence each other in positive and negative ways. Tugcu et al. (2012) explained the long run and causal connections between renewable and non-renewable energy consumption and financial development using ARDL approach for G7 nations for 1980-2009. As a result, they noted the non-attendance of details on the relationship between renewable energy consumption, monetary improvement and financial development in case of Turkey. There are both hypothetical considerations on the relationship between energy consumption and financial development (Sarı and Soytas, 2007; Narayan and Smyth, 2008; Apergis and Payne, 2010; Apergis and Tang, 2013). The investigators search about on the relationship between energy utilization and monetary advancement within the European Union are as takes after; Ciaretta and Zarraga (2010), Menegaki (2011), Pirlogea (2012) and Chtioui (2012). The investigators mention the significance of monetary improvement on financial development. For instance, Al-Yousif (2002), Masten (2008), Fung (2009), Antonios (2010), Wu (2010), Zagorchev (2011), and Çoban and Topçu (2013) inspected the relationship between monetary improvement and energy consumption by taking the 27 part states of the European Union (EU) into the 1990-2011 period. The result of consideration, the creators found solid proof of the effect of monetary improvement on energy conspumtion in EU individuals.

Shahbaz and Incline (2012) conducted a research covering the period of 1971-2008 on the impacts of energy utilization in Tunisia on monetary improvement, financial development, industrialization and urbanization. By utilizing Granger causality strategy, a relationship between energy utilization, financial development, industrialization and urbanization in Tunisia has been affirmed. Islam, Shahbaz, Ashraf and Alam, (2013) conducted a research on Malaysia. There are positive outcomes with respect to the presence of a long-term relationship between financial development and energy utilization and the course of causality. In addition, it is decided that a developing economy will have an expanding requirement for more energy. They expressed monetary advancement seem to diminish energy consumption on the off chance that energy effectiveness increments. South Korea and the Philippines concluded that there was one-way causality from development in South Korea to energy utilization and within the Philippines from energy utilization to development in their causality examination. (Yu and Choi 1985). Granger's causality test connected energy consumption and financial development. Concurring to come about of this test, no causality relationship found between the two factors within the US. Akarca and Long (1980). Yu and Hwang (1984) conducted a causality examination on the US economy utilizing the procedure 1947-1979 period. In this think about, the relationship between energy and work has been inspected. There was no causality relationship between energy utilization and financial development. Sarı, Soytas and Özdemir (2001) utilized Johansen cointegration test for Turkey within the 1960-1995 period. There encompasses a long-term relationship between energy utilization and development as a result of the think about. In addition, they found that there contains a one-sided causality relationship from energy usage to development. Altınay and Karagöl (2005) looked at the causal relationship between energy usage and development in Turkey. The result of the think about was there was a unidirectional causality development of energy usage. Karagöl Erbaykal and Ertugrul (2007) inspected the relationship between financial development and the energy framework in Turkey for the 1974-2004 periods. The cointegration relationship found between the arrangement and within the brief term. There was a positive relationship between the factors and this relationship was negative within the long term. Sengul and Tuncer (2006) inspected the genuine causal relationship between energy and GDP cost list utilizing commercial energy usage in Turkey from the periods of 1960-2000. There encompasses a one-way causality relationship from commercial energy usage to GDP found concurring to this think about. Yalta (2011) examined the development of energy consumption and cointegration in Turkey between the long times 1950-2006 a long time. As a result, there is no relationship between energy consumption and GDP.

When it takes a gander, it goes over a few examinations on sustainable power source potential and usage of Turkey. With the guide of its potential, Turkey can take action against high-energy security with this sustainable clean energy source and with superior air quality (Naciri M. 2017). In one of the investigations, focusing on the circumstance of sustainable power source in Turkey (Çapik et al. 2012), it is expressed that Turkey's most encouraging sustainable power source is wind energy with a yearly mean breeze speed of 2.58 m/s and a breeze thickness of 25.82 W/m2. In Toklu's examination (2013), it is discovered that despite the tremendous potential in Turkey for sunoriented vitality, there is not a significant rate of solar energy production. In another investigation of Toklu (2013), in which biomass energy in Turkey examined, it mentioned that biomass energy is energy for Turkey in power age. Then, Melikoglu (2017), again, contemplated geothermal energy in Turkey, indicating that the introduced power limit of geothermal energy has just achieved the estimation of 600 MW before the end of 2015, and he analyzed that geothermal energy focuses in 2023 vision aim are low and should be changed. In another examination by Ozcan (2018), Turkey's autonomy, he found that the rate of freedom is 25.05% in 2014, whereas it was 54.42% in 1980, suggesting that it is reducing. Then, independence rate in Turkey for energy, likewise, diminished from 77% to 37% in the range of 1980 and 2014. It gives the high-energy request, high reliance on imported coal and petroleum gas, and low sustainable energy source usage as the principle purposes behind this change. As a proposal to accomplish 2023 sustainable energy source targets, which guarantees independence, Turkey ought to present new energy arrangement instruments for sustainable energy source, for example, exchanging appropriations to the improvement of sustainable energy source ventures, putting successful carbon assesses on carbon outflows, etc. In an alternate report by Tükenmez and Demireli (2012), sustainable energy source is portrayed as the key for Turkey to take care of its energy related issues. These issues are depending exceptionally on imported energy, draining of petroleum product holds, rising energy costs, and expanding the natural contamination. Sustainable energy source arrangement in Turkey has quite recently begun. They made plans to accomplish the objectives such as, both expanding the energy from sustainable energy source assets in Turkey and bringing up offers to limit the energy reliance of Turkey. In the long run, first sustainable energy source law to produce electrical energy was accomplished on May 18, 2005. After this law, certain guidelines and corrections are acknowledged in the next years. These guidelines are managing either Renewable Energy Support Mechanism, pronounced to people in general by EMRA (Energy Market Regulatory Authority of Turkey) on July 21, 2011, or locally produced segments utilized in the energy offices dependent on sustainable energy source assets, declared by the Ministry of Energy on June 19, 2011.

In Turkey, there are many articles of these issues concerning the causal relationship between energy consumption and economic growth. There have appear mixed results, as well. For instance, Soytaş et al. (2001), Sarı and Soytaş (2004), Altınay and Karagöl (2005), Karagöl et al. (2007) observed uni-directional causality running from energy consumption to income according to Turkey's energy development period. On the other hand, Doğan (2015), Doğan (2016), Özata (2010), Uzunöz and Akçay (2012) found uni-directional causality running from GDP to energy consumption. Table 1 gives summary data of the mentioned studies regarding to Turkey. Say and Yucel (2006) observed the relationship between GNP, total energy consumption and carbon emissions. The result shows CO2 emissions have positive effect on GDP. Öcal and Aslan (2016), Halicioglu (2009), Bulut and Muratoglu (2018) mentioned the relationship between renewable energy via Granger Causality tests ARDL, co-integration running from GDP to energy consumption. In a many think about like Altınay and Karagöl (2004), Durgun (2018), Jobert and Karanfil (2007), Çetin and Seker (2012) comes about indicated no causality between these two factors in Turkey, although Erdal et al. (2008), Akpolat and Altıntaş (2013), Bayar (2014) recognized bi-directional relationship.

Table 1: Summary of recent literature on an energy consumption and economic growth in Turkey

Study	Period	Methods	Findings
Soytaş et.al. (2001)	1960-1995	Johansen Co-integration	EC → GDP
Sarı and Soytaş (2004)	1969-1999	Generalized Forecast Error Variance Decomposition Analysis	The total energy consumption clarifies the forecast error variance of GDP
Altınay and Karagöl (2005)	1950-2000	Granger Causality	EC → GDP
Karagöl et al. (2007)	1974-2004	Bound Test	EC → GDP (Short Run)
Erdal et al., (2008)	1970-2006	Johansen Co-integration, Granger Causality	EC↔ GDP
Uzunöz and Akçay (2012)	1970-2010	Johansen Co-integration, Granger Causality	GDP → EC
Akpolat and Altıntaş (2013)	1961-2010	Johansen Co-integration, VECM	EC↔ GDP
Say and Yucel (2006)	1970-2002	GNP, Total energy consumption, Carbon Emissions	CO2 emissions have positive effect on GDP
Halicioglu (2009)	1960-2005	Granger Causality ARDL, Co-integration	GDP----EC
Sarı and Soytaş (2009)	1960-2000	Causality Test	GDP----EC
Öcal and Aslan (2013)	1990-2010	ARDL, Yamamoto Causality	GDP → EC
Doğan (2015)	1990-2012	Granger Causality ARDL, Co-integration	EC → GDP
Doğan (2016)	1990-2012	Granger Causality ARDL, Co-integration	EC↔ GDP
Öcal and Aslan (2016)	1990-2009	Causality, ARDL	GDP → EC EC → GDP
Alper (2018)	1990-2017	ARDL, Causality Toda-Yamamoto	GDP → EC
Durğun (2018)	1980-2015	ARDL Toda-Yamamoto	EC↔ GDP
Bulut and Muratoglu (2018)	1990-2015	ARDL Causality	EC Ø GDP

CHAPTER THREE

ENERGY SOURCES IN TURKEY

Turkey has a wide range of energy sources. Hard coal, lignite, gasoline, natural gas, uranium and thorium are the significant fossil energy sources in Turkey. Hydroelectric power, geothermal energy, solar energy, wave energy, biomass are the renewable energy sources in Turkey. Turkey's existing energy sources cannot meet the growing need for energy. Turkey imports 98% of natural gas, 92% of oil and 50% of coal, meaning that a huge amount of energy is dependent on foreign supply. This occupies 72% of the total energy sources. Energy independence is a key aspect for countries, such as Turkey, in terms of achieving economic independence. Turkey's 2017 year-end 295.5 billion kWh of electric energy production, consumption seems to be 294.9 billion kWh. (BP Statistical Review). Turkey's annual electricity production rate continues to exceed 5% on average for 15 years.

Considering the oil and natural gas production of Turkey, there is not much change in crude oil production compared to the previous years, whereas the amount of natural gas production is changing. As of the end of 2016, natural gas production was 381.6 million m^3 against 17.9 million barrels of crude oil production and 27.6 million tons of crude oil and 46.1 billion m^3 of natural gas were consumed. Crude oil consumption increased by 5.7% and natural gas consumption increased to 2.7 times in 2016 compared to 2002. (BP Statistical Review). Nevertheless, the ratio of consumption of natural gas produced in Turkey remains at a very low level of 0.8%.

Turkey also has a great potential in terms of renewable energy sources. With humid and warm climate properties, the geographic location of Turkey provides convenient circumstances to utilize renewable energy. Turkey’s energy sources vary according to geographical segments. Each geographic region has its own position and strategy. These two main features change the quality of the energy source to use. However, the potential of Turkey’s renewable energy sources has not been utilized well. According to the study by Ozcan (2018), Turkey has evaluated approximately 70% of its existing economic hydropower potential, 8.9% of the wind power potential, 0.45% of the solar power potential, 30.7% of the geothermal potential, and 17.3% of its biomass potential.

Moreover, Turkey has gradually increased the installed capacity of wind power plants licensed and realized by the end of 2017 6.353 MW. Turkey' wind power potential is 48.000 MW and considering this potential, the total area corresponds to 1.3% of Turkey's surface. These numbers show that the geography is very advantageous for the efficient use of wind energy.

The two types of energy sources, non-renewable and renewable energy sources in Turkey, will be discussed in more detail.

3.1. Nonrenewable Energy Sources

3.1.1. Coal

Coal is generally used as a fuel in iron and steel factories. A large part of the coal in Turkey is used for iron-steel factories in Eregli and Karabük, the remaining is used for power generation power plants in Çatalağzı. Since the cost of this resource is very high, it directly affects the production. Electricity consumption is the result of the processing of coal used for energy production in industrial areas. It is also used as a source of heating in homes and workplaces.

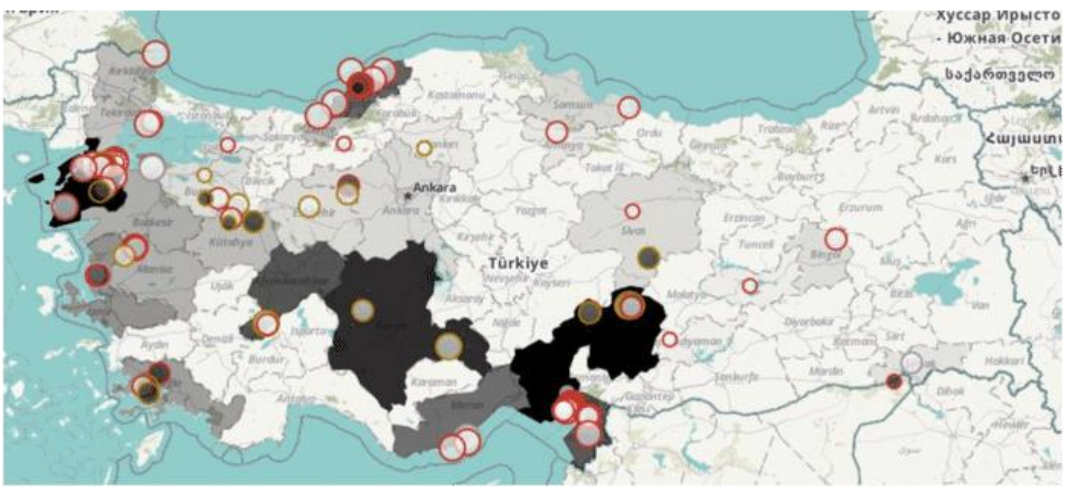

Figure 1: Map of Coal Plants

3.1.2. Lignite

Turkey has an abundance of lignite deposits. Lignite is especially used for generating electricity. It is additionally utilized in industrial and private heating. Lignite is one of the sources, which is mined in Turkey. The high calorific value makes this source exceptionally important. Low-calorie lignite assets are also available. Turkey’s major power plants, which utilize lignite, are Manisa (SOMA), Kütahya (SEYİTÖMER, TUNÇBİLEK), Muğla (YATAĞAN), Kahramanmaraş (AFŞİN-ELBİSTAN), Bursa (ORHANELİ) and Ankara (ÇAYIRHAN).

3.1.3. Oil

A huge portion of Turkey’s energy needs comes from petroleum products. Due to the very restricted reserves, dependence on foreign resources is high. Therefore, it is exceptionally crucial to find modern oil reserves due to the increasing consumption and services. The increase in oil energy utilization extends the power of Turkey within the world since Turkey is transit country for energy transfers with pipelines. A moderately low portion of oil and oil products consumption in Turkey is carried out in private and industrial sectors, the biggest consumption stems from transportation sector.

3.1.4. Natural Gas

Natural gas is a clean and economical fuel. As of late, the utilization of normal gas has increased in Turkey as well as all over the world. It causes less natural pollution than other fossil fuels. It is also used in thermal power plants, residential warming and industry. Turkey has a critical importance for Russia, beacuse of importing the highest amount of natural gas.

Figure 2: Natural gas transfer map of Turkey

3.1.5. Hydroelectric Energy

Hydroelectric Energy is the cleanest energy source. Turkey is the third in terms of hydropower potential within the European continent after Russia and Norway. Turkey uses existing hydropower potential at a 32% rate (Republic of Turkey Ministry of Energy Review). It is created by withdrawing electricity from hydroelectric power plants or from dams. In this completely natural process, with the assistance of set up mechanisms, Turkey diminishes its electricity utilization and thus decreasing its imports.

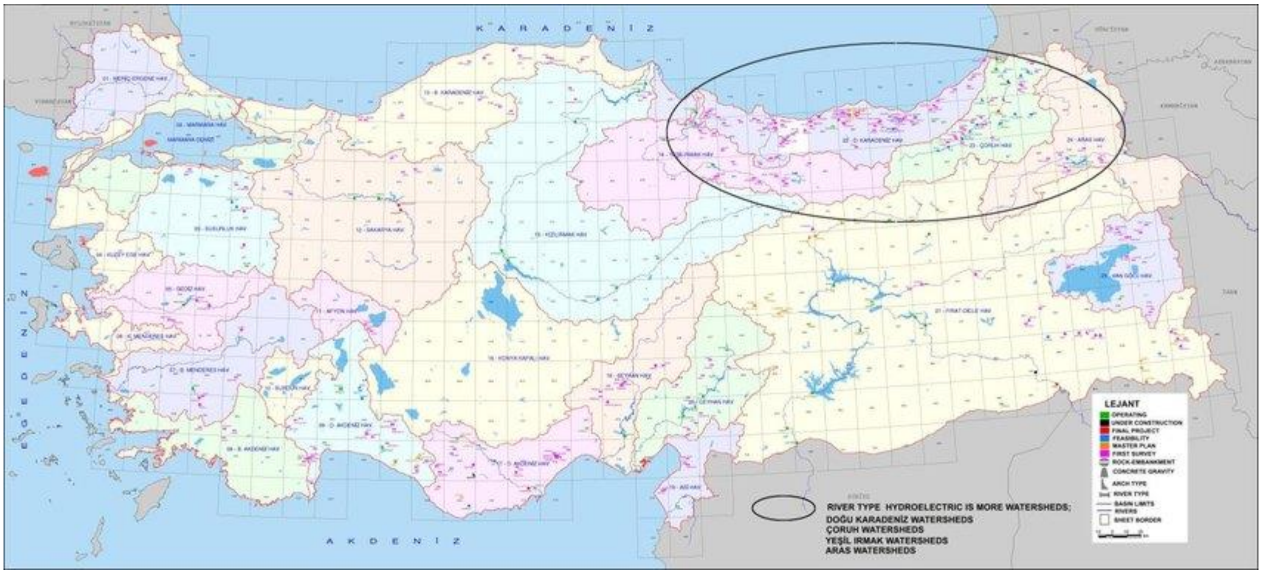

Figure 3: Turkey Hydroelectric Energy Potential Map

The need of developing modern strategies for water resources management comes up regularly in Turkey. In any case, in Turkey, an integrated water policy and a "Water Framework Act", setting out a system for standards and strategies related to water management, is not available. In these cases, the policies for water management in Turkey have led to the formation of a series of inconsistencies (Ürker and Çoban, 2012). There are numerous impacts on hydroelectric energy on the common, historical and social legacy and socio-economic environment, shifting from venture to extend. It is expected that hydroelectric power is one of the ways of energy production. It does not consist of any poisonous waste during the operation process and later; greenhouse gas emissions are very low according to hydropower plants. Due to these reasons, recently, hydroelectric energy is one of the most commonly used type of renewable energy along with the solar, wind and geothermal assets.

3.2. Renewable Energy of Turkey

Turkey's geographical area has many advantages for extensive utilization of renewable energy sources. Turkey has extraordinary variety of renewable energies opportunities, such as wind, solar, geothermal, biomass, hydraulic, etc. Turkey is a wealthy country, in terms of particularly wind energy, which globally is a critical part of renewable electricity generation. (Tükenmez, M 2012). Moreover, renewable energy resources, such as sun, hydroelectric, biomass, wind, sea and geothermal energy, are inexhaustible.

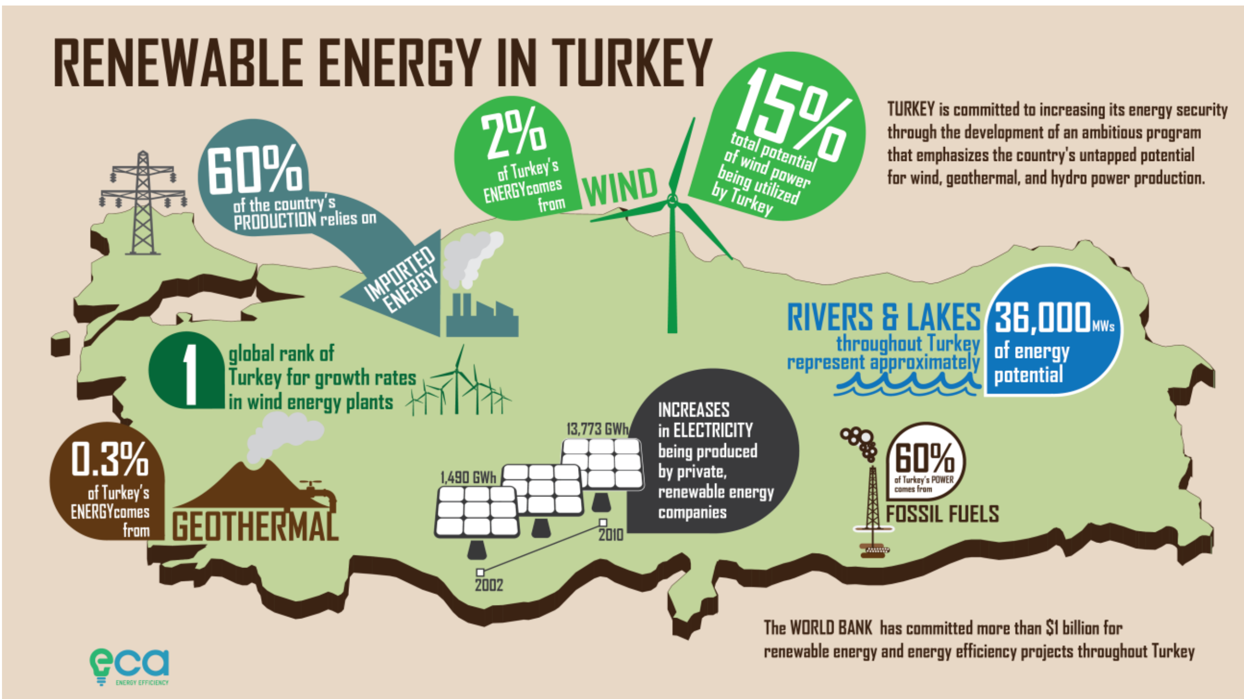

Figure 4: Renewable Energy Map of Turkey

Energy consumption of Turkey has rapidly grown especially in recent years. According to International Energy Agency (2018) data, Turkey's energy consumption was 40,169 ktoe in 1990, in 2000; it had become 57,908 ktoe, and reached 85,545 ktoe in 2014. The growing economic performance of Turkey with the increased per capita GDP are boosting energy consumption. It is estimated to increase around 4–6% per year up in the coming decade (Kaplan, 2015). On the other hand, energy generation of Turkey shows up to be poor compared to energy utilization. Consequently, Turkey's dependency on foreign energy has shown a very critical increase, approximately 70% increase from early 1990's to early 2000s (Turkish Petroleum 2017), Ministry of Energy and Natural Resources (MENR), 2018).

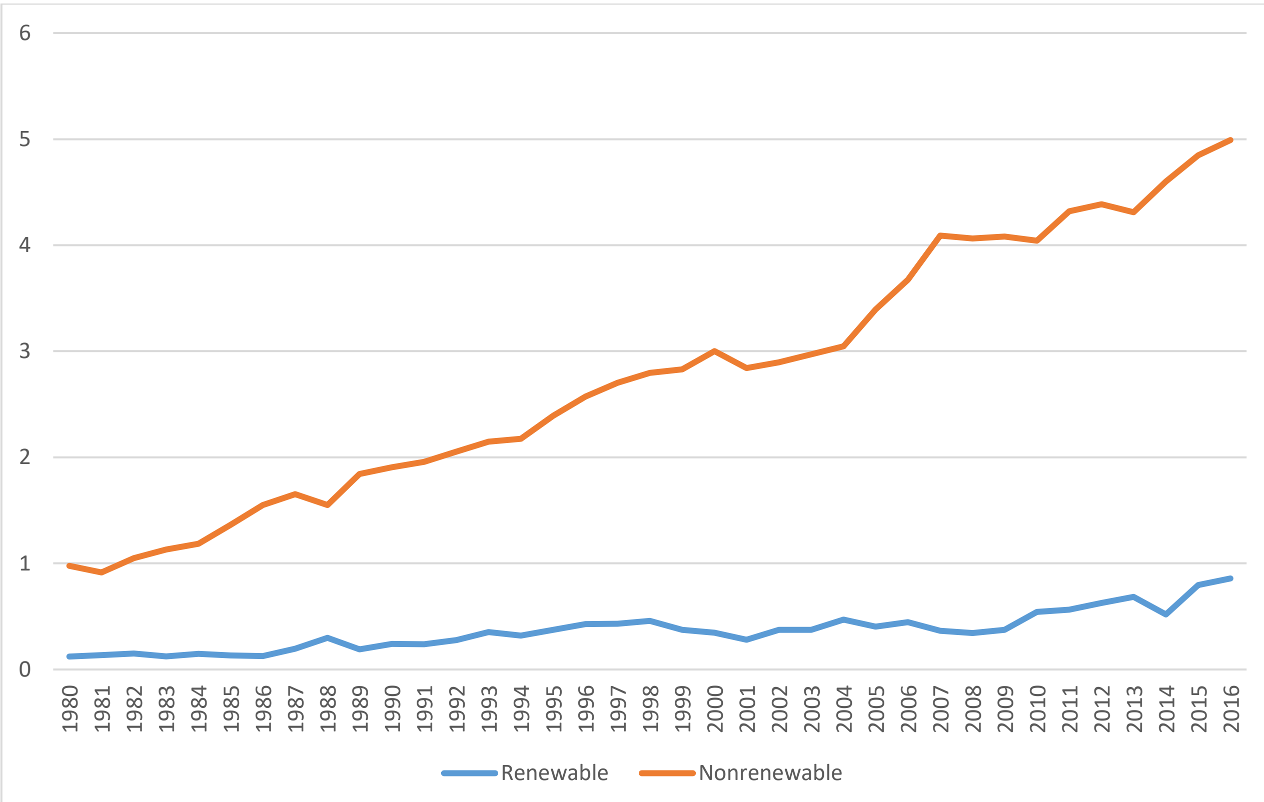

Figure 5: Renewable and Non-renewable Energy of Turkey

Renewable energy potential of Turkey is approximately 13% of EU-27's renewable energy potential. Additionally, its potential of renewable energy sources has not been utilized appropriately. Renewable energy sources help the countries to meet the energy need. Turkey is a wealthy country with regard to sustainable power source resources; especially wind, sun, geothermal, biomass, and water driven energies. Even if Turkey is able to utilize a reasonable percentage of its incredible maintainable power source potential, it has been compelled to turn into a subordinate country because of the inadequate power source utilization. For example, Turkey's dependence on imports is approximately 75%, whereas EU's is nearly 54%. Considering EU is geographically near Turkey, Turkey needs an aggressive energy strategy to reach its potential. In its extraordinary circumstance, Turkey needs to diminish its energy reliance by solving the administrative problems and developing techniques for using more sustainable energy source (Dursun, 2014).

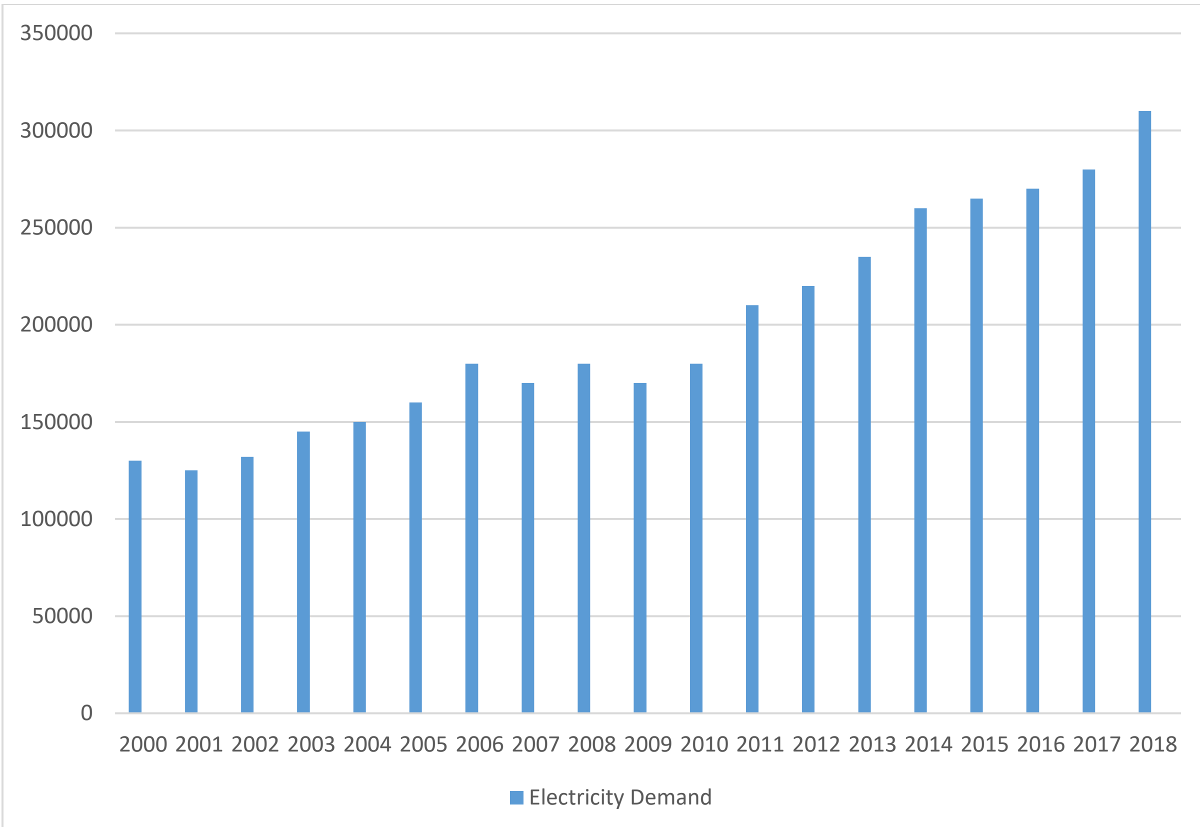

Figure 6: Electricity Demand of Turkey

Turkish energy markets have a crucial importance for improving energy demand and decreasing energy dependence on import. Turkey takes important steps to reduce this dependence one import. Considering Turkey's geographical position, which is close to energy-producing countries, Turkey has come up with some obligations as well as opportunities in terms of energy security. Because of having geostrategic importance, Turkey should protect and adopt its critical position. In this regard, Turkey should focus on improving its position between East-West and South-North Energy. The East West Gas Pipeline Ventures brings gas from Caspian and the Center East regions to Europe through Turkey, described as Southern Gas Section. South Caucasus Pipeline, Baku-Tbilisi-Erzurum Ordinary Gas Pipeline, Turkey-Greece Interconnector are the existing pipelines. Trans Anatolian Pipeline Venture constitutes the spine of the Southern Gas Section, which was presented on 12 June 2018. It is expected that Trans Adriatic Pipeline Expand (TAP) will be completed in 2019 and will transport Azerbaijani gas to Europe by 2020.

3.2.1. Wind Energy

Wind power or wind energy describes the way by which wind is utilized to produce mechanical energy or power. Wind turbines convert the dynamic energy within the wind into mechanical energy. This mechanical energy can be used for particular tasks or can be changed over into energy by a generator. Wind turbines can be used for energy consumption as well as for dealing out for exchange bargain. Price-performance efficiency of a wind turbine also needs to be considered. Private energy consumption requires a small turbine customarily less than 10 kilowatts, creating the entirety of energy that a household requires for a day. Medium-sized machines can generate adequate energy to arrange greater commercial onsite loads.

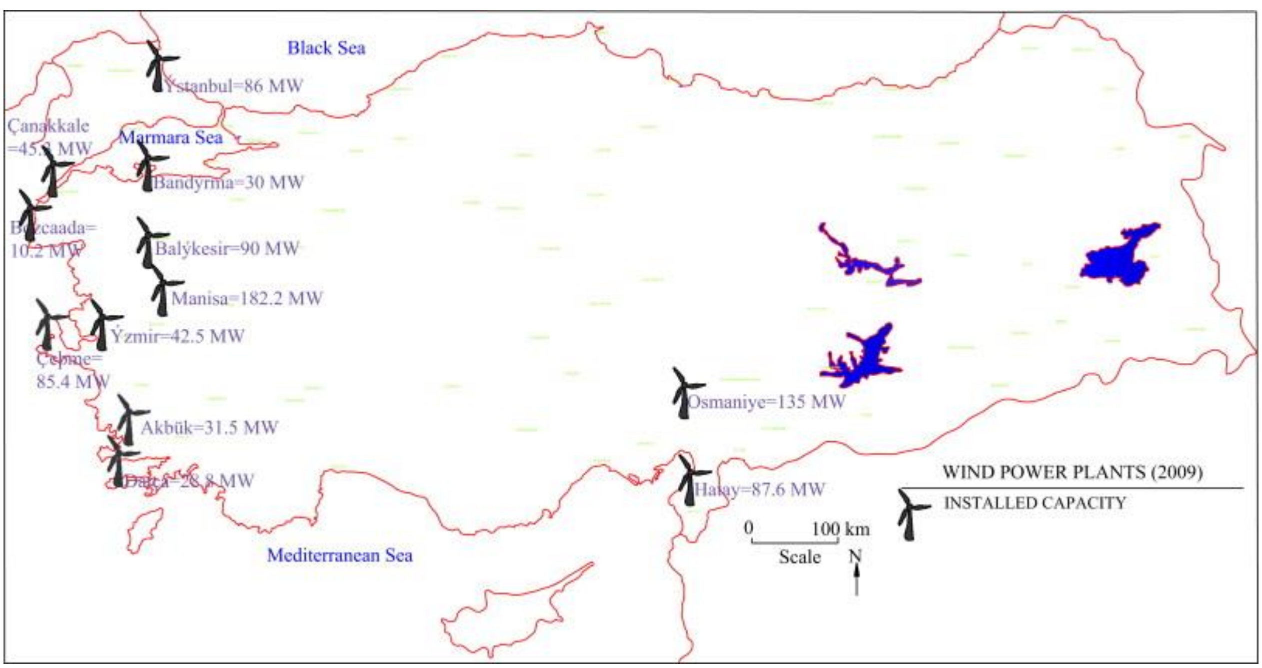

Figure 7: The wind power plants capacity of Turkey

In terms of wind power, Turkey uses “2023 Energy Targets” proposal. A cutting-edge plan is custom-made for the energy system of Turkey. Through the wind energy vision, the objective of Turkey was evaluated by applying a setting based on 20,000 MW wind power capacity installation by 2023 (Sulukan 2018). As a developing and emerging country, Turkey, which is still in the industrial progress is trying to search for different options to meet the growing energy demand with domestic resources and other type of alternatives. Many different countries all over the world use a variey of approaches in order to optimize the energy, economy and ecology characteristics (Sulukan 2018). Turkey’s energy policy targets have been formulated to provide adequate, economic and energy supplies in order to support both social and economic performance, to protect the energy supply security, and to support related investments for meeting the increasing energy demand. It is so clear that all these problems could be overcome with the usage of more renewable energy sources and therefore, if Turkey is able to generate enough financial sources to reach the desired target, the energy economic development of Turkey may be increasing because of using the wind energy potential (Sulukan 2018).

The developments in wind energy will reduce the dependence on fossil powers like coal, oil and gas in the following decade. As a renewable and clean source of energy, wind energy does not make any nauseous gasses. Research is conducted to address the challenges of wind power generation as a cheaper and more practical option for people and businesses to generate energy. However, there are some cons for wind energy. For example, wind reliability is a significant problem. Moreover, the wind energy does not regularly blow, and turbines work at around 30% capacity or so. Real storms or strong winds can damage wind turbines, especially if struck by lightning.

Another negative effect of wind energy is the threat to natural life. The edges of wind turbines may not be safe for the typical life of especially furry animals and other flying creatures, which will be inside the zone. Even if there is no way to avoid it, it should be taken into consideration. The wind turbines work noise and make visual pollution. Wind turbines make a sound that can be between 50 and 60 decibels. Some individuals accept that wind turbines are terrible for their life, so neighbors may complain about them. Additionally, the others think that wind turbines are not attractive and may disturb the magnificence of scenes. Strong storms and winds may cause harm to the edges of wind turbine. A broken edge may be a threat to the people working with or around the machine.

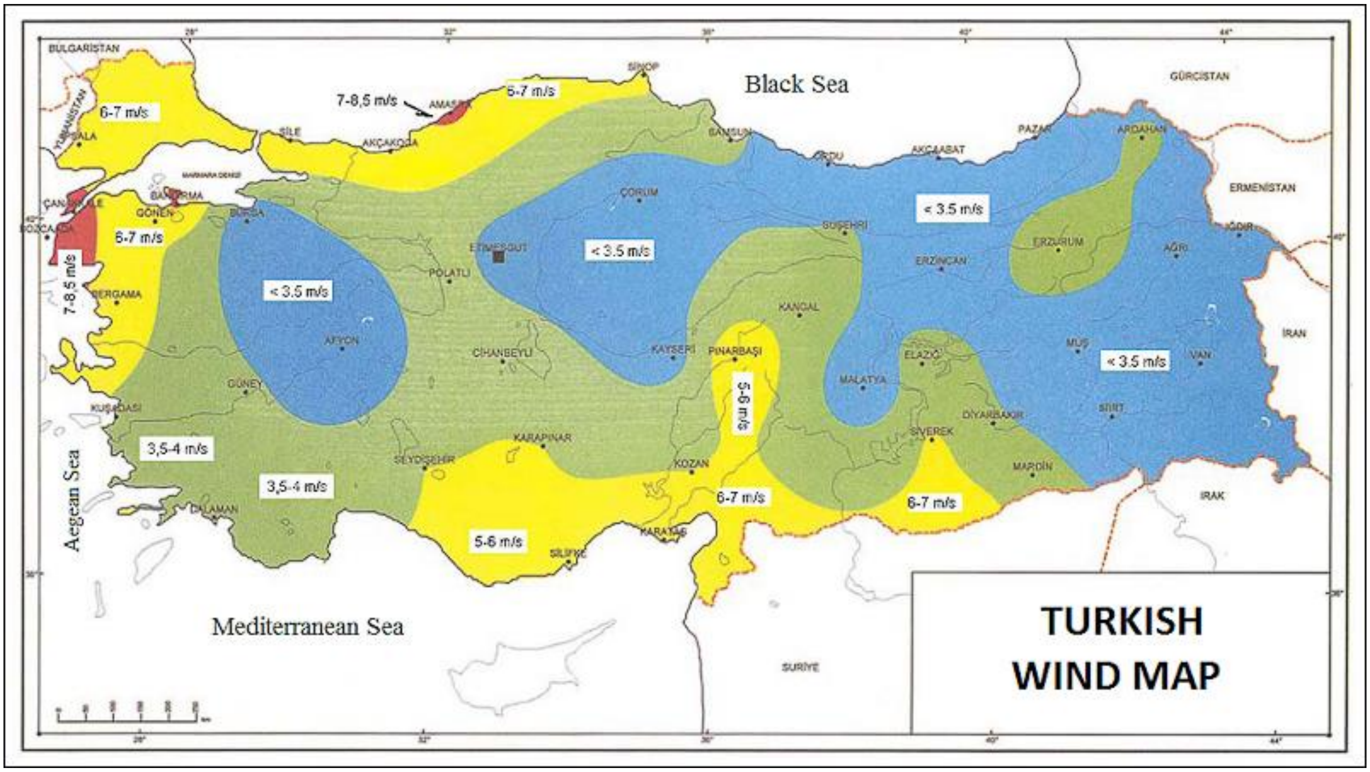

Figure 8: Map of Wind Potential in Turkey

Wind energy can be loaded at certain zones where speed of wind is high. Since they are largely setup in blocked off ranges, transmission lines have to be built to in order to bring the power to the private homes inside the city, which needs extra, walks to set up the system. The installation of the wind turbines requires a large zone, while cutting down the trees. Even if the selected areas to install the wind turbines seem very suitable, they may not be so easy to utilize them. Moreover, during the installment process of the wind tribunes, complying with city rules and requirements may be one of challenges to overcome.

3.2.2. Solar Energy

Solar energy is the energy generated from the sun. Solar panels utilize sunlight to produce electricity. These panels are mounted on the roof, facing the sun. Many countries all around the world use solar energy to reduce their dependence on fossil powers and try to increase its share in the total energy supply. Additionally, many people use solar energy in order to reduce their energy bills. Solar energy has become an incredibly important part the world that we live in. In this part, it going to take a closer look at solar energy and its pros and cons, so that we can make a correct decision about whether or not this is the right choice to consider when switching energy resources.

There are many pros of using solar energy. First of all, solar energy is a clean energy source, which reduces carbon emissions and protects the environment, while producing the energy. Unlike nonrenewable energy sources, such as oil, and coal, are finite, solar energy is free source of energy, which is renewable, and inexhaustible, meaning that it is infitine. Compared to nuclear energy, solar energy will be at the top in terms of being a more environmentally friendly solution.

Another advantage of solar energy is that it is sustainable. Sustainable, means to be able to meet the current needs without compromising the needs of the long term. Sun will probably exist for another 6.5 billion years, according to NASA, and it is inexhaustible. One of the extraordinary benefits of solar energy is the capability to bring energy to the most inaccessible areas, which are not essentially associated to a national electrical grid. The foundation of solar panels in remote zones is considerably cheaper than laying the tall voltage wires that are fundamental to supply these regions with electricity. Solar energy may be used even on cloudy/dull days. Solar panels may be placed on any number of rooftops, which wipes out the issue of attempting to discover enough space for power plants. Not only does it spare space, but it can end up saving people a barrel of money as well, despite the fact that the establishment of solar panels can take a toll. The utilization of solar energy to produce consumable energy allows individuals to be free of the limitations of fossil fuels. Financing solar panels can aid dispenseing the upfront cost. In addition, homeowners can offer surplus electricity generated to utility companies to diminish their month to month electricity charge. Daylight is available all through the world and can easily be harnessed in almost all countries.

It is assessed that the world’s oil reserves will come to an end in approximately 50-60 years, while sunlight is accessible for the next few billion years and can be utilized without harming the planet. Modern solar panels require less support as they do not involve any moving parts and last for almost 20-25 years. They require few meters of space for private use and require cleaning a few times a year. The creation of energy from fossil fuels and other renewable energy sources may be incredibly noisy; however, solar energy produces power quietly. They operate silently, hence, favored by many individuals.

There are, however, some cons of using solar energy, one of which is the initial installation cost, which covers all costs regarding the generation of power during day and also its expensive storage. The foremost significant con of solar energy is how much it costs to install the solar panels at home. Nowadays, the costs of the most excellent quality solar cells may be over $1000, and a few families may require more than one. This makes solar-powered panels more expensive at the beginning of the process. Solar energy is, as it were, able to generate energy within the daytime when the sun is out. This implies that, for around half of the day, solar panels are not producing energy for home, although the stored energy can be used at any time. The climate and climate patterns of zone can influence how well solar panels work as well. In the event that there's some discussion about the pollution in area as of now, it may cause a few issues. Pollution levels can affect solar cells’ adequacy; typically, this is important for organizations or businesses, which are looking to place solar panels in more polluted areas.

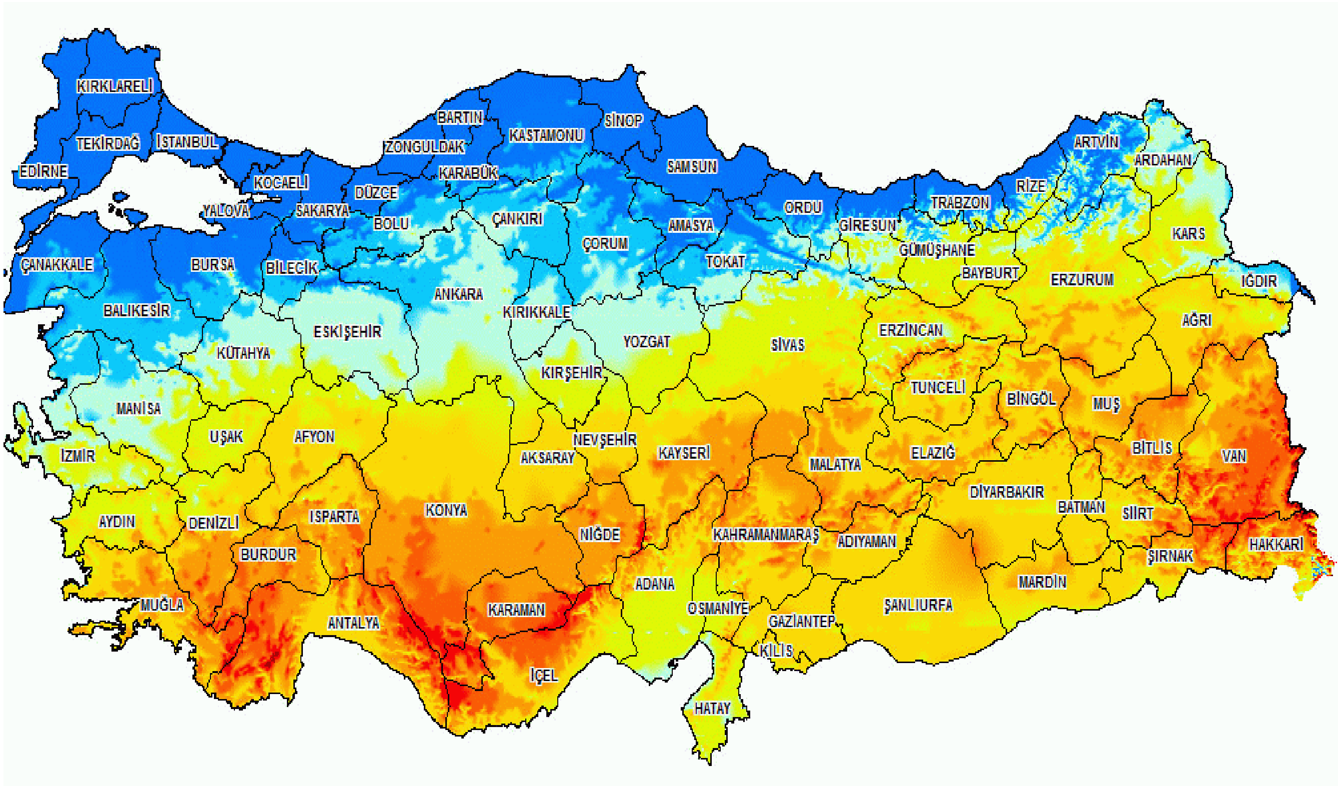

Figure 9: Turkey's Solar Map

Turkey has great regional potential for solar power. Although Turkey is in great condition in terms of having solar energy potential, unfortunately, it does not sufficiently and effectively utilize this potential. The most common utilization of sun based hot water heating frameworks is in Turkey. The Turkish company, Marsan Marmara Holding, has declared that it will start creating solar energy in a modern factory, established in Turkey. The company plans to start with 230 MW of generation capacity in July and points to increase that up to 270 MW of PV module era capacity in the short term and up to 1 GW interior the following four years. Concurring to Marsan, its items will include poly 260 W, mono 280 W and bifacial modules, which the firm claims have an efficiency rate of 16%, 17.2% and 20%. The company is operating in different sectors: tourism, real estate, nourishment and IT. Apart from building solar panels, the firm has some plans to develop sun-based PV plants in Turkey. Marsan said in a statement that its solar panel production followed more than a year of cooperation with specialists from the Netherlands, China and Taiwan.

Geothermal energy may be a type of energy that can truly make it simple for companies to reduce the use of fossil fuels within the manufactoring process. In this chapter, we take a closer look at a couple of of the basic pros and cons that related to utilizing geothermal energy for commerce as an energy source.

3.3.3. Geothermal Energy

Geothermal energy is extracted from earth's center and will be available as long as soil exists. This means that it is renewable and also can be utilized for another 4-5 billion years. While fossil fuels, covering a large portion of today's energy supply, are finite, renewable sources like geothermal energy do not run out. Geothermal energy is a clean energy in all perspectives of its utilization. It is known as having the smallest influence on nature amongst all the energy sources. When it comes to the strategy of creating and making it, geothermal energy can be produced within the country, which means that there is no cash or capital outflow, which in turn means economical independence. There is zero carbon emission when it comes to this sort of energy. Furhermore, it can clean out sulfur that would have been emitted in other ways. No fuel is used at all during the utilization of the energy. Since there is no mining or transportation needed for producing geothermal energy, it is favorable in terms of protecting the nature. With geothermal energy, there are no deficiencies or other sorts of issues that presently and after that happen with other sorts of energy. They are not subject to the same issues as solar or wind energy, which suggests that a climate-based deficiency is not possible. There's for all intents and purposes, a boundless supply. It is reliable; therefore, it will not be more of a bother than it is worth. It might seem expensive to begin with but 30-60% investment on warming and 25-50% investment on cooling can cover that after a few years. A geothermal energy pump can help saving adequate cash in energy costs. Geothermal energy extricates warmth from hot water, the steam from hot water move the turbines that convey control. To utilize this energy, impressive entirety of channeling required to lay underground. Geothermal energy has the smallest trace of any major energy source in the world. The costs are especially high. When it comes to green energy, geothermal energy is one of the essential types of energy being developed, which is likely to be less demanding than other types in dealing with a number of challenges to come with the innovation as time goes on. Upcoming improvements are guaranteed to be able to utilize lower temperatures in future emphasises of the advancement as well.

There are also negative aspects of geothermal energy. For instance, it can only be used in particular regions. Prime objectives are remarkably zone particular; therefore, it is not possible to find geothermal energy control outside of those ranges. In development, the prime objective for an energy source to be far from urban locales, which proposes that geothermal energy is basically pointless when it comes to cities and such. Another negative way of geothermal energy is high beginning costs: For those private proprietors who are considering to utilize geothermal energy, high costs is something that turns out to be a colossal incident. Geothermal warm pumps still require a control source that can run it. The pumps require control to run that can trade energy from sources center to the domestic. For a property holder, who wants to go green can utilize few solar panels that can control warm pump to draw energy from the earth's supply. Geothermal has been accused for causing seismic tremors, as setting up of geothermal control plants can alter the land's structure. Water fueled breaking, could be a on a very basic level parcel for building a broad scaled and capable geothermal system control plants that can trigger seismic tremors. There are some natural concerns. Water usage is one of the major concerns, since geothermal energy control uses a portion of water. There are a number of different compounds that need to be examined; water and ground, checking sulfur dioxide, both of which can hurt the environment on the off chance that it is not properly calculated. Sometimes it is needed to deal with some specialized challenges that result from the way that geothermal energy control is utilized. Problems can happen because of how far off the control must travel, and botches can happen and afterwards, it may be troublesome for the energy to be used by the people in an effective way.

3.3. Energy Utilization of Turkey

Renewable energy sources have been vital for people since the beginning of civilization. For centuries, and in numerous ways, biomass has been utilized for warming, and cooking. Numerous centuries back, humankind was utilizing the clearly unmistakable control of water for mechanical drive purposes, as was the case with wind. As observed above, the most elevated impetus is given to the solar energy. Nowadays, water plants are still utilized in our towns, in spite of the fact that their numbers are decreasing. On the other hand, Turkey is an energy-importing nation with more than half of the energy being provided by imports, and air contamination is becoming a considerable concern in the country, (Arif, 2004). In this respect, renewable energy is to be one of the most productive and viable arrangements for economical improvement and preventing contamination of the nature in Turkey. Turkey's geological area has a few focal points for broad utilization of most of the renewable energy sources. Since this and the reality that it has restricted fossil fuel assets, a slow move from fossil fuels to renewables appears to be genuine and the most obvious choice for Turkey. This article presents the contemporary ponders on the renewable energy sources and their potential in Turkey. There is no power generation by which depicts the most astounding motivation rates solar energy capability of Turkey. Biomass energy pursues solar energy in motivating power costs as indicated by the table. There is a decent potential however not used in Turkey regarding power generation. Since power generation stations made by biomass energy are mostly made locally, the segment motivators in biomass are lower than that of solar energy, while the feed-in duty costs are equivalent. After solar power, biomass and geothermal energy takes the second and third spot in all out-motivation rates. Rates and reasons of the geothermal energy-based power creation are like that of biomass with only lower incentives appearing of geothermal energy when contrasted with biomass. Wind and water powered energies take last positions separately in the impetus table with exceptionally close qualities. Turkey delivers an adequate percentage of its power by pressure driven and wind energy, and this shows that they do not have 50% of the motivating forces for solar energy. Therefore, Turkey needs to expand power creation by water driven and wind energy to diminish coal (ecological issues) and flammable gas (high import issues) based power generation. The main sustainable energy of Turkey might be wind energy.

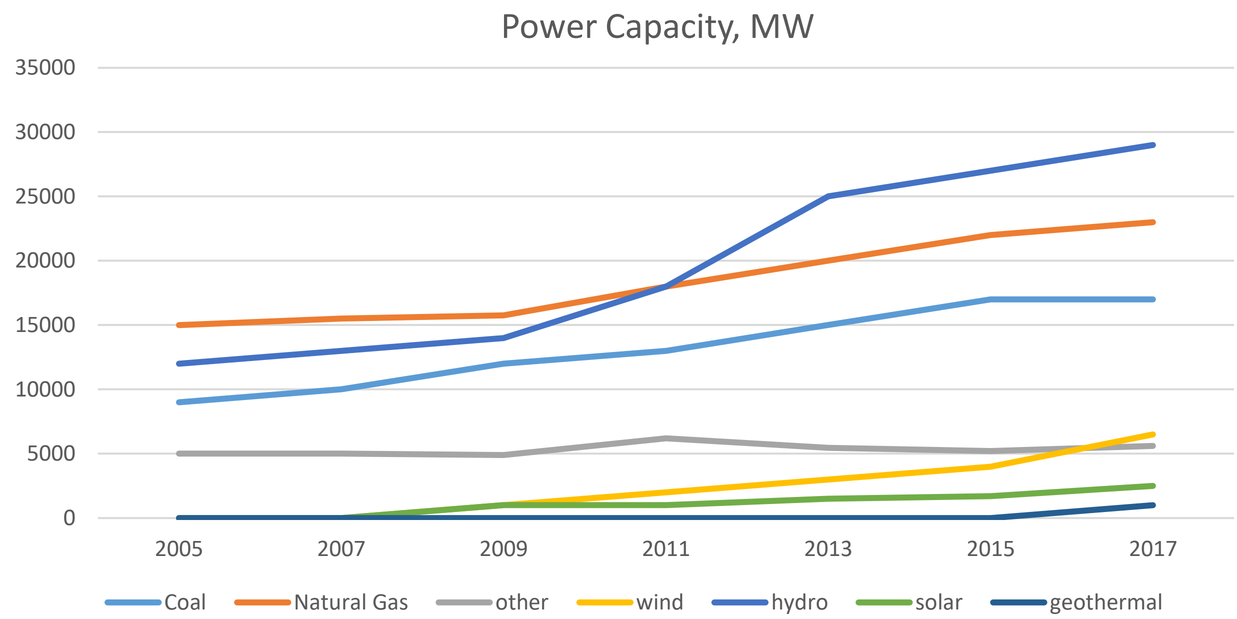

Figure 10. Development of the installed power capacities according to years

It is obvious from Figure 10 that energy has been utilized and has expanded by almost 300 times in this timeframe. It is a staggering advancement, yet lacking (considering the high measure of the unused wind energy potential involving practically 90% of the complete potential). Other two sustainable power sources, which are solar and geothermal, have a little rate for introduced control limit; they have a major ascent particularly for the most recent years. For instance, solar energy generation limit increases up itself 2-3 times each passing year.

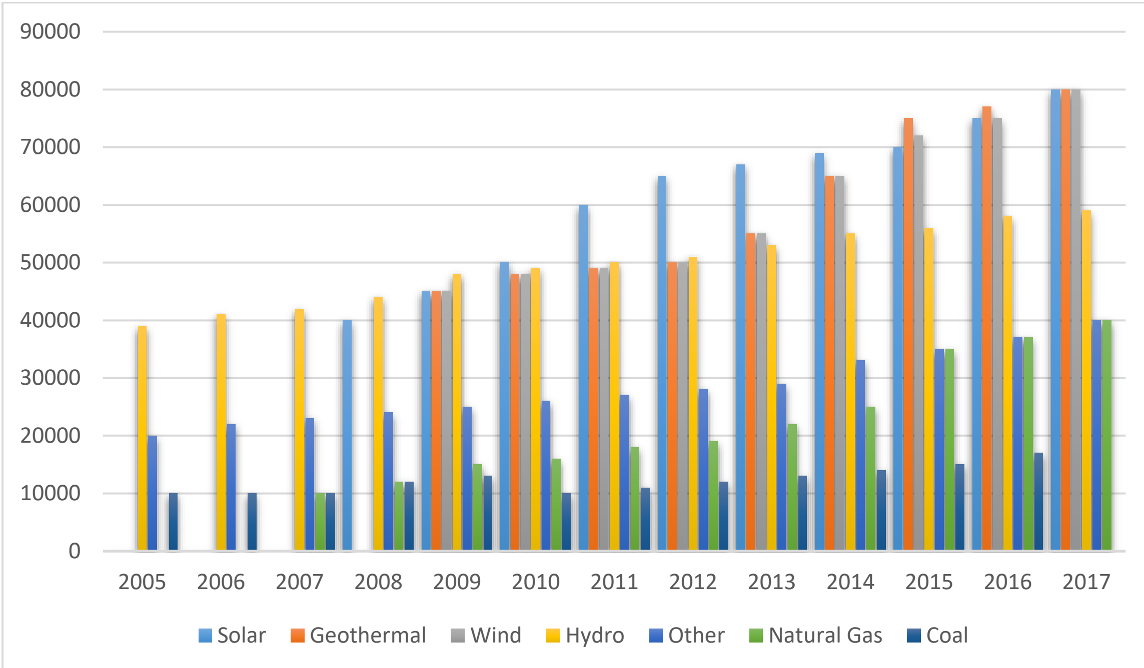

Figure 11. Share of the energy resources in the cumulative demonstration

In Figure 11 is shown all the current energy assets and the introduced power limit in the range of 2005 to 2017 until July. As indicated by the figure, introduced control limit of Turkey increases consistently from the year 2009. Together with observing the ascent in coal, petroleum gas, and water driven energy sources, it is obvious that use of sustainable power source in Turkey is not adequate in spite of the ascending use of renewable energy, particularly wind energy, in the previous ten years.

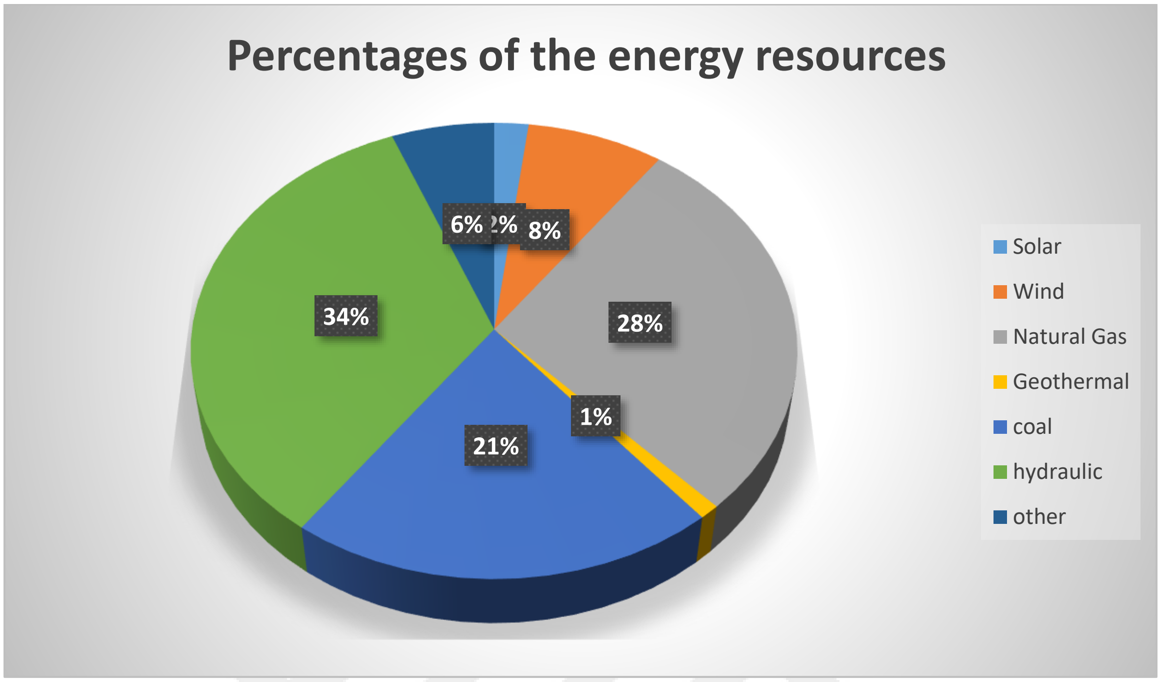

Figure 12. Percentages of the energy resources in the total installed capacity in 2017

Figure 12, gives an extensive perspective on Turkey's last position of energy limit as far as power creation in 2017. Water powered, gaseous petrol, and coal take the main, second, and third spot, respectively. Different sources, which are heat-based sources, show up in the fourth spot as observed from the figure evidently. As of sustainable energy sources, which establish our primary subject, wind energy ventures out in front of solar and geothermal energy. Absolute offer of the inexhaustible sources is about 11%. The offer of the solar energy generation limit demonstrates that it has had extraordinary development in recent years.

3.4. Significance of Renewable Energy in Turkey

Turkey has a significant geographical position and links Europe to Asia. Turkey features a population of 80 million officially. According to World Bank audit, Turkey may be a rapidly developing nation. This circumstance leads to extensive energy demand. Energy consumption per capita constitutes one of the essential reasons for financial and social change. Turkey's energy demand has expanded in parallel with quickly developing technology. Turkey's increasing energy demand affects the increase in dependency on foreign currency related sources. Turkey meets most of its energy request from fossil sources that is an over the top energy source and it takes long time to built and has various common threats. The world's needs increase rapidly day by day. Due to the uncontrolled increase in world population, fast urbanization and industrialization increment and require for energy is expanding in parallel. Turkey's fast-growing population combined with quick industrialization rate raise the demand for energy. Energy is a crucial component of existence, which is one of the most important generation inputs after crude fabric in mechanical sector. Energy is one of the preeminent basic needs for humans. Household utilities, such as washing machines, dishwashers and TVs, the transportation means such as busses and metro, as well as various things that are utilized inside the all-manufacturing businesses work with energy. In the second half of the 20th century, oil crises are the best example for the worldwide chaos caused by lack of available energy. Energy is the main factor that make political, military and financial procedures of the nations. It has ended up obligatory to supply the energy needs of the world in a satisfactory, maintainable, ecofriendly, solid and economical way. The worldwide financial crisis has brought political and social chaos.

Nations are actualizing distinctive energy arrangements to meet increasing energy demands. In general, in under-developed or developing countries, the main energy source is coal or oil. The European countries such as Germany and the UK have started to contribute progressively in eeofriendly renewable energy sources such as wind and solar energy in order to meet the energy demand. It is of vital importance that energy resources are cheap, high quality, and innate within the 21st century for monetary enhancement and fast industrialization. Turkey has the geopolitical position to set up the country as a gateway for global oil and gas trade via the Eurasian energy passage (Kaygusuz, 1999). High-energy imports are the first reason for the increase of exterior trade shortage in Turkey. One of the leading ways of closing or minimizing the current account deficiency is to decrease energy imports. Turkey must be compelled to make residential estimations for the rich energy resources such as solar and wind energy.

Renewable energy may be exceptionally valuable since it is both prudent, maintainable as well as being ecofriendly. Turkey's geological area has a few points of interest for broad utilization of the renewable energy sources such as hydropower, geothermal, solar and wind (Bilgen et al., 2008). Developing renewable energy advances and energy capability needs to be considered in the energy approach of Turkey. In this sense, collaboration between the government, the private companies and clients is fundamental for reducing the cost of energy. The main objective of renewable energy approaches on Turkey are pulling in the reserves required for the estimations; and the government must pursue a progress in the renewable energy area. Turkey has financial problems and these problems are significant for energy supply, reliability, sufficiency and sustainability. These are very crucial for Turkey's energy policy.

The Turkish government ought to focus on development of clean energy sources and must take measures in this field to form progression in renewable energy time. Turkey has specific energy targets in progressing renewable energy, such as utilizing long-term energy as open, private, and outside capital; decreasing reliance in energy by utilizing private resources more; minimizing hardships and costs in energy era, transmission, conveyance and utilization, and securing the environment (Simsek, 2013). Renewable energy resources and utilization in Turkey are closely related to conservative improvement. Governments must give more attention to renewable energy resources. Governmental and non-governmental organizations need to work together to advance renewable energy utilization in Turkey. As mentioned a few times, as of late, the renewable energy advancements are cost-effective and ecofriendly (Simsek, 2013). Turkey's endeavors in progressing renewable energy are exceptional, especially considering true course of action. Reaching the goals require a conclusive commitment and execution of suitable approaches (Simsek, 2013).

3.5. Renewable Energy of Europe

After World War II, many European nations concurred for rebuilding their economies. The European Coal and Steel Community was created in 1951. The European Coal and Steel Community was a universal organization making common rules for coal and steel among the member states. The essential countries were Belgium, France, Italy, Germany, The Netherlands, and Luxembourg. This was the essential step toward the creation of the European Union (Dinan, 2015). The European countries continued towards integration by making a widespread energy collaboration six years later by establishing The European Atomic Energy Community (Europa Overviews, 2016). Energy was a core issue inside the headway of the European Union (Agraa, 2011). Most of the imports come from Africa, Russia, and Organization of Petroleum Exchanging

Countries. International Energy Agency (IEA) predicts that Europe's energy dependence will increase in the longer term by 90% in 2035. Renewable energy sources play a key part inside Europe which is considered a global actor in wind energy. The starting activities were taken in Denmark, in the late 1980s where the introduction of Europe to begin with sea wind development took hold, gathering basic research for future use (Mani and Dhingra 2013). Considering the fact that wind control may be a significant energy for renewable energy progressions, administrative issues can affect the long run of the wind industry. The European Union countries respect and comply with global and European legislative issues (Kolios and Inspected 2013). The target in greenhouse gas diminishment and an energy productivity target highlights this conspicuous portion within the EU's 2020 and 2030 energy framework. Renewable energy sources contribute to the three objectives of European energy approach, such as progressing security of supply climate change and financial benefits such as financial development (cf. Duscha et al., 2014). The European Union approaches to this issue in key areas such as trade, agribusiness and transportation. The European Union made a budgetary and money related union, custom union, an overseeing an account union coordinated by the European Central Bank and extend of free advancement that is one of a kind in the world. The Energy Union is based on a sustainable financial improvement. European energy system ought to move from the supply side to the demand side. The European Energy Union makes riches and well-being for all European countries. An advanced mechanical strategy must be made based on the utilization of energy and data advancements inside the energy fragment in Europe. (Andoura, 2015). Public and private energy investments must center on advancement, instead of on the sending of develop innovations on the showcase. European energy strategy guards energy movement venture around the world. This discretion protects European interface in European exchange arrangements. These arrangements must together guarantee the development of individuals for energy resources. Worldwide components such as industrialization, urbanization and people improvement cause energy demand to increase. U.S. Energy Information Administration (EIA) predicts that energy consumption will increase by 48% between 2012 and 2040; the energy source to have the highest increase in this period is renewable energy.

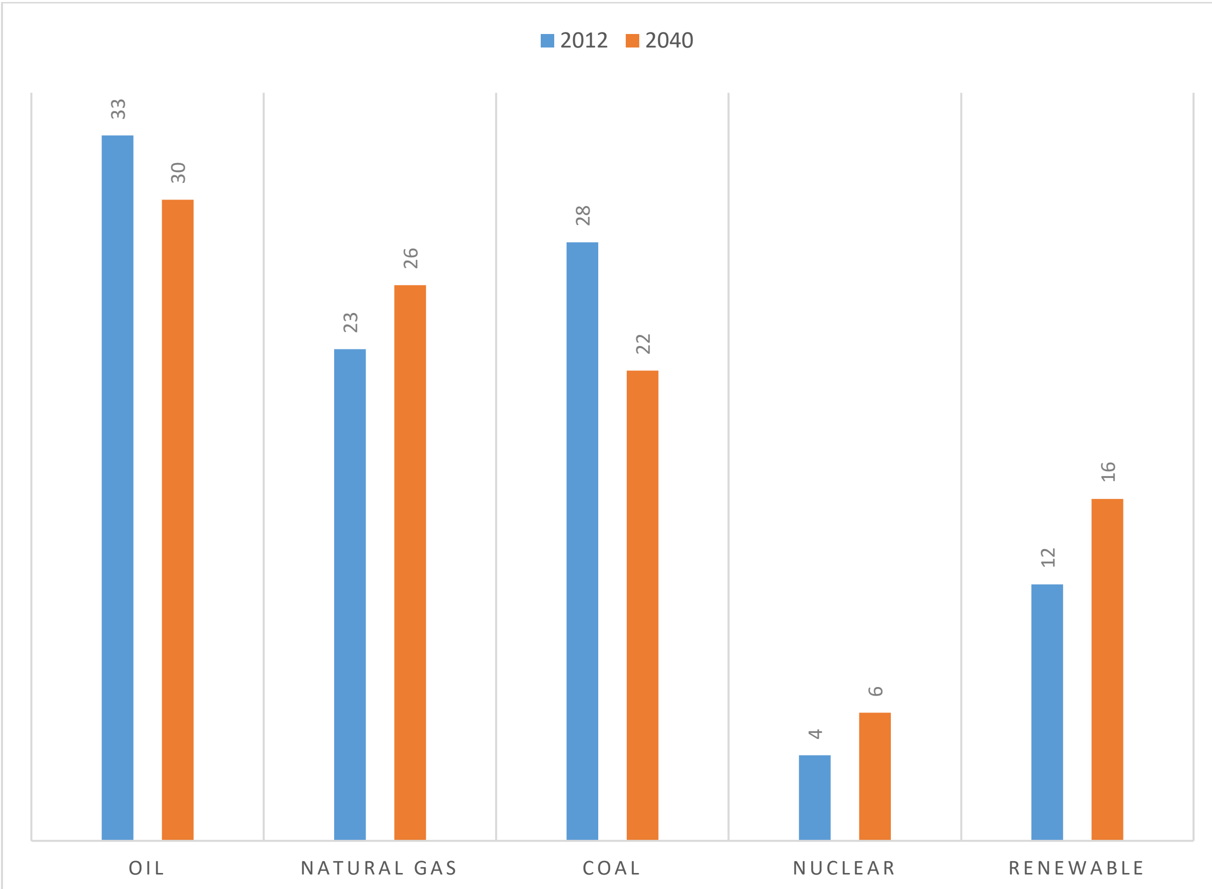

Figure 13: Global Energy Consumption According to Sources (percentage)

CHAPTER FOUR

DATA AND METHODOLOGY

4.1. Data

Within the light of the past literature, to look at the presence of energetic short and long run relationship as well the casual relationship between financial improvements, renewable and nonrenewable energy consumption and financial improvement in Turkey, yearly information of all variables is utilized for the analysis over the period 1980-2016. All the information collected from World Bank Database- World Development Indicators. Monetary development measured as a share of domestic credit given by financial sector to GDP. Economic development is proxied as GDP in current Dollar term. Nonrenewable energy data consists of the full utilization of natural gas, petroleum and coal. Renewable energy data includes renewable energy consumption of all the following technologies; hydro, modern and traditional biomass, and wind, and solar, fluid biofuels, biogas, geothermal, marine and waste. Both renewable and nonrenewable energy consumption measured in quadrillion BTU.

4.2. Methodology

The subject of effect of renewable energy on financial growth has well examined inside the energy monetary things composing for making and developed countries. It is significant for relationship between energy consumption and financial development in arrange to arrange compelling energy and impacts of renewable energy. The modeling technique used has three steps. As of now to modeling time arrangement information. This think around decide arrange of integration of the factors and ensure that it is rise to for all arrangement.

The unit root tests, to be particular Augmented Dickey and Fuller (Dickey and Fuller, 1979) (ADF test) and Philips Perron (Phillips and Perron, 1988) (PP test), are utilized to check the nonstationary of arrangement. The arrangement that coordinates of the same arrange, other step is to perform co-integration tests for long-run relationship. One self-evident strategy that peruses think of is to test for unit root and look at the autocorrelation work of the course of action of intrigued. In any case, in spite of the fact that shocks to a unit root get ready will stay inside the system indefinitely, the act for a unit root handle we regularly seen to decay absent outstandingly gradually to zero.

In this way, such a handle may be mixed up for an exceedingly determined but stationary prepare. It is not conceivable to utilize the act or agreement to decide whether a course of action characterized by a unit root or not. Other than, even in the event that the genuine data creating get ready for $^{\gamma t}$ contains a unit root. The results of the tests for a given test may lead one to believe that the process is stationary. Subsequently, what is required is a few kinds of formal speculation testing strategy that answers the address, given the test of information to hand, is it conceivable that true information generating process for $^{\gamma}$ contains one or more unit roots?

4.2.1. Unit Root Test

4.2.1.1. ADF Unit Root Test

The early and pioneering work on testing for a unit root in time arrangement was done by Dickey and Fuller (Fuller, 1976; Dickey and Fuller 1979). The essential objective off the test is to examine the invalid speculation that ø=1 in

$$^{\gamma t} = ø^{\gamma t} - 1 + u^{t} \quad (1)$$

Against the one-sided alternative $ø < 1$. Thus, the hypotheses of interest are

Ho: series contains a unit root

Versus H^1: series is stationary.

In practice, the following regression is employed, rather than (7), for ease of computation and interpretation

$$\Delta^{\gamma t} = \boldsymbol{\psi}^{\gamma t} - \mathbf{1} + \boldsymbol{u}^{t} \quad (1.1)$$

so that a test of $ø = 1$ is equivalent to a test of $\boldsymbol{\psi} = 0$ (since $ø - 1 = \boldsymbol{\psi}$).

Dickey-Fuller (DF) tests are moreover known as **τ**-tests: **τ**,u, $\boldsymbol{\tau}^{t}$. The moment when third of these tests, **τ**u, $\boldsymbol{\tau}^{t}$. Are identical to the primary, but that the moment and third permit for a constant, and a steady and deterministic trend. The models under the invalid (Ho) and alternative H^1 hypothesis within the three cases are;

(I) Ho: $^{\gamma t} = {}^{\gamma t}\text{-}1 + \boldsymbol{u}^{t}$ (1.2)

H^1: $^{\gamma t} = ø^{\gamma t} - 1 + \boldsymbol{u}^{t}, ø < 1$ (1.3)

This is test for random walk against a stationary autoregressive process of order one (AR (1)).

(ii) Ho: $^{\gamma t} = {}^{\gamma t}\text{-}1 + \boldsymbol{u}^{t}$ (1.4)

H^1: $\gamma^t = ø\gamma^t - 1 + u + \boldsymbol{u}^t$, $ø < 1$ (1.5)

This is test for random walk against a stationary AR (1) with drift.

(iii) Ho: $\gamma^t = \gamma^t\text{-}1 + \boldsymbol{u}^t$ (1.6)

H^1: $\gamma^t = ø\gamma^t - 1 + u + \lambda^t + u^t$, $ø < 1$ (1.7)

Typically test for irregular walk against a stationary AR (1) with drift and a deterministic time trend. The tests can moreover be composed within the taking after way. For the invalid hypothesis in all three cases.

$$\Delta\gamma^t = u^t \quad (1.8)$$

Where $\Delta\gamma = \gamma^t - \gamma^t\text{-}1$. The alternatives may be expressed as

$$\Delta\gamma^t = \psi\gamma^t - 1 + u + \lambda^t + u^t \quad (1.9)$$

With $u = \lambda = 0$ in case (i) and $\lambda = 0$ in case (ii) and $\boldsymbol{\psi} = ø\text{-}1$ for all three cases.

In each case, the tests based on the t-ratio on the γ^t-1 term within the estimated relapse of $\Delta\gamma^t$ on γ^t-1, additionally a steady in case (ii) and a steady and trend in case (iii). Note that in moment and third tests, the values of nor the significances of the intercept and trend are not under test, are simply allowed for within the unit root testing procedure. In another paper, Dickey and Fuller (1981) give a set of extra test insights and their basic values for joint tests of the significance of the laggedγ, and the consistent trend terms.

Table 1.1 Critical values for DF tests (Fuller, 1976, p.373)

Significance Level	%10	%5	%1
CV for constant but no trend	-2.57	-2.86	-3.43

CV for constant and trend	-3.12	-3.41	-3.96

These are not examined further here according the test statistics for the original DF tests of (I), (ii) and (iii) are defined as

$$\text{Test statistic } \frac{(\boldsymbol{\psi})}{S\,\grave{E}(\boldsymbol{\psi})} \tag{1.10}$$

The test statistics do not take after the usual distribution beneath the invalid speculation, since the invalid is one of non-stationarity, but or possibly the take after a non- standard dissemination. Fundamental values are gathered from reenactments tests in. For case Fuller (1976), important cases of the distribution appeared table 1.1. A full set of Dickey tables at the conclusion of this book. A conversation and case of how such basic values given inside the reference section of statistical tables. Compare these with the standard basic values; it can be seen that DF basic values are determined utilizing simulations methodologies presented.

Comparing these with the standard typical values, it can be seen that the DF fundamental values are much greater in incomparable theory is required inside the setting of unit root tests than beneath standard t-tests. This arises for the most part from the inherent precariousness of the unit root prepare, the fatter distribution of the t-ratios inside the setting of non-stationary data and coming around instability in deduction. The invalid theory of a unit root rejected in support of the stationary elective in each case in the event that the test measurement is more negative than the basic value. The tests over are substantial as it were on the off chance that u^t expected not to be auto correlated but would be so on the off chance that there were autocorrelation within the dependent variable of the regression, which has not demonstrated. On the off chance that this is the case, the test would be oversized meaning that the genuine measure of the test would be higher than the ostensible measure. The solution is to increase the test utilizing p slacks of the dependent variable.

The model in case (i) written

$$\Delta^{\gamma t} = \boldsymbol{\psi}^{\gamma t} - \mathbf{1} = \sum_{i=1}^{p} \alpha\, i\, \Delta^{\gamma t} - i + u^{t} \tag{1.11}$$

The lags of $\Delta^{\gamma t}$ presently soak up any dynamic structure display in the dependent variable, to ensure that u^{t} is not auto correlated. The test known as an expanded Dickey-Fuller (ADF) test and is still conducted, and the same basic values from the DF tables utilized as some time recently. An issue presently arises in deciding the ideal number of lags of the subordinate variable. There are two ways to do this. To begin with, the frequency of information can be utilized to choose. For instance, in the event that the information is month to month utilize 12 lags; on the off chance that the information is quarterly utilize four lags. Clearly, there would not be a self-evident choice for the number of slacks to utilize in relapse containing higher frequency financial information. Moment, an information creation utilized to choose. Subsequently, this select the number of slacks that minimizes the value of a data basis. It is very critical to attempt to utilize an ideal number of lags the dependent variable within the test regression, since counting as well few will not evacuate all of the auto relationship and utilizing as well numerous will increment the coefficient standard blunders. The last-mentioned impact arises since an increment within the number of parameters to appraise employments up degrees of flexibility. Subsequently, everything else being break even with, the absolute values of the test statistics will be decreased. This will result in a reduction within the control of the test, inferring that for a stationary process the invalid theory of a unit root rejected less frequently than would something else have been the case.

4.2.2.2. Phillips-Perron (PP) tests

Phillips and Perron have created a more comprehensive hypothesis of unit root non-stationary. The tests are comparable to ADF tests, but they join a programmed correction to the DF strategy to allow for auto-correlated residuals. The tests regularly provide the same conclusions as, and suffer from most of the same imperative limitations as, the ADF tests. The foremost imperative feedback that has been level at unit root tests is that their power is moo on the off chance that the method is stationary but with a root near to the non-stationary boundary. The invalid speculation of unit root ought to reject. It has contended that the tests are destitute at deciding, for occurrence whether ø=1 or ø = 95, particularly with little test sizes. The source of this issue is that, under the classical hypothesis-testing system, the invalid theory is never accepted. It stated that it either rejected or not rejected. This implies that disappointment to dismiss the invalid theory might happen either since the invalid was adjusted, or because there is insufficient data within the sample to enable rejection. One way to induce around this issue is to utilize a stationary test as well as the unit root tests described. Stationary tests have stationarity under the invalid hypothesis, in this way reversing the invalid and options beneath the invalid hypothesis, in this way switching the invalid and choices under the Dickey-Fuller approach.

Co-integration

In most cases, on the off chance that two factors that are I (1) are directly combined, at that point the combination will moreover be I(1). For the most part, in the event that variables with differing orders of integration combined, the combination will have an arrange integration rise to to the largest. On the off chance that Xi, t ~ I (di) for i =1, 2, 3…, k so that there are k variables each coordinates of arrange di, and letting.

$$\mathrm{Z}t = \sum_{i=1}^{k} aiXi, t \qquad (1.12)$$

$\mathrm{Z}t$ ~ I (max di). $\mathrm{Z}t$ in this context is simply a linear combination of the k variables Xi . Rearranging (1.13).

There are numerous cases of possible co-integrating relationships in back. Agreeing to this hypothesis ought to propose where two or more factors would be expected to hold a few long run a relationship with one another. There are numerous cases in back of regions where co-integration might be expected to hold, counting; spot and futures costs for a given commodity or resource, proportion of relative costs and exchange rate, value prices and profits. In all three cases, advertise powers emerging from no-arbitrage condition recommend that there ought to a harmony relationship between the arrangement concerned. The least demanding way to get it this idea is maybe to consider what would be the impact in the event that the arrangement was not co-integrated.

In case, there was no co-integration, there would be no long run relationship official the arrangement together, so that the arrangement would seem to meander separately without bound. Such an impact would emerge since all linear combinations of the arrangement would be non-stationary, and subsequently would not have a consistent mean that would return as often as possible. Spot and futures costs may be expected to be co coordinates since they are clearly costs for the same resource at distinctive focuses in time, and subsequently will be influenced in exceptionally comparative ways by given pieces of data. The long run relationship between spot and prospects costs would donate by the cost of carry. Purchasing power parity (PPP) hypothesis states that a given agent basket of goods and administrations ought to cost the same wherever it bought when changed over into a common cash. PPP suggests that the proportion of relative prices in two nations and the trade rate between them ought to co coordinates. In the event that they did not co coordinated zero exchanges costs, it would be beneficial to purchase merchandise in one nation, offer them in another, and change over the money obtained back to the currency of the original nation. Thus, in case it is expected that a few stocks in a specific company is held to perpetuity, at that point the only return that would gather to that investor would be within the shape of an infinite stream of future profit.

4.2.3. Johansen Technique based on VARs

Assume that a set of g variables ($g \geq 2$) are beneath thought that are I (1) and which thought may be cointegrated. The Johansen test can be effected by the lag length utilized and it is valuable to attempt to choose the lag length optimally. The Johansen test focuses on an examination of the Π network. Π can be interpreted as a long run coefficient network, since in equilibrium, all $\Delta^{\gamma t}$-i will be zero, and setting the error terms, Ut, to their expected value of zero will take off $\Pi^{\gamma t}$-k = 0. Take note the comparability between this set of conditions and the testing condition for an ADF test, which contains a to begin with differenced term as the dependent variable in conjunction with a lagged levels term and lagged contrasts on the RHS. The test for cointegration between the y's is calculated by looking at the rank of the Π network by means of its eigenvalues. The rank of a matrix is rise to the number of its characteristic roots that are distinctive from zero. The eigenvalues, signified λi are put in rising arrange.

$\lambda 1 \geq \lambda 2 \geq \dots \dots \dots \geq \lambda g$

In the event that the λs are roots, in a setting, they must be less than one in absolute value and positive, and λ1 will be the biggest, whereas λg will be the smallest. On the off chance that the factors are not co coordinates, the rank of Π will not be essentially different from zero, so, λi≈∀ i. The tests statistics really join in (1- λi), instead of the λi themselves, but still, when λi = 0, ln(1-λi)=0. Assume presently that rank (Π) = 1, at that point ln (1- λ1) will be negative and ln (1- λi) = ∀ I > 1. If I is non-zero, then eigenvalue must be important role of non-zero, while others will not be significantly different from zero. There are two test results for cointegration under the Johansen approach, which are formulated as

$$\lambda \text{ trace } (r) = -\mathrm{T} = \sum_{i=r+1}^{g} \ln(1-\lambda \mathrm{i}) \qquad (1.13)$$

And

$$\lambda \max(r, r+1) = -T \ln(1-\lambda \mathrm{r}+1) \qquad (1.14)$$

Where r is the number of co integrating vectors beneath the invalid hypothesis and λi is the estimated value for the requested esteem from Π lattice. Naturally, the bigger is λi, the larger and negative will be ln (1- λi) and subsequently the larger will be the test measurement. Each eigenvalue demonstrates a critical co coordination vector. Λ trace could be a joint test where the invalid is that the number of co joining vectors is less than or break even with to r against an unspecified or general alternative that there are more than r. It starts with p eigenvalues, and after that, progressively the largest is removed.

Λtrace is a joint test where the invalid is that the number of co integrating vectors is lower than or higher than r against an unspecified or general elective that there are more than r. It begins with p eigenvalues, and after that, successively the largest is removed.

$$\lambda\text{trace} = 0 \text{ when all the } \lambda\mathrm{i} = 0 \text{ for i} = 1, \dots \dots \text{g}. \qquad (1.15)$$

λ max Conducts separate tests on each eigenvalue, and has as its invalid hypothesis that the number of co coordination vectors is r against an alternative of r + 1. Johansen and Juselius (1990) give basic values for the two statistics. The distribution of the test statistics is non-standard and the basic values depends on the value of g-r. The number of non-stationary components and constants are included in each of the conditions. Intervention can be included either within the co coordination vectors themselves or as additional terms within the VAR. The latter is comparable to counting a trend within the information generating prepares for the levels of the series.

The investigation explores the short-run elements by determining the sum of data each variable contributes to the other variables in VAR models. Particularly, the estimate errors variances provide data almost the rate of the developments caused by claim stuns vis-avis stuns in other factors. Within the empirical literature, we observed that two diverse modeling strategies are received within the examination of the subject, specifically, bivariate and multivariate approaches.

4.2.4. Hypothesis testing using Johansen

Engle-Granger did not allow the testing of hypothesis on the co joining relationships themselves, but the Johannsen setup does allow the testing of theory around the equilibrium relationships between the factors. Johansen permits a researcher to test a theory almost one or more coefficients within the co-integrating relationship by seeing the speculation as a restriction on the Π framework. On the off chance that there exist r co integrating vectors, will be stationary. In reality, the network of co coordination vectors β can be multiplied by any non-singular conformable framework to get a unused set of co-integrating vectors.

A set of required long-run co productive values or connections between the co efficient does not necessarily suggest that the co coordination vectors have to be restricted. This is because any combination of co coordination vectors is additionally a co-integrating vector. It may possible to combine the co coordination vectors hence distant obtained to provide a new or new set having the properties. The less complex and less are the specified properties, the more likely that this recombination process will automatically surrender co coordination vectors with the desired properties. In any case, the limitations have to be more various or involve more of the coefficient of the vectors.

CHAPTER FIVE
EMPIRICAL RESULTS

5.1. Unit root test results

For testing a long-run relationship among the variables, as a first stage it is important to determine univariate properties of the series used in this study, i.e. whether these variables are I (1), stationary in first differences. We, therefore, performed the ADF (see Dickey and Fuller, 1981; Said and Dickey, 1984) and PP unit root tests (see Phillips and Perron, 1988) in levels and first differences. The selection of the number of lags carried out using the Schwarz Information Criteria (SIC) in the ADF regressions. The results of the ADF and the PP tests computed over the sample period for the levels and first differences of variables presented in Table 1. Test results indicate that the hypothesis of a unit root in level series cannot rejected at the 1% level of confidence, suggesting that the variables are not level stationary. Table 1 also shows that both the ADF and the PP tests confirm that the five variables subject to empirical analysis are first-difference stationary.

Table 2. Results of Unit Root Tests

Variables		ADF Statistics			Philips-Perron Statistics		
	Level/First Difference	***No trend***	***Trend***	***None***	***No trend***	***Trend***	***None***
GDP	***Level***	**-0.423**	**-2.878**	**2.710**	**-0.423**	**2.934**	**2.710**
	First Difference	**-6.188***	**-6.091***	**-5.194***	**-6.189***	**-6.091***	**-5.308***
Financial Development	***Level***	**-0.206**	**-1.789**	**1.184**	**-0.221**	**-1.767**	**1.222**
	First Difference	**-5.741***	**-5.843***	**-5.583***	**-5.740***	**-5.935***	**-5.599***
Renewable Energy	***Level***	**-1.131**	**-3.035**	**-1.923**	**-0.750**	**-2.987**	**-2.632**
	First Difference	**-7.723***	**-7.607***	**-7.202***	**-8.813***	**-8.608***	**-7.212***
Nonrenewable Energy	***Level***	**-1.610**	**-1.856**	**3.128**	**-1.922**	**-1.765**	**2.237**
	First Difference	**-6.759***	**-7.518***	**-3.978***	**-6.697***	**-7.635***	**-4.324***

Note: * denotes statistical significance at 1% significance level.

5.2. Cointegration test results

After meeting the condition of the same order of integration, the existence of long run relationship among the variables is tested by using Johansen and Juselius (1990) cointegration test. Before conducting cointegration test results, the number of lags, which are used in vector error correction models, should be determined. The relevant number of lags is determined based on the Akaike information criterion (AIC), the Schwarz information criterion (SIC) and the Hannan-Quinn (HQ) information criterion.

The results of the cointegration test are shown in Table 2. According to the Johansen- Jueslius test, the null hypothesis refers to no cointegration among the variables, whereas the alternative one refers to cointegration. Therefore, the rejection of the null hypothesis makes us accept the alternative hypothesis. Based on the Trace and Maximum Eigenvalue test statistics, the null hypothesis of no cointegration is rejected at 5% significance level, implying that there are four cointegrating relationship among all the variables. This implies that the renewable and nonrenewable energy consumption, financial development and economic growth are related in the long run.

Table 3. Johansen Juselius Maximum Likelihood Cointegration Tests

Trace Test				Maximum Eigenvalue Test			
Null	Alternative	Statistic	95 % Critical Value	Null	Alternative	Statistic	95 % Critical Value
r=0	r≥1	43.491	55.245	r=0	r=1	18.103	30.415
r≤1	r≥2	25.388	35.010	r≤1	r=2	10.906	24.525
r≤2	r≥3	14.482	18.397	r≤2	r=3	7.936	17.147
r≤3	r≥4	6.545**	3.841	r≤3	r=4	6.545**	3.841

Note: The notation "r" denotes the number of cointegrating vectors. *, ** implies significance of 1% and 5%.

5.3. Causality test results based on VECM

Having determined the presence of cointegrating relationship for both models, the next step is to proceed to the creation of the VECM model to explore the presence or absence of long-run and short-run causality and joint causality among the variables. The causality test results based on VECM captures both the short-term dynamics between time-series data set, as well as, their long-term equilibrium relationship. Table 3 represents the results of the short and long-run causality tests among all the variables based on VECM. In the Table, the dependent variable is economic performance, and the model analyzes the short and long run joint causality between the economic growth and all the other independent variables, namely, financial development, renewable energy and nonrenewable energy consumption. Based on the results of Model 1, there is no short run causal relationship between the economic development and the other variables. As for the long run causal relationship among the variables, the statistically significant and negative coefficient of lagged error correction term (ECT) gives us the existence of long run bi-directional causal relationship among the variables; moreover, it shows us how fast the variables would turned back to equilibrium in the process and the speed of adjustment. According to the results of Model 1, the lagged ECT is negative and statistically significant at 5% level, supporting the existence of bi-directional long-run causality among the economic performance and renewable, nonrenewable energy consumption and financial development. Regarding the negative value of lagged ECT as 0.257, the variables will be correcting its previous period disequilibrium at a speed of 25.7% in one year. Particularly, the bi-directional causal relationship between financial development and economic performance is understandable. Economic growth results in more demand for domestic credit, and thereby, increased financial development for the country. In other words, financial performance leads to higher economic performance for the economy, because many businesses can directly and easily get an access to the credits, therefore, leading to more investment and more production.

The case of the bi-directional causal relationship between energy consumption and economic growth is explained via four hypotheses, as mentioned above. Economic growth leads to more energy consumption, since more investment, and more production requires more energy. In the case of the casuality from the energy consumption to economic growth, more energy leads to the existence of bi-directional causal relationship between renewable and nonrenewable energy consumption and economic growth supports the "*feedback hypothesis*" in Turkey.

Table 4. Vector Error Correction “Causality Results

	Dependent Variable	Short Run Estimates				Long Run Estimates
		GDP	Financial Development	Renewable Energy	Nonrenewable Energy	ECT(-1)
Model 1	GDP	-	2.436	2.243	0.302	-0.257**

Note: *, and ** indicate statistical significance at 1% and 5% levels, respectively. ECT represents the vector of error correction term.

5.4. Long-run parameter estimates

After the establishment of the cointegarion test results and causal links among the variables, in order to explore the impact of explanatory variables, renewable energy consumption, financial development and nonrenewable energy consumption on the economic performance of Turkey, the ordinary least squares method is used. Table 4 shows the results of the long run parameter estimates by using the OLS test. According to the long-run parameter estiamates, the coefficient of the financial development is positive and statistically significant at 5% level, implying that financial development seems to have a positive and significant impact on economic development.

Non-renewable energy seems to contribute to the economic development since the coefficient of nonrenewable energy is positive and *p*-value is significant at 1 % level. However, renewable energy does not have a significant impact for the development of Turkish Economy. This result reveals the fact that even if nonrenewable enegy has an increasing impact for the economic development of Turkey, renewable enegy consumption does not have. This could be explained due to the less usage of renewable energy in the industries compared to other developed countries. This result is expected because of the intensified usage of nonrenwable energy as compared to renewable energy.

Table 5. Long Run Estimates

Dependent Variable	Explanatory Variables	Coefficient	Standard Error	t-statistic	p-value
GDP	Constant	23.374	0.537	43.476	0.000*
	Financial Development	0.438	0.136	3.223	0.002**
	Renewable	0.115	0.182	0.633	0.530
	Nonrenewable	1.481	0.223	6.623	0.000*
	R^2= 0.95 F-statistic = 191.075 [0.000] *				

Note: *** and ** denote statistical significance at 1% and 5% significance level.**

CHAPTER SIX

CONCLUSION and POLICY IMPLICATIONS

In today′s world, renewable energy source is a very important issue, because it is a clean source of energy and has less negative environmental impact. In addition, countries using these sources will be less dependent on import fossil fuels. All countries must increase their activities for both consumption and production of renewable energy. This paper uses Johansen test, cointegration techniques and Granger causality tests to investigate impacts of renewable energy on economic growth. It is significant for policymakers to understand the relationship between energy consumption and economic growth in order to design effective new renewable energy policies.

Accomplishing arrangement to natural issues that we confront nowadays requires long-term potential activities for maintainable improvement. In this respect, renewable energy assets show up to be the one of the foremost productive and viable arrangements. In spite of the fact that, Turkey has considerable potential in renewable energy assets, genuine utilization of these assets are very low. Turkey is a developing country and Turkey needs energy to improve, sustain and enhance its economic growth. Energy dependency is the biggest economic problem for Turkey. Turkey's economic growth and energy dependency dilemma needs to be taken care of when making new policies. Large numbers of studies about this subject, found different results for different countries as well as for different time periods within the same country. For that reason, the determination of relationship and direction of these variables are substantial for all countires.

This paper analyses the causal relationship between energy consumption and economic growth. We tested Johansen test, cointegration techniques and Granger causality tests among variables of both models on level 1. There is continuing increase population and demand for energy in the next two decades according to the official energy projections for Turkey. The higher demand for energy consumption in Turkey is growing rapidly. There is technical, social and economic development so this reason led to impacts of renewable energy on economic development examining this issue highlights a potentially significant relationship since energy will play an increasingly vital role in Turkey. In addition to achieve sustainable economic growth, the results imply that Turkey needs to secure energy resources. Turkey's interpretations and implications of the results can be discussed in an economic point of view. Economic growth promoteds electricity consumption so countries need to improve their energy policies. Turkey is developing country so the electricty consumption used in several sectors is growing rapidly. Furthermore, Turkish people use more electricity equipments so it has a higher income of households. Turkey an energy conservation policy may not damage to GDP according to empirical results. Turkey needs to improve use some combination of policy like energy taxes, energy saving technical process, renewable energy policy and energy efficieny.

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