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MASTER THESIS

ENERGY ECONOMICS, RENEWABLE ENERGY & ITS SIGNIFICANCE FOR THE TURKISH REPUBLIC AND ITS ECONOMIC DEVELOPMENT

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ABSTRACT

ENERGY ECONOMICS, RENEWABLE ENERGY & ITS SIGNIFICANCE FOR THE TURKISH REPUBLIC AND ITS ECONOMIC DEVELOPMENT

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Energy is the most important need that is used in every sector. For instance, people need energy for heating, industry and technological developments. Turkey is a country, whose industry, economy and population is rapidly growing day by day. Thus, energy demand of Turkey is perpetually increasing. Turkey is an abundant country in terms of renewable energy and subterranean resources. In our day, Turkey satisfies most of its energy needs from oil, coal, natural gas and electricity. However, these energy resources cannot renew themselves and spontaneously get depleted after a certain amount of time. Furthermore, using these types of energy has negative effects on environment and the ozone layer. For this reason, United Nations imposed some sanctions on the countries in order to reduce greenhouse gas emissions. United Nations Framework Convention on Climate Change and Kyoto Protocol cover these sanctions on greenhouse gas emissions issue.

In addition to these, Turkey produces energy from renewable energy resources as well. These energy resources are green energy and therefore they have no negative effects on the environment. Moreover, renewable energy resources are types of energy, which are clean, highly productive, without fuel expenses and with short amortization. Renewable energy resources in Turkey are hydropower, solar, geothermal, wind, biomass and wave. However, the amount of energy produced from this energy resources do not satisfy Turkey's needs. Although, Turkey is a very abundant country in terms of renewable energy resources, it is a country, which imports a large part of its energy needs. Import of energy, creates another burden on current deficit, which is an important problem of Turkey. Therefore, the Ministry of Energy and Natural Resources of Republic of Turkey should make important investments on renewable energy resources to scale down energy dependency on foreign resources. The purpose of writing this thesis is to indicate the energy potential of world, especially Turkey, and emphasizing the importance of renewable energy resources for energy and economic balances.

Keywords: Energy, Renewable Energy Resources, Turkey, Energy Import, Current Deficit, Economics.

ÖZET

ENERJİ EKONOMİSİ, YENİLENEBİLİR ENERJİ VE TÜRKİYE CUMHURİYETİ İÇİN ÖNEMİ VE EKONOMİK GELİŞİMİ

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Enerji her sektörde kullanılan en önemli ihtiyaçtır. Örneğin, insanlar ısınma, sanayi ve teknolojik gelişmeler için enerjiye ihtiyaç duyar. Türkiye sanayisi, ekonomisi ve nüfusu günbegün hızlı bir şekilde büyüyen bir ülkedir. Böylece, Türkiye'nin enerji talebi sürekli olarak artmaktadır. Türkiye yenilenebilir enerji ve yeraltı kaynakları bakımından zengin bir ülkedir. Günümüzde, Türkiye enerji ihtiyacının büyük kısmını petrol, kömür, doğalgaz ve elektrikten karşılar. Ancak, bu enerji kaynakları kendini yenileyemez ve belli bir süre sonra tükenirler. Ayrıca, bu enerji türlerinin kullanımının çevre ve ozon tabakası üzerinde olumsuz etkileri vardır. Bu nedenle, Birleşmiş Milletler sera gazı emisyonlarını azaltmak için ülkelere bazı yaptırımlar uyguladı. Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi ve Kyoto Protokolü sera gazı emisyonu meselesiyle ilgili bu yaptırımları içermektedir.

Bunlarla birlikte, Türkiye yenilenebilir enerji kaynaklarından da enerji üretmektedir. Bu enerji kaynakları yeşil enerjidir ve bu sebeple, çevre üzerinde negatif etkileri yoktur. Bundan başka, yenilenebilir enerji kaynakları temiz, yüksek derecede

verimli, yakıt gideri içermeyen ve kendini kısa sürede amorti eden enerji türleridir. Türkiye'deki yenilenebilir enerji kaynakları hidrogüç, güneş, jeotermal, rüzgar, biyokütle ve dalgadır. Ancak, bu enerji kaynaklarından üretilen enerji miktarı, Türkiye'nin ihtiyacını karşılamamaktadır. Türkiye yenilenebilir enerji kaynakları bakımından çok zengin bir ülke olmasına karşın, enerji ihtiyacının büyük bir kısmını ithal eden bir ülkedir. Enerji ithalatı Türkiye'nin önemli bir problemi olan cari açığa da büyük yük oluşturmaktadır. Bu yüzden, Türkiye Enerji ve Tabii Kaynaklar Bakanlığı dış kaynaklar üzerindeki enerji bağımlılığını düşürmek için yenilenebilir enerji kaynakları üzerine önemli yatırımlar gerçekleştirmelidir. Bu tezin yazılış amacı, başta Türkiye'nin olmak üzere dünyanın enerji potansiyelini göstermek ve yenilenebilir enerji kaynaklarının enerji ile ekonomik dengeler için önemini vurgulamaktır.

Anahtar Kelimeler: Enerji, Yenilenebilir Enerji Kaynakları, Türkiye, Enerji İthalatı, Cari Açık, Ekonomi.

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LIST OF ABBREVIATIONS

°C	Centigrade
BTOE	Billion Tons of Oil Equivalent
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CH4	Methane
CO2	Carbon Dioxide
CSP	Concentrated Solar Power
EP	European Parliament
EPDK	T.C. Enerji Piyasası Düzenleme Kurumu (Republic of Turkey, Energy Market Regulatory Agency)
ETKB	Türkiye Cumhuriyeti Enerji ve Tabi Kaynaklar Bakanlığı (the Ministry of Energy and Natural Resources of Republic of Turkey)
ETM	Emission Trading Mechanism
EU	European Union
FMOLS	Fully Modified Ordinary Least Squares
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GNP	Gross National Product
GT	GigaTon
GW	GigaWatt
GWh	GigaWatt hour
H2O	Water Vapor
HPP	Hydropower Power Plants
JIM	Joint Implementation Mechanism
Km	Kilometer
Km^2	Square Kilometer
KP	Kyoto Protocol
KW	Kilowatt

kWh/m	KiloWatt hour/ meter
kWh/m²	KiloWatt hour/ Square meter
M/h	Meter/ hour
M³	Cubic Meter
MM	Millimeter
MTA	Maden Tetkik ve Arama Genel Müdürlüğü (General Directorate of Mineral Research and Exploration)
MTE	Million Tons of Equivalent Petrol
MTOE	Million Tons of Oil Equivalent
MW	MegaWatt
N2O	Dinitrogen monoxide
O3	Ozone
OECD	The Organisation for Economic Co-operation and Development
PV	Photovoltaics
RES	Renewable Energ Source
Sm³	Natural Gas Measurement Unit
TWh	Tera Watt hours
TWh/yr	Tera Watt hours/year
TY	Toda - Yamamoto
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USA	United States of America
USD	United States Dollars
VECM	Vector Error Correction Model
W/m²	Watt/ Square meter

INTRODUCTION

Fossil fuels have retained a significant part of the energy production so far. However, it has been changing nowadays. Renewable energy resources are deemed to replace the fossil fuels. The definition and the significance of the renewable energy resources is to be pointed out in a detailed way in this study. Renewable energy resources can easily be produced and renewed. The renewable energy resources can never be depleted. People need more energy resources day by day and expendable energy resources (fossil fuels) have negative effect on environment. However, the renewable energy resources don't have negative effects on the environment. It safeguards the environment against the damage of expendable (fossil fuels) energy. The renewable energy will continue forever worldwide.

Turkey is an abundant country due to its renewable energy resources although Turkey imports 72% of the energy needs from abroad. Therefore, the Ministry of Energy and Natural Resources of Turkey should invest on renewable energy resources. Types of renewable energy resources are wind, solar, hydropower(water), geothermal, biomass and wave in Turkey. Nowadays, renewable energy is crucial for the growth benefits of Turkey. For this reason, if Turkey produces more renewable energy, it totally influences the welfare and economic development of itself in a positive way. Additionally, if Turkey boosts the investment activities on renewable energy resources, the dependence of energy to abroad will decline.[1]

[1] Yılmaz, M., (2012). ''The Energy Potential of Turkey and Its Importance of Renewable Energy Sources in terms of Electricity Production''. Ankara University, Journal of Environmental Sciences 4(2), :33-51.

CHAPTER ONE

1. THE IMPORTANCE OF ENERGY CONSUMPTION, ENERGY POLICY ISSUES & TYPES OF ENERGY RESOURCES

1.1.The Concept of Energy

Energy is a word which originates from Greek origin, meaning that it is an internal-work. Energy having a social feature as well is used in skill of creating business, power and dynamism.[2] Energy is always one of the most leading and indispensable needs of people. Nowadays, the energy consumption is used per capita as a criterion of the development. In the 21th century, the energy demand of people has increased along with the technology, which evolved in the past due to the influence of the population. Also, the population keeps rising rapidly in the world. Due to these factors, the needs and wants will also increase. One of the biggest problems of the world is the inadequacy of the energy and not being able to provide the continuity.[3] Energy, which is defined by the capability of doing a job, is one of the fundamental inputs of the economy. It is possible with possessing cheap, sufficient, quality and reliable energy resources for the healthy development.[4]

Energy, which is the indispensable component of humanity, has become one of the most influential elements of economic progress in the second half of the 20th century. Energy has been the strategic living resource for each country. Especially, it has one of the fundamental items of the development of the foreign countries. That's why, countries are continuously in search of new energy resources. In the forthcoming

[2]Aksöz, H., (2014). ''Analysis of the Relationship Between Energy Import and Current Account Deficit in Turkey''. Unpublished Master's Thesis. İstanbul University, Institute of Social Sciences, Department of Economics Department of Economic Policy, İstanbul: 4.
[3]Arı, V., (2007). ''Energy Sources, Energy Planning and Energy Strategies''. Unpublished Master's Thesis. Çukurova University, Institute of Science Department of Mining Engineering, Adana: 24.
[4]Coşkun, A., (1982). Energy Saving Panel. Istanbul Chamber of Commerce Publication, January 14, Seminar Series. No: 11,:95.

centuries, the energy will be prevailing in the economic and social advancements of the foreign countries.[5]

1.2. An Overview of the Renewable Energy Resources & Its Significance

There are many features that distinguish renewable energy resources from non-renewable energy resources. It can easily be produced and renewed. Besides, it diffuses fewer pollutants to the nature. For this reason, renewable energy resources are fundamentally different from fossil fuels. The renewable energy resources are utilized in many countries, including Turkey.[6]

The need for energy resources in the world continues to increase each passing day. The reason of this issue is that the rise of the population, industrial progresses and technological developments keep getting prevalent day by day. Owing to these reasons, the needs and wants of humans will raise. Fossil fuels have retained a significant part of the energy production. However, fossil energy resources cause serious environmental problems in the world and fossil reserves will be consumed in the near future. Moreover, fossil fuel prices are constantly increasing.[7] However, it has been changing nowadays. Countries embark on the new energy resources. Particularly, the industrialization movement that started towards the end of the 18th century became a turning point for renewable energy resources. Especially, developed countries using renewable energy sources for electricity production and other things. Currently, the renewable energy is the rival of the fossil fuel.[8] However, fossil energy resources are more dominant than renewable energy resources. It is predicted that the fossil energy resources have a future of less than half a century.[9]

There are two important reasons why countries invest in renewable energy resources. First reason is to increase energy diversity by using natural resources. The second is to provide sustainable energy production. However, there is a need for

[5]Prugh et al., (2005). ‘’Changing the Oil Economy, 2005 Situation of the World, Tema Publications, İstanbul: 125.
[6]Temiz, D. & Gökmen, A., (2010). ‘’The Importance of Renewable Energy Sources in Turkey’’. International Journal of Economics and Finance Studies, Vol 2, No:2. p.24.
[7]Yılmaz, 2012: 34.
[8]Erdoğan, M., (2014). ‘’ Turkey's Renewable Energy Potential is Examined with Thermodynamic Analysis Method, the Use of Renewable Energy Evaluate of Future Projections’’. Unpublished Master’s Thesis. İstanbul Aydın University, Institute of Science, Department of Mechanical Engineering, Makine Mühendisliği Bilim Dalı, İstanbul: 12.
[9]Gökmen, A. & Temiz, D., (2015) The Importance and Impact of Fossil and Renewable Energy Sources in Turkey on Business and the Economy, Energy Sources, Part B: Economics, Planning and Policy, 10:1, 15.

advanced technology to take advantage of renewable energy resources. In particular, technology that will deliver and distribute the generated energy are very important for countries.[10]

Turkey isn't an abundant country in terms of fossil fuels and it imports 71.8% of energy needs from the abroad. If Turkey doesn't develop additional investment possibilities on renewable energy resources, the energy dependency to abroad will increase. This dependency can lead to considerable problems in terms of Turkey's supply security and economy.[11]

1.3. Types of Energy Resources

There are various types of energy resources in the world. These energy resources are used for technological developments, industry and heating. Energy resources are divided into two categories as primary and secondary. Types of energy resources have been indicated in the table[12]

Table 1: Classification of Energy Resources

TYPES OF ENERGY RESOURCES	
1) Primary Energy Resources	**2) Secondary Energy Resources**
1.1) Nonrenewable Energy Resources	2.1) Electricity Energy
1.1.1) Fossil Fuel	2.2) Hydrogen Energy
1.1.1.1) Coal	
1.1.1.2) Natural Gas	
1.1.1.3) Petrol	
1.1.2) Nuclear	
1.2) Renewable Energy Resources	
1.2.1) Solar	
1.2.2) Wind	
1.2.3) Hydropower	
1.2.4) Geothermal	
1.2.5) Biomass	

Source: Erdoğan, 2014

[10]Demir, R., (2015). ''Turkey's Energy Import and Current Account Deficit''. Unpublished Master's Thesis. TOBB Ekonomi ve Teknoloji University, Institute of Social Sciences, Department of Management. Ankara: 16.
[11]Yılmaz, 2012: 51.
[12]Erdoğan, 2014: 42.

1.3.1. Primary Energy Resources

The definition of primary energy resources are the components, which provide energy from natural resources. The primary energy resources are divided into two, as nonrenewable and renewable.[13]

1.3.1.1 Nonrenewable Energy Resources

Nonrenewable energy resources are coal, natural gas, petrol and nuclear energy. Main source for generating nuclear energy is uranium and thorium. These energy resources are limited in the world. Hence, these are called as nonrenewable energy resources.[14] Non-renewable energy resources have some advantages, which are providing energy in a short period of time, being cheap and high efficient, having also some disadvantages. These disadvantages are having limited reserves, creating dependency on import, revealing risks due to price variability, affecting human health and environment negatively.[15]

1.3.1.2 Renewable Energy Resources

Renewable energy is described as the energy generated by natural resources that are renewed within a few years.[16] The renewable energy resources are basically comprised of massive radiation caused by solar energy.[17] Furthermore, renewable energy resources can easily be produced and renewed. Also, it spreads fewer pollutants to the nature. Besides, the renewable energy resources can never be depleted worldwide. Therefore, these types of energy resources are called as renewable energy resources.[18] Renewable energy sources (RES) meet 14 percent of the world's energy demand. The renewable energy resources are solar, wind, hydropower, geothermal, biomass and wave.[19] However, renewable energy resources have some disadvantages. The infrastructure costs of renewable energy resources are high and their efficiency is low according to non-renewable energy resources. In other words, renewable energy

[13]Erdoğan, 2014: 42-43.
[14]Arı, 2007: 27.
[15]Aksöz, 2014: 8.
[16]Lund, H., (2010). ‘’Renewable Energy Systems: The Choice and Modeling of 100% Renewable Solutions.’’ Amsterdam: Elsevier/AP: 7.
[17]Boyle, G., (2004). ‘’Renewable Energy: Power for a Sustainable Future’’. United Kingdom: Oxford University Press: 2.
[18]Arı, 2007: 38.
[19]Panwar, N.L., Kaushik, S.C., & Kothari, S., (2010). ‘’Role of renewable energy sources in environmental protection: A review’’. Renewable and Sustainable Energy Reviews 15 (2011) 1513–1524.

resources depend on weather conditions. At the same time, it needs to integrate with intensive technology.[20]

Table 2: Economic Advantages and Disadvantages of Renewable Energy Resources

Advantages	**Disadvantages**
Provides low operating costs	High pre-investment required
Provides low maintaining costs	Requires long-term planning
Green energy source	Requires long-term agreements
Provides long life period	Excessive competition
Preserves ecosystems	Requires new legal code
Provides efficient energy production	
Reduces greenhouse gas emissions	
Improves air quality	
Helps decelerate climate change and global warming	
Improves living conditions	
Creates new job opportunities	
Encourages regional development	
Generates tax and income	

Source: Gökmen & Temiz, 2014

1.3.2 Secondary Energy Resources

The secondary energy is a type, which is obtained as a result of the physical conversion of the primary energy resources. Electricity and hydrogen energy are included in the secondary energy resources. Therefore, primary energy resources are the principal source for the generation of the secondary energy resources.[21] Electric energy is among the mostly needed and used secondary energy resource. Per capita electricity energy consumption is considered as a part of computations for per capita energy consumption as a criterion of development. Electricity demand is increasing day by day in developed and developing countries around the world. Electricity is a highly preferred type of energy all over the world because of its high quality and less

[20]Aksöz, 2014: 9.
[21]Erdoğan, 2014: 44.

harm to the environment. People use electricity energy in many areas such as industry, housing and lighting.[22]

1.4 Types of Nonrenewable Energy Resources

The most important nonrenewable energy resources (fossil fuels) are coal, oil and natural gas. These resources constitute a large part of the world's energy production. Besides, nuclear energy has become an important nonrenewable resource of energy in recent times.[23]

1.4.1. Coal

Coal is a solid fossil fuel, which is flammable sedimentary rock and mine. It can be black, dark gray, brown-black brilliant or matte. It usually contains sulfur and nitrogen in small quantity stemming from oxygen, carbon and hydrogen. Required duration for coaling changes between 15 to 400 million years. Older coal sources are to be far more quality and high-calorie.[24] According to BP's publication, definite coal reserves of world are 892 billion tons. This amount of coal reserves is sufficient for 142 years of energy production. Furthermore, coal has the highest production/reserve ratio compared to other fossil fuels. Coal is regarded as a lower-cost alternative compared to natural gas in many regions in electricity generation. Therefore, coal is the resource which is the most commonly used in electricity generation.[25]

Table 3: General Coal of International Classification

Stone Coals (Stiff Coals) **Over 5700 kcal/kg**	**Brown Coals** **Below 5700 kcal/kg**
1. Coking Coals (It is in the quality that allows the coking production and proper to high ovens) 2. Non-Coking Coals a) Bitumen coals b) Anthracite	1. Subitem Coals Between 4,165-5,700 kcal/kg in Calorific value, it doesn't indicate coking feature. 2. Lignite Below 4,165 kcal/kg in Calorific value, it doesn't indicate coking feature.

Source: Erdoğan, 2014

[22]Aksöz, 2014: 8.
[23]Demir, 2015: 10.
[24]Erdoğan, 2014: 45.
[25]Demir, 2015: 14.

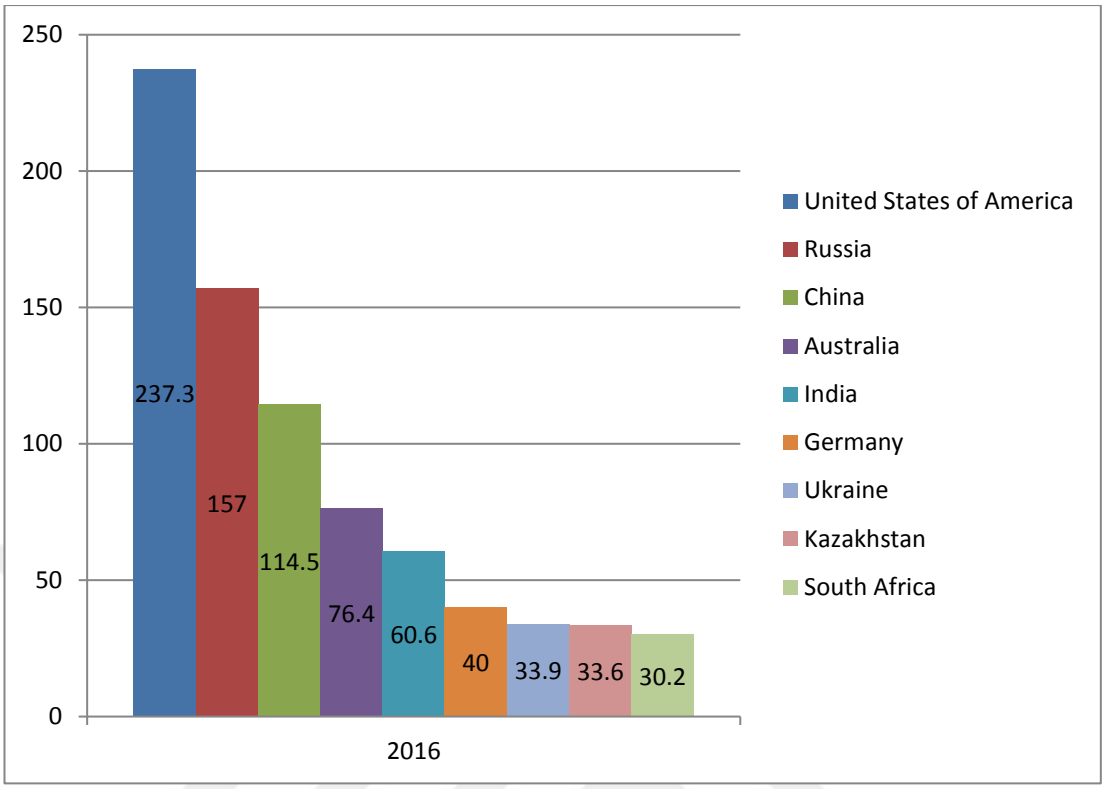
Table 4: Lignite Reserve Amounts Which Were Identified Between 2005-2015 in Turkey

Lignite Reserve Region of Turkey	**Reserve**	**Unit**
Karapınar-Ayrancı	1,832	Billion tones
Çerkezköy	0,495	Billion tones
Elbistan	0,515	Billion tones
Malatya-Yazıhan	0,017	Billion tones
Eskişehir-Alpu	1,453	Billion tones
Afyon-Dinar	0,9415	Billion tones
Vize-Pınarhisar	0,140	Billion tones
Konya-Ilgın-Merkez	0,0305	Billion tones
Amasya-Merzifon	0,0092	Billion tones
Isparta-Şarkikaraağaç	0,3067	Billion tones
Denizli-Çardak	0,0442	Billion tones
Denizli-Çivril	0,0075	Billion tones
Elbistan-Elektrik Üretim AŞ (EÜAŞ)	1,3	Billion tones
Soma-Türkiye Kömür İşletmeleri (TKİ)	0,205	Billion tones
Çayırhan-Elektrik Üretim AŞ (EÜAŞ)	0,0833	Billion tones
Total	**7,38**	**Billion tones**

Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[26]

[26] http://www.enerji.gov.tr/en-US/Pages/Coal ; accessed January 2017.

Figure 1: Coal Recoverable Reserves by Country in 2016 (Gigaton)

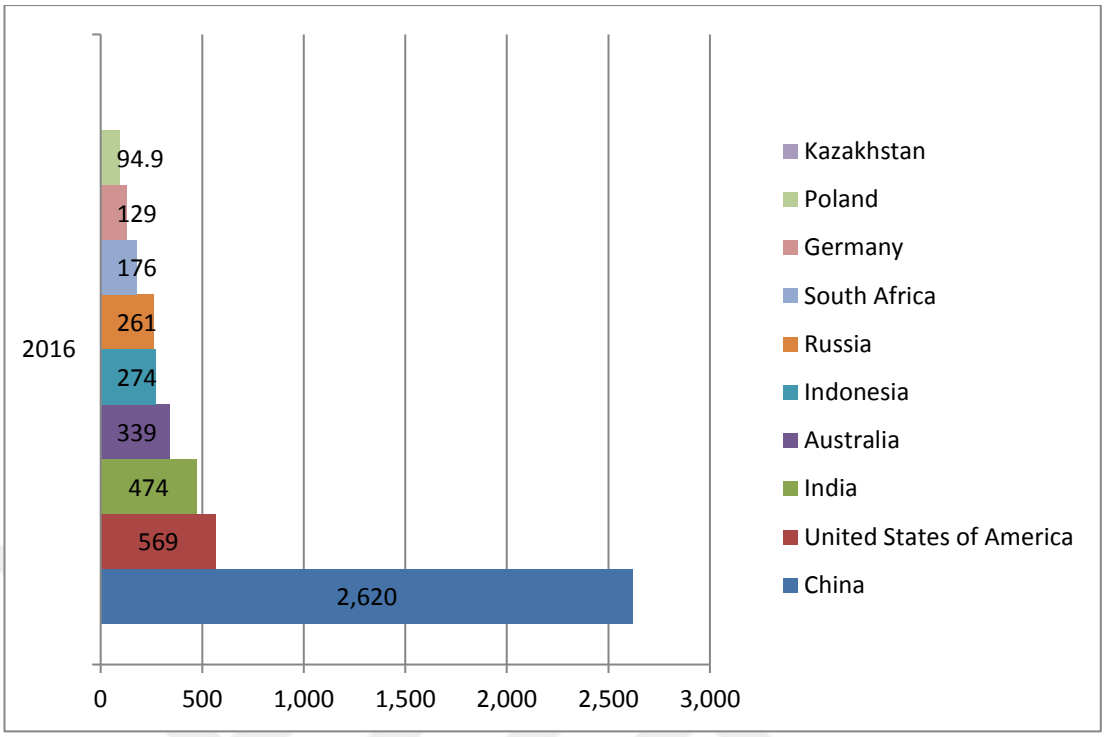


Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[27]

According to Figure 1, the US has largest part of global coal reserves with 237.3 gigatons. Russia is the second abundant country in terms of global coal reserves with 157 gigatons. Russia is followed by China with 114.5 gigatons of coal reserves. These two countries are respectively followed by Australia-76.4 gigatons, India-60.6 gigatons, Germany-40 gigatons, Ukraine-33.9 gigatons, Kazakhstan-33.6 gigatons and South Africa-30.2 gigatons. Hence, these nine countries have more than 90% of the global coal reserves in their territory.

[27] http://www.enerji.gov.tr/en-US/Pages/Coal ; accessed January 2017.

Figure 2: Top 10 Countries Producing Coal in 2016 (Million tons of oil equivalent)



Source: World Energy Council, 2016[28]

As it was indicated on the Figure 2, China has the highest rate as part of coal production activities in 2016. China has a massive superiority with 2620 million tons of oil equivalent in the coal manufacturing. It is unprecedented number in the world about the coal production. So, it is very tough to reach the million tons of oil equivalent of China for the other countries in forthcoming years. United States of America follows China at the second place with 569 million tons of oil equivalent. India, Australia, Indonesia and others respectively keep pursuing China and USA in coal production of 2016.

1.4.2. Natural Gas

Natural gas is a flammable, light to air, colorless and odorless gas. It is an underground resource and it's in the places where the oil is found. It gets transported by the large pipelines.[29] The most significant characteristic of natural gas is being environment friendly and not causing environmental pollution. A blue flame occurs when it burns. In case of turning into the gas, it burns far easier by providing the combination with air, at the same time, it enables this feature to control easily. Natural

[28] https://www.worldenergy.org/data/resources/resource/coal/ ; accessed January 2017.
[29] Erdoğan, 2014: 51.

gas has become one of the cheapest fuels by safeguarding its position within the years in accordance with other fuels. It is estimated that the natural gas will be the fossil fuel with highest consumption rate till 2030 in the world.[30]

By the end of 2016, remaining producible natural gas reserves of Turkey was 18,8 billion m^3.[31] The natural gas consumption of Turkey has been identified as 46.395.060.952 Sm^3 in 2016. Amount of natural gas subscriber is 12.496.511 and the number of eligible consumers is about 504.300 in Turkey.[32]

Table 5: The Natural Gas Consumptions by Sectors in Turkey (Million Sm^3)

Sector	**2016**
Conversion and Cycle Sector	16.730,31
Energy Sector	346,3
Transportation Sector	397,37
Industry Sector	14.094,99
Service Sector	3.098,73
Housing	11.620,38
Other	106,97
General Total	46.395,06

Source: Republic of Turkey Energy Market Regulatory, 2016[33]

According to Table 5, conversion and cycle sector has the highest rate with 16.730,31. It has a huge dominance compared to the other sectors. The industry sector is also prevalent with 14.094,99 in the natural gas consumptions. Housing, service sector, transportation sector, energy sector and other sectors are aligned with the numbers.[34]

[30]Yılmazer, Ö., (2016). ‘’Changing Role of Renewable Energy in Energy Economypolitics and Importance interm of Turkey’’. Unpublished Master’s Thesis. İzmir Kâtip Çelebi University, Institute of Social Sciences, Department of International Relations, İzmir: 5.
[31]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Natural-Gas ; accessed January 2017.
[32] Natural Gas Market 2016 Sector Report, Republic of Turkey Energy Market Regulatory, http://www.epdk.org.tr/TR/Dokumanlar/Dogalgaz/YayinlarRaporlar/Yillik ; accessed January 2017.
[33]http://www.epdk.org.tr/TR/Dokumanlar/Dogalgaz/YayinlarRaporlar/Yillik ; accessed January 2017.

Table 6: 2007-2016 years Natural Gas Generation Quantities of Turkey (Million Sm^3)

Years	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Quantity	874	969	684	682	759	632	537	479	381	367

Source: Republic of Turkey Energy Market Regulatory, 2016[35]

Table 6 shows that the natural gas generation quantity of Turkey has reached to the top in 2008. Then, it has a small decrease as of 2009 and it continues to decline in the next years. The generation rate of natural gas in 2015 in Turkey is low compared to the other years. So, there is no precise stability, which is identified within this table.

Table 7: Natural Gas Import Amounts of Turkey (Million Sm^3)

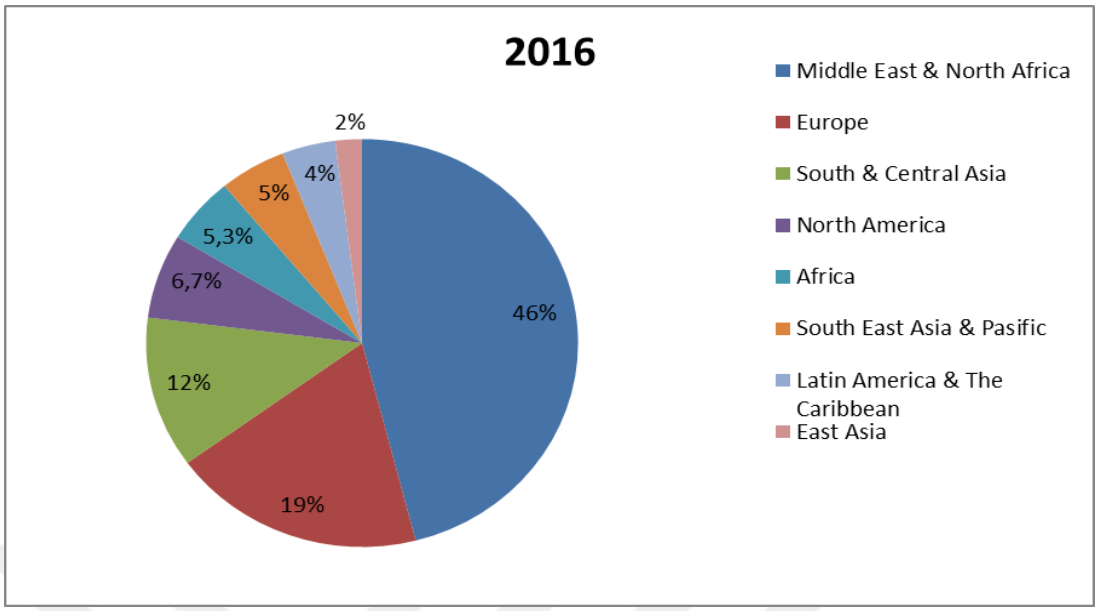
	Russia	Iran	Azerbaijan	Algeria	Nigeria	Others	Total
2016	24.540	7.705	6.480	4.284	1.220	2.124	**46.352**
(%)	52,94	16,62	13,98	9,24	2,63	4,58	**100**

Source: Republic of Turkey Energy Market Regulatory, 2016[36]

In accordance with Table 7, Turkey imports most of the natural gas it uses from Russia. Iran is the second, where Azerbaijan, Algeria and Nigeria come respectively after Russia and Iran. Turkey apparently imports a part of the natural gas from Middle Eastern countries as well as African states.

[35] http://www.epdk.org.tr/TR/Dokumanlar/Dogalgaz/YayinlarRaporlar/Yillik ; accessed January 2017.
[36] http://www.epdk.org.tr/TR/Dokumanlar/Dogalgaz/YayinlarRaporlar/Yillik ; accessed January 2017.

Figure 3: Gas Recoverable Reserves by Region in 2016

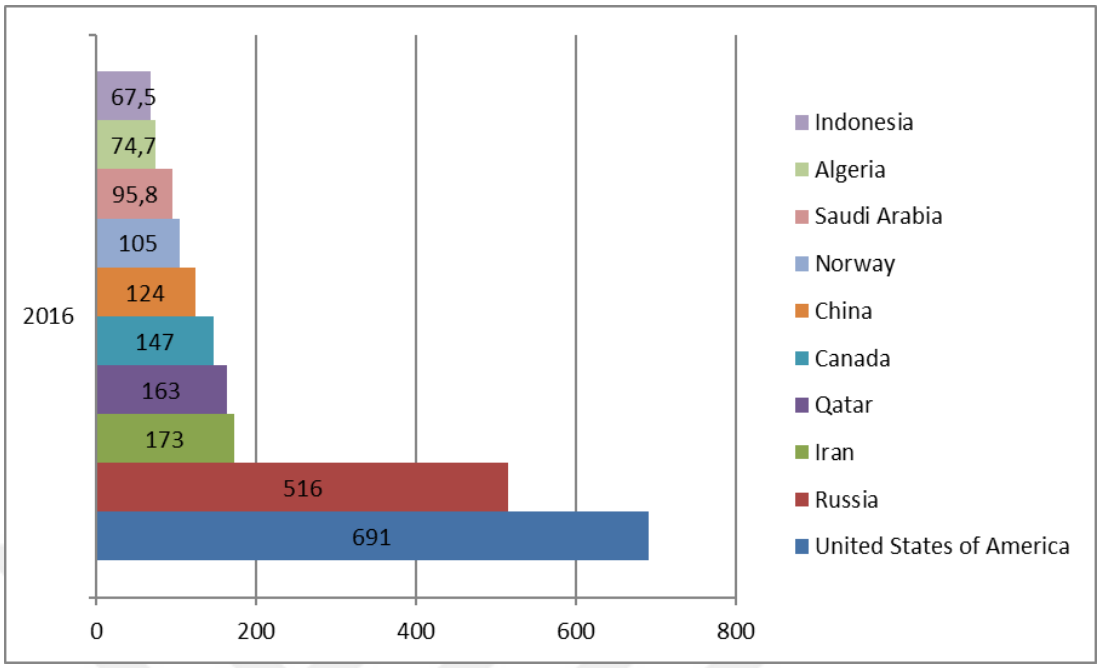


Source: World Energy Council, 2016[37]

According to the Figure 3, The Middle East and North Africa have 79,2 thousand million tons of oil equivalent (46%) of natural gas reserves. Europe has 32,6 thousand mtoe (19%), South and Central Asia has 20,7 thousand mtoe (12%), North America has 11,5 thousand mtoe (6,7%), Africa has 9,14 thousand mtoe (5,3%), South East Asia and Pacific have 8,53 thousand mtoe (5%), Latin America and Caribbean have 6,89 thousand mtoe (4%), East Asia has 3,48 thousand mtoe (2%) of natural gas reserves.[38]

[37] https://www.worldenergy.org/data/resources/resource/gas/ ; accessed January 2017.
[38] World Energy Council, https://www.worldenergy.org/data/resources/resource/gas/ ; accessed January 2017.

Figure 4: Top 10 Countries Producing Natural Gas in 2016 (Mtoe)



Source: World Energy Council, 2016[39]

As it can be viewed in Figure 4, USA and Russia are the first two states with highest yield of natural gas in 2016. Iran is the third one with 173 mtoe and the other countries are aligned within the natural gas production. The Middle Eastern countries are also dominant in the natural gas production in addition to the USA and Russia.

1.4.3. Oil

Figure 5: View of Oil Refinery

Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[40]

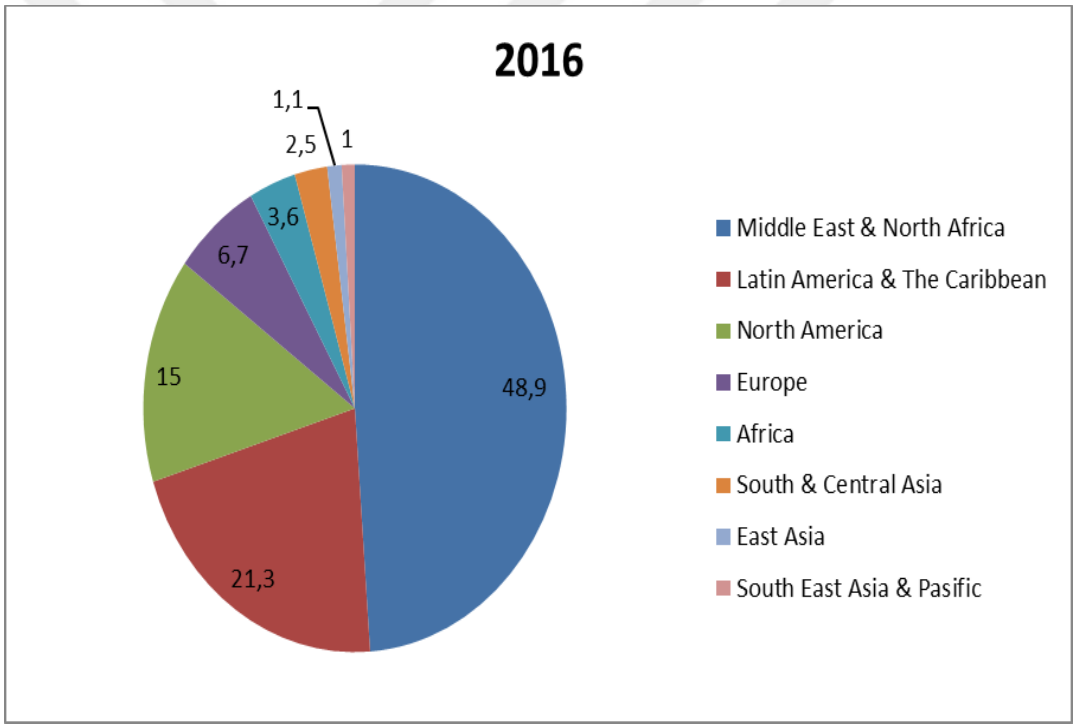
Oil is a complicated component, which is mainly comprised of hydrogen and carbon, as well as nitrogen, oxygen and sulfur. It can be found in solid, liquid and gas

[39] https://www.worldenergy.org/data/resources/resource/gas/ ; accessed January 2017.
[40] http://www.enerji.gov.tr/en-US/Pages/Petrol ; accessed January 2017.

states. Hydrogen and carbon are major components of petrol and natural gas, these are also known as ‘’hydrocarbons’’.[41] Petroleum means crude oil that has not been extracted from underground processing, although it is only contained in the public as a specific fuel (gasoline, kerosene, diesel engine, engine oil, fuel oil).[42]

Furthermore, oil is an important commodity due to its strategic importance. Fluctuations in oil prices have a negative effect on the current account balance. Increases in oil prices can be economically bad for oil-importing countries but it is an economically good news for oil-exporting countries. However, Turkey is a country that imports a large part of its oil needs from abroad. Hence, the rise in energy prices negatively affect Turkey's current account balance.[43]

Figure 6: Recoverable Oil Reserves by Region in 2016 (Billion tons of oil equivalent)



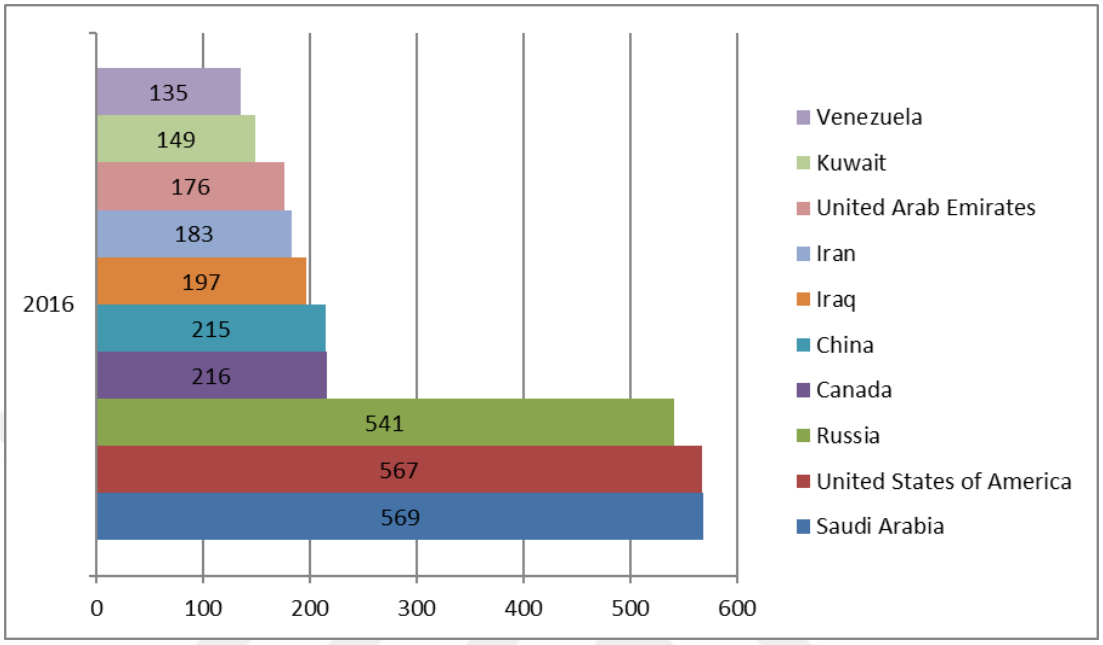
Source: World Energy Council, 2016[44]

According to Figure 6, Middle East & North Africa have 48,9% of total recoverable oil reserves of the world. Latin America & Caribbean have 21,3% of total

[41]Erdoğan, 2014: 49.
[42]Yılmazer, 2016: 8.
[43]Berument, M.H., Ceylan, N.B., & Doğan, N., (2010). ‘’ The Impact of Oil Price Shocks on the Economic Growth of Selected MENA Countries’’. Energy Journal. Vol 31, Issue 1, p.149-150.
[44]https://www.worldenergy.org/data/resources/resource/oil ; accessed January 2017.

recoverable oil reserves. Latin America and Caribbean are respectively followed by North America, Europe, Africa and South & Central Asia.

Figure 7: Top Oil Producing Countries 2016 (Mtoe)



Source: World Energy Council, 2016[45]

According to Figure 7, Saudi Arabia, USA, Russia are highest oil producing countries, where they are producing nearly the same level of oil. These three countries are respectively followed by Canada, China, Iraq, etc.

1.4.4. Nuclear Energy

Today the nuclear energy is a significant energy resource worldwide. It is the energy that occurs by splitting (fission) big atoms (uranium, plutonium) or by merging (fusion) small atoms (like hydrogen). Uranium has been discovered in 1879. The foundations of today's nuclear technology took place in 1934 when the atom decomposition process continued.[46]

[45] https://www.worldenergy.org/data/resources/resource/oil/ ; accessed January 2017.
[46]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Nuclear ; accessed January 2017.

Figure 8: Nuclear Power Plant

Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[47]

Some characteristics of nuclear power plants:[48]

• Nuclear power plants don't get affected from the natural conditions and climate.

• Capacity factors are about 90% average

• Nuclear power plants don't produce greenhouse gas. Therefore, they are the important alternatives in terms of the prevention of the global warming.

• The fuel cost is far lower in accordance with the other resources. Thereby, the fluctuations in the fuel prices don't affect the electricity production costs.

• Uranium, which is the raw material of the nuclear fuel, has been dispersed in the world. For that reason, the nuclear fuels are accessible at all times and conditions.

•Furthermore, the installation zone per unit electricity production of the nuclear power plants is far smaller according to all other powerhouses. For this reason, nuclear power plants have minimal impact on agriculture, habitation and natural life.

[47] http://www.enerji.gov.tr/en-US/Pages/Nuclear ; accessed January 2017.
[48] Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Nuclear ; accessed January 2017.

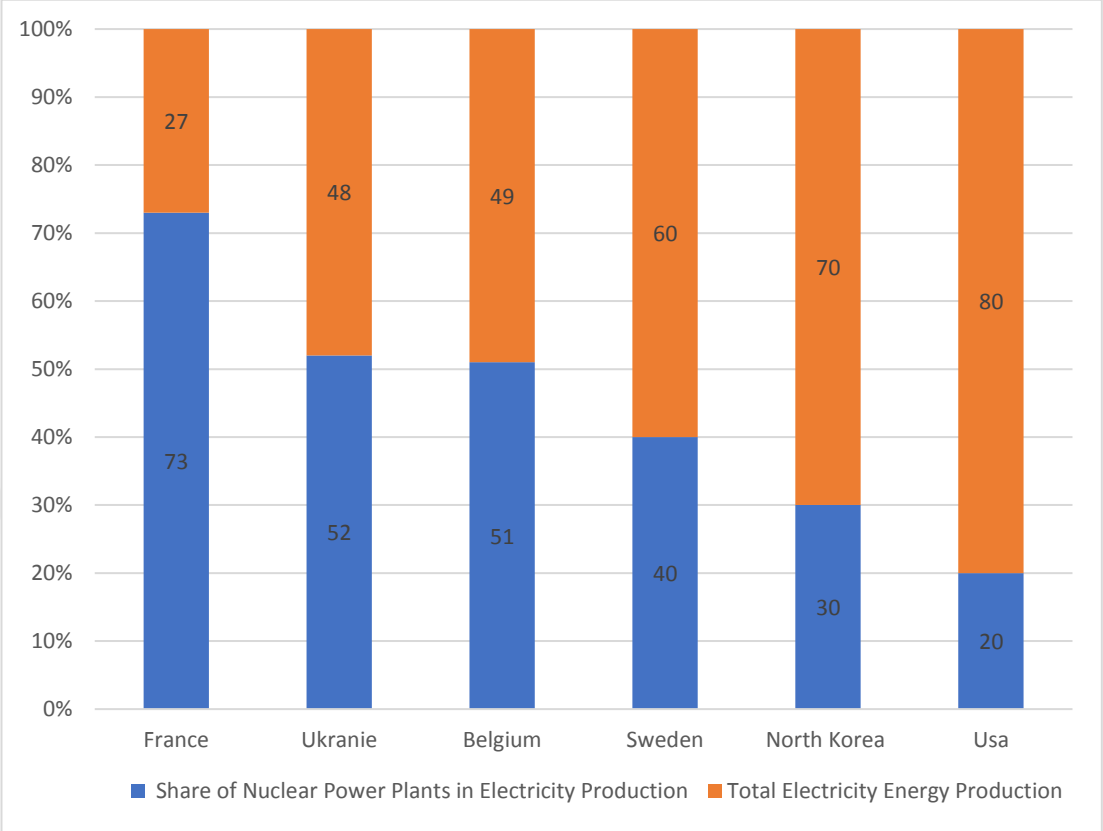
Table 8: Available Uranium Reserves

Country	**Uranium (Ton)**	**Percentage**
Australia	1.661.000	31
Kazakhstan	629.000	12
Russia	487.200	9
Canada	468.700	9
Nigeria	421.000	8
South Africa	279.100	5
Brazil	276.700	5
Namibia	261.000	5
US	207.400	4
China	166.100	3
Ukraine	119.600	2
Uzbekistan	96.200	2
Mongolia	55.700	1
Jordan	33.800	1
Other	164.000	3
Total	**5.326.500**	**100**

Source: Selvi, 2017

According to Table 8, the total available uranium reserves are 5.326.000 ton in the world. Australia is a dominant country in uranium resource with 31%. It is a satisfactory rate on the behalf of Australia. Then, it is respectively followed by Kazakhstan-9%, Russia-9%, Canada-9% and Nigeria-8%. South Africa, Brazil and Namibia has 5% available uranium reserves each. Other countries have remaining of the total available uranium reserves of the world.

Figure 9: The Share of the Nuclear Electricity Production within the Total Electricity Production



Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[49]

1.4.4.1. Nuclear Energy in Turkey

In the recent years, Turkey has begun to invest in nuclear energy. The most significant reason of this is related to the vast demand of energy. Therefore, Turkey has begun to carry out investment projects concerning the nuclear energy in order to generate the huge returns. The initial nuclear project is the Akkuyu Nuclear power plant. It will be launched in 2023 as part of the collaboration project with Russia. The second nuclear project of our country is Sinop Nuclear Power Plant. This business partnership will be conducted by Japan. Energy deficit of Turkey will decline with the launching of these two-nuclear power plants.[50]

[49] http://www.enerji.gov.tr/en-US/Pages/Nuclear ; accessed January 2017.
[50] http://www.enerji.gov.tr/en-US/Pages/Nuclear ; accessed January 2017.

1.5. Renewable Energy Resources Profile on Worldwide

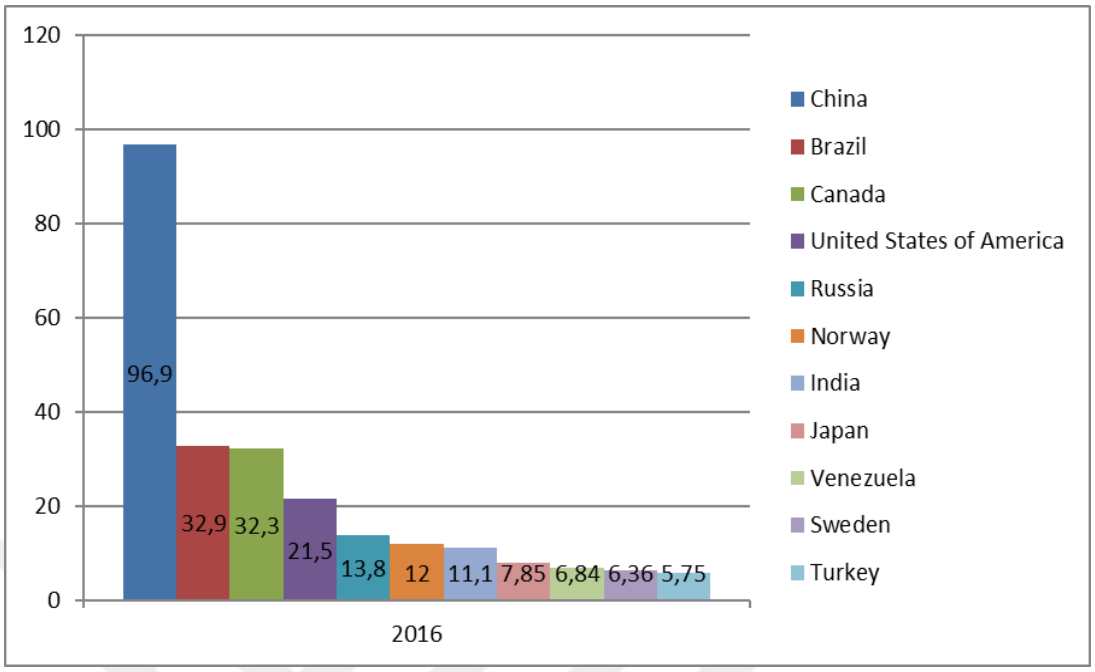
There are serious changes and innovations about renewable energy resources in the world by each passing day. These changes and innovations are thought to be necessary for details of the scale of resources in the field of renewable energy.[51] Nowadays, the most significant renewable energy resources are hydropower, geothermal, wind, solar and biomass energy resources. Reserves of nonrenewable energy resources limited in the world and it affects environment negatively. Therefore, the processing and use of renewable energy resources are increasing continuously in order to provide sustainability for energy and keeping preservation of natural balance.[52]

1.5.1. The Profile on Hydropower Energy

Around 17% of the electricity manufactured all over the world comes from hydropower plants.[53] Hydropower plants (HPP) projects continue in every part of the world. Nowadays, some of the biggest projects might be example about this issue. For instance, 14,000 Megawatt is produced in Itaipu in Brazil and 22,400 MW is produced in Gorges in China from HPP. These two major projects produce 80 to 100 Tera Watt hours (TWh) per year.[54] Moreover, Norway meet nearly a hundred percent of its electricity needs from hydropower plants. This rate is 84% in Brazil, 65% in Austria and 61% in Canada. China and USA are among developed countries that just meet a small percent (16% and 6% respectively) of own electricity needs from HPP.[55]

[51]Yılmazer, 2016: 40.
[52]Aksöz, 2014: 9-10.
[53]Quaschning, V., (2010). Renewable Energy and Climate Change. Singapore: John Wiley & Sons Ltd Press: 207.
[54]Yılmazer, 2016: 53.
[55]Quaschning, 2010: 207-208.

Figure 10: Top Countries Producing Hydropower in 2016 (Mtoe)

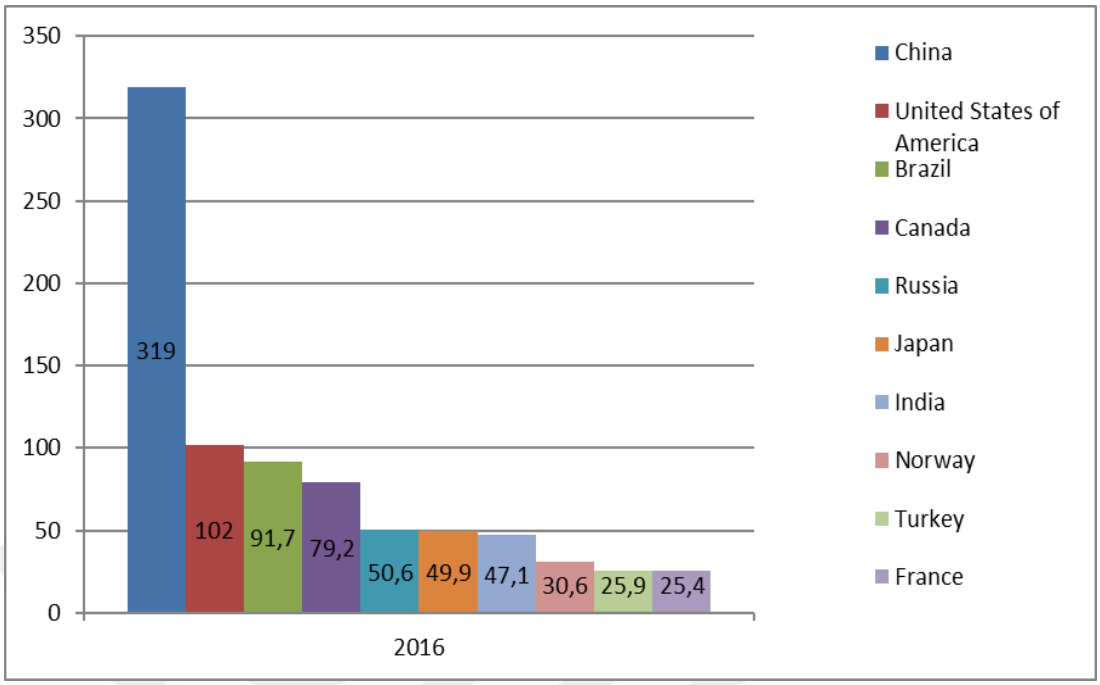


Source: World Energy Council, 2016[56]

The countries producing the highest hydropower are presented in Figure 10. China is the country, which has apparently the highest hydropower rate compared to the other countries. Also, Brazil, Canada and USA are the leading countries in terms of the hydropower generation worldwide. As for Turkey, it has a large potential in hydropower production. Turkey has produced total of 5.75 mtoe within 2016. In the recent years, Turkey has made a huge progress in the hydropower sector in order to engage in the rivalry with the other foreign countries.

[56] https://www.worldenergy.org/data/resources/resource/hydropower/ ; accessed January 2017.

Figure 11: Top Hydropower Installed Capacity by Country 2016 (GigaWatt)



Source: World Energy Council, 2016[57]

As it is indicated in Figure 11, China apparently maintains its lead and superiority against the other countries, owing to its available hydropower capacity. China has 319 gw hydropower installed capacity. USA, Brazil and Canada are aligned after China. The installed capacity of the other countries in the hydropower area are far lower than China. Turkey has also a prodigious amount of hydropower installed capacity along with the other states according to 2016 data, it has 25,9 gw hydropower installed capacity. Thus, there is a high increase in Turkey's hydropower capacity. It proves that Turkey can have higher hydropower possibilities in the future.

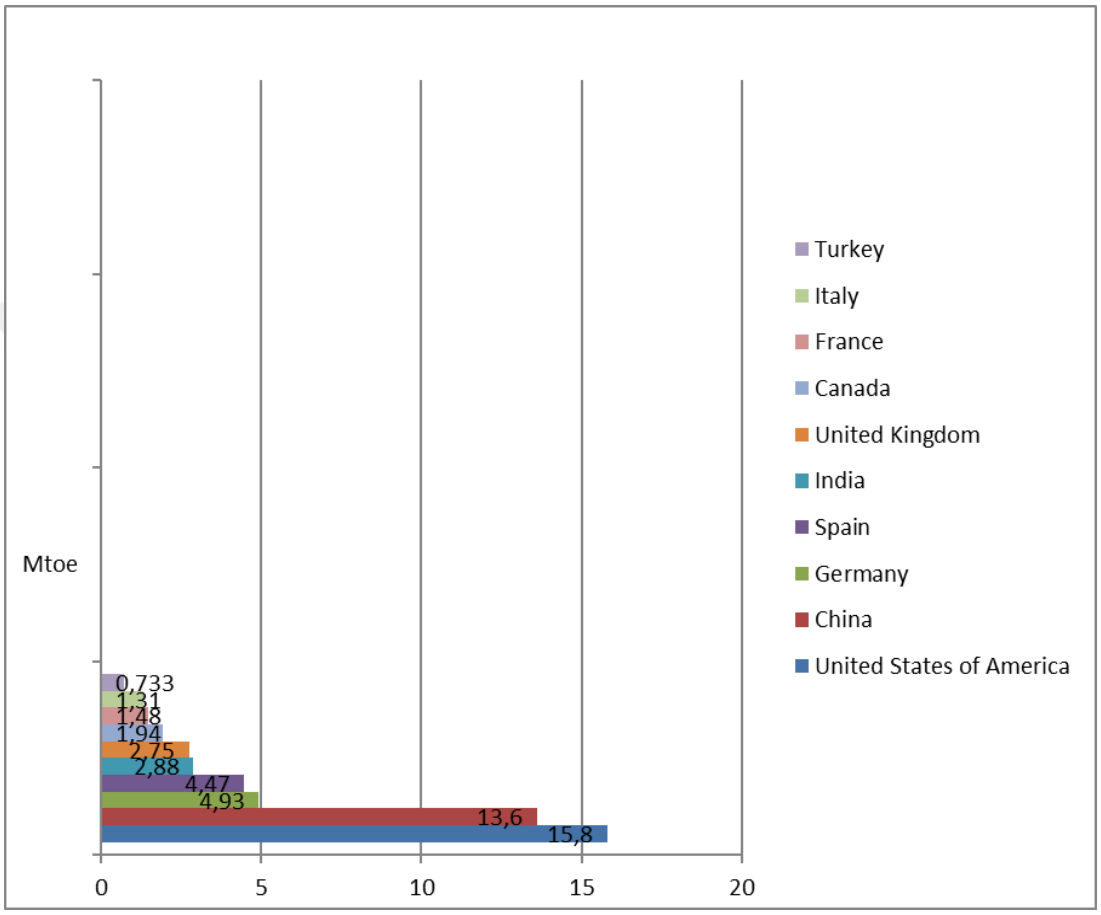
1.5.2. The Profile on Wind Energy

At the end of June 2016, the wind capacity reached to 456.486 MW worldwide. All wind turbines installed worldwide till the middle of 2016 can produce nearly 4,7% of the electricity demand of world. China, USA, Germany, India and Spain are important countries in wind energy due to the wind capacity in these countries. These are the countries with a share of 67% of the world wind capacity within 2016.

[57] https://www.worldenergy.org/data/resources/resource/hydropower/ ; accessed January 2017.

Although, the wind energy market continues to grow within the years, these countries had a higher share, 73%, of the world wind capacity by the end of June 2013.[58] The global wind energy industry works very hard to respond quickly to changes in production.[59]

Figure 12: Top Countries Producing Wind in 2016 (Mtoe)

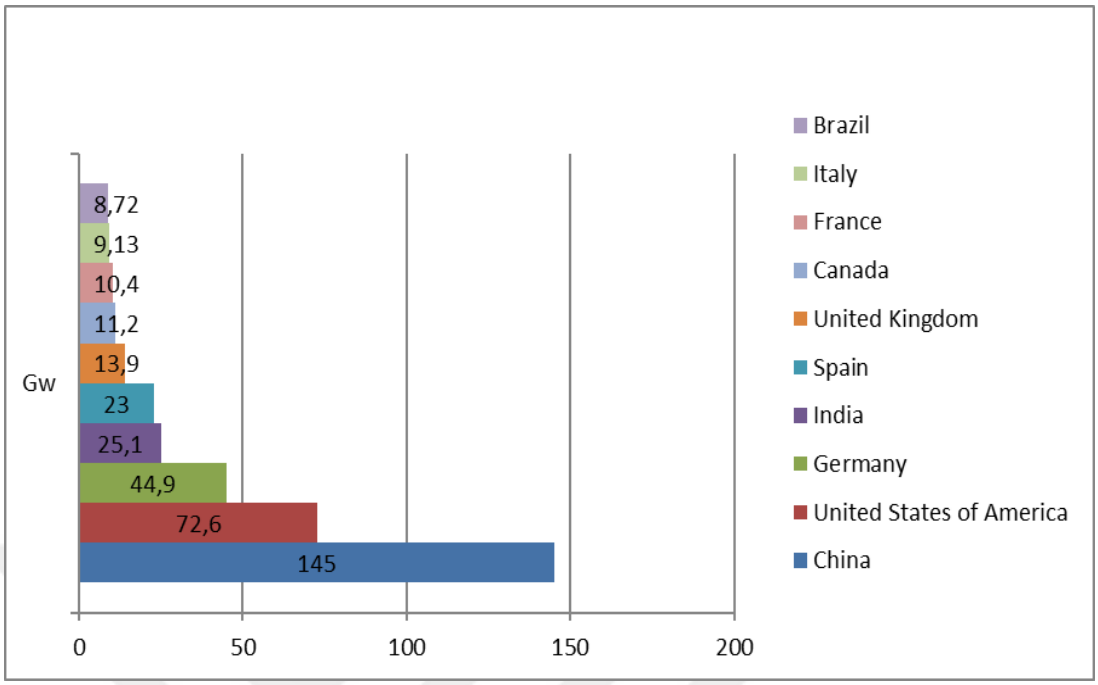


Source: World Energy Council, 2016[60]

According to Figure 12, USA has the highest rate in the wind energy production. It produces 15,8 mtoe per year. China has also high amount of energy generation with a large gap in accordance with the other countries. China is respectively followed by Germany, Spain, India. Turkey is in the first 10 in terms of production. However, it keeps thriving in a rapid way in the wind energy production sector, despite having a lower rate against the foreign countries currently.

[58]The World Wind Energy Association Half-year Report, 2016
[59]Yılmazer, 2016: 45.
[60]https://www.worldenergy.org/data/resources/resource/wind/ ; accessed January 201

Figure 13: Top 10 Countries Which Installed Wind Capacity in 2016 (Gw)



Source: World Energy Council, 2016[61]

With respect to Figure 13, China is the top among all other countries in 2016 It has a 145 gw installed wind capacity. Moreover, USA has also high amount of wind installed capacity. USA is respectively followed by Germany, India, Spain, etc. Unfortunately, Turkey isn't in top 10 countries about the wind installed capacity. However, it keeps developing and widening its wind installed capacity according to the recent years.

1.5.3. The Profile on Geothermal Energy

The development of the technology has provided the possibility for the generation of electricity in fields with large underground heat exchange and low heat. The cost of establishing geothermal energy will be reduced even more by new technological developments. Alpine Himalayan Belt, Central American Volcanic Belt, Ant Volcano Belt, Caribbean Belt, Iceland and other Atlantic islands, and East African Rift System are availably major geothermal resources on the World.[62] China, USA, Turkey and Iceland are the definite leaders in terms of geothermal energy.[63]

[61] https://www.worldenergy.org/data/resources/resource/wind/ ; accessed January 2017.
[62] Yılmazer, 2016: 20-47.
[63] Quaschning, 2010: 221.

Table 9: Decline of Investment Costs in Response to Installed Power Rise in Geothermal Energy in Forthcoming Years Worldwide

	2005	2010	2020	2030	2040	2050
Geothermal (only electricity)						
Global Installed Power (GW)	8,7	12	33	71	120	152
Investment Costs Y($/kW)	17,440	15,040	11,560	10,150	9,490	8,980
Operation and Maintenance Costs($/kWa)	645	557	428	375	351	332
Geothermal (combine circle)						
Global Installed Capacity (GW)	0,24	1,7	13	38	82	124
Investment Costs($/kW)	17,500	13,050	9,510	7,950	6,930	6,310
Operation and Maintenance Costs	647	483	351	294	256	233

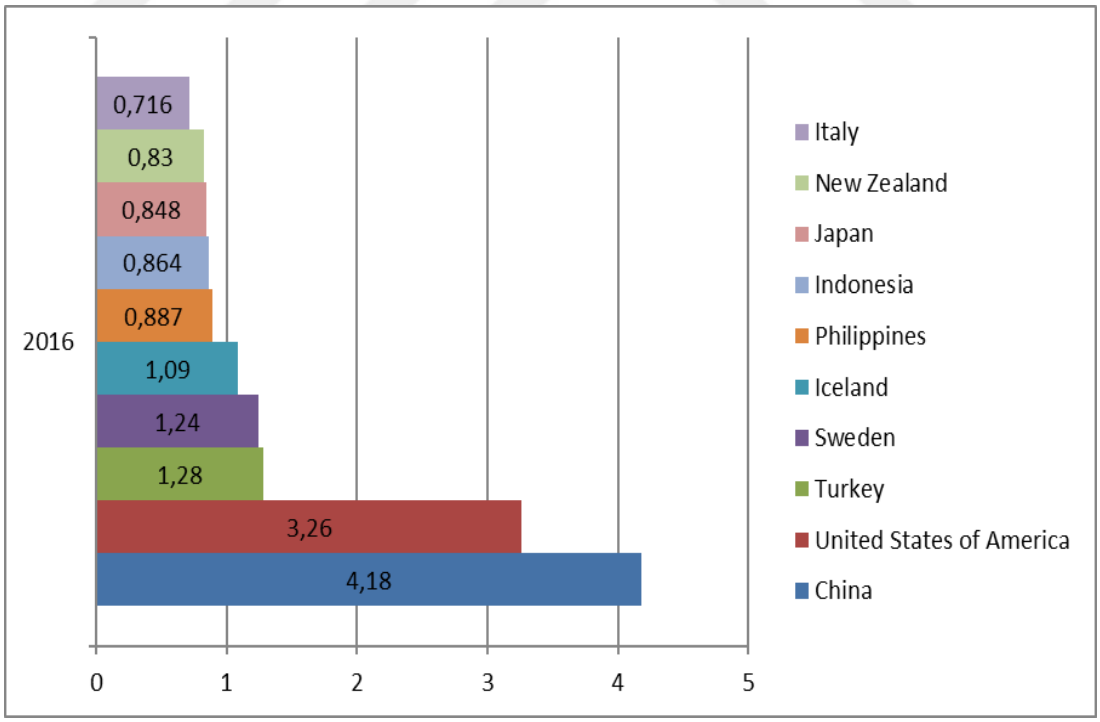
Source: Greenpeace, 2007

With respect to Table 9 of geothermal (only electricity), global installed power manifests a wide upscale step by step in each passing year. Especially, there is a huge gap, which is observed between 2030 and 2040. Then, it will reach to 152 GW in 2050 in accordance with the estimations. As for investment costs of the geothermal energy,

a vast decline is examined year by year. When this cost of the investment is 17440$ in 2005, it is lowered to $8980 in 2050. In other words, operation and maintenance costs are 645$ in 2005. However, this rate will decline to 332$ in 2050. Briefly, there is a downturn stage by stage in the costs of operation and maintenance activities.

According to Table 9 of geothermal (combine circle), global installed capacity keeps growing toward 2050 starting as of 2005. The biggest foreseen rise is indicated between 2030 and 2040. An uptrend will be observed within those periods. This number will reach to 124GW in 2050. Moreover, the investment costs of the geothermal energy (combine circle) will be lowered in each year. In 2005, the total investment cost was 17500$. However, it keeps decreasing in a swift way in each year. The largest interval is between 2005 and 2010 but it continues to decrease in the other years. In 2050, it will reduce to 6310$ in accordance with the outlooks. On the other hand, the operation and maintenance costs begin with 647$ in 2005. A wide downtrend has been identified between 2005 and 2010 about the geothermal in Combine Circle. This rate will decline to 233$ in 2050 with those expectations.

Figure 14: Top 10 Countries Producing Geothermal Energy (Mtoe)

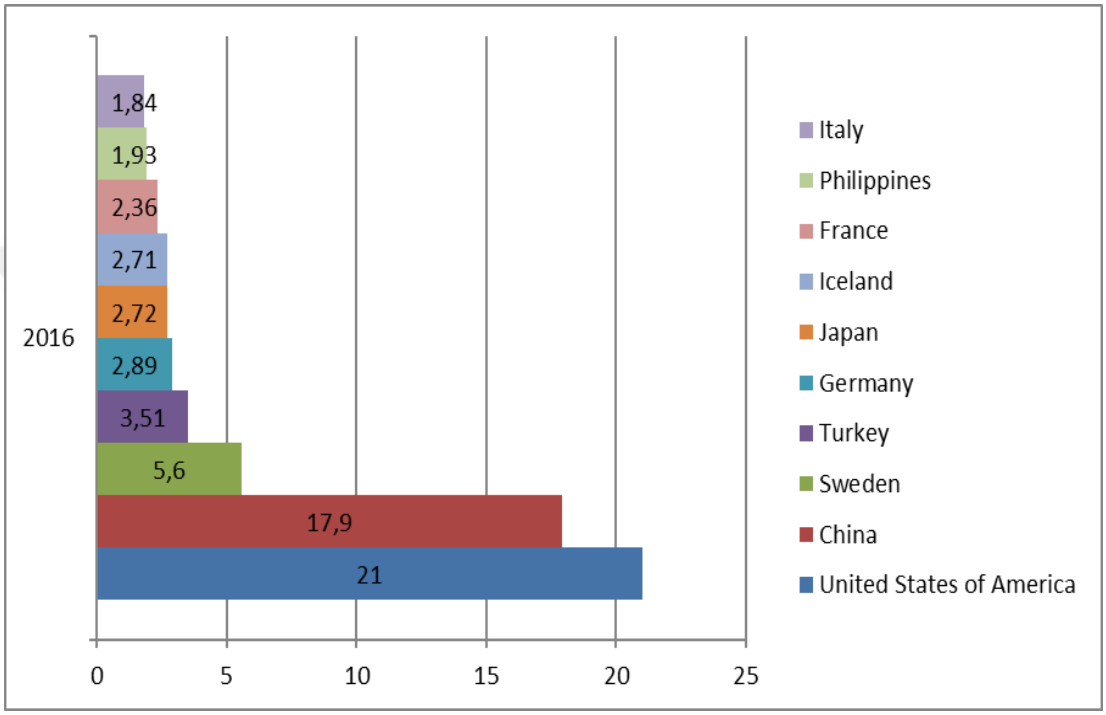


Source: World Energy Council, 2016[64]

[64] https://www.worldenergy.org/data/resources/resource/geothermal/ ; accessed January 2017.

As it is indicated in Figure 14, China is at the first place. It is producing 4,18 mtoe per year. USA and Turkey are respectively the second and third largest countries in terms of the geothermal energy generation. USA and Turkey are respectively producing 3,26 and 1,28 mtoe per year. Turkey is followed by Sweden, Iceland and Philippines.

Figure 15: Top Geothermal Installed Capacity by Country (Gw)



Source: World Energy Council, 2016[65]

As it is indicated in the Figure 15, USA and China have huge potential due to their geothermal installed capacity. Also, Sweden and Turkey have significant geothermal potential. Turkey has 3,51 gw geothermal installed capacity. Turkey is respectively followed by Germany, Japan and Iceland.

1.5.4. The Profile on Biomass Energy

Biomass rises to 14% in global energy usage. Africa, Asia, and Latin America are highly populated areas, which provide the large of their energy needs from biomass energy. Biomass is mostly used for basic human needs such as cooking and heating in

[65] https://www.worldenergy.org/data/resources/resource/geothermal/ ; accessed January 2017.

large part of rural population and in lower income groups of these regions.[66] For instance some countries, such as Mozambique and Ethiopia, use traditional biomass to meet above 90% of their primary energy needs.[67]

The US and Brazil have succeeded in producing 64.7% of the biofuels produced in the world in 2013. Among the reasons for this tremendous production are the effects of having sources of raw materials. However, the consumption - production balance brought about by awareness cannot be ignored. Brazil intensively uses biomass energy. It is one of the best examples of global scale. For Instance, in Brazil approximately 5 million vehicles use pure bioethanol fuel, which is obtained from sugar cane or similar products since the late 1980s. In the United States, biomass fuels generate more than 9000 MW of electricity. In this country, 4% of total energy is obtained from biomass. The European Union (EU) has set targets for improving itself on biomass energy. The sum of the countries within the EU and those close to the EU in the context of the neighborhood policy constitute 16.8% of the world's biofuels by the end of 2013. The EU members Germany and France are two important states that have increased the production of biofuel energy between 2003 and 2012. Although, Germany and France make up 7% of world biofuel production, biofuel production in these countries decreased in 2013.[68]

1.5.5. The Profile on Solar Energy

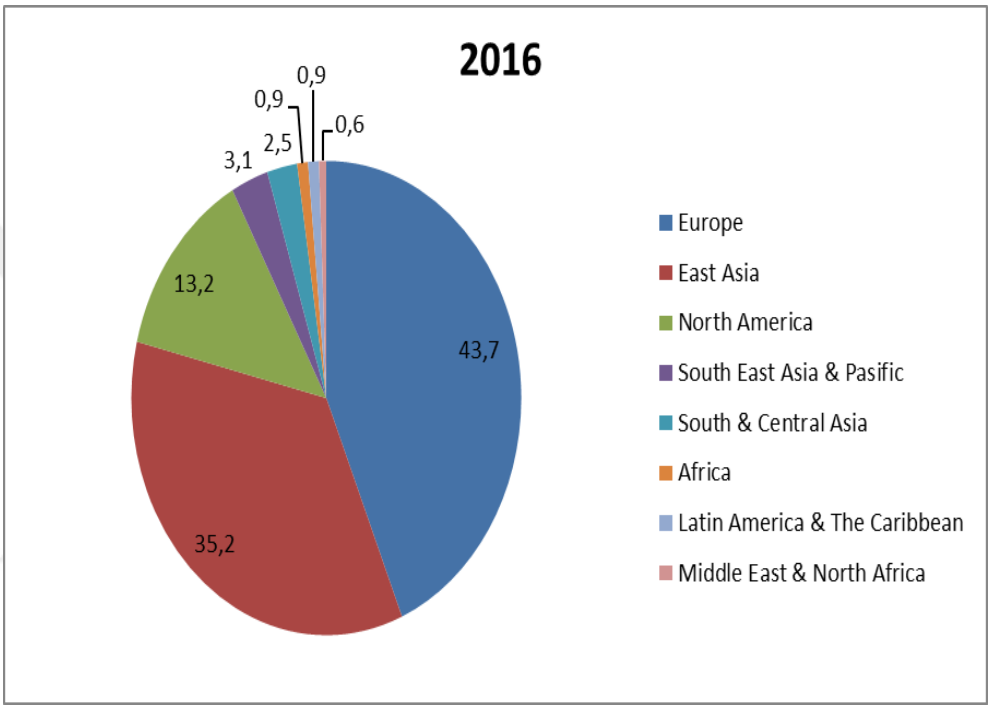
Although, solar energy has a much more potential than other energy resources, adequate technology hasn't been evolved for the solar energy. Major solar energy technology has been developed on four methods: passive and active building heating and cooling systems, photovoltaic electricity generation (PV), concentrated solar energy (CSP) electricity production and solar fuel production. It is aimed to increase productivity and market share of systems with research & development studies.[69]

The work done in the topic of solar energy can be shown as a common example of Europe. According to the guidelines published by the European Parliament (EP), EU member states were asked to set targets for the construction of energy-saving and

[66]Eylem, Ö. & Yarbay, R.Z., (2010). "The Potential and Future of Renewable Energy Sources in Turkey". İstanbul Ticaret University, Journal of Science 18: 89.
[67]Quaschning, V. 2010: 237.
[68]Habitat Derneği, "Temiz Enerji Yayınları: Biyokütle Enerjisi", http://habitatdernegi.org/tr/dl/yayin/TemizEnerjiYayinlari/BiyoKutle.pdf , : 14.
[69]Yılmazer, 2016: 42.

self-generating buildings until 2015. It is emphasized that all public buildings will be such buildings after 2018. It is targeted that this change process will be completed till 2020. It is thought that the application of these systems to the construction sector in the living spaces to increase the productivity will be a right move for developing societies, industrial and agricultural productions due to the increased energy demand created by population growth.[70]

Figure 16: Solar Installed Capacity by Region in 2016 (Mtoe)

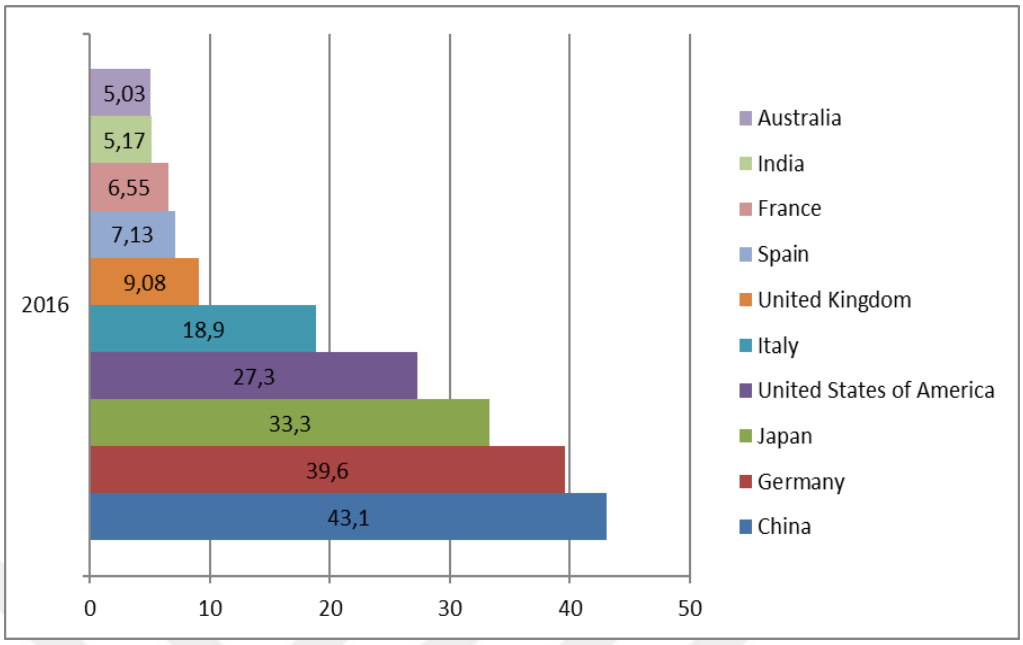


Source: World Energy Council, 2016[71]

According to Figure 16, European Continent is more ascendant than the other continents with 43,7% as part of the solar installed capacity in 2016 data. Afterwards, East Asia is at the second position and it has 35,2% of the total solar installed capacity. East Asia respectively followed by North America, South East Asia & Pacific and South & Central Asia.

[70]Arvizu, D. & Balaya, P., (2011). ‘’IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation -Direct Solar Energy’’, Cambridge: Cambridge University Press:46.
[71]https://www.worldenergy.org/data/resources/resource/solar/ ; accessed January 2017.

Figure 17: Top Solar Installed Capacity by country in 2016 (Gw)



Source: World Energy Council, 2016[72]

In accordance with the Figure 17, China has an ascendancy in the country standings concerning the solar installed capacity among the other countries in 2016. Germany, Japan and USA are respective countries, which follow China in this figure. However, UK, Spain, France, India and Australia have a much lower rate than the other states.

1.5.6. The Profile on Wave Energy

The most potent wave resources occur in the regions, where tough winds moved through long distances. Hence, the most powerful wave resources in Europe occur throughout the western coasts (Atlantic Ocean).[73] According to US Department of Energy, the potential of wave energy in coastal regions can generate about 2-3 million megawatts of energy. The western coasts of Scotland, northern Canada, Southern Africa, Australia, northeast and northwestern coasts of USA are abundant places due to its wave energy.[74]

[72] https://www.worldenergy.org/data/resources/resource/solar/ ; accessed January 2017.
[73] The European Marine Energy Centre, http://www.emec.org.uk/marine-energy/ ; accessed January 2017.
[74] Çabuk, S.Ö., (2011). ''The Evaluation of the Role of Economic Instruments fort he Reduction of the Greenhouse Gas Emissions that Cause Global Warming: Energy Sector Example''. Unpublished Doctorate Thesis. Ankara University, Institute of Social Sciences, Department of Political Science and Public Administration (Urban and Environmental Science), Ankara: 200.

Table 10: Potential of Wave Energy According to Region

Region	**Wave Energy TWh/yr**
Asia	6.200
Australia, New Zealand and Pacific Islands	5.600
South America	4.600
North America and Greenland	4.000
Africa	3.500
Western and Northern Europe	2.800
Central America	1.500
Mediterranean Sea and Atlantic Archipelagos (Azores, Cape Verde, Canaries)	1.300
TOTAL	**29.500**

Source: World Energy Council, 2016

CHAPTER TWO

2. THE KYOTO PROTOCOL, ITS SIGNIFICANCE AND IT CORRELATION TO ENVIRONMENTAL ISSUES

2.1. The United Nations Climate Change Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change entered in force on March 21, 1994. The UNFCCC was named "Rio Conventions" because of its emergence at the 1992 Rio Summit.[75] United Nations Framework Convention on Climate Change aimed combating climate change and keeping greenhouse gas emissions at 1990 level till 2000. Nevertheless, it has been understood that the contract is inadequate since there is no global decline in greenhouse gas emissions. Countries have expressed the view that the contract does not have sufficient obligations to reduce greenhouse gas emissions.[76]

2.2. The Kyoto Protocol

The Kyoto Protocol is an international agreement under the UNFCCC. The Kyoto protocol entered in force as an Annex to the UNFCCC. The international concern about climate change have initiated the Kyoto Protocol negotiations process in December 1997. This negotiation process was ratified in 16 March 1998. It was accepted in the 7th Conference of the Parties in Marrakech, Morocco in 2001. After Russian Federation approved this treaty in November 2004 and so entered in force on February 16, 2005. There are two conditions for the contract to render the validity. First condition, at least 55 states must become the party to the Protocol. Second

[75]Özüt, G.H., (2010). 'Post Kyoto Protocol Period at International Climate Change Negotiations and Local Governments''. Unpublished Master's Thesis. Ankara University, Institute of Social Sciences, Department of Social Environmental Sciences, Ankara: 54.

[76]Eren, İ., (2012). ''Global Climate Protection of the Work Under the Kyoto Protocol and Role of the Local Government Studies Role''. Unpublished Master's Thesis. Adnan Menderes University, Institute of Social Sciences, Department of Finance, Aydın: 16.

condition party states are supposed to create 55% of the total world emissions.[77] The Kyoto Protocol includes the legal obligations that identify activities to reduce the greenhouse gas after 2000. Since the Kyoto Protocol includes stricter sanctions and mechanisms than the UNFCCC, it has been excluded from the Protocol and has a precise mastery over these aspects.[78]

The countries, which become a party to the UNFCCC are also a party to the Kyoto Protocol. There is a condition of becoming the party to the UNFCCC to become in the party of Kyoto Protocol. Countries, which joined as observers to UNFCCC are not under the obligation of becoming a party.[79] Currently, there are 192 parties to both Kyoto Protocol and the UNFCCC. However, Kyoto Protocol and UNFCCC contain 191 States and 1 regional economic integration organization.[80]

The position of United States is different. US is a party to the UNFCCC. However, it declared that it would not ratify the Kyoto Protocol in the beginning. Then, the Protocol was approved by US president. When the senate of United States didn't approve this important protocol, it is still considered as unapproved. Afghanistan, Andorra, Brunei, Chad, Palestine, Iraq, Democratic Republic of Sahara Arab San Marino, Somali, Taiwan, Vatican Countries have not made any declaration or commitment about the issue of becoming a party to the protocol.[81]

Table 11: List of Annex-I of UNFCCC

Germany	US	European Community	Australia
Austria	Belgium	Belarus*	Bulgaria*
Czech Republic*	Denmark	Estonia*	Finland
France	England and Northern Ireland	Netherlands	Ireland
Spain	Sweden	Switzerland	Italy
Iceland	Japan	Latvia*	Lithuania*

[77]Uzoğlu, Y., (2016). ''The Role of the United Nations about Kyoto Period: Economic Analysis of Environmental Impacts of Carbon Trading''. Unpublished Master's Thesis. Çankırı Karatekin University, Institute of Social Sciences, Department of Economics, Çankırı: 24.
[78]Eren, 2012: 17.
[79]Eren, 2012: 17.
[80]United Nations Framework Convention on Climate Change, http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php ; accessed January 2017.

[81]Eren, 2012: 17.

Table 11 Continued

Luxembourg	Canada	Hungary*	Norway
Poland*	Portugal	Romania*	Russian Federation*
Turkey	Ukraine*	New Zealand	Greece
Croatia*	Liechtenstein	Monaco	Slovakia*
Slovenia*			

Countries in Transition Process to Market Economy (*)

The obligations of Annex-I countries have precisely been stated in 4. provision of article 2 (a) of the UNFCCC. The obligations of ANNEX-I countries are limiting greenhouse gas emissions and formulating national policies to reduce climate change.[82]

China, India, Pakistan, Mexico and Brazil are presented in Annex-I as non-party countries that do not have obligations. These are mostly the developing countries. These countries have been defined in terms of agreement as small island states, coastal countries with lower altitude, countries under drought risk, countries prone to natural disasters, economies largely fossil fuel-linked countries. Financial resources and technology transfer are needed to take an action against the harmful effects of climate change in these countries.[83]

Table 12: List of Annex-II of UNFCCC

Germany	US	European Community	Australia
Austria	Belgium	United Kingdom of Great Britain and Northern Ireland	Denmark
Finland	France	Netherlands	Ireland
Spain	Sweden	Switzerland	Italy
Iceland	Japan	Luxembourg	Canada
Norway	Portugal	New Zealand	Greece

[82]Uzoğlu, 2016: 20-21.
[83]Eren, 2012: 12.

In accordance with the purposes of the agreement, the obligations of the Annex-II countries are different from Annex-I countries. The obligations of Annex-II countries are providing financial support to developing countries that reduce emissions. At the same time, it generally assists in technology transfers.[84]

Table 13: Annex-B List of Kyoto Protocol

Parties	Emission Reduction and Control Goals
Austria, Belgium, Bulgaria*, Czech Republic, Spain, Latvia*, Denmark, Estonia, European Union, Northern Ireland, Finland, France, Germany, Greece, Switzerland, Ireland, Italy, Lithuania*, Liechtenstein, Luxembourg, Monaco, Portugal, Romania*, Slovakia*, Slovenia*, Sweden, United Kingdom of Great Britain	-8%
US	-7%
Canada, Hungary*, Japan, Poland*	-6%
Croatia*	-5%
New Zealand, Russian Federation*, Ukraine*	0%
Norway	+1%
Australia	+8%
Iceland	+10%
Countries in Transition to Market Economy (*)	

Source: Çabuk, 2011

According to Table 13, New Zealand, Russian Federation and Ukraine are expected to keep emission levels at the same grade. It can be seen that Norway, Australia and Iceland can raise the gas emission levels with 1%, 8% and 10% respectively. The obligation to reduce emissions by 5% and 8% from 1990 to 2012, including those of the European Union, has been determined for many countries that

[84]Eren, 2012: 12.

are Parties to the Protocol. Some countries have been given the opportunity to protect and increase the emission level. The reason of this article is that when the major countries accept Kyoto Protocol, it seems that emission rates might have stayed under the level of year 1990 or over that level.[85]

Table 14: Comparison Between UNFCCC and Kyoto Protocol (KP)

UNFCCC	**KP**
Basic text of all climate negotiations.	Liabilities are just defined for 2008-2012 period. As of 2005, new negotiations will begin for 2012 period later. New alliances would be founded by this goal.
50 countries are adequate for legislation.	55 countries are supposed to become the side for validity. Greenhouse gas emissions of these countries and 55% of greenhouse gas emissions of Annex-I Countries need to surpass.
Greenhouse gases cannot be defined.	Gases, which are aimed to be reduced as part of Protocol, have been determined in the list of Annex-I. (CO2, CH4, N2O, PFCs, HFCs, SF6)
Only main sectors have been determined. (energy, industry, transportation, agriculture, waste, forestation)	Sub sectors, which would be minded as part of the restriction of the emissions, have been pointed out. (Annex-A) Thereby, sub-sectors have been excluded from this list. For instance, emissions, which arise from international civil aviation.
There is only year 2000 as a target for Annex-I Countries.	In the first term (2008-2012), numerical greenhouse gas emission reduction target of each Annex-I Country has been identified in the list of Annex-B.

[85]Uzoğlu, 2016: 26.

Table 14 Continued

Industrialization degree and OECD membership have just been considered for formulation of the lists.	In the end of negotiations, each country that is in Annex-I has identified a different commitment for itself in the list of Annex-B
Sanction force is weak.	Liabilities are toughened for next terms in case the targets don't converge. (such as liability of decreasing gas emission)
Rules of flexibility are valid for certain countries. (transaction economic countries)	All contracting countries can join (CDM, JI, ET) with condition of obeying rules of Kyoto Protocol.
Change which was accepted in conference of contracting countries get approved if countries don't object within 6 months.	Approval documentaries of ¾ of contracting countries are required for ender validity.
İt gets brought to the agenda even if rapport issue is limited.	The rapport issue hasn't been considered excluding creating a fund with revenues of CDM.
Liabilities of the countries, which aren't member of Annex-I are defined.	Excluding Annex-I Countries, it doesn't lay down any liability or right related to the hosting of CDM Projects, get granted to annex-II countries.
It has decision-making and implementation authorities.	In addition, it has a compliance committee concerning sanction force.

Source: Uzoğlu, 2016

2.2.1. Flexibility Mechanisms

The purpose of the flexibility mechanisms, which was defined in the Kyoto Protocol, is to launch greenhouse gas emission reduction resulting from human activities with minimal cost.[86] Unit cost of greenhouse gas emission reduction shows the difference from country to country. Some countries have low unit cost of GHG emission reduction, but some countries have high unit cost of GHG emission.

[86]Çabuk, 2011:71.

Therefore, it is useful to carry out reduction of the emissions in countries where cost is low. Three basic flexibility schemes are given below:[87]

- Clean Development Mechanism (CDM)
- Joint Implementation Mechanism (JIM)
- Emission Trading Mechanism (ETM)

2.2.1.1. Clean Development Mechanism (CDM)

Clean Development Mechanism is defined in article 12 of the Kyoto Protocol. Beginning date of CDM is 2001 year.[88] It aims to contribute to the reduction of greenhouse gases in the context of sustainable development principles of Non-Annex I countries. Parties included in Annex I would obtain a "Certified Emission Reductions" in the outcome of their project activities which will be conducted in Non-Annex I countries to carry out the emission reduction commitment. Non-Annex I parties will benefit from project activities with emission reductions which were approved by this mechanism.[89]

As of November 24, 2008, 1231 projects have been registered and 4200 projects are in development phase. The estimated CER amount is 2.9 billion tons of CO2 equivalent at the end of 2012. Registered 1231 projects are 30.06% from India, 24.94% from China, 11.86% from Brazil and 8.69% is initiated in Mexico countries.[90]

2.2.1.2. Joint Implementation Mechanism (JIM)

Joint Implementation Mechanism is regulated in the sixth article of the Kyoto Protocol. JIM provides activities and feasibilities to reduce emissions between Annex I parties or the elimination of greenhouse gases by sinks. It is essential to be a party to the protocol in order to benefit from the mechanism.[91] According to the JIM, if an Annex I country invests in a project to reduce greenhouse gas emissions that are related to the human resources in another Annex-I country, it will gain emission reduction units (ERU). This reduction is thought to be the emission liability that was set for that

[87]Eren, 2012: 23.
[88]Uzoğlu, 2016: 28.
[89]Çabuk, 2011: 73.
[90]Özüt, 2010: 59.
[91]Eren, 2012: 23.

country. The unit of emission reduction, which was transferred by the Annex I country, will be declined from the country's own surplus reduction.[92]

2.2.1.3. Emission Trading Mechanism (ETM)

The emission trading mechanism has been regulated by article 17 of the Kyoto Protocol. ETM allows emission commerce between Annex I countries. Any Party, which takes part in the list of Annex I may instigate the commercial activities for a part of the emission reduction amount which was identified in Annex B.[93] In other words, if a state has reduced more than its own emission reduction amount, it can sell the remainder to other foreign states. International registration system has been formed in order to launch emission trade reliably between countries. It is mandatory to make the registration in the International Registry system for international transfer credits. The countries are absolutely supposed to obey those fundamental obligations and conditions about this issue. These procedures are carried out by the UNFCCC Secretariat.[94] The most active emission market is the European Union Emission Trading System (EU ETS). Besides, Various emission trade system is found in New Zealand, Norway and specific provinces of USA.[95]

2.2.2. Turkey Being a Party to Kyoto Protocol

In the beginning, Turkey has taken part in the list of both Annex I and Annex II of the UNFCCC. It has declared that it wouldn't become a party to the contract as it is registered in both Annex-I and Annex-II. Because Turkey cannot fulfill its obligations and specifications within this process because it is registered on both lists.[96] Turkey is in the developing country status in terms of basic indicators. Therefore, Turkey hasn't become a party to the UNFCCC. The reason is that in case Turkey takes part in both sides, the commitments will be far tougher according to itself and predicting that it will be affected in terms of the development and expansion in an adverse way.[97] Turkey is among the developed countries as part of Convention, but it hasn't become a party to Convention. The reason of this affair is that Turkey will not be able to fulfill its obligations to keep CO2 emissions, which are obligations of

[92]Çabuk, 2011: 73.
[93]Çabuk, 2011: 72.
[94]Uzoğlu, 2016: 29.
[95]Özüt, 2010: 59-60.
[96]Karakaya, E., (2009). "Capacity Evaluation of Turkey Under Rio Conventions Project''. United Nations Framework Convention on Climate Change Thematic Report:6.
[97]Eren, 2012: 26.

developed countries at 1990 levels until 2000.[98] Special conditions for Turkey were recognized in COP in Marrakech in 2001. The name of Turkey will remain in Annex-I, but decision, which was made for the name of Turkey in the convention, will be abolished from Annex-II. Thus, it became a party to Convention on 24 May 2004 as the 189th country.[99]

Obligations, which were predicted in Kyoto Protocol between 2008-2012, obligations of Annex-B countries are not binding for Turkey. The obligations that will be predicted after 2012 will be determined at COP 15 and binding for it.[100]

2.2.2.1. Advantages of Being a Party to Kyoto Protocol for Turkey

There are some advantages of being a party to Kyoto Protocol for Turkey.[101]

- Turkey will gain an image of a respectable and environmentally sensitive country in the international area. Also, it totally contributes to the promotion and publicity of Turkey.
- Turkey will be able to defend its interests in the international area regarding climate change.
- Additionally, it has enabled the low-carbon and high-efficiency technological products of Turkey to develop with the technical capacity.
- Turkey has low share in global scale in terms of the responsibility of greenhouse gas emissions.
- Turkey has low per capita greenhouse gas emissions.
- Turkey has a high potential of limiting greenhouse gas emissions with energy efficiency applications and effective usage of existing renewable energy resources.
- Turkey is an abundant country in terms of its renewable energy resources.
- Turkey has high energy saving potential.
- Turkey has vast feasibilities in the renewable energy resources.
- Sensitivity associated with climate change has occurred in society.

[98]Türkeş et al., (2010). "Flexibility Mechanisms Under the Kyoto Protocol)". Tesisat Journal, 52: 84-100.
[99]Karakaya, 2009: 6.
[100]Eren, 2012: 27.
[101]Eren, 2012: 29-30.

2.2.2.2. Disadvantages of Being a Party to the Kyoto Protocol for Turkey

There are some disadvantages of being a party to Kyoto Protocol for Turkey.[102]

- Turkey couldn't create inadequate infrastructure or compulsory legislation as part of Kyoto Protocol.
- Population growth rate of Turkey is high.
- Fossil fuel-based energy usage is widespread in Turkey.
- The systems that will provide renewable energy production and utilization are not sufficient and widespread in Turkey.
- Inadequate government support and incentives for businesses in order to increase their environmental compliance capacities.
- High energy input costs in various industries.
- Environmental protection expenditures are low.
- Environmental financial policies are inadequate in Turkey.
- Turkey doesn't have an obvious energy plan (except for development plans).

2.3. Climate Change and Environmental Impacts

Climate has important effects on life and earth. Climate is indispensable for health, food production, economy, people and country welfare.[103] Nowadays, the climate change is accepted as the considerable global problem on the world.[104] The production rate also increases with the developing trade. However, the consumption rate also scales up in terms of the classes in the same level. This leads to demand beyond production. Thus, balance between production and consumption is steadily increasing. Furthermore, the volatility can entirely be observed in the rates of these activities.[105]

Fossil fuels have negative influences on the climate change, global warming and environment. Fossil fuels spread the greenhouse gas (GHG) emissions to the ozone layer.[106] Water vapor (H2O), carbon dioxide (CO2), methane (CH4), dinitrogen monoxide (N2O) and ozone (O3) are greenhouse gases which are naturally in the atmosphere. However, these gases rise owing to diverse human activities and this rise

[102]Eren, 2012: 31-32.
[103]Uzoğlu, 2016: 6.
[104]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/tr-TR/Sayfalar/Iklim-Degisikligi-ve-Uluslararasi-Muzakereler ; accessed January 2017.
[105]Yılmazer, 2016: 36
[106]Erdoğan, 2014: 12-13.

affect the global warming and climate change in a negative way. Hence, it intercepts the expansion of the environmental possibilities and opportunities.[107]

For instance; temperature will rise 0,3°C within a decade.[108] If precautions are not taken with purpose of mitigating GHG emissions, it is predicted that the temperature will increase by more than 5,8° C within the next 100 years. At the same time, in many parts of the world, millions of people will face with problems such as hunger, malaria, floods and lack of fresh water because of climate change.[109]

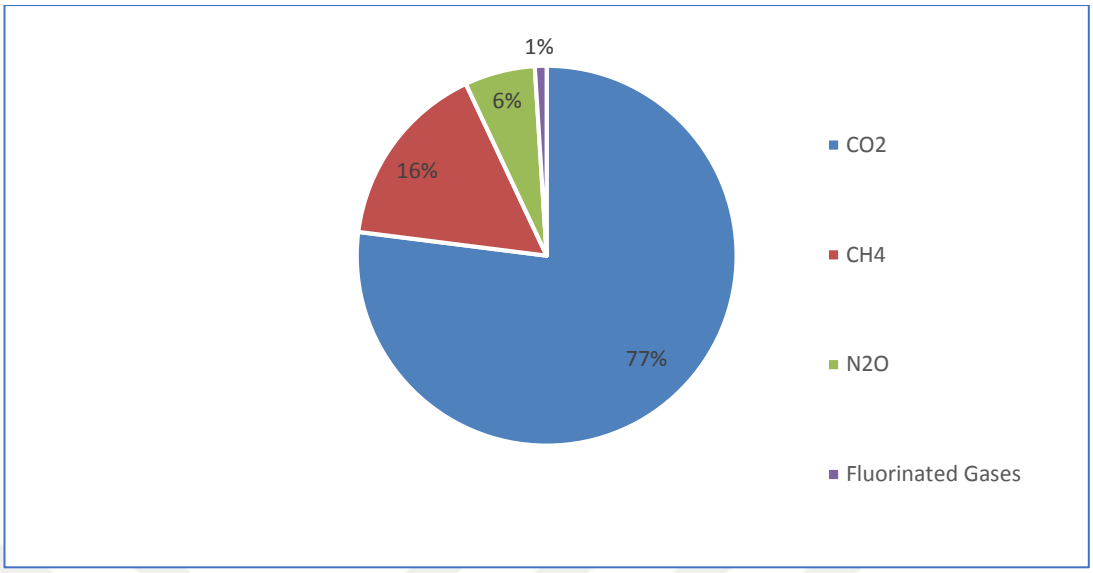
Many scientific studies have shown that overall CO2 levels have increased by 31% over the last 200 years. Methane gas which is liable for ozone layer depletion has more than doubled since 1800.[110]

The level of sea water is estimated to have increased by 17 centimeters during the 20th century. In addition, it is expected that the level of sea water will raise by 18-59 cm until the end of the 21st century. The rise in sea level will bring significant impacts on low-altitude coastal communities. For Instance, in Bangladesh a 1-meter rise in sea level would cause 17% of the country to be under water. Besides, Nederland and United States are under the risk about this subject. Especially, 54% of population in the close places of United States to Ocean are under a big danger.[111]

In many Asian countries, rain, warming changes, violent storms, climate diversities, drought would lower the agricultural productivity because climate is the determinant of agricultural productivity. Climate change affect hydrologic balances, botanical and livestock production, input variances, other components of the agricultural productivity. In this case, food production will decline. Subsistence and nourishment will exacerbate, food costs and prices will increase. These will cause many other problems in socio-economic, biologic zone. The negative impact of climate change on biodiversity, ecosystem, species and genetic diversity are indisputable. By affecting the cycle of life, it will lead to deterioration of genetic structures over time. A 1,5-2,5°C increment in worldwide mean temperature can cause about 20-30% of plant and animal species to be destroyed.[112]

[107]Uzoğlu, 2016: 7.
[108]Erdoğan, 2014: 13.
[109]Yılmazer, 2016: 37.
[110]Panwar, Kaushik, & Kothari, 2010: 1513–1524.
[111]Uzoğlu, 2016: 13-14.
[112]Uzoğlu, 2016: 15.

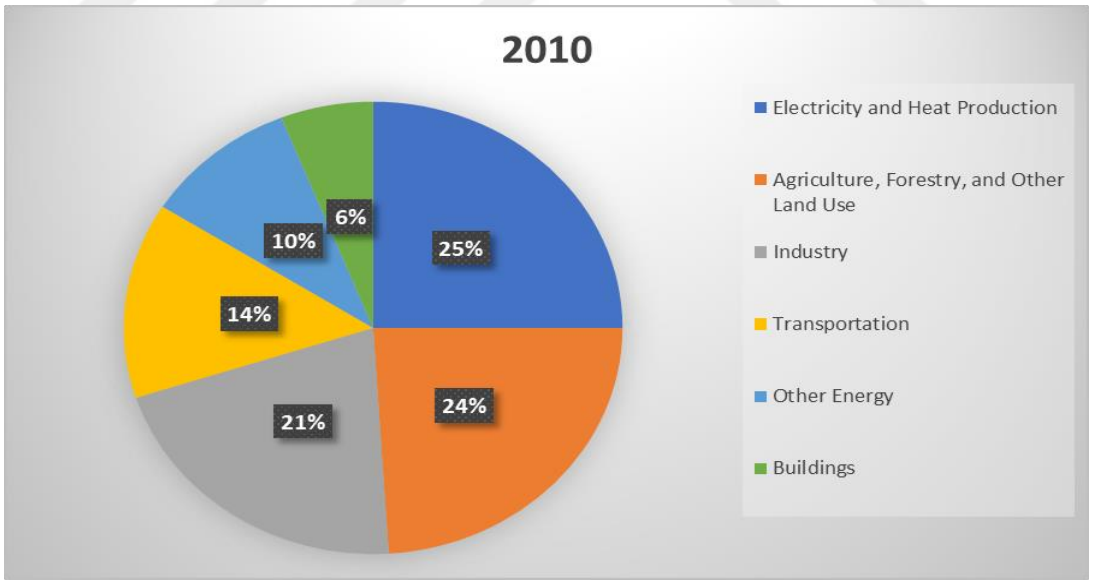
Figure 18: Greenhouse Gas Emissions (CO2 Equivalent) 1990-2013



Source: Uzoğlu, 2016

According to the Figure 18, 77% of the greenhouse gases are CO2. It follows respectively CH4, N2O and Fluorinated gases with 16%, 6% and 1%.

Figure 19: Global Greenhouse Gases Emissions by Economic Sectors



Source: United States Environmental Protection Agency, 2010[113]

[113] https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data ; accessed January 2017.

According to Figure 19, electricity and heat production have highest rate about the global greenhouse gases emissions. Agriculture, forestry and other land usage have 24% as part of the global gases emissions. The industry, transportation, other energy and buildings follow respectively 21%, 14%, 10%, 6% in accordance with 2010 data.

CHAPTER THREE

3. ENERGY ECONOMICS, ECONOMIC DEVELOPMENT & ENERGY ISSUES ON TURKEY

3.1. Energy Economics & Economic Development

People need energy to meet basic needs and sustain their life. The main reason of this topic is that energy is an indispensable resource for humanity. Furthermore, energy is one of the fundamental inputs of economic and social development. On the other hand, the determinative role of energy on the world and humanity keeps raising day by day.[114] The energy industry has a vast relationship with economy. So, that it is required to evaluate energy economy as well as the economy of country. Most of the states have considered activities about this subject. In the aftermath of all these advancements, it has revealed an energy economy which needs to regulate the stipulations, resource, production, consumption and energy affairs of the economy. The energy economy is the result of scientific and technological developments and a meeting field that geopolitical forces, growth strategies, policies, and environmental factors. At the same time, it is a science that undertakes the relationship concerning the economic activities and analyzes the existence of energy resources. Besides, energy economy is a wide scientific issue which contains the energy usage and supply in the society.[115] There are various earnings and costs in the production and consumption of energy. Energy is an important input for goods and service feasibilities. Also, it is a significant input in consumption as well.[116]

The energy economics has some purposes. The first purpose of energy economics is to provide the balance between national energy resources and consumption about national economy appropriately. After 1970s, the energy economy

[114]Biçici, R., (2008). ‘’The Energy Economics of Turkey’’. Unpublished Master’s Thesis. Zonguldak Karaelmas University, Institute of Social Sciences, Department of Economics. Zonguldak: 18.
[115]Aksöz, 2014: 10.
[116]Biçici, 2008: 19.

has begun to grow. The second purpose of energy economics is related to the development of theoretical framework in energy field, providing energy balance, creating reasons and strategies which are associated with imbalance, following of energy market actors and making the analysis of strategies.[117]

3.2. Energy Consumption and Economic Growth

Mechanization with the industrial revolution and speed of the industry has increased energy demand of countries. The countries need to use more energy by making more production for development is required. Energy is the basic input of production for the actualization of social and economic development.[118] Because of the energy crises of the 1970s and especially the rises in oil prices, the economic growths of developing countries have been adversely affected. The energy consumption and economic growth have been extensively examined as of the end of 1970s. Different outcomes have been obtained at different times in both different countries and similar countries.[119]

There is a bilateral relationship between energy and economic growth. Economic growth increases energy consumption. At the same time, energy consumption also affects economic growth. For Instance, 5 cents of electricity which is used by the industry generates for 1$ added value to country's economy. 5 cents of electricity that cannot be given to the industry is the loss of 1$. In recent years, difficulties and price increases which occur in energy assurance have drawn attention over the second stage of economic growth and energy relations. There are two remarks on this subject. In first remark, increase in energy consumption supports economic growth. In second remark, rise in energy consumption restricts economic growth. According to first remark, energy makes investments more efficient, raises the productivity of the labor force. The replacement of the energy with other production inputs is not possible in the short term. When the total output of the economy increases, the usage of energy will also have to increase. If the energy canal is cut off, the growth rate will be decreased.[120]

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[117]Aksöz, 2014: 11.
[118] Yanar, R. & Kerimoğlu, G., (2011). ‘’Energy Consumption, Economic Growth and Current Account Deficit Relations in Turkey’’. Journal of Economics 3: 193.
[119]Aydın, F.F., (2010). ‘’Energy Consumption ve Economic Growth’’. Erciyes University, Journal of Economics and Administrative Sciences 35: 32.
[120]Aydın, 2010: 326.

In their work, Zhang and Cheng (2009) examined China's causal relationship between economic growth, energy consumption and carbon dioxide emissions. The variables involved in the study are real gross domestic product, gross fixed capital formation, energy consumption, carbon dioxide emissions and the city population. TY (Toda-Yamamoto) procedure was used for the Granger causality test. The results indicate that there is a one-way causality from real GDP to energy consumption.[121]

The study of Apergis and Payne (2010) examined the relationship between renewable energy consumption and economic growth for 20 OECD members. Countries in the study are Australia, Austria, Belgium, Canada, Denmark, France, Germany, Iceland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and US. The variables used are real GDP, real gross fixed capital formation, labor force and renewable energy consumption for the period 1985-2005. Tests proposed by Pedroni for cointegration were applied. Accordingly, the panel rejected the null hypothesis that the other 6 tests, other than the ADF, did not involve cointegration at the 1%. Then FMOLS technique was applied for heterogeneous co-integrated panels. According to the results, if renewable energy consumption increases by 1%, real GDP will increase by 0.76%. In addition, a 1% increase in gross fixed capital formation would cause a 0.24% increase in real GDP. A panel VECM was estimated to apply the Granger causality test. According to the test results, short and long-run Granger causality tests revealed a positive bidirectional causality relationship between renewable energy consumption and economic growth. This bidirectional causality emphasizes the importance of renewable energies for OECD countries.[122]

Narayan and Smyth (2008) tested the relationship between energy consumption and economic growth. Narayan and Smyth used the data of 1972 - 2002 period in their studies. This study covers g7 countries. The variables used in this study are real GDP per capita, energy consumption per person and gross fixed capital formation per capita. Granger causality test was conducted, it is seen that the causality of real GDP from energy consumption and gross fixed capital formation is at 1% level of significance according to the results. At the 1% and 10% significance levels, a short-run causality

[121]Zhang, X.P. & Cheng, X.M., (2009). ‘’Energy Consumption, Carbon Emissions, and Economic Growth in China’’. Ecological Economics 68(10): 2706 – 2712.
[122]Apergis N, Payne J.E., (2010). ‘’Renewable energy consumption and economic growth: Evidence from a panel of OECD countries’’. Energy Policy 38(1): 656 – 660.

from capital and energy consumption to real GDP was found. There is also a short-termed Granger causality arising from real GDP at 5% significance level. Later, the long-run elasticities of energy consumption and capital's effect on real GDP have been examined. OLS, FMOLS and DOLS techniques were used for this. The results are similar for all three techniques. According to the results, energy consumption and capital have a positive effect on real GDP. The results show that real GDP will increase by 0.12 - 0.39% when energy consumption is increased by 1%, and a 1% increase in capital will cause a 0.1 - 0.28% increase in real GDP. The findings of this study show that energy consumption is a fundamental factor affecting economic growth.[123]

In the study by Mehrara (2007), examined the relationship between GDP and energy consumption for 11 oil exporters using developed panel cointegration technique by Pedroni. The countries including this study are Iran, Kuwait, Saudi Arabia, United Arab Emirates, Bahrain, Oman, Algeria, Nigeria, Mexico, Venezuela and Ecuador. The variables used are real GDP per capita and energy consumption per capita for the period 1971 – 2002. As a result, it has been concluded that these two variables are cointegrated in the long run. Accordingly, the effect of energy on GDP in both short and long terms is neutral. There is a one-way causality that runs in the short and long run from GDP to energy consumption.[124]

Lise and Montfort (2007) tested the relationship between energy consumption and GDP. Lise and Montfort used the 1970-2003 period data in their studies. According to the cointegration and vector error correction model results, variables were detected to move together in the long run. Besides, the results show that its causality is from GDP to energy consumption.[125]

In the Ouedraogo (2013) study, GDP, per capita energy consumption, per capita electricity consumption and energy prices is used as variables. Ouedraogo aims to explain the causality relationship between variables in this study. Ouedraogo used members of the Economic Community of 15 West African Countries in this study. The data used in the study covers 1980-2008. The long-term causality relationship between

[123]Narayan, P.K. & Smyth, R., (2008). ‘’Energy Consumption and real GDP in G7 countries: New evidence from panel cointegration with structural breaks’’ 30(5): 2331 – 2341.
[124]Mehrara, M., (2007). ‘’Energy Consumption and Economic Growth: The Case of Oil Exporting Countries’’. Univesity of Tahran, Faculty of Economics. Tahran: Energy Policy 35(5): 2939-2945.
[125]Lise, W. & Montfort, K.V., (2007). “Energy Consumption and GDP in Turkey: Is There A Co-Integration Relationship?”, Energy Economics, 29(6), 1166-1178.

energy consumption and GDP has been examined by panel cointegration techniques developed by Pedroni. The hypothesis that there is no cointegration according to test results is at 1% level. In addition to the Pedroni test, two cointegration tests were applied. These are the Kao test based on the two-stage Engle-Granger procedure. According to the results of this test, the zero hypothesis that there is no cointegration for both energy demand and electricity demand functions is 10% and 5%. Finally, the Johansen approach was used for the cointegration analysis of GDP, energy consumption and energy prices and between GDP, electricity consumption and energy prices. There is a panel cointegration between the three variables for the two models according to the results. The all study shows that energy consumption increases the real GDP by 0.11% in the energy model and by 0.25% in the electricity model. These results suggest that an increase in energy and electricity consumption has a statistically positive effect on per capita GDP. This effect has increased when the price change is added to the account. Accordingly, a 1% increase in per capita energy consumption leads to a 0.22% increase in real GDP. A 1% increase in per capita electricity consumption leads to an increase of 0.27% in real GDP. Granger test was preferred for causality between variables. The relationship between short-term energy consumption and economic growth is qualified by one-way causality from real GDP to energy consumption. In the long term there is a causality from energy consumption to GDP.[126]

Energy dependency causes problems between energy supply and demand in developing countries. Economic activities and energy consumption quantities are affected as a result of the imbalance between energy supply and demand. Energy consumption has been increasing which is one of the basic inputs of activities in developing countries in parallel with economic growth. Therefore, it can be said that the problem that may arise in energy supply may affect the economic growth process negatively. Turkey is a developing country which is dependent on abroad energy. This issue is extremely important for Turkey because it imports large part of its energy from abroad.[127]

[126]Ouedraogo, N.S., (2013). ‘’Energy consumption and economic growth: Evidence from the economic community of West African States (ECOWAS)’’. Energy Economics 36: 637 – 647.
[127]Kapusuzoğlu, A. & Karan, M. B., (2010). ‘’ An Analysis of the Co-integration and Causality Relationship between Electricity Consumption and Gross Domestic Product (GDP) in the Developing Countries: An Empirical Study of Turkey’’. Business and Economics Research Journal. Vol 1, No: 2. p.60.

Table 15: Energy Consumption Quantities, Economic Growth Rates and Gross Domestic Product of Countries in 2017

Country	Energy Consumption Quantities (Mtoe)	Economic Growth Rates	GDP (millions of $)
China	3,123	6,8%	11.199,145
United States	2,204	2,2%	18.624,475
India	884	6,7%	2.263,792
Russia	692	1,8%	1.283,163
Japan	437	1,5%	4.940,159
Germany	311	2%	3.477,796
Brazil	289	0,7%	1.796,187
South Korea	288	3%	1.411,246
Canada	273	3%	1.529,760
Iran	248	3,5%	418,977
Turkey	139	5,1%	863,712

Source: EnerData Global Energy Statistical Yearbook 2017; International Monetary Fund & The World Bank[128]

3.3. Energy Trade, Current Account Balance Issues & Turkey

The energy issue has taken its place as well as fundamental macroeconomic problems such as balance of payments deficit, unjust income distribution, price instabilities, unemployment that all countries face after 1970s all over the world. The energy issue is directly or indirectly related to many basic macroeconomic problems. Energy issues cover characteristics which are multidimensional because of developments such as dependency, security, protection of the environment, unjust

[128] https://yearbook.enerdata.net/total-energy/world-consumption-statistics.html
http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD
http://databank.worldbank.org/data/download/GDP.pdf

income distribution, sustainable growth, stable expansion, balance of payments, social welfare, global warming.[129]

With the impact of globalization and industrialization, energy demand has increased in a rapid way in the whole world, but energy supply has increased slowly. The unfair energy access is the main reason for the energy dependence of multiple countries. Energy dependence is not only a problem that Turkey faces. It is a problem that all developed and developing countries face.[130]

Due to structural problems, energy dependency of Turkey creates an issue. As a matter of fact that population rise, internal emigration, unplanned urbanization, and monopolies experienced in the world energy market have scaled up the need for energy. However, insufficient usage in primary energy resource consumption, energy diversity and per capita energy consumption are low, but energy usage severity is high. Therefore, it causes the energy as a problem in Turkey.[131]

Industry sector had been revitalized and using machines became widespread in Turkey after 1980s. As a result, the energy demand of Turkey has increased.[132] However, Turkey is a country which imports a large part of the energy that it needs. A large part of electricity energy that Turkey mostly uses due to dependency to abroad obtains from oil and natural gas. Turkey needs energy to initiate its economic development and growth. However, it needs to carry out production activities for growth and while it is carrying out this production, it needs energy. The energy problem poses another handicap concerning the current account deficit which is an important problem of Turkey.[133]

[129]Aksöz, 2014: 82.
[130]Tüfekci, S., (2012). ‘’The Economy Politics for the Energy- Oriented Power Struggle Maintained in Eurasian Region: Turkey's Role and Her Importance’’. Unpublished Doctorate Thesis. Marmara University, Institute of Social Sciences. İstanbul: 159.
[131]Bilginoğlu, M.A. & Dumrul, C., (2012). ‘’A Co – Integration Analysis on the Energy Dependency of the Turkish Economy’’. Journal of Yasar University, 26(7): 4396-4397.
[132]Uysal, D., Yılmaz, K. Ç. & Taş, T., (2015). ‘’The Relationship Between Energy Import and Current Account Deficit: The Case of Turkey’’. Muş Alparslan University, Journal of Social Sciences.3(1): 65.
[133]Aksöz, 2014: 95.

Table 16: Energy Import and Export Values of Turkey between 2000-2015 (thousand $)

Years	Energy Import	Energy Export
2000	9.540.584	329.313
2001	8.339.366	444.700
2002	9.203.888	691.543
2003	11.575.069	980.133
2004	14.407.288	1.429.186
2005	21.255.586	2.641.145
2006	28.859.098	3.567.425
2007	33.883.135	5.147.932
2008	48.281.193	7.531.776
2009	29.905.305	3.921.300
2010	38.497.229	4.469.479
2011	54.117.539	6.539.030
2012	60.117.407	7.708.169
2013	55.917.155	6.724.654
2014	54.889.415	6.111.840
2015	37.842.990	4.519.941

Source: Selvi, 2017

According to table 16, Turkey's external dependency on energy has seriously increased. The Energy imports of Turkey scaled up continuously till 2008. There has been a serious decline in energy imports between 2008-2009. This number has lowered to 29.905.305$ in 2009. Then, there has been a continuous rise in Turkey's energy imports. Energy imports reached to 60.117.407$ in 2012 and set up the record. Energy exports are always in low level compared to energy imports. Energy export reached to 7.708.169$ in 2012 and beaten the record.

Table 17: Energy Import and Current Deficit (Billion $ and %)

Years	Energy Import (Billion $)	Total Import (Billion $)	Share in Total Import of Energy Import (%)	Current Account Balance (Billion $)	Balance of Foreign Trade (Billion $)
2000	9.54	54.50	17.50	-9.92	-26.72
2001	8.33	41.39	19.5	3.76	-10.06
2002	9.2	51.55	17.85	-6.62	-15.49
2003	11.57	69.33	16.69	-7.55	-22.08
2004	14.4	97.53	14.76	-14.19	-34.37
2005	21.25	116.77	18.20	-21.44	-43.29
2006	28.85	139.57	20.67	-31.83	-54.04
2007	33.88	170.06	19.92	-37.77	-62.79
2008	48.28	201.96	23.9	-40.19	-69.93
2009	29.9	140.92	21.21	-12.01	-38.78
2010	38.49	185.54	20.74	-45.31	-71.66
2011	54.11	240.84	22.47	-75.05	-105.93
2012	60.11	236.54	25.41	-48.49	-84.08
2013	55.91	251.66	22.22	-65.03	-99.85
2014	54.9	242.17	22.66	-43.6	-84.56
2015	37.8	207.23	18.24	-32.1	-63.39
2016	27.2	198.61	13.69	-32.6	-56.05

Source: Uysal, Yılmaz & Taş, 2015; Turkish Statistical Institute, 2017[134]

Table 17 has shown energy import, total import, share in total import of energy import, current account balance, balance of foreign trade from 2000 to the 2016 in Turkey. With respect to the deduction of this table, Turkey has become increasingly dependent on energy imports. As an increase was evident in total import, energy import also raised rapidly. The ratio of energy imports is in total imports roughly 17.5% in 2000 but this rate has risen gradually from previous years to nowadays. It is 19.92% in 2001. However, decline is identified from 2002 to 2004. In 2012, share in

[134] http://www.tuik.gov.tr/PreHaberBultenleri.do?id=24822

total import of energy import has 25.41% and set up the record. Share in total import of energy imports has started to decline. It reached the lowest level in 2016. When it gets revised at the current account balance from 2000 to recent years, current deficit was 9.92 billion of dollars in Turkey in 2000. The only year that the current deficit was not realized in 2001. Then, a significant increase in the current deficit has been observed since 2004. A significant decrease in the current deficit has been observed in 2009 and then in 2011, the current deficit has reached 75 billion dollars and set up the record.

Table 18: Population, Economy and Energy

Years	Populations (000s)	GNP/capita	Total Gross National Product	Total Energy Demand(Mtoe)	Energy/capita(Kep)	Energy Density
1973	38,072	1994	75.915,568	24.6	646	81
1990	56,098	2674	150.006,052	53.7	957	50
1995	62,171	2861	177.871,231	64.6	1,039	44
2000	67,618	3303	223.342,254	82.6	1,218	40
2010	78,459	5366	421.010,994	153.9	1,962	35
2020	87,759	9261	812.736,099	282.2	3,216	33

Source: Temiz & Gökmen, 2010

When the table 18 was reviewed, there is a self-evident rise in accordance with the years in the population and energy demand of Turkey. Hence, the GNP/Capita, Total GNP and Total Energy Demand have a swift increase step by step.

3.4. Energy Consumption & Energy Profile in the Republic of Turkey

In 2010, Aydın carried out two studies to explain the relationship of economic growth and energy consumption in Turkey. These studies are Quarterly data for the period 1996Q1-2004Q4 and 1980-2004 annual data. Regression model used in the study and Aydın found that there was a positive relationship between energy consumption and economic growth during the mentioned periods. For this reason, a

1% increase in energy consumption leads to an increase of 1.03% in economic growth.[135]

In 2009, Mucuk and Uysal conducted the study to point out the relationship between energy consumption and economic growth in Turkey. Study includes 1960-2006 period. As part of this study, they used cointegration and Granger causality tests. Because of the study, it has been determined that the direction of cause was from energy consumption to economic growth.[136]

Table 19: Distribution of Net Electricity Consumption by Sectors in Turkey

Year	Total (GWh)	Household	Commercial	Government	Industrial	Illumination	Other
1975	13.492	17,5	4,9	3,7	64,8	1,9	7,2
1985	29.709	19	5,5	3,0	66,0	1,4	5,1
1995	67.394	21,5	6,2	4,5	56,4	4,6	6,8
2005	130.263	23,7	14,2	3,6	47,8	3,2	7,5
2015	217.312	22,0	19,1	3,7	47,6	1,9	5,7

Source: Turkish Statistical Institute, 2017[137]

It is evident in Table 19, as it was 13.492 total (GWh) in 1975, this figure reached to 217.312 in 2015. There are no more changes in the government and the other activities according to the years. The largest change is the industrial sector and it keeps declining rapidly due to lack of reserves and no investments. As for the illumination, there is only a wide change in 1995. Excluding 1995, no any change in the illumination. In the commercial sector, it gained a great rise and stability owing to the export potentialities and feasibilities because the massive investment projects have been spearheaded in the recent years in Turkey in the commercial area.

[135]Aydın, 2010: 332.
[136]Mucuk, M. & Uysal, D., (2009). ''Energy Consumption and Economic Growth in Turkish Economy''. Journal of Finance. 157: 105-115.
[137]http://www.turkstat.gov.tr/UstMenu.do?metod=temelist ; accessed January 2017.

Table 20: Past, Present and Future Total Final Energy Production in Turkey (Mtoe)

Energy Resources	1990	2000	2005	2010	2020	2030
Coal and Lignite	12.41	13.29	20.69	26.15	32.36	35.13
Oil	3.61	2.73	1.66	1.13	0.49	0.17
Gas	0.18	0.53	0.16	0.17	0.14	0.10
Com. Renewables and Wastes	7.21	6.56	5.33	4.42	3.93	3.75
Nuclear	-	-	-	-	7.30	14.60
Hydropower	1.99	2.66	4.16	5.34	10.00	10.00
Geothermal	0.43	0.68	0.70	0.98	1.71	3.64
Solar/Wind/Other	0.03	0.27	0.22	1.05	2.27	4.28
Total Production	25.86	26.71	34.12	39.22	58.20	71.68

Source: Temiz & Gökmen, 2010

Table 21: Past, Present and Future Total Final Energy Consumption in Turkey (Mtoe)

Energy Resources	1990	2000	2005	2010	2020	2030
Coal and Lignite	16.94	23.32	35.46	39.70	107.57	198.34
Oil	23.61	31.08	40.01	51.17	71.89	102.38
Gas	2.86	12.63	42.21	49.58	74.51	126.25
Com. Renewables and Wastes	7.21	6.56	5.33	4.42	3.93	3.75
Nuclear	-	-	-	-	7.30	14.60
Hydropower	1.99	2.66	4.16	5.34	10.00	10.00
Geothermal	0.43	0.68	1.89	0.97	1.71	3.64
Solar/Wind/Other	0.03	0.27	0.22	1.05	2.27	4.28
Total Consumption	53.01	77.49	129.63	152.22	279.18	463.24

Source: Temiz & Gökmen, 2010

In 2010, the production and consumption of energy has reached 39.22 and 152.22 tons of oil equivalent (mtoe), respectively (Table 20 and Table 21). The most important developments are observed in coal and lignite, hydropower, solar and wind energy. As to the other energy resources, there is no a consistent increment in the oil, geothermal and gas rates. However, a decline has been identified in the oil production since 1990. Also, a downscale is observed in the renewables and wastes. In accordance

with the conjectures and estimations of the forthcoming years, the energy deficit of Turkey would keep increasing in a rapid way.

3.4.1. Renewable Energy Resources Profile of Turkey

Nonrenewable energy resources are depletable and affects environment in a negative way. At the same time, it will increase the dependence to abroad on energy. Due to these reasons, the importance of renewable energy has risen in Turkey as it happened in world.[138] Turkey is a prosperous country in terms of geographical and mathematical location. Turkey needs to lead to renewable energy resources. Thus, the sustainable economic development of Turkey will flourish. Besides, the environmental pollution will lower within this process. Besides, contribution which was made in renewable energy resources of Turkey will inevitably raise in overall energy consumption.[139] The projects which were carried out about the field of renewable energy have begun between 2001-2003 in Turkey. In Turkey, it has been implemented for the models under the law which is related to the production of electricity before 2001. However, these implemented models haven't been successful. The electricity market code 4628 which was enforced in 2001 has enabled initial regulations to carry out about renewable energy production licenses.[140]

3.4.1.1. Hydropower Energy Profile of Turkey

Hydroelectric (hydraulic) energy means the power provided by the water in motion. In other words; hydroelectric energy is provided by converting the potential energy of water into kinetic energy.[141] Hydroelectric power plant (HPP) work in a compatible way with the environment. Also, HPP are clean, renewable, highly productive and there are no fuel expenses. Otherwise, the role of an insurance is provided by hydroelectric power plants in energy prices, having a longevity, low operation costs and not dependent on import.[142]

HPP can be built in certain geographical locations. The reason of this issue flow and regime characteristics of stream must be productive for hydropower. The most appropriate streams are for generation of hydropower energy having high flow, large extent, regular rain regime and high drop points.[143] The purpose of hydroelectric

[138]Aksöz, 2014: 65-66.
[139]Yılmazer, 2016: 72.
[140]Demir, 2015: 54.
[141]Arı, 2007: 38.
[142]Erdoğan, 2014: 22.
[143]Arı, 2007: 39.

power plants isn't just to generate electricity energy. Also, it is useful to prevent flood, regulating irrigation affairs, building up fishery, making transportation easier, providing for afforestation, contributing to the development of tourism sector.[144]

The annual amount of precipitation in Turkey is different according to the seasons and regions. The amount of rainfall is 643 mm and there is approximately 501 billion m³ of water per year in Turkey. However, some of the water is evaporating and mixed with underground and sea waters. Consequently, Turkey's consumable underground and surface water resources are roughly 110 billion m³ per year.[145] Turkey has huge hydroelectricity potential that is 1% of theoretical of the world. Besides, hydroelectricity potential of Turkey is equal to 16% of the hydroelectricity potential of Europe in terms of economic circumstances.[146]

Figure 20: View of Hydropower Plant

Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[147]

[144]Yılmazer, 2016: 24.
[145]Erdoğan, 2014: 58.
[146]Ministry of Energy and Natural Resources of Republic of Turkey,http://www.enerji.gov.tr/en-US/Pages/Hydraulics ; accessed January 2017.
[147]http://www.enerji.gov.tr/en-US/Pages/Hydraulics ; accessed January 2017.

Figure 21: Hydropower Plants of Turkey

Source: General Directorate of State Hydraulic Works, 2015[148]

3.4.1.2 Wind Energy Profile of Turkey

Wind energy is proper almost all around the world, but it has huge variabilities in terms of wind strength and stability. The resource of wind energy is the sun.[149] The wind energy takes place the result of the displacement of the air masses due to the fact that the weather temperatures are not always the same in everywhere by the sun.[150] Approximately 1-2% of the solar energy which reaches the earth is converted into wind energy.[151] The wind energy is a resource which is used prevalently in world and the most convenient renewable energy resource in commercial sense. The wind energy is more advantageous in accordance with the energy production from fossil fuels in terms of intercepting the pollution of wind turbines and ease of assembly. However, during the production of wind energy, the cost of converting the energy into electricity by holding the energy carried by the wind is high. For Instance, the cost is calculated as 750 Dollars / kW in the US and 1400 Dollars / kW in the EU. In order to produce wind energy economically it must be 1000 USD / kW. A research & development study is required for the economic production of wind energy.[152]

[148] http://www.dsi.gov.tr/dsi-resmi-istatistikler/resmi-i-statistikler-2015/2015-y%C4%B1l%C4%B1-verileri ; accessed January 2017.
[149] Yılmazer, 2016: 19.
[150] Boyle, 2004: 245.
[151] Yılmazer, 2016: 19.
[152] Çabuk, 2011: 198-199.

In accordance with the basic forecasts, there is 1 million GW of wind energy favorable from the total land coverage of the earth, and it was included only 1% of this terrain at achievable efficiencies, this would cover the prospects of the global electricity demand. Even though most wind energy is currently generated onshore, offshore wind farms are becoming more prestigious as a larger resource area with the low environmental effect (particularly considering noise and visual pollution). Wind power production capacity of world has reached 435 GW at the end of 2015, around 7% of total global power production capacity. Global wind power production in the amount of 950 TWh in 2015, almost 4% of total global power production.[153]

Figure 22: Wind Energy Power

Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[154]

3.4.1.2.1. In meteorological terms, wind can develop in the following locations:

Wind can build and develop in some areas: [155]

- Locations which have a lot of changes are high in the pressure.
- High, smooth hills and valleys.
- Regions which remained under the influence of the potent geostrophic winds.
- Coastal strip.
- Mountain ranges, valleys and hills where canal effects occurred.

3.4.1.2.2. The Advantages of Wind Energy

There are many advantages of wind energy: [156]

[153]World Energy Council, https://www.worldenergy.org/data/resources/resource/wind/ ; accessed January 2017.
[154]http://www.enerji.gov.tr/en-US/Pages/Wind ; accessed January 2017.
[155]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Wind ; accessed January 2017.
[156]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Wind ; accessed January 2017.

- Wind is a renewable and pure resource of energy, and it is environmentally friendly;
- Its source is reliable, and there are no risks of running out or prices increasing over time.
- Its cost has reached the level where it is able to compete with the power plants of today.
- Maintenance and repair costs of wind energy are low.
- The employment raises.
- Its raw materials are totally domestic, and it does not pose any obligation for the import utility.
- The technology which was operated and formed within this stage is simple.
- It might be included into the operation system in the shortest time.

3.4.1.2.3. Classification of the Electricity Energy Generated from Wind

The classification of the average wind speed at the turbine hub height of the electric energy generated from the wind is given below:[157]

- 6.5 m/s is medium rating in terms of wind speed energy.
- 7.5 m/s is good rating in the sense of wind speed energy.
- 8.5 m/s and above speeds are very good rating for wind speed energy.

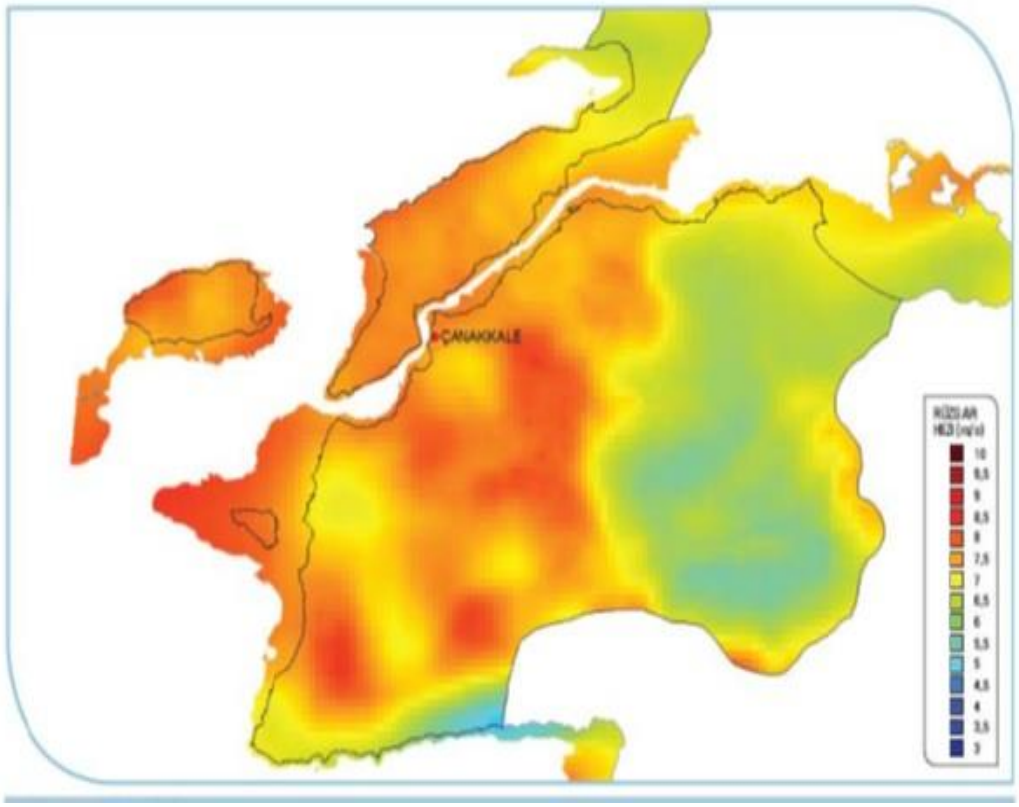
Turkey is an abundant country by virtue of its wind energy. The wind energy potential indicates distinction among regions as a dependency to the speed and continuity of the wind in Turkey. Particularly, Çanakkale, Balıkesir and İzmir are available cities to build more wind energy. These three cities of Turkey are productive in the wind energy sector. They are almost prolific every day in terms of the wind energy. Also, these three cities can boost the quality of the wind energy in the future by carrying out the production system. The investment activities can be launched for these three cities about the wind energy sector. Thus, Turkey can thrive the productivity and stability in the generation of the wind energy and it doesn't need immense resources from the abroad. At the same time, it generates the large profits

[157]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Wind ; accessed January 2017.

against the other foreign countries having plenty of resources in the wind energy and it entirely constrains the imports in this area.

3.4.1.2.4. Çanakkale Wind Resource Information

Figure 23: Wind Speed Distribution - 50 Meters in Çanakkale

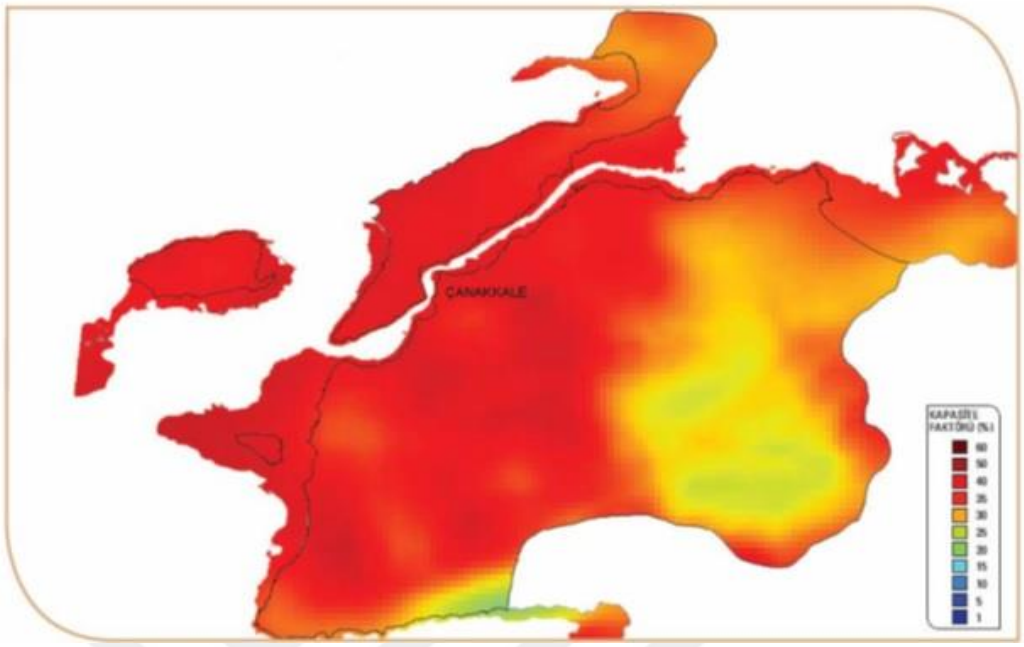


Source: General Directorate of Renewable Energy of Turkey, 2017[158]

For the Economic Renewable Energy Source Investment, a wind speed of 7/m or higher is required.

[158] http://www.eie.gov.tr/YEKrepa/CANAKKALE-REPA.pdf ; accessed January 2017.

Figure 24: Wind Capacity Factor Distribution - 50 Meters in Çanakkale



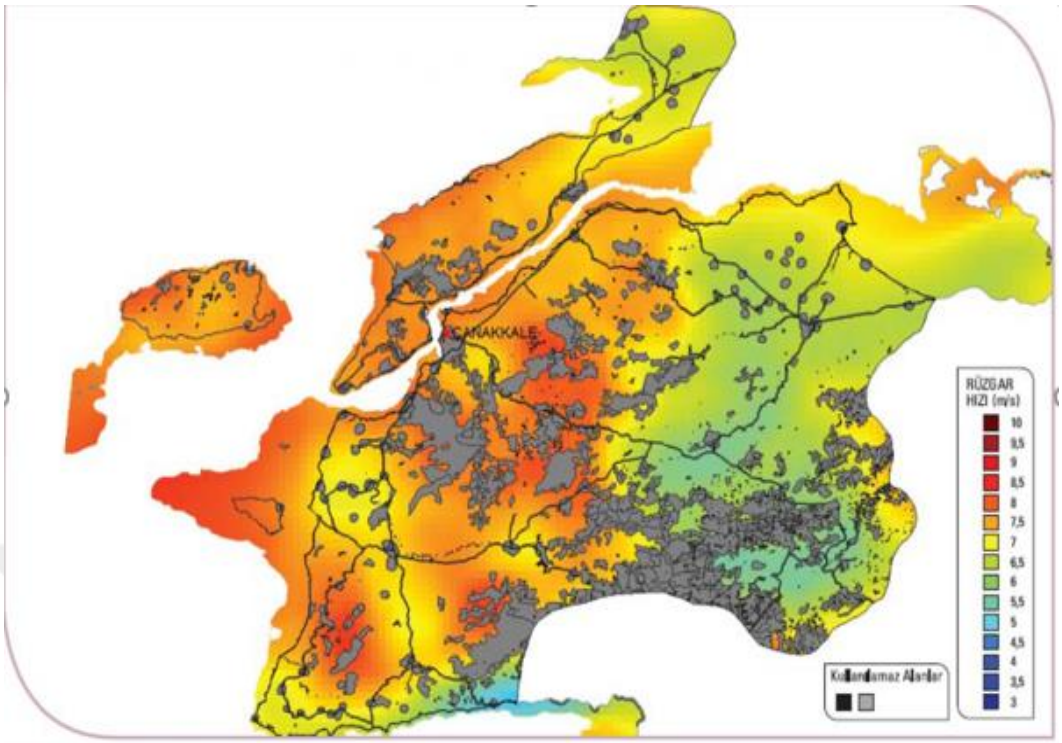
Source: General Directorate of Renewable Energy of Turkey, 2017[159]

For the Economic RES Investment needs 35% or over 35% capacity factor.

As it was identified in the map of Çanakkale, it is almost appropriate all over Çanakkale to disperse the impact of the wind energy. Particularly, the wind energy is commonly prevalent in the western territory and Galipoli Peninsula of Çanakkale. Moreover, Gökçeada is also included in generation of the wind energy. In addition, Çanakkale is really a wealthy region in terms of the wind energy in Turkey. Therefore, the Ministry of Energy and Natural Resources of Turkey should increase the investments on this region about the wind energy.

[159] http://www.eie.gov.tr/YEKrepa/CANAKKALE-REPA.pdf ; accessed January 2017.

Figure 25: The Wind Power Installation Fields in Çanakkale



Source: General Directorate of Renewable Energy of Turkey, 2017[160]

It was accepted that the wind power plant won't be set up on to the gray fields. However, the installation fields and zones were identified within the map.

Table 22: The Power Capacity of the Wind Energy Power Plant to be Installed on Çanakkale

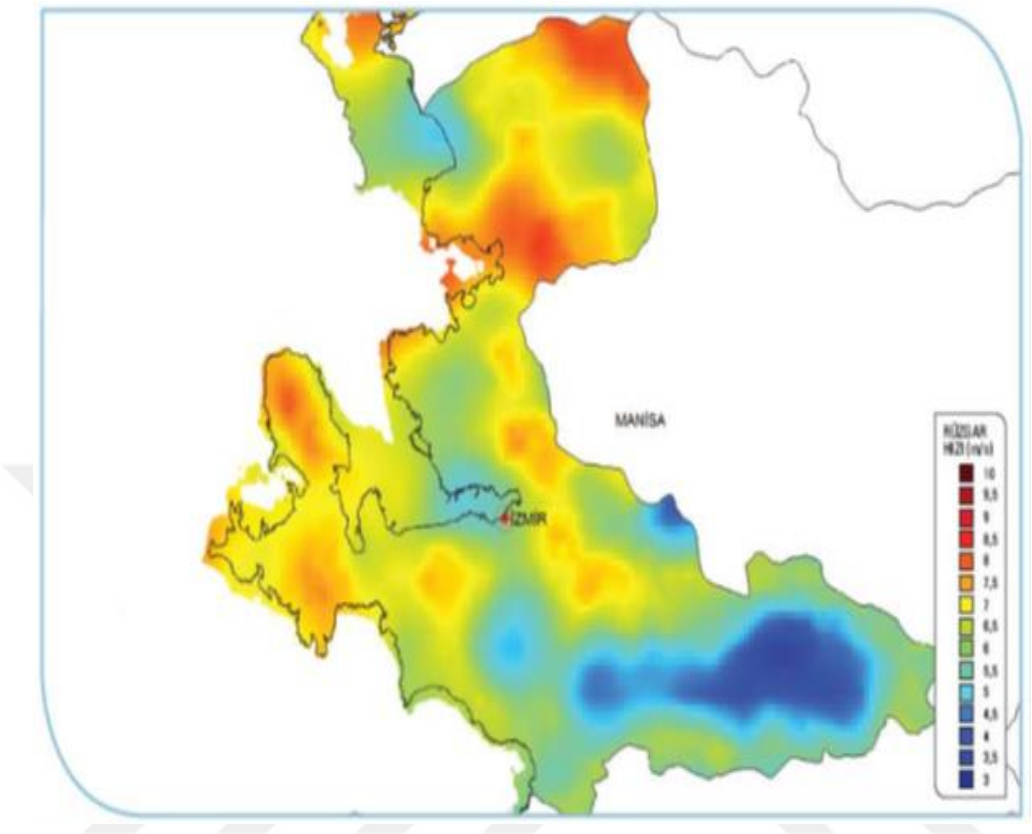
Wind Power at 50 meters (w/m²)	Wind Speed at 50 meters (m/h)	Total Area (km²)	Total Installed Power (MW)
300-400	6.8-7.5	863,70	4.318,48
400-500	7.5-8.1	802,99	4.014,96
500-600	8.1-8.6	761,09	3.805,44
600-800	8.6-9.5	174,74	873,68
>800	>9.5	0,00	0,00

Source: General Directorate of Renewable Energy of Turkey, 2017[161]

[160] http://www.eie.gov.tr/YEKrepa/CANAKKALE-REPA.pdf ; accessed January 2017.
[161] http://www.eie.gov.tr/YEKrepa/CANAKKALE-REPA.pdf ; accessed January 2017.

3.4.1.2.5. İzmir Wind Resource Information

Figure 26: Wind Speed Distribution - 50 Meters in İzmir

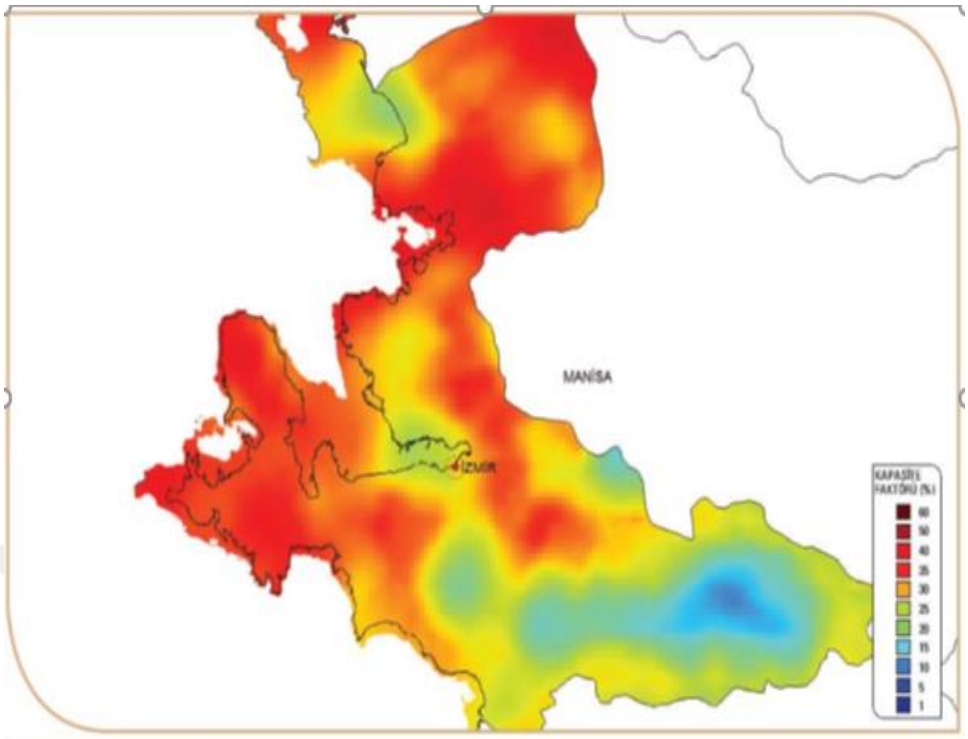


Source: General Directorate of Renewable Energy of Turkey, 2017[162]

For the Economic RES Investment, a wind speed of 7/m or higher is required.

[162] http://www.eie.gov.tr/YEKrepa/IZMIR-REPA.pdf ; accessed January 2017.

Figure 27: Wind Capacity Factor Distribution - 50 Meters in İzmir



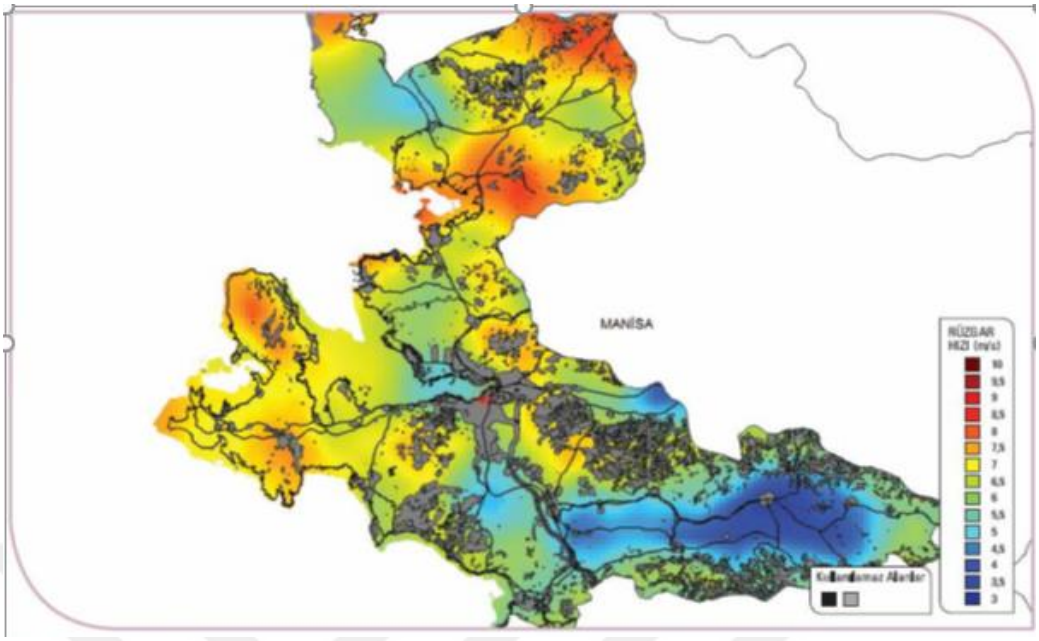
Source: General Directorate of Renewable Energy of Turkey, 2017[163]

For the Economic RES Investment needs 35% or over 35% capacity factor.

As it is evident in the Figure 27, the wind energy is mostly common in the northern region and western territory of Izmir. Those areas are entirely convenient to install the power plants of the wind energy. As to the southeastern territory, it isn't appropriate to build the formation of the wind energy power plant. Particularly, it commonly gets produced in Karaburun Peninsula and Çeşme County of the city.

[163] http://www.eie.gov.tr/YEKrepa/IZMIR-REPA.pdf ; accessed January 2017.

Figure 28: The Wind Power Installation Fields in İzmir



Source: General Directorate of Renewable Energy of Turkey, 2017[164]

It was accepted that the wind power plant won't be set up on to the gray fields. However, the installation fields and zones were identified within the map.

Table 23: The Power Capacity of the Wind Energy Power Plant to be Installed on İzmir

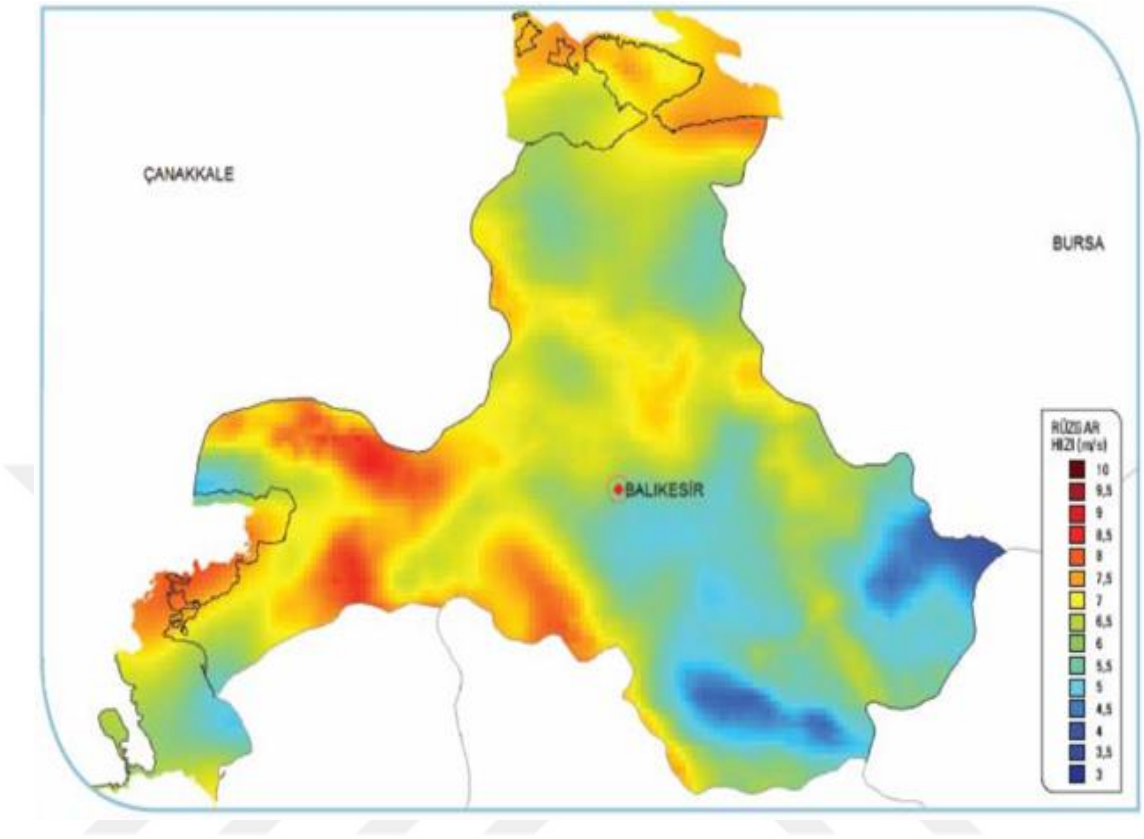
Wind Power at 50 meters(W/m²)	Wind Speed at 50 meters(m/h)	Total Area (Km²)	Total Installed Power (MW)
300-400	6.8-7.5	933,09	4.665,44
400-500	7.5-8.1	868,30	4.341,52
500-600	8.1-8.6	317,68	1.588,40
600-800	8.6-9.5	251,78	1.258,88
>800	>9.5	0,02	0,08
		2.370,86	11.854,32

Source: General Directorate of Renewable Energy of Turkey, 2017[165]

[164] http://www.eie.gov.tr/YEKrepa/IZMIR-REPA.pdf ; accessed January 2017.
[165] http://www.eie.gov.tr/YEKrepa/IZMIR-REPA.pdf ; accessed January 2017.

3.4.1.2.6 Balıkesir Wind Resource Information

Figure 29: Wind Speed Distribution - 50 Meters in Balıkesir

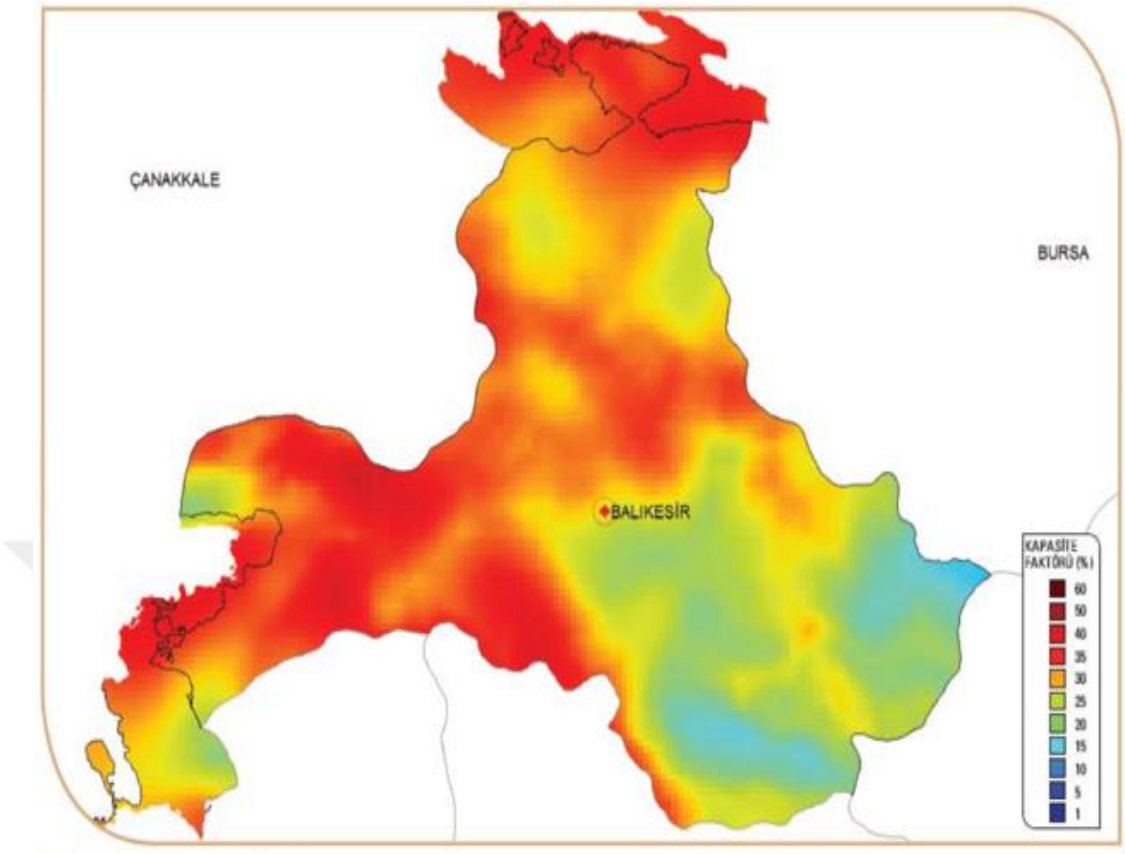


Source: General Directorate of Renewable Energy of Turkey, 2017[166]

For the Economic RES Investment, a wind speed of 7/m or higher is required.

[166] http://www.eie.gov.tr/YEKrepa/BALIKESIR-REPA.pdf ; accessed January 2017.

Figure 30: Wind Capacity Factor Distribution - 50 Meters in Balıkesir



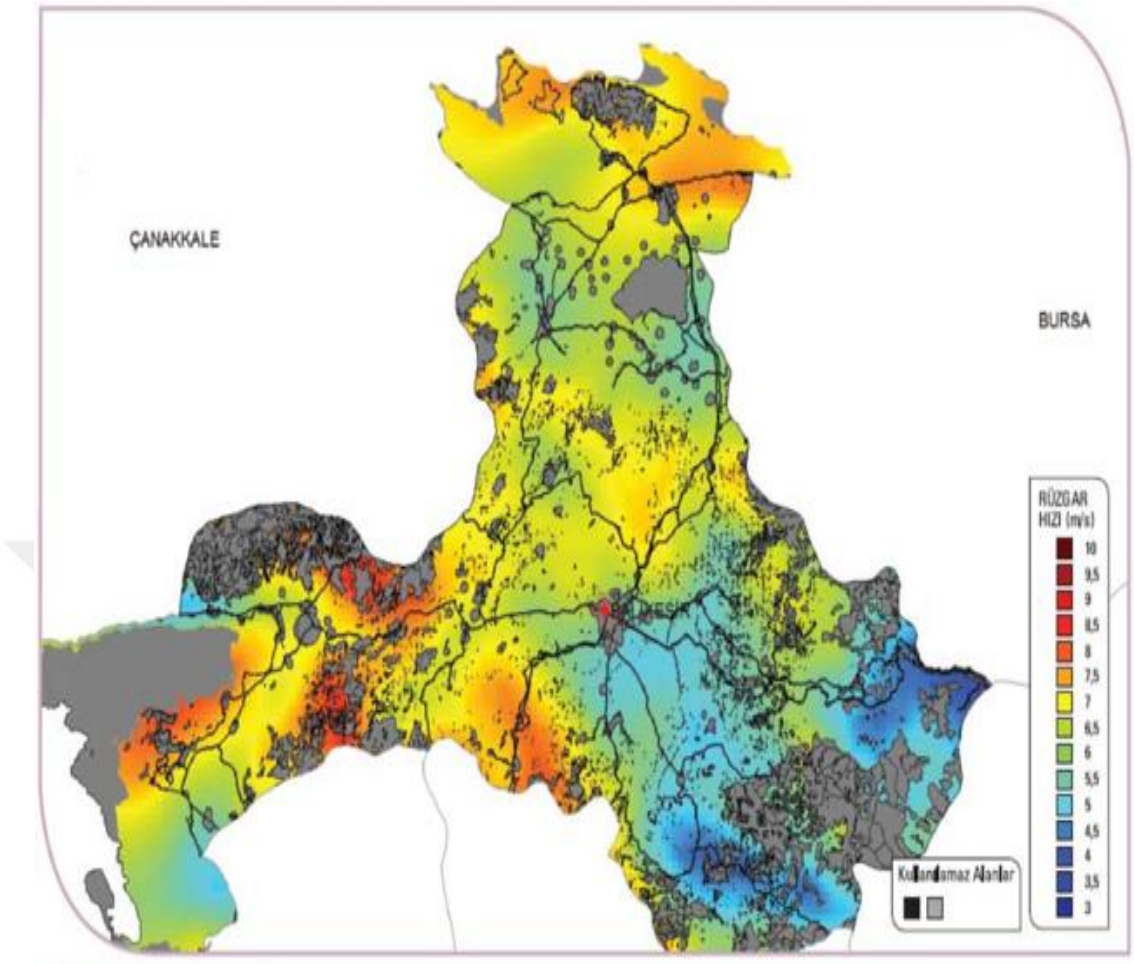
Source: General Directorate of Renewable Energy of Turkey, 2017[167]

For the Economic RES Investment needs 35% or over 35% capacity factor.

As it is evident on the location of Balıkesir, it is one of the the most proper places in terms of the wind energy in the northern territory and western region of this city. The density is entirely widespread in these parts of the city in order to conduct the investment opportunities in the best way because there is a vast advantage along with nearly and over 35% energy capacity in the red parts. As for the southeastern territory of Balıkesir, it is unsteady and below 35% so it is inconvenient place to install the wind energy.

[167] http://www.eie.gov.tr/YEKrepa/BALIKESIR-REPA.pdf ; accessed January 2017.

Figure 31: The Wind Power Installation Fields in Balıkesir



Source: General Directorate of Renewable Energy of Turkey, 2017[168]

It was accepted that the wind power plant won't be set up on to the gray fields. However, the installation fields and zones were identified within the map.

[168] http://www.eie.gov.tr/YEKrepa/BALIKESIR-REPA.pdf ; accessed January 2017.

Table 24: The Power Capacity of the Wind Energy Power Plant to be Installed on Balıkesir

Wind Power at 50 meters(W/m²)	Wind Speed at 50 meters(m/h)	Total Area (Km²)	Total Installed Power (MW)
300-400	6.8-7.5	1.511,42	7.557,12
400-500	7.5-8.1	850,96	4.254,80
500-600	8.1-8.6	284,51	1.422,56
600-800	8.6-9.5	115,23	576,16
>800	>9.5	3,34	16,72
		2.765,47	13.827,36

Source: General Directorate of Renewable Energy of Turkey, 2017[169]

3.4.1.3. Geothermal Energy Profile of Turkey

Figure 32: Geothermal Resources

Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[170]

Geothermal is the term, which was derived from the combination of Greek geo & thermal.[171] Geothermal energy is the energy sort which emerged in the aftermath of reaching to the surface with the heating water and originated from the depth of the earth's crust naturally by transferring to the waters under the ground.[172] Geothermal energy has advantageous aspects compared to other energy resources. Advantageous aspects of geothermal energy are renewable, be continuous, low cost, environment friendly, no need advanced technology for manage. Besides, the most important is that the geothermal energy is a source of domestic energy.[173] Geothermal resources are

[169]http://www.eie.gov.tr/YEKrepa/BALIKESIR-REPA.pdf ; accessed January 2017.
[170]http://www.enerji.gov.tr/en-US/Pages/Geothermal
[171]Yılmazer, 2016: 20.
[172]Arı, 2007: 39.
[173]Arslan, S. & Darıcı, M., Karahan, Ç., ''Geothermal Energy Potential of Turkey''. Geothermal Energy Seminar: 27.

divided into three categories according to different temperature fields. These are Low Temperature Fields (20-70 °C), Medium Temperature Fields (70-150 °C), High Temperature Fields (Higher than 150 ° C).[174]

Turkey is an abundant country in terms of the geothermal energy. The reason is that Turkey is located on a vibrant tectonic zone in terms of the geological and geographical location. It has roughly 1000 geothermal reserves that are located all around the country. 78% of these geothermal areas are in Western Anatolia, 9% in Central Anatolia, 7% in the Marmara Region, 5% in Eastern Anatolia and 1% in the other regions. These geothermal regions have different types of temperatures.[175]

Figure 33: The Fields of Geothermal in Turkey

Source: General Directorate of Mineral Research and Exploration, 2017[176]

[174]Yılmazer, 2016: 21.
[175]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Geothermal ; accessed January 2017.
[176]http://www.mta.gov.tr/v3.0/bilgi-merkezi/maden-yataklari ; accessed January 2017.

Table 25: Usage Zones of Geothermal Energy in Accordance with the Temperature

Temperature(°C)	
180	Production of electricity, refrigerating with ammonium absorption
170	Drying diatomite's, stiff water and hydrogen sulfate yield
160	Lumber and fish drying
150	Aluminum yield Bayer's method
140	Conservatism and drying the farm crops rapidly
130	Sugar and salt industry
120	Yielding the distillation with pure water
110	Cement drying
100	Drying organic substances (algae, lawn, vegetable) wool washing and drying
90	Fish drying (fish inventory)
80	Location and greenhouse heating
70	Refrigeration (lower temperature limit)
60	Greenhouse, barn and coop heating
50	Nurturing mushroom, hammam
40	Soil heating
30	Swimming pools,
20	Fish farm

Source: (Arslan, Darıcı, & Karahan)

Table 26: Places that are Warmed by Geothermal Energy in Turkey

Region	**Installed Capacity (Housing)**	**Current Heating (Housing)**	**Temperature of Fluid (°C)**
Gönen (Balıkesir)	4500	3000	80
Simav (Kütahya)	6500	2700	120
Kızılcahamam (Ankara)	2250	2000	80
Balçova (İzmir)	15000	6500	125

Table 26

Continued

Narlıdere (İzmir)	5000	700	98
Sandıklı (Afyon)	5000	1000	70
Kırşehir	1800	1800	57
Afyon	10000	4000	95
Kozaklı (Nevşehir)	1000	1000	90
Diyadin (Ağrı)	1500	1500	78

Source: (Arslan, Darıcı, & Karahan)

3.4.1.4. Biomass Energy Profile of Turkey

Biomass energy can be defined as the form of chemical bond energy present in the bodies of living or in their wastes. Besides, Biomass is also identified as an organic carbon.[177] The materials of biomass energy are vegetable and animal products. Biomass energy obtained from biomass, a fuel of organic origin, is an energy type that has been used since the earliest days of human life.[178] For instance, humanity has learned to obtain energy from the wood 790,000 years ago which is called Stone Age. Thereby, biomass is the oldest energy resources compared to other energy resources.[179] Besides, it theoretically protects the environment in terms of CO2 emissions for the protection of the environment and climate. Energy needs of communities are increasing due to growing population and evolving industrialization. A source of energy that can provide energy demand without causing pollution.[180]

Biomass energy resources can be used for many purposes such as heating, fuel and electric energy production. Bioenergetics is used to refer to systems that generate electricity or heat using biomass. Biofuel is used for express solid, liquid and gas which are generated by biomass fuels.[181] Biomass is called as a biogas to the mixture of flammable gas obtained in the aftermath of converting into fermentation of biomass in an anaerobic environment. The aftermath of fermenting 1 ton of biomass in an airless environment, it has been calculated that an energy equivalent of 1.2 barrels of oil

[177]Yılmazer, 2016: 16.
[178]Arı, 2007: 40.
[179]Quaschning, 2010: 237.
[180]Yılmazer, 2016: 16.
[181]Erdoğan, 2014: 27.

would be generated. On the other hand, biogas is a gas mixture which is generated by biomass resources, burning with a bright blue flame and having high calorific value. Unit volume of biogas includes CH4 gas at 40% to 70%, between 30% and 55% CO2, the nitrogen, hydrogen and hydrogen sulfide have the remainder of rates. Characteristic of burning of biogas has gained due to methane.[182]

According to the statistics, there are 3.6 tone of fertilizer per year for 1 bovine, 0.7 tone of fertilizer per year for 1 ovine, 0.022 tone of fertilizer per year for 1 game fowl. From these values, 1 tone of cattle fertilizer can be produced around 33m³/year biogas, 1 tone of game fowl fertilizer can be produced 78m³/year biogas and 1 tone of sheep fertilizer can be produced 58m³/year biogas. In accordance with the predictions, the biomass potential of Turkey is around 8.6 million tons of oil equivalent. Turkey's biogas quantities that might be manufactured from biomass is 1,5-2 MTEP.[183]

Table 27: Biomass Resources

1.Herbal Biomass Resources	**2.Forest and Forestry Product Biomass Resources**	**3.Animal Biomass Resources**	**4.Organic wastes, biomass resources obtained from urban and industrial wastes**
Oil-bearing crops (canola, sunflower, soybean, etc.)	Wood and forestry waste (energy forest, energy crops, various trees)	Cattle, horses, sheep, chickens waste, slaughter house waste and animal wastes that arise during the processing of products	Sewage sludge, paper industry and food industry wastes, industrial and domestic waste water, municipal waste and large industrial facilities waste
Sugar and starch crops (potatoes, wheat, corn, sugar beets, etc.)			

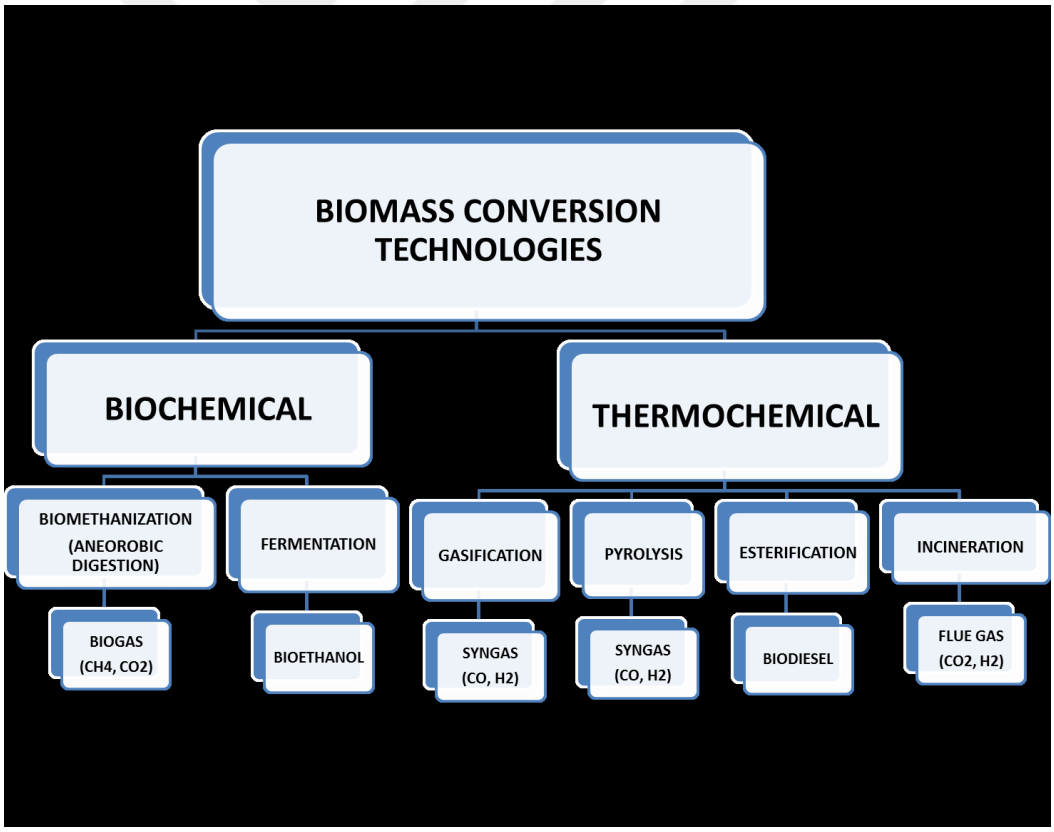
[182]Arı, 2007: 40.
[183]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/File/?path=ROOT%2f1%2fDocuments%2fSayfalar%2fHayvansal+Kaynaklardan+Elde+Edilebilecek+Ortalama+G%C3%BCbre+ve+Biyogaz+Miktarlar%C4%B1.pdf ; accessed January 2017.

Table 27 Continued

Staple crops (flax, kenaf, hemp, sorghum, miscanthus, etc.)			
Protein crops (peas, beans, etc.)			
Herbal and agricultural residues (branches, stalk, straw, root, bark, etc.)			

Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[184]

Figure 34: Biomass Conversion Technologies



Source: Ministry of Energy and Natural Resources of Republic of Turkey, 2017[185]

[184] http://www.enerji.gov.tr/en-US/Pages/Bio-Fuels ; accessed January 2017.

[185] http://www.enerji.gov.tr/File/?path=ROOT%2f1%2fDocuments%2fPages%2fbiomass.pdf ; accessed January 2017.

3.4.1.5. Solar Energy Profile of Turkey

The sun is a mass of 1.39 million kilometers in diameter and about 150 million km away to the world. The solar energy is a powerful energy resource which occurs in the aftermath of the fusion reaction converting hydrogen gas into helium and exists in the core of the sun. A small part of this energy coming to Earth is in the amount that humanity can meet all its energy needs.[186] One of the most important energy resources is indisputably sun in the world. Most of the natural energy resources are rooted in the sun. Solar energy is used for purposes such as heating and electricity generation.[187] Solar energy is a pure and renewable energy resource that does not cause to pollution. However, solar energy requires a higher cost than other renewable energy resources. The solar energy has 0 to 1100 W / m volume on the ground surface.[188]

Turkey is located between 26°-45° eastern longitude and 36°- 42° latitude of the North. Thereby, Turkey is in one of the most appropriate positions of the earth in order to possess the solar energy potential. There is high amount of solar energy power in Turkey owing to the geographical and mathematical locations.[189] The study which was conducted by Ministry of Energy and Natural Resources of Republic of Turkey is in accordance with the solar energy potential atlas (GEPA) of Turkey, the annual total sunshine duration is around 2.737 hour (Daily total 7,5 hours). It was identified that the annual total solar energy was 1.527kWh/m².[190]

[186]Erdoğan, 2014: 16.
[187]Yılmaz, 2012: 44.
[188]Çabuk, 2011: 199.
[189]Yılmaz, 2012: 44.
[190]Ministry of Energy and Natural Resources of Republic of Turkey, http://www.enerji.gov.tr/en-US/Pages/Solar ; accessed January 2017.

Figure 35: Different Types of Solar Energy Heat and Electric Systems

Source: Erdoğan, 2014

3.4.1.5.1. Solar heat collectors are divided into three categories owing to temperature degrees and areas to be able to be applied.[191]

3.4.1.5.1.1. Flat Collectors: It consists of a system of mirrors. Flat collectors convert potential energy to kinetic energy of solar radiation. The temperature which is obtained below 100°C. It is used to provide hot water to housing. At the same time, it supplies hot water to the radiator system, heat of greenhouses and drying of some agricultural crops.

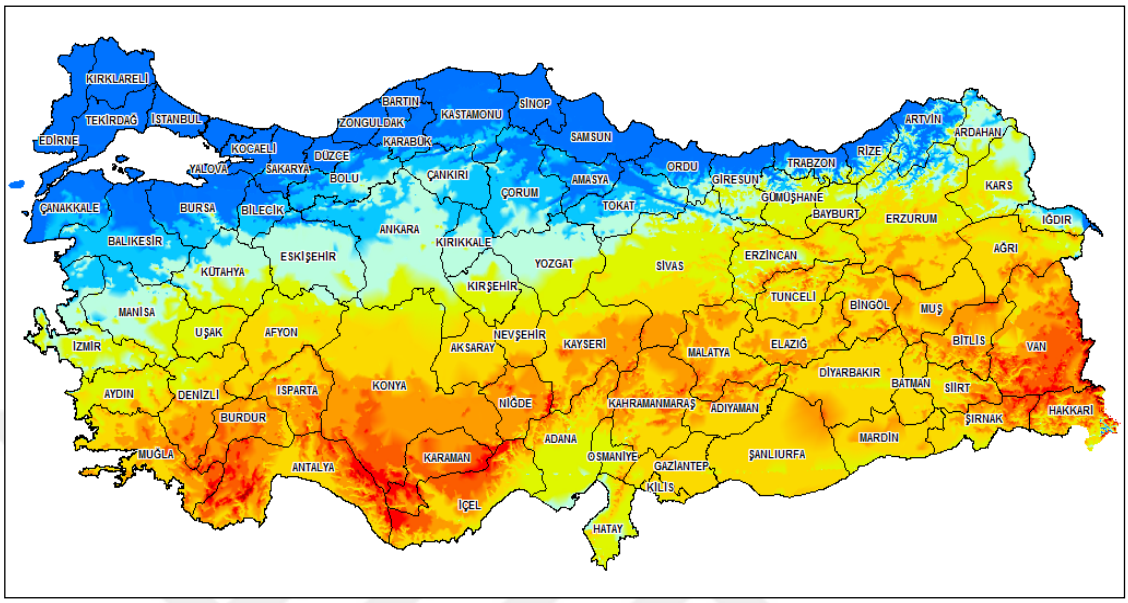
3.4.1.5.1.2. Focus Collectors: It is a lens system, which collects solar energy. This system was formatted by lenses and it is comprised of a high number of lenses. In such a system, temperature can obtain between 100°C and 350°C. It benefits from these energies and in various types of cooking jobs and furnaces.

3.4.1.5.1.3. Grand Solar Furnaces: Those are the collectors of solar energy having big capacity which resembles the modality of towers. They consist of thousands of

[191]Arı, 2007: 43-44.

lenses-mirror systems. These collectors can yield temperature of nearly 350-400°C to 2500-4000°C.

Figure 36: Total Solar Radiation According to City



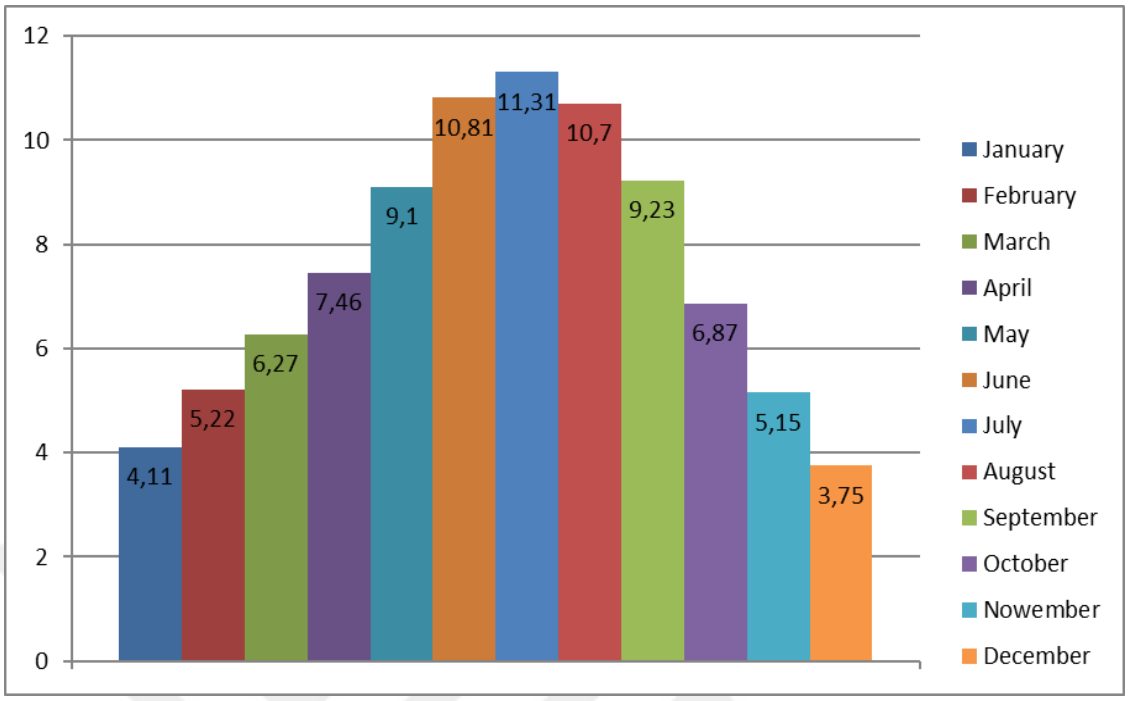
Source: General Directorate of Renewable Energy of Turkey, 2017[192]

According to Figure 36, the entire Mediterranean, the South of Aegean Sea and Central Anatolia and almost the whole eastern Anatolia and southeastern Anatolia territories have large amount of solar energy potentials and powers. All these parts are convenient for production of the solar energy potential. Thereby, the power plants can be installed for the solar energy.

In other words, the solar energy isn't commonly prevalent in the Black Sea Territory of the country because the rain seems widespread in Black Sea part and the weathers are cloudy and turbid. In this case, the solar energy power plants cannot be set up in this part with the impact of the negative climate conditions. For this reason, the production of the solar energy cannot generally be carried out in the Black Sea Region. Furthermore, it doesn't get established in any part of Marmara. Also, it isn't proper to the solar energy for the North of Aegean and Central Anatolia.

[192] http://www.eie.gov.tr/MyCalculator/Default.aspx ; accessed January 2017.

Figure 37: Sunshine Duration of Turkey (Hour)

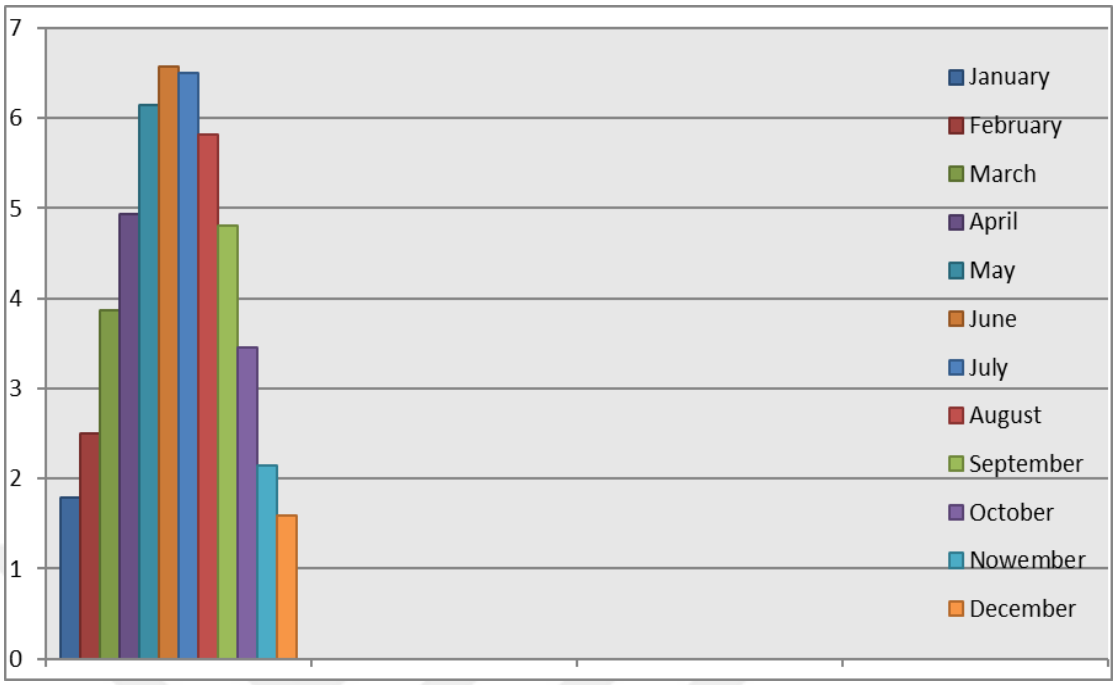


Source: General Directorate of Renewable Energy of Turkey, 2017[193]

As it is indicated in Figure 37, it is classified in accordance with the seasonal periods of the sunshine duration. There is a rapid upscale from the winter to the summer season in the sunshine duration. Particularly, this rise is appropriate in both spring and summer months for production of the solar energy. It shows the downturn in the autumn and winter. Therefore, the solar energy cannot be generated effectively in those seasons.

[193] http://www.eie.gov.tr/MyCalculator/Default.aspx ; accessed January 2017.

Figure 38: Global Radiation Value of Turkey (KWh/ m²-day)



Source: General Directorate of Renewable Energy of Turkey, 2017[194]

According to Figure 38, May, June and July are the most opportune and efficient for production of the solar energy about the global radiation values. However, a downscale is observed as of August. As for the months of the winter season, January, February are far lower and less convenient about the production of the solar energy. The upscale is also identified as of march. Also, there is an instability on October, November and December because of the radiation values.

3.4.1.6. Wave Energy Profile of Turkey

Waves are formed by gravitational pulling from the sun and moon by hitting the open waters by the wind. Force of waves are differentiating in atmospheric pressure, earthquakes etc.[195] Wave energy is a method especially used for obtaining electricity generation. Oceans and seas have a great potential for wave energy. One percent of the wave power in the great seas and in the oceans, which has the potential to cover more than about five times the energy demand of the world.[196] Wave energy technologies are clean, renewable, new and largely unused types of energy resources

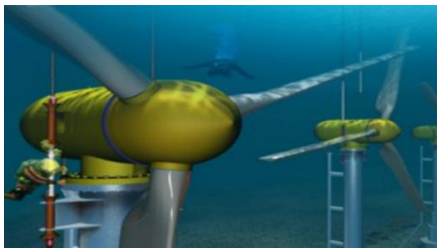
[194] http://www.eie.gov.tr/MyCalculator/Default.aspx ; accessed January 2017.
[195] Duman, Ç., (2010). ''Evaulation and Comparison of the Wave Energy Potential in Selected Coastal Regions in Turkey''. Unpublished Master's Thesis. Middle East Technigal University, Graduate School of Natural and Applied Sciences, Science in Civil Engineering. Ankara: 19.
[196] Erdoğan, 2014: 37-38.

compared to other renewable energy resources, but they have high cost of development. Therefore, it cannot compete financially with other renewable energy resources.[197]

Electricity generation by wave energy is based on Archimedes principle. Potential energy is stored by hitting the specially positioned propellers of the waves. Thus, the energy that is continuously taken from the waves is kept in the same balance with the stored energy and the linear electric energy is generated. The last thing to do is to convert the linear electric energy into electrical energy by the methods used today. There are some limitations to the use of the wave energy. Wave length is different everywhere and therefore different wave dimensions are used. Wave energy projects cannot be built on routes through ship roots, fishing habitats, underwater cabling, and military area.[198]

Turkey is an abundant country due to its wave energy. The reason is that three sides of Turkey are surrounded by seas but there is no adequate technology for the construction project to the wave energy in Turkey. Especially Black Sea, Aegean and Mediterranean territories have energy potential to build the wave energy technologies.[199]

Figure 39: Wave Energy System

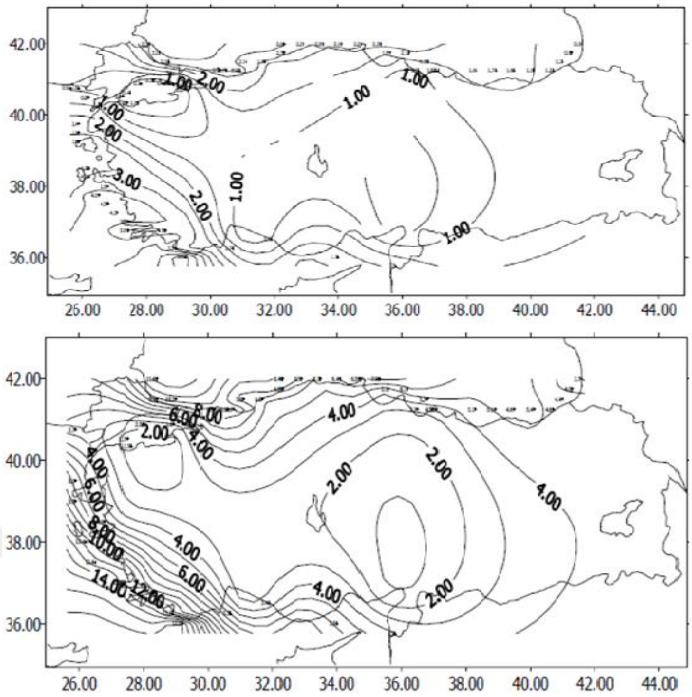


Source: Erdoğan, 2014

Wave energy converters are more environmental than other energy resources converters because they have lack of potential for chemical pollution. Also, wave energy converters usually operate with low noise even in the case of crashing wave. They have no difficulties to migrating fish. Wave energy converters present a tiny peril for shipping but not in a significant level.[200]

[197]Çabuk, 2011: 200.
[198]Erdoğan, 2014: 38-39.
[199]Erdoğan, 2014: 65-66.
[200]Boyle, 2004: 334.

Figure 40: Lowest and Highest Wave Energy Levels in Turkey



Source: Erdoğan, 2014

Table 28: Regional Average Wave Density in Turkey

Regions	**Power**
Mediterranean	2.59-8.26 kWh/m
Aegean	2.86-8.75 kWh/m
Black Sea	1.96-4.22 kWh/m
Marmara Sea	0-31-0.69 kWh/m

Source: Erdoğan, 2014

According to Table 28, Marmara Sea has lowest wave energy potentiality as well as the other seas. Aegean Sea has the highest rate in terms of wave power and resources. The most essential reason of this affair is relevant to mountains which totally stretch toward Aegean Sea Region in a vertical way. Wave energy potential rate

is higher and more dominant in Aegean Sea. Thus, it always maintains its ascendancy and dominion with respect to the other parts.

Besides, Mediterranean and Black Sea territories have also high wave energy possibility within the geographic situations of Turkey. As for Mediterranean and Black Sea, waves stretch directly to the seashore of the mountains in a parallel way. It is the biggest distinction about the routes of the mountains between Mediterranean-Black Sea and Aegean.

CONCLUSION

Energy is always one of the most leading and indispensable needs of the people. Besides, energy is the most important need that is used in every sector. For instance, people need energy for heating, industry and technological developments. With the impact of globalization and industrialization, energy demand has increased in a rapid way in the whole world, but energy supply has increased slowly. Hence, the energy supply didn't meet of energy demand. The unfair energy access is the main reason for the energy dependence of multiple countries. Nowadays, the energy consumption is used per capita as a criterion of the development. In the 21th century, the demand of the people to the energy has increased along with the technology which evolved in the past due to the influence of the population. Also, the population keeps rising rapidly in the world. Due to these factors, the needs and wants will also rise. However, nonrenewable energy resources (fossil fuels) don't meet the needs of people. Also, the fossil fuels spread the greenhouse gas (GHG) emissions to the ozone layer. These gases rise owing to diverse human activities and this rise affects the global warming and climate change in a negative way. Therefore, the countries are seeking to search for new resources. These resources are renewable energy resources. They can easily be produced and renewed. Also, it diffuses fewer pollutants to the nature. Furthermore, the renewable energy resources can never be depleted worldwide. The renewable energy resources are solar, wind, hydropower, geothermal, biomass and marine.

The energy issue has taken its place as well as fundamental macroeconomic problems such as balance of payments deficit, unjust income distribution, price instabilities, unemployment that all countries face after 1970s all over the world. The energy issue is directly or indirectly related to many basic macroeconomic problems. Energy issues cover characteristics, which are multidimensional because of developments such as dependency, security, protection of the environment, unjust income distribution, sustainable growth, stable expansion, balance of payments, social welfare, global warming.

The renewable energy resources are solar, wind, hydropower, geothermal, biomass and wave in Turkey. Turkey is an abundant country due to its geothermal energy which is the third country with 1,28 mtoe in terms of producing geothermal energy worldwide. Especially, Aegean territory has huge geothermal energy potential. Furthermore, Turkey has a high solar energy potential except Black Sea and North of East. The study which was conducted by Ministry of Energy and Natural Resources of Republic of Turkey is in accordance with the solar energy potential atlas (GEPA) of Turkey, the annual total sunshine duration is around 2.737 hour (Daily total 7,5 hours). It was identified that the annual total solar energy was 1.527kWh/m². Otherwise, Turkey is in the first 10 country in terms of producing wind energy. Particularly, Çanakkale, İzmir and Balıkesir have very huge wind energy potential. Also, Turkey has huge hydroelectricity potential that is 1% of theoretical of the world. Besides, hydroelectricity potential of Turkey is equal to 16% of the hydroelectricity potential of Europe in terms of economic circumstances. Moreover, Aegean, Mediterranean and Black Sea have high wave energy potential due to geographic situations of Turkey. However, Turkey hasn't adequate technology for take advantage of wave energy. In accordance with the predictions, the biomass potential of Turkey is around 8.6 million tons of oil equivalent. Turkey's biogas quantities that might be manufactured from biomass is 1,5-2 MTEP.

Turkey is an abundant country in terms of its renewable energy resources though it imports large part of energy needs from abroad. Especially, Turkey is importing natural gas from Russia and Iran for energy production and other industrial needs. Hence, energy import of Turkey affects current account balance negatively. Energy imports of Turkey reached to 60.11 Billion $ in 2012 and set up the record. In 2012, share in total import of energy import of Turkey has 25.41% and set up the record. Energy imports of Turkey has 27.2 Billion $ and share in total import of energy import of Turkey has 13.69% that is the lowest level. One of the most important reasons for the decline of Turkey's energy imports is Turkey's invest to renewable energy resources.

There are many studies that show the relationship between energy consumption and economic growth in the literature. Some studies show that there is a one-way causality from the GDP to energy consumption. In the studies of Mehrara (2007), Lise-Montfort (2007) and Zhang-Cheng (2009) argue that there is a one-way causality from

the GDP to energy consumption. Some studies indicate that there is a bidirectional relationship between energy consumption and economic growth. In the studies of Apergis and Payne (2010) argue that there is a bidirectional relationship between energy consumptian and economic growth. Aydın (2010) carried out two studies to explain the relationship of economic growth and energy consumption in Turkey. Aydın found that there was a positive relationship between energy consumption and economic growth. For this reason, a 1% increase in energy consumption leads to an increase of 1.03% in economic growth. According to many studies that there is a bilateral relationship between energy consumption and economic growth. Economic growth increases energy consumption. At the same time, energy consumption also affects economic growth. For Instance, 5 cents of electricity which is used by the industry generates for 1$ added value to country's economy. 5 cents of electricity that cannot be given to the industry is the loss of 1$ value to country's economy.

Turkey needs energy to initiate its economic development and growth. The energy problem poses another handicap concerning the current account deficit, which is an important problem of Turkey. Turkey is an abundant country due to its renewable energy resources although Turkey imported 72% of the energy needs from abroad. Due to structural problems, energy dependency of Turkey causes an issue. Energy dependence is not only a problem that Turkey faces. It is a problem that all developed and developing countries face. In addition, if Turkey raises the investment activities on renewable energy resources, the dependence of energy to abroad will decline. Hence, the impact of Turkey's energy imports on the current account deficit will be reduced.

REFERENCES

Aksöz, H., (2014). ‘’Analysis of the Relationship Between Energy Import and Current Account Deficit in Turkey’’. Unpublished Master’s Thesis. İstanbul University, Institute of Social Sciences, Department of Economics Department of Economic Policy, İstanbul.

Apergis N, Payne JE (2010) Renewable energy consumption and economic growth: Evidence from a panel of OECD countries. Energy Policy.

Arı, V., (2007). ‘’Energy Sources, Energy Planning and Energy Strategies’’. Unpublished Master’s Thesis. Çukurova University, Institute of Science Department of Mining Engineering, Adana.

Arslan, S. & Darıcı, M., Karahan, Ç., ‘’Geothermal Energy Potential of Turkey’’. Geothermal Energy Seminar.

Arvizu, D. & Balaya, P., (2011). ‘’IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation -Direct Solar Energy’’, Cambridge: Cambridge University Press.

Aydın, F.F., (2010). ‘’Energy Consumption ve Economic Growth’’. Erciyes University, Journal of Economics and Administrative Sciences.

Berument, M.H., Ceylan, N.B., & Doğan, N., (2010). ‘’ The Impact of Oil Price Shocks on the Economic Growth of Selected MENA Countries’’. Energy Journal.

Biçici, R., (2008). ‘’The Energy Economics of Turkey’’. Unpublished Master’s Thesis. Zonguldak Karaelmas University, Institute of Social Sciences, Department of Economics. Zonguldak.

Bilginoğlu, M.A. & Dumrul, C., (2012). ‘’A Co – Integration Analysis on the Energy Dependency of the Turkish Economy’’. Journal of Yasar University.

Boyle, G., (2004). ‘’Renewable Energy: Power for a Sustainable Future’’. United Kingdom: Oxford University Press: 2.

Coşkun, A., (1982). Energy Saving Panel. Istanbul Chamber of Commerce Publication, January 14, Seminar Series.

Çabuk, S.Ö., (2011). ‘’The Evaluation of the Role of Economic Instruments fort he Reduction of the Greenhouse Gas Emissions that Cause Global Warming: Energy Sector Example’’. Unpublished Doctorate Thesis. Ankara University, Institute of Social Sciences, Department of Political Science and Public Administration (Urban and Environmental Science), Ankara.

Demir, R., (2015). ‘’Turkey’s Energy Import and Current Account Deficit’’. Unpublished Master’s Thesis. TOBB Ekonomi ve Teknoloji University, Institute of Social Sciences, Department of Management. Ankara.

Duman, Ç., (2010). ‘’Evaulation and Comparison of the Wave Energy Potential in Selected Coastal Regions in Turkey’’. Unpublished Master’s Thesis. Middle East Technigal University, Graduate School of Natural and Applied Sciences, Science in Civil Engineering. Ankara.

EnerData Global Energy Statistical Yearbook 2017
https://yearbook.enerdata.net/total-energy/world-consumption-statistics.html

Erdoğan, M., (2014). ‘’ Turkey's Renewable Energy Potential is Examined with Thermodynamic Analysis Method, the Use of Renewable Energy Evaluate of Future Projections’’. Unpublished Master’s Thesis. İstanbul Aydın University, Institute of Science, Department of Mechanical Engineering, İstanbul.

Eren, İ., (2012). ‘’Global Climate Protection of the Work Under the Kyoto Protocol and Role of the Local Government Studies Role’’. Unpublished Master’s Thesis. Adnan Menderes University, Institute of Social Sciences, Department of Finance, Aydın.

Eylem, Ö. & Yarbay, R.Z., (2010). “The Potential and Future of Renewable Energy Sources in Turkey”. İstanbul Ticaret University, Journal of Science.

General Directorate of Mineral Research and Exploration (2017).
http://www.mta.gov.tr/v3.0/bilgi-merkezi/maden-yataklari ; accessed January 2017.

General Directorate of Renewable Energy of Turkey (2017).
http://www.eie.gov.tr/YEKrepa/CANAKKALE-REPA.pdf ; accessed January 2017.

General Directorate of Renewable Energy of Turkey (2017). http://www.eie.gov.tr/YEKrepa/IZMIR-REPA.pdf ; accessed January 2017.

General Directorate of Renewable Energy of Turkey (2017). http://www.eie.gov.tr/YEKrepa/BALIKESIR-REPA.pdf ; accessed January 2017.

General Directorate of Renewable Energy of Turkey (2017). http://www.eie.gov.tr/MyCalculator/Default.aspx ; accessed January 2017.

General Directorate of State Hydraulic Works (2015). http://www.dsi.gov.tr/dsi-resmi-istatistikler/resmi-i-statistikler-2015/2015-y%C4%B1l%C4%B1-verileri ; accessed January 2017.

Gökmen, A. & Temiz, D., (2015) The Importance and Impact of Fossil and Renewable Energy Sources in Turkey on Business and the Economy, Energy Sources, Part B: Economics, Planning and Policy.

Greenpeace (2007). '' Sürdürülebilir Bir Dünya İçin Enerji Yol Atlası'' http://www.greenpeace.org/turkey/Global/turkey/report/2008/4/enerji-devrimi-raporu.pdf

Habitat Derneği, "Temiz Enerji Yayınları: Biyokütle Enerjisi'' http://habitatdernegi.org/tr/dl/yayin/TemizEnerjiYayinlari/BiyoKutle.pdf

International Monetary Fund (2017). http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD ; accessed January 2017

Kapusuzoğlu, A. & Karan, M. B., (2010). '' An Analysis of the Co-integration and Causality Relationship between Electricity Consumption and Gross Domestic Product (GDP) in the Developing Countries: An Empirical Study of Turkey''. Business and Economics Research Journal.

Karakaya, E., (2009). "Capacity Evaluation of Turkey Under Rio Conventions Project''. United Nations Framework Convention on Climate Change Thematic Report.

Lise, W. & Montfort, K.V., (2007). "Energy Consumption and GDP in Turkey: Is There A Co-Integration Relationship?", Energy Economics. http://dx.doi.org/10.1016/j.eneco.2006.08.010

Lund, H., (2010). ‘’Renewable Energy Systems: The Choice and Modeling of 100% Renewable Solutions.’’ Amsterdam: Elsevier/AP: 7.

Mehrara, M., (2007). ‘’Energy Consumption and Economic Growth: The Case of Oil Exporting Countries’’. Univesity of Tahran, Faculty of Economics. Tahran: Energy Policy.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Coal ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Petrol ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Nuclear ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Hydraulics ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/tr-TR/Sayfalar/Iklim-Degisikligi-ve-Uluslararasi-Muzakereler ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Wind ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Geothermal ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Solar ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/File/?path=ROOT%2f1%2fDocuments%2fSayfalar%2fHayvansal+Kaynaklardan+Elde+Edilebilecek+Ortalama+G%C3%BCbre+ve+Biyogaz+Miktarlar%C4%B1.pdf ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/en-US/Pages/Bio-Fuels ; accessed January 2017.

Ministry of Energy and Natural Resources of Republic of Turkey (2017). http://www.enerji.gov.tr/File/?path=ROOT%2f1%2fDocuments%2fPages%2fbiomass.pdf ; accessed January 2017.

Mucuk, M. & Uysal, D., (2009). ‘’Energy Consumption and Economic Growth in Turkish Economy’’. Journal of Finance.

Narayan, P.K. & Smyth, R. (2008). ‘’Energy Consumption and real GDP in G7 countries: New evidence from panel cointegration with structural breaks’’.

Ouedraogo, N.S, (2013). ‘’Energy consumption and economic growth: Evidence from the economic community of West African States (ECOWAS)’’. Energy Economics.

Özüt, G.H., (2010). ‘Post Kyoto Protocol Period at International Climate Change Negotiations and Local Governments’’. Unpublished Master’s Thesis. Ankara University, Institute of Social Sciences, Department of Social Environmental Sciences, Ankara.

Panwar, N.L., Kaushik, S.C., & Kothari, S., (2010). ‘’Role of renewable energy sources in environmental protection: A review’’. Renewable and Sustainable Energy Reviews.

Prugh et al., (2005). ‘’Changing the Oil Economy, 2005 Situation of the World, Tema Publications, İstanbul.

Quaschning, V., (2010). Renewable Energy and Climate Change. Singapore: John Wiley & Sons Ltd Press.

Republic of Turkey Energy Market Regulatory (2016). http://www.epdk.org.tr/TR/Dokumanlar/Dogalgaz/YayinlarRaporlar/Yillik ; accessed January 2017.

Selvi, N., (2017). ‘’The Relationship Between Economic Growth and Energy Consumption: Turkey sample’’. Unpublished Master’s Thesis. Cumhuriyet University, Institute of Social Sciences, Department of Economics, Sivas.

Temiz, D. & Gökmen, A., (2010). ‘’The Importance of Renewable Energy Sources in Turkey’’. International Journal of Economics and Finance Studies.

The European Marine Energy Centre (2017). http://www.emec.org.uk/marine-energy/ ; accessed January 2017.

The World Bank (2017). http://databank.worldbank.org/data/download/GDP.pdf

The World Wind Energy Association Half-year Report, 2016 http://www.wwindea.org/download/market_reports/Half-year_Report_WWEA_2016.pdf

Turkish Statistical Institute (2017). http://www.turkstat.gov.tr/UstMenu.do?metod=temelist ; accessed January 2017.

Tüfekci, S., (2012). ‘’The Economy Politics for the Energy- Oriented Power Struggle Maintained in Eurasian Region: Turkey's Role and Her Importance’’. Unpublished Doctorate Thesis. Marmara University, Institute of Social Sciences. İstanbul.

Türkeş et al., (2010). “Flexibility Mechanisms Under the Kyoto Protocol)”. Tesisat Journal.

United Nations Framework Convention on Climate Change (2017). http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php ; accessed January 2017.

United States Environmental Protection Agency (2010). https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data ; accessed January 2017.

Uysal, D., Yılmaz, K. Ç. & Taş, T., (2015). ‘’The Relationship Between Energy Import and Current Account Deficit: The Case of Turkey’’. Muş Alparslan University, Journal of Social Sciences.

Uzoğlu, Y., (2016). ‘’The Role of the United Nations about Kyoto Period: Economic Analysis of Environmental Impacts of Carbon Trading’’. Unpublished Master’s Thesis. Çankırı Karatekin University, Institute of Social Sciences, Department of Economics, Çankırı.

World Energy Council (2016). https://www.worldenergy.org/wp-content/uploads/2016/10/World-Energy-Resources-Full-report-2016.10.03.pdf ; accessed January 2017.

World Energy Council (2016). https://www.worldenergy.org/data/resources/resource/coal/ ; accessed January 2017.

World Energy Council (2016). https://www.worldenergy.org/data/resources/resource/gas/ ; accessed January 2017.

World Energy Council (2016). https://www.worldenergy.org/data/resources/resource/oil ; accessed January 2017.

World Energy Council (2016). https://www.worldenergy.org/data/resources/resource/hydropower/ ; accessed January 2017.

World Energy Council (2016). https://www.worldenergy.org/data/resources/resource/wind/ ; accessed January 2017.

World Energy Council (2016). https://www.worldenergy.org/data/resources/resource/geothermal/ ; accessed January 2017.

World Energy Council (2016). https://www.worldenergy.org/data/resources/resource/solar/ ; accessed January 2017.

Yanar, R. & Kerimoğlu, G., (2011). ‘’Energy Consumption, Economic Growth and Current Account Deficit Relations in Turkey’’. Journal of Economics.

Yılmaz, M., (2012). ‘'The Energy Potential of Turkey and Its Importance of Renewable Energy Sources in terms of Electricity Production’’. Ankara University, Journal of Environmental Sciences.

Yılmazer, Ö., (2016). ‘’Changing Role of Renewable Energy in Energy Economypolitics and Importance interm of Turkey’’. Unpublished Master’s Thesis. İzmir Kâtip Çelebi University, Institute of Social Sciences, Department of International Relations, İzmir.

Zhang, X.P. & Cheng, X.M., (2009). ‘’Energy Consumption, Carbon Emissions, and Economic Growth in China’’. Ecological Economics.

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