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Energy security, energy consumption, and energy transition in emerging economies

The case of Turkey

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Dedicated to my mother, my sister, and my partner. I appreciate all of the love and support you provided me that helped me in completing my bachelor's degree.

I'd also want to express my gratitude to my mentor Xavi for his guidance, supervision, and advice during the thesis writing process.

ABSTRACT

Energy security, energy transition, and growth in energy consumption are challenges facing emerging and developed economies around the world today. Since the industrial revolution in the 18th century, demand has grown unprecedentedly but hit by several energy crises in the last 50 years, the idea of building robust energy security and supplying reliable, continuous, and affordable energy to a country's population has become an issue of growing concern and research. This is also where the concept of energy independence and sovereignty comes in, as the growing dependence on foreign energy suppliers has created an energy system that is vulnerable to changes in international relations and conflicts, among other factors. In addition, awareness and commitment to the transition to renewable energy and energy efficiency have grown in recent years due to the current climate crisis, and nations have joined together through treaties, international organizations, and agreements, setting targets and goals to reduce pollution and emissions. In this thesis, I will answer how Turkey's energy demand has evolved over the last 20 years, how it relates to GDP growth, how Turkey is addressing its energy security and energy independence, its cooperative role with the EU as an energy transit country, and how Turkey's energy transition to renewable energy is being managed.

Key Words:
Turkey, Energy Security, Energy Transition, Energy Consumption, ENergy Efficiency, Renewable Energy

RESUMEN

La seguridad energética, la transición energética y el crecimiento del consumo de energía son retos a los que se enfrentan hoy en día las economías emergentes y desarrolladas de todo el mundo. Desde la revolución industrial del siglo XVIII, la demanda de energía ha crecido sin precedentes, pero golpeadas por varias crisis energéticas en los últimos 50 años, la idea de construir una sólida seguridad energética y suministrar energía fiable, continua y asequible a la población de un país se ha convertido en un tema de creciente preocupación e investigación. Aquí entra también el concepto de independencia y soberanía energética, ya que la creciente dependencia de proveedores de energía extranjeros ha creado un sistema energético vulnerable a los cambios en las relaciones y conflictos internacionales, entre otros factores. Además, la conciencia y el compromiso con la transición hacia las energías renovables y la eficiencia energética han crecido en los últimos años debido a la actual crisis climática, y las naciones se han unido a través de tratados, organizaciones internacionales y acuerdos, estableciendo objetivos y metas para reducir la contaminación y las emisiones. En esta tesis, responderé a cómo ha evolucionado la demanda energética de Turquía en los últimos 20 años, cómo se relaciona con el crecimiento del PIB, cómo está abordando Turquía su seguridad e independencia energética, su papel cooperativo con la UE como país de tránsito energético y cómo se está gestionando la transición energética de Turquía hacia las energías renovables.

Título: Seguridad energética, consumo energético y transición energética en las economías emergentes: El caso de Turquía

Palabras clave:
Turquía, Seguridad Energética, Transición Energética, Consumo Energético, Eficiencia Energética, Energía Renovable

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INTRODUCTION

The world has passed from an era of abundant fuel, cheap and reliable supplies, to another of scarce fuels, expensive and supplies exposed to all kinds of political uncertainties. At this point is where energy security policies take on importance, both to avoid interruptions in the day-to-day life of consumers and to ensure the stability of the nation's economy. We can define energy security as the capacity of a nation to ensure the energy systems (electricity, gas, and also other hydrocarbons, such as oil and its derivatives) offer final consumers a flow of energy (electricity, natural gas, etc.) with a certain level of continuity and quality in a sustainable way and at affordable prices. The security of energy supply depends on the magnitude of the risks that can affect the continuity, quality, sustainability, and price of the energy flow.

How does it affect emerging economies? China's economic growth is faltering under the pressure of the construction slowdown and the energy supply crisis, which has raised warnings of a shock among its trading partners and global financial markets. Given that China is the world's second-largest economy and is deeply embedded in the global economic system, any recession could have direct and uncertain effects on the rest of the world's markets, especially on emerging markets.

Turkey, which is the country with the fastest increase in energy demand in the last 20 years among the Organization for Economic Cooperation and Development (OECD) countries, has a unique geo-economic importance as it is not only an important energy importer but also a bridge between consumer and producer countries. Last October 2021, the Parliament of Turkey unanimously ratified the Paris Agreement, becoming the last G-20 country to join the climate pact. With the awareness of the fact that energy is of great importance in the real establishment of national independence as well as being the main element of development, Turkey took initiatives to reduce foreign dependence on energy and to increase the use of local resources. On the other hand, Turkey continues its efforts to increase the share of renewable energy resources in the national energy mix, starting from the goal of combating climate change.

Therefore the objective of this paper is to analyze the increased energy demand in Turkey in the past two decades and the strategies that Turkey is following to strengthen the nation's energy policies, emphasizing energy security, which is based on a combination of energy efficiency policies, the development of clean energies and an increase in domestic production, reducing the existing dependence on external providers. On the other hand, this paper also analyzes how this energy security strategy affects economic efficiency and environmental protection, taking into account the role of Turkey as a transit energy country since it is among three areas of energy influence such as the EU, the Russian Federation, and the Middle East and Asia.

On a personal level, I've always been curious about how the world works and what drives leaders to make certain decisions or follow specific policies. This, together with my interest in politics, economics, and sustainability issues, prompted me to do research on "Energy Security, Energy Consumption, and Energy Transition in Emerging Economies: The Case of Turkey."

And the reason why I chose Turkey as the country of this research, comes from two reasons. First, I have always been intrigued by this country, its history, its culture, its rulers, and its geostrategic and geo-economic position between Asia and Europe. Secondly, for a personal reason, my partner is of Turkish origin, and thanks to her I've been able to further expand my knowledge about this country.

In the framework of the current energy crisis, and the transition towards the use of cleaner alternative energies, the increasing demand for energy by emerging countries, the strategic position in which Turkey finds itself, and the growing concern about energy dependence and energy security, leads me to the following research questions (Q):
(Q1) How has the evolution of energy demand in Turkey been over the last 20 years, and does this increasing energy demand correlate with increasing GDP and economic growth?
(Q2) How has Turkey addressed the issue of energy security, energy transition to cleaner energy, and energy efficiency?, and how does Turkey's geo-economic position between the EU, the Russian Federation, and Asia (Middle East, Central Asia) influence EU's energy security?

Then, two hypotheses (H) are inferred from these questions that will be confirmed or discarded through the analysis conducted throughout the Final Degree Project.
H1: Turkey's growing GDP in the last 20 years is related to its higher energy consumption.
H2: Turkey's energy consumption is not efficient, and Turkey's investment in clean energy and domestic production is helping Turkey to strengthen its energy security, as well, Turkey's geo-economic position is essential for energy security in the EU.

The methodology used in this research to find out the answers to these questions is based on a "Literature Narrative Review" through the comparison of official data sources (e.g. International Energy Agency, Turkey Ministry of Energy and Natural Resources), authors (e.g. Dr. Mitat Çelikpala, Ronald Soligo, Kenneth B. Medlock, Daniel Yergin or Dr. Ploetz among others) and if necessary, the application of theoretical foundations to the analyzed problem. The literature narrative review is a detailed, selective, and sometimes critical study that aims to examine what has been published. With this methodology I aim to explore, describe and discuss the topic of my final project, in a broad manner, considering multiple factors from a theoretical and contextual point of view.

The structure followed through this paper will be divided into four main chapters; firstly the energy security theoretical framework where I will analyze four of the most important theoretical energy security perspectives; the second section will the energy consumption in Turkey where I will analyze the relation between GDP and energy consumption, the energy mix of Turkey and energy efficiency issue; thirdly the Turkish energy security situation and its cooperation with the EU; and the fourth chapter, where I will address the topic of the energy transition to renewable energy sources in Turkey, the international organizations and treaties framework, and it's the future trend. I will finish with a conclusion where I will show the results of my research.

I. THEORETICAL FRAMEWORK

For humankind, energy is a necessary and crucial component and it plays a strategic role in international relations theory. "Energy Security" is perhaps the most important pillar of this. Even if there are no clear definitions for energy security, comprehensive research provides a basic concept. The most fundamental explanation is that it was created to ensure that the people of a country have access to sustainable and reliable fuel and energy services. Energy security is a broad term that refers to issues that may develop throughout the exploration, production, transmission, and commercialization of energy resources. Security of energy supply, demand, and transportation routes. (Ediger, 2010:46).

Countries that export surplus energy within the scope of energy demand define security as continuous supply and high-priced purchasers. On the other hand, energy supply security is characterized by energy importing countries' continuous delivery of energy resources at affordable costs. Availability, affordability, sustainability, and accessibility are all important factors in supply security (IEA, 2014).
When we consider the historical context of energy security, its relevance has grown significantly since the end of the Cold War, and it has now joined the category of new generation security threats. Energy security, which is now more important as a result of this, requires a conceptual definition. In this framework, I will analyze energy security from the theoretical frameworks of realists, liberals, constructivists, and neo-Gramscians.

1. Realist Theory

Following the events of World War I, the field of international relations was founded, with the goal of creating a world where conflicts are avoided and peace prevails. In this framework, international organizations have been established to promote universal balances and seek peace. However, the Great Depression of the period, as well as the rise to power of authoritarian governments in Europe, pushed the world to undertake an expansionist agenda that stands in opposition to the goals of existing institutions. All of these events led to the birth of realism theory in this field. It is well known that realism includes viewpoints that are fundamentally opposed to idealism and liberalism. Realists believe that the international system has an anarchic structure and that the state is the only player that determines international politics. It claims that in order to succeed in this society, one must be more powerful than others. Ethics and moral ideals have little impact on international politics in this anarchic environment, according to contemporary state theorist Machiavelli. Although it appears to be centered on military strength, it also promotes dominance in other areas such as economics and politics.Energy security is a subset of realism's power and security-oriented approach, which focuses on asymmetric dependency, interests, and the system's structure (Dukhan, 2015 p62).

In this anarchic order, states must be powerful in order to achieve their national interests. The most crucial step in achieving this power is to get control of energy resources. Revenues from energy resource domination, which offer a high economic return, can be transferred to military spending. In this framework, military supremacy will be achieved in potential confrontations with other nations, both economically in terms of energy production and exports, and in terms of resource domination with its developing and strengthening army (Samuel R. Schubert, Johannes Pollak, 2011 p7).

This is why the United States, China, Russia, the European Union, Japan, and India, among others. In order to access energy resources, they are engaged in regional and global power confrontations.

Interdependence, in the realist sense, means that the weak grow increasingly dependent on the strong rather than reciprocal benefit. Energy security, which is regarded as one of the most important aspects of national security, should be assessed not just in terms of economics but also in terms of politics. States should exercise caution in this scenario. States that rely on imports for energy resources, in particular, should analyze alternative energy supplies in terms of energy supply diversification, rather than relying on a single state. This will prevent the asymmetric reliance that realism emphasizes within the context of energy security. For example, following the 1973 oil crisis, the OPEC embargo, the union of oil-exporting nations' embargo, and the tough condition of the United States and the European Union, the transition to new energy sources, particularly nuclear, was made. The realist approach, which sees the state as the sole international player, opposes private or international organizations' role and leads in ensuring energy security. Finally, natural resource nationalism is critical within the realist paradigm for energy security. Natural resource nationalism may be described as a desire for governments to gain more advantages from their own natural resources.

2. Liberal Theory

In terms of liberalism and idealism approaches, it is the total opposite of realism, as previously indicated in the paragraph on realism. Individualism is at the heart of liberalism. The state's capabilities are constrained in this situation because a powerful state might interfere with the individual and push the individual to the background. In this viewpoint, the state's sole responsibility is to safeguard the liberties and interests of individuals by keeping them at the forefront. In contrast to realism, it recognizes not just states but also international organizations and non-state actors as participants in interstate relations. The decisions they make are rational in the liberal view because these actors will attempt to maximize their own interests.

Mutual collaboration is emphasized in the liberal approach. Mutual cooperation is the growth of two countries in all aspects within the framework of a win-win partnership rather than being dependent on each other. While military strength is the most significant factor in realism, from a liberal perspective, armed action is justified as the last resort because it will increase costs. International collaboration based on mutual interests is the most crucial component of the liberal approach to energy security. Energy is being given to countries through multilateral alliances rather than independently, especially when it is transferred through multiple countries.

As an example, after the conflicts between Ukraine and Russia in 2014, the United States of America, the G7, and the European Union collaborated on energy security. The liberal viewpoint, which recognizes the existence of active players other than the state, claims that the state is not the only one accountable for energy security. The International Energy Agency, OPEC, the European Union, and the United Nations are the best examples of this. The competitive determination of resource pricing within the free market equilibrium is examined within the scope of energy security, according to the liberal approach, which embraces the minimal involvement of the state on the individual. (Tayyar & Cetin, 2013 p109-115)

3. Constructive Theory

In international relations, constructivist theory analyzes events primarily via ideas like identity and national interest. Social meanings, according to this view, are useful in international relations. It is possible to encounter social meanings, historical relationships, ideas, values, and beliefs, among other things. The constructivist approach to energy supply security in this scenario is based on socially relevant relationships between the two actors. The best example is the European Union's dependence on Russia.

The impact of local structures on the state can also be considered into the social meaning framework. The difference in reactions displayed during the 1973 oil crisis, although the amount of damage on developed nations was the same, is an example of this. France, with its strong central structure, responded to this scenario with a more effective foreign policy understanding, supporting energy firms in a timely manner, and transitioning to nuclear energy, which is an alternate energy source.
Due to its federative structure, the United States of America, which was susceptible to self-interested reactions from non-state players such as environmental organizations, oil firms, and industrialists, had to pursue a more indecisive agenda.

4. Neo-Gramscian Theory

The neo-Gramscian theory is based on the Marxist philosopher and politician Antonio Gramsci's ideas. The neo-Gramscian perspective views society as a flexible and intricate system in which social forces act in three dimensions: material, organizational, and rhetorical. Aside from these aspects, society split into the state, civil society, and the economic sphere, each of which has its own set of goals.

The neo-Gramscian perspective, which regards social reality as a "socially constructed" combination of rhetorical, organizational, and material factors that strong players may manipulate, is well suited to this discussion over the meanings of energy security and its political implications. It's a useful theory for analyzing political rationale for energy security, which originates from a desire to safeguard existing power positions, rather than more altruistic political aims.

A core alliance is formed by a collection of government and corporate entities. This theory explains how this group, which is basically founded on mutual interdependence among its members, has the most authority and power and controls the economic sphere. It also demonstrates how these actors legitimize each other's acts through rhetorical, organizational, and material backing.

As an example, the Caspian pipeline consortium was signed by the governments of Russia and Kazakhstan. The collaboration was developed with the cooperation of energy corporations such as CHEVRON, LUKOIL, and ENI, as well as Russia's TRANSNET and Kazakhstan's KMG. (Sorbello, 2014)

II. ENERGY CONSUMPTION IN TURKEY

1. Relationship between energy consumption and Turkey's GDP growth

The relationship between energy consumption and GDP begins with the industrial revolution, therefore, with the development of the industrial sector, energy consumption also increases. After the industrial revolution, especially the energy and economic growth spiral began. A wheel emerges in a way that the development and growth of a country depend on production and production depends on energy.

With the increase in GDP, countries aim to increase their social welfare, and today, one of the most important inputs to increase GDP is energy. The need for energy, which started to increase rapidly after the industrial revolution, has reached the highest levels today. In particular, the increase in the demand for fossil fuels increases the damage to the environment and causes a decrease in the reserve of fossil fuels, which is a non-renewable resource, and produces an increase in the price as it runs out.

Energy sources have three main characteristic features:

- Not abundant
- They are unevenly distributed around the world
- Non-Renewable energy conversion causes environmental pollution

Energy sources can be classified under two headings as commercial energy sources and non-commercial energy sources. Commercial energy sources encompass energy forms that meet the needs of a modern industrial economy with a wide international and national market. The energy utilized by the traditional sector of the economy is known as non-commercial energy. Examples of commercial energy sources are oil, natural gas, hydropower, and nuclear energy while wood, animal residues, and agricultural residues can be given to non-commercial energy sources (Bilginoglu 1991).

As the economy develops, the demand for commercial energy resources and the production of these energy resources increase, while demand for non-commercial energy sources is decreasing.

Energy sources can be classified as primary and secondary energy sources and non-renewable and renewable according to their production:

- Primary energy: refers to directly available natural resources. That is before they are converted or transformed. Primary energy is contained in fossil fuels, solar, wind, geothermal, and other forms of energy that can be fed into the distribution system. Primary energy that is not directly usable can be transformed into some form of secondary energy.

- Secondary energies: also known as useful or final energies are obtained from primary energies through a transformation process by technical means. This is the case of electricity or fuels derived from petroleum, for example.

- Non-Renewable Energy Sources: They are fossil energies of animal and plant origin and nuclear energy. Characteristics of this kind of energy are ease of transportation, export potential, environmental impact, end-use flexibility, potential alternatives, etc. These resources are also known as depleting energy or conventional energy. These are coal, oil, natural gas, and nuclear energy.

- Renewable Energy Sources: These are hydroelectric, solar, geothermal, wind, sea-wave, and biomass (wood, manure, etc.) energies. These resources are also called renewable energies. The main advantage of renewable energies is that they help protect the environment by reducing carbon dioxide emissions. Since they are domestic, they can also contribute to reducing dependency on energy imports and improving employment. Finally, people desire the development of renewable energies more than other energy sources, largely for environmental reasons (AKTT, 2000).

On the other hand, energy consumption per capita and energy intensity are two important energy indicators. Energy intensity is a measure to calculate economic energy inefficiency. Calculated as the amount of primary energy consumed per gross domestic product (GDP). High energy intensity indicates high prices or costs for converting energy to GDP. Low energy intensity indicates low prices or costs for converting energy to GDP. This indicator first increases during the development process of the economy and then decreases again. The pace of economic development and the standard of living are two factors that determine energy demand.

The increase in total energy demand reflects changes in the nature of production and consumption in the economy and reflects changes in energy intensity. In particular, as the country moves out of the industrialization stage of development and the consumption of energy becomes more efficient, the income elasticity of energy demand declines (Medlock and Soligo, 2001).

1.1 Energy-GDP Relationship Studies

The interest in the existent effect of energy on GDP has increased especially after the oil crisis in the 1970s. As a result of the studies carried out in this area, different hypotheses have been put forward.

There are 4 different hypotheses on energy consumption and GDP.

- Neutrality hypothesis: According to this hypothesis, energy consumption does not affect GDP. In other words, it is neutral (Ersoy, 2012).
- Economic growth hypothesis: According to this hypothesis, an increase in energy consumption increases GDP (Usta and Berber, 2017).
- Conservation hypothesis: In the conservation hypothesis, there is a unidirectional causality running from GDP to energy consumption (Keskin, 2017).
- Feedback hypothesis: In the feedback hypothesis, energy consumption and GDP mutually affect each other (Kesbic, 2017).

There are many studies in the literature to test these four hypotheses described above explaining the energy-GDP relationship. I will highlight some of these studies.

- Apergis and Payne conducted three different studies in 2010, 2011, and 2012. In this study, OECD, Central American countries, and 80 countries were taken as samples respectively. In all these studies, they concluded that there is bidirectional causality between GDP and energy consumption.

- Sadorsky (2009) examined the relationship between renewable energy and GDP by taking 18 developing countries as a sample. They used 10-year panel data analysis covering the years 1994 to 2003. The results of the analysis determined that increases in per capita income increase energy consumption.

- Menegaki (2011) examined the relationship between GDP and renewable energy in Europe in his study. As a sample, they took 27 European countries. They used final energy consumption, greenhouse gas emissions, and employment as independent variables in the model. He concluded that there is a positive relationship between renewable energy and GDP.

- Tiwari (2011) examined the effect of renewable and non-renewable energy on GDP and CO2 emissions. Panel data analysis was used for the period between 1965 and 2009 by considering European and Eurasian countries. As a result of the analysis, he concluded that the energy obtained from non-renewable sources has a negative effect on GDP and CO2, while renewable energy has a positive effect on GDP.

- Zhixin and Xin (2011) investigated the causal relationship between energy consumption and GDP. In their research, they used the GDP, energy consumption, fixed asset investments and workforce variables of Shandong Province between 1980-2008. As a result of the study prepared using panel data analysis, they revealed that there is a bidirectional causality relationship between energy consumption and GDP.

- Pao and Fu (2013) examined the relationship between renewable energy and non-renewable energy to GDP over Brazil. Between 1980 and 2010, data on non-hydroelectric renewable energy consumption, total renewable energy consumption, non-renewable energy consumption, and total primary energy consumption in Brazil were utilized. They obtained findings that there is a one-way causality relationship between the non-renewable energy source and the GDP. Among their findings, they also revealed that there is a bidirectional causality relationship between renewable energy and GDP.

- Al-Mulali et al. (2014) examined the relationship between electricity consumption, which is used from renewable and non-renewable sources, and economic growth. In their studies, they used the data of 18 Latin American countries between 1980 and 2010 by making panel data analysis. In addition to renewable and non-renewable electricity consumption variables, they also used labor, gross fixed capital, and trade as variables. As a result of the analysis, it was found that all variables have a positive effect on growth in the long run.

- Sebri and Ben-Salha (2014) examined the causal relationship between renewable energy consumption and economic growth in their research. They analyzed the data of BRICS countries on economic growth, renewable energy consumption, trade openness and carbon dioxide variables between the years 1971-2010 with ARDL and VECM methods. They found evidence that renewable energy consumption promotes economic growth.

- Maji (2015), in his study, examined whether clean energy contributes to GDP or not, with the example of Nigeria. Data on Nigeria's GDP between 1971 and 2011 and electricity generation from two types of sources (nuclear energy and renewable) are used. According to the ARDL limit test results, it is suggested that there is a positive relationship between economic growth and renewable energy.

As a synthesis of all these studies presented, there are 4 fundamental variables in the relationship of energy consumption with economic growth, these are, the consumption of renewable energies, the consumption of non-renewable energies, C02 emitted (CO2 intensity), and GDP growth.

Also, it is verified that the hypothesis with more force and that is fulfilled in most cases is the Feedback Hypothesis, where energy consumption and GDP mutually affect each other, although with some nuances that I will explain below.

The nuance is CO2, which only affects GDP unidirectionally, according to studies carried out by the World Economic Forum, on C02 emissions (burning gas, coal, and oil) it results in, that only air pollution has an estimated $2.9 trillion economic cost, equaling 3.3 percent of the world's GDP.

After that, I conclude that the growth of the GDP requires an increase in the energy needed by industries and homes to sustain the economy, the difference here is that if the energy used is renewable energy, this would positively affect the economy since the decrease in CO2 emitted, results in the lower collateral cost of pollution, in the other hand a greater increase of the energy efficiency, reduces the consumption of energy since energy intensity decrease, less energy is needed by GDP unit.

2. Energy mix in Turkey

Turkey's energy consumption is constantly increasing due to developments in many fields such as industrialization, urbanization, population growth, and traffic volume increase. Domestic resources are not enough to cover this consumption, therefore, the import value of oil, natural gas, and coal occupies an important position in the total import value.
The most consumed energy sources in Turkey are fossil fuels such as oil, natural gas, and coal. On the other hand, the use of inexhaustible natural resources such as water, wind, and solar energy has not yet reached desirable levels. The main energy sources in Turkey are oil, lignite, hard coal, natural gas, hydraulic energy, wind energy, geothermal energy, solar energy, and biomass energy.

2.1 Non-Renewable Energy

- Oil

Oil fields in NorthWest and Southeastern Anatolia are so old and expensive that Turkey's production costs are very high. Turkey's oil reserves are very limited and the quality of the oil is low, far from meeting the needs of the country. Turkey produces only 8.7% of the 200 million barrels needed annually. (Daily, 2009).

Since 2010, Turkey's oil production has declined by 24%. This downtrend is expected to continue for the next 10 years due to poor and old infrastructure. If no new fields are created, Turkey's oil reserves are expected to be exhausted in 19.3 years at current production rates. (TPAO, 2009).

A large part of Turkey's total energy need, about 42%, is met by oil, and the country purchases approximately 90% of Turkey's oil supply from abroad. The geopolitical position of Turkey brings some risks in oil imports and foreign dependency on oil. Crude oil is transported to refineries by pipelines and tankers. The most important oil pipeline is the Baku-Tbilisi-Ceyhan (BTC) pipeline. Thanks to this line, Azerbaijan and Kazakhstan oil are transported through Turkey and delivered to the world market. Turkey earns significant income from this transportation. The Kirkuk-Yumurtalik pipeline is also important, but not reliable due to the conflicts in the Middle East. In 2019, most of the oil consumed in Turkey was imported from Russia, Middle East countries, and Algeria.

- Coal

Organic sedimentary rock in some lands was formed in the first geological time. Due to its high calorific value, a large part of it is used in the iron and steel industry, and the rest is used in electricity generation at the Çatalagzi thermal power plant. Hard coal deposits are located in the Western Black Sea Region, especially around Zonguldak and in a strip stretching from Eregli to Amasra, and although there are no legal restrictions on private sector participation, the state-owned Turkish Hard Coal Corporation (TTK) is the largest producer and distributor of coals in Turkey.
The hard coal deposits in Turkey are not in regular layers but are divided into small pieces. The veins in which the hard coal is found are sometimes too thin to work and are interrupted. Therefore, there are difficulties in the extraction of hard coal and production is low. It is mainly imported because Turkey can’t meet the needs of the iron and steel industry, but supply difficulties and increasing coal prices in the last two years have once again revealed the importance of domestic production.

- Lignite

Is a type of coal that was formed in the third geological time and has fewer calories than hard coal. Even though its quality is lower than hard coal it is an important mineral because it is found in many parts of Turkey and in abundance. High-calorie lignites are generally used as fuel in residences, while low-calorie ones are used in thermal power plants. The most important of Turkey’s lignite deposits are Elbistan, Soma (Manisa), Tunçbilek, Seyitömer, Tavsanli (Kütahya), Yatagan (Mugla) and Çan (Çanakkale).

- Natural gas

Is the gas mixture formed above the oil in underground spaces. Once extracted, it can be transported by pipelines or by ships in a liquefied form and delivered to other countries. It is a highly preferred fuel because it does not cause environmental pollution after consumption. Its usage areas are becoming more and more widespread. Turkey's main natural gas deposits are located in Thrace-Hamitabat, Mardin, and Siirt. Since Turkish natural gas reserves are very insufficient, it has been imported from Russia for many years. Compared to its wealthy neighbors, Turkey's natural gas reserves are very small. According to studies, Turkey's natural gas reserves are estimated to have a lifespan of 6.7 years. Although domestic natural gas production has shown an increasing trend in the later years, with new discoveries in the Thrace region and the Black Sea, new production wells are being drilled. (TPAO, 2018).

The produced natural gas meets about 2% of the consumption. In many provinces of Turkey, natural gas is used to heat houses. In addition, electrical energy is obtained from natural gas in natural gas cycle power plants in many cities. So much so that 37% of Turkey's electrical energy production comes from natural gas. Turkey meets its natural gas needs from Russia, Iran, Azerbaijan, Algeria, and Nigeria.

- Radioactive Minerals (Nuclear Energy)

These are uranium and thorium. A large amount of energy is released as a result of the splitting of the atomic nucleus. This energy is called nuclear energy. In Turkey, important uranium deposits are located in Manisa-Salihli and Yozgat-Sorgun, and thorium deposits are in Eskişehir-Sivrihisar. There are no uranium and thorium deposits opened for operation in Turkey, despite the fact that research to establish a nuclear power facility in Turkey began in 1965. However, this project was delayed due to some financial and regulatory factors (Nuclear Energy Agency, 2008). Until January 2010, Turkey decided to build the power plant in cooperation with Russia, demonstrating its commitment to nuclear power. In order to realize Turkey's 50-year-old dream of establishing a nuclear power plant, it started to come true with the signing of the cooperation agreement on the establishment and operation of a nuclear facility in the Akkuyu field. This power plant is programmed to be functional in 2023 and two more (Sinop and Igneada) in the next years to increase its energy independence. Many countries make a large part of their electricity production from nuclear energy. France provides 70% of its electricity production, Belgium 67%, and Sweden 50%.

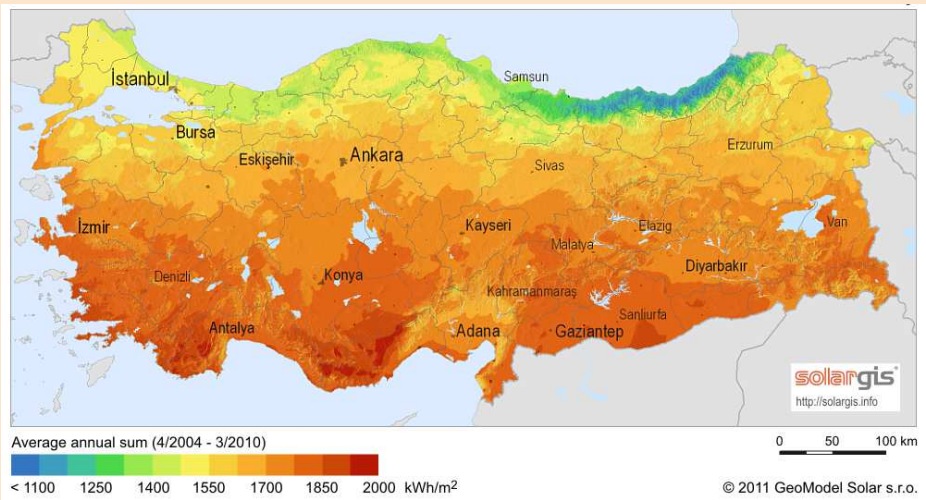
2.2 Renewable Energy

- Solar energy

Solar energy is usually a local energy source for a country. Both solar collectors and solar PV systems are usually installed close to buildings or where they are needed. While it doesn't use any fuel, solar energy doesn't add to the costs and problems of recovery, transportation, and landfill. Solar energy is practical and renewable after the initial investment has been earned (Tsikalakis, 2011). Solar energy is also a clean energy and electricity generation or solar thermal activities cause little greenhouse effect or air pollution.

Due to the geographical location of Turkey, it has the opportunity to benefit from solar energy at a high rate. (see Figure 1) Although the sunshine duration of Turkey varies throughout the year, the annual average is 2 thousand 738 hours. Turkey has approximately 7.5 hours more sunshine than Germany, that is, it can benefit from more than 60% sunlight. However, in 2015 and later years, it has been able to make progress equivalent to 1/6 of Germany in terms of installed power capacity.

Figure 1: Global Horizontal Irradiation in Turkey



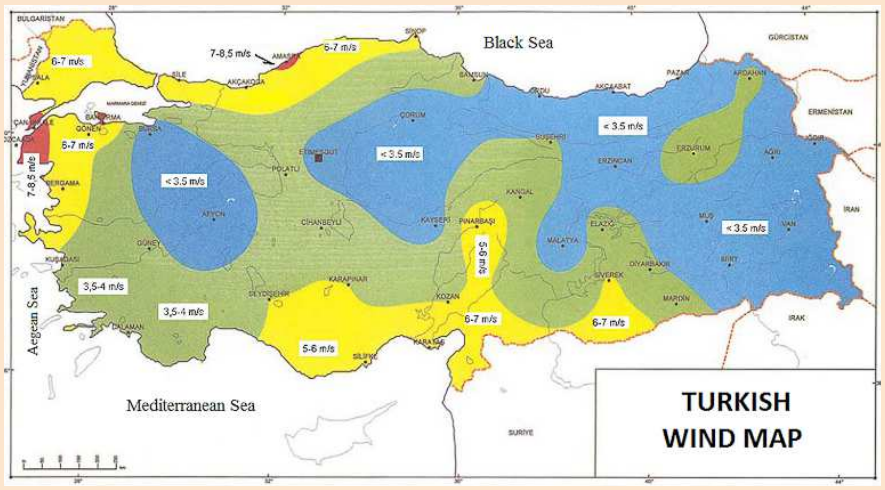
Source: Solargis, 2011

The energy of the sun is the energy source with the highest potential among the renewable resources in Turkey. Considering that the total installed power of electrical energy is 79 thousand MW on average at the end of 2016, it has been seen once again how important it is to transform the existing potential in solar energy into production. Turkey's electricity generation via solar energy is still in its infancy. Turkey's solar energy technical potential is approximately 189 GW h/year in electricity generation. Turkey has approximately 30 percent more solar energy potential than France and Spain, which have the closest ratios to Turkey in this field. It continues to work to increase the wind and solar energy capacity in Turkey's total installed power from 0.5% of its current value to over 10% by 2020. Amendments to the relevant law in 2008 allowed the use of the public utility network. In addition, the ministry of energy in Turkey announced that will add some support mechanisms to the existing renewable energy laws to benefit from solar energy.

- Wind power

The State Meteorological Organization and the General Directorate of Electricity published the Turkey Wind Map. This map shows that some regions of Turkey have strong wind conditions. Especially the south of the Marmara region (west Turkey), some interior parts of the coastal and Aegean region, parts of the West Black Sea, the eastern part of the Mediterranean, and the rugged mountains in Eastern Anatolia are particularly promising regions (Figure 2) (Öztopal et al. 2000). According to EIE data, wind speed in Turkey is sufficient for electricity generation in most regions. However, especially in terms of wind speed, the northwest coast of Turkey has important potential. Marmara region, Aegean, and Southeast regions are other suitable regions to apply the energy of the wind. According to the calculations, the potential of the current wind energy is calculated as 80 thousand MW.

Figure 2: Turkish Wind Map



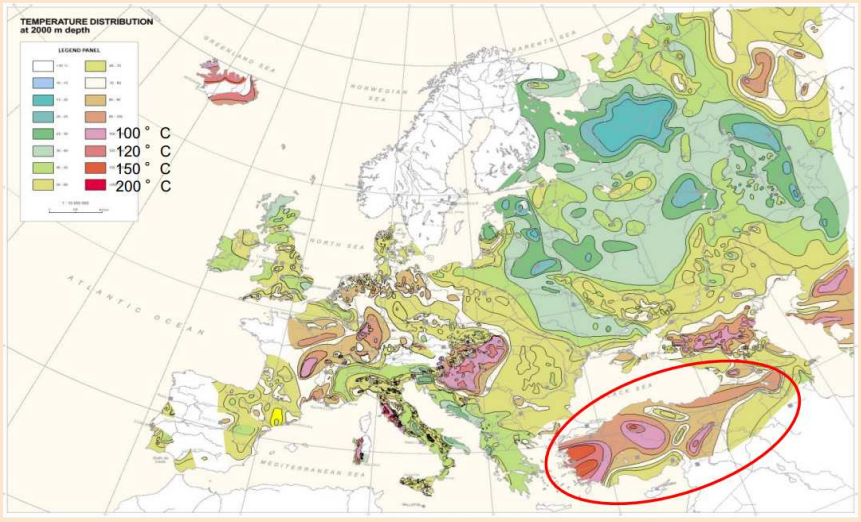
Source: Directorate of Meteorology, 2018

Turkey is the country with the highest technical potential among European countries with 166 TW / year. By 2023, it can be estimated that the total installed power capacity of wind energy (20 thousand MW) will be realized. It is aimed that a capacity increase rate of approximately 1,868 MW will be reached when the 61 Wind Power Plants (WPP) under construction are completed.

- Geothermal energy

Turkey is located in the Alpine-Himalayan belt, which has a high geothermal potential as we can see in Figure 3. According to the records of the Mineral Exploration Directorate, there are approximately 274 hot water areas in Turkey. About 25 of these are already used for direct and indirect use.

Figure 3: Geothermal Map of Europe



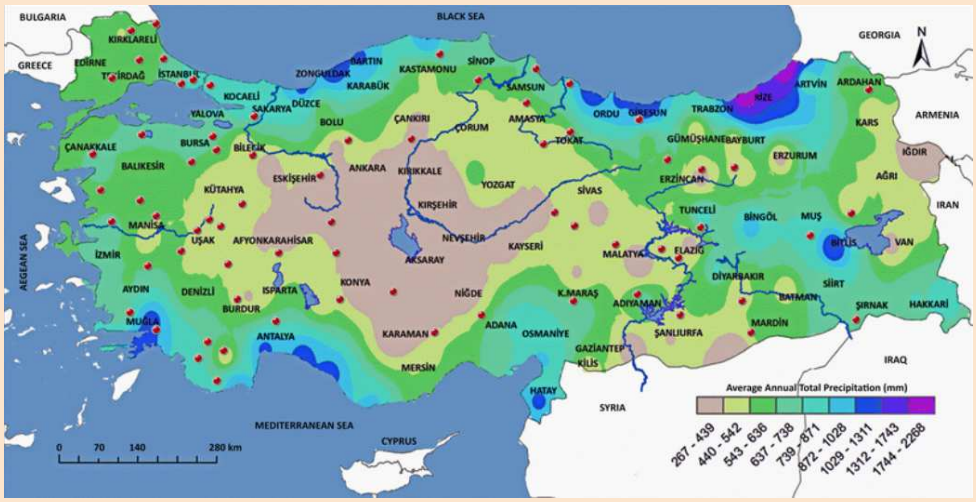
Source: Federal Ministry for Economic Affairs and Europe, Germany, 2018

While this installed power was 17.5 MW in 2002, it reached 821 MW by the end of 2016. The projection of this value in 2023 is aimed to reach a thousand MW. This energy has an important place in Turkey in terms of potential in geothermal energy.

- Hydropower

Compared to some Middle Eastern countries, Turkey can be considered relatively "water-rich". Annual rainfall is up to 250 cm in the eastern Black Sea and up to 30 cm in some parts of Central Anatolia. The southeastern region has the most abundant water resources, accounting for 28% of Turkey's total water potential.

Figure 4: Map of 1981–2010 average annual precipitation in Turkey



Source: Stochastic Environmental Research and Risk Assessment, 2010

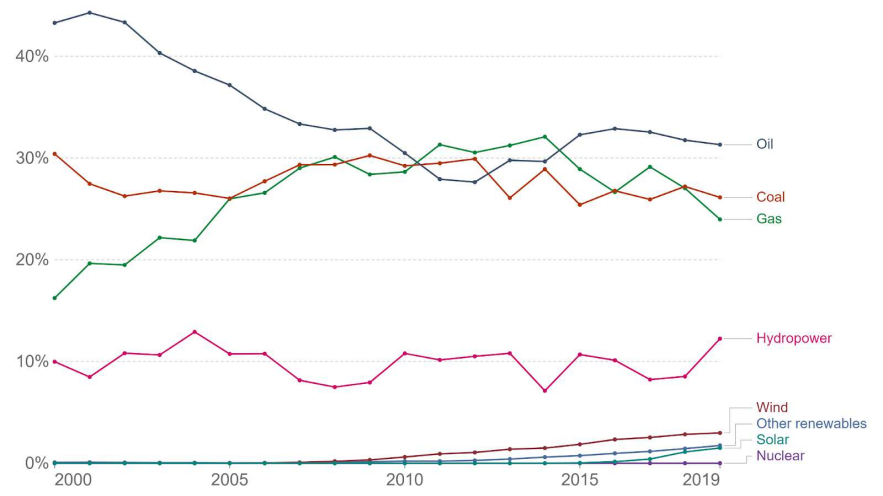
The hydraulic energy power, which had an installed capacity of 11,175 MW at the beginning of the 2000s, increased by 140 percent at the end of 2016 and reached the level of 27 thousand MW in total. Approximately 20 thousand MW of this is the dam type and 8 thousand MW is river type. It is estimated that the targeted hydraulic energy installed power capacity in 2023 will reach around 36 thousand MW. Turkey has great potential in terms of hydraulic energy. In Turkey, which turns the energy production phase into an advantage, the highest rate among renewable resources is hydraulic energy, ranking third in Europe after Russia and Norway in terms of hydroelectric potential.

Hydroelectric systems that use water energy in terms of raw materials have the lowest cost among other energy sources. In addition, hydroelectricity becomes a price stabilizing factor as it makes electricity with high costs cheap. Hydraulic energy, which is a completely renewable and domestic resource, is one of Turkey's most influential sources in terms of electricity generation.

- Bioenergy

Biomass also contributes to Turkey's renewable energy production. Turkey's most important biomass resources are wheat germ, grain powder, and nutshell. Turkey has 28 million hectares of cultivated land, which corresponds to approximately 36% of the country's total surface area. There are many unused abandoned agricultural lands in Turkey. Creating demand for biomass fuel will help to bring these areas to the economy (Erdogdu, 2008).

Figure 5: Share of energy consumption by source in Turkey



Source: Our World in Data based on BP Statistical Review of World Energy, 2020

Through the data of energy consumption by source (Figure 5), and taking into account that in recent years, since 2015 Turkey is not increasing the consumption of non-renewable energy, it is seen that Turkey is making efforts to convert its energy mix into a less polluting and more renewable one according to the times we live in of global warming.

It can be noticed that although the use of renewable energy is not at its maximum potential, every year the amount of renewable energy installations and production is increasing, and the investment in this type of energy is increasing compared to the investment in non-renewable energies.

Of course, the fact that the consumption of non-renewable energy is decreasing and the use of renewable energy is increasing is not only a climate issue, but also favors the country's energy efficiency and energy independence, on the one hand, thus increasing Turkey's energy security.

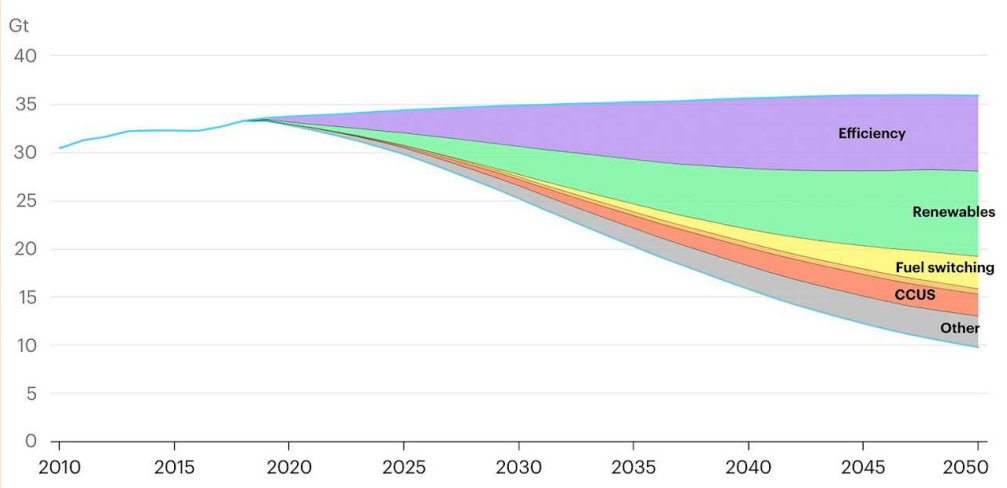
3. Energy Efficiency

Energy, which has a very important effect on the economic growth and development process of countries, is also a critical factor in determining the international policies of countries (Ismic, 2015). It is through the use of energy that countries can produce more goods and services and increase their living standards. Therefore, in parallel with the increasing population, energy consumption is also increasing.

Considering the constraints such as rapid consumption of natural resources, increasing environmental pollution, and high energy costs, it is seen that energy should be used more efficiently and effectively in every field. Considering that the world economy will be four times larger in 2050 and 80% more energy and natural resources will be needed than today (OECD, 2012), the absolute necessity of energy efficiency studies is clearly seen.

Although global energy investments increase every year to meet the world's energy demand, according to the data of the International Energy Agency (IEA) It is estimated that 35% of the total investment to be made in the energy sector on a global scale between 2020 and 2050 will be in energy efficiency as we can see in Figure 6.

Figure 6: Global CO2 emissions reductions (in Gigatonnes of CO2) by measure in the Sustainable Development Scenario relative to the Stated Policies Scenario (2010-2050)



Source: International Energy Agency, World Energy Outlook Report, 2019

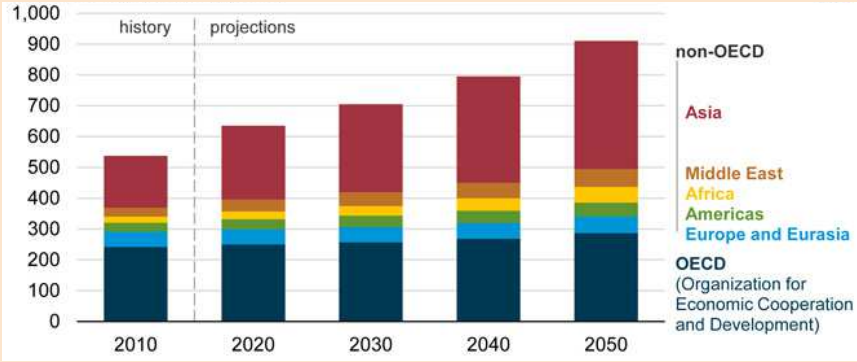
3.1 Energy efficiency in the world and in turkey

With the Industrial Revolution, mechanization has increased rapidly in the world and this has led to an increase in energy consumption in Turkey and all over the world. According to the data of the International Energy Agency, while the world's primary energy demand is 14 billion tons of equivalent oil (TOE), it is estimated that it will reach 20.3 billion TOE levels with an increase of 45% in the next 20 years. While fossil fuels constitute 81% of the world's primary energy resources as of 2016, it is expected that the use of fossil fuels in world primary energy consumption will decrease to 79% in 2040 (GAZBIR, 2016).

In addition, when the countries that consume the most energy in the world as of 2015 are examined, Turkey (29.3 million TOE) ranks 19th in primary energy consumption (GAZBIR, 2016). Despite the successful execution of investments in energy efficiency studies in Turkey and in the world, it is estimated that there will be a significant increase in global energy consumption in the coming years due to the increase in energy demand, except for OECD countries.

With the International Energy Outlook 2019, the Energy Information Administration (EIA) (Figure 7) predicts that global energy consumption will increase by almost 50% between 2018 and 2050. Most of this growth comes from countries that are not members of the Organization for Economic Co-operation and Development (OECD), and this growth is concentrated in regions where strong economic growth is driving demand, especially in Asia.

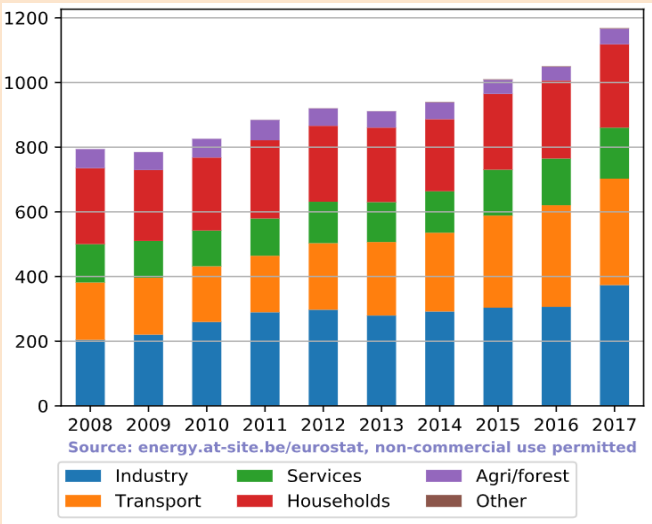
Figure 7: Global primary energy consumption by region (2010-2050)



Source: U.S. Energy Information Administration (EIA), 2019

In 2016, Turkey's primary energy consumption increased by 71.5% compared to 2000 and reached 136.2 MTEP, and the rate of imported energy resources in the primary energy supply is around 75% (YEGM, 2018). The sectoral energy consumption (Eurostat, 2017) in Turkey by year is given in Figure 8**,** and it is seen that Turkey's energy consumption has increased on a yearly basis for all sectors and that total energy consumption tends to increase in the long run.

Figure 8: Sectoral Energy Consumption in Turkey (2008 -2017)



Source: Eurostat, 2017

When a sectoral evaluation is made in terms of energy consumption, as of 2017, it is seen that the industry sector ranks first with 40%. On the basis of the energy efficiency index (ODEX), when the developments in the energy efficiency process in Turkey and EU-28 countries are examined, it has been observed that an improvement of 24.8% in total, 1.8% on an annual basis in Turkey between 2000-2016, and 18.1% in total in EU-28 countries and 1.3% on an annual basis.

When the sectoral distribution of the energy is analyzed, it has been observed that the transportation sector is 32.3%, the manufacturing sector is 24.7% and the housing sector is 16.8%. In the last 15 years, the housing sector has become the sector with the fastest development in terms of energy efficiency (27.3%), manufacturing industry with 20.4%, transportation sector with 13.4%, and service sector with 5.7%. follows the sector (YEGM, 2018).

According to the data of the General Directorate of Renewable Energy (YEGM, 2017), the sub-sectors with the highest energy consumption in the Turkish industry are the manufacturing of basic metal and non-metallic minerals (cement, glass, ceramics) and the energy consumption in these sectors constitutes 55% of the total energy consumption. In these sectors, which constitute more than half of the energy consumption amount of the Turkish industry, the electricity and heat-saving potential varies between 7-21% for the metal sector and 7-34% for the non-metallic minerals sector (MMO, 2012).

On the other hand, although the energy consumption shares of the paper, sugar, and textile sub-sectors in the Turkish industry are relatively low, it is seen that there is an energy-saving potential reaching 57% in these sectors (MMO, 2012). This situation reveals the importance of all sub-sectors in terms of Turkey's energy economy. It is obvious that energy efficiency studies in the Turkish industry should be carried out urgently in all sub-sectors.

Energy efficiency alone is the most effective in achieving national strategy objectives such as using energy in high efficiency in production, transmission, distribution, and consumption processes, ensuring safe energy supply, combating foreign dependency in energy supply, creating sustainable energy policies that encourage economic growth and environmental protection. It is stated that the energy efficiency investments planned to be implemented for these purposes will contribute 18 trillion USD cumulatively to the global economy by 2035, and this value will be greater than the total economy of North America (America, Canada, and Mexico) (IEA, 2017).

Effective use of energy, prevention of waste, The Energy Efficiency Law No. 5627 (EVK), which was prepared with the aim of increasing the efficiency in the use of energy resources and energy in order to alleviate the burden of energy costs on the economy and to protect the environment, is an important turning point for Turkey. A legal framework for energy efficiency studies with the relevant law has been acquired. Within the scope of the law, the concept of energy efficiency is defined as "reducing energy consumption without causing a decrease in the standard of living and service quality in buildings and production quality and quantity in industrial enterprises" (EVK, 2007).

Although energy efficiency studies have increased with the legal regulations in 2007 and after, Turkey ranks 16th in the world in energy efficiency ranking according to the Turkey Energy Development

Report and the American Council for Energy-Efficient Economies (ACEEE). This situation shows that the level of energy efficiency in Turkey is not at the desired level.

Between 2010-2030 in the world, in case of efficiency in transportation, buildings, and industry, and an investment of 8.3 trillion dollars in new technologies, in the same period, 8.6 trillion dollars will be saved on a global scale (WWF, 2011), while the EU is expected to reach its 20% energy efficiency target (an annual value of 60 billion Euros) by 2020 in accordance with the Energy Efficiency Directive**.** Within the scope of the national energy efficiency action, Turkey's primary energy consumption will be reduced by 14% in 2023, a cumulative saving of 23.9 MTEP will be achieved and an investment of 10.9 billion USD will be made for this saving, it is predicted to be USD 2 billion (MENR, 2018).

3.2 Energy intensity

The concept of energy intensity, which is an important indicator of energy efficiency, is used to monitor and compare the energy efficiency of countries, sectors, or businesses. The increase in the energy density value, which is determined as the amount of energy consumed in order to produce a unit of output, is an indication that the energy is used less efficiently. Countries with high energy density are Poland, Mexico, Canada, the USA, New Zealand, and Turkey, respectively. In developed countries such as Japan and Germany, energy density is low and these countries use energy more effectively and efficiently.

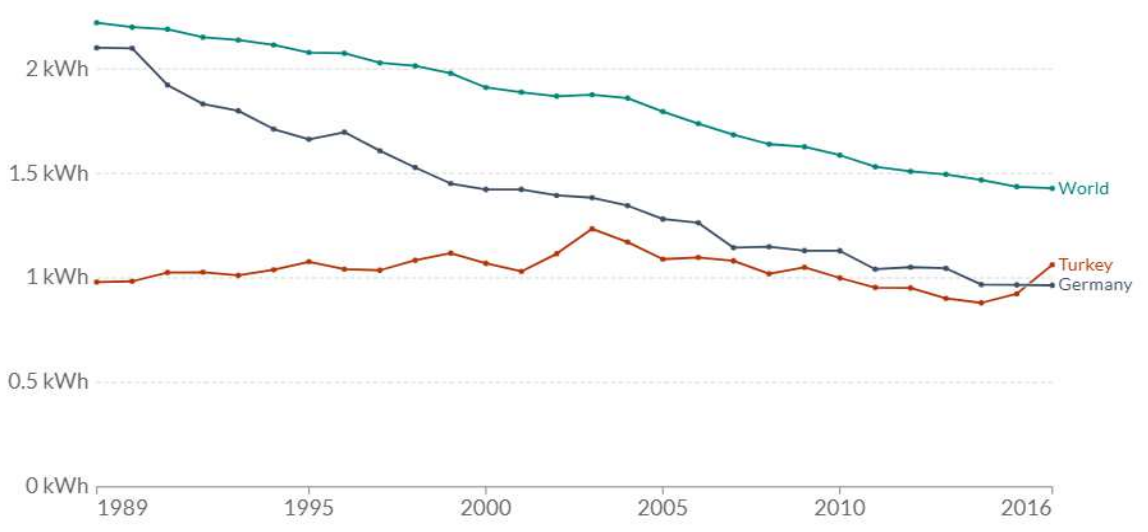
While the world average is 0.18 and the OECD average is 0.11 in terms of primary energy intensity, the 2015 average of Turkey was 0.12. According to these values, it is seen that Turkey is better than the world average and around the OECD average. When a comparison is made with developed countries (EU-28 average 0.09, Germany 0.08, and Japan 0.07), it is striking that Turkey's primary energy density is high (YEGM, 2018).

These values show that Turkey has significant energy-saving potential. Sectoral evaluation should be made in order to reduce energy intensity and increase energy efficiency on a country basis. Sectoral evaluation, to determine the environmental effects that occur during the utilization of energy resources, to ensure that energy resources are used more effectively, to determine the values, types and places of waste and losses in energy systems, to develop effective design methods by reducing inefficiencies in existing energy systems, to ensure sustainable development by using energy resources in a sustainable way, to determine the usage areas of high and low-quality energy resources and their priorities in terms of utilization, It has benefits such as identifying areas that can be improved by using technologies (Duman, 2014).

Energy intensity values in Turkey are as in Figure 9 on a yearly basis, and it is seen that even if values in Turkey are better than the world average, there is no significant decrease in energy intensity despite all the energy policies developed, compared for example with Germany the most energy-efficient country.

Figure 9: Energy intensity

Energy intensity is measured as primary energy consumption per unit of gross domestic product. This is measured in kilowatt-hours per 1.90$ (2011 PPP).



Source: Our World in Data based on BP; World Bank; and Madison Project Data Base, 2017

In the sectoral evaluations, the industry sector should be considered as a priority area due to the increasing share of the country in total energy consumption. As a result of all these studies, although the energy intensity values of the Turkish industry on the basis of sub-sectors decreased in important sub-sectors such as textile, paper, chemistry, an increase in energy intensity values is observed in other important sub-sectors such as basic metal and food.

3.3 Energy efficiency and climate change

Significant emissions occur in all processes in energy production and consumption, and these emissions are the most important cause of climate change. In addition to these emissions, the use of fossil fuels releases toxic gasses such as nitrogen oxides and sulfur oxides, as well as greenhouse gasses, and these gasses cause many health and environmental problems such as acid rain. Energy efficiency is the most economical and effective way to optimize energy needs, emissions, and therefore climate change. Energy efficiency, which is indispensable in the fight against climate change, is an environmentally friendly practice due to its contribution to the protection of natural resources, as well as meeting the increasing energy need in the most economical way.

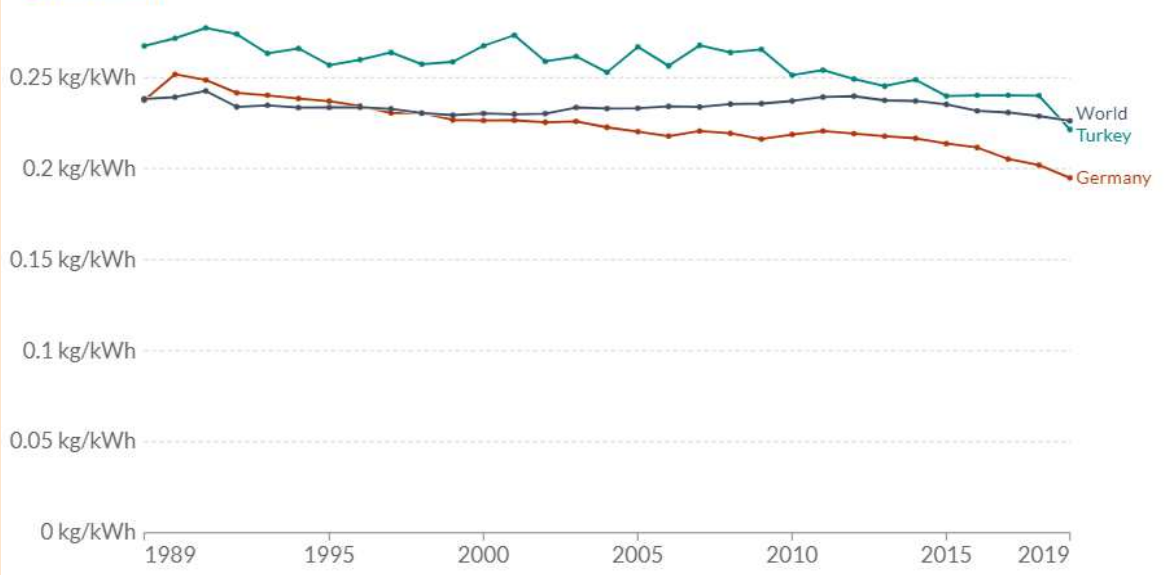
When energy efficiency is evaluated in terms of sustainability, it is stated that energy production and consumption, which is shown as one of the most important causes of the air pollution problem in the world, ranks 4th among the causes of death in the world and causes the death of an average of 6.5 million people every year (MMO, 2018). For this reason, increasing energy efficiency is one of the most important measures in terms of reducing the effect of air pollution. It is estimated that achieving the 30% energy efficiency target in the EU will be followed by a decrease in death rates due to air pollution and the economic value of this will be 2.9 - 6.6 billion Euros by 2030. In Turkey, energy efficiency has become the most important measure to reduce the negative effects of climate change

and reduce CO2 emissions. In the energy scenarios and emission comparison study of the International Energy Agency, it is calculated that the cumulative CO emission will decrease to 18.3 Gt in 2040 (MMO, 2018).

Although carbon capture and storage is an important element, especially in the industrial sector, measures taken to increase the use of renewable energy in energy production and other fields are the most weighty measures in reducing carbon emissions. One of the indicators used to monitor and evaluate the emission values in the world and to make comparisons between countries is the Carbon emitted per capita or Carbon Intensity. As it can be seen in Figure 10, although Turkey's emission value is now below the world average, it is still higher than more developed countries like Germany. With advanced technology, there is an increase in the amount of energy consumed per capita and, accordingly, the greenhouse gas emission values per capita increase if the consumption is not efficient.

Figure 10: Carbon Intensity of energy production

The carbon intensity of energy production is measured as the quantity of carbon dioxide emitted per unit of energy production. This is measured in kilograms of CO2 per kilowatt-hour.



Source: Our World in Data based on the Global Carbon Project, BP and Shift Energy Data Portal, 2020

3.4 Recommendations for energy efficiency

Energy efficiency is considered an important resource in the realization of many goals of countries such as economic growth, energy supply security, climate change, and sustainability. If energy efficiency studies are not emphasized, it will be inevitable that new investments made to meet the excess energy demand will be realized at higher capacities and therefore at higher costs. If the necessary plans are not made on energy efficiency, the energy problem for Turkey will grow even more and the economy will become more energy-intensive.

It is seen that the energy demand in Turkey is increasing gradually and this increase will continue in parallel with the developments in the industrial sector. The first application to be made to meet the energy demand of the industrial sector could be the implementation of sustainable energy efficiency objectives in all sectors. In order to meet the rapidly increasing energy demand in Turkey, it is of great importance to develop and implement policies and strategies for optimizing the use of the limited natural resources, making energy production more efficient with new technologies, and increasing the efficiency of existing technologies.

Ensuring energy supply security, solving the foreign dependency problem of 73% by establishing a competitive energy market and reducing the related economic risks, increasing the efficiency in the fight against climate change, increasing the efficiency in all processes from energy production to consumption, the eliminating of waste points and the reduction of energy density are of great importance and have become mandatory in Turkey as well as in many other countries in the world.

In this context, energy efficiency projects should be accelerated in all sub-sectors, especially in the production of basic metal and other non-metallic mineral products, which have an increased energy density and have a very important place in industrial energy consumption. In addition, energy policies should be determined in all industrial enterprises in order to prevent energy losses and reduce energy density values, and in this context, the energy efficiency practices of enterprises should be supported.

Energy efficiency is also accepted as one of the most important political tools for purposes such as not wasting and protecting domestic energy resources, preventing foreign dependency by using domestic resources in energy supply, effective use of installed power, and reducing its negative environmental effects. In parallel with energy efficiency policies, policies aiming to reduce carbon intensity should be adopted on a local, national and global scale in order to combat climate change. Despite the positive results achieved to date, stronger new policies are needed in the world.

III. ENERGY SECURITY

Energy, which in its most basic sense means "moving power", is also used to describe the resources that have a great place in the life of human beings. Energy can be studied under two basic states, potential energy, and kinetic energy. However, it is found in quite different forms and its importance has increased day by day. The fact that energy has great importance in the life of human beings has come into question with its use in various fields so that we can continue our lives. Especially after the industrial revolutions, with the increase in the use of energy resources in the field of industry, its importance has increased at the same rate. That is why, the security of such resources, the safety of the transportation routes of these resources, and the reliability of the importing country are very important issues.

The fact that imported energy resources are indispensable and so important for the continuation of human life has brought the concepts of energy geopolitics and energy security. In general terms, the concept of geopolitics examines the interaction of peoples in certain geography with other peoples and various environmental elements. The concept of energy geopolitics, on the other hand, includes not only the areas where energy resources are located but also the ways used to reach energy importing countries. Here, on the other hand, the concept of energy security, which has been a leading or an active issue in many wars for years, emerges. Events and structural changes in the wars that deeply affected the world and in the internal relations of states have brought the energy issue and energy geopolitics to the agenda. The concepts of energy security and energy geopolitics have become indistinguishable from each other since the early 1900s.

1. Energy Security in Turkey

From past to present, non-renewable energy resources have been positioned as a political and economic power factor, at the same time, it determined the economic and political power of the countries, and energy was accepted as the determining factor in the international arena. Over time, the energy needs of the countries have changed with the increasing population and the change in the energy resources used in the industry. The issue of security of energy and energy routes has gained significant importance due to the change in resource reserves, especially the increasing dependence of developing countries and rapidly increasing population on imported energy countries, the political changes in energy-exporting countries, the use of energy as a bargaining and power element and the mobilization of the markets.

Oil, natural gas, and coal, which are used as raw materials in sectors that are among the main non-renewable energy sources and have a great impact on our lives, are mostly found in geographies such as the Middle East, Central Asia, Russia, and America. The geographies where the energy centers are located, the area where the trade will take place, the roads through which the received energy will be delivered to the country, and the safety of these roads are very important for the countries that buy energy. The exhaustion of resources and their use as a power factor in the political field have revealed supply and security problems.

Energy, which is accepted as an indicator for increasing the welfare level and quality of life of societies, gained importance, especially after the Industrial Revolution. The addition of oil and natural gas to the industrialization process, which started with coal, with the effect of technological

developments, created a significant diversity in energy resources and forced societies to pursue these resources. The security of these resources, which are also used as a threat tool in hostilities from time to time, has become as important as their existence. Turkey, due to its geographical location, is rich in energy supply with the east. It is located at a critical point with the west, where its demand is high but its reserves are low, constitutes an energy corridor. Although there are not enough fossil fuel reserves on its territory to meet its needs, it has the desire to turn the negative situation into an advantage with its transit country position. With the energy policies it has put forward and the oil and natural gas pipeline projects it carries out, Turkey contributes not only to itself but also to the energy security of the countries it is associated with.

The 1973 Oil Crisis was effective in shaping the perception of energy security in the modern era. From the beginning of the 1960s to the 1970s, the world economy grew rapidly, and accordingly, the need for energy/oil increased. International developments during the 1950s led oil-producing countries to establish the Organization of Petroleum Exporting Countries (OPEC) in 1960 in order to strengthen cooperation among themselves, including determining the price of oil. OPEC has been an organization that set out to ensure oil supply security in general and its impact was not felt much until 1974 (Çelikpala, 2014).

1.1. Turkey's Energy Profile

Turkey, which has around 70% of world-proven oil and gas reserves to the east of them in the Middle East, the Caspian Basin and Central Asia, and Russia in the north, is at an important point in terms of energy geopolitics due to its location. In energy geopolitics, the geographies where oil and natural gas reserves are located are important, but the countries used in the transit of energy resources are just as important. Turkey, which can meet only 26 percent of its total energy demand from domestic sources does not have important energy resources such as oil and natural gas, but it is in a key position due to the fact that these resources are on the transition route. (Ozler, 2015).
Turkey is a country with a much more stable structure compared to the countries in the region, attracting attention with its developing economy in the last period and having a geopolitical meaning due to the bridge it has built from production resources to demand centers. Turkey has an important role to play in ensuring energy security. The natural energy corridor location at the junctions connecting 70% of the world's proven oil and natural gas reserves to western markets makes the security of existing and potential oil and natural gas pipelines passing through the country extremely important.
Although Turkey is a country rich in renewable energy resources, its resources are not enough to meet its energy needs. Turkey, which is a poor country, especially in terms of oil and natural gas, can meet only 10% of oil consumption and only 3% of natural gas from domestic sources (Sadan, 2009). However, Turkey, which has a strong potential in terms of renewable energy resources, will be able to reduce its energy dependence on foreign energy when it uses its resources efficiently. Turkey, which ranks 7th in the world in geothermal energy and 1st in Europe, ranks 3rd in Europe in hydroelectric potential. While 26 percent of the country's energy needs are supplied from existing energy resources, the rest is imported. According to the "Turkey National Renewable Energy Action Plan" published by the Ministry of Energy and Natural Resources in December 2014, it is aimed to meet 30 percent of the total electricity production from renewable energy by 2023.

1.2. Turkey's Energy Security Policies

Energy constitutes an important pillar of the economic and political development of countries. Those who direct the energy and country administration are obliged to provide one of the most basic needs of the people in an uninterrupted, cheap, and clean way (Pamir, 2003). Turkey is in an effort to create energy policies by acting with this general point of view.

Turkey geographically constitutes a natural energy bridge between the East, which is rich in energy supply, and the West, which has a high energy demand. Turkey, whose need for energy is increasing with its increasing population and developing economy day by day, is in an effort to create a policy in the most pragmatic way by using its geopolitical position (Selcuk, 2010). Being a strategic transit country, Turkey is also a candidate country to become an energy market by using this advantage. For this reason, it is important for Turkey to undertake projects that will ensure supply security, resource diversity, and safe transfer of resources in oil and natural gas imports (Bayrac, 2009).

In this context, it would be appropriate to examine Turkey's energy security policies through two main trends. The first is to increase the diversity of resources to ensure energy supply security, and to realize the goal of becoming an energy corridor and epicenter on the East-West and North-South lines. The second is to use renewable energy resources by activating its own existing and potential energy resources and to achieve a high level of efficiency by minimizing possible energy losses (Durmusoglu, 2015). While Turkey is forming its energy policies, it strives to be compatible with global energy policies, especially the EU. In this context, the main objectives of Turkey's energy policy can be listed as follows:

- To ensure resource diversity by giving priority to domestic resources.
- Increasing the share of renewable energy sources in the energy supply.
- To increase energy efficiency.
- To improve the investment environment by reaching full free-market conditions,
- To ensure resource diversity in oil and natural gas, to take precautions against risks arising from imports.
- To make Turkey an energy corridor and terminal with regional cooperation in the field of energy.
- To ensure that energy activities are carried out by considering environmental sensitivities.
- To increase the contribution of natural resources to the country's economy.
- To increase the production of industrial raw materials, metal, non-metallic mines, and to ensure that they are evaluated in the country.
- To make energy available to consumers in terms of cost, time, and quantity.

1.3. Problems in Turkey's Energy Supply Security

Due to Turkey's geopolitical position, being an energy corridor between the East and the West brings the issue of energy supply security to a much more important point. Because being in such an important position both in meeting its own energy needs and in the transit of energy to other countries requires much more attention in terms of security.
In both cases, Turkey is faced with some negativities. The most important problem faced by Turkey in terms of energy supply security is that although there is not enough oil and natural gas in its territory, the need for these two fossil fuels is increasing day by day and this need brings energy imports. In particular, the excessive use of natural gas in electricity generation, the fact that Turkey is in great need of Russia, and the constant increase in the need for oil in transportation aggravate this problem.
The inefficiency arising from the current energy system in Turkey also emerges in terms of energy supply security. Energy efficiency in Turkey corresponds to about half of OECD countries. That is, 37% more energy is used for one unit of production in Turkey than in OECD countries (Kinik, 2009).

Increasing energy demand due to industrialization and increasing population, but not having sufficient fossil fuel reserves, has led Turkey to alternative energy sources. Although important studies have been carried out on renewable resources recently, these resources are still being utilized far below their potential. The reasons for this situation are the insufficient political and economic support of the state in the first decade of the 2000s, without developing on time the necessary R&D, it can be listed as the very low level and the lack of awareness of the public on this issue years ago.

In addition to the resource, technological inadequacies, and some problems of economic and political origin, the problems that exist on an international scale are also effective in the disruption of Turkey's energy policies and targets. For example, international ships passing through the Turkish Straits carry great risks for Turkey and especially for Istanbul. Approximately 60 thousand marine vessels pass through the Turkish Straits annually, of which more than 5000 are oil tankers. Oil tankers passing through the straits account for approximately 3.7% of the world's energy consumption. In the event of an accident, both the countries to which energy shipments are made will be affected and Istanbul, with its population of 15 million, will suffer greatly. Therefore, being a transit country provides a great advantage for Turkey, but it also poses significant risks in terms of energy security (Durmusoglu, 2015).

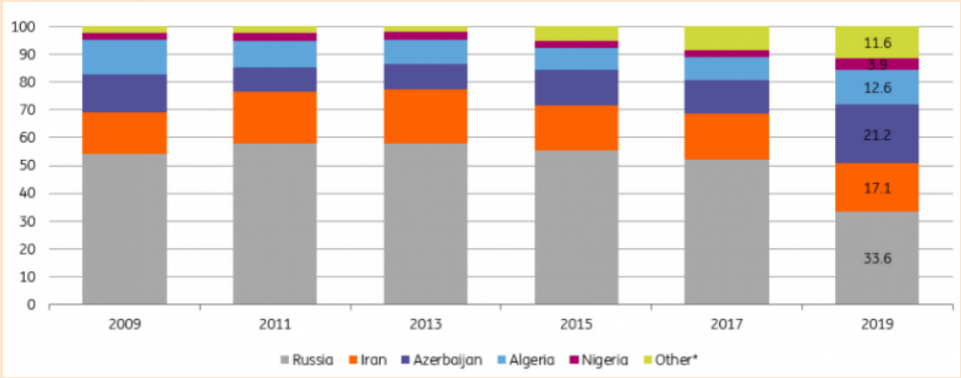
Moreover, in the recent past, the PKK terrorist organization in Turkey wanted to strike a blow to security in general and energy security in particular, with sabotage actions that carried out at least 3 oil and natural gas pipelines in the summer of 2015. As the Energy Minister of the time, Taner Yildiz, stated, "The PKK, by organizing these sabotage actions, aims to create panic and uncertainty about the security of pipelines passing through Turkish territory in order to devalue Ankara's strategic position, Thus, it aimed to prevent the stability and development of the country."
Although Turkey takes the right steps in line with the plans it targets in foreign policy, sometimes events outside of it can block the way to its goals. The Middle East govern instabilities, and lately, the events of the conflict between Russia and Ukraine and then ended with an armed intervention revealed the reality of the concerns about energy security (Durmusoglu, 2015).

1.4. Energy Dependence

Turkey is heavily dependent on oil and gas imports. Its energy policy includes efforts to promote domestic oil and gas exploration and production, increase investment in renewable energies, diversify oil and gas sources, and reduce energy consumption through improved energy efficiency. And even domestic crude oil production increased from 2017 to 2019, demand is still largely met by imports.

Therefore, Turkey will continue to rely heavily on imported oil and gas to meet consumer needs. On the other hand, Turkey's dependence on foreign natural gas imports will diminish after the recent discovery of a huge Sakarya oil field in the Black Sea. The field is scheduled to begin production in 2023, giving Turkey the bargaining power to extend its natural gas import contract. Also, Turkey has succeeded in diversifying its gas supply sources and routes for natural gas security. In the early 2000s, the Russian Federation was the main gas supplier, but Turkey began importing gas from Iran and Azerbaijan, diversifying in this way suppliers. It can be seen the evolution of the main countries supplying energy to Turkey from 2009 to 2019 in Figure 11. Turkey has recently further expanded its gas import infrastructure by increasing the capacity of its existing pipelines. Investing in liquefied natural gas, renewable energies, and from 2023 nuclear energy, is considered a priority for promoting a rise in energy independence.

Figure 11: Country Breakdown of Natural Gas Imports



Source: Energy Market Regulatory Authority, ING, 2020

1.5. Energy Sovereignty

In the energy sector, strategic sovereignty is defined as a situation in which adequate, dependable, and inexpensive energy supplies and services are provided in a manner that does not conflict with the country's objectives, interests, or foreign policy views. So, for Turkey and the rest of the world, energy sovereignty is not equivalent to energy security, however, it necessitates a robust energy system that is resilient to crises and free of political interference, constituting the foundation of a state's strategic autonomy and ability to act in energy matters. While such sovereignty is vital, it is insufficient in and of itself to ensure a country's long-term energy security.

How long-term energy security is guaranteed determines strategic maneuvering capacity. This involves adaptability, diversification, and the ability to select from a wide range of possibilities. Current and future energy supply should not prevent the key actors from pursuing and achieving their own political, foreign policy, security, and energy goals. At the same time, governments should have the institutional, political, and material resources to cooperate or, if required, independently achieve these goals. Dependence should be reduced when it creates vulnerability and challenges the effective capacity to act. Autonomy, on the other hand, should not be confused with autarchy. Strategic collaborations and ties, on the other hand, can assist increase the scope and range of action possible. (Daniel Yergin, 2020).

2. Turkey-EU Energy Security Cooperation

The energy needs of Turkey, which is experiencing a rapid development process with the EU, one of the world's largest economies, is increasing in all areas depending on many factors, especially industrial production. Increasing energy demand is met by using fossil energy sources such as oil, natural gas, and coal, and renewable energy sources such as wind, solar and hydroelectric. Natural gas, on the other hand, is one of the energy types that both actors consume most intensely among these energy sources.

However, the fact that the EU and Turkey are very poor in terms of natural gas resources despite their intense consumption causes them to become dependent on supplier countries. Increasing import dependency on supplier countries brings with it similar risks and uncertainties in terms of energy supply security for Turkey and the EU. Access to alternative supplier countries and the creation of alternative energy transmission lines come to the fore among the measures to be taken against these crises that endanger energy supply security.

In this context, Turkey's geographical location, which can provide energy flow between the countries of the Middle East and Caspian Region, which is rich in energy resources, and the EU, is very important in terms of taking these measures. Turkey's geographical location plays a decisive role in the development of Turkey-EU energy relations. In addition, the existence of similar risks and targets for both actors in the energy field also positively affects the development of energy cooperation.

With Turkey's ratification of the Energy Charter Agreement in 1994, energy relations have made progress within the scope of many programs and projects until today.

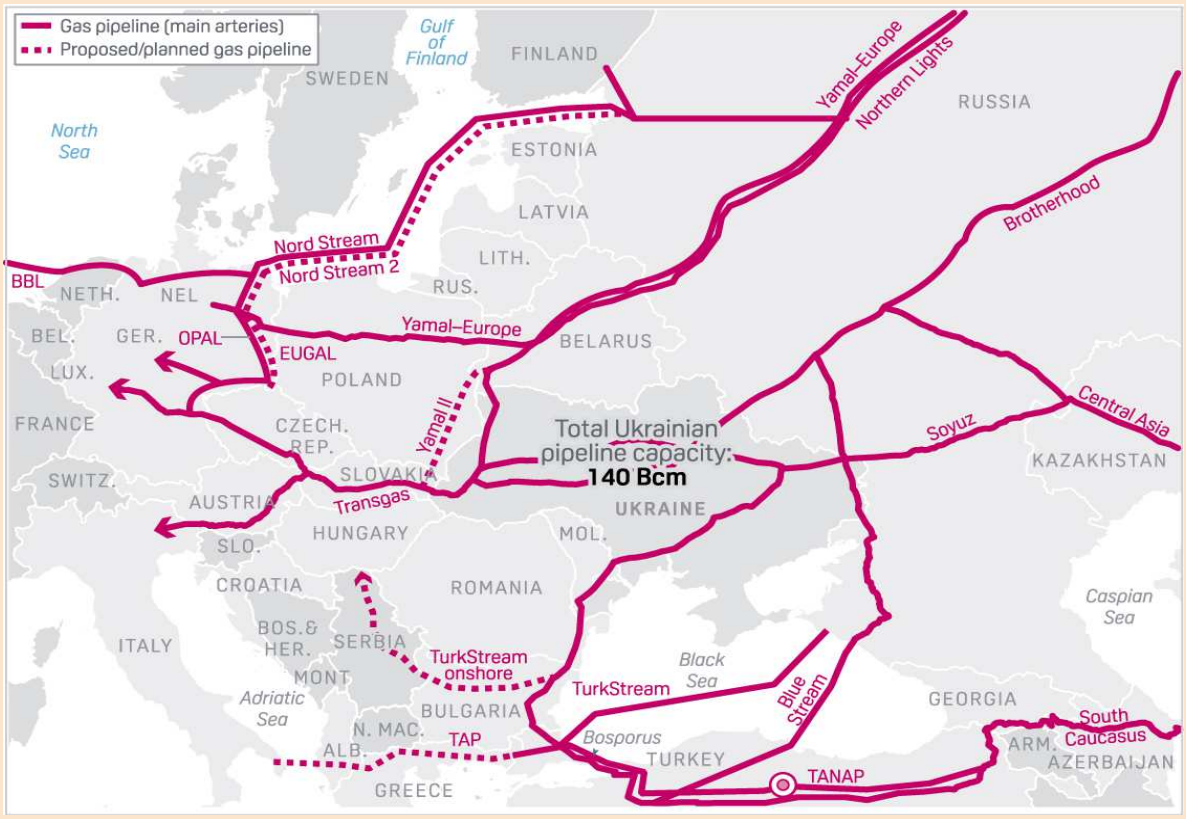
2.1. Turkey and EU's dependence on natural gas

Despite the increase in the use of renewable energy in Europe, natural gas is among the most consumed energy sources in many EU member countries. Countries with large economies such as Germany, France, Italy, and Spain, including Turkey, continue to use natural gas, which is a cleaner energy source than oil and coal, although they tend to use more renewable energy. This is observed in statistics on energy consumption, approximately 24% of the EU's total energy consumption (British Petroleum, 2018) and 28% of Turkey's total energy consumption are met by natural gas (Turkish Petroleum, 2018).

Natural gas consumption is mostly met by importing it from the supplier countries. The EU accounts for about 66% of natural gas consumption, Russia is the country from which the EU and Turkey import the most natural gas among supplier countries. It can be seen all the current and planned gas

pipelines from Russia to Europe in Figure 12. According to the statistics published by British Petroleum, European countries, including Turkey, imported approximately 190 billion cubic meters of natural gas from Russia in 2017. Among these countries, Germany ranked first with 48.5 billion cubic meters, while Turkey ranked second with 27.6 billion cubic meters. (British Petroleum, 2018).

Figure 12: Europe's Gas Pipeline ties to Russia



Source: S&P Global Platts, 2021

According to the statistics of the European Union Statistical Office, Eurostat, the EU met 38.5% of its total natural gas imports from Russia in 2017 (Eurostat, 2018). In terms of some EU countries, the import dependency on Russia is well above these rates. Baltic and southeast European countries are almost completely dependent on Russian natural gas (Dickel et al., 2014). Eleven member states, including Bulgaria, Czechia, Estonia, Lithuania, Hungary, Austria, Poland, Romania, Slovakia, Slovenia, and Finland, meet more than 75% of their national natural gas imports from Russia alone (Eurostat, 2018).

One of the most important reasons for this high level of dependency is that these countries have very limited access to alternative supplier countries other than Russia. In this respect, when compared to EU countries, Turkey has a more advantageous position as it can supply natural gas by pipelines from Russia, Iran, and Azerbaijan, and by sea from supplier countries on other continents. The most important factor that provides this advantage to Turkey is its geographical location close to supplier countries rich in energy resources.

However, since Turkey continues to meet more than half of its natural gas demand from Russia, it is also considered a country with a high risk of energy supply security. The natural gas cuts caused by the political crisis between Russia and Ukraine make the EU and Turkey feel the negative consequences of their dependence on Russia. The fact that Russia has stopped the flow of natural gas reaching EU countries through Ukraine many times during the crisis creates the impression that natural gas is used by Russia as a political tool for consumer countries. For this reason, the possibility of Russia using the natural gas card as a political tool for political reasons in its relations with the EU and Turkey increases the uncertainties regarding energy supply security for both actors.

2.2. Turkey-EU energy relations

Turkey-EU energy relations started to develop after energy security was considered an important and vital issue for the EU to affect national security. Especially the EU and Turkey's natural gas import dependency on Russia and the energy security concerns caused by this dependency have a significant impact on the development of relations. Turkey-EU energy relations develop on the basis of international agreements involving both actors, energy policies with similar objectives, EU's regional initiatives, aid programs, and membership negotiations. The Middle East, the Caspian Region, the Black Sea and the Eastern Mediterranean are the regions where both actors try to develop common policies. Energy relations are supported by international energy transmission line projects reaching Europe from these regions, in which Turkey plays a role as a transit country, and it is necessary for Turkey's accession to the EU.It forms an important part of the positive agenda that will stimulate the negotiation process.

2.3. Energy Charter Agreement

Turkey-EU energy relations gained momentum after Turkey signed the Energy Charter Agreement on 17 December 1994 and ratified it on 20 July 2000. The Energy Charter Treaty, signed by 52 countries, including EU countries, basically aims to increase energy supply security, increase efficiency in all energy-related stages, and encourage investments by removing obstacles (The Energy Charter Treaty, 2017). Liberalization of international energy trade and facilitating the transportation of energy resources are among the basic principles. Another goal of the agreement for the EU is to provide access to the energy resources of the Caspian Region. Turkey, which is the most suitable country to act as a corridor in the transport of these energy resources to the EU, plays an important role within the scope of the agreement. It actively participates in the Transit Protocol negotiations and is the Chairman of the Budget Committee (Demir, 2017).

2.4. Energy Transmission Lines

The energy cooperation between Turkey and the EU has brought various pipeline projects to the agenda, especially in the field of natural gas, in which Turkey is at the center. In this context, the Nabucco Project and the Trans-Anatolian Natural Gas Pipeline Project (TANAP) are the most important projects that have come to the fore so far. With the Nabucco Project, one of the first plans, 31 billion cubic meters of natural gas to be procured annually from Azerbaijan, Turkmenistan, Iran, and Iraq, delivered to South East and Central European countries. (see Figure 13)

Figure 13: Existing and planned oil and natural gas pipelines to Europe

Source: Ömer Esen, Namik Kemal Üniversitesi, 2016

The EU's efforts to access supplier countries that could be an alternative to Russia were not limited to the Nabucco project. With the EU Energy Security and Solidarity Action Plan published in 2008, the creation of the Southern Gas Corridor (GGK) was brought to the agenda. The GGK is aimed to transport the natural gas resources of the Caspian Region and the Middle East to the EU. According to the EU Energy Security and Solidarity Action Plan, it is recommended to reach an agreement with the transit countries, especially Turkey, in terms of developing cooperation and establishing new pipelines with Azerbaijan, Turkmenistan, and Iraq, which stand out as supplier countries in the region (European Commission, 2008). Apart from TANAP, another project that aims to transport natural gas to Europe via Turkey and is under construction is the Turkish Stream. Turkish Stream, which aims to make Russian natural gas available to Turkey and EU countries, consists of two separate pipelines. One of the pipelines with a total capacity of 31.5 billion cubic meters is planned to meet the natural gas needs of Turkey and the other EU countries (Pirani, 2016). The start of the construction of the Turkish Stream in 2016, despite the energy crises caused by Ukraine, shows that Russia maintains its position as an important supplier country in meeting the natural gas needs of the EU and Turkey in the short term.

2.5. Turkey-EU Reinforced Energy Cooperation

The existence of similar policies and goals in the field of energy between the two actors ensures that steps are taken to keep the negotiation process alive, which is stalled and shaken by the crises in the political field. In this context, at the meeting held in Stuttgart on 14 June 2012 with the participation of the EU Commission members and the Minister for EU Affairs and the Minister of Energy and Natural Resources from Turkey, it was decided to establish an Enhanced Energy Cooperation between the EU and Turkey within the framework of the positive agenda.

At the meeting, it was mentioned that energy has key importance for Turkey and the EU, and it was stated that Turkey's progress as an energy center and energy bridge would be beneficial for the EU and Turkey. In addition, the importance of providing a comprehensive market integration between Turkey and the EU was emphasized. Within the framework of the Strengthened Energy Cooperation target between the EU and Turkey, it has been stated that there are similar long-term priorities in energy supply security, diversification of supply sources, and energy efficiency and that cooperation in these areas will be mutually beneficial. In particular, the mutual opening of the Turkish and EU natural gas markets and the natural gas flow from Turkey to the EU and from the EU to Turkey, and the integration between energy markets (European Commission, 2012).
In this context, the development of bidirectional pipeline connections around the Southern Black Sea region is supported to ensure energy supply security. It is also stated that the GGK will be supported by the EU in order to have the capacity to handle the natural gas volume that will increase in the future. It is also mentioned that these improvements in natural gas infrastructure, construction of natural gas storage facilities, and LNG terminals are important for Turkey to become an energy center (European Commission, 2012). Meetings for the development of Enhanced Energy Cooperation between the EU and Turkey are held periodically. At the meeting held in 2016, the EU Energy and Climate Commissioner stated that Turkey has important geography to transform into an energy center and that Turkey will play an important role in the delivery of Eastern Mediterranean natural gas to Europe, as well as Azerbaijan and Turkmenistan natural gas (European Commission, 2016). It has also been announced that the EU will help Turkey to become an energy center and that Turkey can benefit from EU funds for the construction of new natural gas storage facilities (Bloomberg, 2017).

Despite the problems experienced during the negotiation process and the tense political relations, Turkey-EU energy relations are developing. This is because Turkey and the EU have common interests, goals, and policies in the field of energy. Both actors act primarily with the aim of ensuring their own energy supply security. However, the natural gas import dependency on Russia and the goal of reducing this dependency by providing access to alternative supplier countries increase the interdependence between Turkey and the EU. The fact that the natural gas resources in the Caspian Region, the Middle East, and the Eastern Mediterranean are among the most important alternatives to diversify the EU energy market and that Turkey is the most suitable route in terms of access to these resources, thanks to its geographical location, increases the EU's dependence on Turkey. This interdependence between Turkey and the EU may also have an effect on accelerating the negotiation process, which came to a freezing point, especially after the coup attempt in Turkey on 15 July 2016.
The positive effect of the developments in the energy field may encourage EU countries to increase integration with Turkey in all areas in the future, or it may pave the way for closer ties by creating a partnership between both actors within the framework of a win-win approach outside of EU membership. This relationship model may become more meaningful for Turkey after the UK left the EU after the Brexit process. The new relationship model that will be formed between the UK and the EU can be established between Turkey and the EU in many fields, especially in energy. The creation of new energy transmission lines that can provide access to alternative supplier countries outside of Russia has a key role in the development of Turkey-EU energy relations. In this context, in order for Turkey to become an important transit country for the EU, it is very important to give priority to projects such as TANAP that will transport the Caspian region gas to the EU and increase the number of alternative supplier countries, instead of developing projects such as Turkish Stream that will increase natural gas dependence on Russia.

In this respect, Turkmenistan, Kazakhstan, Azerbaijan, Iraq, and Eastern Mediterranean countries are among the target countries. Turkey should strive for the inclusion of Kazakhstan and Turkmenistan, especially the Caspian Region countries, in TANAP, and develop energy dialogue with the supplier countries in the Eastern Mediterranean that it has problems with. Steps to be taken in this direction, naturally, will cause the reaction of Russia, which does not want to lose its dominance in the European energy market, and will reveal Russia's attempts to prevent it. At this point, the EU and Turkey should act jointly in their own interests and take measures to support each other.
Moreover, while the problems between Turkey and the Greek Cypriot Administration of Cyprus due to the Cyprus Conflict cause the negotiation process to be delayed, it also prevents the energy flow to be provided between the Eastern Mediterranean and the EU through Turkey. In this respect, first of all, the Cyprus Conflict should be resolved. Solving the problem will remove the biggest obstacle to the opening of negotiations on a total of six topics, mainly energy and other topics, and will facilitate the delivery of Eastern Mediterranean natural gas to Turkey and the EU. The EU's financial support for the realization of Turkey's projects in the field of energy and especially for the development of its energy infrastructure is important.

2.6. EU-Turkey projects

Within the scope of the ongoing accession process between Turkey and the European Union (EU), the EU-Turkey Financial Cooperation Instrument (IPA) II. The period covers the years 2014-2020. In this direction, the Turkish Energy Ministry, the Energy Sector Leading Authority in the IPA II Period, together with its Implementation Unit, the Central Finance and Contracts Unit (CFCU), forms the Annual Operating Structure for the projects to be carried out in the energy sector. In the IPA II Period, the following priority areas to be supported by EU grants in the energy sector were determined with the "Indicative Strategy Document for Turkey (2014-2020)":

Priority Area 1 - Market Integration and Infrastructure Development:

- Modernization of Turkey's electricity grid in accordance with the rules of the European Network of Electricity Transmission System Operators (ENTSO-E),
- Modernization of Turkey's natural gas network in accordance with the rules of the European Network of Natural Gas Transmission System Operators (ENTSO-G),
- Software and hardware support, including Remote Control and Monitoring System (SCADA),
- Harmonization of Turkey's electricity and natural gas legislation and network operation regulations with the EU.

Priority Area 2 – Renewable Energy and Energy Efficiency:

- Developing and implementing renewable energy and energy efficiency programs,
- Developing the capacities of Energy Efficiency Consulting (EVD) companies,
- Increasing the competitiveness of SMEs and micro-investors,
- Measurement, monitoring, and reporting of energy-saving and greenhouse gas emission data,
- Increasing awareness of energy efficiency in industry, commerce, and households.

Priority Area 3 – Nuclear Safety:

- Improvement of the regulatory and operational framework in the field of nuclear safety in line with EU standards.

IV. ENERGY TRANSITION

Energy has become one of the world's and humanity's most crucial necessities nowadays. Due to the increasing demands and the production processes developed to meet these demands, the need for energy and energy use is also increasing. In order to find permanent solutions to the energy, it is necessary to define energy problems correctly, to find applicable solutions, to distinguish between old and current best energy technologies, and not to use old technologies that do more harm than good (Ploetz et al., 2016). Considering the energy market and energy needs, fossil fuels are under pressure and this makes the renewable energy market, which has just begun to mature, advantageous. Fossil fuels are a significant problem since they contribute to global climate change and environmental hazards. Fossil fuels are finite resources that are on the verge of becoming extinct. Due to the greenhouse gasses formed by the use of fossil fuels in energy production, both climate change and ecological balance deterioration are observed. The limitation of fossil fuel sources requires diversification of energy sources to ensure the availability of energy. It is predicted that turning to new and renewable energy sources will be the right step in meeting the energy needs of the future (Ploetz et al., 2016).

In order to meet the increasing energy demand in Turkey, to reduce foreign dependence on energy resources, and to make an environmentally friendly production, it is of great importance to make use of renewable energy resources at the highest level. In Turkey, various renewable energy sources have a utilizable potential to provide added value to the economy. The fact that renewable energy potential is not completely employed puts strain on the country's economy and has detrimental consequences for the ecology, particularly air pollution and climate change. The most up-to-date and effective solution proposal for improvement is accepted as the "Transition to 100% Renewable Energy" approach. Renewable energy includes high entropy resources suitable for the realization and conversion of energy production of the desired quality. The benefits of transitioning to 100% renewable energy can be listed as follows:

- Fuel wealth
- Possible decrease in energy prices
- Reducing foreign dependency on energy
- Clean and safe energy production
- Protection of public health, Improvement of air, water and environmental pollution
- Regulation of the local economy (Ploetz et al., 2016).

Of course, besides the advantages of renewable energy sources such as being clean energy and being infinite, there are also disadvantages that should be taken into account. These relate to limited potential, high cost, and energy densities. The high initial investment costs of the projects to be made for the use of renewable energy sources in energy production and the existence of energy storage problems create a disadvantage in the use of renewable energy sources (Ploetz et al., 2016).

Looking at the development of the last 10 years in Turkey, while the share of renewable generation was 19.58% in 2008, this share was 32.08% in 2018. Regarding fossil fuel-based energy production, while it had a share of 82.06% in 2008, this share decreased to 67.60% in 2018. This information shows that significant progress has been made in the transition to 100% renewable energy in Turkey.

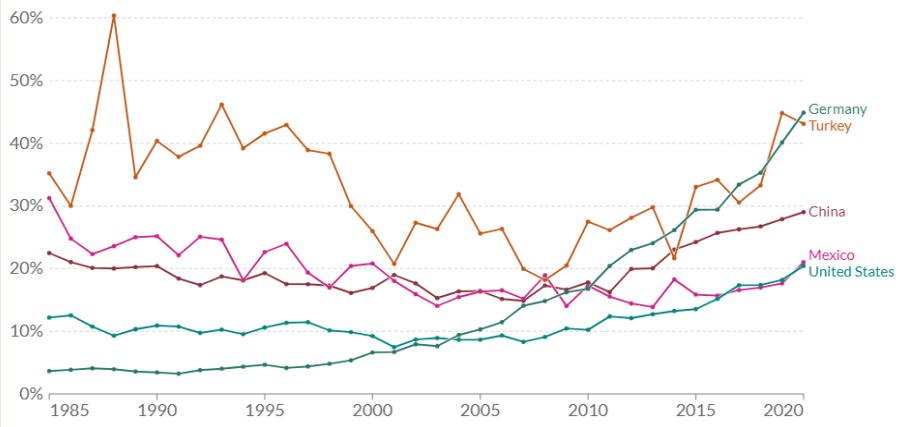
1. 100% Renewable Energy

Fossil fuels resources are facing increasing supply, environmental pollution, and climate change problems, while renewable energy can offer the best prospects for energy, renewable energy sources differ from fossil fuels in many important ways. The term "100% renewable energy" refers to the use of 100% certified renewable energy sources in all sectors where energy is utilized, particularly in power generation, transportation, and heating and cooling. Achieving this goal will enable Turkey and the world to reduce unsustainable energy demand, increase energy efficiency, and produce much cheaper and much cleaner energy.

1.1. Transition to 100% Renewable Energy in the World

Progress in the renewable energy sector is still centered in the field of power production, with heating, cooling, and transportation growing at a considerably slower pace. With electricity accounting for only one-fifth of worldwide energy use, renewable energy's role in transportation and heating is crucial to the energy transition. In the global journey to 100% renewable transition, 2018 has maintained a steady profile. In 2018, the renewable energy sector employed over 11 million people (direct and indirect) throughout the world. Despite advances in energy efficiency and the transition to 100% renewable energy, the world still lags below the United Nations Sustainable Development Goals and the Paris Agreement. Carbon dioxide (CO2) emissions from the world's primary energy source, fossil fuels, increased by 1.7% in 2018 due to increased consumption. Since 2017, the consumption of fossil fuels has climbed by 11%. Fossil fuel companies continue to spend hundreds of millions of dollars on advertising to delay, control, or circumvent climate change policies and influence public opinion. In Figure 14, renewable energy productions of Turkey and countries that are one step ahead of other countries in the transition to 100% renewable energy are compared. Looking at Turkey, it has been ahead of countries like China, the USA, and Germany in renewable electricity generation in the transition to 100%.

Figure 14: Share of electricity production from renewable energies



Source: Our World in Data based on BP Statistical Review of World Energy, 2021

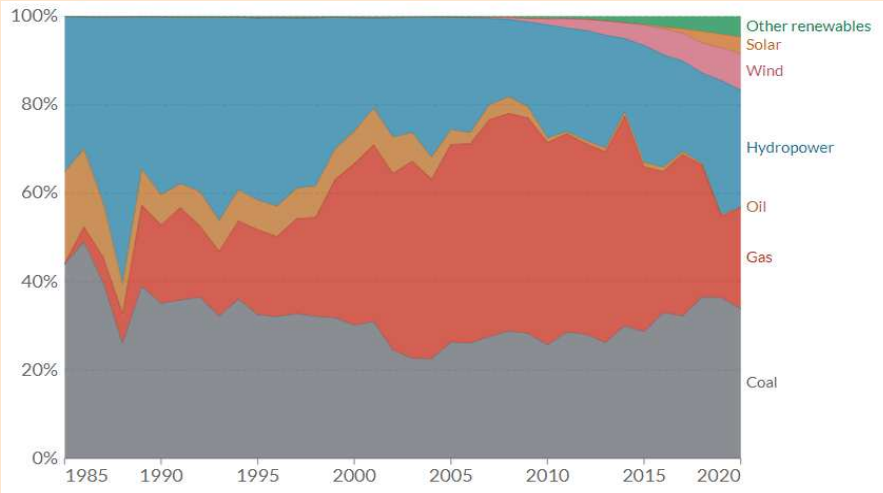
Countries seeking to shift to 100% renewable energy have plenty of modest and major projects in place to help them reach their objective. According to data from the International Energy Agency from 2018, renewable energy accounts for 26% of worldwide electricity generation. This demonstrates that the worldwide transition to 100% renewable energy is 26% complete. At the national or state/provincial level, 169 nations plan to shift to 100 percent renewable energy by 2018. Solar buses in Uganda, solar ferries in India, and wind-powered trains in the Netherlands have all begun to be utilized to transition to renewable energy since buses contribute more to air pollution than other public transportation vehicles.

There are also a number of policy measures implemented by countries to move forward on the path to 100% renewable energy. Albania, Norway, and Costa Rica are among the countries that have transitioned to 100% renewable energy. In the Dutch rail network systems, 100% of its trains are powered by wind energy.

1.2. Transition to Renewable Energy in Turkey

As in the whole world, both energy demand and energy production are increasing day by day in Turkey. However, despite the increase in this energy production and energy demand, the world is turning to 100% renewable energy due to the decrease in fossil fuel resources, which form the basis of energy production resources, and the environmental pollution of fossil fuel resources. For this reason, the trend towards renewable energy sources, which is an alternative energy source, and the concept of transition to 100% renewable energy has also increased in Turkey. According to Figure 15**,** the development of electrical energy by source has varied since 2007. Turkey's proportion of fossil energy generation in electrical energy production fell from 80% to 67 % in 2018. In contrast, the share of renewable generation has increased from 19% to 32% since 2007.

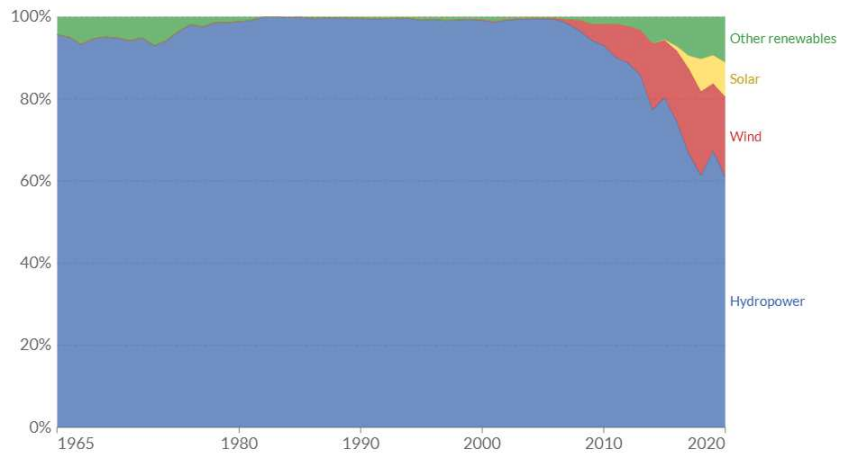
Figure 15: Electricity production in percentage by source in Turkey



Source: Our World in Data based on BP Statistical Review of World Energy, 2021

When Figure 16 is analyzed, hydraulic energy, geothermal energy, wind energy, solar energy, and biomass energy are the most effective renewable resources in electricity generation in Turkey, respectively. Each type of renewable energy has increased overall since 2007.

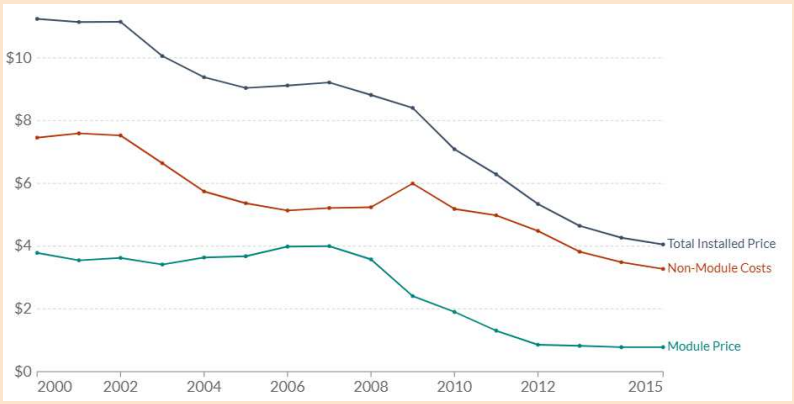
Figure 16: Renewable Energy Generation in Turkey



Source: Our World in Data based on BP Statistical Review of World Energy, 2021

While 35,000 GWh of electrical energy was produced in 2007 with hydraulic energy, this production reached 60,000 GWh in 2018. While 156 GWh of electrical energy was produced in 2007 with geothermal energy, this production reached 7400 GWh in 2018. In the last 11-year period, all energy types have increased significantly in energy production. continued. Electricity generation with solar energy started in 2014, and by 2018, 7800 Gwh of electrical energy was produced with solar energy, (As it's seen in Figure 17, the solar PV system costs through the years is decreasing, it is making the investment easier to do).

Figure 17: Solar PV System costs 2000 - 2015



Source: Barbose and Darghouth, 2016

Among all these energy types, as of 2018, biomass energy has the lowest share of electrical energy production with 2600 GWh. The reason for the decrease in the share of all energy types in electricity

production in 2013-2014 is the licenses and regulations brought by EMRA for renewable energy generation. The development of renewable energy sources is extremely important to Turkey and increasing the use of domestic and renewable energy resources is one of the primary aims of the National Energy Policy. Turkey has ascended to 5th place in Europe and 12th in the world in terms of renewable energy installed power in 2021. Renewable energy sources account for 52% of Turkey's installed electricity as of the beginning of 2021.

The ever-increasing share of renewable energy in Turkey's energy profile shows that Turkey is progressing positively in the transition to 100% renewable energy and there is a very important renewable energy resource potential in Turkey that is open to evaluation. The reason for the energy crises in the country is due to the wrong policies that have been maintained for many years in energy planning and management. In the transition to 100% renewable energy, taking into account the realities of the country in energy planning and energy management, the right policies should be established by getting support from universities and professional chambers, and legal regulations should be made.

2. International organizations and agreements in the field of energy

- International Energy Agency (IEA)

The International Energy Agency (IEA) was founded in 1974 under the authority of the Organization for Economic Cooperation and Development (OECD) to assure oil supply security. In the sphere of energy, the IEA now functions within a considerably larger framework. Turkey is one of the IEA's founding members. Its headquarters are located in Paris.

- International Atomic Energy Agency (IAEA)

In 1957, the International Atomic Energy Agency (IAEA) was founded as a non-governmental organization. The IAEA was established to expand the potential peaceful applications of nuclear energy. The IAEA works within this framework to avoid the use of atomic energy for non-peaceful purposes. Turkey was one of the first countries to join the International Atomic Energy Agency (IAEA) in 1957. Vienna is the headquarters of the organization.

- International Renewable Energy Agency (IRENA)

Turkey became a founding member of the International Renewable Energy Agency on January 26, 2009, upon signing the agreement at the end of a conference in Bonn (IRENA). IRENA is an international organization that was founded in 2011 to promote the widespread and increasing use of renewable energy for sustainable development. It had 162 members by 2020. The company's headquarters are in Abu Dhabi.

- Energy Charter Treaty

The Energy Charter Pact is a multilateral agreement that intends to assure energy security by developing transparent, competitive markets and promoting long-term growth in this direction. It contains rules on problems such as energy investments, energy commerce, energy efficiency, and dispute resolution in this framework. It had 56 members in 2020. Turkey is a signatory to the Accord. Brussels is home to the organization's secretariat.

- Paris Climate Agreement

The Paris Climate Agreement aims to support the principles of sustainable development by aiming to improve the implementation of the United Nations Framework Convention on Climate Change. Since the Kyoto Protocol expired in 2020, the 21st Conference of the Parties was held in Paris, France in 2015, and the Paris Climate Agreement was adopted to be valid after 2020. The Paris Climate Agreement aims to support the principles of sustainable development by aiming to improve the implementation of the United Nations (UN) Framework Convention on Climate Change. Keeping the global average temperature rise at a controllable level is one of the main objectives of the agreement. The agreement imposes responsibilities on the countries to reduce emissions. These responsibilities differ according to the level of development of the countries, and developed countries are committed to reducing their emissions further. Thus, by 2050, developed countries are expected to reach zero emissions. Although Turkey signed the Paris Climate Agreement with the representatives of 175 other countries in 2016, it waited until 2021 to implement the agreement. There were two main reasons behind Turkey's wait until 2021. The first of these was about whether Turkey could be treated in the same way as countries similar to it in order to access financial and technical support. The second was about whether Turkey could meet the expectations regarding emission reductions, given the criteria such as economic growth and population growth.

- United Nations Sustainable Development Goals (Agenda 2030)

UN, Turkey, and its partners are working towards achieving the Sustainable Development Goals: 17 ambitious, interconnected Goals aiming to solve the main problems faced by people all over the world, including Turkey. UN Turkey continues its support to achieve these Goals by 2030. The Sustainable Development Goals aim to end poverty, protect the environment, take precautions against the climate crisis, fair distribution of wealth, and peace between others.

In the topic of energy security, efficiency, and energy transition, the most important ones are

- SDG 7: Providing access to affordable, reliable, sustainable, and modern energy for all

7.1 Universal access to modern energy

Ensure universal access to affordable, reliable, and modern energy services by 2030.

7.1.1 Proportion of the population with access to electricity

7.1.2 Proportion of population using clean fuel and technology for heating, light, and cooking.

7.2 Increasing the global share of renewable energy

Significantly increase the share of renewable energy in the global energy mix by 2030.

7.2.1Renewable energy share in total final energy consumption.

7.3 Doubling the improvement in energy efficiency

By 2030, improve water quality by reducing pollution, eliminating dumping, minimizing the release of harmful chemicals and substances, and dramatically increasing recycling and safe reuse globally.

7.3.1 Primary energy and energy intensity measured in terms of gross domestic product (GDP)

7. A. Supporting access to clean energy research, technology, and investments

Developing international cooperation and promoting investment in energy infrastructure and clean energy technology areas to facilitate access to clean energy research and technologies, including renewable energy, energy efficiency, and advanced and cleaner fossil-fuel technology by 2030.

7.a.1 International financial flows to developing countries to support clean energy research and development (R&D) and renewable energy production, including hybrid systems.

7. B Expanding and improving energy services for developing countries

By 2030, expand infrastructure and develop technology to provide modern and sustainable energy services to all in developing countries, particularly least developed countries, small island developing states, and landlocked developing countries, within the framework of their support programs.

7.b.1 Amount of foreign direct investment in sustainable development services in the form of financial transfers for infrastructure and technology and the ratio of investments in energy efficiency to gross domestic product (GDP).

- SDG 13: Climate Action Take urgent action to combat climate change and its effects

13.1. Strengthening resilience and adaptability in all countries to climate-related hazards and natural disasters

13.2. Integrating climate change measures into national policies, strategies, and plans

13.3. Developing training, awareness-raising, and human and institutional capacity on climate change mitigation, adaptation to climate change, mitigation and early warning

13.a Implement the commitment to jointly mobilize $100 billion annually by 2020 to address the needs of developing countries in the context of meaningful mitigation actions and transparency in implementation undertaken by developed countries that are party to the United Nations Framework Convention on Climate Change and the Green Climate Fund fully operational as soon as possible through capitalization

13.b Supporting mechanisms to increase capacity for effective climate change planning and management in the least developed countries and small island developing states, with a focus on women, youth, local communities, and marginalized groups.

3. Towards a Renewable Future

The energy issue is a big problem all over the world and in Turkey. Most of the energy problems arise from not making the right investments and risky projects, and switching to renewable generation and switching to 100% renewable energy will be the cleanest and right solution. Leaving aside the debate of profit/loss in the energy industry, and energy system focused on efficiency, scientifically acceptable, and safeguarded by legislation against political pressures should be implemented for the transition to 100% renewable energy. Turkey is dependent on foreign sources at a rate of 75% in electrical energy production.

The regulations that are tried to be implemented within the scope of energy efficiency can not contribute to taking a very important distance in this regard. Unfortunately, this reliance also obstructs political and economic freedom. The most significant thing that can be done to accomplish local management's efforts to meet the objective in the transition to 100% renewable electricity is to set a target. The applicability will be aided by local government authorities' efforts to migrate to 100 % renewable electricity while developing energy-related regulations.

The world is at a turning point due to the effects of climate change. With the increasing population, energy demand, and energy use, the energy issue has become a problem and renewable energy sources, including solar, wind, hydroelectricity, are at the center of the transition to less carbon and more sustainable energy system, and it is a fact that the more investments are made in renewable energy sources, the cheaper the electricity production will be.

V. CONCLUSION

Coming to the end of my final thesis, I will show the results obtained throughout my research, and whether my objectives for this study have been met.

Regarding my first question (Q1) How has the evolution of energy demand in Turkey been over the last 20 years, and does this increasing energy demand correlate with increasing GDP and economic growth? Here my hypothesis (H1) was that Turkey's growing GDP in the last 20 years is related to its higher energy consumption.
In my first hypothesis, I pointed in the right direction, and by conducting this research, I can now give a much more complete answer to my first question.

The Turkish economy has been growing during the last decades due to different factors, and this has caused the energy demand in Turkey to be growing in the same way, due to technological advances, an increase in the Turkish population, and an increase in its economic position in the region between Europe and Asia, as well as its position as an energy transit country from East to West. On the other hand, I have been able to identify that this growth has been mainly based on the consumption of fossil fuels such as oil and gas. It was not until the beginning of the 2010s that investment in renewable energies began to be taken seriously, and since 2015 there has been an exponential growth in the use of renewable energies, and a decrease in the use of non-renewable energies. Although Turkey still has a long way to go in terms of economic growth based on renewable energies, it is expected that following last years trend, this shift from non-renewables to renewables will continue to grow every year, and the goal of 100% renewable energy by 2050, set by the Paris Climate Agreement, is expected to be met. In the same way, the UN, Turkey, and its partners continue their support and effort to achieve the Sustainable Development Goals (SDGs) by 2030.

Referring to the second part of the question, if this increasing energy demand correlates with increasing GDP and economic growth?
Through the numerous studies I have been able to analyze on this subject, I have concluded that GDP growth has a positive effect on the growth of both renewable and non-renewable energy consumption if it is not taken into account the energy efficiency factor. While the growth of renewable energy consumption has a positive effect on the economy and makes it more competitive because it does not contribute to CO2 emissions.

The consumption of non-renewable energy has a negative effect (or not as positive as renewable energy) because the pollution and CO2 emissions produced, leads to an economy with higher collateral costs, for example, due to pollution control, damage to the health of the population, and the contamination of crop fields or marine fishing areas. In addition, the use of non-renewable energies causes a greater energy dependence on foreign suppliers, all of these factors cause the economy to lose competitiveness.

Finally, if it is taken into account the factor of efficiency in energy consumption, it is an important variable in this equation, since if the growth of the economy is based on the use of efficiently consumed energy, the economy would continue to grow, but energy consumption would grow more

slowly or even decrease, since using energy efficiently achieves the same economic results by requiring less energy consumed per unit of GDP. On the other hand, if energy consumption is not efficient, more energy will be required for each unit of GDP, so if the energy is not renewable, it translates into more pollution and CO2 emissions.
Turning now to the second question of my thesis, (Q2) How has Turkey addressed the issue of energy security, energy transition to cleaner energy and energy efficiency, and how do Turkey's geo-economic position between the EU, the Russian Federation, Central Asia, and the Middle East influence EU's energy security? Here the hypothesis I proposed before starting this project was that Turkey's energy consumption is not efficient, and Turkey's investment in clean energy and domestic production is helping Turkey to strengthen its energy security, as well, Turkey's geo-economic position is essential for energy security in the EU.

In this case, my hypothesis was true, but again with the research, I have been able to carry out I can now give a much more complete answer to this question.

Turkey's energy consumption is not as efficient as it could be, the latest data show that it is ranked 16th in the world in energy efficiency. This, together with the data I have presented in this paper, shows that Turkey's efficiency is not at the desired levels, that it is not on par with the world's leading economies, but it is not in a bad place either, because thanks to the efforts of recent years in terms of renewing more efficient technology in energy consumption, the efficiency levels are improving.

On the other hand, investment in renewable energy has intensified over the last 7 years, and thanks to the economization of renewable energy installations, the interest in increasing domestic energy production, and also the commitment shown through various international treaties in favor of the energy transition, Turkey is now in 12th place in the world ranking of countries that have shown the greatest renewable energy transformation. As with energy efficiency, due to the late investment in this kind of project, Turkey is lagging behind the world's leading economies, but the strong performance shown in the last few years forecasts a good future for Turkey, which is on the right track to exploit its full potential in renewable energy production.

Regarding Turkey's energy security and if its geo-economic position is essential for energy security in the EU. I arrived at the conclusion that Turkey is important for the EU's energy security, as it is its connection to the Middle East, Caucasus, and Central Asia.

This search for diversification of energy suppliers, in which Turkey plays an essential role as a transit country, has come about because of Europe's heavy dependence on Russian gas, which makes the EU's energy security vulnerable. This diversification sought by Europe is also sought by Turkey for its own energy security and sovereignty. In the early 2000s Turkey was heavily dependent on Russia and today it has other important suppliers such as Iran and Azerbaijan.

In addition, the current global crises such as the virus pandemic, which has brought us a shortage of resources and energy, and the crisis it is being experienced between Russia and NATO because of the Ukrainian conflict, a possible hostility between the two parties could appear both for the EU and Turkey, as they gave their support to Ukraine.

On the other hand, the latest alliances of Turkey with countries of the Persian Gulf like Qatar and U.A.E. could raise tensions with Iran, one of the most important energy suppliers of Turkey, as Iran and the Gulf States don't have a good relationship, and it would have a negative impact on energy security.

Turkey as well as the EU, which are dependent on foreign energy, are now more than ever accelerating the search for alternatives to Russian gas, and so the idea of domestic energy production, the use of renewable energies, and investment in energy efficiency to gain energetic independence is gaining more strength. Here Turkey would have an essential role to play in the search for alternatives to Russia to guarantee itself and the EU enhanced energy security.

Lastly, I would like to comment on my experience throughout this final degree thesis. As I have always had an inquisitive personality, and I have always liked to keep up to date with what is happening in the world, I can firmly say that I have enjoyed writing about Turkey, and the energy challenges it is facing. I am pleased to know that I have learned much more than I imagined, and I know that this work that I have done, even if it is about Turkey, could be extrapolated to any country since energy security and energy transition are challenges that all nations are facing in the world, and still topics that need much more research and future investigations.

To close this final bachelor's degree thesis, I would like to remark on a quote by Mustafa Kemal Atatürk founder of the Republic of Turkey, he wrote it at the beginning of the 20th century, but it could be applied to the times we live in of globalization, interculturality and where humanity is facing together, problems of huge magnitude like the COVID-19 pandemic, global warming, or refugee migrations around the world.

> "Humankind is a single body and each nation is a part of that body. We must never say "What does it matter to me if some part of the world is ailing?" If there is such an illness, we must concern ourselves with it as though we were having that illness."
>
> ***— Mustafa Kemal Atatürk***

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