ENERGY OUTLOOK

2021

TSKB

PREPARED BY

Kubilay Kavak, Ph.D. – Escarus
Burcu Bektaş – Escarus
Can Hakyemez – Economic Research
Damla Özçelik Yanık – Financial Advisory
Efe Merkit – Project Finance
Emre Karakaya – Project Finance
Emre Yanık – Development Finance Institutions
Orçun Yıldızca – Engineering and Technical Advisory
Sena Serhadlıoğlu – Engineering and Technical Advisory
Şakir Turan – Economic Research
Zümray Şentürk – Loan Analysis
Mukaddes Emecen – Advisory Services and Marketing (Design)

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Abbreviations

BCM: Billion Cubic Meters
BDLH: Bunker Delivery License Holders
BOTAŞ: Petroleum Pipeline Corporation
BP: British Petroleum
BPP: Biomass Power Plant
CBRT: Central Bank of the Republic of Turkey
CETC: China Electronics Technology Group Corporation
COP: Conference of the Parties
DFI: Development Finance Institutions
DSM: Demand Side Management
EBRD: European Bank for Reconstruction and Development
ECA: Export Credit Agencies
EED: Energy Efficiency Directive
EGD: European Green Deal
EIA : U.S. Energy Information Administration
EIB: European Investment Bank
EML: Electricity Market Law
EMRA: Energy Market Regulatory Authority
EPC: Engineering, Procurement and Construction
EPİAŞ: Energy Exchange İstanbul
ESS: Energy Storage Systems
ETS: Emissions Trading System
EU: European Union
EÜAŞ: Electricity Generation Company
EVÇED: Energy Efficiency and Environment
FED: US Federal Reserve
FEM: Futures Electricity Market
FSRU: Floating Storage and Regasification Unit
GDP: Gross Domestic Product
GNAT: Grand National Assembly of Turkey
GPP: Geothermal Power Plant
GW: Gigawatt
GWh: Gigawatthour
HPP: Hydroelectric Power Plant
IEA: International Energy Agency
IMF: International Monetary Fund
kW: Kilowatt
kWh: Kilowatthour
LCOE: Levelized Cost of Energy
LNG: Liquefied Natural Gas
LPG: Liquefied Petroleum Gas
LRST: Last Resort Supply Tariff
MCM: Million Cubic Meters
MCP: Market Clearing Price
MENR: Ministry of Energy and Natural Resources Department
MTEP: Million Tons of Oil Equivalent
MW: Megawatt
MWh: Megawatthour
NEEAP: National Energy Efficiency Action Plan
OECD: Organization for Economic Co-operation and Development
OPEC: Organization of the Petroleum Exporting Countries
OWPP: Offshore Wind Power Plant
PMI: Purchasing Managers' Index
PMR: Partnership for Market Readiness
SCT: Special Consumption Tax
SMP: System Marginal Price
SPP: Solar Power Plant
SPPA: Solar Power Potential Atlas
TANAP: Trans-Anatolian Natural Gas Pipeline
TEİAŞ: Turkish Electricity Transmission Company
TL: Turkish Lira
TOE: Tons of Oil Equivalent
TOGG: Turkey's Automobile Joint Venture
TSKB: Industrial Development Bank of Turkey
TÜPRAŞ: Turkish Petroleum Refineries Corporation
TWh: Terawatthour
UNCLOS: United Nations Convention on the Law of the Sea
USA: United States of America
VAP: Efficiency-boosting Project
WBG: World Bank Group
WPP: Wind Power Plant
WTI: Western Texas Intermediate
YEK: Law on the Use of Renewable Energy Sources for the Generation of Electric Energy
YEKA: Renewable Energy Resource Area
YEKDEM: Renewable Energy Resources Support Mechanism
YEK-G: Renewable Energy Resource Guarantee Certificate
YETA: Renewable Energy Supply Agreements

Introduction

It is known that the Covid-19 pandemic, which took its toll across the world in 2020, rendered economies fragile and caused interruptions in supply chains, adversely affected almost the entire year. In general, efforts came to the fore in 2021 to overcome the difficulties experienced in 2020, to repair the damage and to bring the conditions to the pre-pandemic level. At the same time, 2021 stood out as a year in which the concrete repercussions of the climate crisis were observed at an increasing and intensifying level, with different implications in almost every geography of the world. Therefore, the calls on the axis of combating this crisis were strengthened, with collective quests and collaboration efforts being intensified.

The revival of economic activities around the world in 2021 naturally resulted in an increase in the demand for energy and the revival of the energy markets. In spite of differences in terms of geography, a strong growth trend emerged in both primary energy and electricity demand in manufacturing industry sectors, and in electricity demand in residences and the service sector. Severe droughts in certain regions of the globe triggered by the impacts associated with the climate change, relatively affecting hydraulic generation as well as extreme weather events (extreme hot weather and unexpected cold spells) resulting in a rise for energy demand also caused a rise in fossil fuels.

Another interesting development of 2021 was the constraints experienced in the supply of some fossil fuels due to both the impacts of natural disasters and post-pandemic conditions and some technical (hurricanes in the USA, lack of new drilling investments, etc.) and political (Russia's export preferences, etc.) reasons. A conjuncture, in which the demand for primary energy resources grew but the supply remained limited, brought about abnormal and occasionally astronomical price increases. The first reason for the record price increases is undoubtedly the sudden increase in demand, which was postponed until after the pandemic, but it should not be ignored that the constraints and unexpected drops on the supply side strengthened these price increases. Increases in commodity prices in general, and oil, natural gas and coal prices in particular, were among the hot topics of the global energy agenda in 2021. During the 12-month period covering November-2020 and October-2021, European coal price rose by 305%, the global benchmark Brent oil price by 89%, and the Henry Hub natural gas price by 91%. The emergence of such a picture in terms of prices in 2021, during which the questioning of fossil fuels deepened at global level, shows that discussions and quests on this subject will continue for a long time.

The turmoil in the global commodity and energy markets turned upside down by the Covid-19 pandemic and in search of striking a new balance also deeply affected Turkey. It is possible to say that the most important development leaving its mark on 2021 in the Turkish energy market was the increase in oil, natural gas and coal costs. Turkey's oil and natural gas production is at a very low level as of today and it does not have a large buyer position (its high share in global consumption) so that it is not in a position to guide the developments in the world, rendering Turkey largely vulnerable to the above-mentioned developments and vulnerable to energy price shocks.

Striving to rapidly increase its storage capacity and diversify its resources, Turkey does not have many policy options to cushion sudden price increases. Initiation of production in the natural gas fields discovered off the Black Sea as well as a rise in domestic supply capacity heave into view as an alternative source of assurance.

Deferred economic activity strengthened following the pandemic, leading to the recovery of energy demand from the stagnation observed in 2020. In the first three quarters of the year, natural gas demand grew by about one third year-on-year. There is a similar trend in the demand for petroleum products. The total domestic sales of petroleum products for January-July 2021 period increased by 7.1% year-on-year, with the easing of the Covid-19 restrictions, and stood at 16.7 million tons. This value is higher than the 16.3 million tons of sales during the same period of 2019, which can be referred to as a basis for the pre-pandemic levels.

While the energy demand in Turkey grew strongly, it was not possible to meet this demand in an affordable way. The price of pipeline gas imported by BOTAŞ between December 2020 and November 2021 rose by approximately 60% in USD terms. Considering the increase in exchange rates (in the same period, the increase in the USD exchange rate was approximately 25%), it is observed that there is a significant rise in the cost of imported gas. This cumulative cost was reflected on consumers in 2021. In the residential group representing households, the natural gas sales price increased by 17.7% in TL terms during January-November 2021 period, while this rate was 147.5% in the industrial group and 182.9% in power plants. The hike in natural gas for the residential consumer group remained around the inflation rate, while the increase rates in the industrial and especially the power plant subscriber groups reached very high levels.

The quantity of electricity consumption during the first 9 months of 2021 stood at 219.9 TWh. This consumption level is 10.1% above the value of 199.8 TWh observed during the same period of 2020. When compared with the 2017-2019 period instead of 2020, it is observed that there was an average annual growth of 8.9% during the first 9 months of 2021. The rise in the cost of primary energy resources led to a rise in electricity prices in Turkey, albeit in a gradual and delayed manner. While hydraulic generation was falling, the increase in generation from imported coal and natural gas-based power plants brought about an increase in electricity generation costs due to rising input costs. With the surge in electricity demand during summer months, the power plants generating electricity at a more expensive price level came into operation within the system, which resulted in the balancing of electricity prices in the free market at higher levels.

In a conjuncture where the demand for both fuels and electricity revived so strongly, but the supply side was not dynamic enough, prices also followed an upward trend, excluding inflation and exchange rate effects. It is predicted that price increases, which are somewhat similar to the global markets, will be one of the most debated topics in the energy sector in 2022.

It should be noted that the private sector contributed an average of USD 3.2 billion annually to fixed capital investments in energy between 2010 and 2021, these figures decreased in 2019 and 2020, and a result converging to the average value is expected again by the end of 2021. The cash loan stock provided by the banking sector to the energy sector reached its highest level in 2017, reaching around USD 37 billion. As of September 2021, this figure went down to USD 32.5 billion through the repayment of existing energy investments and a drop in new investments in the sector. The various legislative arrangements in the energy sector, especially in the field of renewable energy, the support extended to thermal power plants within the framework of the capacity mechanism, and the fact how the prices in YEKA tenders will affect new investment decisions and how it will play a role in strengthening the investment environment are expected to be among the hot topics in 2022. Finally, it is predicted that the steps to alleviate the climate crisis, exemplary developments in energy efficiency and new explorations in this direction will be discussed much more than in previous years.

Structured in two chapters as “2021 Energy Sector Outlook” and “Themes Standing Out in 2021”, this report aims to analyze the aforementioned developments with a prudent approach and to project potential innovative approaches in the energy sector. Striving to integrate technical, economic, financial, environmental and social viewpoints from a macro perspective, this report also aims to draw the panorama of the Turkish energy sector in 2021 as well as discussing the opportunities and risks in the sector.

Macro Overview

Outlook in the Global Economy

The recovery that started in the second half of 2020 in the world economy following the sharp contraction caused by the COVID-19 pandemic is continuing in general. Despite the continuation of vaccination, the high number of cases infected with different variants feeds the challenges in the management of the pandemic and disruptions in supply processes. While this makes the global growth outlook fragile, it leads to questioning the proposition about the temporary nature of high levels of inflation together with accumulated costs and increasing the uncertainties regarding economic policies.

The supportive monetary and fiscal policies introduced during the pandemic period led to a rapid recovery in the global economy. According to the estimates of the International Monetary Fund (IMF), the global gross domestic product, which contracted by 3.1% in 2020, returned to its pre-pandemic level in 2021. Size of the monetary and fiscal support policies launched throughout this process and the success of the fight against the pandemic were decisive in the performances of economies. While the countries that engaged in an effective and rapid vaccination campaign recovered relatively faster, the divergent impacts of the pandemic were observed in the fields of activity and different segments of the society. Although the total gross domestic product returned to the pre-pandemic level, employment could not return to its pre-pandemic level at global level. However, employment losses were more sharply experienced among the youth and low-skilled workforce. The variants triggered by the imbalance of vaccination programs between countries and between various segments within the country result in a high number of cases. While the vaccines developed against the Covid-19 pandemic were introduced at the beginning of 2021, only 37% of the global population was fully vaccinated by the end of October. Significant divergence was observed in vaccination levels, as well as in economic performance. Although the slowdown in the total number of new cases has recently continued in Asia and North America, the figures have started to increase in Europe and South America.

Although the impact of the pandemic on economic activity remained limited thanks to vaccination, the recent data flow indicates that the downside risks on the global growth outlook remain significant. Lead data on economic activity, which peaked in the first half of 2021, signals a slowdown in the third quarter. Reaching 21.2% in June 2021, the quarterly average annual growth rate in global trade slowed down to 11.0% in August. During the same period, the annual growth rate in global industrial production decreased from 14.8% to 8.6%. Standing at 57.5 in June, the global services purchasing managers' index (PMI) declined to 53.4 in September, while the manufacturing industry PMI decreased from 55.5 to 54.1, pointing to a moderate slowdown. Supply constraints and accumulated costs in some products boost inflationary risks. After recovering from the first shock of the pandemic in the global economy, the total demand recovered rapidly, while the pandemic measures and climate-related problems led to a rise in commodity prices and the prolongation of supply processes.

However, the asymmetrical structure triggered by the failure of countries to achieve simultaneous recovery led to an increase in transportation costs, deepening the disruptions in supply chains and supply-demand imbalances. While the cumulative costs incurred under these conditions increased input prices, rapid increases were observed in consumer inflation with the emergence of deferred demand. Standing at 1.2 % at the end of 2020, annual consumer inflation in OECD countries rose to 4.3% as of August 2021. Throughout the same period, annual producer inflation in manufacturing industries increased from 0.6% to 11.8%.

The recent high volatility due to short-term imbalances in energy prices and the supply problems triggered by climate-related problems have boosted the upside risks on the inflation outlook. For this reason, inflationary expectations rise while there is an increase in the bond interest rates of developed countries. On the other hand, data disclosed on economic activity in many countries remains below expectations, while data on inflation is above expectations. Coupled with the expectation that supply-side problems may continue as long as the pandemic continues, this situation results in questioning the proposition for the temporary nature of high levels of inflation and increasing the uncertainties regarding economic policies. As for developed economies, the US Federal Reserve (FED) started slowing down its asset purchases. Varying expectations about when the interest rates can be raised during periods when inflation data is above expectations cause volatility in global capital flows. However, in the second quarter of 2021, it is seen that more countries are involved in the normalization steps regarding the monetary policy interest rates of some emerging economies.

In the light of these developments, IMF predicts that the global economy, which it calculates to have recovered by 5.9% in 2021, will grow by 4.9% in 2022. However, it also thinks that the divergent performances of countries in vaccination and pandemic management may affect economic activity. IMF expects the global trade volume, which contracted by 8.2% in 2020, to expand by 9.7% and 6.7% in 2021 and 2022, respectively. It estimates that inflation, which is expected to remain high until mid-2022, will decline at a moderate pace in the second half of the year as temporary factors disappear.

Outlook in the Turkish Economy

Despite the global recession, the Turkish economy completing 2020 with growth gained momentum in 2021. In addition to strong export performance, progress in vaccination has supported tourism and the external balance has recovered. However, macro-financial risks remain high due to the limited slowdown in domestic demand.

While the slowdown in domestic demand remains limited, economic activity proves to be strong as foreign demand remains strong. The ongoing impacts of monetary and credit expansion in 2020 play a role in the annual growth, which reached 14.3% in the first half of 2021. During the same period, positive developments in the supply chain supported exports, while net foreign demand contributed to the growth. Lead data indicates that the economy recorded a limited slowdown in the second half of the year, but that the annual growth may exceed 8%. In addition to the strong recovery in the trade partner economies, the current account deficit narrowed due to the improvement in tourism. Standing at USD 26.0 billion in the first 8 months of 2020, the current deficit decreased to USD 14.0 billion during the same period of 2021 due to the decline in the foreign trade deficit and the recovery in services. Despite the potential positive impact of the weak Turkish lira (TL), commodity prices remain important as a factor that may limit the improvement in the foreign trade balance and current account.

While the slowdown in domestic demand remained limited, inflation increased due to the cumulative costs caused by global developments. Completing 2020 at 14.6%, consumer inflation increased throughout the year and reached 19.9% as of October 2021. In addition to the strong economic activity, producer inflation, which rose from 25.1% to 46.3% throughout the same period, played a role in this development. The cumulative cost factors reinforced by global inflationary risks will be closely monitored in the upcoming period.

Sensitivity of the Turkish economy to global trends is expected to remain high in the upcoming period. While it is estimated that the growth may decrease to 5% in 2022 due to the slowdown in the global economy, it is calculated that the current account balance may have a deficit of around 1.5% compared to the ratio of national income. The improvement in consumer inflation is expected to be limited, and it is considered that the extent of the improvement in inflation depends on global developments.

Energy Sector Outlook for 2021

This report has been issued by TSKB Energy Working Group and aims to assess the dynamics, developments and expectations in the energy sector which supports a great many high added value sectors and makes a close and direct impact on operations in those sectors.

This section of the report examines as main themes the components of the Turkish energy sector, the trends and expectations of energy markets as well as energy investments and financing. It covers the sub-sectors of electricity, natural gas, oil, renewable energy and energy efficiency, energy investments and finance in Turkey.

In early 2000s, some legal regulations were launched and resolute liberalization steps were taken, triggering an evolution in the electricity sector into the current competitive, multi-player model where operations are segregated.

1.1.

Electricity Sector Outlook

Turkish electricity sector focuses on the principle of supply security at its heart and developed and continues to develop with an aim to contribute to economic growth and national prosperity. Until the 1990s, power services in Turkey had been delivered by public institutions operating within a vertical integrated structure. In early 2000s, some legal regulations were launched and resolute liberalization steps were taken, triggering an evolution in the electricity sector into the current competitive, multi-player model where operations are segregated. Today, actors of the private sector are mainly active in the electricity sector. With its competitive nature, strong dynamism, enriched and specialized human resources, and deepening structure, it is one of the most important components of the Turkish energy sector.

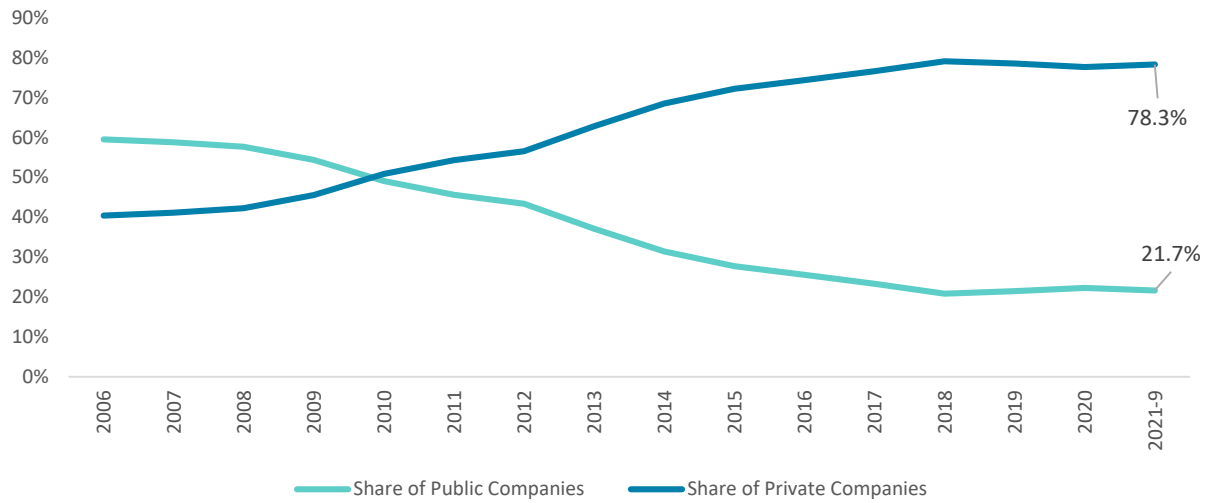
The Turkish electricity sector continues to develop with a kind of dynamism in line with the needs of the age thanks to both capital diversification and existing expertise and management experience. Previous problems such as capital and investment challenges, inadequacy in project finance as well as confusion in legislative infrastructure were mostly overcome in the sector. Current hot topics include the mainstreaming of efficiency, continuing to engage in the diversification of the energy mix, the protection of consumer rights, the boosting of grids' resilience and focusing on more sophisticated matters (demand-side management, evaluation of alternative fuel use and hybrid generation options, grid optimization, etc.). Although sensitivity to the changes in commodity prices remains to be valid, it is possible to argue that the electricity sector, when considered as a whole, is much more resilient and prepared against potential risks compared to previous periods.

1.1.1. Current Market Structure in Turkey

Development and liberalization of the electricity market in Turkey started with the entry into force of the Electricity Market Law No. 4628 in 2001. With the decoupling of the vertically-integrated structure and the establishment of the Energy Market Regulatory Authority (EMRA), more advanced liberalization steps were taken in the electricity sector. In the subsequent 20 years, the electricity sector has turned into a competitive multi-player sector, where market efficiency stands out.

An analysis of current ownership status regarding generation plants shows that the public power plants are affiliated to Electricity Generation Corporation (EÜAŞ) and the public share within the installed capacity declined from 81.7% to 21.6% as of the end of October 2021. The reason why EÜAŞ's sector share remains around 20% even though the power plant privatizations continue unabated is the transfer of the build-operate-transfer power plants, whose term has expired, to EÜAŞ in accordance with the contracts. Privatizations in electricity distribution through the transfer of operating rights were completed in 2013, and today, all 21 distribution regions are operated and managed by private sector actors.

Chart 1: Shares of Generating Institutions in Turkey's Installed Capacity by Years

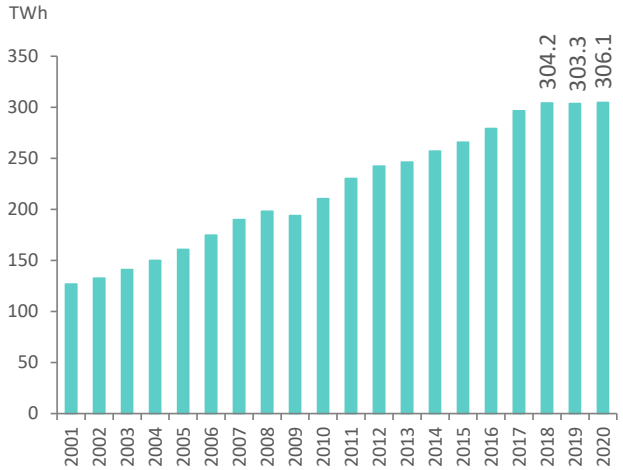


Source: Turkish Electricity Corporation, TSKB

1.1.2. Electricity Demand

The total demand for electricity in Turkey between 2000 and 2020, excluding the years 2011, 2009 and 2019, did not decline and maintained a constant increase. Standing at 304.2 terawatthours (TWh) in 2018, the total demand for electricity materialized as 303.3 TWh as of the end of 2019. In 2020, when the Covid-19 pandemic came to the fore, electricity demand rose to 306.1 TWh with a limited rise of 0.9% year-on-year.

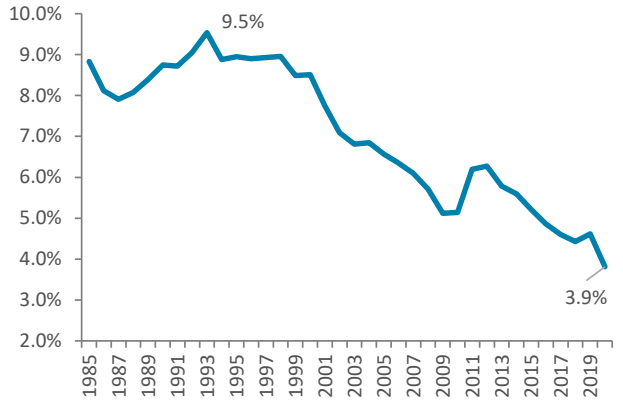
Chart 2: Development of Total Electricity Demand by Years



Source: TEİAŞ, TSKB

An analysis of 10-year moving average values of Turkey's demand for electricity between 1985 and 2019 points to a general downward trend between 1993 and 2009 followed by an upward trend between 2010 and 2012 and back to a downward trend between 2013 and 2020. These changes are considered to be related to the economic growth performance of the country.

Chart 3: Development of Total Electricity Demand (10-Year Moving Average)

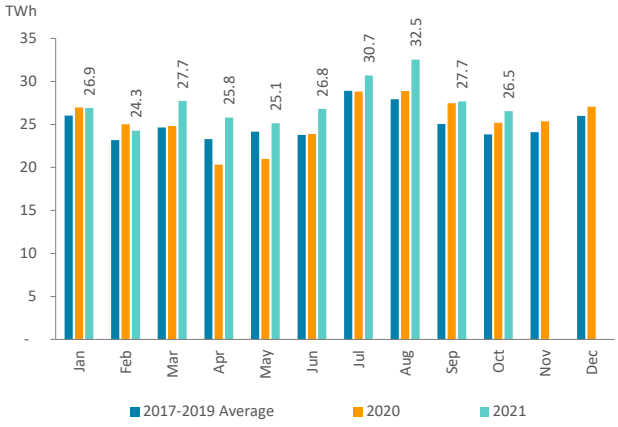


Source: TEİAŞ, TSKB

After the Covid-19 pandemic, which took its toll in Turkey as well as the whole world in 2020, 2021 has been a year in which electricity demand has increased.

According to the monthly data announced by TEİAŞ, significant rises were observed during all of the first 10 months year-on-year, except for January and February. Having decreased by 0.4% and 3.3% year-on-year in January and February, respectively, the monthly electricity demand rose by 26.7% in April and 19.6% in May due to the base effect. Having dropped to single digits in July, the monthly electricity demand growth increased by 12.5% in August. Having broken records on the basis of daily data, the monthly total electricity demand of 32.5 TWh in August was recorded as the highest monthly demand. In September and October, it was observed that the gross electricity demand decreased to 27.7 TWh and 26.5 TWh, respectively. The demand for the first 10 months of 2021 stood at 274.1 TWh, 8.3% above the total of 253.2 TWh in 2020.

Chart 4: Comparative Breakdown of Monthly Electricity Demand



Source: TEİAŞ, TSKB

When compared with the 2017-2019 period instead of 2020, it is observed that there was an average annual growth of 9.4% during the first 10 months of 2021. During each month of 2021, growth was recorded compared to the average of the same period of these 3 years, and the highest rise was observed in August with an increase of 16.6%.

The total demand for the first 10 months of 2021 stood at 274.1 TWh, 9.4% above the total of 250.7 TWh during 2017-2019. Analyses show that the 2% increase in electricity demand on an annual basis during the last 2 months of 2021 will result in the total electricity demand in 2021 being 7.2% higher year-on-year. If the monthly demand for electricity in the last quarter is the same as the level in the last quarter of 2020, it is estimated that total electricity demand for 2021 will reach a value 6.8% higher than that of 2020. All these analyses indicate that electricity demand, which has been stagnant for the last 3 years and has not grown as predicted, will record a strong increase in 2021.

Last Resort Supply Tariff (LRST)

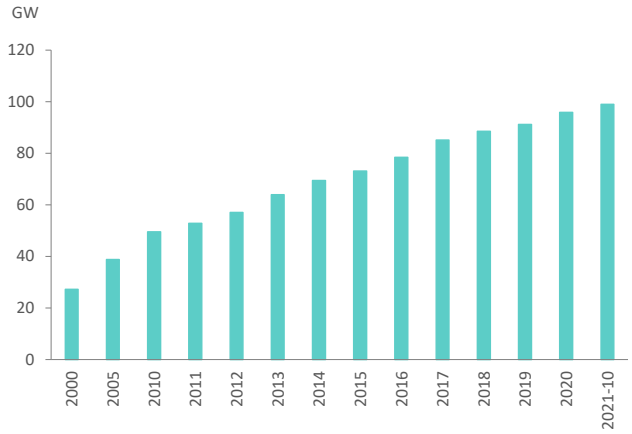
Eligible consumer is defined as any real person or legal entity that has the right to choose its supplier, due to its consumption of more electricity than the amount set by the Energy Market Regulatory Board (EMRA) or its direct connection to the transmission system or its status as an organized industrial zone legal entity. As the years progressed, the electricity energy consumption limit was gradually reduced within a year in order to increase the number of eligible consumer subscribers. While the electricity energy consumption limit set by the Board for 2021 is 1,200 kilowatthours (kWh) for eligible consumers, all consumers with a total consumption of 1,200 kWh and above in the area of consumption during the previous calendar year or the current year are set as "eligible consumers". EMRA set the consumption amounts in the last resort supply to be applied as of January 1, 2022 for the consumers who do not supply electricity energy through bilateral agreements although they are eligible consumers.

Accordingly, the consumption amount in the residential consumer group in the last resource supply for 2022 has not changed, and remains constant at 50 million kWh/year and 7 million kWh/year in agricultural irrigation. In other consumer groups, the last resort supply consumption amount was reduced from 7 million kWh/year to 3 million kWh/year.

1.1.3. Installed Capacity Analysis

Turkey's total installed capacity was around 27.3 gigawatts (GW) as of 2000 but rose to 99.1 GW by the end of October 2021. Total installed capacity has improved in the wake of increased incentives extended to power plants generating electricity from renewable energy resources and local resources until 2021.

Chart 5: Development of Installed Capacity by Years



Source: TEİAŞ, TSKB

Between 2011 and 2020, the average annual net increase in installed capacity stood at 4.6 GW. It is observed that the rise in installed capacity was higher than the total demand for electricity during this period and one of the major reasons is considered to be the incentives extended to renewable energy power plants. Annual average installed capacity of the renewable energy power plants commissioned between 2011 and 2020 stood around 3.2 GW. Total installed capacity for renewable energy sources rose around 4.8 GW in 2020 but the total installed capacity materialized around 4.6 GW in Turkey due to the closure of some power plants. Total net installed capacity of thermal power plants decreased around 0.2 GW in 2020 while the share of wind and solar power plants in total installed capacity rose by 1.9 GW.

Total installed capacity of Turkey reached 99.1 GW by the end of the first ten months in 2021. The installed capacity increased by about 3,160 megawatts (MW) in the first ten months. This increase was attributable to power plants generating electricity from renewable resources. An installed capacity increase of 485 MW was achieved through hydroelectric power plants (HEPP), 1,420 MW from wind power plants (WPP) and 991 MW from solar power plants (SPP). The net total installed capacity of natural gas power plants and multi-fuel power plants decreased by 141 MW during the relevant period.

Given the new net installed capacity increase values between 2016 and 2020, it is understood that an annual average installed capacity of 4,549 MW was commissioned. The highest net installed capacity increase between these years was materialized in 2017 with 6,702 MW. 49.7% of the power plants commissioned in 2017 consist of WPPs and SPPs. In 2018, 62.7% of the total installed capacity increase of 3,350 MW resulted from WPPs and SPPs.

The share of renewable energy resources in the total installed capacity has risen since 2005. Standing at 33% in 2005, the share of power plants generating electricity from renewable energy resources, in particular HEPPs, in the installed capacity rose to 51.7% by the end of 2020. It is considered that the Renewable Energy Resources Support Mechanism (YEKDEM) played a decisive role in this rise. 62.5% of the renewable generation plants reaching a total of 49.6 GW by the end of 2020 were composed of HEPPs, 17.8% of WPPs and 13.4% of SPPs.

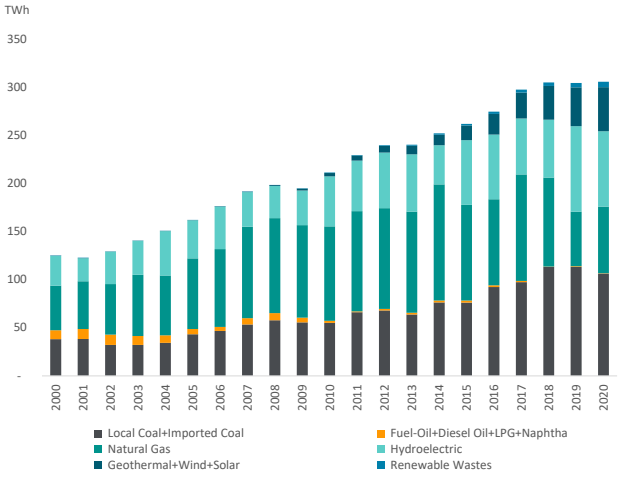
An analysis of the data regarding the first ten months of 2021 shows that the share of the power plants generating electricity from renewable energy resources in the installed capacity has risen to 53.4%. Coming to an end in July, USD-denominated YEKDEM played an important role in this rise. According to the Eleventh Development Plan covering objectives between 2019 and 2023, it is estimated that Turkey's total installed capacity will reach 109.5 GW by 2023.[1] An analysis of market developments and the investment environment by considering the remaining 2 years shows that it is not easy/possible to achieve this target. However, falling behind the target in installed capacity is not expected to pose a problem in electricity supply security.

1.1.4. Electricity Supply

Due to very low import and export volumes in the electricity sector, total electricity generation followed a parallel course with electricity demand. Major investments have been made from the beginning of 1980s so as to meet the rapidly-rising demand for electricity, thus leading to a considerable rise in the total gross electricity generation of Turkey. Shrinking by 1.8% in 2001 and 2009, the gross electricity generation experienced a limited drop by 0.2% in 2019. Standing at 304.3 TWh in 2019, the gross electricity generation rose to 305.4 TWh by the end of 2020.

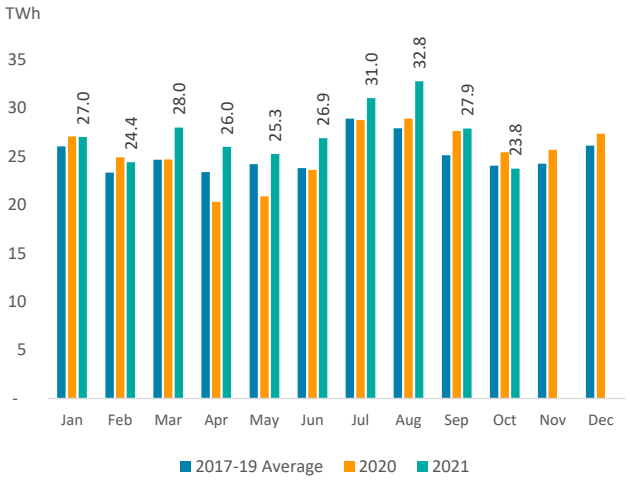
After the Covid-19 pandemic, which also affected Turkey in 2020, 2021 has come to the fore as a year of growth. Compared to 2020, significant increases have been recorded in monthly total electricity generation since March. Having contracted by 0.2% and 2.0% in January and February, respectively, the monthly total electricity generation rose by 13.3% in March. After achieving a growth rate of 20% in April and May, electricity generation continued to rise by 13.9% in June, 7.9% in July and 13.3% in August. While a limited rise of 1% was observed in September, a decrease of 6.6% was observed in October on an annual basis. Considering the total amounts of the first ten months, a rise of 8.2% was achieved year-on-year and generation reached 273.1 TWh. When the total amount of the first ten months of 2021 is compared with the average of the total amounts of the first ten months of 2017-2019, a rise of 8.6% is observed in 2021.

Chart 6: Gross Electricity Generation by Primary Source by Years



Source: TEİAŞ, EMRA, TSKB

Chart 7: Outlook of Monthly Gross Electricity Generation

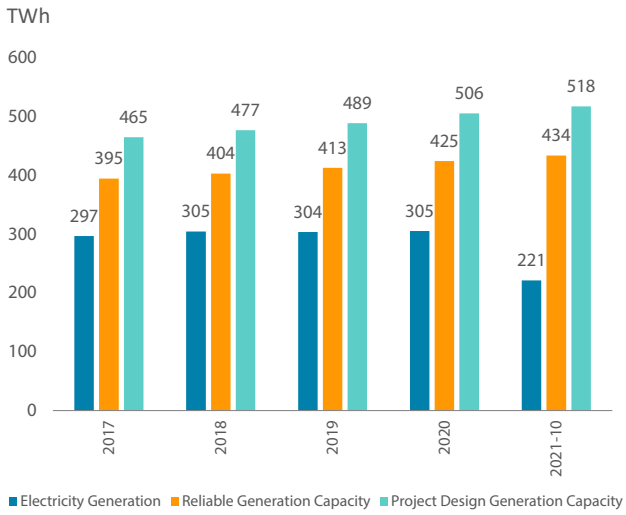


Source: TEİAŞ, EMRA, TSKB

[1] TR Presidency of Strategy and Budget, 2019. https://www.sbb.gov.tr/wp-content/uploads/2019/11/ON_BIRINCI_KALKINMA-PLANI_2019-2023.pdf

In the first ten months, import and domestic coal power plants were responsible for 30.7% of total gross electricity generation while natural gas power plants were responsible for 33.1%. Compared to the breakdown regarding the first ten months of 2020, a decrease of 3.6 percentage points was observed in the electricity generated from coal power plants. Similarly, the share of electricity generated from hydroelectric power plants decreased by 10.3 percentage points. 89% of the decrease (increase by 12.4 points) caused by coal power plants and hydroelectric power plants was met by natural gas power plants. The drought in 2021 and the increase in imported coal prices were the decisive factors in this breakdown change during the first ten months of 2021.

Chart 8: Generation Capacity and Actual Generation

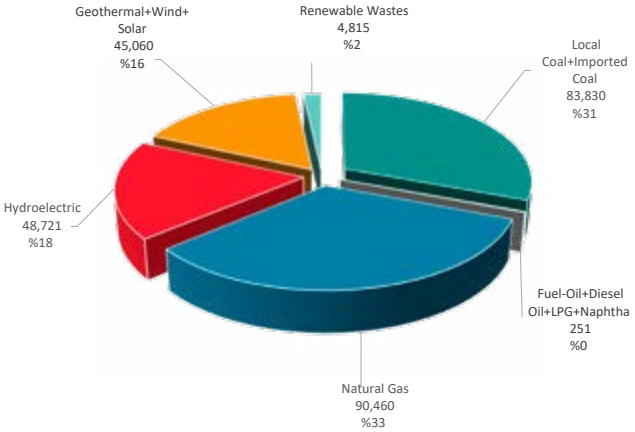


Source: TEİAŞ, Chamber of Mechanical Engineers[2], TSKB

An analysis of the breakdown of fuels in the total installed capacity of Turkey and generation capacities for these fuels reveals an approximate annual project capacity of 506 TWh in Turkey by the end of 2020. Based on the reliable generation capacity of these projects, it is estimated that there is a generation potential of 425 TWh. When considered by excluding factors such as seasonal fluctuations, power plant failures and unplanned maintenance needs, imported fuel restrictions, it is possible to say that there is an excess supply capacity in Turkey and each new capacity to be added will increase the excess supply if the increase in electricity demand remains limited (similar to the previous 3 years).

At the end of the first ten months of 2021, during which demand and generation records were broken, the share of electricity generated from renewable energy resources stood around 36.8%.

Chart 9: Gross Electricity Generation by Primary Source During the First Ten Months of 2021 (GWh)



Source: TEİAŞ, TSKB

It is considered that the high share of electricity generated from natural gas power plants in the first ten months is due to the decrease in the amount of electricity generated from hydroelectric power plants. Although the amount of electricity generated from both wind and solar resources increased in 2021, the share of electricity generated from renewable energy resources decreased due to a dry period.

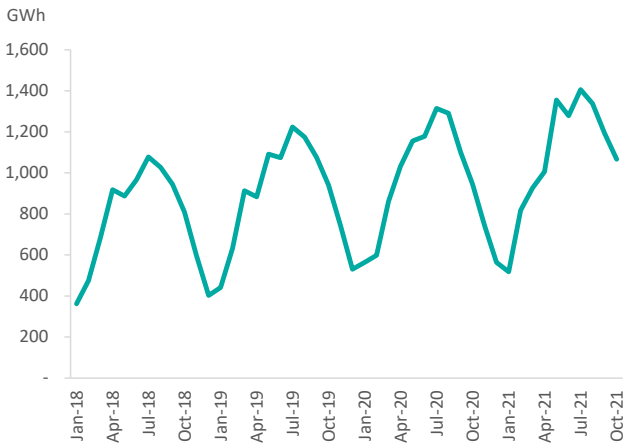
The first unlicensed electricity generation regulation that entered into force at the end of 2010 allowed for the establishment and operation of unlicensed power plants with an upper limit of 500 kilowatts (kW) and independently from the consumption or power of the associated generation facility. The upper limit was increased to 1 MW in March 2013. The upper limit for installed capacity at renewable power plants that are eligible to operate without a license was increased from 1 MW to 5 MW through a Presidential Resolution in May 2019. The resolution stipulates that the installed capacity be limited to the connection power in the connection agreement of the power consumption facility and that both generation and consumption take place at the same measurement point. The resolution also states that the retail single-time active power fee for the specific subscriber group announced by the EMRA will apply to the surplus electricity generated at rooftop and facade solar power plants and other renewable power plants for a period of 10 years starting from the commissioning date of the plant.

Total installed capacity of the unlicensed power plants commissioned starting from 2016 reached 8,463 MW by October 2021.

[2] https://www.mmo.org.tr/sites/default/files/EnerjiGorunumu2018_1.pdf

While SPPs accounted for most of these power plants, their contribution to total generation varied monthly. Contributing to total gross electricity generation by 3% in 2018, unlicensed power plants increased their share in gross electricity generation to 3.5% and 3.7% in 2019 and 2020, respectively. During the first ten months of 2021, the share of unlicensed power plants in total electricity generation increased to 4.0%.

Chart 10: Development of Generation by Unlicensed Power Plants on a Monthly Basis



Source: TEİAŞ, TSKB

1.1.5. Incentives

Throughout the development of the electricity sector in Turkey, incentive mechanisms were developed and introduced for both fossil fuels and renewable energy resources within the framework of the objectives of ensuring electricity supply security and increasing the electricity generated through renewable energy resources. These mechanisms include the capacity mechanism as well as YEKDEM and Renewable Energy Resource Area (YEKA) intended for renewable energy resources.

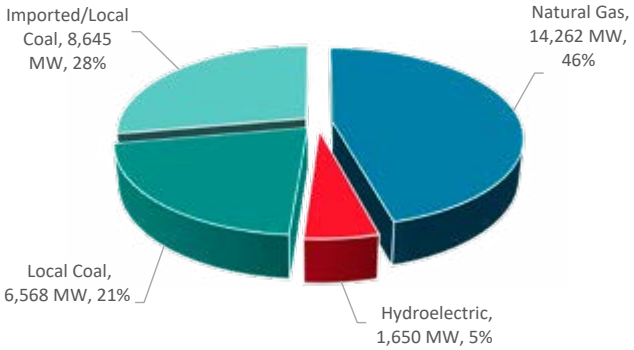
Pursuant to the Law on the Use of Renewable Energy Resources for Electricity Generation (YEK), YEKDEM is a feed-in tariff available for wind, solar, geothermal, biomass, wave, current and tidal power plants as well as hydropower plants with a canal or river or reservoir area of less than fifteen square kilometers. On the other hand, YEKA is a system for determining, grading, protecting and using renewable energy resource areas suitable for electricity generation in public and treasury lands and its main purpose is to support the production of domestic equipment. YEKDEM and YEKA will be explained in detail in Chapter 1.4 of this report "Renewable Energy and Energy Efficiency".

Capacity Mechanism

The capacity mechanism for natural gas and coal-powered plants which was published in the Official Gazette of January 20, 2018 deserves attention as an incentive mechanism required for supply and system security. Calculated in consideration of the association between the fixed and variable costs of power plants and the Market Clearing Price (MCP), this incentive is available for natural gas power plants, domestic coal-powered plants and import coal-power plants (in proportion to the ratio of the domestic coal used thereby). 20 thermal power plants with a total installed capacity of 20,912 MW benefitted from the capacity mechanism incentive amounting to TL 1.4 billion in 2018.

The amendment made in November 2018 enabled the hydroelectric power plants fulfilling the conditions stipulated to benefit from the capacity mechanism. This amendment increased the total number of power plants to 43 and total installed capacity to 24,137 MW. The amount distributed via the capacity mechanism in 2019 stood at TL 2 billion. The total amount to be distributed via the capacity mechanism in 2020 reached TL 2.2 billion. As for the power plants benefitting from the capacity mechanism in 2020, natural gas power plants generate 9,790 MW, coal-powered plants 11,616 MW and hydroelectric power plants 1,666 MW.

Chart 11: Breakdown of Installed Capacity by Capacity Mechanism Resources in 2021[3]



Source: TEİAŞ, TSKB

[3] It shows the breakdown following the amendment published in the Official Gazette No. 31487 of May 21, 2021.

In 2021, 46 power plants with a total installed capacity of 25,401 MW have the right to benefit from the capacity mechanism. 22 of 46 power plants are coal-powered thermal power plants while 15 of them are based on domestic coal and the rest on imported/domestic resources. Resolution of EMRA Board set the total budget as TL 2.6 billion.[4] In 2021, another change took place in the capacity mechanism. Through this amendment published in the Official Gazette No. 31487 of May 21, 2021, power plants that have build-operate contracts and that operate/have been operating within the scope of these contracts even though the contracts have expired are included in the capacity mechanism.[5] In addition, the existing and operational power plants the age of which is older than 13 years when calculated starting from the date of provisional acceptance of its oldest unit as specified in its license and is not based on domestic resources are also included in the mechanism. In this respect, 5 power plants with a total installed capacity of 5,810 MW were included in the capacity mechanism.

In order to benefit from the capacity mechanism, the efficiency of natural gas power plants must be above 50%, the weighted average capacity utilization rate should not be below 10% for those based on domestic resources and 15% for others during the 12-month period retrospectively from the last date when applications are received.

1.1.6. Electricity Prices

The electricity price in Turkey is formulated for each hour over a supply curve as well as price-quantity pairs listed in ascending order and combined in a single bid. After the demand curve is formulated similarly, the intersection of supply and demand curves indicate the MCP for the hour concerned. The price in the balancing market depends on whether or not there is an energy deficit or energy surplus within the system. If there is an energy deficit in the system, the maximum hourly bid price in the system is taken as the system marginal price (SMP). When there is a surplus, the minimum bid price accepted is taken as the SMP. Although electricity prices depend on power plant availability, climate conditions, and economic and geopolitical factors, they react instantly to any changes in commodity prices.

Minimum and maximum limits of MCP are set by EMRA. Until 2017, the minimum and maximum limits of MCP were TL 0 and TL 2,000 per megavatthour (MWh). Through the resolution of EMRA of January 6, 2017, the maximum limit was set as TL 500/MWh between January 6, 2017 and March 1, 2017. In order to reduce the volatility in prices, EMRA changed its methodology regarding the determination of maximum prices. According to the resolution of EMRA published in the Official Gazette No. 31266 of October 6, 2020, it was decided to retrospectively apply the maximum price limits twice as the weighted averages of 12-month MCPs, starting from the calendar month two months prior to the current

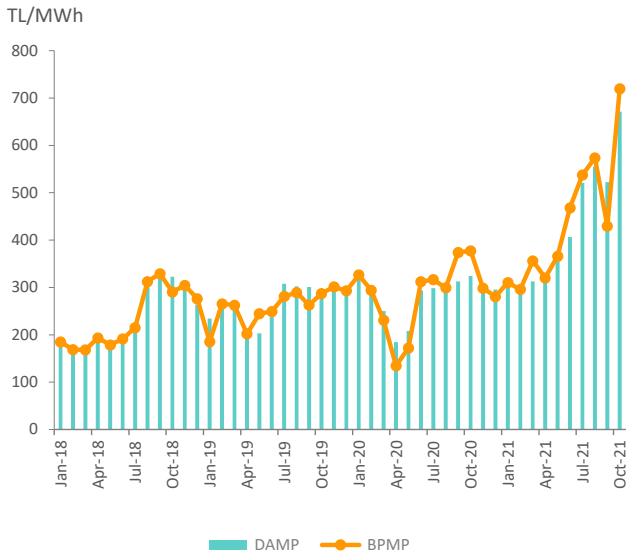
calendar month.[6] Finally, due to the increases in natural gas and coal prices in global markets starting from April 2021, some natural gas and imported coal-based power plants were not allowed to come into operation based on the determined maximum limits. For this reason, through the resolution of EMRA issued on October 14, 2021, the maximum price limits were updated and while setting the maximum limits, it was decided to retrospectively apply the maximum price limits three times as the weighted averages of 12-month MCPs, starting from the calendar month two months prior to the current calendar month.[7] This update aimed to keep the natural gas and imported coal-based power plants, which experienced difficulties in getting into operation, within the system.

[4] It is considered that this value will be updated following the amendment published in the Official Gazette No. 31487 of May 21, 2021. In June, a payment was made differently from the budget announced at the beginning of 2021.
[5] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2021/05/20210521.pdf
[6] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2020/10/20201006.pdf
[7] Resolution of the Board issued on October 14 was published in the Official Gazette No. 31629 of October 15, 2021. It can be viewed at: https://www.resmigazete.gov.tr/eskiler/2021/10/20211015.pdf

As a result of the Covid-19 pandemic, there were significant decreases in electricity demand and commodity prices starting from March 2020. The weighted average MCP decreased to TL 250/MWh in March and to TL 184/MWh in April. Having increased gradually since April 2020, the MCP increased to TL 324/MWh in October 2020. Having a recorded a slight decline during the winter months of 2020 and the spring of 2021, the MCP stood at TL 313.91/MWh on average in April 2021.

Due to the drought experienced in Turkey starting from April, the increase in demand and the increase in natural gas prices in global markets led to a rise in MCP prices as well. On the basis of annual increases, double-digit increases have been observed since April, and this growth rate was calculated above 70% in April and May. After a 38.5% growth in June, MCP rose by 74.5% and 84.4% in July and August, respectively, and reached a monthly average of TL 555.38/MWh. In September, it decreased to an average of TL 522.39/MWh due to the decrease in electricity demand. In October, the average MCP rose to TL 671.07/MWh, especially with the effect of imported coal and natural gas prices in the spot market.

Chart 12: Monthly Weighted Average MCP/SMP



Source: Energy Exchange İstanbul (EPİAŞ), Central Bank of the Republic of Turkey (CBRT), TSKB

Standing around TL 136/MWh by the end of 2009, weighted average MCP gradually rose until 2015 and dropped to TL 144/MWh in average in 2015. Gaining an upward trend following 2015, electricity prices made a considerable leap in 2018 to reach TL 233/MWh in average. Standing at TL 267/MWh in average during 2019, MCP rose to TL 282/MWh in 2020. During the first nine months of 2021, the average MCP stood at 398 TL/MWh due to the increase in commodity prices in the global markets as well as the drought and the increase in demand. However, an analysis of the situation on the basis of USD reveals a different picture: Soaring to USD 95/MWh in average during 2010, weighted average MCP gradually decreased following 2010 and stood at USD 47/MWh and USD 40/MWh in 2019 and 2020, respectively. During the first ten months of 2021, this downward trend changed and the average price increased to USD 52/MWh.

Chart 13: Annual Weighted Average Growth in MCP

Source: EPİAŞ, CBRT, TSKB

While the increase in industrial production after 2020, when the pandemic was most active, and the extreme cold and hot weather in 2021 caused a rise in electricity demand, the drought decreased electricity generation from hydroelectric power plants and increased the amount of electricity generation from fossil fuel-based power plants. According to the data announced by TEİAŞ, there was a 36% decrease in the amount of water coming to the main basin dams during the first nine months of the year, which led to a decrease in the amount of electricity generated from hydroelectric power plants. In addition to these incidents, the increase in global natural gas, oil and imported coal prices starting from April was reflected in some of the thermal power plants within the system, which led to a rise in MCP. It is possible that a rebalancing in commodity prices in global markets will also have repercussions for prices in Turkey. The duration and the point at which the said rebalancing will occur will impact the new level of MCP prices.

Futures Electricity Market (FEM)

Aiming to protect against price risks and increase predictability in electricity markets, the Futures Electricity Market (FEM) was put into operation on June 1, 2021 within EPİAŞ. Through FEM, it is expected to eliminate all risks that may arise from transactions that are not organized, unregulated or, in other words, that are not carried out through an exchange (over-the-counter markets). In this framework, spot market (Day Ahead and Intraday markets) and FEM respond to the varying needs of market players and complement each other. Futures can be traded in organized markets as well as through bilateral agreements in over-the-counter markets. Launched on June 1, 2021, FEM aims to create sound forward-looking price expectations, facilitate feasibility studies for electricity and electricity-based investments and create an environment of trust for potential investments. Following all these developments, the first match in FEM was completed as 1 lot at TL 405 per MWh for October 2021 base contract on June 1, 2021 at 13.00.12.[8]

TSKB Price Forecast Model

Short and long-term electricity price predictions are created via TSKB Price Forecast Model (Model) developed within the TSKB Energy Working Group to estimate MCP. The model creates a supply curve for each hour as well as price-quantity pairs listed in ascending order and combined in a single offer and after the demand curve is formulated in a similar way, the intersection point of the supply-demand curves is determined as the MCP of the relevant hour. These forecasts include different scenarios that consider the changes in global commodity prices, and climate-related risks such as drought and excessive precipitation.

The Model carries out estimation studies for parameters such as GDP growth rate, hourly demand curve, hydrological cyclicity and seasonality, the availability of power plants, new power plant and efficiency investments, capacity increases, natural gas constraint, oil, coal and natural gas prices, and calculates unit marginal costs separately for each power plant type. While creating commodity price forecasts, the forecasts published by international sources on commodity prices are mainly used. Estimates of natural gas prices in particular have an impact on electricity price forecasts, and in this context, BOTAŞ's pricing policy is closely followed. The Model generates outputs such as hourly, daily, monthly and annual price and demand forecasts and their maximum, minimum and average values, installed capacity and electricity generation development on the basis of power plant type, backup calculation by installed and available power, and natural gas consumption.

The Model is updated periodically, depending on developments in global markets and Turkish energy markets, fluctuations in the commodity market, and economic variables such as inflation and interest rates. In each update period, short and long-term MCP is estimated under different scenarios. Within the scope of the Model, different scenarios for the MCP estimation of 2022 are evaluated. In the Model, if BOTAŞ cuts its price policy in the first quarter of 2022, MCP is expected to fluctuate throughout the year, realizing over an average of USD 60 per MWh in 2022 and not exceeding an average of USD 70 per MWh. However, if BOTAŞ maintains the similar price curve in its price policy after the 47% increase in TL based tariff in November, MCP is estimated over the USD 70 per MWh on average in 2022. Although MCP is predicted to decline in medium term in line with the expectations of a decrease in commodity prices, factors such as regulatory changes, commodity price fluctuations, climate factors, the practices and market developments affecting supply and demand may change this course.

[8] Dünya Newspaper. Available at: https://www.dunya.com/sektorler/enerji/vadeli-elektrik-piyasasi-isleme-acildi-haberi-623221#:~:text=t%C3%B6renle%20i%C5%9Fleme%20a%C3%A7%C4%B1ld%C4%B1.-,VEP'te%20ilk%20e%C5%9Fle%C5%9Fme%2C%201%20Haziran%202021%20saat%2013.00.,y%C4%B1llara%20g%C3%B6re%20artt%C4%B1%C4%9F%C4%B1n%C4%B1%20dile%20getirdi.

Turkey is a net importer of natural gas and natural gas ranks second after oil in Turkey's total final energy consumption.

1.2.

Natural Gas Sector Outlook

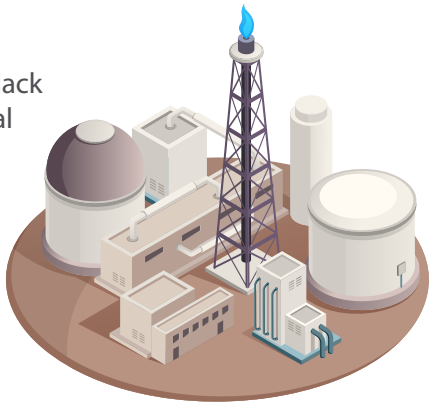
Natural gas consumption grows in direct proportion with its population, industrialization and urbanization patterns and in inverse proportion with weather temperature. Turkey is a net importer of natural gas as well as oil due to limited underground richness. For a long time, natural gas production in Turkey has been below 2% of consumption. Turkey's dependency on natural gas imports is over 99% with the country's gas import playing an important role in its foreign trade deficit. Natural gas ranks second after oil in Turkey's total final energy consumption. In the country, it is expected that natural gas will be the only fossil fuel the consumption of which will increase in the short-medium term in line with the energy consumption estimates made on a global scale.

Recent studies evaluate the integration of hydrogen into the natural gas distribution network. Hydrogen technologies are intended for reducing the carbon footprint while it is expected to decrease natural gas import albeit partially. Having made a significant breakthrough in natural gas distribution, Turkey has no province left without natural gas as of 2019.

As a result of the investments of natural gas distribution companies, natural gas was supplied to a total of 554 districts and 35 towns, including all 81 provincial centers, as of the end of 2020. Standing around 1 million in 2010, the total number of subscribers for natural gas services rose to 17.8 million in July 2021.

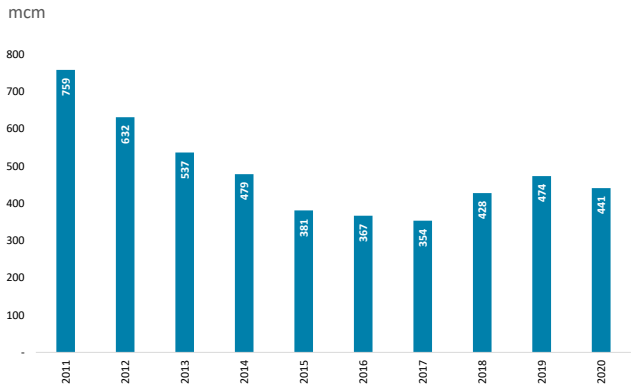
1.2.1. Natural Gas Reserve, Production and Discoveries in Turkey

Excluding the disclosed and potential reserves in the Mediterranean and Black Seas, Turkey has approximately 4.2 billion m^3 (bcm) of remaining natural gas reserves. Limited production in these reserves can only meet 1% of the annual total consumption.[9] 969 million m^3 (mcm) level achieved in 2008 could not be reached in terms of domestic natural gas production in the following periods, and it tended to decrease after 2008, except for 2011, 2018 and 2019. In 2020, Turkey's natural production decreased by about 7% year-on-year to 441 mcm.



[9] BOTAŞ. https://www.botas.gov.tr/Sayfa/sikca-sorulan-sorular/92

Chart 14: Turkey's Natural Gas Production by Years



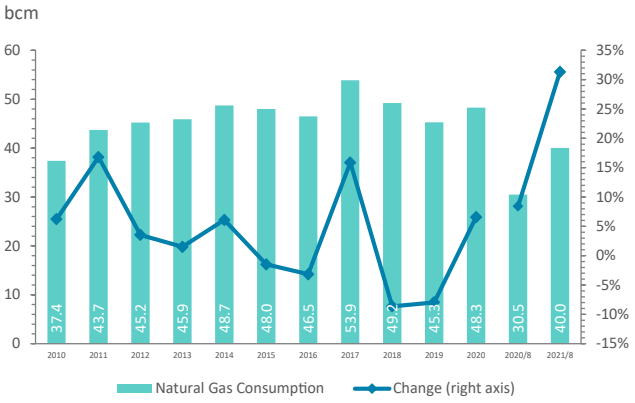
Source: EMRA, TSKB

According to the announcement made by President Recep Tayyip Erdoğan on August 21, 2020, Fatih drillship performing deep-sea drilling in Black Sea explored a natural gas reserve of 320 bcm in Sakarya Gas Field (Tuna-1 Zone). It was announced on October 17, 2020 that an additional natural gas reserve of 85 bcm was explored in Tuna-1 Zone, thus increasing the explored natural gas reserve from 320 to 405 bcm. According to the announcement made on June 4, 2021, another 135 bcm of natural gas was explored in the Amasra-1 well located in Northern Sakarya Gas Field. With the last discovery, the total amount of reserves discovered in Tuna-1 and Amasra-1 wells reached 540 bcm. Recent explorations and ongoing seismic and deep-drilling activities point to a potential rise in the natural gas production of Turkey in the upcoming period.

1.2.2. Natural Gas Consumption in Turkey

Having recorded the highest level in its history with 53.9 bcm in 2017, Turkey's natural gas consumption could not reach this level in the following years. Continuing to decline by 8.6% and 8% in 2018 and 2019, respectively, natural gas consumption rose by 6.6% in 2020 to 48.3 bcm, despite the Covid-19 pandemic. A year-on-year comparison of the first seven months of 2021 reveals that the upward trend regarding natural gas consumption is still prevalent at around 30%. So much so that the total consumption during the first seven months of 2021 was 13% higher than the same period of 2017 known as a record-breaking period. Variables such as the weather in the rest of the year, the share of natural gas in electricity generation and the amount of natural gas that can be imported are thought to be effective for a potential record-breaking gas consumption at the end of 2021. It is considered that the rise in the production of power plants generating electricity from natural gas and temperatures are effective in this upward trend in 2021. It is considered that by relying on the factors such as the absence of any procurement problem, the share of natural gas power plants in electricity generation and the developments in the weather forecast a record-breaking natural gas consumption of approximately 55-60 bcm would happen in 2021.

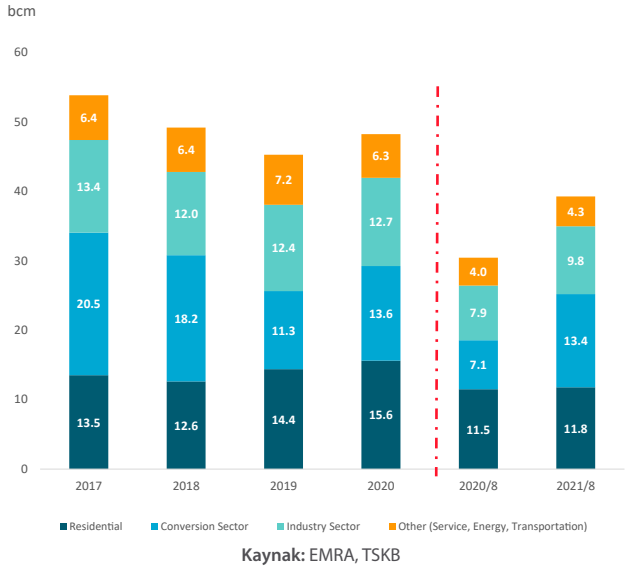
Chart 15: Natural Gas Consumption and Change in Turkey



Source: EMRA, TSKB

In 2020, natural gas consumption increased in the aforementioned period due to the development of conversion/cycle sectors (electricity and heat power plants) and the continuation of working from home practices triggered by the Covid-19 pandemic and the contribution of the increasing number of subscribers to household natural gas consumption. Although gas consumption in the conversion/cycle sectors rose by 21% in 2020 year-on-year at 13.6 bcm, it remained below 20.5 and 18.2 bcm recorded in 2017 and 2018, respectively. However, the performance observed during the first eight months of the year shows that the picture in this sector will change radically in 2021. In 2020, household gas consumption stood at 15.6 bcm, marking a year-on-year increase of 8%.

Chart 16: Breakdown of Natural Gas Consumption in Turkey by Sectors



Kaynak: EMRA, TSKB

Consumption in the energy sector, mainly in oil refineries, stood at 12.7 bcm with a limited rise over 2019 while consumption in industry decreased to 1.6 bcm. During the first eight months of 2021, when the impact of the Covid-19 pandemic was relatively limited, natural gas consumption rose by approximately 31% year-on-year. The increase in demand in almost all sectors, especially the conversion sector, industry and housing, was effective in this increase. It is estimated that natural gas consumption in 2021 will result in a rise in all sectors year-on-year.

1.2.3. Natural Gas Trade in Turkey

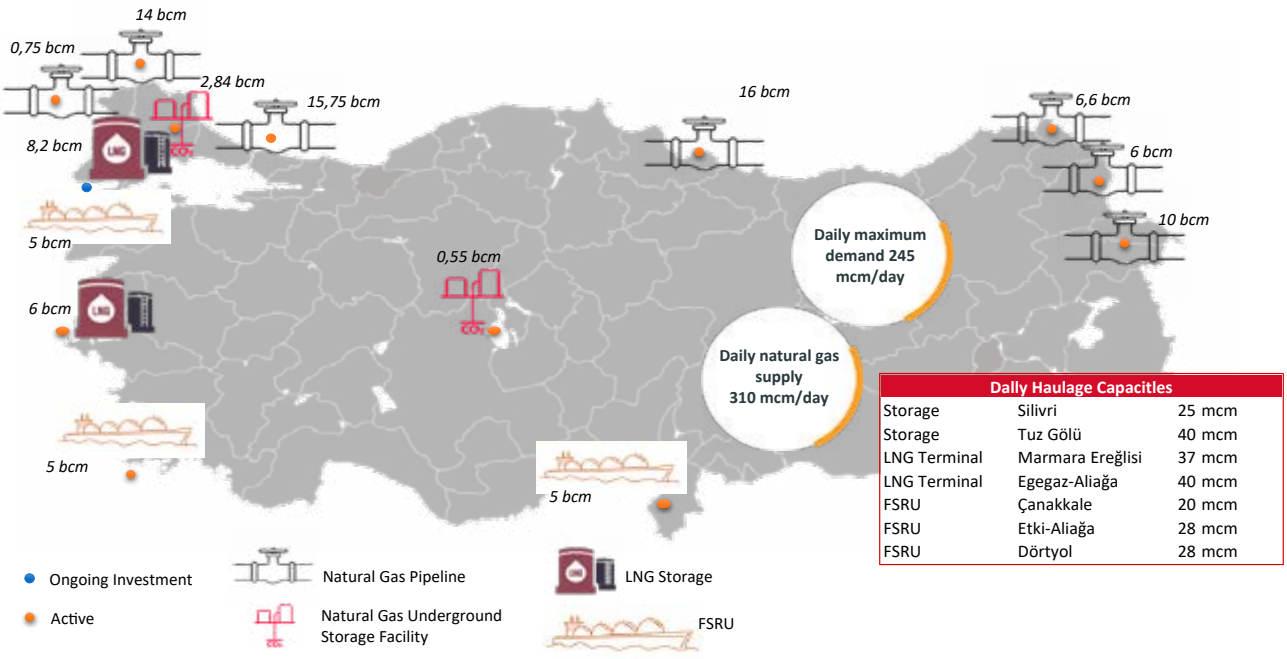
Turkey meets almost all of its natural gas consumption through import. 48.1 bcm of natural gas was imported in 2020, and the amount of import increased by 6.4% year-on-year due to the base effect, but remained below 2017 and 2018. During the first eight months of 2021, 38.5 bcm of natural gas was imported, increasing by over 33% year-on-year. While natural gas export decreased to 578 bcm in 2020, the lowest level since 2008, it remained below the same period of the previous year during the first eight months of 2021.

Underground storage activities play a critical role in ensuring supply security and diversity. Such activities have considerably improved in recent years, attaining an actual storage capacity of about 3.7 bcm by the end of 2020. In addition, the storage capacity of the four operational LNG terminals established to store, gasify and transfer liquefied natural gas (LNG) to the transmission line rose to 0.96 bcm. These are Marmara Ereğlisi LNG Terminal (1994-BOTAŞ), Ege Gaz A.Ş. LNG Terminal (2006-Ege Gaz), Etki Liman LNG Facility (2016-Etki Liman) and BOTAŞ Dörtyol Floating Storage and Regasification Unit (FSRU) commissioned in 2017.

In addition to the facilities in question, Ertuğrul Gazi, the first FSRU ship having a Turkish flag, equipped with a storage capacity of 170,000 m^3 of LNG (around 0.102 bcm of natural gas) was also added into the fleet of BOTAŞ in 2021. Due to the increase in the number of FSRUs, LNG storage facilities and underground storage capacities, a significant progress has been made to ensure short-term and medium-term supply security.

According to the Presidential Annual Program for 2022, it has been stated that Saros FSRU facility will be completed and put into operation and a new FSRU will be procured.[10] In addition to these developments, the Futures Natural Gas Market, which aims to offer product diversity and alternative trade channels in the natural gas market, was launched within EPİAŞ as of October 1, 2021.

Figure 1: Turkey's Natural Gas Entry-Exit Ports



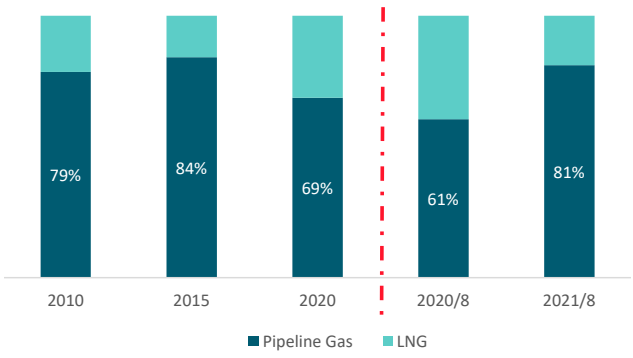
Dally Haulage Capacitles		
Storage	Silivri	25 mcm
Storage	Tuz Gölü	40 mcm
LNG Terminal	Marmara Ereğlisi	37 mcm
LNG Terminal	Egegaz-Aliağa	40 mcm
FSRU	Çanakkale	20 mcm
FSRU	Etki-Aliağa	28 mcm
FSRU	Dörtyol	28 mcm

Source EMRA, TSKB

[10] TR Presidency of Strategy and Budget. https://www.sbb.gov.tr/wp-content/uploads/2021/10/2022-Yili-Cumhurbaskanligi-Yillik-Programi-26102021.pdf

Turkey uses both pipeline gas and LNG methods to meet its natural gas consumption. According to the data of EMRA, the share of LNG in Turkey's gas imports has been increasing each year, reaching 15.1 bcm following an increase of about 19% in 2020. It is observed that the share of LNG in Turkey's natural gas imports, which rose to a historically high level (31%) both in terms of quantity and rate in 2020, stood at 19% during the first eight months of 2021 (2020/8: 40%). This ratio is expected to rise at the end of the year due to the rising demand and the capacity limits in the pipelines. The fact that LNG imports have remained above a certain level over the years indicates that LNG will play an important role in Turkey's gas trade in the future.

Chart 17: Development of Pipeline Gas and LNG Share Within Turkey's Natural Gas Import (%)



Source: EMRA, TSKB

It is observed that the share of Russia in natural gas imports standing at 54% on average between 2010 and 2018 decreased until 2020 after reaching 58% in 2013. The share of Russia in Turkey's natural gas import dropped down to 33.6% in 2019 and 2020 due to recent resource diversification activities and the completion of pipeline projects such as Trans-Anatolian Natural Gas Pipeline Project (TANAP). However, due to the rising demand during the first eight months of 2021, the share of natural gas imported from Russia stood at 49%, exceeding the same periods of 2019 (36%) and 2020 (24%). While the share of Iran, from which 5.3 bcm of natural gas was imported in total in 2020, stood at %11 in total natural gas import, a total of 6.5 bcm of natural gas was imported from Iran during the first eight months of 2021 and the share of this country in total natural gas import rose to approximately %17 (2020/8: 11%). The shares of Azerbaijan and the countries with which LNG is traded within total supply as well as the quantities of gas supplied thereby grew until 2020. Azerbaijan supplied 10.8 bcm of gas in 2020, marking the highest natural gas export to Turkey up to now. Although Azerbaijan's share in natural gas import decreased during the first eight months of 2021, import in terms of quantity ranked the second highest period after the same period of 2020, which was a record-breaking period. Within the framework of the said course of development, Azerbaijan, which had a 21.2% share in 2019 and a 24% share in 2020 in the Turkish gas import market, remained at a 15.5% share during the first eight months of 2021 (2020/8: 26%).

About 18 bcm of Turkey's natural gas contracts, including the 2.1 bcm annual contract with Qatar, expires in 2021. In addition to the aforementioned amounts from 2021, the 4.4 bcm Algerian LNG contract will expire in 2024 and the 16 bcm Blue Stream contract will expire in 2025. According to the announcement made by the Minister of Energy and Natural Resources, Fatih Dönmez, an additional 11 bcm natural gas trade agreement was signed with Azerbaijan, which will be valid until the end of 2024 and will be transported from the Baku-Tbilisi-Erzurum Line.[11] Azerbaijan Minister of Energy Parviz Shahbazov stated that they signed a new agreement for the sale of natural gas to Turkey from Shah Deniz-1 field.

Minister Shahbazov announced that 2.5 bcm of natural gas would be delivered from Shah Deniz-1 field to Turkey next year and 3.5 bcm in 2023.[12] According to a news article covered by Reuters, BOTAŞ signed a three-year agreement with Azerbaijan for 6 bcm of natural gas instead of the 6.6 bcm contract that expired.[13] The said agreement will set import prices based on Italy's PSV hub prices instead of the petroleum products index specified in former contracts.

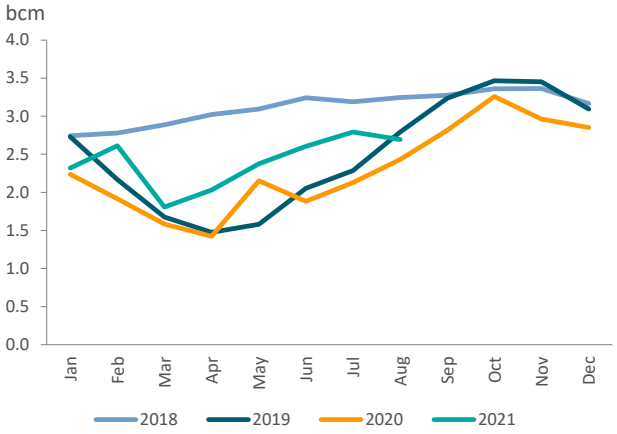
[11] PetroTurk, "An additional natural gas trade agreement covering 11 billion cubic meters signed with Azerbaijan", October 15, 2021. Available at: https://www.petroturk.com/dogalgaz/bakan-donmez-azerbaycanla-11-milyar-metrekupluk-ilave-dogal-gaz-ticaret-anlasmasi-yapildi
[12] Dünya Newspaper, "Azerbaijan increases its natural gas exports to Turkey", October 14, 20201. Available at: https://www.dunya.com/sektorler/enerji/azerbaycan-turkiyeye-dogalgaz-ihracatini-artiriyor-haberi-636601
[13] Reuters, "Turkey braced for costly winter as record gas demand and expiring contracts bite", October 12, 2021. Available at: https://www.reuters.com/world/middle-east/turkey-braced-costly-winter-record-gas-demand-expiring-contracts-bite-2021-10-12/

1.2.4. Natural Gas Storage in Turkey

As a result of investments in the field of natural gas storage in Turkey, significant increases were observed in both underground storage capacity and LNG terminal capacity. For this reason, significant increases were observed in the amount of the natural gas stored over the years. Despite the aforementioned rises, the average annual consumption rate of storage capacities in Europe is 20% while this rate is around 8% in Turkey. While the monthly average amount of natural gas stored between 2014 and 2016 was below 2 bcm, it was 3.1 bcm in 2018, during which the highest level of storage was achieved. According to the data of last 2 full years, it is observed that 2.5 bcm of natural gas was monthly stored in average in 2019 and 2.3 bcm in 2020. During the first eight months of 2021, a monthly average of 2.4 bcm was stored.

Fatih Dönmez, Minister of Energy and Natural Resources, announced on October 22, 2021 that three-quarters of the underground natural gas storages were full and that they would completely filled in the upcoming period.[14]

Chart 18: Month-end Natural Gas Stock Amounts by Years



Source: EMRA, TSKB

Minister Dönmez also stated that the natural gas stored in Silivri Natural Gas Underground Storage Facility reached 3.14 bcm while the natural gas stored in Tuz Gölü Underground Natural Gas Storage Facility to be completed in 2023 was around 1 bcm.

The Presidential Annual Program for 2022 aims to increase the total underground natural gas storage capacity to 10 bcm by completing Tuz Gölü Underground Natural Gas Storage Project and Northern Marmara Natural Gas Storage Expansion Project.[15]

1.2.5. Natural Gas Prices in Turkey

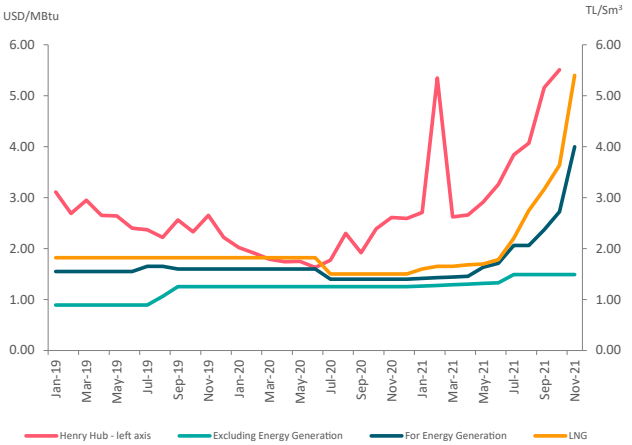
Natural gas prices in Turkey are calculated in parallel with the prices in BOTAŞ's long-term contracts, oil prices and exchange rate movements. As there was not a free natural gas market in the past, the tariffs BOTAŞ imposed on eligible consumers and distribution companies were considered as the reference price within the wholesale network.

It is observed that natural gas prices for electricity generation and for other purposes, which had a similar course in 2017, have recently differed from each other. Natural gas prices for purposes other than electricity generation remained stable in 2020, and after a 14% reduction in natural gas prices used for electricity generation in July, the prices were not updated until the end of the year.

[14] BloombergHT, "We have filled 3/4 of our underground natural gas storage facilities", October 22, 2021. Available at: https://www.bloomberght.com/donmez-yer-alti-dogal-gaz-depolarimizin-4-te-3-unu-doldurduk-2290306
[15] TR Presidency of Strategy and Budget. https://www.sbb.gov.tr/wp-content/uploads/2021/10/2022-Yili-Cumhurbaskanligi-Yillik-Programi-26102021.pdf

On the other hand, 2021 started on a relatively-volatile way compared to the stable course in 2020, and natural gas prices showed an upward trend in TL terms. A 1% increase was observed regarding natural gas prices for purposes other than electricity generation during the first six months of the year in a row and the prices were increased by 12% for household consumption and 20% for industrial facilities. While there was no price increase in household segment in the following period, the price was increased by 96% in total in the natural gas consumed by the industry between September and November.

Chart 19: Growth of Natural Gas Prices



Source: BOTAŞ, U.S. Energy Information Administration (EIA), CBRT, TSKB

On the other hand, prices of the natural gas used for electricity generation rose during all months except August. As of November 2021, there was a price increase of approximately 186% compared to the end of 2020. During the same period, LNG prices rose by 260%.

It is considered that the natural gas price movements observed in the global markets prior to the winter period, when the demand will increase especially due to the need for heating, may put upward pressure on the prices of the Turkish natural gas market, which is subsidized by BOTAŞ in the short-medium term. In the medium-long term, the course and pricing of expiring bilateral natural gas agreements will be important.

Currently, most of the natural gas import agreements consist of long-term pipeline-based procurement agreements while the remaining portion is composed of LNG agreements. In addition to the aforementioned agreements, spot LNG imports are also in place.

Turkey has strengthened its hand with regard to the natural gas procurement agreements with Russia, Algeria and Qatar, the earliest of which will expire in 2021, owing to recent infrastructure investments made for increasing supply security and resource diversity such as TANAP and FSRU. However, it seems possible for the country to be adversely affected by the rising prices due to the recent global pipeline gas supply restrictions and the rise in spot LNG markets. As a result of its investments, Turkey now has more opportunities to supply natural gas both at more affordable prices and through agreements with shorter duration but the course of developments in global markets and fluctuations in gas prices will be effective and decisive for the renewal of the agreements in question.

Recent Global Natural Gas Prices

A significant upward trend has been observed in natural gas prices globally since April 2021. The mild weather conditions in 2020 and the pandemic, which had taken its toll globally, caused a decrease in energy demand. Therefore, there was an excess supply in energy markets in 2020, leading to lower prices in general. In 2021, severe cold weather was observed in Europe, Asia and America. Storm "Filomena" in Spain in January[16], the snowstorm in the US state of Texas in February[17], the coldest morning in China's capital Beijing in decades[18], and the coldest April in Europe since 2003 are prominent examples.[19] These weather conditions increased gas consumption. On the other hand, supply constraints in gas markets due to various technical and political reasons resulted in a gradual rise in prices on one hand and caused the depletion of Europe's natural gas stocks on the other.

While the demand for natural gas in the industry grew with the loosening of the pandemic measures, the limited contribution of renewables in electricity generation increased the demand for natural gas in electricity generation. In addition, the rise in carbon prices in Europe accelerated transition from coal to natural gas in electricity generation. Averaging around EUR 25 per ton in November 2020, carbon prices increased to EUR 64 in October 2021. Due to the increase in energy demand in Asia, the demand for Australian coal also increased, leading to a rise in coal prices at global level. In addition to carbon prices, rises in the prices of coal, which is a substitute for natural gas in the market, triggered not only the demand for natural gas, but also the rise in spot natural gas prices. In addition to the aforementioned factors, long-term droughts observed in countries such as Turkey and Brazil with hydroelectric intensity in electricity generation also played a role in the rise in natural gas demand.

Having started in Europe as of April, the natural gas shortage deepened further due to the certain/ limited quantity of natural gas that could be supplied through pipelines, leading to a rise in LNG demand. Spot market and LNG options were activated regarding the extra demand for- natural gas. This caused LNG prices to increase more than expected. The increase in natural gas demand was not limited to Europe alone. Hurricanes in the USA in September restricted domestic generation, an increase in natural gas demand was also experienced in Asia, all of which triggered competition concerning incoming LNG to Europe and resulted in a price hike. Therefore, price increases in Europe revealed the importance of clean energy alternatives for a balanced energy supply.

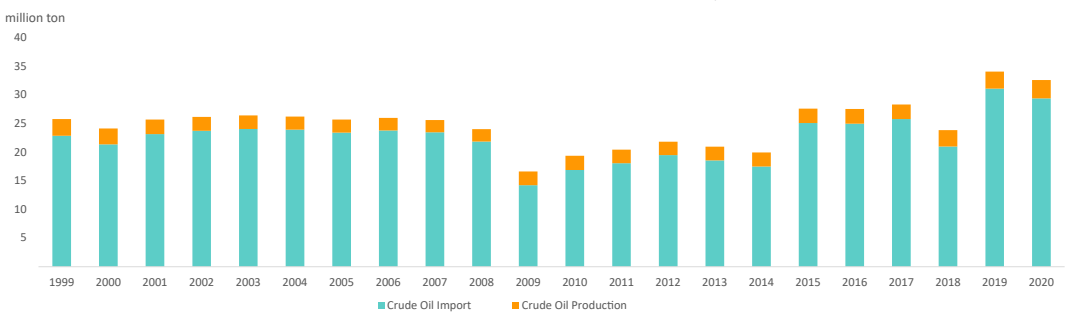
All these global impacts related to natural gas were also observed in Turkey as expected. The share of natural gas in electricity generation in Turkey, gas consumption in industry, the amount of gas in stores and the development of weather temperature will be important in relation to the course of natural gas prices in the upcoming winter period.

[16] The Guardian, "Storm Filomena brings record snowfall to Spain, 21.01.2021. Available at: https://www.theguardian.com/weather/2021/jan/21/storm-filomena-brings-record-snowfall-to-spain
[17] Texas Tribune, "At least 57 people died in the Texas winter storm, mostly from hypothermia", 15.03.2021. Available at: https://www.texastribune.org/2021/03/15/texas-winter-storm-deaths/
[18] The Straits Time, "Beijing records coldest morning in more than five decades", 07.01.2021. Available at: https://www.straitstimes.com/asia/east-asia/beijing-records-coldest-morning-in-more-than-five-decades
[19] Copernicus. https://climate.copernicus.eu/surface-air-temperature-april-2021

1.3. Oil Sector Outlook

Oil has a major role in Turkey's supply of energy products as well as its final energy consumption. Although Turkey's crude oil production has increased in years, the growth in demand has been higher, thereby resulting in a low ratio of production meeting demand. Turkey's natural oil resources are limited and the country meets more than 90% of its need through imports. This is considered as one of the main reasons for the rise in foreign trade deficit. Oil sector activities in Turkey have gained momentum when compared to previous periods while oil and natural gas exploration projects have accelerated.

Chart 20: Crude Oil Import and Production by Years



Source: Directorate General of Mining and Petroleum Affairs (MAPEG), TSKB

1.3.1. Oil Reserves, Oil Production, Refineries and Refinery Products in Turkey

In 2020, Turkey's producible oil reserves stood at 340 million barrels and are mainly located to the southeast of the country. Most oil fields in Turkey are old and well yields are falling steadily. For this reason, emerging technologies and practices intended for improving production yield are of great importance. In 2020, a total of 106 wells comprising of 58 exploratory wells and 48 production wells were drilled. 78 of these wells are co-owned by Turkish Petroleum Corporation (TPAO) while 28 thereof were drilled by other companies operating in the sector.[20]

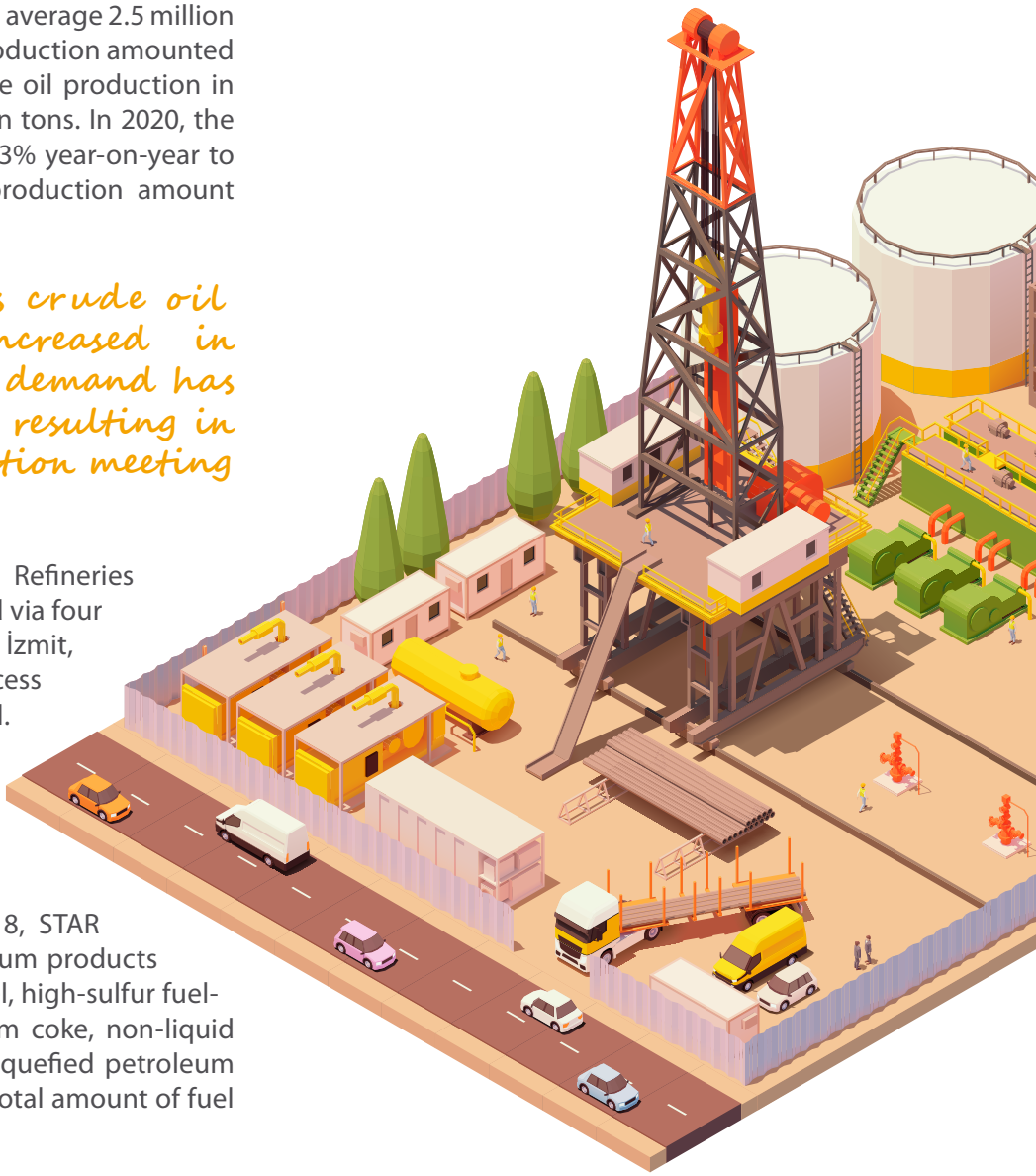
Considering the ten-year period preceding 2020, crude oil production stood at an average 2.5 million tons. Average daily crude oil production amounted to 61,700 barrels in 2020. Crude oil production in 2020 stood at almost 3.2 million tons. In 2020, the crude oil production rose by 7.3% year-on-year to reach the highest crude oil production amount following 1999.

Although Turkey's crude oil production has increased in years, the growth in demand has been higher, thereby resulting in a low ratio of production meeting demand.

In 2020, Turkish Petroleum Refineries Corporation (TÜPRAŞ) operated via four oil refineries located in İzmir, İzmit, Kırıkkale and Batman to process 23.4 million tons of crude oil. During the first 6 months of 2021, the production amount stood at 11.1 million tons.

Commissioned in October 2018, STAR Refinery manufactured petroleum products such as diesel, high-sulfur diesel, high-sulfur fuel-oil, jet fuel, naphtha, petroleum coke, non-liquid refinery gas, marine fuel and liquefied petroleum gas (LPG) in 2020. In 2020, the total amount of fuel production at STAR Refinery stood at 6.8 million tons, while the total manufacturing amount of products not covered by fuel was 3.9 million tons. In 2020, Turkey's total refinery production fell by 4.03% year-on-year to stand at 33 million tons. The total refinery production between January and August 2021 was 22.9 million tons.

In 2020, the imports of diesel types decreased by 21%, fuel oil types by 39%, aviation fuels by 64%, other petroleum products by 0.04% year-on-year while only the imports of marine fuels rose by 296%. In August 2021, total imports increased by 38.9% year-on-year to stand at 4.1 million tons. On the other hand, total exports decreased by 37% in 2020 year-on-year and stood at approximately 9 million tons. In August 2021, total exports increased by 60.9% year-on-year to stand at 780 thousand tons.[21]



[20] TPAO.
[21] EMRA, 2020 Oil Market Report. It can be viewed at: https://www.epdk.gov.tr/Detay/Icerik/3-0-107/yillik-sektor-raporu

1.3.2. Oil Consumption in Turkey

Following an upward trend until 2017, the consumption of oil and petroleum products decreased in 2018 and 2019, a fall extending into 2020. During this period, the consumption of aviation fuels and fuel-oil types as well as total oil consumption decreased significantly due to the travel restrictions imposed in line with the measures taken in the wake of the Covid-19 pandemic.

Table 1: Sales, Import and Export Quantities for Petroleum Products in 2020

Product Type (million tons)	Production	Import *	Export **	Domestic Sales ***	Total Supply (Refinery Production + Import)	Total Demand (Domestic Sales + Export)
Gasoline Types	4.17	-	1.87	2.34	4.17	4.21
Diesel Types	16.70	8.64	2.68	22.66	25.34	25.34
Fuel Oil Types	(0.04)	0.34	-	0.30	0.30	0.30
Aviation Fuels	2.92	0.13	2.43	0.70	3.05	3.13
Marine Fuels	0.52	0.12	0.60	0.04	0.64	0.64
Total	**24.27**	**9.23**	**7.58**	**26.04**	**33.50**	**33.62**

* Sum of Refinery Imports and Imports by Distributors and BDLH (Bunker Delivery License Holders).
** Sum of Refinery Exports and exports by Distributors and BDLH.
*** Sum of Refinery Sales, Fuel Sales by Distributors, Bunker Sales by Distributors and BDLH.

Source: EMRA, TSKB

The total domestic sales of petroleum products for January-August 2021 period increased by 6.5% year-on-year, with the easing of the Covid-19 restrictions, and stood at 19.6 million tons. This value is higher than the 16.3 million tons of sales during the same period of 2019, which can be referred to as a basis for the pre-pandemic levels.

Table 2: Domestic Sales of Petroleum Products in January-August 2020-2021

Domestic Sales (Consumption)		
Product Type (million tons)	**January-August 2021**	**January-August 2020**
Gasoline Types	1.55	1.84
Diesel Types	15.90	16.85
Fuel Oil Types	0.18	0.14
Aviation Fuels	0.48	0.61
Marine Fuels	0.03	0.03
Kerosene	0.01	0.01
Other Products	0.28	0.14
Total	**18.41**	**19.60**

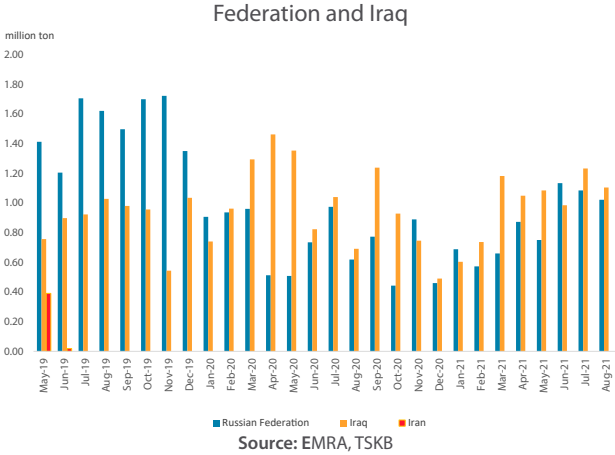
Source: EMRA, TSKB

1.3.3. Trading of Petroleum Products in Turkey

Turkey's crude oil import in 2019 stood at 31 million tons. In 2020, there was a 5.5% decrease in crude oil imports year-on-year and it amounted to 29.4 million tons. During January-August 2021, imports rose by 13.5% year-on-year. No oil has been imported from Iran since the last six months of 2019.

In 2020, total export decreased by 37.4% year-on-year to stand at around 9 million tons. Standing 485 thousand tons in August 2020, the export quantity increased by 61% in August 2021 to 780 thousand tons. The share of TÜPRAŞ refineries and STAR Refinery within the petroleum products exported in 2020 stood at 48.1% and 17.3%, respectively.

Chart 21: Monthly Change of Oil Imported from Iran, Russian Federation and Iraq

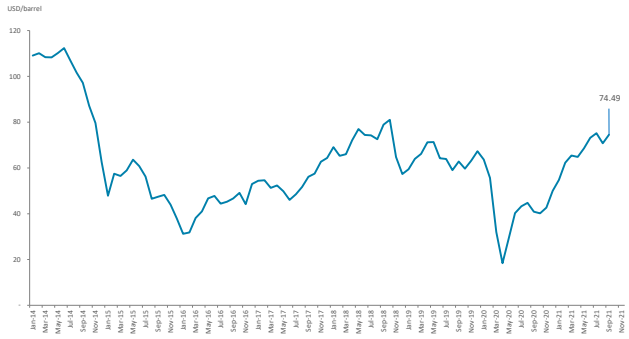


Source: EMRA, TSKB

1.3.4. Growth of Oil Prices

The Covid-19 pandemic continues to affect the transportation industry at global level. Although oil demand increased in 2021 due to increased mobility, it is still at a lower level compared to the pre-pandemic period. Consumption of aviation fuels is quite lower than pre-pandemic levels due to reasons such as international travel restrictions, limited progress in vaccination rates in developing countries, and changing air travel patterns. Demand for both diesel and gasoline is expected to return to pre-pandemic levels by early 2022, but ongoing public health risks, the widespread use of remote working models, especially in developed economies, and the rise in the sales of electric vehicles limit growth.[22]
An already low demand for oil at global level

Chart 22: Growth of Brent Crude Oil Prices per Barrel



Source: International Energy Agency (IEA), TSKB

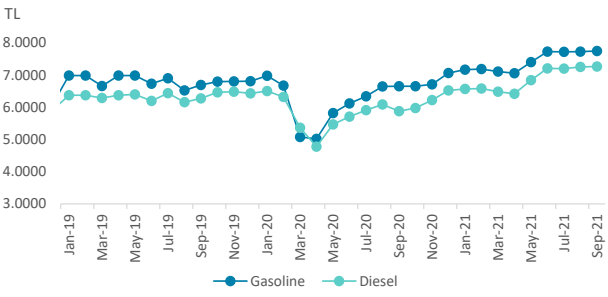
weakened further in 2020 due to reasons such as surplus supply, a rise in the value of USD, the rapidly-spreading Covid-19 pandemic and weak economic outlook and the average barrel price of reference Brent Crude decreased down to USD 20. The barrel price of American West Texas Intermediate (WTI) crude, on the other hand, turned negative for the first time in history, albeit for a short time.

While the Covid-19 pandemic played a significant role in the decline in oil prices, the disagreement between Russia and Saudi Arabia during the first months of 2020 also affected this result. Following an upward trend following May 2020, the price of Brent Crude stood at USD 40-45/barrel during June-October 2020. Standing at USD 55 in January 2021, the price of Brent crude continued to increase throughout the year, reaching USD 75 in September. When this rise in crude oil prices is coupled with the multiplier effect of the increase in the exchange rate, the rise of fuel prices in the domestic market becomes inevitable. As a matter of fact, it is observed that the rises in crude oil prices in international markets also affect domestic fuel prices with a delay of few months, and the prices are following a gradual upward trend.

Prices of petroleum products in Turkey are impacted by the changes in crude oil prices, the exchange rate volatility and taxes. Similar to the Brent Crude prices, both diesel fuel and gasoline prices followed an overall downward trend in the first half of 2020 and an overall upward trend in the second half of 2020. Throughout 2020, diesel fuel and gasoline prices fluctuated in Turkey depending on the prices on international markets. In 2020, the average dealer sales price excluding tax was TL 2.87 per liter (lt) of 95 octane unleaded gasoline and TL 3.02 per lt of diesel fuel.

An indicative analysis of distribution for the shares of gasoline and diesel fuel within the final price including tax in the European Side of Istanbul reveals that 50% of the final price of 95 octane unleaded gasoline standing at TL 6.689/lt on average during 2020 is composed of tax and income share, 39% the product cost and 11% the gross profit margin of the companies operating in the market. It is observed that 49% of the final price for diesel products standing at TL 5.935/lt on average during 2020 is composed of tax and income share, 37% the product cost and 14% the gross profit margin of the companies operating in the market. Starting from January 2021, both diesel and gasoline sales prices started rising in Turkey. The average sales price of 95 octane unleaded gasoline per liter on the European Side of Istanbul in April 2021 stood at TL 7.06 while the average sales price per liter in September 2021 was TL 7.75. Standing at TL 6,42, the average sales price of diesel fuel per liter on the European Side of Istanbul in April 2021 rose to 7.27 in September 2021.

Chart 23: Growth of Gasoline and Diesel Fuel Prices in Turkey



Source: EMRA, TSKB

[22] International Energy Agency (IEA), Global Energy Outlook, 2021.

Being among the most important components of green growth, renewable energy investments and energy efficiency studies have been on Turkey's agenda for a long time.

1.4.

Renewable Energy and Energy Efficiency

Great importance is attached to renewable energy and energy efficiency in many countries around the world for creating a sustainable development route, supporting transition to a low-carbon energy system and mainstreaming clean energy. Being among the most important components of green growth, renewable energy investments and energy efficiency studies have been on Turkey's agenda for a long time. Having been strengthened by hydroelectric power plant breakthrough in the mid-2000s, studies in renewable energy have gained diversity with other types of power plants over time, and Turkey has made tremendous progress in this area during the last decade.

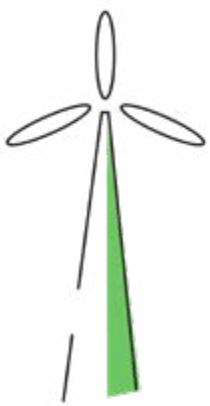
When Turkey takes decisive steps to maintain this momentum on renewable energy, especially wind and solar, it will cross a critical threshold in the path of decarbonization, especially due to the reduction of the grid emission factor. Being undoubtedly the cleanest energy source, energy efficiency has not yet reached the desired level in Turkey in terms of creating macro-scale effects. In the energy efficiency sector, where significant policy and legislative reinforcements have been completed and many foreign-funded projects have been carried out for the last 5-10 years, there is a need to harmonize efforts and integrate them into other energy/development policies. Just as in the renewable energy sector, strong finance mechanisms and ambitious support programs are needed in this area.

In this part of the report, developments and activities in the field of renewable energy and energy efficiency in Turkey will be outlined.

1.4.1. Renewable Energy

It is possible to classify the supply side of the energy sector by resource types and consolidate them under three headings (fossil fuels, nuclear energy and renewables). Diversification of generation and supply resources in order to render the energy system more flexible is among the main supply security policies of our country.

In this context, renewable energy is of special importance in terms of diversifying resources, making better use of domestic resources and meeting energy demand with greener options.



1.4.1.1. Installed Capacity Analysis

Turkey's installed capacity in renewable energy shows an upward trend in years. Standing at 25.6 GW in 2013, installed capacity based on renewable energy resources increased by 10% on average per year to reach around 53 GW by September 2021 while its share within total installed power standing at 40% in 2013 rose to 53.2% by September 2021. HEPPs are on the top for the rise in installed capacity based on renewable energy resources with a rise of 9.2 GW between 2013 and September 2021. HEPPs are followed by SPPs with a rise of 7.5 GW, WPPs with a rise of 7.4 GW, geothermal power plants (GPPs) with a rise of 1.6 GW and biomass power plants (BPPs) with a rise of 1.3 GW.

Table 3: Growth of Installed Capacity for Renewable Energy

Resource (MW)	2013	2014	2015	2016	2017	2018	2019	2020	2021/9
Hydroelectric	22,289	23,643	25,868	26,682	27,273	28,291	28,503	30,984	31,447
Wind	2,760	3,630	4,498	5,751	6,516	7,005	7,591	8,832	10,168
Solar	-	40	310	833	3,421	5,063	5,995	6,667	7,534
Biomass	224	288	345	467	575	739	1,163	1,485	1,782
Geothermal	311	405	624	821	1,064	1,283	1,515	1,613	1,650
Total Renewables	**25,583**	**28,006**	**31,645**	**34,554**	**38,849**	**42,381**	**44,768**	**49,581**	**52,581**

Source TEİAŞ, TSKB

While HEPPs had a share of 87% within the installed capacity of renewable energy resources in 2013, this share decreased over the years especially due to the increases in WPPs and SPPs. However, HEPPs have the largest share in the installed capacity of renewable energy sources by 60% as of September 2021. With a rapid increase in the investments for unlicensed power plants in recent years, the shares of WPPs and SPPs in the installed capacity of renewable energy sources are 19% and 14%, respectively. The share of GPPs in the installed capacity of renewable energy resources is 3.4% while the share of BPPs is around 3.1%.

1.4.1.2. Electricity Generation Analysis

Standing at 261.8 GWh in 2015, total electricity generation across Turkey rose by 4% per year on average to reach 306.7 GWh in 2020. Electricity generation based on renewable energy sources, which was 84.2 GWh in 2015, rose to 129.6 GWh by 2020. Standing at 31.8% in average between 2015 and 2018, the share of renewable energy resources within total generation rose to 42.3% in 2020 as a result of a rise in generation observed in all renewable energy power plants and a drop-in generation by natural gas power plants. In the first 9 months of 2021, this share stood at 36.7%. HEPPs had a share of 79.8% within renewable energy-based electricity generation in 2015 while there was a decline in this share over years. Natural gas power plants achieving a share of 32% within total gross electricity generation during the first 9 months of 2021 are followed by imported and domestic coal-powered plants with a share of 31.1%, HEPPs with a share of 18.4%, WPPs with a share of 9%, SPPs with a share of 4.4%, GPPs with a share of 3% and BPPs with a share of 2%.

Turkey has significant resources in terms of wind, geothermal and solar power. Developing these resources is of vital importance in terms of both combating the climate change and reducing import and fossil fuel dependency in energy.

Table 4: Development of Renewable Electricity Generation

Resource	2015	2016	2017	2018	2019	2020	2021/9
Hydroelectric	67,146	67,231	58,219	59,939	88,886	78,095	45,481
Wind	11,653	15,517	17,904	19,949	21,515	24,513	22,286
Solar	194	1,043	2,889	7,800	10,542	11,977	10,755
Geothermal	3,425	4,819	6,128	7,431	8,230	9,316	7,406
Biomass	1,758	2,372	2,972	3,623	4,524	5,737	4,834
Total Renewables	**84,175**	**90,981**	**88,111**	**98,741**	**133,697**	**129,638**	**90,762**

Source: TEİAŞ, TSKB

1.4.1.3. Renewable Energy Resources Support Mechanism

Pursuant to the Law No. 5346 on the Use of Renewable Energy Resources for Electricity Generation (YEK Law), wind, solar, geothermal, biomass, wave, current and tidal power plants as well as hydropower plants with a canal or river or reservoir area of less than fifteen square kilometers can benefit YEKDEM for 10 years. Power plants commissioned or to be commissioned from May 18, 2005, the effective date for YEK Law, to June 30, 2021 were covered by YEKDEM. Feed-in tariffs covered by YEK Law are valid for 10 years starting from 2022 for the facilities commissioned until the end of 2020, and for 9 years starting from 2022 for the facilities that were put into operation upon provisional acceptance between January 1, 2021 and June 30, 2021.

The YEKDEM mechanism encompassing new conditions for power plants that came into operation after June 30, 2021 were stipulated by the Presidential Resolution published in the Official Gazette No. 31380 of January 30, 2021. Accordingly, the feed-in tariffs, incentives for domestic components and upper limits for USD cent to be applicable to YEK-certified generation facilities to be commissioned from July 1, 2021 to December 31, 2025 and the feed-in tariffs and incentives for domestic components covered by the existing YEKDEM mechanism in relation to the power plants commissioned until June 30, 2021 are as shown in the table:

Table 5: Feed-in Tariffs Under YEKDEM and Incentives for Domestic Components

Type of Facilities (Power plants commissioned until June 30, 2021)		Feed-in Tariff (USD cent/kWh)		Incentive for Domestic Components (USD cent/kWh)
Hydroelectric power plant		7.3		1.0—2.3
Wind power plant		7.3		0.6—3.7
Geothermal power plant		10.5		0.7—2.7
Biomass power plant (including landfill gas)		13.3		0.4—5.6
Solar power plant		13.3		0.5—6.7
Power plants commissioned after July 1, 2021 Type of Renewable Power Plant		**Price (Kurus/KWh)**	**Domestic Contribution (Kurus/KWh)**	**New Upper Limit (USD cent/KWh)**
Hydroelectric power plant		40	8	6.4
Wind power plant		32	8	5.1
Geothermal power plant		54	8	8.6
BPP	Landfill Gas/Waste Tyre	32	8	5.1
	Biomethanization	54	8	8.6
	Thermal Disposal	50	8	8.0
Solar power plant		32	8	5.1

Source: EMRA, TSKB

Prices set for YEK-certified generation facilities to be commissioned from July 1, 2021 to December 31, 2025 will be updated every year in January, April, July and October, starting from January 1, 2021 quarterly and on a resource basis. The first update will be on April 1, 2021. Details of the calculation method and calculation items regarding the resolution published in the Official Gazette No. 31380 of January 30, 2021 are as follows.

$$YEKDEM_{GD} = YEKDEM_{\ddot{O}GD}\, x\, [(\frac{26}{100} x \frac{PPI_{A-2}}{PPI_{A-5}}) + (\frac{26}{100} x \frac{CPI_{A-2}}{CPI_{A-5}}) + (\frac{24}{100} x \frac{FX_{D-A}}{FX_{D-B}}) + (\frac{24}{100} x \frac{FX_{E-A}}{FX_{E-B}})$$

Table 6: Details of YEKDEM Calculation Items

Calculation Items	Contents of Calculation Items
YKF_{GD} [23]	Domestic Component Support price calculated for 3 (three) months period (TL/kWh)
$YKF_{ÖGD}$	Domestic Component Support price calculated for the previous 3 (three) months period (TL/kWh)
PPI_{A-2}	Domestic Producer Price Index for the second month before the first month of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply
PPI_{A-5}	Domestic Producer Price Index for the fifth month before the first month of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply
CPI_{A-2}	Domestic Consumer Price Index for the second month before the first month of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply
CPI_{A-5}	Domestic Consumer Price Index for the second month before the first month of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply
FX_{D-A}	Average values of daily US dollar buying rates published by the CBRT for the second, third and fourth months of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply
FX_{D-B}	Average values of daily US dollar buying rates published by the CBRT for the fifth, sixth and seventh months of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply
FX_{E-A}	Average values of daily Euro buying rates published by the CBRT for the second, third and fourth months of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply
FX_{E-B}	Average values of daily Euro buying rates published by the CBRT for the fifth, sixth and seventh months of the 3-monthly period (quarter) in which the current Domestic Component Support price will apply

Due to the aforementioned feed-in tariffs and the increase in foreign exchange rates, the number of renewable energy power plants that wish to benefit from the USD-based feed-in tariffs under YEKDEM has increased. In this context, the number of power plants to benefit from YEKDEM in 2021 increased to 910, and the total installed capacity rose to 21,530 MW. In addition to licensed power plants, unlicensed power plants also benefit from YEKDEM.

Table 7: Development of Final YEK List

Installed Capacity (MW)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Hydroelectric	21	930	217	598	2,218	9,561	11,096	11,706	12,588	12,372	12,221
Wind	469	685	76	825	2,775	4,320	5,239	6,200	6,496	6,456	6,702
Biomass	45	73	101	147	193	204	300	349	503	654	857
Geothermal	72	72	140	228	390	599	752	997	1,253	1,404	1,462
Solar	-	-	-	-	-	-	13	14	82	163	289
Total	**607**	**1,760**	**534**	**1,798**	**5,575**	**14,684**	**17,400**	**19,266**	**20,921**	**21,050**	**21,530**

Source: EMRA, TSKB

Deadline for registration in YEKDEM as per the "Regulation Amending the Regulation on Certifying and Supporting Renewable Energy Resources" was deferred from October 30 to November 30 through the Official Gazette No. 31573 of August 19, 2021.[24] Upon this amendment, the applications filed as per the regulation will be announced as preliminary YEK list within the first 10 days of December on the website of EMRA after the examination of relevant applications. Final YEK list covering the applications that are eligible for YEKDEM will be completed by December 31.

1.4.1.4. Renewable Energy Resource Area

In 2016, MENR developed YEK auctions model in relation to large-scale investments for the transfer of the areas specified for electricity generation from renewable energy resources to investors on the condition that domestic-made equipment be used. YEKA projects in Turkey support our country's strategy for supply security, domestic and renewable energy resources. They are also of great importance in terms of sustainable energy objectives. Tenders help attract foreign investors. On the other hand, the production of domestic energy equipment and incentives intended for R&D centers are also considered positive in terms of creating added value for the country's economy, reducing the current account deficit and creating employment opportunities.

[23] Rounded to two digits after the decimal point.
[24] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2021/08/20210819-2.htm

The first YEKA tender was organized for Karapınar SPP in 2017, and Kalyon and its South Korean partner Hanwha were awarded with the tender. However, Hanwha decided to withdraw from the joint venture in January 2019 due to financial issues. In October 2019, Kalyon Energy and China Electronics Technology Group Corporation (CETC) closed a deal for a 500-MW solar panel factory, which was commissioned in August 2020. In October 2021, 394 MW of the 1,000-MW SPP was commissioned and the SPP started generating electricity.

The first 1,000-MW WPP YEKA tender held in 2017 was awarded to Siemens-Türkerler-Kalyon joint venture over a bid of 3.48 U.S. cents/kWh. Siemens Gamesa Renewable Energy company started manufacturing nacelles (bodies) in the newly-established company at the end of November 2019.

Tabe 8: Completed YEKA Tenders

	YEKA SPP-1	YEKA WPP-1	YEKA WPP-2	YEKA SPP-3
Location	Konya Karapınar	Edirne, Kırklareli, Sivas, Eskişehir	Aydın, Balıkesir, Çanakkale, Muğla	Various cities[25]
Date	March 20, 2017	August 3, 2017	May 30, 2019	April 26-29, 2021 and May 24-27, 2021
Capacity (MW)	1,000	1,000	1,000	1,000
Awarded Price	USD 69.9/MWh	USD 34.8/MWh	USD 35.3-45.6/MWh	TL 182/MWh-TL 320/MWh
Sponsor Company	Kalyon, CETC	Kalyon, Siemens Gamesa, Türkerler	Enerjisa (Aydın, Çanakkale) Enercon (Balıkesir, Muğla)	30 Companies
Period of Feed-in Tariff	15 years	15 years	15 years	15 years
Domestic Equipment Ratio	60% for the first 500 MW, 70% for the second 500 MW	60%	55%	70%

Source: EMRA, TSKB

YEKA WPP-2 tender was held on May 30, 2019. The tenders covered WPPs with an installed capacity of 250 MW in Balıkesir, Çanakkale, Aydın and Muğla. Enercon and EnerjiSA were each awarded two tenders out of the remaining four tenders. Enercon's bid of 4.00 U.S. cents/kWh enabled the company to win the Muğla tender while a bid of 3.53 U.S. cents/kWh secured the Balıkesir tender. EnerjiSA, on the other hand, was awarded the Aydın tender with a bid of 4.56 U.S. cents/kWh and the Çanakkale tender with a bid of 3.67 U.S. cents/kWh. It was announced in 2018 that January 2019 would be the deadline for applications regarding Turkey's second largest solar power plant tender. This tender incorporated three separate contests, one for an installed capacity of 500 MW in Viranşehir, Şanlıurfa, one for 200 MW in Erzin, Hatay and one for 300 MW in Bor, Niğde. However, it was announced in January 2019 that the tender was canceled. YEKA tenders continued in 2018 as well. On June 21, 2018, a tender for a 1,200-MW offshore wind farm project was announced but this tender was postponed since the tender failed to attract a sufficient demand.

YEKA WPP-3 tender notice was issued regarding the allocation of wind energy-based renewable energy resource areas and connection capacities, and the application date for 2,000-MW installed capacity in 42 regions was indicated as December 14, 2021. YEKA SPP-5 tender notice was issued regarding the allocation of solar energy-based renewable energy resource areas and connection capacities, and the application date for 1,500-MW installed capacity in 23 regions was indicated as January 12, 2022. Similarly, YEKA SPP-4 tender notice was issued regarding the allocation of solar energy-based renewable energy resource areas and connection capacities, and the application date for 1,000-MW installed capacity in 3 regions was indicated as March 30, 2022.

[25] Adıyaman, Aksaray, Ankara, Antalya, Ağrı, Batman, Bayburt, Bilecik, Bingöl, Bitlis, Burdur, Bursa, Çankırı, Çorum, Diyarbakır, Elâzığ, Erzurum, Eskişehir, Gaziantep, Hakkâri, Iğdır, Kahramanmaraş, Kars, Kilis, Kırşehir, Malatya, Mardin, Mersin, Muş, Nevşehir, Osmaniye, Siirt, Şırnak, Uşak, Van, Yozgat

Table 9: Canceled, Postponed, Pending YEKA Tenders

	YEKA SPP-2 (Cancelled)	YEKA OFFSHORE WPP-3 (Postponed)	YEKA WPP-3 (Applications to be accepted) *	YEKA SPP-5 (Applications to be accepted) **	YEKA SPP-4 (Applications to be accepted) ***
Location	Niğde, Hatay, Şanlıurfa	Gelibolu, Saroz, Kıyıköy	42 regions	23 regions 76 tenders	Bor, Erzin, Viranşehir
Capacity (MW)	1,000	1,200	2,000	1,500	1,000
Ceiling Price	USD 65/MWh	USD 80/MWh	TL 450/MWh	TL 400/MWh	TL 400/MWh
Period of Feed-in Tariff	15 years	-	Equivalent to the feed-in tariff generated starting from the date of initial acceptance concerning the power plant for each megawatt MW value of the connection capacity		
Amount of Feed-in Tariff		50 TWh	35 GWh	23 GWh	23 GWh
Domestic Equipment Ratio	-	50 TWh	35 GWh	23 GWh	23 GWh
	60%	60%	55%	75%	75%

* Applications will be accepted on December 14, 2021.
** Applications will be accepted on January 12, 2022.
*** Applications will be accepted on March 30, 2022.

Source: EMRA, TSKB

1.4.1.5. Green Tariff (YETA) and YEK-G System

Within the scope of EMRA's "Resolution Amending the Procedures and Principles Regarding the Tariff Practices of Legal Entities with Distribution License and Commissioned Supplier Companies" of July 23, 2020, "Green Energy Fee" was set as 69.97 kurus per kWh and as of July 2021, it was increased to 92.62 kurus. Green electricity tariff is a tariff that was introduced to be applicable to all end consumer types and came into effect on August 1, 2020.

Aim of the green electricity tariff is to encourage the end consumer to use electricity generated from renewable energy sources. Looking at examples around the world, this tariff is often designed to give large commercial and industrial consumers the option to meet their sustainability goals. Initially standing at high levels, the tariff prices started falling down in time upon the rise of renewable energy investments. The most powerful and well-known support mechanism for renewable energy is feed-in-tariff (FiT). Currently, YEKDEM implemented in Turkey is a classic example of FiT. However, as the market grows mature (after the number of power plants generating electricity from renewable sources increases and these power plants acquire a certain share in electricity supply), FiT, which usually imposes a large financial burden, is abolished and alternative approaches are introduced. The green electricity tariff is one of these alternative support mechanisms. Considering good examples around the world, it is observed that the green electricity tariff is generally launched together with the "renewable energy portfolio standard (mandatory quota practice)" and the "green certificate system". It is of great importance to verify that the electricity generated through both practices is green.

On November 14, 2020, the Renewable Energy Resource Guarantee Certificate (YEK-G Certificate) was created as a transparent and reliable verification mechanism and create under the green electricity tariff to make sure that the energy used by consumers that would like to supply electricity based on renewable energy resources is generated out of these resources. "Regulation on Renewable Energy Resource Guarantee Certificate (YEK-G) in Electricity Market" was published in the Official Gazette No. 31304 of November 14, 2020 to allow for tracking, proving and disclosing the generation of a certain quantity or ratio of the electrical energy supplied to consumers by licensed legal entities out of renewable energy resources and for supplying consumers the electrical energy generated out of renewable energy resources by way of certification for the purposes of disseminating the use of renewable energy resources in the generation and consumption of electricity and of protecting the environment. Under YEK-G System, those generating electricity will be able to increase the use of renewable energy resources in electricity generation and consumption. As per their obligations, supply companies will be able to verify that they have renewable energy within their portfolio. Consumers will be able to contribute to mitigating the effects of climate change and protecting the environment while they can obtain information about the source of the energy they purchase and have the opportunity to choose between electricity products.

In this respect, YEK-G System is considered as a practice contributing to the process of transition to a low carbon economy and to a sustainable future.

Organized YEK-G market was launched on June 1, 2021 and is a market organized and operated by EPİAŞ where YEK-G certificate is traded among market players. At organized YEK-G market, the contracts imposing an obligation to receive or deliver a YEK-G certificate equal to the amount of matching over the matching price are traded by EPİAŞ through the continuous trading model. In addition, no operation fee is charged at YEK-G market by the end of 2021.

YEK-G certificates issued as of the end of October 2021 approximately amount to 8.2 million MWh. It is observed that the largest share among renewable energy power plants with regard to issued certificates corresponds to hydroelectric power plants by 87%.

Table 10: Organized YEK-G Market Amount of YEK-G Certificates Issued

Resource (MWh)	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Total	Share (%)
Hydroelectric	5,758,768	391,157	238,827	313,120	425,234	7,127,106	87.0
Geothermal	440,299	94,848	233,541	117,532	-	886,220	10.8
Wind	39,532	9,857	32,683	14,549	22,824	119,445	1.5
Biomass	16,739	12,174	7,087	7,556	15,001	58,557	0.7
Solar	-	-	-	-	-	-	0.0
Total	**6,255,338**	**508,036**	**512,138**	**452,757**	**463,059**	**8,191,328**	**100.0**

Source: EPİAŞ, TSKB

Matching amounts regarding the organized YEK-G market stand at 25,695 MWh as of the end of October 2021. It is observed that the largest share among renewable energy power plants with regard to matching amounts corresponds to hydroelectric power plants by 44.3%. Hydroelectric power plants are followed by geothermal power plants with a share of 36.2%. It is observed that the share of wind and biomass power plants remains limited.

Table 11: Organized YEK-G Market Matching Amounts

Resource (MWh)	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Total	Share (%)
Hydroelectric	2,045	2,779	18	26	6,520	11,388	44.3
Geothermal	29	1	5,800	-	3,469	9,299	36.2
Wind	635	301	12	-	1,100	2,048	8.0
Biomass	1	-	-	-	2,959	2,960	11.5
Solar	-	-	-	-	-	-	-
Total	**2,710**	**3,081**	**5,830**	**26**	**14,048**	**25,695**	**100.0**

Source: EPİAŞ, TSKB

Matching prices on a resource basis in the organized YEK-G market are given below. As of October 21, 2021, it is observed that the min-max values of matching prices on a resource basis vary between TL 0.20 and 1/MWh.

Table 12: Organized YEK-G Market Min-Max Matching Prices

TL/MWh	21.06.2021		29.07.2021		20.08.2021		21.09.2021		21.10.2021	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Hydroelectric	0.01	3.00	0.35	0.98	0.28	0.33	0.19	0.29	0.20	1.00
Geothermal	1.90	5.00	0.50	0.50	0.45	0.45	-	-	0.20	0.50
Wind	0.05	1.99	0.01	1.00	1.00	1.00	-	-	1.00	1.00
Biomass	5.00	5.00	-	-	-	-	-	-	-	-

Source: EPİAŞ, TSKB

Increasing the share of electricity generated based on renewable energy resources is of great importance for transition to a low carbon economy. However, it is absolutely necessary to make good use of the potential of energy efficiency, now considered a supply resource, and benefit from the opportunities offered thereby to achieve comprehensive transformation.

1.4.2. Energy Efficiency

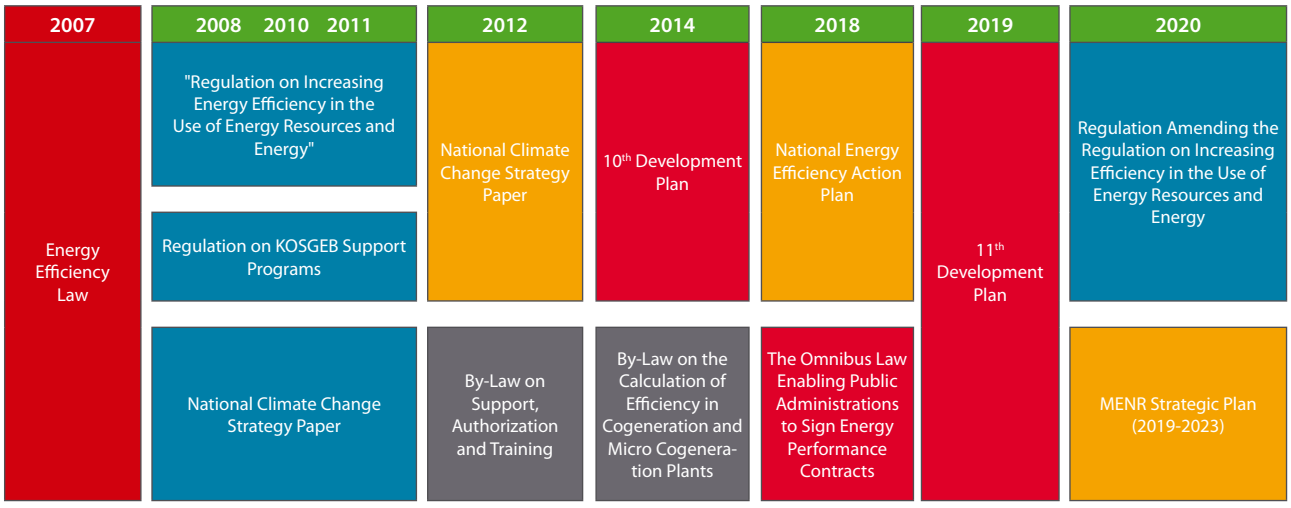
Energy efficiency is a concept referring to the utilization of energy resources at all stages from generation to consumption with maximum efficiency. In this sense, energy efficiency means preventing energy losses that may materialize in many different forms such as heat, gas, steam, pressurized air and electricity as well as the reduction of energy consumption through the use of new and innovative technologies without affecting production, service provision, comfort standards and social welfare. As it is a horizontal area that complements other national objectives in the energy sector and supports transition to a low-carbon economy, energy efficiency is one of the most important pillars of efforts to render development sustainable. It is expected to make an expenditure of USD 750 billion on clean energy technologies and energy efficiency on a global basis by the end of 2021. However, when the said expenditures are considered within the scope of combating climate change, they remain low. In order to keep the total temperature increase in the world below 2 degrees, clean energy investments should be at the level of 2 times those made in 2020, and at the level of 3 times to keep it below 1.5 degrees.[26] Investments in transition to clean energy must rise to around USD 4 trillion per year by 2030 to move the world on the path to net zero emissions.[27]

Energy efficiency is one of the fields of investment and activity that has the highest share in this transition projection.

1.4.2.1. Energy Efficiency Policies, Legislation and Organizational Infrastructure

Systematic activities specifically intended for energy efficiency were initiated starting from the 2000s. The "Energy Efficiency Law" No. 5627, which entered into force in 2007, aims to alleviate the burden of energy costs on the economy and improve efficiency in the use of energy to protect the environment. Published in 2012, the "Energy Efficiency Strategy Paper" sets energy efficiency objectives for 2023.

Figure 2: Major Energy Efficiency Policy Documents and Legislation



Source: TSKB

In line with emerging needs and in order to improve the 2012 strategy further, the "National Energy Efficiency Action Plan (NEEAP)" was prepared in 2017, considering the best practices across the globe. Covering 55 actions to be implemented between 2017 and 2023 under the categories of horizontal matters, buildings and services, industry and technology, energy, transport and agriculture, the NEEAP aims to reduce primary energy consumption by 14% by 2023 (savings of 23.9 million tons of oil equivalent (MTOE)). In order to achieve this amount of savings, it is foreseen that an investment of USD 10.9 billion will be made and that these investments will yield a cumulative return of USD 8.4 billion in 7 years. It is known that investments will continue to provide returns for long years in the upcoming period, but this issue has not been included in the calculations.

[26] IEA, World Energy Investments, 2021.
[27] IEA, World Energy Outlook, 2021. Available at: https://iea.blob.core.windows.net/assets/88dec0c7-3a11-4d3b-99dc-8323ebfb388b/WorldEnergyOutlook2021.pdf

Table 13: NEEAP: Required Investment Amount and Targeted Energy Savings

Required Investment Amount (USD 000)															
2017		2018		2019		2020		2021		2022		2023		Total	
958		1,279		1,593		1,681		1,748		1,824		1,846		10,929	
Energy Saving															
2017		2018		2019		2020		2021		2022		2023		Cumulative	
kTEP	000 $	kTEP	000 $	kTEP	000 $	kTEP	000 $	kTEP	000 $	kTEP	000 $	kTEP	000 $	kTEP	000 $
577	202	1,630	571	2,493	872	3,378	1,182	4,298	1,504	5,264	1,842	6,261	2,191	23,901	8,364

Source: MENR NEEAP, TSKB

MENR stated that energy savings of 3.19 MTOE corresponding to USD 1.1 billion in monetary terms were cumulatively achieved during 2017-2020 within the framework of the actions under the NEEAP. It was announced that a total of USD 635 billion was invested for energy efficiency in 2020 and, as a result, primary energy savings of 451,000 TOE corresponding to USD 158 million in monetary terms were achieved. Although the Covid-19 pandemic in 2020 resulted in an NEEAP realization rate of 53%, it was stated that the objectives for 2020 were fulfilled by 97% between 2017 and 2020.[28] Although there is no analytical explanation on how these realization rates are calculated, it is a promising development for the sector that a public action plan is monitored closely and progress is reported in this way.

In Turkey, additional support programs have been implemented since 2009 to encourage energy efficiency projects in the industry, among which there are efficiency-boosting project (known as VAP in Turkish) supports. In this context, TL 83 million-worth of support was offered to 434 completed and ongoing projects totaling TL 307 million, resulting in annual monetary savings of TL 173 million and resource savings of 90 thousand TOE.[29] Considering the level of improvements achieved during 2017-2020 as well as the overall problems experienced in economy in 2020, it is understood that it will not be easy to reach the targets within the NEEAP for 2023. However, it is important to monitor the targets set and share the findings with the public in order to demonstrate the determination on this issue. The NEEAP is coordinated by the Energy Efficiency and Environment Department (EVÇED) established under MENR in January 2019 to engage in energy efficiency, sustainability and climate change actions. It was stated that the Eleventh Development Plan published in July 2019 aimed to ensure uninterrupted, high-quality, sustainable, reliable and affordable energy supply. There are objectives regarding energy efficiency within the Eleventh Development Plan. These objectives have a cross-sectoral content. Although the objectives encompassing many topics from power plant rehabilitations to industrial symbiosis, from district heating and cooling systems to green port certification are complementary to each other, it is necessary to strengthen the implementation, to mainstream pilot practices and to carry out impact assessment activities for a few common practices so as to ensure that these objectives not tied to any quantitative and concrete indicators can create macro impacts.

[28] MENR, National Energy Efficiency Action Plan 2020 Development Report, Executive Summary, 2021.
[29] In 2020, USD 635 million investment were realized for energy efficiency.", 07.04.2021. Available at: https://www.enerjiportali.com/enerji-verimliligi-icin-2020de-635-milyon-dolar-yatirim-yapildi/

Otherwise, it is probable that at least some of the objectives will be nothing but wishes at the end of the planning period. Progress was made in the efforts to amend the secondary legislation issued in 2008 and revised several times in line with the evolving needs over the years, and the "Regulation Amending the Regulation on Improving Efficiency in the Use of Energy Resources and Energy" was published in the Official Gazette No. 31019 of January 25, 2020. This Regulation stipulates that the number of consumers subject to energy efficiency audits must be increased, the audit processes (application, evaluation, etc.) must be facilitated, the facilities obliged to appoint an energy manager or establish an energy management unit must establish ISO 50001 Energy Management System while measurement-verification specialists were also defined in the legislation. In May 2020, the Strategic Plan covering the years 2019-2023 was published by the MENR. This strategic plan aims to sustain activities intended for supporting energy efficiency, create a market infrastructure for demand-side engagement for electricity and natural gas, engage in activities to raise public awareness on energy efficiency and plan the energy system for electric vehicles so as to prioritize energy efficiency and increase the number of practices in this vein.

The "Regulation Amending the Regulation on Electricity Market's Ancillary Services" published in the Official Gazette No. 31377 of January 27, 2021 defines demand-side backup service and takes initial steps for demand-side management, which is a very important energy efficiency option. Initially, it is foreseen that consumption facilities with a minimum energy consumption of 10 million kWh will offer demand-side backup service, and it is considered that the practice may become widespread with the deepening of the legislation on this subject.

1.4.2.2. Evaluation of Energy Efficiency on a Sectoral Basis

Considering various good practice examples for energy efficiency, it is observed that major topics such as strengthening buildings in terms of insulation and heat performance, the implementation of energy efficiency projects on the basis of both processes and auxiliary enterprises in the manufacturing industry, the creation of innovative financing mechanisms for energy efficiency investments to be made both in the industry and in buildings, developing minimum requirements and eco-design standards for electrical devices and equipment (transformers, power supplies, pumps, motors, air-conditioners, household appliances, lighting equipment and home appliances, etc.), improving the performance of motor vehicles and increasing fuel efficiency and encouraging sustainable urban transport and integrated transport come to the fore.

Table 14: Selected Energy Efficiency Policies in Industry and Buildings

Country	Policy/Action	Description
Canada	Energy Efficiency Regulations	Industrial energy-consuming products (e.g. electric furnaces, heat pumps) need to meet federal standards to be imported, or sold or leased across provinces.
	Canada Greener Homes	Grants and interest-free loan programmes to finance deep home retrofits. Dedicated funding stream available for low-income home owners.
Chile	Law on Energy Efficiency	Mandatory reporting of energy efficiency ratings for all new buildings.
EU	A Renovation Wave for Europe	Double the annual rate of building retrofits in the European Union by 2030.
France	Multi-Annual Energy Plan	+27% improvement of energy efficiency by 2030. Investment support for building retrofits. Industry final consumption target of 269 TWh by 2028.
India	New Energy Performance Standards for Air Conditioners	Mandate a default set point temperature of 24 °C for all room air conditioners.
Japan	Strategic Energy Plan	New buildings to have net zero emissions by 2030.
Korea	Green New Deal	Funding for retrofits of public service and residential buildings.
UK	Industrial Energy Transformation Fund	Support investment in energy efficiency and the use of low-carbon technologies in energy intensive industries.
	Future Homes Standard	Fossil fuel heating systems banned from new homes by 2025.
USA	Better Plants Program	Energy management plans and energy performance tracking.

Source: IEA, TSKB

The two sectors that have been leading in energy efficiency activities in Turkey for many years are the manufacturing industry and buildings. In these two areas, a certain level of maturity has been achieved in terms of total savings, increased awareness, competent human resources and intellectual capital. However, it has been demonstrated by various national and international studies that there is still a huge energy-saving potential in these two areas.

High energy consumption in the industry makes this sector a priority target sector for incentivizing energy efficiency investments. Noteworthy developments are present in Turkey due to the projects and supports executed in the country. Energy audits, VAPs, ISO 50001 practices and voluntary agreements are concentrated in this sector. However, there is still a huge room for improvement in the industrial sector in general, but especially in SMEs. Although the areas for improvement in the manufacturing industry differ in terms of fields of activity and processes, it is observed that there is still an important potential in almost every sub-sector. It is seen that innovative options such as trigeneration, heat pump and renewable energy integration have been integrated into some of the service buildings constructed in recent years, and an extremely-good energy performance has been achieved in some buildings. However, it is observed that most of the buildings with energy performance certificates are not at high efficiency levels (more than 1 million existing and new buildings with energy performance certificates are only in C class and above), and the desired performance levels cannot be achieved even in newly-constructed buildings. It is known that old (existing) buildings are generally lagging behind in terms of energy efficiency, and this situation is even worse in residential buildings. This picture indicates that there is a significant potential in Turkey for an initiative similar to the renovation wave in the EU.

In energy generation-distribution systems and in the agricultural sector, significant projects that are associated with energy efficiency or are directly related to energy efficiency have been launched in recent years. There is a need to develop these efforts, which are largely isolated and have not yet been systematically linked. Another important need in this area is to engage in monitoring, reporting and data collection concerning the studies carried out with a focus on energy efficiency.

The transportation sector is a sector that requires macro policies and develops under the guidance of the central government and national policy regulations. However, some practices must be introduced by local administrations, leading to coordination problems from time to time. The transportation sector, on the other hand, is a sector that is of interest to energy efficiency in terms of issues such as strengthened urban public transportation, integrated transportation based on transition between modes, logistics centers, hybrid and electric vehicles, fuel efficiency, signaling and traffic optimization.

Recent Significant Legislative Amendments, Studies and Projects Carried Out by Sectors

Industry

- Mandatory energy audits that industrial enterprises with an annual energy consumption of more than 1,000 TEP are obliged to perform or commission every 4 years
- Energy efficiency project support practices carried out in the industry (VAP supports, voluntary agreement supports, 5th region incentives)
- "Increasing Energy Efficiency in Industry" and "Energy Efficient Industrial Facility" competitions organized by MENR
- "Promoting Energy Efficient Engines in Small and Medium-Sized Enterprises in Turkey Project" organized under the collaboration of the Ministry of Industry and Technology and UNDP
- Performing benchmarking studies in selected manufacturing industry sub-sectors (textiles, cement, iron-steel, glass, food, etc.)
- Establishment of Competence and Digital Transformation Centers (Model Factory) and Innovation Centers organized under the coordination of the Ministry of Industry and Technology
- "Framework Energy Labeling Regulation" published in the Official Gazette No. 31411 of March 2, 2021

Buildings

- Legislative amendment enabling public institutions to conclude long-term contracts for energy efficiency improvements to be made in their buildings (Integration of energy performance contracts (EPCs) into the Energy Efficiency Law No. 5627 through the "Law Amending Tax Laws and Some Laws and Decree Laws" published in the Official Gazette No. 30373 of March 27, 2018) and the publication of the "Presidential Resolution on the Principles and Procedures Regarding Energy Performance Contracts in Public Sector" in the Official Gazette No. 31220 of August 21, 2020)
- Initiating the implementation of the "Energy Efficiency in Public Buildings Project" supported by the World Bank; switching to EPC practices intended for improving the energy performance of public buildings within the scope of the project; Offering trainings to practitioner companies, energy managers and MENR trainers on subjects such as measuring and verification, energy audits and dispute resolution
- Publication of the "Building Sector Energy Efficiency Technology Atlas" under the collaboration of the Ministry of Environment and Urbanization and the German International Cooperation Agency (GIZ)
- Increasing the ratio of loans to be extended for buildings certified with A and B-class energy performance certificates through the "Regulation Amending the Regulation on the Lending Operations of Banks" published in the Official Gazette No. 30666 of January 25, 2019
- Publication of the Presidential Circular No. 2019/18 on "Energy Saving in Public Buildings" in the Official Gazette No. 30860 of August 16, 2019 and setting a target for the public buildings liable to assign an energy manager to achieve a minimum energy saving of 15% by the end of 2023

Power Plants, Transmission and Distribution Infrastructures

- Introducing an obligation to conduct audits in order to evaluate waste heat potential (primarily for heating and cooling purposes in buildings and then in other sectors) in thermal power plants with an installed capacity of 20 MW or more
- Identifying energy efficiency potential in power plants under the energy efficiency study carried out by MENR-EVÇED in thermal and hydraulic power plants and the field research conducted in 189 power plants
- Performing energy use analysis for the system in relation to the natural gas transmission infrastructure owned by BOTAŞ
- Network improvement and network expansion activities carried out by electricity distribution companies within the framework of targeted loss rates

Transportation

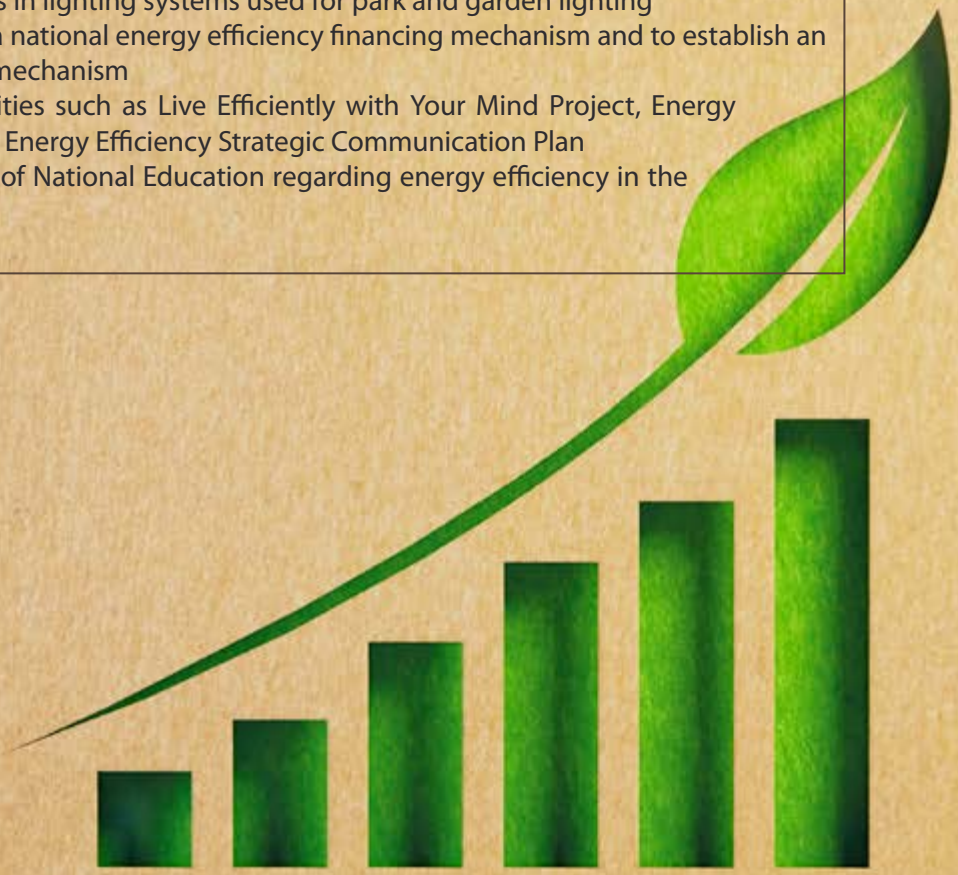
- Infrastructure activities (high speed and fast railway projects and conventional railway projects) carried out to strengthen railway transport, which is a more energy efficient transportation option
- Efforts for the establishment of logistics centers and combined freight terminals in order to shift some of the road freight transport to rail and maritime transport.
- Preparation of the “Master Plan on Inter-city Transport and Touristic Bicycle Routes” for a route of approximately 3,000 km in length to be integrated into the European Cycle Route Network (Eurovelo)
- Taking measures and introducing practices to encourage the use of bicycles and scooters by some local governments

Agriculture

- Offering rural development support for the modernization of individual on-farm irrigation systems
- Engaging in audits and practices to renew agricultural irrigation facilities and to boost the efficiency of the pumps in gradual irrigation systems
- Offering support, albeit limited, for the purchase of tractors and combine harvesters in line with the goal of reducing total fuel consumption by creating economies of scale

Other

- Design, implementation and labeling communiqués published after the "Framework Energy Labeling Regulation"
- Studies carried out within the scope of the cooperation agreement between MENR and the Danish Ministry of Energy, Public Services and Climate, for the dissemination of district heating systems and the creation of the heat market
- Studies carried out within the scope of the "Cogeneration Plant Efficiency Certificate" by MENR-EVÇED
- Requirement to use LED fixtures in lighting systems used for park and garden lighting
- Studies carried out to develop a national energy efficiency financing mechanism and to establish an energy efficiency competition mechanism
- Communication-oriented activities such as Live Efficiently with Your Mind Project, Energy Efficiency Awareness Index and Energy Efficiency Strategic Communication Plan
- Changes made by the Ministry of National Education regarding energy efficiency in the curriculum



Steps are being taken to deepen the electricity, natural gas and renewable energy markets In Turkey.

1.5.
Energy Market Trends and Expectations

In order to reduce the effects of the climate crisis and to prevent global warming from exceeding 1.5°C, shift towards renewable energy resources is accelerating. Similar to the prevailing trends in the world, the tendency towards renewable energy has increased in our country, and as stated in the previous sections, 53.3% of the total installed capacity was composed of renewable energy power plants by the end of September 2021. Considering the paths globally pursued for transition to renewable energy, the resulting picture is as follows: First of all, incentive mechanisms were developed to create an environment for investment in renewable energy power plants, then a competitive market was established by switching to the tender system, and at the last stage, consumers were taken into consideration and mechanisms were developed to certify that the consumed energy was obtained from renewable energy sources.

Following a similar path, Turkey firstly developed YEKDEM incentive, then it engaged in announcing YEKA auctions and incentivizing the domestic production of related technologies, and finally, YEK-G certification system was developed. Considered from this perspective, globally-accepted methods in transition to clean and renewable energy have been introduced in Turkey within the framework of the country's unique dynamics.

It is possible to state that the policies and approaches implemented for fossil fuels in Turkey are largely in line with global trends. Possessing very limited oil and natural gas resources, Turkey does not have many options other than exploration and development drilling and proactive position-setting against price movements. The steps to improve the natural gas storage capacity and the quest for making Turkey an energy hub are the topics that need to be addressed in this context. Although significant progress has been made in pipeline investments, the pursuit of multilateral cooperation still maintains its importance. There is also a need to strengthen the legal and economic infrastructure required for becoming an energy hub. Considering the developed energy hubs across the world, it is observed that a significant part of the trade is performed through forward contracts, and high transaction volumes and liquidity are created by forward contracts. In this context, a new step towards turning Turkey into an energy hub was taken by EPİAŞ on October 1, 2020 with the launch of the Natural Gas Futures Market.

It is a fact that the attitudes and actions regarding coal in Turkey diverge somewhat from the prevailing global trends. While the high dependence of two major emission sources such as China and India on coal for electricity generation weighs heavily on one side of the scale, G7 countries' declaration in 2021 not to finance a new coal power plant stands out as a radical stance on the other side of the scale.[30] Likewise, the Chinese President's announcement at the UN Summit that it would not finance coal-powered plant projects outside its borders added a new dimension to this radical step.[31] Although it is not clear exactly to which direction the process will evolve and how it will be negotiated, it has already become clear that coal-powered plant construction will gradually become less of a preferred option.

It would not be a wrong guess to say that discussions will focus mostly on the dates on which the coal-powered plants within the system will be decommissioned.

In recent years, important steps have been taken in Turkey regarding energy efficiency, which is considered as the "first fuel" in the fight against climate change and along the clean development journey of countries. Although some of them are still immature and have not entered into the desired route, it is possible to say that the developments in this field are getting closer and closer to following a course parallel to global trends. Stronger practical examples are needed in order to deal with energy efficiency, whose policy framework has already been established, as a stand-alone energy topic and an important policy parameter intersecting all areas horizontally.

Apart from these general trends, some of the trends that became evident in 2021 are briefly described below.

[30] Carbis Bay G7 Summit Communiqué, June 11-13, 2021. Available at: https://www.consilium.europa.eu/media/50361/carbis-bay-g7-summit-communique.pdf The relevant part of the communiqué reads as: "... we stress that international investments in unabated coal must stop now and we commit now to an end to new direct government support for unabated international thermal coal power generation by the end of 2021, including through Official Development Assistance, export finance, investment, and financial and trade promotion support."
[31] BBC News, "China pledges to stop building new coal energy plants abroad", 22.10.2021. Available at: https://www.bbc.com/news/world-asia-china-58647481

1.5.1. Some Global Trends and Energy Transformation

In general, efforts were made to relieve the damage caused by the Covid-19 pandemic taking its toll on economies around the world and painting a relatively-negative picture for the supply chain and to return the conditions to pre-pandemic levels in 2021. At the same time, 2021 stood out as a year in which the concrete repercussions of the climate crisis were observed at an increasing level, with different implications in almost every geography of the world. Therefore, the calls on the axis of combating this crisis were strengthened.

In 2020, it was observed that the breakdown of energy supply by resources across the world differed from previous years. As indicated in BP's annual "World Energy Statistics" report, it is estimated that there was a 4.5% decrease in global energy demand in 2020.[32] It is considered that the most important factor in this decline is the disruption of the transportation sector and a decrease in oil demand due to the quarantines imposed during the pandemic process. As the share of carbon-intensive fuels in energy supply decreased with the decrease in oil demand, there was a record decrease (-6.3%) in carbon emissions in 2020. As indicated in the same report, oil prices dropped to an average of USD 41.8 per barrel in 2020, the lowest level since 2004. This record decline in oil demand followed a more moderate course in natural gas. Despite a 2.3% decrease in natural gas demand, the share of natural gas within primary energy resources rose to 27.7%. The decline in oil demand played an important role in the rise of this share. The main reason for the partial decrease in natural gas demand is the decrease in demand in the USA and Russia. However, the increase in natural gas demand in 2020, especially in China and Iran, stands out as another factor that played a role in rising share of gas in global energy supply.

In 2021, the recovery of economic activity across the world, the strong growth of both primary energy and electricity demand in industry and electricity demand in residential and service sectors, severe droughts in certain regions of the globe triggered by the impacts associated with the climate change, relatively affecting hydraulic generation as well as extreme weather events (extreme hot weather and unexpected cold spells) resulting in a rise for energy demand also caused a rise in fossil fuels.

The emergence of such a picture in 2021, during which the questioning of fossil fuels deepened, shows that discussions and quests on this subject will continue for a long time.

[32] BP, World Energy Statistics, 2021.

The common conclusion where the 2021 trends and the research on global energy transformation converge is that green and clean energy investments have gained momentum despite all the drawbacks experienced in the past year.[33,34,35] When the installed capacity of wind and solar energy is considered together, approximately 238 GW of additional capacity has been added to the system globally, thus the share of renewables in installed power has increased tremendously. Despite all the difficulties experienced in 2020, the growing renewable energy investments are considered as an encouraging indicator in the fulfillment of the strategies and commitments by the countries in line with the "Net Zero Emission (NZE)" targets in order to mitigate the effects of the climate crisis. According to the "2021 Energy Outlook" report published by Total Energies, it is predicted that the world population will increase by approximately 2 billion and reach 10 billion by 2050. It is expected that the rise in the population and the improvement of living standards will play a role in increasing the energy demand.

According to the report published by Total Energies, there are various actions and practices that need to be prioritized to achieve the NZE target. These are summarized as follows:

- Ban on new internal combustion engine sales for the transportation sector in 2035,
- Electrification of light vehicles and increased adoption of hydrogen, hydrogen-based fuels and bioenergy in other transportation vehicles,
- Enabling more utilization of wind and solar energy by using storage technologies,
- Large-scale use of natural gas as a transition fuel, especially in power and industry and
- Single-use plastic ban and increased plastics recycling

. It is emphasized that decarbonization targets should be set in developing countries and strategies should be drawn up in line with these targets, practical examples of energy efficiency should be developed, the ratio of clean energy in global energy supply should be increased by using renewable energy technologies, and hydrogen use should be increased especially in the transportation and industrial sectors so as to achieve a positive outcome beyond NZE criteria.

The potential for the use of hydrogen technology in different sectors is being explored at an increasing rate. Hydrogen can be produced from various sources (renewable energy, nuclear energy, natural gas, etc.), but since the transportation and storage of the resulting hydrogen is costly and technically difficult, the subject has not yet gained sufficient ground in the industry. However, as hydrogen can be produced from low-carbon energy sources and can be used without causing greenhouse gas emissions, potential decarbonization based on hydrogen technology is discussed and studied in various industrial sectors. The EU's announcement of a new Hydrogen Strategy in July 2020 and the recognition of hydrogen as one of the milestones of the European Green Deal are also developments that should be underlined. Hydrogen, which is a relatively old but an emerging energy topic due to its potential impacts, is evaluated separately in the second part of this report by considering its significance.

As mentioned in the relevant section of this report, the use and dissemination of electric vehicles is a strategic matter to reduce the need for oil-dependent energy, especially in the transportation sector. In 2020, a new record was set in the sales of electric vehicles. It is considered that the growth trend in this area will continue to strengthen in the upcoming years. Potentially introducing new items of discussion (dissemination of the charging station infrastructure, demand management optimization, renewal of installed capacity forecasts, etc.), this topic is separately evaluated in the second part of the report.

[33] BP, ibid.
[34] Total Energies, Energy Outlook, 2021.
[35] IEA, World Energy Outlook, 2021.

1.5.2. Steps to Deepen the Renewable Energy Market in Turkey

Through the "Law on the Ratification of Paris Agreement" published in the Official Gazette No. 31621 of October 7, 2021, Turkey took a concrete step towards limiting the global temperature rise to 1.5°C and combating the climate crisis.[36] It is possible to expect that this step will lead to outcomes such as the renewal of climate projections, the announcement of a new climate change position paper, and the strengthening of emission reduction activities. This breakthrough will continue to boost Turkey's interest in renewable energy.

Currently, 53% of Turkey's installed capacity consists of renewable energy-based power plants. From the date of the publication of the Renewable Energy Law No. 5346 of May 10, 2005 to this day, the important developments in the field of renewable energy are highlighted in subsection "1.4.1. Renewable Energy" of this report. However, it will be useful to touch on a few striking points in this subsection.

In all YEKA auctions the tenders of which have already been completed, the feed-in tariff has been set for a period of 15 years. However, feed-in tariff under SPP YEKA-4, SPP YEKA-5 and WPP YEKA-3 auctions announced in the last quarter of 2021 has been set as a standard quantity of electricity fed into the transmission or distribution system per each MW of the connection capacity since the date of provisional acceptance of the project instead of a fixed time period. These quantities have been set as 23 GWh per MW for SPP YEKAs and 35 GWh for WPP YEKA. Currently, it is understood that the feed-in tariffs concerning YEKA have been updated on the basis of generated electricity rather than on the basis of years as a result of a reduction in electricity generation cost. Upon the announcement of new YEKAs, it is estimated that the installed capacity based on solar energy in Turkey will exceed 10 GW and the installed capacity based on wind energy will exceed 14 GW in the upcoming years.

The "Regulation Amending the Regulation on Certifying and Supporting Renewable Energy Resources" published in the Official Gazette No. 31062 of March 8, 2020 introduced the concepts of

"renewable co-generation plant" and "electricity generation plant with auxiliary resources" within national legislation.[37] This revision has made it possible to generate electricity from more than one source in licensed power plants that are currently in operation and will be newly established. With the addition of auxiliary resources, the internal consumption of the main resource will be covered, and the quantity of electricity to be supplied to the grid will be increased. This amendment aims to prevent to some extent the network imbalances that may occur especially due to renewable energy facilities.

Regulations regarding these facilities also known as "hybrid power plants" have been updated recently. According to the Board Resolution of EMRA encompassing hybrid power plant investments published in the Official Gazette No. 31457 of April 17, 2021;

- In multi-source electricity generation facilities with solar energy as an auxiliary source, an area of up to 15 decares for each 1 MW of auxiliary source power can be added to the power plant area as an auxiliary source unit area, provided that it is integrated into the borders of the power plant,
- Electrical power of the auxiliary source cannot exceed the electrical power of the main source in electricity generation facilities whose main resource-based units' total electrical power is 50 MW and lower and the power to be calculated by adding half of the power of the main resource exceeding 50 MW to 50 MW in electricity generation facilities whose main resource-based units' total electrical power is higher than 50 MW,

[36] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2021/10/20211007-7.pdf
[37] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2020/03/20200308-8.htm

- Total electrical power of the auxiliary sources can be 100 MW the most.

In order to maintain the system balance of TEİAŞ, a restriction limited to 15% of the electrical power of the main resource was imposed on the resulting capacity to be allocated for hybrid investment as per the Board Resolution of EMRA No. 10375 of August 26, 2021.[38]

Another important step in terms of the sound operation of the grid and ensuring the electricity supply-demand balance will be the installation of energy storage systems (ESS).[39] To be covered in subsection "2.4. Electric Vehicles and Storage Technologies" of the report, ESSs play a role in storing the excess supply when electricity demand is not high and meeting the demand during peak load periods by releasing this stored electricity. Thus, the voltage and frequency values of the grid are managed to keep balance of the grid.[40]

Use of ESSs in Turkey and their integration into the system are stipulated in the "Regulation on the Acceptance of Electricity Generation and Storage Facilities" published in the Official Gazette No. 31044 of February 19, 2020[41] and the "Regulation on Storage Operations in the Electricity Market" published in the Official Gazette No. 31479 of May 9, 2021.[42] These regulations define the procedures and principles for the acceptance of investments that will enable the addition of ESSs to generation facilities in our country and the supply of stored energy to the grid.

In addition to these steps taken for the continuity of renewable energy investments, new capacities have been announced and our country aims to use these capacities effectively. In addition, the "Renewable Energy Supply Agreement" (YETA) was announced and entered into force on August 1, 2021.[43] YETA is an agreement between an electricity producer and an end consumer on a voluntary basis. The electricity consumed by the end consumer will be supplied by renewable energy plants under YEK-G certificate. Handled under the subsection "1.4.1. Renewable Energy" of this report, YEK-G system will follow stages from generation facilities to consumers and ensure the certification of the energy used by the end consumer as renewable energy.[44]

End-users are required to specify the source of the electricity they purchase within Scope-2 in order for them to calculate their carbon footprint and be a part of the sustainability index. For this reason, it is important that YEK-G certificates be recognized at international level. It is stated that efforts are in place for the use of YEK-G certificates in international sustainability reporting.[45] Upon the recognition of the YEK-G certificate on international platforms, it will be possible to monitor the sustainability index-related targets of companies and to make a contribution in return for carbon tax liabilities.

[38] TEİAŞ. https://www.teias.gov.tr/tr-TR/haberler/bolgesel-kapasiteler-hakkinda-duyuru
[39] TSKB, "Demand Side Management Information Note", 2021.
[40] Koç, İ. M. et al., "Review of energy storage practices under smart grid standards", 6th Energy Efficiency and Quality Symposium and Exhibition, Sakarya, Turkey, 2015.
[41] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2020/02/20200219-1.htm
[42] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2021/05/20210509-3.htm
[43] EMRA. https://www.epdk.gov.tr/Detay/Icerik/2-8181/elektrik-faturalarinda-yesil-isaret
[44] SHURA, Renewable Energy Supply and Certification in Turkey, 2021.
[45] EPİAŞ. https://www.epias.com.tr/wp-content/uploads/2021/05/YEK-G-ITO-SUNUM-20.05.pdf

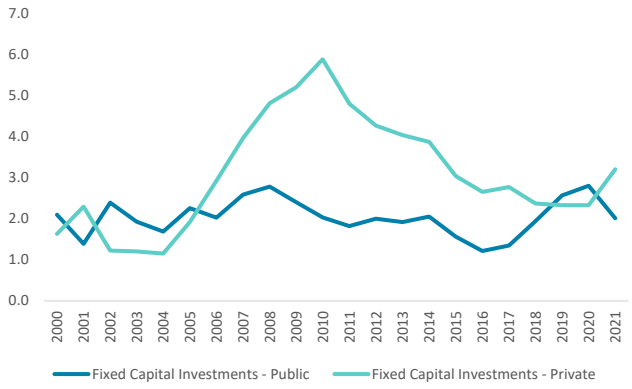
Private sector investments increased steadily until 2010 as a result of the strengthening of incentives granted to power plants that generate electricity from renewable energy sources and domestic sources upon the regulations introduced in early 2000s, decisive liberalization steps and especially the Renewable Energy Law that came into force in 2005.

1.6.

Energy Investments and Financing

Private sector investments increased steadily until 2010 as a result of the strengthening of incentives granted to power plants that generate electricity from renewable energy sources and domestic sources upon the regulations introduced in early 2000s, decisive liberalization steps and especially the Renewable Energy Law that came into force in 2005. 2010 was the year in which the private sector made the highest energy investment with USD 5.9 billion. While private sector investments increased between 2004 and 2010, the share of the public sector in total energy investments decreased.

Chart 24: Energy Sector's Fixed Capital Investments



Source: TR Presidency of Strategy and Budget, TSKB

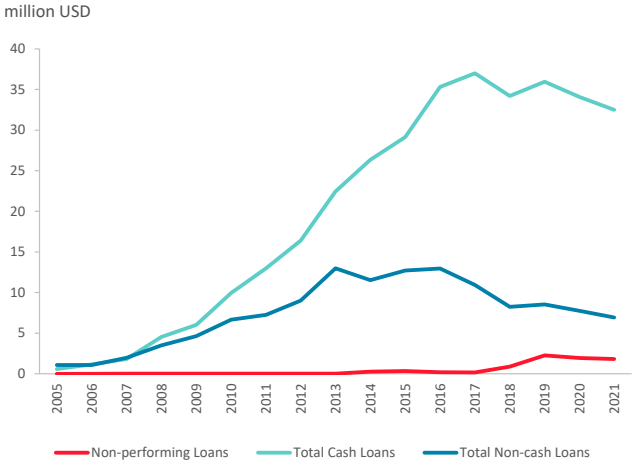
Although the private sector's energy investments experienced a downward trend after 2010 until the end of 2019, it is observed that the private sector contributed an average of USD 3.2 billion dollars annually to fixed capital investments between 2010 and 2021.[46]

As mentioned in the subsection "1.4.1. Renewable Energy" of this report, the private sector's energy investments has broken the downward trend as USD-denominated YEKDEM will come to an end for the facilities which will not be commissioned until June 30, 2021. Having declined to USD 2.3 billion in 2019, the private sector's fixed capital investments recorded a limited rise in 2020. The private sector's fixed capital investments are expected to increase in 2021 and reach USD 3.2 billion by the end of the year.

[46] TR Presidency of Strategy and Budget. Current capital investments denominated in TL as calculated at current prices are calculated in USD terms over CBRT's USD buying rate for that year.

It is observed that energy investments, when considered as a sub-item within private sector investments that declined between 2010 and 2019, mainly shifted to renewable energy investments due to YEKDEM mechanism. In addition to USD-denominated YEKDEM feed-in tariffs, the decrease in renewable energy investment costs had an impact on this trend and the gradual rise of initially wind and then unlicensed solar power plant investments. According to the unit costs per megawatt announced by the International Renewable Energy Agency (IRENA), the unit cost of photovoltaic solar power plants decreased by 81% from 2010 to 2020 while a decrease of 32% was recorded in the unit costs of wind power plants.[47]

Chart 25: Breakdown of Loans by Sectors - Electricity, Gas and Water Resources Prod. Dist. Trad.



Source: BDDK, TSKB

Another important factor in the rising share of the private sector in energy investments was financing opportunities, and banks took the largest share in financing. In the financing of renewable energy investments, the predictability of investments has increased thanks to the USD-denominated YEKDEM feed-in tariffs, and the long-term opportunity of the financing to be extended has made the projects easier to evaluate by both investors and banks.

In 2005, the cash loan stock of the energy sector loans was around USD 580 million, and between 2005 and September 2021, the cash loan stock of the energy sector grew by 5,400%. Stock growth of the cash loans extended by banks to all sectors during the same period stood at 340% and rose to a more limited extent. The cash loan stock growth rate in the energy sector between 2005 and September 2021 is one of the data that most clearly summarizes the stance of both investors and banks towards this sector. The cash loan stock provided extended by the banking sector to the energy sector reached its highest level in 2017, standing at USD 37 billion. As of September 2021, this figure went down to USD 32.5 billion through the repayment of existing energy investments and a drop in new investments in the sector.

Paving the way for the growth of existing loans to the energy sector and of private sector energy investments, USD-denominated YEKDEM feed-in tariff mechanism came to an end as of July 2021. Foreign currency and inflation basket-indexed and TL-denominated new YEKDEM mechanism to be administered through an escalation system explained in detail in subsection "1.4.1 Renewable Energy" of this report was launched in the second half of the year. Although the feed-in tariff will be updated every three months via a formulated escalation system, the unit prices to be applied in TL has decreased the predictability of the return on investments, both by investors and banks, compared to the USD-denominated YEKDEM mechanism in the long run. It is expected that the financing, equity-to-loan ratio and financing maturity under TL-denominated YEKDEM mechanism will be changed compared to the financing structure within USD-denominated YEKDEM.

As per the amendment made to Article 40 through the Circular on Capital Movements, the licensed generation facilities commissioned or to be commissioned starting from July 1, 2021 and the unlicensed generation facilities entitled to receive a call for connection agreement after June 21, 2018 are not entitled to use any foreign currency-denominated loan under YEKDEM.[48]

[47] International Renewable Energy Agency (IRENA), "Renewable Energy Generation Costs in 2020", 2020.
[48] https://www.tcmb.gov.tr/wps/wcm/connect/d58bd2eb-b966-4765-a0cc-626c507449d8/Sermaye+Hareketleri+Genelgesi.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-d58bd2eb-b966-4765-a0cc-626c507449d8-n5kWv2Y

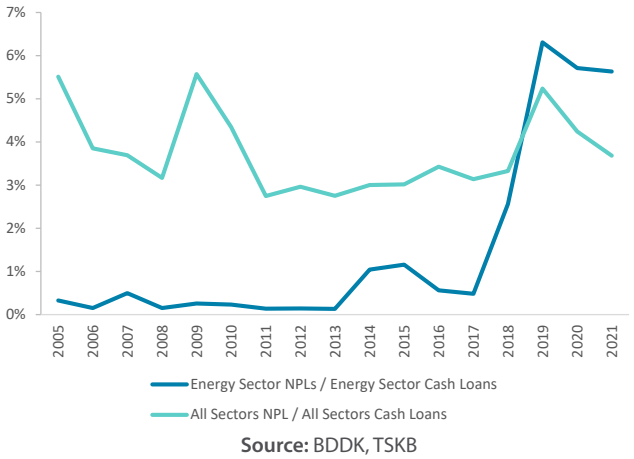
Exemption provisions such as granting the opportunity of using foreign currency-denominated loans to the firms not covered by YEKDEM without any income denominated in foreign currency, holding a risk balance of USD 15 million, holding an Investment Incentive Certificate under the conditions compliant with the Circular and the possibility of using foreign currency-denominated loans within the holding as per Provisional Article 1 of the Circular are still applicable. Articles outlining the scope of these exemptions are still in force.

Compared to the TL-denominated feed-in tariff option applicable under TL-denominated YEKDEM, hybrid investments that can be made in existing facilities have become attractive for investors. Both the management of the imbalance costs of facilities and the opportunity of benefiting from this price in a more efficient way if the existing feed-in tariff mechanism of the facility is still valid are prominent factors for the preference of hybrid investments. From the perspective of the banks offering finances to existing facilities, the cash flow that may emerge with auxiliary resources can be measured more easily since the performance of the main facility has become more definite. On the other hand, in addition to the hybrid investments planned in existing facilities, it is observed that investors have plans for increasing their capacity especially due to the MCP, which has followed an upward trend since the second half of 2021.

Explained in detail in subsection "1.4.1. Renewable Energy" of this report, YEKA tenders, auctions for SPP and WPP investments and especially the tenders organized for the privatization of HEPPs owned by EÜAŞ have granted the existing investors within the sector the opportunity of making additional investment and the investors outside the energy sector the opportunity of entering into the sector.

Soaring to USD 94/MWh in average in 2010, MCP gradually decreased following 2010 and went down to USD 40/MWh in 2020 as mentioned in subsection "1.1. Electricity Sector Outlook" of the report. Some facilities that are not covered by YEKDEM and have high debt stock (especially thermal power plants with lower efficiency) proved to be insufficient to meet their debt servicing.

Chart 26: NPL Legend



Source: BDDK, TSKB

On the other hand, the fact that the majority of the sector's loans are denominated in foreign currency in spite of TL-denominated electricity sales revenues also exposes these facilities to high exchange rate risk. The energy sector differed from other sectors in terms of non-performing loans as generation operations could not materialize as planned and the sales prices in the free market proved to be lower than expected. As of 2020, the non-performing loan stock reached USD 1.9 billion while the non-performing loans ratio of the sector stood at 5.71%. As of September 2021, the non-performing loan stock decreased to USD 1.8 billion and the ratio of non-performing loans decreased to 5.63%. The ratio of non-performing loans in all sectors stood at 3.68% during September 2021.

1.6.1. Green Bonds as an Alternative Source of Funding

As mentioned in the previous section, investments in electricity generation from renewables were mainly funded through the use of long-term loans extended by the banking system. It is possible to state that the majority of energy efficiency investments are financed mainly through the loans extended by the banking sector, excluding equity.

The increasing need for renewable energy financing has brought along a search for new financial instruments. Green bonds constitute a part of climate finance that can be obtained from national or international markets, which aim to mitigate the effects of climate change, and to ensure adaptation to and resilience against climate change.

Table 15: List of Issued Bonds

Date of Issuance	Amount (USD million)	Maturity	Type	Currency
18.05.2016	300	5	Green/Environmentalist Bond	USD
28.03.2017	300	10	Green/Environmentalist Bond	USD
30.06.2017	150	5	Green/Environmentalist Bond	TL
21.08.2019	50	10	Green/Environmentalist Bond	USD
20.12.2019	50	5	Green/Environmentalist Bond	USD
21.01.2020	50	5	Green/Environmentalist Bond	USD
05.08.2020	50	5	Green/Environmentalist Bond	USD
08.12.2020	750	5	Sustainable Bond[49]	USD
14.01.2021	350	5	Sustainable Bond	USD
28.01.2021	600	5	Sustainable Bond	USD

Source: TSKB

Green bonds, the first of which was issued by the European Investment Bank in 2007, started to be issued first by financial institutions and then real sector institutions and governments, respectively, within the framework of certain principles following this date. Thus, green and sustainable bonds constituted a new funding area as a capital market instrument for renewable energy financing investments. Green bonds were first issued by TSKB in Turkey in 2016. Offering a maturity of 5 years and an amount of USD 300 million, the first issuance received a demand of USD 4 billion from 317 corporate investors. Since that date, the total amount of green and sustainability-themed bonds issued by the banking sector has reached approximately USD 2.5 billion.

[49] Projects funded by sustainable bonds, issued as a mixture of green (environmentalist) and social bonds, aim to contribute positively to both the environment and social issues.

The practices introduced in Turkey for green bonds, which offer new opportunities, are mostly executed by banks and company groups operating in multiple sectors. As of the first quarter of 2021, a total of more than USD 3 billion was issued through environmental, social and sustainable bonds. Acceleration in the world of green finance has also triggered the convergence of the world of Islamic finance and sustainable finance practices.

The compatibility of ethical finance approach in Islamic finance with the concept of sustainability paved the way for the issuance of sustainability-themed bonds under Islamic finance instruments. Although the efforts to adapt such bonds to Islamic finance were initiated in 2012 with the "DanaInfra Exchange Traded Bonds and Sukuk" program,[50] the first green sukuk was issued in 2017 by Tadau Energy, a solar power company in Malaysia.[51] The first bond in Turkey in the field of Islamic sustainable finance was issued by TSKB in 2020 with a TL 50 million-issuance on behalf of a private sector energy company operatin in the field of energy.[52] In 2018, it was made possible to evaluate the compatibility of sustainability-oriented bonds issued under the principles published by the International Capital Market Association with the Sustainable Development Goals. In Turkey, the Capital Markets Board (SPK) has not issued any separate regulation regarding green bonds, yet. SPK is currently drawing up a green debt instrument and lease certificate manual to encourage the financing of investments that will contribute positively to environmental sustainability. The draft manual was opened for discussion on November 3, 2021. The Action "SPK Green Bond and Green Lease Certificate Manual" within the Economy Reforms Package published in March 2021 aims to encourage the financing of investments that will positively contribute to the environment. This paved the way for legislation on diversifying the finance opportunities of renewable energy projects investments.

1.6.2. Initial Public Offerings

Being an alternative source of finance in the financing of energy investments, the option of initial public offering can be considered as another source instead of using loans or issuing bonds. 2021 has been a different year in terms of the motivation of private energy companies to go public. During the 5-year period covering the period between 2017 and 2021, 56 initial public offerings were completed while 10 of these initial public offerings were listed in Borsa Istanbul Electricity Index and were composed of the companies operating in the field of electricity generation. In 2021, 7 initial public offerings were completed by electricity generation companies, which is a remarkable development considering that 17 companies are listed in BIST Electricity index.

Table 16: Initial Public Offerings by Energy Generation Companies Between 2017 and 2021

Firm	Date	Amount of Funds Raised (in USD)
Enerjisa Enerji A.Ş.	08.02.2018	393,805,170
Naturel Yenilenebilir Enerji A.Ş.	08.08.2019	12,190,636
Esenboğa Elektrik Üretim A.Ş.	09.10.2020	26,394,783
Naturelgaz Sanayi ve Ticaret A.Ş.	01.04.2021	36,705,343
Galata Wind Enerji A.Ş.	22.04.2021	100,753,772
Biotrend Çevre ve Enerji Yatırımları A.Ş.	28.04.2021	92,100,253
Aydem Yenilenebilir Enerji A.Ş.	29.04.2021	155,634,024
Çan-2 Termik A.Ş.	30.04.2021	35,064,346
Kartal Yenilenebilir Enerji Üretim A.Ş.	16.07.2021	13,901,922
Margün Enerji Üretim Sanayi ve Ticaret A.Ş.[53]	-	-

Source: SPK, TSKB

[50] Naji Brazak, "The Launch of Exchange Traded Bonds and Sukuk (ETBS) On Bursa Malaysia with the Maiden Issuance By Danainfra Nasional Berhad", January 8, 2013. Available at: https://najibrazak.com/the-launch-of-exchange-traded-bonds-and-sukuk-etbs-on-bursa-malaysia-with-the-maiden-issuance-by-danainfra-nasional-berhad/
[51] The Sun Daily, "Edra Power's Tadau Energy issues Malaysia's first 'green' sukuk", July 27, 2017. Available at: https://www.thesundaily.my/archive/edra-powers-tadau-energy-issues-malaysias-first-green-sukuk-CTARCH465241
[52] TSKB, "Turkey's First Sustainable Lease Certificate Issuance by TSKB", May 5, 2020. Available at: https://www.tskb.com.tr/web/101-4498-1-1/tskb-site-tr/tr-hakkimizda/tskbden-haberler/turkiyenin-ilk-surdurulebilir-kira-sertifikasi-ihraci-tskbden
[53] Not specified as it is not included in the CMB's Debt Securities summary table as of the date on which the report is drawn up.

Themes Standing Out in 2021

This section of the report gives details of some themes highly discussed and standing out for the energy sector during 2021 as well as a more comprehensive perspective on these headings.

Although there is no OWPP installed in Turkey yet, a framework should be prepared by carrying out technical and administrative work so that the relevant technology can be used in our country as well.

2.1.

Offshore WPP

Having started with Germiyan WPP with an installed capacity of 1.5 MW in İzmir in 1998, Turkey's wind power generation journey has been accelerating due to the recent incentives granted to renewable energy power plants. Standing 8.7 MW at the end of 1998 and holding a share of 0.4% in total installed power, WPP installed capacity rose to 8,832 MW with a share of over 9% as of the end of 2020.[54] Another striking point in the installed capacity of WPP is that despite the difficulties experienced in the supply of imported equipment due to the Covid-19 pandemic, 2020 was the year with the highest annual installed power rise (1.2 GW) along with 2016.

[54] TEİAŞ. https://www.teias.gov.tr/tr-TR/kurulu-guc-raporlari

The rise in the installed capacity of WPPs in 2020 accounted for 27% of the net 4.6 GW increase in Turkey's total installed capacity. In August 2021, Turkey's installed capacity of WPPs exceeded 10 GW.[55]

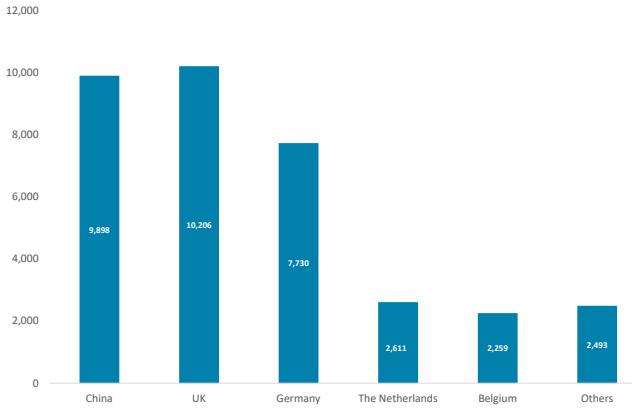
Due to Turkey's geographical location, not only onshore wind energy potential but also offshore wind energy potential draw attention. According to the "Going Global Expanding Offshore Wind to Emerging Markets" report published by the World Bank Group (WBG) in October 2019, Turkey has an approximately 69 GW of offshore wind power potential in total including 12 GW in areas with a water depth of less than 50 meters and 57 GW at depths between 50 and 1,000 meters.[56] The report also states that wind speeds in the Aegean Sea, Black Sea and Marmara are suitable for Offshore Wind Power Plant (OWPP) investments.

In order to benefit from the offshore wind energy potential in Turkey, the tender for a 1,200-MW OWPP project was announced in the Official Gazette in June 2018.[57] Saros, Kıyıköy and Gelibolu were designated as candidate regions for the said offshore project. The tender was postponed as a sufficient number of demands could not be received. This section will cover the development of OWPP across the world, the technical characteristics of OWPP and the obstacles hindering the development of OWPP in Turkey.

2.1.1. Offshore WPP Development Across the World

According to the "Global Wind Report 2021" prepared by the Global Wind Energy Council (GWEC), it is understood that the total installed capacity of WPPs around the world reached approximately 743 GW by the end of 2020.[58] It is estimated that approximately 95.25% of the related installed capacity consists of onshore WPPs and the remaining 4.75% of OWPP.

Chart 27: Breakdown of OWPP Capacity in 2020



Source: GWEC, TSKB

Currently (Chart 27), the majority of installed OWPPs are located in the United Kingdom (29.0%), China (28.12%) and Germany (21.96%). OWPPs with a total capacity of 6.1 GW were installed in 2020, and the total installed capacity across the world reached approximately 35.2 GW.

OWPPs have a limited share compared to the total installed capacity of wind power plants. However, OWPP investments have continuously increased thanks to technological developments, falling investment costs and strong support programs, especially during the last decade. The GWEC report also states that OWPPs are less affected by the Covid-19 pandemic than other power plants.

In order to prevent global warming, the expectations for a rise in renewable energy investments continue. GWEC expects that an additional capacity of 48 GW will be added to the existing OWPP capacity by 2024, and investment will be made in an additional installed capacity of 157 GW between 2025 and 2030.[59]

2.1.2. Measurement Parameters for OWPPs

There are various technical and social factors that support transition from the installation of onshore WPPs to OWPPs. Most important factors in terms of technical matters include higher average offshore wind speeds and lower turbulences to which turbines are exposed.[60] Since the energy to be generated is directly related to the wind speed, there is a higher energy potential in offshore settings.

[55] Enerji Günlüğü, "The installed capacity of WPPs in Turkey exceeded 10 thousand MW", August 23, 2021. Available at: https://www.enerjigunlugu.net/turkiye-ruzgar-enerjisi-kurulu-gucu-10-bin-mwi-asti-44227h.htm
[56] World Bank, "Going Global Expanding Offshore Wind to Emerging Markets", 2019.
[57] Official Gazette. https://www.resmigazete.gov.tr/ilanlar/eskiilanlar/2018/06/20180621-4.htm#%C3%8702
[58] Global Wind Energy Council, Global Wind Report, 2021.
[59] Global Wind Power Council, "Wind power industry to install 71.3 GW in 2020, showing resilience during COVID-19 crisis", 05.11.2020. https://gwec.net/gwec-wind-power-industry-to-install-71-3-gw-in-2020-showing-resilience-during-covid-19-crisis/#:~:text=5%20November%20%2C%202020,GWEC%3A%20Wind%20power%20industry%20to%20install%2071.3%20GW%20in%202020,crucial%20contribution%20to%20economic%20recovery
[60] Serri, L. et al, "Floating offshore wind farms in Italy beyond 2030 and beyond 2060: Preliminary results of a techno-economic assessment", Applied Sciences, Vol.10, No:24, 2020.

In order to design and develop WPPs (whether onshore or offshore) in a sound way, various technical values must be measured with a high degree of accuracy, especially during the feasibility period of the project. Measurements to be made for the development of OWPPs should include both meteorological (mean wind speeds, directions, temperature, humidity, etc.) and oceanographic (wavelength, average wave velocity, current, etc.) parameters.[61]

Meteorological factors provide inputs for where the power plant should be installed, the designation of the turbine type suitable for the site, the arrangement of turbines in the power plant and the calculation of the potential energy to be generated. The most commonly-used platforms for offshore wind measurements are fixed measurement masts and floating measurement stations installed at sea.Economical installation of fixed measurement masts decreases with increasing sea depth. However, compared to floating systems, fixed masts are ideal, especially for long-term measurements, since they also allow for the measurement of oceanographic parameters. Wave height, sea water temperature, pressure and conductivity values can be listed among the oceanographic parameters that can be measured with a fixed measurement platform.[62] Floating measurement stations are much easier and less costly to install than fixed measurement masts. More importantly, it is possible to better understand local wind conditions by making wind measurements at multiple points by moving the stations to different points after the measurements are completed at certain times within the boundaries of the planned power plant.

The oceanographic parameters to be measured in the areas where the power plants are planned to be established include the physical characteristics of water (temperature, density, salinity, etc.), waves, currents, and water level. By examining these characteristics, structural loading calculations and corrosion estimations of the offshore turbines to be installed are performed, and inputs are offered for matters such as access to construction site and construction planning.[63] In addition to meteorological and oceanographic parameters, water depths and seabed topography (bathymetry) are also very important factors at seas where OWPPs will be installed. Foundation type of the OWPPs to be installed is selected by considering the bathymetric characteristics of the area.

2.1.3. Investment and Operating Expenses

Various factors affect the investment costs of OWPPs. Some of these include:[64]

- Size of the power plant,
- Conditions depending on the area such as sea depth, distance of the power plant to the shore, connection to the grid and wave height in the area,
- Supply chain constraints (e.g. supply of installation ships, problems in finding skilled workers),
- Commodity and energy prices,
- Exchange rates,
- Different pricing strategies of equipment suppliers and installation companies.

As stated in the "Offshore Wind in Europe – Key Trends and Statistics" report drawn up by WindEurope, a new OWPP investment with a total installed capacity of 7.1 GW was financed in Europe in 2020.[65] The same report indicates that the total investment amount of the projects in question is EUR 24.2 million and an additional investment of EUR 2.1 million has been invested in offshore transmission system infrastructure. In 2020, the average investment expenditure of OWPPs in Europe is calculated as EUR 3.4 million/MW.

Considering the operating costs, all turbine and power plant maintenance-repair expenses as well as transmission system expenses, rental fees that may be required for the installed area of the power plant and all other expenses related to the power plant should be taken into consideration for the efficient operation of the turbines within a power plant. The most important matters affecting the operating costs of a power plant can be listed as the distance of the power plant to the port/coast, local meteorological and oceanographic conditions (in terms of transportation to the power plant) and the total number of turbines within the power plant. It is quite difficult to cite a certain level in this regard as the operating costs depend on power plants and the areas where they are installed, but it is estimated that fixed-base OWPPs have average operating costs in the range of EUR 115,000 – 131,000/MW/year.[66]

[61] AWS Truepower, "Metocean data needs assessment for U.S. offshore wind energy", prepared for US Department of Energy, Contract DE-EE0005372: National Offshore Wind Energy Resource and Design Data Campaign – Analysis and Collaboration, 2015.
[62] Durak, M., "Wind measurements for offshore wind power plant (OWPP) projects", 5th İzmir Wind Symposium, İzmir, 2019.
[63] AWS Truepower, Ibid.
[64] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, 2018 Offshore Wind Technologies Market Report, 2018.
[65] WindEurope, Offshore Wind in Europe – Key trends and statistics in 2020, 2020.
[66] Serri et al. Ibid.

2.1.4. Barriers to Offshore WPP Development in Turkey

Although there is no OWPP installed in Turkey yet, a framework should be prepared by carrying out technical and administrative work so that the relevant technology can be used in Turkey as well. Various criteria should be considered in the regions where OWPP projects will be developed. The most important criteria include the wind energy potential of the region, sea depth and base structure, distance to the shore, environmental and social factors. In addition, the OWPP project area to be established should not be within the military forbidden zone, should not prevent fishing and maritime traffic, and should not pose a problem in terms of the continental shelf.[67] It is possible to summarize the topological and administrative barriers to OWPP development in Turkey as follows:

Plant location and local geographical characteristics:

The best offshore wind potential in Turkey is in the Aegean Region, followed by the Sea of Marmara. However, the rapid increase in sea depths in both regions indicates the existence of suitable areas for the installation of turbines with floating bases rather than turbines with fixed bases. In the installation of offshore wind turbines, construction costs increase as the depth increases. On average, 33% of the investment costs in OWPPs corresponds to the construction of turbines while 24% is relevant to the construction of bases.[68] In onshore WPPs, this breakdown occurs as 68% for turbine and 9% for base construction.

Continental shelf:

In addition to wind potential and sea depth, continental shelf is important for our country. Considering the Aegean Sea, which has a high wind energy potential, the width of territorial waters of both Turkey and Greece is currently 6 nautical miles (11 km). As such, the territorial waters of Greece cover 40% of the Aegean Sea. Under Article 3 of the United Nations Convention on the Law of the Sea (1982), the jurisdictions of countries are currently 12 nautical miles (22 km) wide. If Greece increases its territorial waters to 12 nautical miles under this article, Greece's territorial waters will increase to approximately 70% while Turkey's territorial waters will correspond to less than 10% of the Aegean Sea. Therefore, the continental shelf must be considered when positioning an offshore wind turbine in the Aegean Sea.

Legislation and permit:

Currently, there is no regulation regarding the development of OWPP in Turkey yet. Since the delays in the planning of OWPP projects cause significant rises in the investment costs of the projects, it is important that the relevant legislation is issued to include all necessary permits and licenses.[70] Within the scope of OWPP development, a 3-year cooperation agreement was signed between Turkey and Denmark in March 2019 for the designation of tender procedures, the preparation of financial framework, and the establishment of the port infrastructure.[71]

Financing structure:

It is not possible to evaluate the financing for offshore WPP investment independently of the investment itself.

As stated in WindEurope's report "Financing and Investment Trends – The European Wind Industry in 2020", since OWPPs are larger projects than onshore WPPs, they are mostly executed under project financing. According to the report, the monetary need of EUR 21.6 million corresponding to 82% of the OWPP investments made in Europe in 2020 was met under project financing.[72] Projects were financed by borrowing at a level of 71% in related investments.

Issues such as the absence of legislation regarding OWPPs in Turkey, high investment costs, longer investment periods required for OWPP than onshore WPP projects, high financing costs, volatility in exchange rates, and the need for advanced technology increase the risks to be assumed by investors. It is considered highly probable that all these factors will pose various obstacles in obtaining financing for potential investments.

[67] Durak, Ibid.
[68] Enerji Portalı, "Denizüstü (Offshore) Rüzgâr Enerjisi Santrali Nedir?", October 18, 2018. Available at: https://www.enerjiportali.com/denizustu-offshore-ruzgar-enerjisi-santrali-nedir/
[69] Wikipedia. https://tr.wikipedia.org/wiki/Ege_sorunu
[70] EWEA, Deep water the next step for offshore wind energy, 2013.
[71] Rekabet ve Regülasyon, "Mavi Vatan'da Yeni Fırsatlar: Deniz üstü (Offshore) Rüzgâr Santralleri", 06.01.2021. Available at: http://www.rekabetregulasyon.com/mavi-vatanda-yeni-firsatlar-deniz-ustu-offshore-ruzgar-santralleri/
[72] WindEurope, "Financing and investment trends – The European wind industry in 2020", 2021.

While electrification is making rapid progress in many areas, the robustness and reliability of the electric system infrastructure is becoming more and more important.

2.2.

Demand-Side Management

The existing energy system and infrastructure developed in line with the goal of responding to the demands of consumers at all times is changing and evolving due to technological developments such as smart grids, artificial intelligence, and the internet of things. This change and evolution are gradually increasing its importance and impact in today's world where electrification is growing rapidly in every field. While electrification is making rapid progress in many areas, the robustness and reliability of the electric system infrastructure is becoming more and more important. As in the entire world, the demand for electric energy in Turkey continues to grow due to the increase in population and electrification.

In order to meet the expected increase in electricity demand and especially the peak demand, electricity generation plant investments are made to increase the generation capacity. Demand-side management ("DSM"), on the other hand, comes to the fore as an alternative to conventional solutions in electricity supply and is applied via different methods.

2.2.1. What is DSM and How Does It Work?

DSM is an approach encompassing targets such as reducing electricity system expenditures and carbon emissions, balancing electricity supply and demand at a lower level, flattening the electricity load curve and changing the electricity demand of consumers. DSM covers demand-side technologies, incentives, actions and programs aimed at managing and reducing electricity consumption to contribute to these goals. DSM was defined by Clark W. Gellings as "planning, implementation and monitoring activities to change the shape, time pattern and size of the load curve of electricity companies by influencing consumers' electricity use".[73] At the same time, DSM is considered as one of the key elements for low-cost electricity conversion.[74]

[73] Gellings, C., "Evolving practice of demand-side management", Journal of Modern Power Systems and Clean Energy, No:5, 2017.
[74] Science Direct. Available at: https://www.sciencedirect.com/science/article/pii/B9780444642356501686

DSM aims to benefit both sides of the network by spreading the flexible consumption of consumers during peak hours throughout the day, reducing technical losses within grids, increasing energy efficiency and reducing the bills of users. In short, DSM targets a better quality, better responsive, more flexible and more economical grid management. The aim of DSM is to ensure that consumers can respond to the signals of the grid operator and can shift their flexible demand[75] via the signal.

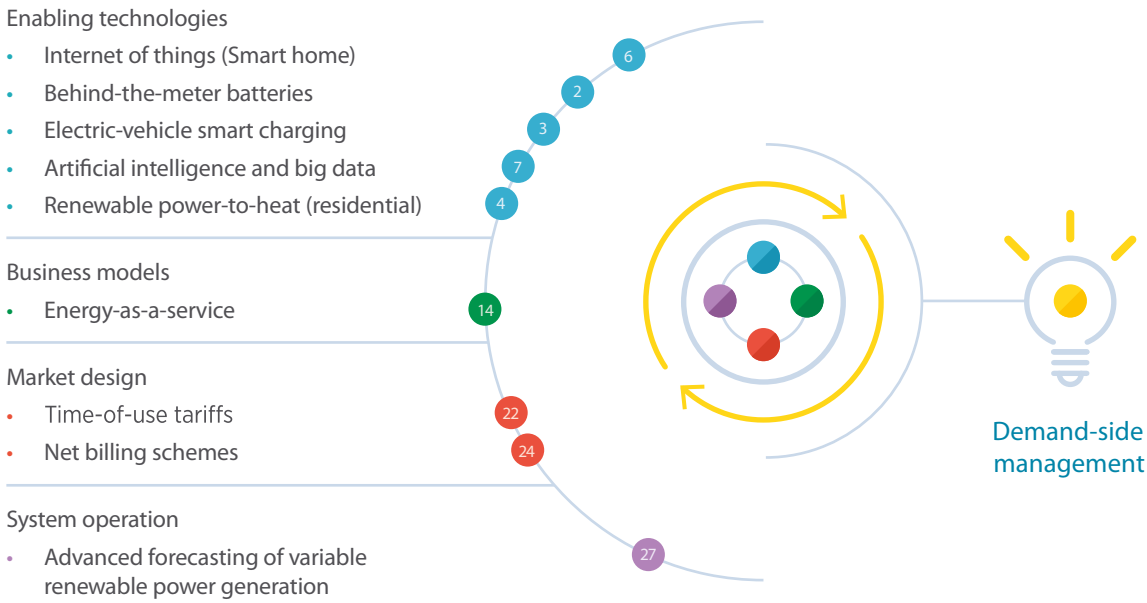
DSM encompasses collaborative activities that will result in changing the customer load profile to achieve the payload pattern. DSM enables consumers to apply restrictions in case of necessity and to earn income as much as the restricted load in a way not to adversely affect the consumers.

In this context, the transmission operator receives load-shifting options from demand collection companies[76] and large consumers and, if necessary, concludes an annual agreement with consumers that can apply restrictions within their systems to stipulate the duration of restrictions and under which conditions they can apply these restrictions. As DMS develops and finds more space in the system, these transactions may come to the fore for smaller consumers as well. There are many methods that can be preferred within the scope of DSM and synergy can be created in different ways. However, DSM activities can be broadly classified into three main categories:[77]

- Energy reduction programmes - reducing demand through more efficient processes, buildings or equipment;
- Load management programmes - changing the load pattern and encouraging less demand at peak times and peak rates;
- Load growth and conservation programmes.

The methods in question have been developing for years and they have also been evolving with technological developments.

Figure 3: IRENA and Demand-Side Management



Source: IRENA, TSKB

[75] Flexible demand refers to the level of demand that consumers can give up in return for a certain amount of income, if given short notice. Inflexible demand, on the other hand, is the level of demand that consumers cannot respond to the price or grid operator's signal, depending on price and time.
[76] Demand collection companies are not consumption facilities, but are companies contributing to the demand side by collecting small consumers under them and creating a load pool.
[77] UNIDO ve REEEP, Sustainable Energy Regulation and Policymaking for Africa. Available at: https://www.unido.org/sites/default/files/2009-04/training_manual_on_sustainable_energy_regulation_and_policymaking_for_Africa_0.pdf

DSM is considered by IRENA as an innovation that creates solutions for a future based on renewable energy.[78]

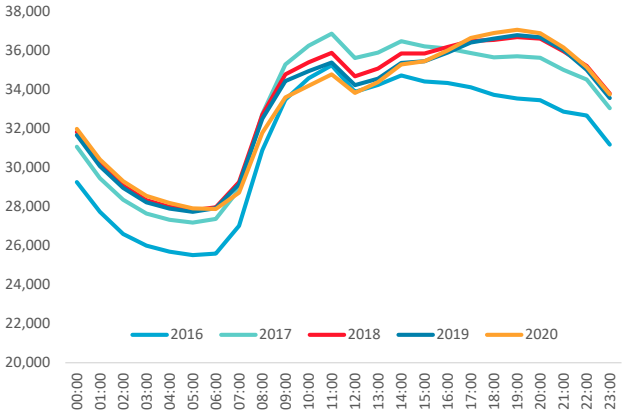
IRENA states that the use of various DSM tools such as the internet of things, artificial intelligence and smart charging stations will increase with the developments in technologies. Thanks to these developments, consumers will be able to respond to price signals given by the grid operator in real time. Upon the developments in technology and increasing awareness, various business models are put forward by energy service companies (ESCO) and these models are developing together with DSM. With the development of electricity markets, daily, monthly, annual net-metering opportunities and various tariffs support DSM. All these developments will increase the benefits of DSM by creating synergies in the upcoming period.

In general, DSM aims to improve electricity prices, increase the efficiency of the system, reduce peak demand to a more feasible level, reduce the need for new investments, increase system security, increase the share of renewable resources in the system and use battery systems.

2.2.2. DSM in Turkey

In Turkey, DSM can be remembered with more frequent interruptions in the past, and today it can find areas for itself through different applications. Today, electricity demand follows a fluctuating course throughout the day as observed in the chart below. In order to reduce the fluctuating course in question, various DSM practices may be used. For example, subscribers are offered two subscription options: single-time and multiple-time (over 3-time ranges). While the electricity consumed is billed at a single unit price in a single-time subscription, different pricing is applied at different time intervals during the day in a multiple-time subscription.

Chart 28: Average Hourly Electricity Consumption in Turkey



Source: TEİAŞ, TSKB

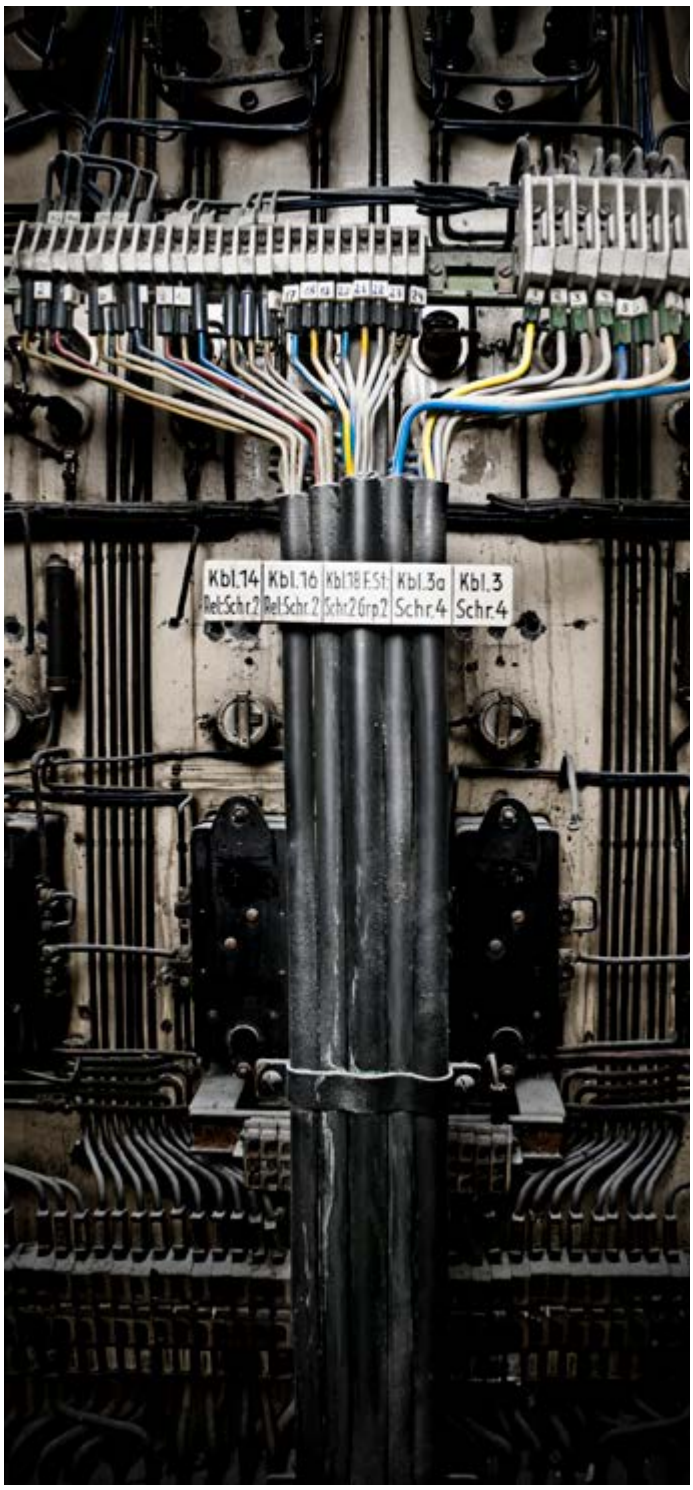
[78] IRENA, Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables, Abu Dhabi, 2019.

The said tariffs are currently divided into daytime (06:00-17:00), peak (17:00-22:00) and night (22:00-06:00). In this tariff, the most expensive pricing applies to peak hours, and the cheapest pricing applies to night hours. As can be understood from the said pricing, DSM aims to shift the demand during peak hours to night hours. In addition, different studies refer to daylight saving practices as a kind of DSM since the peak demand is shifted within the day.[79]

In addition to the aforementioned benefits, DSM is also very important in terms of its contribution to the country's economy and reducing foreign dependency. Based on this importance, DSM is referred to in public documents. For example, the Eleventh Development Plan (2019-2023) published on July 15, 2019 states that a market infrastructure will be created to ensure DSM.[80] The NEEAP announced in 2017 defines demand-side engagement as a mechanism that enables the management of peak demand by taking advantage of the flexibility of electricity consumers with flexible/shiftable loads. Under the NEEAP, 10 actions are designated in order to create a market infrastructure under demand-side engagement.[81]

DSM is an area that will be on the agenda more and more in Turkey as in the world due to emerging technological developments and the rise of electrification, and its importance will gradually increase. For example, the charging demands of electric vehicles, which are expected to increase in the upcoming period, will play a very decisive role in terms of grid and supply security. Assuming that the targeted electric vehicle sales are realized and the charging infrastructure is sufficient, it will become increasingly critical to manage the demand for electric vehicles on the day before the holiday (inner city) and during the journey (intercity and perhaps off-grid) during holidays when the use of individual automobiles is very high. Currently, a level of intensity may be experienced similar to that in gas stations, which will increase the load on the electricity system of the region.

Regulatory legislation is of great importance for the functioning of DSM. In recent years, regulations dealing with DSM have entered into force in Turkey. The Regulation on the Ancillary Services of the Electricity Market (Instant Demand Control Service), The Regulation on the Balancing and Settlement of the Electricity Market (Day Ahead Electricity Market) and the Regulation on Consumer Services Within the Electricity Market (Eligible Consumer and Eligible Consumer Limits and Bilateral Agreement) also encompassing matters regarding DSM are decisive in this regard.



[79] European Bank for Reconstruction and Development (EBRD), "Daylight saving all year round? Evidence from a national experiment", Working Paper 251, December 2020.
[80] TR Presidency of Strategy and Budget. https://www.sbb.gov.tr/wp-content/uploads/2019/07/OnbirinciKalkinmaPlani.pdf
[81] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2018/01/20180201M1-1.htm

2.2.3. Advanced Structures Under DSM

Storage technologies, dynamic electricity pricing, the internet of things, big data and smart devices are used effectively in DSM. In terms of electricity storage, Gateway Energy Storage with an installed capacity of 250 MW in USA and the lithium-ion (li-ion) storage facilities with a capacity of 20 MW in California state are prominent examples. Smart meters come to the fore with regard to DSM practices based on variable electricity tariffs. The said storage facilities make it possible to store the electricity generated from photovoltaic SPPs and WPPs and use it as an additional energy source during peak hours of the day. With the introduction of the compulsory use of smart meters in Sweden in 2009, advantages such as preventing losses, offering more sensitive monitoring, facilitating system error detection and reducing the electricity demand during peak hours were observed. A smart building commissioned in Australia in 2017 can generate, store and effectively use its own electricity. Storage technologies, dynamic electricity pricing, the internet of things, big data and smart devices are used effectively in DSM. Although its examples are limited in Turkey and across the world, the importance and effectiveness of DSM will rise with the mainstreaming of topics such as energy and resource efficiency.

2.2.4. DSM and Climate Change

The energy sector including incineration plants/systems in the industry stands out as the sector with the highest impact on climate change since it accounts for approximately 90% of global carbon emissions. The steps to be taken in the energy sector are important in achieving the targets set by Paris Agreement. Thanks to the benefits it offers, DSM's contribution to the achievement of the targets set with regard to climate change is expected to continue incrementally.

It is expected that inefficient inputs to/outputs from the system will decrease with the reduction of peak load, the efficiency of the system and power plants will increase, and generation losses will decrease with the use of DSM. In this way, DSM aims to reduce unnecessary and inefficient electricity generation and increase overall efficiency. Thanks to the reduction/postponement of the new investment need of the electricity sector through DSM, the emissions of the sector will decrease. In addition, it will be possible to see a rise in the share of renewable energy by shifting the load in the system towards the hours during which electricity is generated by renewable resources. On the other hand, any potential development regarding the storage technologies of renewable energy power plants with disadvantages due to intermittent generation capabilities may rise their generation efficiency, thus reducing the dependency of systems on thermal power plants. It is considered that these developments, which are expected to emerge with DSM, will make significant contributions to the reduction of emissions originating from the energy sector.

Hydrogen and fuel cells play an important role in the field of energy generation with its potential for use in a wide range ofmapplications in almost all sectors, especially in transportation , industry and housing.

2.3.

Hydrogen Energy

Hydrogen is the simplest and most common element on earth, consisting of a proton and an electron. Due to its unstable structure, hydrogen is not found in free form on the earth, but is contained in different compounds. There are different numbers of hydrogen atoms in coal, oil and gas derivative organic compounds known as hydrocarbons.

Hydrogen stands out as a clean fuel that produces only water, electricity and heat when consumed in a fuel cell. Hydrogen and fuel cells play an important role in the field of energy generation with its potential for use in a wide range of applications in almost all sectors, especially in transportation, industry and housing.

Clean hydrogen has also started to attract attention as an alternative energy source, especially in this period when the climate crisis has gained weight as a policy parameter in global markets and clean energy sources has turned into a priority to limit air pollution and global warming. In recent years, many experts have been investigating the potential of using this source for the production of hydrogen from various sources, its transportation and storage and for offering emission-free final energy supply. Two properties of hydrogen may explain the increasing interest in its widespread use. These properties are that hydrogen can be used directly without air pollutants or greenhouse gas emissions and can be produced from low-carbon energy sources. Hydrogen is a resource that is significant for developing methods that can ensure decarbonization in sectors where it is difficult to reduce emissions such as transportation, petro-chemistry and iron and steel. In addition, hydrogen can help improve air quality and increase energy security.

2.3.1. Characteristics of Hydrogen Energy

Hydrogen is a light gas. Various R&D activities gain momentum for hydrogen, which is considered as one of the energy components of the 21st century. Although hydrogen is not a natural fuel source, it can be produced from sources such as water, biomass, nuclear and hydrocarbons by utilizing primary energy production and stored as an energy carrier and thus used in fuel cells to generate electricity and heat. Hydrogen is a clean fuel that produces only water, electricity and heat when consumed in a fuel cell. Hydrogen and fuel cells have the potential for use in many sectors, especially in transportation, industry and housing. There are applications in various industries or systems listed below regarding hydrogen and fuel cells.

- Distributed or combined heat and power systems;
- Backup power systems;
- Renewable energy storage; and
- Auxiliary power for air, land and marine means of transport.

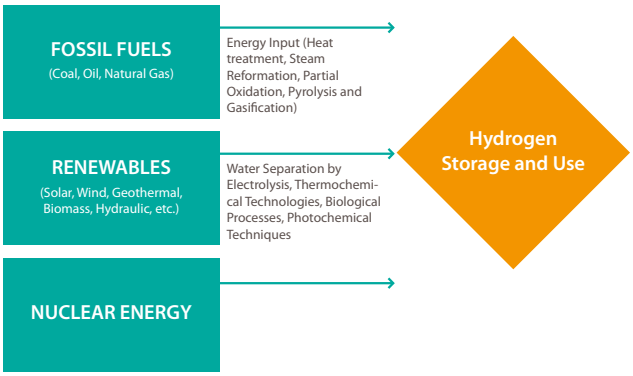
Hydrogen can be produced via a high temperature process in which methane reacts with hydrocarbon fuel by steam reforming. Another common method of hydrogen production is called electrolysis. Hydrogen can also be produced through biological reactions using microorganisms such as bacteria or microalgae. In such biological processes, microorganisms produce hydrogen gas by consuming plant products. In addition, hydrogen is also produced using sunlight. These production methods can be photobiological, photoelectrochemical, photovoltaic electrolysis and thermochemical methods.

There are various methods for storing and transporting hydrogen after the production thereof. It is transported by compressing hydrogen in gas form or converting it into liquid form in a pressurized environment and then loading it into tankers. However, due to the increasing need for hydrogen in the upcoming years, it is possible to transport hydrogen through existing natural gas pipelines. As a matter of fact, the capacities of pipelines between countries are sufficient to transport hydrogen. For storage, the priority is given to methods that allow transportation. Methods that prioritize transportation for the storage of hydrogen are liquid hydrogen, gaseous hydrogen, metal hydride and chemical storage.

2.3.2. Hydrogen Energy Sources

It is possible to produce hydrogen from a wide variety of sources including fossil fuels such as hydrocarbons, renewable energy sources such as biomass, and nuclear sources. Currently, most of the hydrogen is produced from fossil fuels, especially natural gas. Apart from fossil fuels, hydrogen production technologies from renewable sources are also developing.

Figure 4: Hydrogen Production Methods by Sources



Source: Çimen T., 2006[82]

2.3.2.1. Fossil Fuels

Among the techniques used to obtain hydrogen from fossil fuels, production technologies such as reformation, partial oxidation, pyrolysis and gasification come to the fore. Hydrocarbon molecules that make up fossil fuels are reformed by the reforming process, resulting in the release of hydrogen. Reformation can be summarized as the rearrangement of the reacting gases at the end of the reaction. Out of these techniques, the most important one is pyrolysis, through which biomass is converted into solid organic coal, oil and gas-containing compounds by heating it at high temperatures under 0.1-0.5 MPa in an oxygen-free environment.

Pyrolysis is classified in two ways as low pyrolysis and fast pyrolysis. Generally, low pyrolysis is not preferred a lot because the products are organic coal. Rapid pyrolysis takes place at high temperature. In rapid pyrolysis, products can be present in solid, liquid and gaseous form. In order to increase the production of hydrogen energy, water can be converted into gas. While obtaining hydrogen from fossil sources, as a result of the reaction, many pollutants such as sulfur oxide (SO_x), nitrogen oxide (NO_x), mercury (Hg) and other particles, as well as greenhouse gases such as carbon dioxide are released.

The reformation of low-cost natural gas is considered as an alternative technology that can provide hydrogen fuel for electric vehicles equipped with fuel cells. In the long term, hydrogen production from natural gas is expected to increase in parallel with the use of renewable, nuclear, coal (with carbon capture and storage) and other low-carbon energy sources.

2.3.2.2. Renewable Energy Sources

The process of splitting water into hydrogen and oxygen by applying direct current is called electrolysis. Also defined as an electrochemical hydrogen production technique, electrolysis is a highly advanced method in terms of technology. Electrolysis is performed in units called "electrolyzers". Like fuel cells, electrolyzers consist of two electrodes (anode and cathode) separated by an electrolytic liquid. By applying direct current on the electrodes, current is transmitted from the positive electrode (anode) to the negative electrode (cathode) through the electrolytic liquid.

[82] Çimen, T., Thermal Analysis and Optimal Design of Liquid Hydrogen Tanks. Master Thesis, Istanbul, 2006.

By applying direct current on the electrodes, current is transmitted from the positive electrode (anode) to the negative electrode (cathode) through the electrolytic liquid. At the end of the process, water within the electrolyte decomposes into hydrogen and oxygen. Systems that can use renewable energy efficiently and hydrogen production technologies are currently being developed. It is possible to obtain green hydrogen from renewable sources, resulting in almost zero greenhouse gas emissions.

It is possible to produce hydrogen from different sources by integrating hydrogen production methods such as electrolysis into electricity-generating systems. For example, hydrogen can be produced by electrolysis using wind energy. Electrolysis and hydrogen production with wind energy stands out as a preferred method, as electrolyzers have the potential of adapting to voltage changes depending on wind speed, which is one of the problems experienced in electricity generation out of wind energy. On the other hand, it is possible to construct hybrid wind power plants that can use this energy to produce hydrogen instead of stopping the wind turbines when there is an excess supply of electricity. Similarly, there are hydrogen production systems integrated into photovoltaic panels using solar energy on an industrial scale. Electrolysis is considered as an advantageous method since it can work in integration with different sources. With the rise in the ratio of renewable resources in the current electricity supply basket, the potential for greener hydrogen production is also increasing.

Biomass is also a renewable resource and can be converted into hydrogen and other by-products via a number of methods. Hydrogen production processes using biomass can be classified as gasification, the reformation of liquid obtained from biomass, and microbiological biomass conversion. Used to obtain hydrogen from fossil fuels, the gasification method is also used to obtain hydrogen from biomass. Liquids derived from biomass sources including bio-based fuels such as ethanol are repurposed to produce hydrogen through a process similar to natural gas reforming. Currently, studies are carried out on the direct production of hydrogen from biomass based on the metabolic activities of microorganisms and it is estimated that these technologies can be applied on a commercial scale in the medium-long term.

2.3.2.3. Nuclear Energy

Existing nuclear power plants can produce high quality steam at lower costs than natural gas boilers and can be used in many industrial processes, including steam reforming. When this high-quality steam is electrolyzed and decomposed into pure hydrogen and oxygen, it is possible to obtain hydrogen at high efficiency. Since nuclear power plants do not cause carbon emissions, they are considered as a green energy source, and the hydrogen to be produced through these reactors is accepted as green hydrogen.[83]

2.3.3. Development of Hydrogen Energy

In the 21st century, energy is an indispensable source of life for humanity. The fact that the energy source to be used must be both renewable and environmentally-friendly has shifted research towards alternative energy sources. Since there are some limitations in the use of renewable energy sources, it is foreseen to use hydrogen together with renewable energy sources. Although it varies depending on the type of production, the importance of hydrogen energy has been increasing in recent years as it is widely accepted as a clean and environmentally-friendly form of energy.

In 1970s, interest in hydrogen began to increase as a result of the rise in oil prices, the scarcity of oil, and environmental awareness. In 1970, John Bockris coined the term "hydrogen economy" for the first time during a speech at the General Motors Technical Center. Organized on March 18-20, 1974 at Miami University in Florida, USA under the presidency of the Director of Miami University Clean Energy Research Institute Prof. Nejat Veziroğlu, the "Hydrogen Economy Miami Energy Conference" became a starting point for the modern use of hydrogen energy.[84]

[83] Fuel Cell & Hydrogen Energy Association, "Using Nuclear Power to Produce Green Hydrogen", May 11, 2020. Available at: https://www.fchea.org/in-transition/2020/5/11/using-nuclear-power-to-produce-green-hydrogen

[84] Yumurtacı, Z., Bekiroğlu, K. N., Akaryıldız, E., "Hidrojen Enerjisi Kullanımında Temel Kriterler", TMMOB Makina Mühendisleri Odası Tesisat Mühendisliği Dergisi, Issue: 72, 2002.

In 1990s and early 2000s, the wave of interest in hydrogen rose again due to growing concerns about climate change. Similar to 1970s, research focused heavily on the transportation sector, but this time with more emphasis on carbon capture and storage, the eco-friendly properties of hydrogen were further explored.

Hydrogen energy technologies have not gained a sufficient ground in the industry due to high production cost, storage difficulties and high transportation costs. The interest in hydrogen is getting stronger today, especially when the climate crisis is discussed at global level and clean energy sources are considered as a priority to cope with this crisis. Hydrogen is increasingly forming the basis of mainstream energy discussions in almost all regions. Various countries and companies consider hydrogen as an important resource that is likely to play a role in the future of the energy sector.

Hydrogen, which can be transported in liquid form by pipelines, tankers and ships, can be converted into electricity and methane and used as energy for households or manufacturing sectors, or as fuel for automobiles, trucks, ships and aircraft.

Almost all of the hydrogen consumed worldwide is provided by natural gas and coal sources. In this respect, 6% of the natural gas produced and 2% of the coal produced are used in hydrogen production. The IEA's "Future of Hydrogen" report indicates that approximately 45 million tons of hydrogen are used in the iron and steel industry and methane production without decomposing from other gases in addition to 73.9 million tons of pure hydrogen demand realized in 2018.[85] In recent years, hydrogen demand in the refinery sector has increased significantly as a result of growing refining activity and increased needs for hydro-refining and hydrocracking. The International Maritime Organization introduced a new fuel regulation limiting the sulfur content of marine fuels to no more than 0.5% from 2020, which is expected to lead to a significant rise in hydrogen demand for marine fuel production.

The factors that will ensure the widespread use of hydrogen include the supply of more efficient and low-cost energy and the search for clean sources that do not pollute the environment. Hydrogen is considered as a very important resource in parallel with the current and foreseen situation of oil, import dependency, carbon dioxide emissions caused by fossil fuels and emission reduction targets as a requirement of Paris Agreement. The development of hydrogen policies has taken its place among the prominent issues in the energy sector, and many national strategies and initiatives have been created by countries in this direction. The hydrogen initiatives announced by some countries between June 2018 and November 2020 are mentioned below. In parallel with the developments at national level, the number of initiatives in the private sector has also increased. Wishing to become the leading country in hydrogen production and applications, Germany published its "National Hydrogen Strategy" in 2020.[87] In this context, Germany is planning to invest EUR 9 billion to introduce hydrogen as the sustainable energy source of the future. Through the "Strategic Roadmap for Hydrogen and Fuel Cells"[88] published in 2019, Japan is discussing transition to the hydrogen society. China, the largest producer and user of hydrogen in the world, expanded its Energy Law to include hydrogen energy in April 2020. China announced that it would focus on renewable resources such as solar and wind energy by reducing the use of fossil resources such as coal, natural gas and oil in hydrogen production.

A platform called "Hydrogen Energy Network" was established to discuss hydrogen among EU member states, and the said platform held its first meeting in June 2019. 28 EU member states, nearly 100 businesses, various institutions and organizations, as well as the organizations encouraging cooperation on sustainable hydrogen technology signed the Linz Declaration "Hydrogen Declaration". The European Commission's "A Hydrogen Strategy for a Climate-Neutral Europe" was published in July 2020. The strategy outlines the requirements of the European energy system to achieve the carbon neutrality target by 2050 and considers hydrogen and hydrogen-based synthetic fuels as a relevant element of the energy system integration strategy.

[85] IEA, "The Future of Hydrogen", 2019.
[86] International Maritime Organization, 2020. https://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx
[87] https://www.bmbf.de/files/bmwi_Nationale%20Wasserstoffstrategie_Eng_s01.pdf
[88] https://www.meti.go.jp/english/press/2019/pdf/0312_002b.pdf

2.3.4. Hydrogen Energy Developments in Turkey

In early 2010s, Turkey strived to increase its hydrogen research and development by supporting International Centre for Hydrogen Energy Technologies (ICHET), which was established in Istanbul in 2000s under the leadership of UNIDO. In this context, "Bozcaada Hydrogen Island Project" was conducted in 2011 with the support of MENR. Commissioned on October 7, 2011, the project met the electricity needs of Bozcaada District Governor's Office and the health center through the hydrogen produced. [89] However, the project failed to go on and hydrogen production was terminated.

May 2, 2007 stands out as the first date of entry of hydrogen energy into official documents. The "Energy Efficiency Law" published in the Official Gazette No. 26510 of May 2, 2007 defines hydrogen as an alternative fuel the use of which should be encouraged together with biofuel.[90] In addition, a regulation on hydrogen-fueled vehicles was issued in 2011.[91] The said regulation regulates the type approval of vehicles running on hydrogen fuel as well as covering preliminary preparations with the expectation that these vehicles would be on the agenda after a while. Until January 2020, hydrogen did not receive serious attention in Turkey's energy policies. Briefly included within national program documents at the beginning of 2000s, hydrogen was not considered as a part of energy policies in the following period. After a long period of time, the importance of hydrogen was explained to the public through the "Hydrogen Exploration Conference" organized by MoENR on January 15, 2020.[92] The integration of hydrogen into natural gas pipelines, which was initiated in 2018, was assigned to the Natural Gas Distribution Companies Association of Turkey (GAZBİR) by MENR. On April 2, 2021, GAZBİR's technical center GAZBİR-GAZMER was launched in Konya. Delivering a speech at the opening ceremony, Minister of Energy and Natural Resources Fatih Dönmez stated that the facility was completed with a total investment of TL 6 million, and that the project of feeding domestic appliances by mixing natural gas with hydrogen was introduced for the first time in Turkey.[93] While mixing 5% to 20% hydrogen with 95% to 80% natural gas for testing purposes under laboratory conditions, the resulting mixture was burned for testing purposes.

Possessing 73% of the world's boron reserves, Turkey also has the potential of using its rich boron reserves for hydrogen production. Boron is important since it combines with hydrogen to form boron hydrate and, if desired, can absorb hydrogen into it. Hydrolysis of metals such as boron and aluminum can produce hydrogen as much as desired in portable systems. Enabling the use of hydrogen energy at high efficiency, boron is among important raw materials for the development of sodium borohydride fuel cells.

After the ratification of Paris Agreement by the Grand National Assembly of Turkey in October 2021, it is expected that hydrogen will be among alternative technologies in the country's potential strategy development efforts for low-carbon energy generation solutions. Thus, devising a policy for both electricity supply and industrial use of hydrogen by using the renewable energy infrastructure, which is getting stronger every year, will take its place on the agenda of Turkey in the upcoming period.

[89] UNIDO, 2011. https://www.unido.org/news/first-hydrogen-energy-production-turkish-island-has-started-bozcaada
[90] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2007/05/20070502-2.htm
[91] Official Gazette. https://www.resmigazete.gov.tr/eskiler/2011/06/20110607-4.htm
[92] MENR. https://enerji.gov.tr/bilgi-merkezi-enerjide-arama-etkinlikleri-ve-belgeler
[93] GAZBİR. https://www.gazbir.org.tr/uploads/page/Mart-Nisan-2021-Bulten.pdf

The need to take measures on topics such as combating climate change and improving air quality strengthens the tendency towards electric vehicles.

2.4.

Electric Vehicles and Storage Technologies

Wider recognition of an eco-friendly perspective and sensitivity to global warming at global level as well as increasing energy need and limited conventional energy resources such as coal, natural gas and oil support the emergence of electric vehicles as an alternative in the search for new technologies.

The number of electric vehicles in circulation across the world is approximately 11 million by the end of 2020. In our country, 2,355 electric vehicles are in use.

2.4.1. Development of Electric Vehicles Around the World

The need to take measures on topics such as combating climate change and improving air quality strengthens the tendency towards electric vehicles. In addition to the wider adoption of an eco-friendly perspective and the fight against climate change, the reduction in the known theoretical lifespan of fossil fuels also highlights the importance of electric vehicles. Standing at 17,000 in 2010, the number of electric vehicles in circulation reached approximately 17 million by the end of 2020. Considering the total number of electric vehicles in circulation by regions as of the end of 2020, it is observed that China ranks first with 4.5 million vehicles followed by Europe with 3.2 million vehicles, and the USA with 1.8 million vehicles.[94] In 2009, the Chinese government introduced "10 Countries 1,000 Vehicle Programs" with the aim of becoming the world leader in electric vehicle production and having a more livable environment by reducing carbon emissions.

The main obstacle to the widespread use of electric vehicles is the charging station infrastructure. Through the "Electric Vehicles Charging Infrastructure Development Guide 2015-2020" program launched in 2015, charging stations were also integrated into this system and it was planned to install over 12,000 charging stations and 4.8 million charging points. Although the planned number of charging stations have not been established yet, China is the leader in terms of the number of electric vehicles in circulation.[95]

[94] IEA, "Global Electric Vehicles Outlook", 2021.
[95] World Energy Council, "Electric Vehicles", 2018.

In 2020, a total of 1.4 million electric vehicles were sold in Europe including 395,000 in Germany, 185,000 in France, and 176,000 in the UK. For the first time, Europe sold more electric vehicles than China (1.2 million units) with 1.4 million sales, and the environmental policies followed by governments, tax reliefs, decrease in production costs and increase in model diversity were effective in this increase.[96] It is known that 1.8 million electric vehicles are in circulation in the USA as of the end of 2020. US electric vehicle manufacturer Tesla is one of the leading manufacturing companies in the industry. Despite the analysis companies' sales forecasts of 480,000 units in 2020, Tesla has outperformed the forecasts by selling 499,550 vehicles.[97]

2.4.2. Turkish Electric and Hybrid Vehicle Market

In order to pass on a sustainable future to the next generations, it is of great importance to use clean technologies in the automotive sector, as in all other sectors, and to support technologies that will contribute to energy efficiency and the reduction of emissions. In this context, like many other sectors, the automotive sector has also entered into a transformation phase and throughout this process, electric vehicles come to the fore.

In 2019, the Turkish automobile market shrank by 20.4% on a unit basis in spite of the Special Consumption Tax (SCT) incentives introduced by the government in this period due to reasons such as increasing vehicle prices triggered by the SCT regulation issued at the end of the previous year as well as the upward trend of the exchange rate and the rising trend of vehicle loan interest rates until the first half of the year. Despite the contraction in automobile sales in 2019, the number of electric and hybrid automobiles sold rose to 12,228.

In 2020, the Turkish automobile market grew by 57.5% year-on-year due to reasons such as the reactivation of demands postponed due to the Covid-19 pandemic in summer months, the tendency of individual towards driving their own vehicles by avoiding public transport as a measure and the offering of vehicle loans by state banks at low interest rates while the electric and hybrid automobile sales rose at a higher rate to stand at 23,116 units.

Table 17: Breakdown of the Turkish Automobile Market by Engine Type

Quantity	2020	Share (%)	2021/6	Share (%)
Gasoline and Diesel Engine	560,308	91.8	269,746	86.9
Autogas	26,685	4.4	14,569	4.7
Hybrid	22,272	3.7	25,119	8.1
Electric	844	0.1	891	0.3
Total	**610,109**		**310,325**	

Source: Automotive Distributors' Association, TSKB

Although the share of electric vehicle sales in the automobile market, which was 0.1% as of 2020, increased to 0.3% between January and June 2021, it is still at a very low level. Hybrid vehicles encompassing both an electric engine and an internal combustion engine attract more attention from users as it is possible to drive with the internal combustion engine in case the vehicle runs out of battery. 310,325 automobiles were sold in the Turkish automobile market between January and June 2021, of which 8.4% are electric and hybrid automobiles.

[96] IEA, 2021, Ibid.
[97] Indy Türk, "Elon Musk's Tesla breaks sales record in 2020", January 3, 2021. Available at: https://www.indyturk.com/node/294641/ekonomi%CC%87/elon-musk%C4%B1n-teslas%C4%B1-2020de-sat%C4%B1%C5%9F-rekoru-k%C4%B1rd%C4%B1.

Table 18: Electric Vehicle Sales in Turkey

Quantity	Segment	2015	2016	2017	2018	2019	2020	2021/6	Total
BMW i3	C2	83	24	35	37	50	39	3	271
BMW iX3	*	-	-	-	-	-	-	1	144
DFSK SERES 3								17	17
Jaguar I-Pace	E7	-	-	-	38	119	178	2	344
Mercedes Benz EQC	E7	-	-	-	-	-	42	58	197
MG ZS	*							140	140
Mini Cooper SE	B2	-	-	-	-	-	103	3	110
Porsche Taycan	*	-	-	-	-	-	303	135	537
Renault Zoe	B2	36	20	42	79	31	135	103	518
Smart EQ ForFour	A6	-	-	-	1	22	9	-	32
Smart EQ ForTwo	A6	-	-	-	-	-	35	7	42
XEV IEV7S	*							3	3
Total		**119**	**44**	**77**	**155**	**222**	**844**	**894**	**2,355**

Source: Turkish Electric & Hybrid Vehicles Association (TEHAD),

2.4.3. Actions to be Taken in the Turkish Electric Vehicle Market

Turkey has just started developing its own market with 2,355 electric vehicles in circulation as of the end of June 2021. However, there is a significant potential for the rise in the use of electric vehicles with the increase in vehicle ownership and the growth of population. In addition, Turkey is expected to start domestic electric vehicle production (TOGG) soon. This will pave the way for the improvement of local air quality in cities and the reduction of carbon dioxide emissions based on the generation and consumption of energy in both the transport and electricity sectors owing the electricity generated based on renewables.

Critical factors in mainstreaming electric vehicles are sales price, vehicle brand, charging station network, vehicle range and charging time. More affordable prices for electric vehicles than the price of gasoline vehicles, the presence of well-known brands and specialized manufacturers regarding vehicle brands and models, the availability of suitable and sufficient charging points (in shopping malls, gas stations, locations close to houses and along long-distance routes), short charging times and meeting the expectation that electric vehicles can travel long distances with a full charge are critical priorities for the widespread use of electric vehicles. One of the most important factors affecting the demand for electric vehicles is the sales price of vehicles.

The most important component affecting the cost and sales price while manufacturing electric vehicles is battery technologies. About 30% of the cost of an electric vehicle consists of the cost of batteries. Electric vehicle battery costs are still high, but are expected to decrease with emerging technologies. In this way, electric vehicle manufacturers will be able to offer more advanced vehicles in terms of range at more affordable prices. In the light of this determination, it is important for Turkey to make progress in battery technologies as well. China is experimenting a new business model for the sales prices of electric vehicles. Accordingly, the battery and the body are separated. The body is sold while the battery is rented. Some companies also offer fast charging by offering a service to replace an empty battery with a full one.[98]

There are many incentives in various areas such as purchase subsidy, registration tax, value added tax, scrappage scheme, annual license plate tax, parking and toll fees and the use of special lanes across the world with regard to the electric vehicles considered as one of the most important solutions for both boosting energy efficiency and reducing carbon emissions. In our country, it is predicted that the possibility of choosing electric vehicles will decrease with cost-inducing practices such as the special consumption tax.

[98] The Conversation, "What electric vehicle manufacturers can learn from China – their biggest market", 03.08.2021. Available at: https://theconversation.com/what-electric-vehicle-manufacturers-can-learn-from-china-their-biggest-market-161536.

2.4.4. Energy Storage Technologies

Energy storage aims to store the waste energy in areas where energy is used on one hand and to eliminate the difference between energy supply time and demand by storing energy out of renewable energy resources which can generate energy only at certain times on the other.

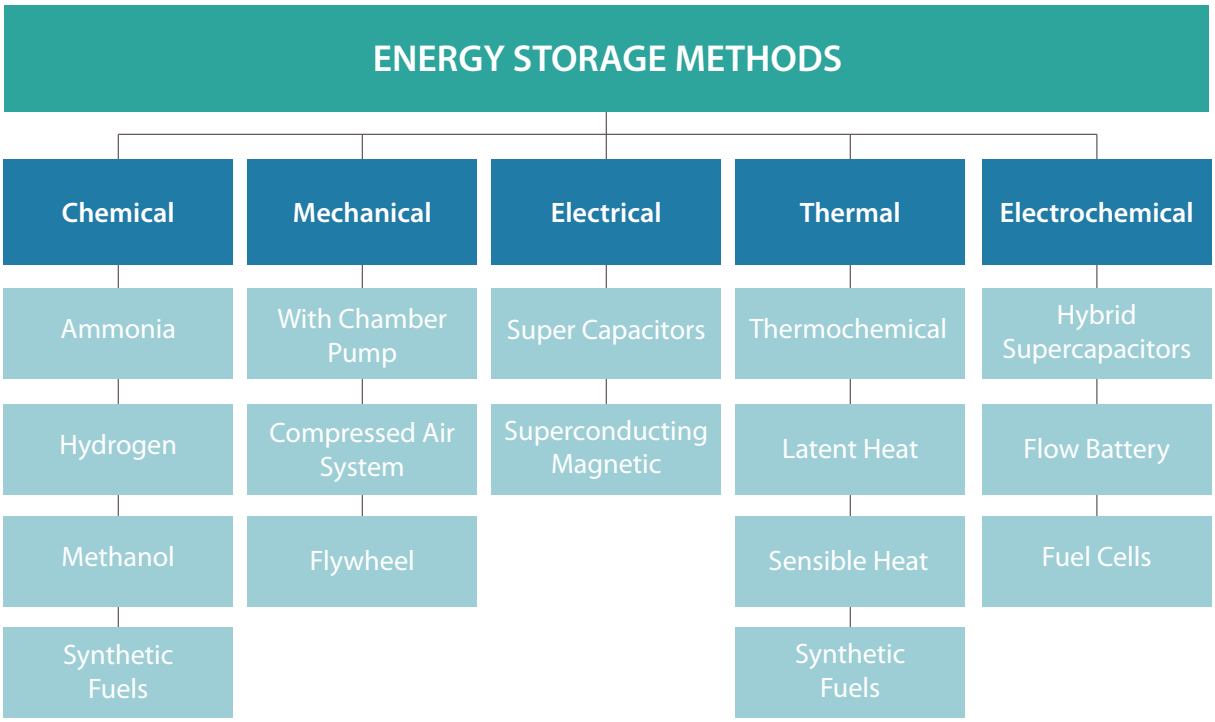
Renewable energy and the storage of generated energy are becoming more and more important in Turkey and across the world as conventional energy sources such as coal, natural gas and oil are limited and these resources are gradually decreasing due to the increasing energy need.

It is considered that electric vehicles will play a key role in the transformation of mobility in the near future and in reducing carbon emissions from transportation. Therefore, the development of storage technologies is very important.

Research for energy storage solutions gained momentum in 2000s due to increasing concerns about the environmental impacts of fossil fuels and the capacity and resilience of energy grids around the world. The IEA estimates that the world needs energy storage at a level rising from 176.5 GW in 2017 to 266 GW in 2030 to keep global temperature rise below 2°C.[99]

There are many potential methods for the storage of energy which is available in almost all forms. These methods are divided into main headings by storage principles (Figure 5) and each storage principle has its own subheadings. This section outlines commonly-used energy storage methods.

Figure 5: Energy Storage Methods



Source: World Energy Council[100], TSKB

[99] Environmental and Energy Study Institute, "Energy Storage", 2019.
[100] World Energy Council, "Five Steps to Energy Storage: Innovation Insights Brief | 2020", 2020.

2.4.4.1. Chemical Storage

It is a method storing energy through the bonds formed by chemical compounds. It is also possible to recover energy with the help of exothermic (heat-releasing) reactions. In this storage method, ammonia and hydrogen come to the fore.

As mentioned in section "2.3. Hydrogen Energy" of this report, hydrogen, which can be obtained from renewable sources by electrolysis method, can be transported via pipelines in addition to tankers or other storage options. In addition, if hydrogen is produced through renewable energy sources, it is also called green hydrogen due to zero carbon emissions in the production process.

2.4.4.2. Electrical Storage

Electrical storage refers to the storage of energy in the form of an electric or magnetic field. Supercapacitors and Superconducting Magnetic Energy Storage Systems directly store electrical energy, becoming more convenient and safer charging alternatives than batteries.

2.4.4.3. Mechanical Storage

Mechanical energy storage is potential energy or kinetic energy storage. Pumped hydro (with chamber pump) storage systems (pumped storage hydroelectric power plants), compressed air storage and flywheel energy systems are the most well-known systems.

2.4.4.4. Electrochemical Storage

Electrochemical storage is a method of storing electricity in chemical form as both electrical and chemical energy share the same electron. This form of storage is one of the most conventional methods of all energy storage technologies. Basically, battery cells consist of two different chemicals. One is the negatively-charged cathode while the other is the positively-charged anode. When connected to a device, electrons flow through the device from the negative electrode to the positive pole or, in other words, the anode. The cathode and anode are surrounded by a chemical medium called an electrolyte. Chemicals that are commonly used for batteries today are lead, nickel, sodium and lithium. Developed with emerging technologies, batteries in liquid form are produced with elements such as vanadium, chromium and iron. Each electric battery has its own characteristics such as capacity, energy and power output, charging/discharging status, efficiency and lifetime.

Li-ion Batteries

Li-ion battery is an electrochemical battery technology using lithium ions. During the discharge cycle, the lithium atoms at the anode are ionized and separated from their electrons. Lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and become electrically neutralized. Lithium ions are small enough to pass through a micro-permeable separator between anode and cathode. Partly due to lithium's small size, li-ion batteries have very high voltage and charge storage capacity per unit mass and unit volume.[101] Today, most solar power systems use li-ion storage technology.

Lead Acid Batteries

Lead-acid batteries are among the first battery technologies used for energy storage. It consists of lead, lead dioxide and sulfuric acid. However, they are not suitable for grid storage due to their low energy density, short cycle and lifetime. Generally used for electric vehicles in the past, these batteries are now mostly replaced by longer-lasting li-ion batteries.

Nickel-Cadmium Batteries

Nickel-cadmium batteries, the efficiency of which is around 75%, are not used very often, but are known to be rechargeable. In this type of batteries, nickel oxide hydroxide and cadmium are used as electrodes. This model, the use of which has decreased due to its negative environmental impacts, has left its place to nickel metal hybrid and li-ion batteries.

[101] World Energy Council, 2020, Ibid.

2.4.5. Battery Technologies in the Electric Vehicle Market

Electric vehicles, which are expected to play a key role in reducing carbon emissions from transportation, offer a quieter, eco-friendlier and more economical transportation opportunity owing to the electrical energy used as fuel. As hybrid vehicles and electric vehicles, in which battery technologies are used as energy resources, become widespread, the need for storage technologies increases.

Battery, super capacitor and internal combustion production unit are used as energy sources in hybrid vehicles driven by an internal combustion engine and an electric engine. Having an average range despite its low emission ratio, this technology has a limited market share for now. Electric vehicles driven by electric engines use battery groups, super capacitors or fuel cells as energy sources.

Compared to other battery technologies in electric vehicles, li-ion batteries are more preferred because they have important advantages such as high rated voltage, high energy density, and long lifetime. Li-ion batteries used in electric vehicles are constantly increasing their market share with the increasing need for storage.

Global investments in battery storage technologies reached USD 4.0 billion in 2019 in parallel with the decrease in battery costs, the rapid improvement and developments in their performance, as well as the increase in the demand for electric vehicles and the energy generated from renewable energy sources. While 27% of the investments made in battery storage in 2019 originated from Europe, South Korea, the USA, China and Japan acquired shares of 17%, 17%, 16% and 8% in total investment, respectively.[102]

Battery costs account for 30% of the cost of an electric vehicle. It is important for the future of electric vehicles to decrease battery costs, reduce weight, increase storage speed and produce powerful batteries. Currently, batteries are a product group with the lowest cost and the least harm to the nature if the charging need is met from renewable energy sources.

[102] BDO, "Battery Storage", October 2020.

Even if the emission of all greenhouse gases in the world is stopped as of today, the effects of climate change already experienced as an accumulation of long years will continue to be visible in the next decades.

2.5.

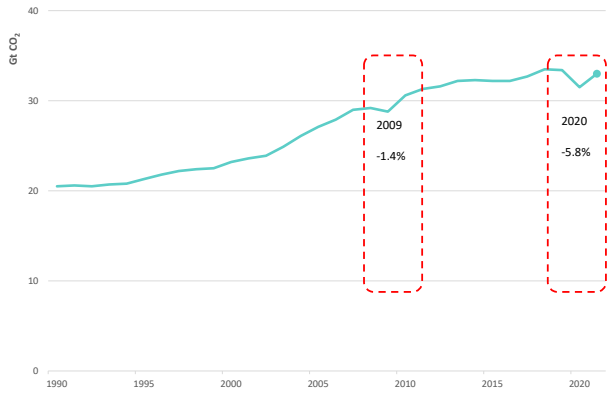
Emissions and Climate Steps

Climate change causes various negative impacts on health, food and water security as well as public safety, livelihoods, economy, infrastructure and biodiversity. All these impacts have become more visible today. Even if the emission of all greenhouse gases in the world is stopped as of today, the effects of climate change already experienced as an accumulation of long years will continue to be visible in the next decades.

Greenhouse gas emissions decreased by 5.8% in 2020 year-on-year, almost four times the drop in 2009 following the global financial crisis in 2008.

While the rate of renewable resource use has increased, greenhouse gas emissions decreased more than energy demand in 2020 as the Covid-19 pandemic affected oil and coal demand more severely than other energy sources. Despite the decline in 2020, global emissions from energy remained at 31.5 gigatons, contributing to the highest ever average annual concentration of CO_2 in the atmosphere.

Chart 29: Global CO_2 Emissions from Energy (1990-2021)



Source: IEA, 2021[103]

Studies estimate that temperatures will rise by 4°C in 2100 above pre-industrial levels.[104] It is predicted that in case of even a temperature rise of 1.5°C, average annual draught period will be extended by 2 months, the number of people to experience water scarcity across the world will reach 271 million people, the areas burnt due to forest fires in the Mediterranean will rise by 41%, the frequency of extreme precipitation will increase by 17%, the losses arising out of annual flood disasters will surpass USD 10.2 trillion due to a rise of the sea level, global GDP will shrink by 8% until 2100, the geographical areas with a potential for the contagion of malaria will be expanded by 19% and the possibility of unprecedented summer temperatures in Europe will rise by 47%. It is stated that such impacts will be felt in a much more severe in case of a rise at or over 2°C. This means that a temperature rise of 4°C will cause irreversible devastating effects on the world.

In this context, mitigation activities to eliminate the effects of sources that cause climate change continue incrementally. Organized in Glasgow in November, the 26th UN Climate Change Conference of the Parties (COP26) prioritized mitigation and adaptation.

The steps to be taken by China, the USA and EU member states, which have the highest contribution to global greenhouse gas emissions, and the commitments of development finance institutions regarding the funds to be transferred to developing countries had a significant coverage in the COP26 agenda.

It is known that the greenhouse gas emissions triggering climate change are mostly caused by developed countries, but the countries where the effects of climate change are observed the most and which are most prone to climate risks are underdeveloped and developing countries. The countries that will be affected the most by climate change in the first place are those in the low and middle-income groups. One of the most obvious consequences of this change is extreme weather events. Therefore, if developing countries lose faith in the willingness of developed countries and development finance institutions for financial and technical support, this climate of insecurity may hinder progress regarding the decisions to be taken against climate change following COP26. In this respect, efforts to allocate adequate climate finance to combat the climate crisis will be important in the upcoming period.

Multilateral development banks such as the "WBG, EBRD" and the European Investment Bank (EIB) offered USD 66 billion in climate finance in 2020. While USD 49.9 billion of this financing was allocated to mitigation investments, USD 16.1 billion was channeled to adaptation investments. The development of low-carbon technologies and the financing of renewable energy projects had an important share in mitigation investments.[105]

With regard to the fight against climate change and extreme climate events, it is likely that the fastest growing energy resources in the next 30 years will be renewable energy resources, especially wind and solar power. Investments made for capacity building in wind and solar power are expected to increase significantly. In parallel with the use of hydrogen and the development of energy storage technologies, the decrease in costs in these areas and, thus, the widespread use of hydrogen will gain momentum in the upcoming years.

[103] IEA, "Global Energy Outlook", 2021.
[104] World Bank, "Turn Down the Heat: Confronting the New Climate Normal", 2014. Available at: https://openknowledge.worldbank.org/handle/10986/20595 License: CC BY-NC-ND 3.0 IGO.
[105] World Bank, "Joint Report on Multilateral Development Banks' Climate Finance", 2021.

2.5.1. Development of Climate Policies in Europe

Signed under the leadership of the United Nations, the United Nations Framework Convention on Climate Change is the first intergovernmental environmental agreement on global warming and entered into force on March 21, 1994. The convention aims to reduce the level of greenhouse gases in the atmosphere and to keep the negative effects of these gases at a certain level by minimizing them, acknowledging that human-induced environmental pollution has dangerous impacts on the climate. Under the Convention, a conference of the parties, also known as the "COP", is held every year.

Creating the framework of post-2020 climate change regime, the Paris Agreement was adopted at the United Nations Framework Convention on Climate Change's 21st Conference of the Parties organized in Paris in 2015 and entered into force on November 4, 2016. The agreement aims to limit the average global temperature rise to a maximum level of 1.5°C when compared to pre-industrial levels. Today, a temperature rise of 1°C has already been achieved. In order not to surpass the target of 1.5°C, CO_2 emissions must be reduced by 45% in 2030 when compared to 2010 and net zero emission must be achieved by 2050.

Countries and regional administrations introduce various practices in order to ensure that international climate policies achieve their intended purposes. In this area, the EU stands out especially with the plans and policies it has introduced during the last 5 years. In March 2020, the Climate Law was submitted to the EU Parliament by the European Commission to make the net zero emission target legally binding within the EU and the legislative proposal was approved by the Commission on June 24, 2021 and entered into force on July 9, 2021. In addition, the European Green Deal (EGD) entered into force with the aim of reducing the amount of greenhouse gas emissions, developing new business opportunities, introducing circular economy models and increasing living standards. Designed and monitored under the European Commission, the Green Deal is defined as the new growth strategy of the EU encompassing the main objectives of ensuring that there are no net emissions of greenhouse gases by 2050, economic growth is decoupled from resource use and no person and no place is left behind. The agreement is followed with great interest not only by the member states, but also by all third-party countries that have close commercial and political relations with the EU. Changes regarding climate and environment involve both risks and opportunities for many countries, including Turkey.

The steps to be taken within the scope of EGD objectives are grouped under 8 policy areas.

1. Raising climate target for 2030 and 2050
2. Providing clean, accessible and reliable energy
3. Mobilizing industry for a clean and circular economy
4. Performing energy and resource efficient building and renovation
5. Developing fair, healthy and eco-friendly food systems within the "From Farm to Fork" approach
6. Protecting and restoring ecosystems and biodiversity
7. Aiming at zero pollution for a clean environment
8. Accelerating transition to sustainable and smart transportation

Under each policy area, different goals and objectives have been defined, and relevant legislation and strategies have been listed in order to achieve the objectives.

Aim of the activities to be performed under clean energy is to support energy efficiency and develop a power sector based largely on renewable sources, Secure and affordable EU energy supply and create a fully integrated, interconnected and digitalized EU energy market. From this point of view, the aim is to review the current energy legislation of the EU and revise it, and to transpose the revisions to the national laws of the member states by 2023.

The European Commission aims to reduce greenhouse gas emissions by at least 55% by 2030 and to be carbon-neutral by 2050. Under this objective, contribution areas are defined for all sectors of the EU economy and society and the necessary policy actions are put forward to achieve the objective.

According to the Climate Law published in the Official Journal of the EU on July 9, 2021, EU institutions and member states will be obliged to take necessary measures as a whole, both at the EU level and at national level, in order to achieve the target of reducing net emissions by 55% compared to 1990 levels by 2030. In addition to the climate-neutrality target by 2050, the Climate Law encompasses the development of the EU's carbon sinks, setting a climate target for 2040, a commitment to negative emissions after 2050, the establishment of an independent advisory board to offer scientific advice, the definition of more stringent adaptation provisions, ensuring strong alignment between EU policies with the goal of being climate neutral, and drawing up sector-specific roadmaps.

Through the "Fit For 55" Harmonization Package announced together with the European Climate Law, the EU has identified the actions to be taken and the steps to be taken in all sectors, including increasing energy efficiency and renewable energy practices, and has started submitting detailed legal proposals as of July 2021. Under the package, the Commission presented its new proposals for the Energy Efficiency Directive and the Renewable Energy Directive. Within the scope of the Energy Efficiency Directive, amendments were proposed such as the renewal of at least 3% of the buildings of public institutions in the member states every year as near zero energy buildings, increasing the annual energy saving obligation for the member states from 0.8% to 1.5% for the period between 2024 and 2030 and reducing primary energy consumption by 39% and final energy consumption by 36% by 2030. Within the scope of the Renewable Energy Directive, amendments were proposed such as increasing the share of member states concerning renewable energy within the heating and cooling sector by 1.1% per year, increasing the annual target for increasing the share from renewable sources and waste heat for district heating and cooling from 1% to 2.1% and enabling third parties supplying their energy from renewable sources and waste heat to connect their system to the heating and cooling systems of member states with a capacity higher than 25 MW_{th}.

The new regulations are committed to ensuring that the EU moves towards a climate-neutral economy and fulfills its commitments under the Paris Agreement. In addition, the "Fit For 55" Harmonization Package also gives details on issues such as the "Carbon Border Adjustment Mechanism" and the extension of the European Union "Emissions Trading System" (ETS) to new sectors.

The Union has a 2030 climate and energy framework with EU-wide policy targets for the period from 2021 to 2030. Main targets in the field of energy are listed below:

- Connecting all energy systems to an interconnected system
- Integrating renewable energy sources into grids
- Promoting innovative technologies and modern infrastructure
- Increasing the eco-design feature and energy efficiency of products
- Decarbonizing the gas sector
- Promoting smart integration across industries
- Helping energy-poor EU member states
- Promote EU energy standards and technologies at global level

In 2020, the "Energy Systems Integration Strategy" was announced to the public. In this context, it was announced that a more efficient integrated system was designed to connect energy resources and infrastructure. Under the targeted new system, it will be encouraged to reuse the waste heat generated in industry, synergy will be provided between energy infrastructures, it will be encouraged to use agricultural residues for biogas and biofuel production, renewable energy generation will be increased, it will be promoted to use tools and equipment such as heat pumps, electric vehicles and efficient furnaces, etc. in buildings, transportation and industry, charging stations will be established for electric vehicles, the use of low-carbon fuels and renewables-based fuels including hydrogen will be increased, carbon storage and use will be encouraged for cement production, hydrogen fuel-based clean iron-steel plant projects will be launched, the tax system within energy markets will be revised in line with decarbonization and the use of digital energy services will be supported in buildings.

Another energy-related strategy document of the EU is the Hydrogen Strategy. With the acceleration of clean hydrogen production, the EU aims to install at least 40 GW of renewable hydrogen electrolyzers within the integrated energy system from 2025 to 2030, to produce up to 10 million tons of renewable hydrogen, and to use hydrogen on a large scale across all sectors from 2030.

It is expected that the 2030 targets set under the European Climate Law introduced under the EGD, the commitment to achieve negative emissions after 2050, and the relevant supportive strategies and developments are expected to closely affect the institutions operating with emission-intensive processes in Turkey, and it is considered that concrete steps will need to be taken.

2.5.2. Development of Climate Policies in Turkey

Total greenhouse gas emission of Turkey, which is among the important energy consumers of the world with its developing economy, was calculated as 506.1 million tons of CO_2 equivalent in 2019. This amount corresponds to about 1% of global emissions. Energy-related emissions account for the highest share (72%) out of the emissions generated by Turkey in parallel with the global outlook. Energy-related emissions are followed by agricultural activities at 13.4%, industrial processes and product use at 11.2% and waste sector at 3.4%.[106]

Climate policies in Turkey began to develop in 2000s. Turkey became a party to the United Nations Framework Convention on Climate Change in 2004 and then, to the Kyoto Protocol in 2009. The protocol divides countries into different categories based on historical responsibility for emissions and financial responsibility for extending financial support to developing countries. Turkey is an Annex-1 country and therefore, not subject to any emission reduction commitment.

Activities intended for developing the legislative infrastructure and policies for the energy sector were initiated in early 2000s to support the climate policies in Turkey. In this respect, the Law on the Utilization of Renewable Energy Resources for Generating

Electricity was enacted in 2005 in order to support and improve renewables. As in various geographies around the world, the share of renewables in both the installed capacity and generation started rising from 2009 in Turkey in parallel with the applicable climate change policies.

Similarly, the Energy Efficiency Law entered into force in 2007 for the effective implementation of energy efficiency. The National Energy Efficiency Strategy Paper was issued in 2012. The Regulation on the Monitoring of Greenhouse Gas Emissions, a regulation directly related to climate change, was published in 2014 while the communiqués under the Regulation were issued in subsequent years.

[106] TurkStat, Greenhouse Gas Emission Statistics, 1990-2019.

The National Energy Efficiency Action Plan was announced at the beginning of 2018. Besides, Turkey contributes to voluntary national reduction commitments through the "Climate Change Strategy" and "Climate Change Compliance Strategy and Action Plan" published in 2010 and 2011, respectively. The EU comes to the fore among the countries/ regions with which Turkey has commercial ties. As an important outcome, a significant internal reform process has started in Turkey along with the new regulations implemented by the EU within the scope of the EGD. In this context, a draft EGD Action Plan has been drawn up within the framework of 9 main topics, including awareness-raising activities. These main topics are as follows:

- Combating Climate Change
- Financing
- Carbon Border Adjustment Mechanism
- Green and Circular Economy
- Clean, Economic and Secure Energy Supply,
- Green and Sustainable Agriculture
- Transportation
- Diplomacy and Information

Regulations regarding the Climate Law and ETS are discussed under the main topics listed above for the purposes of improving Turkey's access to international finance, engaging in activities for more effective use of national financing opportunities, and developing the National Energy Efficiency Financing Mechanism by 2023. Considering the Carbon Border Adjustment Mechanism, preparations are in place for identifying Turkey's situation regarding carbon pricing. Turkey aims to announce the Turkish Circular Economy Action Plan in 2022, and the national action plan and implementation schedule for the implementation of the EU Integrated Pollution Prevention and Control legislation in 2023. In the field of energy, it is planned to offer technical support to companies through energy efficiency projects and to carry out awareness-raising activities on the Green Tariff and YEK-G Certificate.

In particular, Turkey has a significant share regarding the sectors in which the Carbon Border Adjustment Mechanism announced together with the "Fit For 55" Harmonization Package will be implemented as a priority. Therefore, it is observed that important obligations will be at the top of the agenda. As stated in the proposal for the Carbon Border Adjustment Mechanism published on July 14, 2021, the period between 2023 and 2025 will be considered as a transition period and the law will be applicable to the iron-steel, cement, fertilizer, aluminum and electricity sectors. During the transition period, importers within the EU will need to notify or report their emissions in relation to the products they import, which will bring about the same obligations for manufacturers in the country of origin.

The cost to be incurred during the implementation period, which will start after the transition period, will be calculated depending on/based on EU ETS prices. Many studies on the subject are planned within the scope of the initiatives and projects that Turkey has already launched. Under the economic reforms announced on March 12, 2021, it is on the agenda to include buildings, agriculture and service sectors under energy efficiency supports. On the other hand, it is planned to engage in activities such as launching green Organized Industrial Zones that meet their own energy and have high resource efficiency, and developing electric vehicle charging infrastructure.

Another program introduced for combating and adapting to climate change in Turkey is the Partnership for Market Readiness Program which was launched by the WBG in 2011 to support developing countries with the reduction of greenhouse gas emissions within the framework of combating the climate change and in which Turkey joined in 2013. The first phase of the project was completed at the end of 2018, and the second phase officially started in February 2019. The project has so far hosted various studies on defining the emission limits and developing the national allocation plan, developing emission trade simulations, and preparing the legal and institutional infrastructure draft for the ETS pilot practice in Turkey. In February 2020, the first draft of the carbon pricing communication strategy was completed in Turkey. In November 2020, the latest progress in the Development of Legal and Institutional Infrastructure for the ETS Pilot Practice in Turkey Project was presented.

Turkey is among the first countries that signed the Paris Agreement in 2015. The bill for the ratification of the Paris Agreement was accepted in the Plenary of the Grand National Assembly of Turkey on October 6, 2021, and the law on the Paris Agreement entered into force upon publication in the Official Gazette No. 31621 of October 7, 2021. Prior to the ratification of the Paris Agreement, activities were performed for creating the institutional infrastructure and the Draft Climate Change Law was developed to set procedures and principles required for taking actions so as to contribute to the efforts of keeping well below the globally-accepted level of 2°C and to protect current and future generations against the negative effects of the climate change. The main topics stipulated within the draft law are the reduction of greenhouse gas emissions, adaptation to the effects of the climate change, the distribution of duties, authorities and responsibilities regarding the implementation of climate change policies, the establishment of market-based mechanisms, audits and sanctions. The draft law gives a detailed overview of monitoring, reporting and verification processes, legal regulation tools, strategies, action plans and programs, adaptation policies, risk assessments and country targets.

2021 is considered as a year in which Turkey took more radical steps under climate priorities compared to previous periods, and it is possible to say that the general trend is parallel to global climate trends. As with many topics related to climate from waste management to the protection of forests and the efficient management of water resources, necessary infrastructure and support activities are in place for achieving a greener and more environmentally sensitive system also in the energy sector.

Meclisi Mebusan Caddesi No.81
Fındıklı İstanbul 34427, Türkiye
T: +90 (212) 334 50 41
F: +90 (212) 334 52 34